

School of Economics and Finance

**A Paradigm of Inquiry for Applied Real Estate Research:
Integrating Econometric and Simulation Methods
in Time and Space Specific Forecasting Models--
Australian Office Market Case Study**

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Abstract

Office space oversupply cost Australia billions of dollars during the 1990-92 recession. Australia, the United States, Japan, the U.K., South Africa, China, Thailand, and many other countries have suffered office oversupply cycles. Illiquid untenanted office buildings impair investors' capital and cash flows, with adverse effects on macroeconomies, financial institutions, and individuals. This study aims to develop improved methods for medium term forecasting of office market adjustments to inform individual project development decisions and thereby to mitigate office oversupply cycles. Methods combine qualitative research, econometric estimation, system dynamics simulation, and institutional economics. This research operationalises a "problem solving research paradigm" concept advocated by Ken Lusht. The research is also indebted to the late James Graaskamp, who was successful in linking industry and academic research through time and space specific feasibility studies to inform individual property development decisions. Qualitative research and literature provided a list of contributing causes of office oversupply including random shocks, faulty forecasting methods, "fee driven deals," prisoners' dilemma game, system dynamics (lags and adjustment times), land use regulation, and capital market issues. Rather than choosing among these, they are all considered to be causal in varying degrees. Moreover, there is synergy between combinations of these market imperfections. Office markets are complex evolving human designed systems (not time invariant) so each cycle has unique historical features. Data on Australian office markets were used to estimate office rent adjustment equations. Simulation models in spreadsheet and system dynamics software then integrate additional information with the statistical results to produce demand, supply, and rent forecasts. Results include models for rent forecasting and models for analysis related to policy and system redesign. The dissertation ends with two chapters on institutional reforms whereby better information might find application to improve market efficiency.

Keywords. Office rents, rent adjustment, office market modelling, forecasting, system dynamics.

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Chapter 1 Research Objectives and Significance

“Curtin University’s strength is its focus on technology...defined as... ‘application of creative thinking and ingenuity to the solution of definable and practical problems in all fields of human endeavour’....This model fits very comfortably with the way we undertake research across a broad range of disciplines whilst not distinguishing between fundamental and applied research.”

Paul Rossiter (1997)

*Curtin University Deputy Vice-Chancellor,
Research and Development¹*

1.1 Research Objectives

This dissertation addresses two related problems: 1) The existence of cycles of oversupply leading to investor losses in office markets, and 2) Difficulty in applying results of academic research to office market decisions. The models described here were prepared at the request of industry clients and are intended for use by the property industry. This “problem solving” orientation led to a broader than customary “combination of methods” approach to research. Goals are:

1. To improve information to help reduce the amplitude of office market cycles and thereby improve investment outcomes and reduce occupancy costs.

¹ Single quotes indicate Rossiter’s quotation of former Curtin Vice-Chancellor Haydn Williams. This quote would have been heresy to my father, who considered himself a “basic” researcher (in biochemistry) and saw basic research as the best route to progress in science. Rossiter’s position reflects a shift in the philosophy of science towards more tolerance of diverse approaches, interdisciplinary research, and interest in applications.

2. To develop forecasting models for office development decisions incorporating qualitative research, econometric, and system dynamics methods.
3. To increase office market efficiency through proposals for redesign of system policies and institutions.

Better forecasting may lead to better office market decisions, but not necessarily so, depending upon the institutional context. Problem solving requires more than a conventional narrow positivist approach to research.

1.1.1 Listing of Chapters

This chapter introduces the problems addressed by the study and motives for the research. Chapter 2 begins with calls for paradigm innovation by two American Real Estate and Urban Economics Association (AREUEA) presidents and ends by combining ideas from the philosophy of science, qualitative research, econometrics, and system dynamics literatures into an applied research methodology. Chapter 3 is qualitative exploratory research--explanations for office oversupply provided by market participants. This qualitative work identifies forecasting/information issues, as well as institutional, strategic behavioural, and agency problems as reasons for past forecast failures. Chapter 4 is a development history of four major Perth office projects, which reveals a prisoner's dilemma game in office development decisions. This chapter also provides a case study of office markets' supply lags, documenting stochastic delays at various stages of development. Chapter 5 reviews literature on office market quantitative models, mainly found in the American real estate and urban economics journals. Chapter 6 presents a specification search for econometric models of the Sydney office market, exploring autoregressive distributed lag (ADL), vector autoregression (VAR), and error correction (ECM) equations to forecast rent adjustments. Forecast errors in a withheld portion of the sample are compared for equations which pass diagnostics tests. Chapter 7 uses these econometric results to drive rent forecasting simulations in two versions a) spreadsheet, b) system dynamics (SD) software. The system dynamics paradigm provides a representation

well adapted for study of system redesign and policy changes and is also a way of coping with limited data and simultaneity.² Chapter 8 discusses methods to implement valuations based on cyclical cash flow forecasts. Chapter 9 identifies leverage points to improve system design through institutional reforms (Senge,1990).

These chapters represent four diverse research paradigms: Chapters 1-4 are qualitative research (with philosophy of science touched upon briefly in chapter 2); chapters 5 and 6 follow a positivist empiricist econometric paradigm, Chapter 7 is also quantitative research, but using the engineering or management paradigm of system dynamics. Chapters 8 and 9 are institutional economics, proposing changes to institutions required for effective implementation of more rational, informed, and efficient office supply decisions.³ This combination of approaches seems necessary to achieve what Ken Lusht (1996) calls a “problem solving paradigm.” We not only need to improve information, we must also think about the context in which information is used.

Taking an eclectic research approach in this dissertation does not mean rejecting work with a narrower focus--if there were no specialised research there would be nothing to combine. One pays a penalty in attempting interdisciplinary work--breadth is attained at the cost of depth. Nevertheless, my premise is that there should be at least a few generalists who attempt to integrate diverse approaches. Each paradigm provides important information other paradigms find difficult or impossible to observe and process. Representing a problem in diverse ways aids problem solving.

Qualitative work helps identify candidate variables and system structure, especially dynamic structure--lags and expectations. Qualitative research gives us mental information (Forrester, 1991) inaccessible to other techniques which helps us interpret the meaning of events. Econometric methods summarise past data

2 In system dynamics, “policy” has a broad meaning which includes changes in decision criteria for market actors.

3. Discussion of considerable reading in the philosophy of science is largely omitted from the dissertation, but provides a perspective on methodological issues.

efficiently and provide empirically supported quantitative estimates of relationships among variables. Applied econometric methods are clearly the dominant paradigm in real estate research over the past quarter century. Perhaps the main complaint one could make against econometric methods is that they have proven too successful--so diverse, powerful, and fast developing that they have driven other paradigms from the pages of the real estate journals.

System dynamics simulations allow us to carry on modelling where data leaves off and to explore system redesign and policy alternatives in complex, non-linear systems. Institutional contexts determine whether quantitative results are misused or applied in a rational fashion. The key synergistic relationships among methods form a pairwise chain: Qualitative research helps with econometric model specification. Econometric equations provide an empirical basis for system dynamics simulations. Simulations make possible modelling hypothetical changes in institutional structures to improve efficiency.

Each paradigm has weaknesses which can be partly remedied by other paradigms: Qualitative work may lead nowhere because results may be open to alternative interpretations (low inter-observer reliability) and too imprecise to justify decisions. System dynamics simulation models may be too heuristic and not empirically supported by data. SD software produces few statistics for model validation excepting forecast errors so evaluating models is difficult. Econometric approaches provide quantitative estimates but may suffer from misspecification biases, pre-testing biases, process instability, lack of data, and other problems that may be partially remedied by adding information from qualitative, SD, or institutional methods.

Moreover, positive economics provides information, but does not guide action. The objectives and values integral to the other three paradigms help guide applications of quantitative results. But this goes both ways--institutional reform seems likely to go astray without quantitative understanding of the implications of alternative institutional structures and policies.

1.2 The Office Space Oversupply Problem

This study began with exploratory research in Perth, Western Australia, during 1992-95. During the late 1980s, spurred by a mining boom, financial deregulation, and high inflation rates, Perth experienced an unprecedented surge of office commencements. By 1989 with economic growth slowing and impending oversupply obvious, new construction starts ceased. A prolonged recession led to net decreases in office demand (leased space) each year during 1990-1992. By January, 1993, the Perth central business district experienced 430,000 m² of vacant space, 32% of net lettable area (BOMA, 1993). Consequences included bankruptcy of developers of new projects, as well as considerable losses of investor and lender capital. Premium grade net effective office rents fell from a high near \$350/m² in 1989 to as little as \$65/m² in 1993.⁴ Capital values declined throughout the market, affecting all owners, not just owners of new projects. The most lasting ill effects fell upon owners of older buildings whose tenants shifted to newer buildings in response to leasing incentives.

After the property market collapse, losses were widespread. Municipal tax bases dropped as buildings, indeed entire central city office districts, were revalued downwards. Mortgagees' sales of nearly new Perth buildings during the trough in 1993 brought prices as low as 25-35% of cost. Investment in major office projects by state superannuation boards, banks, and property trusts spread billions of dollars in losses on office investments widely among Australian public employees and savers.

Although Perth is an extreme example, similar oversupply cycles have developed in many office markets around the world. Dallas, Texas, suffered a 30% vacancy rate in the mid 1980s, following a decline in oil prices. Hendershott and Kane (H&K) attributed vacancy rates around 20% or more in 30 US office markets to "lender frenzy" resulting from misguided government policies (1992a:61). H&K estimated in aggregate the cost of office overinvestment in the U.S. to be U.S.\$130 billion, calculated mostly as the present value of lost rents in untenanted buildings.

⁴ Anthony Jones, Hooker Research, personal communication

London's docklands redevelopment efforts were marred by the failure of the five billion dollar Canary Wharf office project, which contributed to bankruptcy, in 1990, of Olympia and York, then the world's largest developer of office space (Ghosh, Randall & Sirmans, 1995). Oversupply has also at various times appeared in Toronto, Tokyo, Johannesburg, French, German, and Scandinavian cities, the four largest Chinese cities (BRW, 7 Aug. 1995:13), and most Australian capital cities. The Building Owners and Managers Association (BOMA) reported early 1993 central business district (CBD) office vacancy rates were 27% in Melbourne and 22% in Sydney. (BOMA, 1993). Moreover, office oversupply is not unique to the 1990s, but has occurred in several previous economic cycles, notably during the 1975-1977 period. At the moment, impending or actual oversupply is apparent in several of the "Asian tiger" capital cities, from Bangkok to Seoul. Non-performing real estate loans have crippled banks and held down economic growth in Japan since the 1989 collapse of the "bubble economy."

Ghosh, Guttery, and Sirmans (1995:1) found that "The 1989-1992 financial crisis in the United States and around the world was precipitated by ...real estate play(ing) a central role in this credit cycle as overbuilding and regional recessions wreaked havoc with the asset base of banks and other financial institutions." Brueggeman (1993) points out that time lags occur as lenders clear their asset base of failed projects delaying economic recovery and new investment in property. In the next few years, growth in Asian economies will feel the drag of damaged bank balance sheets due to property oversupply, so, once again, overinvestment in non-performing property assets may play a role in the world macroeconomy.

Major depressions of the last century are associated with liquidity problems created by an oversupply of non-performing real estate product. The Melbourne crash of the 1890s, the U.S. 1930s depression, as well as the recessions of 1973-75 and 1990-92 all featured large oversupplies of unmarketable and illiquid commercial real estate developments. These are not the only cause of economic problems, of course, and perhaps office oversupply is a symptom of more deep seated economic system

failures. Nevertheless it seems clear that better office market decisions would help lead to better macroeconomic outcomes.

Sykes (1996:573) puts the total of Australian bank "net bad debt writeoffs and provisions" 1989-1993 at \$28.3 billion, with a further \$20 billion lost by the major "bold riders" companies. These figures are the same order of magnitude as the annual average increase in Australia's GDP. Sykes (1996:28-32) provides succinct summaries of the unsound lending practices that led to the losses.

This boom-bust cycle left disturbing legacies to the Australian economy. Important longstanding Australian financial institutions were destroyed, notably the State Banks of Victoria and South Australia with losses also to the R&I, the publicly owned bank of Western Australia. Australia's largest private bank, Westpac, lost about three billion dollars of its capital base and fell from top ranked position among banks to third, largely due to bad property loans. Destruction of capital perpetuated Australia's capital shortages and created opportunities for overseas capital to take over Australian property and companies at distress sale prices. The aggregate legacy of poor individual property commencement decisions in the 1980s includes long term losses of national wealth, and sovereignty.

Professional malfeasance played a role. Many of the major accounting and property valuation firms faced court actions for their failures of professional duties of care. These professions need more objective, theoretically sound, and legally defensible methods of forecasting future property market outcomes upon which current values depend.

Several different perspectives on office oversupply are possible. To an economist the issue may be efficient marginal allocation so that markets clear and supply equals demand at market prices. Deviations would be seen as market imperfections. From a management perspective, office oversupply may be seen as a problem of how to create a flexible production system with just in time delivery and optimum or minimum inventory. A city planner would have a third view--either authoritarian (Stockholm, Singapore) release of land to meet social objectives, or for free market planner, institutions to provide minimal interference and let markets decide how

much to produce. This dissertation takes a “problem solving” approach, combining qualitative and quantitative methods with institutional economics and system dynamics perspectives.

1.3 The Gap Between Academic Research and Industry Practice

Recent academic research has primarily sought to use econometric techniques to specify and estimate structural models for quantitative real estate market forecasting. David Dickinson, Director of Research at JLW Advisory, one of Australia’s leading private sector property research firms, maintains that JLW has tried seriously to apply these academic research methods (econometric modelling) to property forecasting problems with “disappointing” results.”⁵ Dickinson believes the property markets evolve too quickly for methods using historical data to succeed. Moreover, data resources are insufficient and variables too numerous to allow precise estimation. Most industry decision makers do not go even this far in attempting to use academic research.

Why does academic research lack credibility? Statistical techniques applied to office market variables look backwards to past behaviour, while markets are more interested in forecasts. Poor data leading to lack of efficiency and unknown errors, complexity leading to misspecification, and system openness leading to structural change all plague property modeling efforts.

But surely appeals to “judgment and experience” are even more open to bias and error. Although it is difficult to forecast supply, demand, and rent, market decisions nevertheless require quantitative estimates. Unfortunately as statistical research methods improve, at the same time they become more complex and difficult for market participants to understand. Makridakis and Wheelwright (1989:64) point out that responsible managers usually refuse to use methods they do not understand. A pension fund manager, for example, with fiduciary responsibilities to safeguard

⁵ Personal interview, Sydney, June, 1996

investors' funds would not wish to respond to charges of lack of due diligence with "I never understood the math." The criteria of esoteric and sophisticated methods that lead to success in academic publication lead to models incomprehensible to the real estate industry.

Another problem is that most academic work in real estate addresses market aggregates--supply, demand, or price indices at a metropolitan or national level. Real estate decision makers, however, need *individual* project forecasts. Because real estate is diverse in design, location, tenants, etc., different market segments and different buildings may have quite different fates. Timing is also important in office markets—there are brief windows of opportunity, not timeless truths. There is little reason to hope that a coefficient which is based on 3 year old data, perhaps from another country, will lead to an accurate forecast for a particular building. Research and publication lags therefore guarantee that market participants would use models reported in the literature at their peril--results are almost certainly outdated.

Academic attention should be directed towards modeling disaggregated decisions in imperfect and rapidly changing real estate markets. Decision makers need "time and space specific decision models," rather than the usual "theory" or "generalisation seeking" models published in the literature. Their concern is what *will* actually happen in a complex specific situation rather than what *would* happen if the world were controlled by only a few variables identified by theory and simple dynamics. Harvard Business School developed qualitative case study methods in the 1950s, but we have yet to perfect quantitative case study methods for forecasting applications.

Progress in quantitative academic research in recent years, while at the same time the industry has become more interested in using the results of research, means the time is ripe to link these two worlds more closely. Both industry and academia need to adjust their approaches to research. Industry is acquiring from academia more commitment to the use of theory, empirical data, quantitative methods, and objectivity. At the same time applied case study research provides academic researchers with data on complex systems, real world testing of models, and

appreciation of information's time and cost constraints, all of which lead to much improved models.

During 1993-1995, I undertook three office market forecasting exercises as a consultant to commercial clients. These companies--a diversified property company, a large regional bank, and a property trust--were all interested in projecting patterns of recovery in oversupplied office markets. Because markets were so inactive and illiquid, traditional valuation methods based on recent sales were difficult and uninformative. Current values, especially for untenanted buildings or buildings with expiring leases, depended upon when demand and rents would recover. Development of the models reported in this dissertation has been partly financially supported by, Knight Frank Independent, the research arm of a diversified property company. Jones Lang Wootten Advisory also provided data.

1.3.1 Theoretical versus Applied Research

If we think of the number of variables treated by research and the number of applications of research results as two dimensions, the academic paradigm considers few variables or issues, generalised to many applications, while an applied paradigm more suited to the industry requires the consideration of many topics with respect to a single application (Table 1.1). These are "ideal types" and one could find exceptions--in particular, industry research is often incomplete.

Table 1-1 Theoretical versus applied research paradigms

	Many issues considered	Few issues considered
Many applications		<i>Academic Style Research</i> Theoretical, rigorous Deep, focused, Generalisation seeking
Specific application	<i>Industry Style Research</i> Cost constrained, pragmatic Holistic, comprehensive Decision oriented	

This dissertation follows the “Wisconsin idea” in attempting to link the two.⁶ Senge (1990) says applications imply interdisciplinary methods which requires a team of specialists. A generalist may also be useful as a “translator” or coordinator of the effort.⁷

1.4 Contribution

If it were easy to solve the problems of office oversupply cycles by application of academic methods, the two problems listed at the beginning of this chapter would not have remained so widespread given the considerable talents and effort previously applied to understanding these problems. In any case, solving these problems will require individual and institutional changes that may take decades to implement, if

6 The “Wisconsin idea” is a phrase dating from the Progressive era around 1900 when Governor Robert M. LaFollette recruited University experts to reform a corrupt state government and the University adopted the concept that “the boundaries of the university are the boundaries of the state.” During that period, Wisconsin professor Richard Ely, a founder of the American Economics Association, pioneered academic studies of real estate.

7 Lacking specialist skills, I am forced to apply for this job.

they can be implemented at all. Nevertheless, I think this dissertation is partly successful in developing information and methods relevant to solving the two problems. Classifying by the four methodological paradigms provides the following listing of contributions:

1.4.1 Qualitative contributions

1. Evidence regarding causes and suggested remedies for office oversupply cycles. Wheaton (1995) remarked that the 1980s U.S. office cycle is “overdetermined,” that is, it could be explained in half a dozen ways as a function of government policy, agency issues, supply lags, baby boom demographics, etc.⁸ My work provides evidence for various causes of office cycles and discusses diverse remedies implied by these causes. It identifies synergism between causes implying that multi-faceted solutions could have greater collective effect than relying on single remedies. And I argue that causes of office cycles vary across time and space, dooming searches for a universal parsimonious theory of office cycles. Historical case studies leading to time and space specific models will serve better to inform particular decisions.
2. Documentation of stochastic lags in the supply response. This is important information for modelling supply responses and demonstrates important characteristics of the strategic behaviour, prisoners dilemma problem faced by developers. Without an understanding of lag structures, it is hard to model office market processes.
3. Description of hitherto little studied lags on the demand side of office markets. Understanding these “inventory holdings” and institutional (created by leases, etc.) lags may greatly improve ability to connect office demand proxies to economic fundamentals like employment or GDP changes. This is particularly interesting because if the dynamic relationships through time between employment, for example, and office demand were

⁸ Personal communication, 1995.

better understood, then much longer and perhaps less error prone data series (ie employment series rather than office market data) could be used to estimate models of office demand. This account of demand side lag structures will aid future modelling efforts. Again, a case study approach is needed since there is no inevitable sameness in the process over time--demand lag structure would vary with expectations changes, changes in customary lease terms, etc.

4. Documentation of the importance of agency problems in office market decisions. This means supply decisions in some markets (eg. Perth, 1980s) may be virtually unconnected with the price and demand fundamentals that should signal for new supply. This information will also be useful in model specification. The information on lags and agency can contribute to refining models such as Grenadier's (1994) version of supply cascades, by defining better the information a game theory analysis must consider.

1.4.2 Econometric contributions

1. I feel it is a contribution to take a sceptical, critical stance to regression modelling. Hendry regards model destruction or a test, test, test approach as essential to producing empirically valid social science (Hendry, 1993). The aim, however, is not to discard or denigrate econometric methods. Rather the aim is extending their reach to smaller samples and unstable processes, which is only possible if great care is taken to recognise consequences of violation of assumptions and other pitfalls. It is no criticism of previous investigators who have produced many clever specifications of office market processes to say that in light of recent developments in time series methods, most of the literature reports biased or spurious models. Out of sample forecasts are likely to have less validity than indicated by confidence bounds. Bias, uninterpretable statistics, and possibly spurious relationships are inherent features of statistical methods in non-experimental settings with small samples and changing data generating processes.

2. Few office market papers in the literature follow the recent time series literature recommendations to test for stationarity and lag structures, report results of diagnostic testing, recognise pretest bias, simultaneity, and cointegrating relationships. I am not aware of other studies that have applied these time series methods to Australian office market data.
3. In office markets, supply lags require forecasting perhaps 4-5 years into the future. Because long term leases lock in current market prices, investment outcomes depend importantly upon the level of rent in the year of completion. Narrowing the focus to a single year's outcome at a specific future time (t+4 or t+5) focusses forecasting efforts on the most relevant issue for project specific decisions.
4. While common in the forecasting and econometric literature, use of withheld sample forecasts to validate models is uncommon in office market research.
5. Among other econometric issues, I have compared models in levels, differences, VAR, and cointegrating VAR formats.

1.4.3 System dynamics contributions

1. Use of SD software to create models with innovative features in office market studies. I did not encounter system dynamics models in the real estate literature, an odd omission given the extensive use of simulations (spreadsheets) by industry, the paucity of data for statistical estimation, and the importance of lags and feedback structures. The models reported below are also groundbreaking in incorporating both office market segmentation (in the spreadsheet version) and cyclical market behaviour into simulation forecasts.⁹ In addition, the use of econometrically estimated equations in system dynamics models is rare in the system dynamics literature.
2. The simulations are simple and presented in a "hands on" format to create a useful interface between econometric results and industry decisions. They

⁹ Many econometric papers fit equations to cyclical data, but cyclical simulation forecasts for industry decision making are rare.

seek to present information in a way intuitively intelligible to decision makers without extensive statistical skills. The models will make it possible for implications of market changes, such as commencement of competitive projects, to be understood more quickly, more quantitatively, and therefore with more effect on subsequent decisions. Capacity for quicker adjustments to information amounts from an SD perspective to a redesign of the office market control system which should improve efficiency. Whether these simulations will make a difference in practice remains to be tested and may be conditional upon institutional reforms suggested in my final chapter.

3. The three SD simulations presented serve different purposes: Model 1 (without prices) is useful for studying system design and system policies. Model 2 (with prices, supply and demand exogenous) allows quick quantitative updating of rent forecasts in a format very accessible to non-expert decision makers and useful for sensitivity analysis and strategic planning of competitive strategies. Model 3 (with prices, supply endogenous, demand exogenous) combines 1 and 2 and might be preferred for forecasting purposes, provided one was assured by institutional changes that the market's supply response would be as rational as the model's. This is therefore a *New Atlantis* version of an office forecasting model.¹⁰ In a world of fee driven deals, such a rational supply response could not be assumed.
4. The models presented here are among the first specifically designed to generate quantitative forecasts of cyclical office market behaviour. They also are unique in that they demonstrate a convenient way to incorporate additional information into forecasts through a combination of qualitative, econometric, and simulation methods.

¹⁰ New Atlantis was Sir Francis Bacon's technocratic utopia where society organised itself according to scientific research results (Peltonen, 1996).

1.4.4 Institutional contributions

1. Revised valuation methods for cyclical cash flows are discussed in chapter 8. I list this as an institutional contribution because the methods used by valuers are a matter of agreed upon standardised methods, rules, and requirements delineated by regulatory agencies, the courts, clients, educational institutions, and professional societies.
2. Proposal of remedies to the problem of office oversupply through the following institutional means:
 - i. a prisoners dilemma solution via rule changes in the game
 - ii. market information institutions to create objective data
 - iii. agency issues guidelines to improve lending decisions

Considering the role of academic researchers in the property industry we can see that information cannot improve market outcomes unless there are unbiased rational institutions for creating and applying information. Neither information creation nor applications are adequate under present system design.

1.4.5 Combination of methods contribution

Graaskamp's holistic time and space specific feasibility modelling approach was an early applied project specific real estate research paradigm. My research is closer to academic approaches in that the analysis is at the market level, not the individual project level like Graaskamp's work. Nevertheless, combining qualitative, econometric, SD, and institutional methods leads to a wider understanding of the office market system and how it might be redesigned to improve market efficiency through better individual project decisions.

Chapter 2 Paradigm diversity in property research

There is no trick at all in constructing a theoretical model; you simply leave out a lot of the features of the real world.

Scott Gordon (1991:109)

The platonic roots of science point to a deeper truth--that science itself is a form of mysticism.

Brian Appleyard (1992:63)

2.1 AREUEA Presidents' Call for New Paradigms of Inquiry

In his presidential address to the American Real Estate and Urban Economics Association (AREUEA) in early 1995 Austin Jaffe called for re-examination of paradigms for real estate research. Jaffe's use of the word "paradigm" comes from Thomas Kuhn's (1970) well known *The Structure of Scientific Revolutions*.¹ In Greek, "paradigm" means "pattern." Kuhn uses the term to mean a general approach to research. Increasingly, Jaffe worried, academic research in real estate merely applies theory developed in other fields (eg. finance or economics) to real estate data. The winner of the prize for best paper at the 1995 meeting was an example--an application of finance theory to the term structure of office rents (Grenadier, 1995).² Jaffe believes the field should establish some separate claim to its own intellectual identity.

¹ Kuhn has been criticised for using the term paradigm loosely, or perhaps with several meanings at different points in his exposition.

² Grenadier's paper applies finance theory to derive a model for a term structure of rents in real estate office markets. One can look at this paper the other way around, however. Grenadier took the trouble to understand the institutional structure of office leases, giving the finance theory realism and usefulness that it would have otherwise lacked. It was getting the details of leases right that made the application of theory useful. Under different lease terms, results would differ.

Jaffe called upon his colleagues to develop alternative paradigms, perhaps returning to the approaches of early 20th century work incorporating spatial analysis, law, and institutions.

Lack of real estate theory may be a long term problem for both research and practice in the field. Another perspective, however, would be to say that since real estate is a branch of applied economics, there needs to be *more* attention to economic theory in real estate research.³ Certainly some of the difficulties of the valuation profession can be traced to the failure of traditional valuation methods to update their theoretical economic foundations and especially their failure to empirically quantify uncertainty in forecasting.

2.1.1 Criticism of Business School Research

Ken Lusht, Pennsylvania State University Business School Research Dean and former AREUEA president, presented a seminar at Curtin University in May, 1996 entitled "*Business School Research: Where we have been and speculations on where we may be heading.*" Lusht began by saying "Business school research is being heavily criticised. Many think business school research hasn't done the job." According to Lusht's account, much research is considered unreadable, too esoteric, or irrelevant by the business constituencies it aims to serve. Disciplines are too narrow; so they don't match real world problems. Academics produce papers containing language and equations suitable for talking to other academics, but not to business people. Dickinson's comments reported in chapter one are an example of this criticism. Based on my conversations with practitioners, this scepticism about academic work is widespread in the property industry.

Lusht maintained that a paradoxical result of increased power of computers and software is that "data has been discredited." Readers know that published quantitative results arise from practices such as "data mining" and that a variety of alternative and inconsistent models can be proposed, all with acceptable degrees of "fit" to the data. Rapid change in the business world makes data and research

³ In a postmodernist world, contradictory positions can both be true to some degree.

quickly out of date. Advances in some fields of study come from universities, but innovations and advances in business don't come from business school research. Kuhn would have called Lusht's observations symptoms of "paradigm strain," one of the precursors of a paradigm shift.

Lusht divided the history of business school research into three periods:

1. Pre-1960's--largely descriptive
2. 1960's to the present--explanatory and analytical
3. Future (Lusht hypothesises)--"problem solving research."

During the descriptive period, most business school research got little respect from "more advanced" disciplines like economics. Two major reports by the Ford and Carnegie foundations in the late 1950's highlighted the need for more analytical approaches. Business schools responded, first by changing the names of subjects and courses of study. Insurance became risk management.

These cosmetic changes were followed by substantive change in methods. In the analytical period, approximately 1960 to the present, the research paradigm sought to explain and understand behaviour. Mission statements mentioned "creation of knowledge." Business research became more analytical by turning to "mother disciplines" and upgrading methodology. Marketing, for example, hired psychologists; management became more mathematical, and so on. Real estate studies adopted econometric and finance methods and theory. Much progress was made in learning about business management and how markets work. For a long time, these approaches seemed to "pass the market test." It was often not clear what would end up as applied or useful, so there was a tolerance for abstract work. But by the early 1980s, criticisms began to emerge. In Lusht's words there was, "Uneasiness about bits-and-pieces-approaches applicability to real problems. People used to think 'It will pay off eventually.' Now, having seen certain lines of inquiry not pay off for a long time, they ask 'When?'"

2.1.2 Problem Solving Research

Lusht speculates that future business research will adopt a more “problem solving” perspective. This progression, Lusht said, has been followed by other disciplines. For example, medical research went through stages of description, explanation, and finally, problem solving.

The characteristics of the new paradigm are, according to Lusht:

1. More applied work (but still rigorous and based in theory).
2. More outside funding for research. Some of this goes all the way to consultancy, but Lusht urges researchers to seek publications as well.
3. More diverse and mundane research topics.
4. Ongoing relationships with industry clients.
5. Often the results of such studies have more to do with improving methods (eg. how to forecast), rather than with “findings” typical of traditional explanatory papers.
6. Problems arise with confidentiality, pressure from “clients” for reports favouring their interests, and in terms of the opportunity cost of faculty time spent on applied research (versus teaching, etc.).

Lusht reports that editors of journals are beginning to ask “Who cares?” when evaluating papers. Furthermore, academics are beginning to get credit for coming up with innovations that industry can use. The diversity of papers appearing in journals is increasing. There are more non-mathematical papers and more review articles because individual quantitative studies are no longer considered conclusive. To build a convincing case for an empirical results or theories, meta-analysis is needed, summarising and evaluating research by many investigators.

2.2 Limits of explanatory paradigms

Herbert Simon's work on "the sciences of the artificial" points out that when the subject matter is a purposefully designed human artefact, it can be changed at will. Positivist approaches have difficulties with explanation and prediction when the subject can decide to change his/her behaviour or invent new behaviour (Simon, 1969). In a televised interview a British former chief economic policy adviser remarked "We used to think the economy was like a machine--you could pull a lever and predict how it would respond. Now we think of it as more like a frog--we poke it with a stick, but can't predict which way it will jump."⁴

Darnell and Evans (1990) point out that accepting complexity means becoming more methodologically sophisticated:

"During the 1960s, many had hoped that econometrics would provide a sound 'scientific' foundation for economics along the lines of the standard hard science model of, for example, physics...The optimism was, and is, misplaced; however, the appropriate response to the dissatisfaction...is not to discard either methodology or econometrics..."⁵

The world has turned out to be too complex, open, and changeable for research on "bits and pieces" of systems to solve problems. Simple models are only true *ceteris paribus*--other things being equal. In complex business applications, other things are usually different, so predictions from simple models can be wrong. In complex systems, the very notion of causality is a matter for debate. Harvard biologist Richard Lewontin says "things are both causes and effects...things interpenetrate each other" and "there are no general rules or principles in biology" because "everything depends" (King, 1996). Cambridge University philosopher of science Hugh Mellor emphasises that there are many necessary, but not sufficient side conditions assumed in any simple causal model.⁶ Changes in side conditions are

4 A 1995 Australian television broadcast of a BBC series.

5 Popper (1982), arguing against historical materialism made a powerful argument against determinism.

6 Address to the Philosophy of Science society of W.A., ca March 1996.

common in economic systems and cannot be dismissed as random shocks because many variables are unit root processes where the effects of shocks are permanent. Processes do not vary around a mean but rather follow stochastic trends. In contrast to fields like medicine and chemistry, it is not clear that the descriptive and analytical (causal model seeking) phases of real estate research have created a foundation for “problem solving.”

2.2.1 Defining terms: Paradigm, Theory, Model

Kuhn uses paradigm to mean either method/process or substance/content. Kuhn argued that science progresses not by a linear accumulation of knowledge, but rather by “revolutions” whereby one paradigm (eg. Newtonian physics) is replaced by another (eg. quantum physics and relativity). Revolutions occur, according to Kuhn, when progress following the old paradigm slows, when data appears that is inconsistent with the old paradigm, or when there are practical problems it can not solve, and most importantly, when a new paradigm is found that can better encompass the data.

The word “theory” is also used in several senses in science and common speech. Many academic researchers, especially in economics, would mean by “theory” a set of equations showing relationships between variables with considerable power to explain and predict beyond the data from which the parameters of the equations were estimated. Graaskamp’s (1981) *Fundamentals of Real Estate Development* may be a theory of real estate.⁷ This is not, however, a system of equations, but rather an account of a complex multi-disciplinary process whereby real estate assets are created. Darwin’s theory of natural selection is a similar account in words of the basic rules or functioning of evolution of species.

A model is a representation of a real system by something purporting to behave like the system. In medical research, rats, monkeys, or pigs are “animal models” for humans. Watson and Crick used a three dimensional physical model to help visualise the structure of DNA. In econometrics, a model is usually an equation or system of

⁷ Fred Rendahl, a colleague at Wisconsin, offered the opinion that Graaskamp’s paper might be a theory of real estate.

equations. A model embodies or represents theories, which are abstract ideas about the relationships depicted by the model. The appropriateness of a theory or model depends importantly upon its purpose. For example, a complex model might represent a system with greater precision, but be too costly or too opaque to users. Reification--confusing a model with reality--is a common fallacy among modellers. Peter Kennedy (1993) comments:

“It is now generally acknowledged that econometric models are “false” and that there is no hope, or pretence, that through them “truth” will be found. Feldstein’s (1982, p. 829) remarks are typical of this view: “in practice all econometric specifications are necessarily ‘false’ models...The applied econometrician, like the theorist, soon discovers from experience that a useful model is not one that is “true” or “realistic’ but one that is parsimonious, plausible, and informative.” This is echoed by an oft-quoted remark attributed to George Box-- “All models are wrong, but some are useful.”-- and another from Theil (1971, p. vi): “Models are to be used, but not to be believed.”

Nevertheless, most of the published literature in real estate implicitly follows a positivist empiricist research paradigm borrowed from the natural sciences and therefore assumes a time invariant process, barring a few dummy variables to represent shocks. We speak of finding the “best model” or the “true model” for a data generating process as if that process were time invariant and a matter of universal law rather than human design. Journals report tables of coefficients and T-statistics without mentioning use-by dates, perhaps because many of these would have expired in the lag between research and publication. Review articles bemoan the lack of consistency between parameters estimated from different samples and large sizes of forecasting errors. It is too easy to fit a model within a sample and too hard to forecast out of sample. But these outcomes should not surprise us--process instability is an empirically observable feature of human designed system behaviour. But if processes are not stable over time, cumulative knowledge is less important than better methods to keep track of change and produce desired outcomes. Why blame models for

forecasting failures that are really inherent in underlying processes? The models are fine; it is the processes that are disorderly.

2.2.2 Paradigm of inquiry

Research starts with epistemological questions like: What is worth knowing? What is there to be known. How can we know about it? What data and data sources are relevant and trustworthy? What kinds of results or theories are sought? How are models or theory tested and validated, what are standards of proof? Other relevant meta-methodological issues have to do with the social context of research: What are the social roles, qualifications, training, motivations, values and ethical standards of the investigators? Who supports research, controls research funding, employment, and research agenda? What are investigators rewards and incentives? What do investigators do with results, how are research results applied in society? John Ziman explores some of these issues in *The Force of Knowledge* (Ziman, 1976). Reason and Rowan's *Human Inquiry* is another interesting source on meta-research issues (Reason & Rowen, 1981).

In the 13th century, Thomas Aquinas laid the philosophical foundations for the rise of science by distinguishing between knowledge that could be obtained by observation and knowledge that could only come through reflection and faith. At the beginning of the 19th century, La Place postulated a deterministic universe. The human desire for order and meaning is a powerful cultural tradition, extending back at least to Homer, whose heroes cannot escape predestined fates. While it is a fine dramatic device in an epic poem and a comfort in confusing circumstances, the existence of universal order, like the existence of God, cannot be proven by observation. Science--like other belief systems--remains poised over what Gordon calls "a metaphysical abyss" (Gordon, 1991).

For evolving, human-designed phenomena like office markets, investigators should assume disorder and change as the metaphysical foundation of a modelling strategy, rather than time-invariant Platonic order. On the other hand, there is enough observable order and structure in the economy that we may be fairly certain that

economic growth will increase employment and that employees will continue to work in offices in the near future. The degree of disorder is an empirical question. Makridakis and Wheelwright (1989), in a chapter titled “What can and cannot be predicted,” propose a classification of the orderliness of processes with important modelling and forecasting implications.

J.M. Keynes, in an exchange with Tinbergen, argued that economics must always have “moral content” (Keynes, 1939). Better knowledge of office market processes, for example, does not guarantee better outcomes. What is required are better decisions which must imply therefore objectives, values, and moral choices and an institutional framework to generate and apply better information. Information cannot take effect except through interaction with an institutional context.

2.2.3 Origins of the Positivist Empiricist Paradigm

Gordon documents by direct quotes that virtually all early social scientists sought to emulate Newton by seeking parsimonious laws to “explain much by little.” Smith’s invisible hand, Marx’s historical materialism, Malthus’s “laws” of natural increase, Spencer’s survival of the fittest, Durkheim’s division of labour, and other social science theories all attempted to arrive at simple, broadly applicable explanations of human behaviour in ways analogous to Newton’s laws (or in a few cases, Darwin’s) (Gordon, 1991).

Positivist empiricism, developed in detail by Sir Karl Popper (1982) and a number of other mid-twentieth century philosophers of science, but with roots extending back to Aquinas and Sir Francis Bacon, attempted to codify scientific method by insisting on the primacy of rules for empirical testing of propositions. Popper himself later had to retreat from these rules. Further discussion of these issues would take us too far afield, but essentially, more eclectic philosophies of science have replaced positivist empiricism (Hausman, 1989).

The social sciences, and especially economics, however, did not strictly speaking follow the positivist empiricist paradigm from their beginnings. When difficulties were encountered due to complexity of social behaviour, two important inventions

allowed economists and other quantitative social scientists to cope, but at the cost of losing the certainty and empirical foundations that led to progress in the physical sciences:

1. Deduction from simplifying assumptions (such as “rational economic man”)
2. Use of statistics to summarise distributions of outcomes

These allowed social scientists to discuss stochastic social processes where causal relationships among variables would otherwise have been hidden by random variation. Real estate research, a branch of applied economics, adopted these methods as well. But using deduction from assumptions which Friedman (1953) had to defend as acceptable, although counter-factual, meant economics, far from becoming a science, was still using pre-Baconian methods, closer to Aristotle than to falsificationism. In a stochastic world, single contradictory events do not falsify hypotheses (as Popper recognised), and conclusions can be influenced by arbitrary decisions about sample size and confidence levels.⁸ Lakatos, following Kuhn, decided all scientists have certain “core propositions” which they do not submit to empirical tests (Lakatos, 1970).

2.2.4 Philosophy of natural sciences versus behavioural sciences

A major theme in the philosophy of science literature explores differences between the social and natural sciences. Core questions include the role of cognition and consciousness in behaviour and whether one can get valid results with humans in experimental situations, experiments being the key method of the natural sciences. It is hard to overemphasise the importance of experimental methods for sorting out causation in the natural sciences. Randomisation, control of extraneous causes of variation, ability to vary the independent variable at will, and ability to replicate results are all features of experimental method usually not available in social science.⁹

⁸ Small differences eventually become statistically significant as sample size error increases.

⁹ Sir Francis Bacon, ideological father of scientific method virtually equated science and experimentation. Awareness of the distinctions between experimental and non-experimental sciences is sharpened by reading a book like Box, Hunter, and Hunter *Statistics for Experiments* and contrasting its chapters on experimental design, main and

Human behaviour depends too much on context and we are interested in real world system outcomes, not controlled experimental results, to mention only two of several problems preventing use of experiments in social sciences.

Rosenberg (1988) divides social researchers into two camps, each operating under a variety of related labels:

1. The first group uses the terms naturalism, behaviourism, positivism, empiricism. Those in this camp are realists, meaning they believe scientists should be able to agree on an objective truth, "out there." They believe it best to avoid explicit consideration of human values and motives lest these lead to failures of objectivity and introduction of biases. Their critics argue that this means, in practise, since all behaviour is motivated by implicit values, adopting a particular set of (usually conservative, status quo supporting) values unexamined. Realists, understandably concentrate on observing objective external phenomena. Behaviourists in this group find mental processes to be unmeasurable and therefore "unscientific."
2. The other group operates under the labels idealists, phenomenologists, structuralists, ethnomethodologists, students of semiotics or hermeneutics, post-modernists, deconstructionists. Those in this camp are constructionists, meaning they feel all versions of reality are human constructions and hence inherently reflect characteristics of the observer as well as what is observed. Intelligibility or meanings matter. "A scientific approach to human behaviour is held to miss, when it fails to come to grips with the centrality of meaning and the significance to social knowledge, the moral dimension of social science" (Gordon, 1991: 17). One can never get at meaning solely by observation of actions. They propose a "hermeneutical circle" of belief, desire, action, explaining causal laws of human behaviour in terms of intentions. Interestingly, given this groups' acceptance of the centrality of morality and human values, they are criticised for having made truth and "good" relative

interaction effects, etc. with any econometrics text with its chapters on violation of OLS assumptions. Gordon, 1991, includes a discussion of why experimentation is often impossible in social science research.

terms which seems to open the way for obvious evil to gain legitimacy as just another point of view.

Donald Bannister parodies the two poles nicely by suggesting two “types of papers.” The reductionist positivists are represented by “Short term memory for T-mazes under electrically induced stress conditions in the decorticate wood louse” (no doubt with intent to generalise to humans under stress), while the critical and hermeneutic side gives us “Unconscious aggression and overt sexual fantasies as quasi-religious substrata for international conflicts.” (Bannister, 1981:194) Perhaps this parody of extreme positions makes a valid point in suggesting that perhaps some more tolerant and eclectic middle ground would be more in accord with common sense than extreme versions of either realism or constructivism.

Scott Gordon (1991:51-56) offers relevant comments in his useful *History and Philosophy of the Social Sciences*.

“Nomological propositions are possible only with respect to phenomena that have some reasonable degree of uniformity... Some social phenomena may be so diverse that no nomological proposition can be made. It is likely that some social phenomena will permanently defy nomological generalisation, no matter how advanced the social sciences become. In addition, even those social phenomena that can be covered by nomological propositions seldom have a degree of uniformity and precision comparable to those of the natural sciences.

Humans do not behave in the same sense that rocks, or planets, or even lower organisms can be said to behave. Behind what we observe as human behaviour there are phenomena of consciousness. When we use words such as ‘decide,’ ‘choose’, ‘expect’ and so on we are referred to mental inner states in human individuals for which there is no counterpart in the material world.

Some social scientists have taken the view that the study of social phenomena is greatly assisted by the fact that the scientist, being human himself, can achieve an empathetic understanding of human behaviour...going beyond simply observing what people do, to a comprehension of why they do it...Other

social scientists, however, regard the attempt to explain social phenomena with the aid of mental concepts as an impermissible resort to elements that are unobservable and inexplicable. Many social scientists and philosophers, not to speak of students of the humanities, are more troubled by behaviourism than by the problem it sets out to solve. One social scientist (Frank Knight) remarked that, having waged a long struggle to escape from the idea that stones are like men, we now seem to be intent on showing that men are like stones.

When a positive proposition fails to be supported by empirical evidence, the proposition is called into question; but when a normative proposition is at odds with the state of the world, the state of the world is called into question. When a person's positive beliefs do not agree with the facts, he is rationally obliged to change his beliefs; but when the facts do not agree with a person's normative beliefs, he is morally obliged to change the facts if he can.

May Brodbeck (1968) wrote that the belief that social and physical sciences should be the same is "the unexamined premise of the vast majority of present-day social scientists." Friedrich Hayek coined the phrase "scientism" to deride the view that social and physical sciences are identical (Gordon, 1991:637). The Austrian school and others used Weber's idea of *verstehen* to draw an important distinction between the study of stones and men. Peter Winch (1958) argued that the study of social phenomena must be philosophical rather than scientific, because humans are "rule following" creatures which requires a different notion of causation where reference to meaning is essential. Louch (1966) maintained that "since social phenomena are the result of deliberate individual actions, they are irredeemably moral in character."¹⁰

Gordon takes a middle ground, pointing out important differences between social and physical phenomena--the speed of cultural evolution (and hence the non-constancy of 'laws' that might describe such phenomena), and the importance of mental states as causal agents (beliefs, cognition, values, etc.). However, he sees a basic

10 Cited by Gordon, op. cit. p. 637. It is doubtful social scientists would maintain this consensus in the 1990s.

epistemological unity in all of science in the commitment to empirical methods and the dialogue between theory and theory testing.

Gordon points out the importance of “nomological level”--how aggregated are the phenomena to be described by the “theories” one’s science proposes? Social sciences must take account of “emergent” properties at the level of institutions or societies, in addition to laws founded in methodological individualism (Gordon, 1991: 641).¹¹

Ian Kerr argues that any “explanation” of the determination of relative prices that ignores the underlying human value elements (utility, real costs, and so on) is flawed and that “any predictive power the model might have is likely to be confined to the period of the time series that ‘empirically’ validated the model” (Kerr, 1996).

“Theory” or “priors” or “restrictions” from previous knowledge one brings to the model construction process are, as a practical matter, essential to making sense of data. Otherwise the possible model specifications (variables included, functional forms, lag structures, interaction effects) are infinite and no parameters can be estimated. Hence, modeling involves choices at every stage, and these can only partly be based on empirical data. The data itself are a product of choices.¹²

These issues will not be explored further here, except to state that I agree with the position that social sciences are different from natural sciences and that much of the confusion and slow progress in social sciences can be blamed on the over use of paradigms of inquiry unsuccessfully borrowed from physical sciences.¹³ Social science’s difficulties are not a passing matter of “more research is needed,” but rather a symptom of fundamental human predicaments that are inescapably problematic. These difficulties are both moral and epistemological. They result from the practical

11 Einstein is said to have made a similar comment about science. He said it would be possible to express a Beethoven Symphony in the language of quantum mechanics but “what would be the point?”

12 The dependence of data on theory was one of the heaviest blows against naive empiricism. Russell Hanson’s work in the 1950’s is the chief source on this point.

13 My interest in philosophy of social science began due to the shock of the transition from undergraduate study of a real natural science (BS in chemistry) to a natural science imitating positivist empiricist graduate program in sociology.

reality of “free will” and self-interest and our capacity for making bad or selfish or short-sighted choices and from the impossibility of sorting out reliable causal models in a non-experimental, historical world of openness, complexity, and change, given our inherent mental limitations. Gordon ends his 650 page summary of 400 years of social science history and philosophy with a plea for the openness, self-doubt, and tolerance for diversity which are core features of science:

“Any form of organisation that seriously constrains free competition in the domain of scientific research ... including control by scientists themselves ... is a prescription for the destruction of science, not for the furtherance of scientific knowledge and its reliable application to practical problems. In his famous essay “On Liberty”, John Stuart Mill argued the case for intellectual freedom on utilitarian grounds, as a form of social organisation that promotes the advance of knowledge. The thesis he advanced need not be defended as a matter of faith or liberal political ideology; it is certified by the historical experience of science in all its domains” (Gordon, 1991: 668).

2.3 Qualitative Research Paradigms

The philosophy of science has moved well beyond Friedman’s (1953) naive instrumentalism and Popper’s falsificationism which still constitute the basic philosophy of science equipment of many realist oriented investigators. Townsend (1995) refers to “the waning of positivism” as a major intellectual trend of the three decades following Kuhn’s demotion of science from “the way to truth” to just another corruptible human paradigm. Hausman (1989) provides a very succinct summary of diverse economic methodologies, concluding that eclectic diversity of approaches is preferable to any single orthodoxy.

Articles on what might be called “the philosophy of econometrics” are a fascinating area at the frontiers of positivist paradigms (Kreuzenkamp and Mcaleer, 1995). Recent work in mathematics on complexity shows that some problems are insoluble (Casti, 1993). Chaos theory (Hall, 1991) demonstrate that there are no parsimonious solutions even to certain quite simple problems. Boyd, Gasper and Trout (1991) is a good source on many of the philosophy of science developments of recent years.

Regrettably or thankfully, depending upon one's interest in these issues, this literature is outside the scope of the present discussion. I will, however, present a brief summary of some qualitative research paradigm thinking. This is less familiar to many in real estate research and is the implied methodological paradigm behind chapters 3 and 4.

Lincoln and Guba (1985), include conscious efforts to define methodology for a qualitative research paradigm. They also take a pluralist position, saying the present "postmodern moment" is defined by "doubt that any discourse has a privileged place, any method or theory a universal and general claim to authoritative knowledge."¹⁴

"Qualitative research" paradigms of inquiry seem to be a conscious effort to refute positivist empiricist quantitative paradigm accusations that qualitative research is "soft" not "rigorous" and "may have literary merit but not theoretical power." Positivists see qualitative methods as "an assault on the assumption that truth can transcend opinion and personal bias. Opposition to positive science by the post-positivists and post-structuralists is seen...as an attack on reason and truth" (Lincoln & Guba, 1985:4).

The qualitative research theorists counterattack with some loaded words of their own. "Thin data" is their description of statistical models using only a few variables. They espouse "naturalistic inquiry," that is, the idea that issues must be studied "in context" in order to get meaningful results.¹⁵ They talk about emotional truth, personal responsibility, and an ethic of caring. They say quantitative research accepts numbers (ie. economic data) as if they were generated from a black box, while qualitative researchers try to enter the black box and turn on a light.

The qualitative research concept of *bricolage*, a concept proposed by the anthropologist Levi-Strauss, that is "a pieced-together close-knit set of practices that provide solutions to a problem in a concrete situation", sounds close to Lusht's "problem solving research paradigm." Hamilton, in discussing qualitative research

¹⁴ Laurel Richardson, 1991, quoted in Lincoln and Guba, 1985, p. 2

¹⁵ Those associated with the development of systematic qualitative research methods include Yvonna Lincoln, Egon Guba, Norman Denzin, Ian Dey, David Hamilton.

quotes Machiavelli who wrote "I am disposed to hold that fortune is the arbiter of half our actions, but that it lets us control roughly the other half." Qualitative research emphasises the explicit hope that the research itself may influence the system studied (Lincoln & Guba, 1985:60). "Objectivity" is criticised by qualitative paradigm theorists as a fraud disguising particular values and biases, usually those upholding the status quo.

Credibility for qualitative research is gained through "prolonged engagement, persistent observation, triangulation (getting different points of view or "constructions" of the situation), holistic views, peer debriefing, "member checks" (asking the respondents if they agree with the researcher's interpretations). All this is contrasted with the "thin" data of the quantitative researcher by calling it "thick description" (Lincoln & Guba, 1985:133).

The qualitative paradigm of inquiry's analogy to "statistical significance" in a quantitative study is "trustworthiness," which is obtained by long exposure to the subjects of the inquiry and various other means of validation, including checking with the subjects of the research to see if they agree with the researcher's interpretation. They propose procedures such as a "research diary" of interactions, unstructured, repeated interviews, and participant observation as means to get deeper into the reality of social systems in ways accessible to checking or validation by other investigators. Nu-dist, a software package for content analysis, provides a means of analysing qualitative data.

Not surprisingly, the qualitative research paradigm flourishes in fields of study where human behaviour is a central concern. In university business schools qualitative paradigm research paradigms are adopted by a minority of investigators in management, marketing, and information systems (IS). It is interesting that IS, obviously a bastion of quantitative research, includes investigators who have chosen to use qualitative methods. This has occurred, because research on implementation of new information systems technology has revealed the importance of subjective, qualitative issues. Hamilton remarks "Managerial separation of conception

(research) from execution (implementation) is psychologically, socially, and economically inefficient" (Lincoln & Guba, 1985:67).

Qualitative researchers, rather than striving for objectivity and detachment, seek to "deconstruct" their own biases and social roles to gain deeper understanding of their own approach to the problem. Design of qualitative research "always begins with a socially situated researcher" (Denzin & Lincoln, 1994 :x). The researcher is seen as a key element to understanding the research.

Subjects being investigated are treated as thinking human beings, rather than objects or "respondents." Ethical concerns are assumed to be inescapable in the process and application of research. Qualitative research does not lead to "theory" as "truth" but to "constructions of historical realities." As Carr and Kemmis put it "real practical situations are idiosyncratic" (Carr & Kemmis, 1983: 43). Qualitative researchers tend to talk about "emotional truth" and look down on the quantitative researcher's positivist numbers as not having the power to motivate action. Action can only be can be derived from values and emotions.

Rather than "external validity", which is the key question for the quantitative paradigm, the issue for the qualitative paradigm is "transferability" of results to new situations. If a case study is successful, it may convince people to apply it to their situation (Erlandson, 1993:151).

"Naturalistic" inquiry attempts to solve the problems of complexity and inability to experiment inherent in most social research by careful study of behaviour *in situ*. Naturalistic inquiry advocates (Guba, for example), reacting against laboratory studies of human behaviour, suggest that people act differently in laboratories than in natural settings. An "interpretivist" paradigm emphasises what constructions people create to define or create "reality." Since many interpretations are possible, constructionists find it possible for there to be multiple "realities", even mutually incompatible views.

The professional journals, like *Real Estate Review* and the *Appraisal Journal*, or *The Valuer* often report examples and case studies generally within a "3 approaches to

value” paradigm dating from the 1930s and based to some degree upon obsolete and incorrect economic theory. Academic real estate research, at least that published in the American, UK, and Australian journals like *Real Estate Economics* or the *Journal of Real Estate Research*, is almost entirely in the quantitative positivist hypothesis testing tradition derived from Popperian falsificationism and is built upon a more theoretically sound and up to date economics and finance theory paradigm. Thus the gap between industry and research has grown as academic theory and methods diverged from industry practice, or if you prefer, as industry practice (particularly in valuation) failed to adapt to new thinking.¹⁶

The qualitative methods, while they add depth and insight do not take us where we want to go. - A few Chinese investors may buy Australian office buildings based on *Feng Shui* or qualitative evaluation of buildings, most Australian and overseas investors look at “the numbers” in attempting to make economically rational, wealth maximising decisions. Rents, projected internal rates of return, and net present values drive most real estate decisions, although there are clearly emotional and qualitative issues behind these numbers. A thoughtful student complained that in emphasising financial analysis of real estate we have left out of his education evaluation of real estate from a user perspective--that is, any ability to validate the cash flow numbers by qualitative analysis. Abstract numbers, after all, are merely a code summarising benefits and costs given preferences. How can we evaluate numbers without understanding the qualitative processes which generate them?

Phil Ragan, a senior Australian property analyst remarked “Our models must include the behaviour of actors in the markets.” Qualitative research contributes to better specification of quantitative models and simulations. Talking to market participants will provide better understanding of information available to actors in the system, variables that govern system behaviour, lag and expectations structures, and functional form of relationships to test in quantitative work. This dissertation remains mainly in the quantitative tradition, seeking numbers not interpretations as

¹⁶ The reasons for appraisal methods slow changes may include court decisions and professional society standards which tend to enforce traditional methods, as well as inertia and lack of commitment to lifelong learning on the part of busy practitioners, and the pressures of commercial practice.

outputs. However the reader will agree, I hope, after reading later chapters, that qualitative research enriches the quantitative discussion.

2.4 Research seeking general “laws” versus research to inform specific applications

The inaugural issue of the *Journal of Real Estate Literature* (July, 1993), includes a review by Julian Diaz III emphasising the practical “like engineering” aspect of real estate studies (Diaz, 1993: 183-198). Diaz cites Simon in placing real estate among “the sciences of the artificial” as distinguished from the natural sciences. Diaz suggests “entrepreneurial activity” as the focus of the real estate process asserting that an “activities model brings form to the challenging diversity of real estate” (Diaz, 1993: 187). Diaz sees real estate research as having breadth, but not depth (in contrast to finance) and to be advancing slowly. He concludes: “an engineering imperative...largely drives an applied discipline like real estate” and that the field must satisfy industry constituencies’ need for improved methods. Diaz agrees with Feyerabend who argues “against method” saying science should place no restrictions on questions pursued or method employed. “Competing theories should arise and clash and reveal each other’s inconsistencies and weaknesses, thereby improving the general state of knowledge” (Diaz, 1993: 191).

Elden (1981:258-261), in a discussion of “participative research,” suggested four “critical decisions” in research design:

1. Problem definition--What is the research problem?
2. Methods choice--What methods will provide useful data?
3. Data analysis--What do data mean?
4. Use of findings--What for and by whom?

Elden distinguishes 12 types of research based on the degree of participation by subjects in the four dimensions. If there is no participation at any stage, he calls it academic research, with applied research on the other extreme. Elden found that

“there is a lot left to be done after one has abstracted all the general knowledge that research has produced. This gap can only partially be filled by more general knowledge....interestingly enough, my abstract categories tended not to hold water when we got down to concrete cases.” Elden uses the term “local theory.”

The typical article in academic journals such as *Real Estate Economics* or *The Journal of Real Estate Research* remains at the "market" or "class of buildings" or "financial instrument" level, rather than at the individual real estate decision level. Moreover, typical articles are analytical or reductionist rather than holistic. This means that in a particular instance, additional factors might enter that could reverse the results of the narrower study. We need somehow to bridge the gap between the narrow specialised study and the practical decision which must consider every relevant circumstance operating in a particular case. More than many fields, real estate maintains close contacts between industry practitioners and academic researchers. However, perhaps the field needs a journal called something like "Applied Methods in Real Estate Decision making," devoted to specific practical applications.

2.4.1 Graaskamp's Applied Paradigm

Twenty five years previous to the recent calls for new paradigms for real estate research, the late Professor James Graaskamp (1985; 1988) developed a research paradigm for applied real estate decision problems.¹⁷ Graaskamp's goal was solving specific problems--raising the odds of successful outcomes for particular property investments--rather than developing theory..

Graaskamp assembled diverse information on a specific question (such as whether to buy a building), with research effort constrained by time and cost. He frequently used the words “multi-disciplinary” and "holistic." He felt real estate development takes place in an ethical and aesthetic framework where the activities of real estate entrepreneurs are an art form creating the human environment in which we live. He

17 James A. Graaskamp served from 1962 until his death in 1988 as chairman of the University of Wisconsin Real Estate and Urban Economics Department in the School of Business.

emphasised not only the necessity that the developer make a profit, but also that space users (tenants, purchasers) and public infrastructure remain at least solvent for the development to succeed (Graaskamp, 1988).

Graaskamp had an ethical vision--one's enterprise could only succeed in a society that managed to maintain social justice by keeping everyone solvent in the mutually interdependent "real estate process"(Kummerow, 1994). Graaskamp defined solvency, analogous to the biologists' concept of survival, as the minimum target outcome in real estate investing.

For Graaskamp, property research was not a passive measurement of existing conditions, but a creative synthesis aiming to invent competitive advantage. Summing up Graaskamp's message in one phrase, "details matter." Which means that no simple model can be trusted in a particular case, however true it may be generally. Williams and Elmore, political scientists, argue this position in *Social Program Implementation*, a book on the failure of the U.S. "Great Society" programs (Williams and Elmore, 1976). Theoretically sound programs were brought to ruin, Williams and Elmore argued, by failures in the details of implementation. A theoretical model may be too simple to predict outcomes correctly. Unforeseen problems arise in implementation (Peterson & Heinsohn, 1982). One's conception of the problem evolves through experience.

2.4.2 Theory versus implementation

Galileo's basic research led to a universal and simple law, describing behaviour of physical bodies with a parsimonious mathematical equation relating acceleration of a falling body to a gravitational constant, mass, and inverse of distance squared. This timeless universal law applies to all matter in the universe at all points in time.

But consider application of Galileo's work, which was undertaken to explain the trajectory of cannon balls. To attain the desired result of knocking down the walls of a specific seventeenth century Italian city, many more things must be considered in addition to Galileo's simple law: a) Casting metal capable of sustaining high pressures, b) Manufacturing gunpowder to appropriate specifications, c)

Organising, training, supplying, paying for, and commanding an army, d) Finding means to transport heavy cannon with implications for roads systems, wagons, harness, horse care and training. e) Mechanisms and training allowing accurate aiming of cannon. f) Implying mining, smelting, alloying, factories, labour skills, financing factories, a system of property laws, institutions like money to facilitate exchange, etc. All of this occurs within a political context that in some cases leads to war as the extension of politics by other means.

Applications require a systems approach--many things are necessary but not sufficient conditions for a successful practical application. If any of the sub-systems do not perform adequately, the entire system may function poorly, regardless of the truth of a parsimonious covering law. Each of the subsystems has a certain complexity. Conformity to a simple parsimonious theory could never guarantee success in an application. Rather, failure of any of a number of subsystems (necessary but not sufficient conditions) is likely to cause failure of a project like an office building.

Few of the elements of the 17th century “knock down city walls” system would be relevant today. Technology and institutions have evolved so that the application is quite different in different eras.

The systems analyst *can* generalise from one applied problem to the next in terms of a checklist of issues to consider even if many specifics are unique to each situation. Senge (1990), for example, claims that all feedback systems conform to one of 16 generic “archetypes.” But in applications complexity and sensitivity to minor changes in initial conditions, and interdependence of subsystems rule system behaviour, not the elegant simplicity of scientific “laws”.

Real estate will remain stuck in the region of few observations and many variables. Weinberg (1975) refers to “the law of medium numbers,” which he says is equivalent to Murphy’s Law--anything can happen. The law of large numbers which guarantees consistency when there are many observations of a stable time-invariant process does not hold in time-variant, heterogeneous human designed

systems. Furthermore, in applications one is not interested in distributions of outcomes but rather in the particular outcome at hand.

A second example makes a further point. With thousands of parts working properly, the momentary failure of a single circuit nearly destroyed the multi-billion dollar Apollo 13 project. The astronauts themselves were not interested in the statistical probabilities of surviving; they were interested in problem solving for survival. In applications, a particular event or course of action is the focus of interest, not a frequency distribution of outcomes. We do not need to discuss properties of an infinite time series process, rather we want to know rents in two years time when the building where our money is invested is finished.

This means, we don't *need* a universal simple theory applicable everywhere at every time. Our money is not invested everywhere. We do need enough understanding of the specific system at hand to survive specific historical events. In office investments, and all of human history for that matter, one wishes to survive. History does not replicate experiments. Time is uni-directional. We cannot repeat the 1980s and make better decisions, we can only try to apply the experience to a new and different situation.

Articles in the literature that report "findings" (usually regarding half a dozen variables only or less) as if they would hold true forever and everywhere, imply more generality than is justified by states of nature. Rather than the simplification search of theory construction, in specific applications we may need a complexification search to identify everything that might matter for the outcome of concern in a particular case. How to go about that complexification search was addressed in Graaskamp's feasibility outline, but virtually nowhere else in the real estate literature.

2.5 Paradigm Dialogue

Combining methods decreases the depth of the analysis in each area. But synergy developed through a dialogue between different approaches justifies the difficulties of eclectic research methods.

An analogy that appeals to me is that in building a house the usefulness of each tool is enhanced by the application of other tools. A useable house could not be made with just one tool. In the same way, it seems to me, an eclectic research methods toolkit extends our understanding and ability to solve a practical problem.

The saying, "If all you have is a hammer, everything looks like a nail" applies to the overuse of econometric methods without enough attention to qualitative issues, data quality, system behaviour (lags and feedback control), and institutional context. This does not denigrate the hammer--econometrics is so popular precisely because it is so powerful and appealing. But no matter how useful one tool, using a variety of methods will often build a better solution. One by-product of integrating econometrics with other research paradigms in applications would be, I think, more credibility and wider use of econometrics.

In the search for a real estate research paradigm, Graaskamp's focus on single investment case studies seems to me an important avenue for quantitative academic research to take up. If our field develops its own paradigm it may follow Graaskamp's applied "holistic, multi-disciplinary" time and space specific decision modelling guidelines, although the same ideas pervade decision theory and management. Spatial statistics will probably become much more important with the advent of geographical information system data bases.

This dissertation, meanwhile, extends the tradition of borrowing ideas from other fields for real estate applications, adding to the menu qualitative research and system dynamics methods. American Real Estate academic studies began with institutional economics (Ely at Wisconsin, see Weiss, 1989) and institutions are still central issues. As econometric techniques advance, they will probably remain the tool of choice to help quantify uncertainty, understand causation, and generate forecasts.

Real estate research will continue to extend its ability to understand and predict by borrowing an eclectic toolkit of methods. Borrowing a diverse toolkit and combining methods may be among the best candidates for a real estate research paradigm.

Chapter 3 Market participants' explanations of office market oversupply

3.1 Exploratory Research

Qualitative research literature recommends prolonged immersion in a research topic, obtaining diverse points of views to who reveal different perspectives, then validating one's conclusions by checking them with participants. Becoming personally acquainted with a system helps one understand the motivations of actors and the meanings they ascribe to situations, which leads to better understanding of their behaviour. Personal observation and discussion with participants in a system may bring forth issues not considered in the literature and variables not including in previous modelling efforts. The purpose here is to generate ideas and hypotheses for quantitative testing, not to definitively establish results.

3.1.1 Qualitative studies

During 1992-93 I was the convenor of an Australian Institute of Valuers and Land Economists (AIVLE) Study Group on office markets in Perth, Western Australia. Several study group sessions were held in which a total of about 20 market participants offered opinions on causes and remedies for office oversupply, based on their Perth experiences. My colleague, Erica Walker, and I interviewed participants in the development of four major projects for their explanations of why they all went ahead. Chapter 4 reports on this research. In early 1993, Hooker Corporate and , a diversified property company, requested a model to forecast the future of supply, demand, rents, and values in the Perth office market. This resulted in development of a spreadsheet model to project the Perth office market ten years into the future. In early 1994, Bankwest (then R&I Bank, previous to a name change), Western Australia's largest regional bank, asked for a repeat of the office forecasting exercise. At that time Bankwest was engaged in negotiations to sell the Bankwest Tower, a 38,000 m² CBD tower completed in 1989. This version

generated a property cycle by assuming oversupply would occur again, consistent with past experience.

Paladin Australia Ltd., a new listed property trust, commissioned political further office market research in 1995. This work explored equilibrium vacancy rates using data on rents and vacancy rates from 5 Australian capital cities. Knight Frank Independent (KFI), research arm of a major diversified property company have commissioned continued development of office market forecasting models reported here.

A further study of the Perth office market was undertaken in 1994 at the request of William Kerr, a Perth property consultant. Students surveyed a random sample of 200 suburban office tenants to determine the degree of segmentation between CBD and suburban markets.

I was able to interview knowledgeable leasing and research staff at major property companies in Perth, Sydney, and Singapore. About two dozen attendees were interviewed at the Urban Land Institute 1996 annual meeting. These informants collectively have developed or financed several billions of dollars worth of office projects throughout the USA and elsewhere. In November, 1996, I interviewed a dozen Sydney property industry experts. These informants represent major sources of office project finance and major agency firms in Australia.

From 1992-present, I collected clippings from the *Australian Financial Review*, *Australian Property News* and other press sources on office market developments around Australia. Property company research reports are another useful source of information on current office market conditions.

Finally, academic authorities James Shilling, Richard Green, University of Wisconsin, Patric Hendershott, William Wheaton, Mike Miles, Peter Colwell, Leon Shilton, Tim Riddiough, Kenneth Lusht, and Tom Whipple offered insightful and diverse perspectives on office markets.

3.2 Anecdotal Explanations for the Perth Oversupply

Participants in the Perth AIVLE study group with long experience pointed out that the most recent cycle was not unique: Oversupplies existed in Perth in the late 1960's, in 1975, and in 1983, as well as the 1990-92 period. Supplies were tight, constraining firms growth, during the mid to late 1980s. This is consistent with the American literature which describes repeated office market cycles, although not at the same dates except in 1975.

It is notable that the explanations for oversupply offered by these market participants are so diverse, as if those located at different places in the property industry are like the proverbial blind men touching the elephant, each with a partial answer to the question. In each case, I have appended a sentence or two about possible remedies for each particular kind of market failure. These remedies are as diverse as the diagnoses.

1. The recession.

Some thought decisions taken were correct at the time, but were later embarrassed by a general downturn in the economy. There are two versions of this: a) Then federal treasurer (later prime minister) Paul Keating mismanaged the macroeconomy, a very credible theory in my opinion--Keating allowed the economy to overheat, then brought it down with a hefty interest rate rise which in combination with the 1987 stock market crash caused liquidity problems. b) The property industry forgot about the existence of business cycles, or believed cycles had been moderated greatly by better macroeconomic management

Remedy: Manage the economy for more stability. Expect cyclical economic activity, that is, do not project unending growth over long time periods, especially after several years of an upwards portion of the business cycle.

2. Inadequate market studies, based upon faulty absorption data.

Market studies, following methods that had been adequately predictive of demand in the recent past, were overly simplistic. Past trends were simply projected into the future, without looking beneath aggregate numbers to identify market changes. Picking recent figures in the late 1980's led to a considerable overstatement of demand growth, as there were several successive years in which absorption was well above the longer term growth trend. due in part, one suspects, to fears of short supply and "hoarding" through leasing of excess space to accommodate hoped for future growth.

There was some confusion about space absorption figures in Perth during the 1980s. Many new buildings were being built, so many sites were assembled and cleared. If a tenant moved into a new building, it was not likely to leave a "hole" in an existing building. More likely, the old building would have been demolished. The failure to distinguish between gross and net absorption misled ever-optimistic developers as to the extent of growth in net new office demand. Perth office feasibility studies used figures of 60,000 m²/year demand growth, while the longer term 1980's average net absorption figure was less than half that amount. ¹

The figures provided as "space take up rates" were apparently gross figures for leases in new properties, which did not take into account the "holes" or vacancies thereby created in older buildings. So long as old buildings were being demolished the gross and net take-up rates were in effect similar in terms of vacancy rates because of the supply reduction, but as growth and demolitions slowed, most new leases began leaving a vacancy some place else. With downsizing of some firms during the early 1990s recession, the holes left by moves to new quarters were in some cases much bigger than the new space taken up.

Remedy: Greatly increase budgets for market research (by a factor of 10), improve market research methods. Look at five to ten year average take-up rather than 1-3 year period if historical rates are used to guide decisions. Use smoothing methods on

¹ Thanks to Eric Wilkinson, formerly with St. Martins Properties, for documenting this point.

absorption data, will and/or include a return to trend or error correction term in models predicting short to medium term absorption. Consumer research (primary data gathering from tenants) is needed to identify trends sooner. Use net new demand, not total leasing activity as the proxy for demand change.

3. *"Game of chicken" or "long lag time with unstoppable momentum" or "tragedy of the commons"*

This idea suggests that decision makers knew about other planned projects and perhaps had a fairly realistic idea of future aggregate demand. However, each hoped that other projects would not proceed. By the time it became clear that too many projects would proceed, too much capital was committed and it was impossible to retreat without facing bankruptcy or inordinate costs of holding land til the next building opportunity. If one was broke anyway, why not proceed and hope that the attractiveness of one's project would make it the successful building while competitors' buildings remained empty? Like graziers adding livestock to a paddock owned in common, too many buildings were stocked onto a limited paddock of office demand, ruining the grazing for everyone. The mistake was to assume that one's sheep could stay fat with the common overstocked.

Remedy: If the market cannot regulate supply properly, some regulatory scheme to allocate limited demand among projects is needed in order to protect investors. A queue or requirement to document demand is needed as a condition for regulatory approvals.

4. *"Flood of money" and/or public policy incentives.*

Financial deregulation during 1984-85 allowed a flood of Asian capital to enter the market. Australian yields looked very attractive compared to those in Asian countries with higher savings rates and trade surpluses. These investors were used to low returns and willing to waiting patiently for returns. These investors clearly underestimated the risks posed by different inflation rates between countries, the

downward slide of the Australian dollar in international currency markets, and business risks in oversupplied markets.

In addition, the October stock market crash of 1987 led many investors to seek safety in commercial real estate. In W.A., the state government, under a series of activities later labelled "W.A., Inc.", sought to promote economic development by major investments in partnership with private firms, including two large office projects. "W.A., Inc." led to the downfall of the labour government in W.A. and a series of Royal Commission investigations of corruption.² Similar government support to overly optimistic development schemes were a factor in Queensland, Victoria, and South Australia.

These three factors--overseas capital, financial deregulation, and public-private development partnerships--resulted in too much money chasing too few real opportunities. This could also be called the "stupid money" theory. A variant of this theory is the "especially stupid public money" theory, which would argue that the extra buildings were the result of public investment motivated by corruption or aims, rather than economic rationality. This theory has international evidence in its favour: There is public money in London's Canary Wharf, the project that helped bankrupt Olympia and York, and Melbourne's South Yarra project, two notable office failures. The U.S. 1982 tax act and deregulation of savings and loans in the U.S. are suspected of contributing to U.S. office oversupply.

Remedies: More realistic financial regulation, caution in public "economic development" efforts, care to avoid overly strong tax incentives for property investment.

5. "Agency problems" or "fee driven deals"

² In Australia a "Royal Commission" is appointed to investigate government corruption.

Many people when asked what caused oversupply replied simply “greed.” This was the most common response of the people I interviewed at the ULI meetings in San Francisco (a sampling from across all regions of the USA), in Sydney (a sampling from a broad range in institutional real estate agents, researchers, and investors), and in Perth.

Many of the profit centres in real estate development come during the development process or “above the bottom line.” In other words, even though a project may fail, there are many individuals and firms who may profit nevertheless.³ An extreme version of this theory might even say that the empty buildings weren't at all bad for the W.A. economy because they provided jobs and redistributed money from foreign investors to local construction workers.

In interviewing market participants, the most luxurious office we visited belonged to the project manager for the biggest of the failed Perth office projects. Among those who stood to gain from projects doomed to fail were a wide variety of participants in various aspects of office development. Developers in at least one case profited handsomely in selling assembled land to the project before construction. Staff at lenders were promoted or received bonuses for arranging deals. Property brokers, leasing agents and construction companies all obviously profited from these projects. As one informant put it “There are a lot of people who don't get paid unless a deal happens.”

A phrase often used was “fee driven deals” emphasising that some market participants made large amounts of money despite the ultimate failure of projects. These included consultants, on-sellers of land, agents, project managers, bank lending officers who received bonuses based on loan volume, some developers, construction firms, architects, etc. The finance literature calls this the “agency”

³ Graaskamp advocated this view of “profit center” analysis as a key to understanding behaviour long before it became a popular theme in the Finance literature.

problem--individuals employed by the enterprise may not have the same goals and rewards as the shareholders. Other phrases used in the literature are "asymmetric information" or "asymmetric risk" indicating different actors face different risks and some (the developers) may have insider knowledge not available to others (lenders, property trust unit holders). Misallocation of risks leaves developers with a call option to own the project if it succeeds and a *de facto* put option to the lender if it does not.⁴ Facing little risk and a certain fee income, why would fee earners not wish to proceed with the project regardless of its chances for success?

Remedy: Separate the decision making from fee income. Lenders in particular, must play the role of critic and say no to projects that cannot document demand. In several of the projects, capital sources slipped into the developer mentality (yes, let's overcome the obstacles to this lovely project) rather than maintaining a critical objectivity. Risks and rewards should be more in alignment through the structure of contracts and employment compensation agreements. Increasing market share through imprudent underwriting is a very poor strategy for financial intermediaries.

6. Greed and corruption.

Some blamed corruption in government decision making--two major Perth projects were financed by the state government superannuation and insurance funds under circumstances later investigated by a Royal Commission. The Commission did not lead to criminal prosecutions for the office deals but did note suggestively that the chairman of the state superboard was "accustomed to handling large sums of cash."

⁴ Graaskamp often expressed these views. His view of why projects fail had much to do with "above the line profit centres" (his phrase). With the developer's profits already in hand due to cash flows resulting from the development process, agency fees, or management fees, the developer can regard project success as a kind of call option--owning a profitable project would be nice, but it is not essential to motivating developers in all cases. With near 100% finance and a non-recourse loan, or ability to shift liability to a company or individual without assets within reach of creditors, the project may be put to the lender if it does not succeed.

Approximately 100 pages of Royal Commission findings concern a series of Perth property deals that led to a major office project. So much money is to be made by projects proceeding and so much lost if projects to which tens of millions of dollars have been committed must be delayed, that morally frail humans are simply unable to respond with integrity. Distortions ranging from wishful thinking to outright corruption will occur in such circumstances.

Remedy: Jail terms and legal proceedings to recover substantial damages. Reform of decision making procedures to prevent allocation of large sums without proper review and justification based on research. Perhaps a cultural change is needed to stress values such as honesty and integrity. Blaming public sector involvement seems too easy an explanation to me--the bribes all came from private interests.

7. *"Its the valuers (or accountants) fault,"*

This theory singles out certain professionals who failed (it is alleged) to carry out their proper role as experts serving as impartial sources of information to lenders and others. Valuers (appraisers) may, according to this theory, have bent their professional ethics by reporting unrealistic numbers or basing valuations on assumptions they knew or should have known to be false. For example, valuing buildings on an "as if occupied" basis when in fact demand was insufficient to fill buildings quickly and excess supply likely to reduce rents. Although the majority of professionals might refuse to adopt rosy scenarios, developers or lenders motivated by hopes of profits or fees may shop around for cooperative analysts. There is always someone willing to produce the desired numbers.

In at least one case, a senior analyst in a firm supplying capital to one of the major projects advised against the project, but was overruled. The fact that there are a wazzu half dozen cleared sites in Perth where projects did not proceed indicates that many firms did exercise caution. Perhaps one of the major lessons of the Perth experience is that it is not enough for some firms, perhaps even a majority of firms to "get it right"

regarding decisions to build major projects. Just a few bad decisions (in Perth perhaps 2 or 3 bad decisions) can destroy profits marketwide.

A number of lawsuits and out of court settlements of professional liability claims not only demonstrate the extent of this problem, but also have created very large insurance premiums for valuers. Trevor Sykes reports a \$132 million out of court settlement of a professional negligence action against an accounting firm who gave a clean report just before failure of Tricontinental in Victoria, a debacle that cost the state government \$3 billion. (Sykes, 1996)

Remedy: Strengthen the professional education and independence of valuers and accountants and penalties for professional negligence. Regulation of share markets, accountancy, and valuation to ensure due diligence informative financial reporting.

8. *"Mistakes happen, Chaos rules*

This theme from the AIVLE study group sessions might be called the "random walk" idea. Some thoughtful individuals doubted that subsequent events could have been predicted by anyone. This idea is to some degree contradicted by the fact that other market participants claim they did see a serious oversupply developing, although none predicted the length and severity of the recession and hence no one foresaw vacancies as high as actually occurred in Perth. For example, Frank Gelber of the forecasting firm BIS-Shrapnel warned of potential office oversupply in 1988. Of course, arguing that forecasting is possible because someone happened to be correct is not conclusive. *Ex post* prediction success by a few forecasters is inevitable no matter what the outcome, given the diversity of forecasts.

What could be known *ex ante*? If the information used was the best available and decisions reflected that information, then the market did as well as it could have done in forecasting an indeterminate and chaotic future. Bad outcomes merely reflect the severity of shocks that could not be predicted. In such a world randomly chosen investments do as well as those chosen by experts and all assets are priced correctly.

Questions of what can and can not be known about the future and how to go about study of the future are relevant concerns for study, not settled issues and are crucial in laying a foundation for the modelling efforts of subsequent chapters. My conclusion is that the future is indeed more chaotic than most forecasting and modelling efforts imply (prefer to admit), but that comprehensive attention to marshalling all information available and interrelationships among variables, will allow some improvements in forecasting. One of the forecasting improvements, however, is to acknowledge the importance of uncertainty, complexity, and indeterminacy (Makridakis & Wheelwright, 1989:44).

Remedy: None possible in the sense of improving predictions. However, moving to a risk management perspective would result in lessening exposures, risk sharing, and other risk management tactics to reduce the adverse impacts of expectations not being met. Greater humility in the face of uncertainty would argue for smaller projects, for example.

9. *"Cowboy mentality" or corporate ego*

Many developers apparently believe that "I am, therefore I build." This over-optimistic mindset led them to overextend and build beyond any reasonable limit. The "tallest tower" syndrome as Freudian psychologists would have it (good taste requires omitting a more graphic phrase). A risk taking, gambling approach taken to extremes. The prevalence of gambling, legal and illegal, as a feature of human behaviour (especially in Australian culture) raises the question: Why wouldn't people choose to gamble with other people's funds if so many choose to gamble with their own?

Even this view, however, overestimates the rationality of human behaviour, according to some respondents. They say egos, both individual and corporate, played a major role. Some projects were going to be built simply because the developer or the company were determined to have the tallest tower in the city or a major building as a legacy, regardless of risk or economic considerations. The Sears Tower in Chicago, for a while the worlds tallest building, is a good example:

Sears have now abandoned the Tower for a less costly and more efficient suburban office complex.

Perth's Bob Williams, developer of QVI, a 60,000 m² Perth project, is a particularly tragic example: Williams emotional commitment to his project not only spurred him to go ahead in the face of what he knew would be oversupply, it also led him to turn down an offer to sell the project during construction for a net profit of \$10 million. Williams eventually went bankrupt and QVI went to a Japanese lender which had sold a put option on the project.⁵

Remedy: Reality therapy administered by shocking financial outcomes. The bankruptcy of virtually the entire cowboy developer group suggests that this remedy has been applied and future developers will be more cautious, at least until institutional memory fades. Someone remarked that lenders institutional memories are short because those responsible for major losses are sacked.

10. "Market capture"

Overall demand was correctly perceived, according to this view, but each entrepreneur expected his project to be so superior a product that it would capture a more than proportionate share of the total. This point of view ignores the downward pressure on rents exerted by competitors' empty buildings.

Market research must consider the whole system: At least one project proceeded with a fairly accurate (*ex ante*) estimate of total demand based on a competent market study. They nevertheless were very wrong in their rent and occupancy projections because they failed to project correctly the number of other projects and the fact that rents would fall so far in the resulting competitive tenants' market. No one was, in fact, able to capture so much more than their share of the market as to rent up quickly, at least

⁵ Historian Barbara Tuchman in *The March of Folly* describes half a dozen historical examples where good information was ignored.

not without giving the space away for almost no rent. The most long lasting losses were imposed by new buildings on old buildings that may never regain tenants.

Remedy: More realistic market share assumptions in market research. Good market research will document a realistic capture expectation (Clapp, 1993).

11. *The Palace Hotel theory*

According to one respondent, everyone in Perth's small town property industry congregated a St. George's terrace hotel on Fridays. Under the influence of alcohol, there were no secrets in the property industry and everyone knew how much to trust everyone else. Allan Bond purchased and closed the hotel in order to build the Bond tower (subsequently renamed Bankwest Tower). Loss of this key pub destroyed the industry's communication's network and resulted in market chaos just at a key moment in time (1986) when decisions were made to proceed with too many projects.

Remedy: A new pub. Better communication in the property industry would be one of the easiest system changes to implement, perhaps through an Internet hookup of lenders and developers to update information on projects' stages of development.

12. *Lemmings or sheep.*

According to this theory there is a herd instinct among developers or perhaps irresistible peer group pressure, much like teenagers unable to resist participation in collective mischief. Every few years, according to this theory, developers go mad, build too many projects and thus, in effect, march into the sea.

The fund manager's version is that with fiduciary responsibilities, one can't be too bold in one's investment philosophy. So before venturing into office investment, fund managers want to be certain that such investment is "ok" meaning others are also doing it. By then, of course, it is too late. Too many have entered and returns are bound to be mediocre at best. Moreover, by delaying new supply in the recovery

phase of the cycle, this over-caution leads to short supply which sets the stage for oversupply later by driving rents too high, stimulating too many new projects.

Remedy: Evolution into species more likely to survive for the long run.

13. *MBA's or computer spreadsheets.*

Computer technology lent a spurious credibility to unjustified assumptions about future rents and take up rates. Training of lending institution staff was not adequate to properly evaluate the models and their assumptions.

Perhaps academics themselves may have had a concept of a more orderly and predictable world than in fact proved to be the case. Chaos and openness are to be reckoned with, which is obscured by the seemingly hard numbers of coefficients and standard errors in models. Models that could be applied to property investment decisions are not very reliable. We pretend to be quantitative, but our best efforts probably are still best thought of as leading only to qualitative conclusions. Misspecification, measurement errors, and process change being inevitable, forecasts will violate confidence band estimates on a regular basis.

Remedy: Improve the professional education of staff in institutions that invest in property, stressing understanding of the reality behind the numbers. Build more sensitivity analysis and uncertainty into models in recognition of the openness and complexity of urban systems. Improve statistical training and methods (among academics too) to avoid statistical abuses.

14. *Structural change in office markets*

Another factor is the changing nature of office demand--small to medium tenants seem to be the types of firms that are leasing additional space--that is, the source of

net demand growth, while some large firms (eg. banks) may be rationalising and reducing space needs.

Technological change and competitive pressures may be softening CBD office demand. There have been many media accounts of firms like IBM, General Motors, and many others shedding office jobs, slimming down middle management, in response to competitive pressures in a world economy.

Perhaps some of the growth sectors in the office market, such as accounting, were one time responses to new complicated tax laws. Mining, the main export revenue generator in the W.A. economy, for example, is certainly subject to exploration and development booms that contribute to office employment in Perth and which may or may not be repeated. David Birch, of Cognetics, Inc. has argued based on his corporate demographics data base that the 1980's boom in office employment was a one time phenomenon not to be repeated attributable largely to the post war baby boom's entry into the work force.⁶

Fax machines, mobile phones, home offices, desk sharing by salespeople who are only in offices part of the time, relocation of back office functions to cheaper locations, decentralising of office functions, decentralising of corporate management and so on are changing office demand. Some of this may come about through staff reductions, while reduction in space per worker may also occur.

Clearly as metropolitan areas grow, certain types of office users will follow retailing and clients to the suburbs. Decentralisation was a dominant force to be reckoned with in the 1980s property cycle and will be to an increasing extent in the future.

Remedy: Convert offices to other uses, they will never be needed. Build new offices in suburbia. Downsize the development industry.

⁶ Birch uses a technique he calls "corporate demography" to identify growth in employment and hence office demand.

15. *Bankers Don't Understand How to Turn on a Shower.*

We have all had the experience of turning on an unfamiliar shower in a hotel. Because we don't know flow rates or lags in response to turning the tap, we begin in a state of uncertainty about how to adjust the shower. We know that at first it will be too cold, so we turn on the hot water. After a while, we get scalded, so we turn off the hot and turn on the cold. Because of the time lag, we are still scalded even after turning on the cold water, so we almost inevitable turn the cold on too much, ending up frozen again. And then some joker flushes a toilet. If you are following the analogy carefully you will already have realised that the toilet flush is an unexpected shock such as an oil crisis, interest rate increase, or recession.

A major office project takes about four years to complete (a significant and uncertain time lag). Office demand may be price inelastic. There is uncertainty about future supply and demand, no one knows exactly how far to turn on the tap or how much water will come out. Lenders are unwilling to speculate on future market adjustments, so they prefer to wait until current prices justify construction before backing new projects.

Prices signal for more buildings (more hot water), for a long time before supply can respond, unless developers and lenders anticipate correctly and turn up the heat (ie commence projects) before new supply is signalled for by current prices.⁷ Because it takes years to create a major office project, the market has to be very aware of not only the rent adjustment feedback loop that will send rents downward when projects are completed and vacancies rise, but also of the likelihood that absorption rates will slow when recession comes.

The more than average amplitude of economic cycles in the commodity export driven, Western Australia economy makes the problem of mis-estimating demand due to long lag times very clear. In Perth, as in the Dallas oil economy, commodity

⁷ Since lenders don't know how to adjust a shower, they end up taking a bath.

price changes not only change revenues from existing operations, but they also turn on and off exploration booms.

It is stupid to scald and freeze ourselves with showers, given that we know for certain that the signal we are receiving (cold water) will not persist and has in fact been reversed by our previous action (turning on the hot water). In the same way, markets are foolish to respond to price signals that the cranes on the city skyline clearly show to be transient. But in practice, both showers and office supply are hard to adjust correctly and the time lag makes over responses overshooting very likely.

Remedy: In this view, the main cure for office oversupply cycles is for markets to *believe in* office oversupply cycles. Everyone needs to know that rents will turn down if supply goes up too much and believe with sufficient conviction to modify behaviour based on forecasts, contrary to current price signals and even price trends. Estimate elasticities of supply and demand better and project the rent changes likely to result from supply and demand in the pipeline more accurately and convincingly. It would also help to reduce the time lags between project commitment and completion. This might be done by means of design/build or other ways of cutting the time to design and construct the building, or by institutional changes in the approvals process reducing regulatory delays. Perhaps cities should maintain a queue of pre-approved projects through the planning approvals process to reduce supply response delays when a demand shock occurs.

16. The best of all possible worlds?

Another theme, sounding a bit like Voltaire's Dr Pangloss insisting "This is the best of all possible worlds," was "Well, isn't it all wonderful? The building owner's loss is the tenant's gain. Low rents, would help the local economy, as it would be less costly to start and expand businesses." Moreover, much of the capital "lost" would actually have been paid out to construction workers, leasing agents, et al, and re-circulated with a multiplier effect in the local economy. As some of the capital originated overseas, and more interstate, Western Australia was just getting back some of the money paid out to buy Japanese cars. Even as Allen Bond was

convicted and sent to jail for defrauding investors in his companies, some West Australians said “Yes, but he made things happen to the benefit of the local economy.”

What are the social costs and benefits of mis-matching supply and demand in office markets? It is too early to know the ultimate IRR of the office investments. What is clear is that large losses due to vacancies occurred. Graaskamp was fond of pointing out that the “product” in real estate is space use over time and therefore extremely perishable. Once vacant over a period of time, rents for that period cannot be recovered. Like spoiled vegetables, real estate products--not the buildings, but the “space use over time” services provided by at the buildings--are perishable and bring no revenue if not sold in timely fashion.

Those who say Bond’s activities increased economic activity have forgotten opportunity costs and wealth destruction through negative net present values. Society would have been better off with capital allocated to more productive investments. Moreover, the “benefits to tenants and the local economy” view ignores the role of illiquid non-performing assets in creating and prolonging recessions. Net office demand and employment contracted in Perth in 1990-92 despite office rents falling to a fraction of their former levels. The collapse of the bubble should be netted against the benefits of the boom which inevitably led to the bust. Economic theory claims that the most efficient outcomes are equilibrium solutions with supply and demand remaining in balance over time, growth on a steady path, and full employment of resources at all times. Unemployment over 10% during the early 1990’s hardly looks like “making good things happen.”

Remedy: Broader perspectives, less ideology, more pragmatism.

3.2.1 Classifying the Anecdotes

Probably, each of the above theories (and perhaps more as well) played a part in the office oversupply picture. Each of the market participants had, in fact, touched a real part of the elephant. Moreover, there was synergism. Poor market research, for

example, would not have been such a big problem had it not been for the flood of capital and a recession. It is the more-than-additive effect of several factors that has created such a serious oversupply problem in Perth and other cities. The disasters have been worst where supply due to questionable lending decisions and weak professional analysis hit the market just as demand was contracting due to recession or economic changes. The following is an attempt to classify the above laundry list of explanations for the Perth office oversupply into a more parsimonious number of categories:

Sorting out which theories played a hand in the office oversupply scenario is important because research efforts and remedies to prevent future mistakes vary depending on one's diagnosis of causes of the problem. Table 3-1 classifies the above list of sixteen explanations into six categories: chaos, technical failings, moral hazard, game theory, institutional, and system dynamics.

Table 3-1 Anecdotal Explanations of the Perth Oversupply

I. Chaos in Nature Theories: Forecasts were as good as they could have been.

- A. Unpredictable recession--Government mismanaged the economy
- B. Mistakes happen--random variation (good decisions ex ante)
- C. Structural change in office markets (office automation, work stations)
- D. An unforeseen outcome of the 1987 stock market crash: flight to real estate

II. Technical failings that provided misleading information

- A. Inadequate market studies (over-optimistic projection of trends)
- B. "Its the valuers (or accountants) fault"
- C. Market share fallacy--"Our project is superior"
- D. MBA mentality or computer spreadsheets--mystique of printouts with GIGO
- E. Confusion of gross and net space take up
- F. Naive forecasting methods

III. Moral hazard and Corruption of Decision Processes

- A. The agency problem or fee driven deals
- B. Greed and corruption (especially W.A., Inc.)
- C. Developers' cowboy mentality" or corporate ego
- D. Profit centers above the bottom line create perverse incentives
- E. Bias in experts' evaluation

IV. Strategic Behaviour

- A. Game of chicken
- B. Long lag time with unstoppable momentum
- C. Tragedy of the commons (fixed derived demand, open entry)
- D. The Palace Hotel theory

V. Institutional Economics

- A. Financial deregulation led to a "flood of money"
- B. Public policy incentives seeking economic growth (W.A., Inc.)
- C. Herd instinct, banks and fund managers as lemmings or sheep

VI. System Dynamics

- A. Lags create uncertainty and a tendency to over respond.⁸

3.3 Issues Identified for Future Quantitative Modelling

One of the motives for qualitative research is as "exploratory" research to gain insight into system structure and dynamics for quantitative modelling. Two additional issues observed during qualitative studies of office markets are discussed briefly below--demand lags, and market segmentation. Neither has received much attention in the published literature, yet both seem important to future research on dynamic models of office demand.

⁸ Cobweb models whereby supply and demand adjust to one another imperfectly due to lags such as the so called "hog cycle" have often been modelled with equations including demand and supply as functions of lags of price. See chapter 7 for discussion.

3.3.1 Demand Lags

Office demand in a given year need not necessarily reflect the fundamentals of office demand. Leasing activity and occupied space defined as leased space are proxies for demand. In a particular year or even for several years in a row, a boom or recession mentality may prevail. Expectations of rising rents or falling rents may cause firms to lease more or less (respectively) space than they need at the moment. So take-up, in Perth at least, seems to go to less than zero in bad years and more than two times long term average rates in good years. These good years misled some firms thought the boom was permanent. It would have been wiser to regard the boom years as actually ensuring lower take-up in future because many firms were in fact taking up more space than they currently needed (in anticipation of shortages and rising rents), thus borrowing from future demand. So demand consists of space currently used and space held as inventory for growth and space freed by downsizing of staff or workspace ratios.

BOMA Sydney surveyed tenants during 1988-present to determine the extent of what might be called "vacancy within tenancies"(BOMA, 1995). BOMA and asked a sample of Sydney tenants their current space use and employee numbers and the maximum number of employees they could fit into their current space. Visits to firms at the end of the recession made the nature of this problem immediately obvious--retrenchments left empty offices. BOMA was concerned that demand growth would not appear in the occupied space figures because the latter is defined in terms of leased space, not in terms of bodies at desks. This is a major issue in demand forecasting as the BOMA data showed as much as 20% excess capacity within existing space, declining as the economy recovered in Sydney in the 1993-94 period.

Firms hold inventories of leased space to accommodate growth to avoid disrupting their operations by splitting staff between buildings and to avoid the expense and disruption of moving to new accommodation. These space inventories held within leased space would change with growth expectations and perceptions of the amount of available space on the market. There is less need for tenants to hold inventories when

landlords hold excess space. The time lags in new leasing activity's response to demand growth in the recovery phase of the cycle, impose another element of complexity in dynamic forecasts of office market adjustments over time.

Space absorption figures are in practice calculated by difference: The inventory of gross lettable area less occupied space. There are certain definitional problems (when is space counted as leased), and problems of access to data (what if an information source doesn't want it known that a tenant has left?).⁹ Any errors will be magnified through the differencing process. Over a period of time, these errors will be corrected, so that last year's overstatement will become this year's understatement of net absorption. Adding these data problems to the market's propensity to move leasing decisions forward and back depending upon perceived market prospects argues strongly for including a "return to trend" variable in models of absorption or smoothing the series, perhaps both.

Expectations play a major role, at least in the short run, so actors in the market will be misled if they mistake short term euphoria or "run" on scarce, price-increasing space for fundamental economic growth. Smoothed or average absorption figures are much more to be trusted than absorption in a given year or two. An Australian "task force" on appraisal reform organised by property company Ballieu Knight Frank suggested that analysts project not a constantly rising trend based on a few boom years, but more realistically a sine curve reflecting the whole business cycle (Whipple, 1996).

The effect of prices on demand and vice versa is also likely to interact with economic conditions: When firms are expanding, during an economic upswing, they tend to add staff and to lease space to accommodate expected growth in ensuing years. If there has been an oversupply during the previous recession--the pattern that seems to obtain in many markets--then prices (rents) will be very low during the time when firms are

⁹ I am indebted to Ian Kyneston of BOMA Sydney's research office for an enlightening account of the problems of estimating demand and demand change.

expanding. In these circumstances, it doesn't cost a firm much to take extra space and this space has some option value for possible expansion, so price may influence demand. Price elasticity of demand may be low in early stages of a boom, expecting growth, low rents will influence firms to take extra space which costs little to hold. As the market tightens, however, demand turns price inelastic--in a tight market, if we need space, we will pay what it takes for space needed right now to do business, regardless of rents.

In a recession, especially early stages of a recession when staff are being laid off and costs cut, it is unlikely that lower rents will stimulate additional demand (price inelastic behaviour). Any positive cost is too much for space that is not needed. This is especially true if tenants expect rents to fall further due to impending oversupply.

Economists have found that variables such as labour productivity are correlated with economic cycles--in a recession productivity falls and vice versa. The behaviour of variables like office space absorption, rent adjustments in response to vacancy, "normal" vacancy rate, supply responses, etc. will undoubtedly prove to be associated also with what is going on elsewhere in the economy. In a recession, owners can't give space away, in a boom, owners will be tougher to deal with, even if vacancy is high (for the moment). Price elasticities of office space demand and supply vary depending upon stage of the macroeconomic cycle and levels of rents.

When backlogs appear due to short supply (the decrease in vacancy rates below equilibrium levels can be thought of as the demand backlog on order), orders increase. Moreover, a positive demand shock increases not only demand for consumption by consumers (tenants in the case of office markets), but also demand for larger desired inventory holdings by tenants, landlords, and developers.

With time delays in filling orders, initial supply increases fall short of new demand and the backlog. So supply orders are increased. When the big supply orders finally "arrive" after the supply time lag, demand and desired inventory may have already fallen back to long term levels and oversupply results. Thus cyclical behaviour is generated by a very simple dynamical feedback system involving a demand shock and

a delivery time delay. This systems dynamics explanation is, in my opinion, the most credible hypothesis leading to office market cycles, the construction lag being the common factor linking disparate office cycles in Beijing, Stockholm, Tokyo, New York, and Perth, Australia.

This model leads to predictions:

1. A bigger demand boom is likely to lead to a more serious bust later.
2. Cutting supply lags (ie through quicker planning approvals or faster construction) would decrease the length of the cycle from the current approximately 8-10 years to something less.¹⁰
3. Forecasting and an information feedback to create more timely supply responses would reduce the amplitude of the cycle by delivering required inventory just in time.

This is the rationale for the forecasting models developed in chapter 7. Perhaps forecasts could shift the price signal forward in time, alleviating the delay and overshoot characteristics of the supply response.

3.3.2 Market Segmentation

During 1992 and 1993, and perhaps at most times, according to leasing agents and property company research analysts, at least three fourths of all occupants of new buildings in Perth, came from existing buildings, leaving vacancies behind them. There was a moving up process as tenants upgraded their space in response to rental incentives. The question this raises is how high the walls are between different segments of the market. If tenants for premium quality space are unwilling to rent lower quality or less well located space at any price--if there are high economic walls between segments--then supply and demand must be analysed separately for each

¹⁰ Singapore may have cured its cycles in this fashion.

segment. It would, for example, be conceivable that one could profitably build a new building while overall vacancy in the market was well above "equilibrium."¹¹

A similar question, in Perth, has to do with the segmentation between suburban and CBD tenants--surprisingly few tenants from suburban locations moved to the city despite reversals of the normal relationship of higher CBD rents. Lower CBD rents did not tempt suburban tenants who needed to be near customers, transportation, etc. Ian Edwards, a leasing agent put it "Number one, the building has to work for you. There is no sense enjoying a cheap rent if you go out of business at that location."

It has been the practice for most models published in the literature to not only aggregate across time and across cities, but also to aggregate across market segments. More realistic models would adjust rents in different segments somewhat independently, while relating flows of tenants and rent adjustments to market conditions in a series of segments making up the market. At equilibrium, class B rents might be \$100 lower than class A rents, but in the meantime, they might be only \$50 apart because of oversupply in class A.

¹¹ When vacancy was still over 20% in Dallas, J.C. Penny built a large new suburban office headquarters.

Chapter 4 Strategic Behaviour in the Supply Response: Development Histories of Four Major Perth Office Buildings

Native Americans used a pishkun, a low bluff not visible from more than a few metres distance, as a means of killing bison. A decoy wearing a buffalo hide lured the herd towards the drop, then the tribe, disguised as wolves, stampeded the herd. By the time the bison could see the cliff, it was too late to stop. If everyone is running in the same direction, look ahead for a sudden drop.¹

4.1 Oversupply attributable to a few projects

During 1989-1992 nine office buildings of greater than 11,000 m² were completed in Perth, Australia, totalling 273,000 m² of new supply. At the beginning of 1993 total Perth CBD vacant space was 430,000 m², about 32% of the 1.3 million m² total stock. Subtracting ten percent “normal” vacancy of 130,000 m² left 300,000 m² of “excess” vacant space.² Four major projects stand out as contributors to the oversupply. At 62,000, 61,000, 33,000, and 34,000, the four biggest projects completed in the 1990-1992 period account for 190,000 m² or 63% of the excess vacancy (Table 4-1). Most office markets could similarly point to a few major projects as contributors to oversupply conditions.

¹ Source: Dan Smith, Pishkun buffalo jump state park located near Great Falls, Montana.

²10% normal vacancy is an arbitrary approximation. My Paladin Australia study estimated normal vacancy for Perth over the 1984-1993 period at 11%. See discussion in chapter 5.

Table 4-1 Size and Cost of the Major Late 1980s Perth Office Projects

	Size (m ²)	Cost (millions A\$)
Central Park	62,000	\$500
Exchange Plaza	34,000	\$230
QVI	61,000	\$340
Westralia Square	33,000	\$184
Total	190,000	\$1254
Source: <i>Australian Property News</i> , February 6, 1992		

The first two decisions to build, we might assume, were “good decisions,” justified in light of state of the art market research, while the last decision to proceed with a major project was questionable, possibly involving professional negligence.³ Study of the major projects began with hope of finding out who went first and therefore presumably made a good decision based on projected demand, and who went last, thereby guaranteeing major oversupply and a financial caning for all concerned including innocent bystanders who happened to own existing CBD offices.

While we were unable to obtain access to detailed information about each project, enough anecdotal information and pieces of the puzzle emerge to draw interesting conclusions. We interviewed some of the key participants in the projects, obtained second and third opinions from interested observers, and had access to three market research consultant’s reports, two for projects that went ahead, another for a project which in 1997 remains a vacant site.

³³Australian valuation firms have faced substantial claims from clients who lost money as a result of being decoyed into losing office buildings by overly optimistic valuations.

Each of the two largest buildings is equivalent to about 20% of Perth's peak excess space inventory. If even two developers had decided not to proceed, the oversupply would not have been as serious and markets would have absorbed excess space in less time without nearly as serious damage to investors' balance sheets. This scenario occurred in the previous oversupply cycle in 1983-84, when vacancies quickly dropped back to normal after a moderate oversupply.⁴

The oversupply problem affects the whole market, not just those who make mistakes. It is disquieting that economically rational "good decisions" can have such bad outcomes due to subsequent "bad decisions." This means that innocent parties pay much of the cost of poor decisions leading to oversupply. Property development decisions, clearly involve significant external benefits and costs to others in the market.

The "who went last" question turned out to be less clear cut than expected. Each project went through a series of steps with increasing degrees of commitment to proceeding to completion after each step was taken and with stochastic delays at each step. Projects that might have been first at one stage in the race often ran into unexpected delays. It was like a close horse race where the lead kept changing. In the end, all of the major projects finished later than they had hoped, missing the crest of demand. Completions were more closely bunched together than the market could have absorbed even in the best of times. As it happened, completions coincided with a protracted recession and three years of negative space absorption making the 1983-1993 office oversupply cycle by far the most costly in Perth's history.

A number of major projects pulled up short of construction as shown by late 1980's BOMA lists of projects "mooted." As of 1993, if all the vacant cleared sites in central Perth had been built to their maximum allowable plot ratios, the city would have had another 400,000 metres of office space.⁵ So by no means everyone shared the over optimism. The following are brief accounts of the genesis of four major Perth office projects completed during 1990-1992.

⁴ AIVLE study group

⁵ Knight Frank provided this figure and a list of cleared development sites.

4.1.1 Exchange Plaza

In August, 1985, the Weld Club, a social organisation dating back to 1892, invited proposals from half a dozen firms for redevelopment of their property on the Esplanade below St. George's Terrace. The design eventually chosen by the Club retained the members bowling green and thus allowed the Club continuity while enhancing their financial position which had become uncomfortable due to rising rates and land tax. It was anticipated that Growth Equities Mutual (GEM), at that time an unlisted Perth based property trust, would sell unit interests in the proposed office tower as the permanent financing arrangement. The project achieved development approval from the Perth City Council and broke ground just before the stock market crash of October, 1987. Even after construction commenced, a major problem remained--obtaining frontage on Sherwood Street, which would provide access to St. Georges Terrace. This access to Perth's premium office street was felt to be a key to marketability of the building. The project had therefore acquired a small office building connecting Sherwood Street and the Weld Club site and its leases with the exception of the lease of a single law firm which occupied a relatively small percentage of the building. Realising its strategic bargaining position, the law firm became a very deliberative, unhurried seller of its leasehold rights. Fifteen months later when a deal was finally struck and the building vacated, implosion of the small building caused damage to the new structure rising alongside which added to construction time. The resulting delay in project completion put Exchange Plaza onto the market not at the height of the boom, but as the cycle was fading towards recession. Completion occurred in early 1991.

Initial marketing decisions, in hindsight, may have delayed renting up of the project. With Central Park and QVI to be completed soon after, some leasing people suspect that tenants wanted to wait and take a look at what all three offered before making a decision or striking a deal. Exchange Plaza might have gotten tenants with an aggressive marketing program featuring (for that time) steep rent discounts. However, its marketing effort held relatively firm on rents for a time in a marketing program stressing the prestige benefits of a fine office. After completion of the

other towers it became obvious rents were headed down regardless of marketing efforts.

4.1.2 QVI

QVI, with 61,800 square metres of net lettable area, is one of the two largest office buildings in Perth. In 1984, Bob Williams, Managing Director of the building company Interstruct, conceived an idea of building something in St. Georges Terrace. At that time, Williams was not sure what form the development would take. He became interested in a small (1500 m²) site on the corner of Milligan and St Georges Tce, which was owned by the Saw bear family and left in perpetuity to the University of Western Australia with the rent to be used for medical research. The costs of maintaining the building were using up all the rent, and the University was looking for a solution. Williams offered to lease the site from them for 99 years, thereby removing the need for UWA to go to the Supreme Court for permission to sell the site. This also suited Williams who did not have the available funds to purchase the site.

As the University site was a small one, Williams persuaded the University to buy adjoining sites also, and lease them to him. Buying an electrical store, an Indian Restaurant, and a couple of smaller properties enabled Williams to own the block all the way from St George's Tce to Hay St., with three major frontages.

Many people thought the site was too far out of the centre of town to be a central city property, and this enabled the University to obtain the land for only about one quarter of what they would have paid one block to the East. This in spite of one owner, Fast Eddy's Hamburgers, holding out for \$5 million for a small corner property for which they had paid \$350,000 only a few years before!

Williams' first, 1985, plan for the site was for a serviced apartments hotel, in hindsight a very good idea, but he couldn't get financial backing for this scheme. Buying a block of land across Hay St from the main site allowed Williams to transfer the plot ratio across the road, and build up to 80,000 m² of space.

With the decision to build a major office complex, Denis Horgan's Barrack House Group was introduced as a joint venture partner. The University got cold feet at owning so much city property, and, after receiving Supreme Court permission to sell the corner site, sold the entire parcel of land to the joint venture for about 30 -40 % more than they paid for it.

Williams invited submissions from major architectural firms for a design for the site, and selected David Seidler as the architect. He had always wanted to build a Seidler design, having been very impressed by his office buildings in Sydney. Seidler's design (it has a "sister" in Brisbane) was just what Williams wanted, and the plan was released to the public in October 1987 as QVI, a major 39 floor state of the art office complex.

This left the obstacle of the Parliament House Precinct Height Restrictions to be overcome. Buildings below Parliament House and restricting its view of the City can only be of a limited maximum height. When the project was announced publicly, this was yet to be obtained. The incentive to grant an exemption to the building was offered in the form of a 500 seat State theatre, and the exemption was granted, although in the end, the theatre was not built. The anticipated time table was that building would commence in 1988 and the building would be available for occupancy in 1990.

Before QVI could break ground, however, Lord McAlpine had excavations begun on his office site across the street on the opposite corner of Milligan and St George's Terrace. This was seen by Williams as a bluff to try to prevent him proceeding.

A market analysis for QVI was conducted by Planning Collaborative Australia, and submitted to the developers in February 1988. This analysis examined sources of potential competition (supply) as well as areas of potential growth in demand. It produced a thorough summary of historical data of past growth in office space take up and rents. However, a number of questionable assumptions were made, not the least of which was that a conservative projection for rental increases in prime buildings was 8% with the "traditional rate" at 12%. This in spite of projecting a vacancy rate for office buildings in excess of 17% by 1991, even assuming not all

projects mooted would go ahead because of the impending oversupply! The market study does not canvass the possibility of *falling* rents due to oversupply. But in this it was not alone--as late as 1989 a Jones Lang Wootten report made no mention of impending oversupply. The QVI market report concluded that a major source of tenants for QVI would be those wishing to upgrade from other buildings, and stresses that the calibre of the building is a vital ingredient in its success. QVI's market analysts hoped that Central Park office tower would not proceed, because, with QVI going forward, oversupply was likely if both of the major projects were completed near the same time.

The QVI market study report concludes

"...it may well prove to be a successful project and achieve anticipated rent-up projections by capturing a significant share of the office up-grade market. However, it should be cautioned that any number of other large prestige buildings may be leasing at the same time and could prove to be solid competition for this market."

The First Stage Building License was obtained from Perth City Council in mid 1988, but the Joint Venture was held up for twelve months while a financial package was put together. This was to prove, with hindsight, a critical delay. When the finance was put in place it involved a number of banks, some of them Japanese, the Bankers Trust and the New South Wales Superannuation Board. These last two obtained a formal put option (at a cost of \$10 million) on the project for the total sum of the bank debt. This option was eventually exercised. The research of the Japanese Banks before they joined the project revealed a projected value of \$540 million upon completion, based, obviously on strong projected rental growth.

All major building contracts were signed by mid 1989. When the earthworks were commenced in May of that year, followed by implosions of buildings to be demolished in July, McAlpine did not proceed with his plans to build.

In 1991, Interstruct went into provisional liquidation, and on the building's completion at the end of 1991, the put option for \$340 million, the total value of the

loans, was exercised by the Bankers Trust, and the NSW Superannuation Board, transferring ownership to the seller of the option, a Japanese bank. Williams' Interstruct was bankrupted although he had been offered \$10 million for his share of the project a few months earlier. QVI was completed in late 1991.

Williams still believes that the high quality of the building would have overcome the distance factor and allowed the building to be readily leased up at viable rents, had the market down turn and government-sponsored competitive projects not combined against it. He believes it to be an excellent long term investment.

QVI's aggressive leasing strategy paid off as it obtained large mining and energy firms as tenants, albeit at rents discounted through major leasing concessions. By May, 1993, QVI was 50% occupied and it eventually achieved full occupancy before the other major towers, by about the beginning of 1995. Knowledgeable sources mention rentals as low as the equivalent of 8 years free rent on a 10 year lease and even a lease with net rent of zero--the landlords' incentive being simply a tenant to pay a share of building operating expenses. Lease terms also favoured tenants. Many leases during the 1991-1993 period included "structured" rent reviews--meaning rents would increase only by a fixed percentage during the lease, rather than to market rents.⁶

QVI took over seven years to get from the developers idea and beginnings of site acquisition to completion.

4.1.3 Westralia Square

Understanding development of the Westralia Square and Central Park projects is aided by a brief introduction to "W.A., Inc." In the mid-1980s, a development oriented, activist Labour government in W.A. formed an alliance with local entrepreneurs who were also substantial contributors of funds to the Labour party. To make a long story very short, virtually every project undertaken proved a financial disaster and several of the principles, notably Alan Bond and Laurie

⁶ Property consultant William Kerr describes three "customary lease terms" periods during the early to mid-1990s.

Connell,⁷ as well as a Labour Premier, Brian Burke, were later convicted of frauds. Losses to the taxpayers of Western Australia totalled over two billion dollars and the Labour government, not surprisingly, was rejected by the voters when the details came out.

In 1983, West Australian Labour Premier Brian Burke established a task force to report on future development of the Perth Technical College site which was then Crown Land. The site was in a prime city office location, with the complication of an existing building of great heritage value located on the St. Georges Terrace frontage.

The role of the task force was taken over by the Western Australian Development Corporation in May 1984. In December 1984 a brochure was produced informing the market that the site was available for purchase or 99 year lease. In February 1985, Bond Corporation put in a submission for development by Bond, Connell and the Superannuation Board. In February 1985, the Perth Technical College site was valued by John D. Fleming, Licensed Valuer, at the request of the Western Australian Development Corporation at \$19 million, ignoring current improvements and subject to its highest and best use.

In October, 1985 Brian Burke gave approval to the Superannuation Board to purchase the site. The consortium offer was for \$33.5 million cash with the Education Department to lease back the existing accommodation for 2 years at a rent of \$2 million p.a. in advance. The total purchase by Midtown, the Bond-Connell shell corporation, was financed by the Superannuation Board with no guarantees from Connell or Bond.

The Education Dept occupied the site until December 1987, so holding costs for Midtown were minimal. In October, 1987, the share market crashed. Rothwells Merchant Bank of which Connell was the Managing Director, experienced severe

⁷ Trevor Sykes includes chapters on each of these "bold riders" in his book of the same name.

financial difficulties.⁸ A few days after the crash Connell offered to sell his units in Midtown to the State Government Insurance Commission for \$30 million.

Richard Ellis had valued Connell's share in Central Park at \$16.25 million, and in the Perth Technical College Site at \$36.25 million on June 30, 1987. On October 23, 1987, an urgent sale of Connell's units in Midtown took place for \$30 million, with a buy back clause, and put option granted by Bond Corporation. Bond assigned his interest in Midtown to an associate company Baztan Pty. Ltd.

Robert Holmes a Court's Bell Group had put together a development site of various properties adjoining and in the vicinity of the Perth Technical College Site, including the Forrest Centre, Parmelia Hilton Hotel, MMI House, Commercial Union House, Newspaper House, and the Royal Insurance Building. The State Government Insurance Commission bought these properties from the Bell Group in November, 1987, for a total of \$206 million. The purchases were completed with extraordinary haste--three days from the inquiry to the deposit paid! Holmes a Court was reducing his exposure to recession and interest rate increases by selling assets, following his realisation that the stock market crash signalled trouble ahead.

In late December, 1987, the State Government Insurance Commission acquired Bond's interest in the Perth Tech Site, and Baztan (Bond) acquired the State Government Insurance Commission interest in Central Park. On June, 30, 1988, the State Government Insurance Commission bought the West Australian Trustees Building for \$14 million from WA Trustees Ltd. This was a critical block between the Royal Insurance Building and Perth Technical College, consolidating the whole collection of purchases into one mega-site.

The State Government Insurance Commission sought to sell its investments almost immediately. Lloyd (State Government Insurance Commission) and Warren Tucker, a young Perth property consultant who became Central Park's project manager, examined four proposals submitted by invitation. "Tipperary Developments"

⁸ Trevor Sykes reports that Connell, who at one point owned 300 race horses, had been systematically looting Rothwells from the beginning.

(controlled by Warren Anderson and Kerry Packer) offered \$270 million for the mega-site. The contract of sale was to include a rent guarantee for 5 years after the completion of the building of 32,000 square metres net lettable area at \$400 per square metre commencing June 30, 1991 and escalating at 10% p.a. Another condition of the agreement, was that a large deposit be placed immediately in Connell controlled Rothwells merchant bank, which, as mentioned, was suffering liquidity problems. There was no public tender for the site. The sale was completed on June 30, 1988, Anderson and Packer using companies entitled Sharland and Skeet.

In October, 1988, there was an amendment to the Westralia Square rent agreement. If the planned Mounts Bay Road Building was built first, the guarantee would abate by half the net lettable area, if the St. Georges Terrace building was built first, the abatement would be by 40%. The Westralia Square site was subsequently subdivided, rent guarantees abandoned and Westralia Square Area I (part of the site subdivided for phased development) sold to the State Government Insurance Commission (70%) and the Superannuation Board (30%) on December 29, 1989.

In 1989, the preliminary building licence was obtained from the Perth City Council, and the public launch of the project was announced in a glossy insert into The West Australian newspaper (November 25, 1989) declaring "Westralia Square the Spirit of Achievement" and announcing the construction of three towers, a central tower of 85,000 square metres, and two smaller towers of 32,700 square metres each. One of these smaller towers was built as the first stage. Excavations took place for the others, which will not be continued in the foreseeable future. Westralia Square, building one, was completed in 1991.

4.1.4 Central Park

In the second half of 1984, Warren Tucker, then a senior partner in Richard Ellis, approached Len Brush, the Chairman of the Superannuation Board "with a view to encouraging the Board to consider a real estate development as part of its investment portfolio." The site he favoured was the site known as "the David Jones site", after the department store that operated there until the early seventies. In 1984, the

property was owned by Midtown Pty Ltd, as sole trustee of the Midtown Property Trust, a unit trust owned and controlled entirely by Alan Bond and Laurie Connell. The property, undoubtedly the best located of the four considered here, was described as "ripe for development"

In March 1985, the Superannuation Board Investment Trust (Super Board as sole unit holder) purchased a 50% interest in the site from Midtown - the cost of development to be borne equally by both parties. However, the Superannuation Board was required to lend Midtown an amount equal to its share of the development costs incurred from time to time.

Bond Corporation was to be the project manager at an agreed fee - the idea being to build an office development of about \$100 million. The Superannuation Board procured Perpetual Trustees as trustee of the Superannuation Board Investment Trust, to purchase a half interest in the David Jones site. Two expert valuations were sought to establish the value of the site. The parties split the difference and agreed on \$ 11.175 million as the price for a half share.

On October 85, the contract and purchase were completed, together with a joint venture agreement for development, which included the following aspects: Project to be a joint venture between Perpetual Trustees and Midtown - included rezoning of land, demolition, construction of all buildings and management, leasing and sale of the land as improved. A board of management was to be established. No warranties regarding timing were given, but the estimated completion date was the end of 1987. A fifty percent interest was to be taken by each of Perpetual Trustees and Midtown.

Bond Corporation was appointed manager of the joint venture during the development period at a fee being the lesser of 1.5% of the total construction cost and \$1.5 million with no more than \$500,000 in any one calendar year. After development, Bond would have management of the property at a fee to be determined. The State Superannuation Board was to provide Perpetual Trustees and Midtown with finance from time to time - interest at bank bill rate plus 0.75% capitalised every 6 months. obligations of Midtown guaranteed by Connell and Bond. Guarantees from Connell and Bond proved worthless as they systematically

looted assets from public corporations they controlled, channelling funds into private family companies whose assets could be hidden from creditors. At the peak of his career, Bond looked very bankable on paper, with net worth approaching a billion Australian dollars but this highly leveraged wealth disappeared by the early 1990's leaving an unsatisfied judgement of over \$300 million in Bonds bankruptcy.

Clause 5.2(2) (subsequently waived) of Central Park's joint venture protected the Superannuation Board by providing that "at no time may the Principal sum (loan of Perpetual Trustees to Midtown) exceed 50% of the value of subject land as improved. If the value is disputed it shall be determined by a valuer appointed by the Superannuation Board..."

The first public release of the design for Central Park was in March 1987, and the Perth City Council approval for a first stage building license was issued in the same year, with earthworks beginning in September of that year. By March, 1988, construction of the first stage (a large--400 bay--underground car park) was under way. Problems with management and builders unions resulted in an unusually protracted actual building period of more than three years.

In December 1987, Baztan (Bond) owned Midtown (having bought out Connell), while Midtown and the Superannuation Board held equal interests in the Central Park site. On June 30, 1988, Midtown sold its 50% interest in the Central Park site to Esjay Shelf Co. (Warren Anderson and Armstrong Jones Group) for \$45 million.

In June 88 Warren Tucker was appointed property consultant to the State Government Insurance Commission and in late November, 1988, Tucker prepared a report in relation to the Central Park project in which he warned there were no less than 16 new office proposals for CBD properties and predicted an oversupply in the 90's. In June, 1989, the Superannuation Board bought out Esjay from Central Park for \$83.2 million leaving it the sole owner.

4.1.5 Alternatives to Completion

Many building contracts were in place before the combined effect of oversupply and falling demand were fully appreciated. Developers feared that if contracts did not

proceed, not only would they face costly payouts for the project in hand, but also they would damage future credibility both with builders, and unions. On the suggestion that capping QVI should have been considered prior to its completion, in December 1991, Ian Watson, then project manager and director of QVI observed that stopping work after construction commenced "...often caused problems in rearranging finance, negotiating with unions and often the building's reputation was then devastated in the business community." If a building is capped, it may need drastic re-designing when it is re-started because of technological improvements which occur very rapidly, resulting in obsolescence and further expense.

These four histories, sketchy as they are, demonstrate clearly that many of the people who make the most money out of property development do not depend for their rewards on the success of the project, nor do they the risks of failure. Bond and Connell, for example, stood to earn substantial profits on land and through fees, while having little or none of their own cash in the projects. "Consultant driven" or "fee driven" decision making means those offering advice on a project often have a vested interest in it going ahead and may be unwilling or unable to give objective advice.

Clearly an element of bluff existed between the major players. Each thought that if they pushed ahead, others would draw back. Some did, like Lord McAlpine, who stopped after beginning earthworks and National Mutual which owned an excellent cleared site adjacent to the Bond/R&I/Bankwest tower. National Mutual had held the site for some time and "missed" the previous boom in the early 1980s as well. Clearly in the development stages, fee income and quick profits on land deals far outweighed any concerns about potential oversupply in the minds of market decision makers.

Decision makers for early projects chose not to believe so many other projects would go ahead. Quoting the QVI market research report:

"Between 1986 and 1991 the increase in office space under construction committed or announced will amount to 348,460 square metres (however, it is not likely that all of this space will be completed. Projects with a 1991

completion date such as the David Jones site - 65,000 square metres may well be postponed as these large projects will contribute to a huge oversupply of space)." (Planning Collaborative market report, 1988: 21)

The very accuracy and rationality of this conclusion is disquieting in hindsight, because it did nothing to prevent QVI's losses. Assuming others would act rationally proved a flawed premise. Later projects could not avoid suspecting oversupply, due to projects already under construction, so their market analysts were forced to make optimistic market share assumptions to justify going ahead. Warren Tucker in his report to the Central Park Developers wrote:

"...the development is a major landmark building and is capable of attracting major lessee interest over those of its competitors, including QVI. I am uncertain, however, about its competitiveness against a major tower on Westralia Square and therefore to maintain its market edge, it is relatively important for Central Park to be completed prior to Westralia Square."

Impending oversupply was interpreted as a reason to hurry to completion, rather than delay projects until the market absorbed the new space under construction. Grenadier (see Chapter 5) has proposed an option pricing theory/game theory combination model whereby oversupply is caused by rational developers attempting to pre-empt competitive projects, earn monopoly rents by completing buildings first in an under supplied market, and avoid the unprofitable alternative of having to wait for the next cycle. This results in a cascade of development decisions once one decision to commence has been made. Tucker's quote supports Grenadier's view, but for two things. First, tenants have an option to wait for completion of other projects, rather than paying monopoly rents to the first one completed. Second, when oversupply is obvious, it should be clear that net present values of all projects will be negative. Such projects may be "rational" from an individual's point of view due to above the line profit centres, but they are not socially rational, nor rational from the standpoint of their investors.

By the time phase I (the parking structure and foundations) of Central Park was completed in 1989, there was in Warren Tucker's words, "\$108 million in the

ground.”⁹ Given certain losses inherent in trying to service \$108 million in capital with the income from a parking ramp, proceeding seemed less expensive and perhaps even less risky than pausing, particularly since “capping” the project at ground level was itself estimated to cost \$20 million. At that point it seemed to Tucker and the GESB more sensible to proceed and hope for a new boom period of demand which, if it did not fill the building immediately, would, as happened in 1983-85, “make it right” in a year or two. Early 1980s buildings that had been completed during a temporary supply glut eventually became profitable. Unfortunately, *ceteris paribus* in this case would have been a major boom, while completion in the early 90’s coincided with Western Australia’s longest recession since the 1930s. Sometimes experience teaches the wrong lessons.

A joint venture agreement for the purchase of the Perth Technical College site drafted but not signed, by Bond, Connell and the GESB in 1985 held that one of the prime objectives in making the purchase of the site, was to control development in the area (ie. slow it down) for the benefit of the project which was proceeding on the David Jones site (Central Park). Apparently this motive was later forgotten even though government finance created both of these competing projects.

The Perth experience offers some support for Grenadier’s hypothesis that developers race to complete projects first. But the Perth experience probably offers more support to alternative views based on bounded rationality, prisoner’s dilemma type games, and the agency issues of “fee driven deals.” Seemingly irrational decisions in Perth were very rational from the accounting stance of those earning multi-million dollar development fees or quick capital gains of tens of millions of dollars through sale of land to development projects. Perth developers and their finance sources do not seem to have been sophisticated or unbiased enough to conclude that future rents might fall due to oversupply. Rather, they seemed to overweight current rents and naive extrapolation of current rates of rent increase. Essentially the signal for the development race to start was expected rents high enough to make individual projects look profitable. The comparison, in most cases, probably did not include

⁹ Personal interview, 1994

valuation of development options. Rather the development decision was made simply by comparison of present use versus new building net present values, given naive extrapolation of recent demand growth.

4.1.6 Involvement by Government Bodies

In some cases financial analysis was secondary to other considerations. The Royal Commission investigating the W.A. Inc. property deals implied that the whole set of property deals done through the State Government Insurance Commission and the Superannuation Board, were driven by larger agendas, including the rescue of Connell's Rothwells bank, which in turn was necessary to preserve the credibility of the government which had allied itself closely with Connell. Considered in isolation, the projects do not make financial sense. In relation to Central Park, the Royal Commission found that the financing arrangement by the Superannuation Board was imprudent with inadequate security, the margin over the bank bill rate too low, and the term of the deal too long. Also the size of the development was too large a proportion of the Superannuation Board portfolio. In 1991 the Superannuation Board annual report estimated commitment to this development as 44% of the entire Superannuation Board portfolio!

The Wong Report to the Royal Commission (expert evidence on investment analysis) found "...the loan high risk and the interest rate less than would be expected to compensate for that fact." According to the Wong projections, "...expected cash flow would have been insufficient to fund a development of \$300 million or more..." Recall that Central Park cost the GESB about \$500 million.

Bond and Connell, Perth elicited terms of financing from the Superannuation Board so they were in a risk free situation. In May, 1985, Connell wrote to Super Board chairman Brush asking him to waive clause 5.2(2):

"... Bond Corp and myself will not be called upon to contribute to project costs or to reduce the principal sum. ...the valuation of the property will be

done on the basis of original cost plus cost of development to date plus capitalised interest to date."

Connell and Bond both said in evidence to the Royal Commission that the true arrangement was that the Superannuation Board was to bear the entire cost of the project. In a letter to the Superannuation Board, also in May, 1985, Warren Tucker wrote:

"In my opinion, having regard to the need for diversification of the Board's investment and investment within each particular type, the proposed purchase of a 50% interest in the David Jones site is a suitable investment for the Superannuation Board at this time."

The Royal Commission was critical of Tucker's qualifications to make this advice and of the Superannuation Board for seeking no other advice. Recall, however, that in 1985, it would have been impossible to determine that so many projects would proceed. Portfolio considerations aside, Tucker's 1985 real estate advice was probably reasonable. However, Tucker later reportedly earned over about two million in fees as Central Park project manager. The prime motivator on the Superannuation Board to involve the Board in the property deals was the Chairman, Len Brush. Brush had received a loan from Rothwells, for which he was never asked to pay interest, and which was not repaid until the Rothwells investigations were under way. On the day the loan was repaid, a cash amount exactly equal to the repaid sum was withdrawn from Rothwells, and the Royal Commission was unable to trace its destination.

Obviously the Perth case involved a more than usual share of government finance and the corruption of decision processes by entrepreneurs later convicted of frauds. However, the large amounts of money involved in major office projects mean that nowhere in the world can one assume that the process takes place in a lily pure fashion with no role for greed and undue influence. Both private and public sector office developments are manned by fallible human beings using other people's money.

One hundred percent finance for developments is by no means restricted to projects financed by the public sector.¹⁰

4.1.7 Which Horse Will Win is a Matter of Differing Opinions

Bankwest Tower is probably best called an outlier or laggard from the previous boom, or a unique project due to the entrepreneurial verve of Alan Bond. That 38,000 m² project, Perth's only other building similar in scale to the four buildings discussed above. Bond commenced the project in 1985 while Perth still was suffering high vacancies from the previous oversupply cycle of 1983-84, when rents did not justify new construction, and most so-called rational investors were standing aside. In hindsight, with completion in 1989, this project's timing was certainly better than that of subsequent projects that waited until it was "rational" to build based on current rents. Through long term leases, Bankwest Tower will enjoy rental income above current market rents for most of the first 14 years of its existence. It offers a clear example that forecasting rents is a valuable idea and that waiting for current rents to justify construction can be unwise. Bond, of course, did not forecast rents--he built regardless of market conditions, behaviour that eventually brought down his empire. Exchange Plaza and Quayside on Mill, both completed a year later, suffered long initial vacancy periods and rented at probably less than half the effective rents earned by the Bankwest tower. Rents and demand in year of completion are the keys to determining whether or not an project will enjoy a positive net present value.

The next project, after the Bond Tower, to break ground was a project on a site at the west end of the CBD owned by Lord MacAlpine, a prominent West Australian real estate developer. Evidently, in the game of office construction, even a project that has broken ground won't necessarily become a competitor. MacAlpine's site was still vacant ten years later. Arguably the best office site of all, the National Mutual site, remained cleared and vacant through two booms (early 80's and late 80's) due to the caution and deep pockets of its owners. One would have been wrong in the

¹⁰ Developer John Cushman mentioned at the 1996 ULI meetings that he could get 100% finance for office projects in certain U.S. markets and that this was a warning signal of impending oversupply.

National Mutual site case to assume that a cleared site with financing in hand would become a completed office building. How much less certain the progress of a project like QVI which did not have financial backing in early stages.

QVI proceeded fairly smoothly through a complex land assembly process during the mid 1980s. The developer, a Perth entrepreneur who had never done a project on this scale (about \$400 million) obtained the services of David Seidler, Australia's best known office architect, who created a technologically advanced design featuring large column free floors, energy efficiency, and other desirable, state of the art building features. These advantages convinced the developer that he had a superior product that would capture an adequate market share, despite a location regarded as inferior. However, although his plans were among the earliest to be approved, he hit a snag at the financing stage. It took about a year for QVI financing to be put in place after several false starts. Finance sources required pre-commitments from major tenants. No doubt, this difficulty was a function of the developer's balance sheet, which was weak from the lender's point of view, for a project of this size. The precommitment Williams finally obtained, by the way, from a major law firm, failed to result in an income stream when the tenant later reneged after rents collapsed. While QVI might have been ahead in the office development race at one stage, its lead disappeared during the financing stage.

Exchange Plaza, another major project, actually finished before QVI, but should have finished even earlier. This project encountered a bizarre delay entirely characteristic of real estate development. A law firm, the last remaining tenant occupying one floor of a fifteen story building that needed to be demolished to provide Exchange Plaza with a vital access to St. George's Terrace, calmly held out for more and more money during a 15 month negotiation to buy out their lease. Exchange Plaza may have been tempted to proceed despite impending oversupply by two favourable aspects of its financing: It was built primarily on land leased from an old Perth social and sporting club, reducing capital outlays. Second, the initial plan was to finance the rest of the building through sale of shares through a property trust. Due to serious liquidity problems of the Australian unlisted property trusts, the

project instead ended up financed (and subsequently owned) by its construction lender, Westpac bank.

It is arguable that Exchange Plaza squandered its slight (six months) lead in physical completion date by a marketing strategy error. Exchange Plaza was ready for occupancy first of the major projects, but could not profit by that lead in a soft leasing market. Grenadier needs to add tenants' option to wait for softer market conditions to his model of a rational office market cascade, which would seem to make the landlords' cascade irrational.

Westralia Square and Central Park, were financed by government after land was assembled by private developers and sold (under questionable circumstances involving large unaccounted for sums of money) to government agencies. Westralia Square, of somewhat lower quality standard and height, was designed chiefly to house government agencies. It was tenanted by shifting government departments from other quarters, at a substantial increase in occupancy costs. In this fashion the true cost of the government's error was camouflaged by shifting public expenditure from providing services to paying above market rent occupancy costs to disguise the losses of government insurance and pension fund agencies.

Central Park, the biggest project, at 62,000 m², finished last of all the major projects, but began the process among the earliest and broke ground on its major underground parking structure at about the same time as the other projects. It's size and possibly its government ownership led to construction delays (labor actions). The \$500 million project ended up 100% financed by the state employees pension fund, in violation of prudent portfolio allocation standards.

During the same period, more than half a dozen smaller projects, in the 10,000 m² size category broke ground within a year of the big projects. Most of these finished sooner, because they took less time to build. The earliest were financially successful, but later projects had great difficulty attracting tenants.

The questions "who went first" and "who was to blame" probably do not have simple clear answers. Like horses in a race, a good metaphor for Australia, where

the Melbourne Cup race day is an official holiday, some of the projects were quick starters, but faded in the stretch. Some that looked like winners early on, did not proceed (scratched out of the race) and remain cleared sites or found alternative uses. The development process is complex with many steps. Time required for each step is a stochastic random variable only partly under the developer's control, so date of completion is uncertain, even after construction has commenced and more so at earlier stages.

Each project faced different constraints and had different strengths and weaknesses. It is not crystal clear which projects should not have proceeded. In the end, risk averseness of decision makers turned out to be a key variable. National Mutual, a cautious insurance firm, missed not one but two office cycles and still holds a well located cleared site on St. George's Terrace. Meanwhile, Bob Williams, with far less financial resources and an inferior location started assembling land years later than National Mutual yet proceeded to completion--albeit going bankrupt in the process. Intelligent people might disagree on which projects should have had precedence and which should have been expected to be completed first. Knowledgeable people say all of the projects were committed irrevocably to proceed during about a six month period in 1986.¹¹ This suggests that decisionmakers need much better and more timely information about the state of play of competitive projects (See Palace Hotel theory of previous chapter). A project literally might be a good idea in the morning, but a bad idea in the afternoon--simply because in the interim a competitive project has received finance.

Integrity and ethical behaviour turn out to be crucial variables, because if subsequent projects can receive finance based on corruption rather than market feasibility, clearly no earlier decision is safe from ruin, no matter how well analysed.

Even the idea of irrevocable commitment isn't entirely straightforward because the likelihood of proceeding to completion increases with the accomplishment of each step in the development process, but only approaches certainty after the tower begins

¹¹ AIVLE study group

to go up above ground level. It is technically possible, although so expensive as to almost never be done, to “cap” the below ground foundations, parking, etc and stop construction at that point. But my informants in the property industry seem to offer a consensus opinion that the key step is project finance--any project that receives finance is almost certain to proceed--unless, as we have seen, the owner is a cautious finance institution. Signing of construction contracts, usually within a few days or weeks of obtaining finance, makes stopping the project very expensive and unlikely.

There is an element of bluff in the game--one gains advantage by convincing others to shelve projects, so more projects are announced than completed. This means that players may rightly disregard some competitive projects' claims of development progress and remain overly optimistic about how crowded the market will become. By the time it became apparent in Perth to many of those involved that too many projects were under construction, it was for practical purposes too late to stop.

Based on the experience of the four Perth projects, and discussions with property professionals, table 4-2 summarises the range of variation in time required for major projects.

Table 4-2 Stages in major office project development

1. Concept plan 0-5 years
2. Site assembly 0-10
3. Preliminary plans 3 months-1 year
4. Plan approval 6 month to 2 years
5. Construction plan 3-6 months
6. Arrange finance 0-2 years
7. Site clearance 3-6 months

8. Earthworks 6 months-2 years

9. Construction 1-2 years

10. Lease-up 0-5 years

11. Full Occupancy

Typical time from idea inception to construction completion 6-10 years.

Given that some projects proceeded and some did not, and that timing of each stage would be uncertain, it is reasonable that one would not stop one's building because someone else was drawing plans or assembling land. The competitive project might never proceed. Developers must be braver than to be scared off by other projects in early stages--they would never build anything if they were faint hearted. It is their job to convert doubters, convince cautious fiduciaries to lend them hundreds of millions of dollars, to push through obstacles and take enormous risks. Why should anyone be surprised when people who must have that optimistic, high pressure mentality end up by pushing too hard?

By the time it became relatively certain that other projects would proceed, each of the major projects had momentum in terms of significant capital expenditures that would be unproductive if the project were not completed. When one pays a major-office-site-price to assemble land, one cannot carry its capital costs operating small existing buildings or a parking lot on a cleared site. Most developers, except those with very deep pockets like a National Mutual, must go ahead or face bankruptcy. If one is going to be bankrupt, it may be more appealing to at least leave a monument to one's activities in the form of an empty office building. Where is the glory in going broke running a parking lot?

In a crowded market, it did not seem clear that there would ever be a better opportunity later on if the project were delayed--particularly for developers headed for bankruptcy anyway. And in the midst of a boom, it seemed likely that the consequences of entering the market too early would not be unreasonably costly--one would simply be better positioned for the next cycle of growth.

In the case of Central Park, it would have been politically inconceivable for a government to admit a \$108 million error if any other option offered itself. So they took the gamble that two or three or four years later a boom would fill the project after a tolerable period of vacancy.

Exact losses cannot be known with certainty until the end of the buildings' economic life. They would amount to a risk adjusted difference between the rate earned on this investment and the opportunity return. Notice that those who did not build and still hold cleared sites also lost money--their investments are unproductive as well. One could certainly err by being too cautious as well as by being too much of a risk taker.

All of this uncertainty about who will and who won't proceed, the uncertainty about how long various development stages will delay completion, and the difficulties of deciding the relative market appeal of buildings with disparate locations and designs means we are unable to answer our seemingly simple questions "who went first" and "which projects shouldn't have been built" conclusively. The reality is more complex.

Central Park was the first of the major towers to "go public". When the project was released in March 1987, there was concern that the building might be too big for Perth. Consultant to Central Park Morris Owen disagreed, saying the market would only be bloated if a number of buildings went up at the same time.

"But I doubt that would happen. The market is fairly orderly. Assuming this new building opens in 1991 then other developers will not want to compete with it. There's a queue for central business district development and people

wait their turn. People are much more conservative than they have been in the past." (*Sunday Times*, March 22, 1987)

It is tempting to look at the Royal Commission's condemnation of the involvement of the Government financing in the Central Park and Westralia Square deals, and say that these are the two deals that clearly should not have gone ahead. Projections in the Wong report demonstrated a lack of financial viability based on the figures available at the time. QVI developer Bob Williams asserts that without the favourable government financial assistance these two projects would have been delayed by the forces of financial downturn.

On the other hand, Westralia Square was in fact the first of the major buildings completed, and Central Park was conceded to be the best site and broke ground earlier than QVI or Exchange Plaza. If private money was so much smarter than public money, why did these private buildings proceed in the face of the public sector competition and also lose money for private owners? Private and public investment was lost in roughly equal proportion in an oversupplied market. The momentum of *both* public and private projects was too great to stop. In the words of David Jackson, Colliers Jardine Asia Pacific group economist:

"Perth should look at the whole office oversupply situation as a *big plus*. What you will find is everyone will upgrade to the best accommodation because rents are going down. Rents will continue to decline as far as they can until the new buildings start to fill up, and therefore minimise the loss for the owners." (*The Financial Review*, August 14, 1992)

In 1990, then director of QVI David Berry said that he did not expect the decline in the economy to affect the QVI so hard and dramatically. He said the developers had expected a decline but were surprised at its harshness and duration.

"However, QVI developers have structured an innovative finance package with BTA Property Trust and the State Authorised Superannuation Board of NSW which effectively passes the risk of the project to these parties." (*The West Australian*, December 5, 1990)

4.2 Lessons from the Four Major Projects

4.2.1 Market Failure

The office decisions should perhaps be regarded as an example of market failure:

- Decisions were taken with what proved to be defective information about competitors plans, future market demand, etc. For markets to function properly, decisionmakers must be better informed.
- The main reason markets are supposed to allocate efficiently is that people risk their own money and so face proper incentives. In the office projects, some of the decisionmakers made money, while those who ultimately took the risks (eg. superannuation scheme participants or bank shareholders) lost.
- Finally, of course, some deals may have involved undue influence or even illegal behaviour.

Most economists are sceptical of government's ability to "pick winners" in business investments and even more sceptical of government's ability to manage complex enterprises like major project construction lending. The W.A.,Inc. era is certainly one of the clearest examples one could cite to support these positions. Lest the public sector get too much blame, however, we should point out that the greed leading to the corruption of the public project decision process was largely private (Bond and Connell). These criminals were equally adept at looting private sector firms (eg. Bell Resources and Rothwells).

Better decisions require attention to three issues:

1. **Individual morals and ethics.** As individuals and a community, we should be more aware that malfeasance leads in the end to very widespread losses.

2. **Technical or methodological issues.** Lenders in particular, could improve their property expertise, underwriting techniques, organisational structures for dealing with major loans, and market research methods.
3. **Institutional frameworks.** Perth office oversupply was a failure of public planning. There is a need for bringing more order to major office project markets because individually rational decisions become collectively irrational.

4.2.2 Overentry: An Analogy to Fisheries Economics

There is a considerable literature in economics on the management of fisheries, demonstrating that “open entry” fisheries will inevitably be over exploited, driving profits to zero. (Clark, 1990) Each vessel owner, in light of his common property right to exploit the entire fishery, concludes that it is profitable to invest in additional boats and gear. The collective outcome is economic losses to the fishermen when fish stocks are overfished and catches per unit of effort fall.

One can think of growth in office employment as analogous to “recruitment” of catchable fish in a fishery. Regardless of the price of office space, office demand is more or less fixed at a point in time by the level of employment and economic activity, just as a fish stock produces only so many tons per year due to natural environmental limits. So if too many office buildings are constructed, their returns will fall, just as returns fall when too many boats enter a fishery--and for the same reason--the stock is not infinitely expandable. Rather, numbers of fish and tenants are both fixed exogenously by forces having nothing to do with the number of boats or buildings.

In the depths of the recession in Perth in 1991-92, it is likely that a market clearing price for office space would have been negative. In a recession, employers will not lease extra space no matter how cheap. They don't need it and they are concerned with cutting staff, cutting costs, and survival of the firm, not with taking advantage of cheap space. In a boom, on the other hand, the price of space can double (as it did in Perth) with negligible impact on demand growth in the short run. Indeed,

rising prices may stimulate firms to lock in additional room earlier into which to grow.

The question then, is the same as in managing a fishery: Who shall have the right to profit from exploiting the fixed limited stock of office demand? As in the case of a common property fishery, no one owns office demand, so everyone is free to enter to try to capture a share. Price, in a tight market, will signal clearly that more supply will be profitable. Since most firms would face roughly similar land and construction and capital costs in a given market, once the price signal tells one to build, it is likely, in a scenario of scarce space and booming demand, to tell many to build. Not to build requires the difficult effort of a) Predicting who else will build, b) Predicting absorption, c) Predicting rent's response to (as yet indeterminate) changes in supply. Developers would not be developers if they were to talk themselves into pessimistic projections just when things are booming and the lenders awash with money.

What we saw in Perth, was a process in which there was great uncertainty about which projects would proceed and which wouldn't. This uncertainty affected not only whether the project would ultimately proceed, but also the timing of various stages of each project. Given these uncertainties, it is not surprising that projects achieved unstoppable momentum before likely poor outcomes became apparent to the "dumbest" money.¹²

4.2.3 Quality of market research

One of my hypotheses, going into the four projects study was that market research must have been seriously flawed. This may have been true of some market research, but not need not have been true of all research. Some market that research reports of projects with terrible outcomes were not seriously in error in their demand forecasts.

¹² A cynical theory of the real estate cycle would be that entrepreneurs constantly search for institutional structures to make money stupid enough to invest in fee producing projects regardless of market conditions. Securitising real estate recruits in-expert investors who have no first hand contact with the real estate. Foreign money also tends to be lack knowledge of local market conditions. In both cases, the flaw in the system is that those responsible for evaluating projects earn fees if the deals go forward and therefore face incentives to be optimistic.

A critic of consumer research methods would find little to fault in the QVI market study in terms of demand estimates conditional upon macroeconomic outcomes. The report was not so good at forecasting rent adjustments or competitive supply. In other words, the market study was logically deficient in its market share conclusions and in assuming high vacancies would not affect rents. The report was therefore internally inconsistent. Elementary economics (supply and demand curves) or office market academic work on equilibrium vacancy rates would suggest contrary conclusions. Research on other projects that we did not see was probably less professional. One market participant recalls seeing an Alan Bond market study for a \$100 million Sydney office project that was "literally a scrap of paper."

It was distressing to find that even state of the art market research did not necessarily prevent bad outcomes if the research was too narrow in the issues considered. Clearly market research must be comprehensive in consideration of demand issues from the world to individual building levels, and not neglect consideration of competitive supply. My hypothesis putting the blame on poor demand forecasting proved to be too simple. Buildings based on fairly good market research made their owners bankrupt. In hindsight, perhaps the best market research report we saw was for a project that did not proceed, but its quality and conclusions were not notably different from the market research on projects that did proceed. It was not good market research, rather it was owner caution that prevented that project proceeding.

Market research was too narrowly focussed, or based on incorrect assumptions. QVI proceeded on the assumption that Central Park would not go ahead, because QVI's market research clearly showed that if both proceeded, rents would not justify construction and the projects would both make a loss. When Central Park did go ahead, QVI knew they were in serious trouble. An assumption of rational behaviour by competitors led to ruin. Central Park made a different error, assuming they would obtain a larger market share than they eventually did, and that rents would hold up, despite the lack of tenants for their competitors. No one predicted the extent or duration of the early 90's recession which sent office space takeup negative for three years in Perth.

What emerges clearly from this study is a “game theory” or “strategic behaviour” element in the office project commencement decision process. It was to a significant extent the perception of the “players” at the time that even in the context of the boom euphoria of the late 1980’s, building all four projects was risky. A senior analyst advised his firm against financing one of the four projects but was overruled by management which felt that “everybody else can’t be wrong.” This is an example of the “herd instinct” reported by some to afflict institutional fund managers who feel they can not be criticised too severely in an uncertain world for going along with their peers (cf Pishkun quote at head of chapter). In another case, a developer sent earth moving equipment to a site to “scare off” a competing project across the street. When the competing project broke ground, the first one ceased construction and remained a vacant site throughout the period.

One can argue that perhaps the first project to proceed was a “good” decision, while the last to proceed was probably a “bad” decision. Indeed, once these projects were under way, several holders of cleared sites made what proved to be relatively good decisions under the circumstances by delaying commencement of projects.

An interesting point brought out by the four projects study is that during the early stages of a project, it isn’t easy to tell who is “first.” This is in the nature of the development process which involves stochastic delays for planning, government approvals, obtaining finance, and construction. By the time it is obvious that one’s rivals will proceed, so much has been invested in early stages of a major project, that the project has a momentum hard to stop. Money invested up to the present are sunk costs, so only the additional investment necessary to complete the project really “counts” in decisions about whether to continue to the next step. This will bias decisions in favor of completing partly finished projects even if they are no longer likely to recover full costs. Experienced people compared major projects to steering a ship. Unless the engines are reversed far in advance, momentum will carry it onto a reef.

Momentum has three aspects. First, money spent which becomes a sunk cost and hence irrelevant to subsequent rational decisions. Second, for developers who do

not have deep pockets, holding costs for an expensive vacant site mean bankruptcy is certain if the project doesn't proceed. In this situation one had might as well go ahead and hope for a demand increase or marketing miracle. Third, as the project goes through design, construction of scale models, and an intense selling process, the developer advocates it to planning officials, tenants, and finance sources. This increases "ego involvement" or psychological commitment to the project. Putting a major monument on the skyline has been a powerful (and financially irrational) motive since the days of the pharaohs 5000 years ago. A major building is not merely a financial vehicle, its design can be a major and enduring work of architectural art which can arouse all the passionate commitment which any artist devotes to achieving a vision.

Amusing Freudian analogies can also be drawn, and no doubt post-modern feminist deconstructions involving the relative size and shapes of symbols of corporate or personal power. Alan Bond, one of Perth's more colourful bankrupts (and occasional prison inmate in the 1990's) devoted the penthouse levels of his Perth tower to an art gallery and apartment (complete with gold plated spa fixtures) for personal use by himself and, usually, blonds. Bond's purchase of Van Gogh's "Iris" for \$54 million in borrowed funds, was a record price for a painting sold at auction, but the painting only hung in the penthouse suite briefly. Fortunately, we are not doing a psychological study here, but clearly some of the motives have little to do with economic rationality.

4.3 The Prisoner's Dilemma Game

A game is defined as a series of choices under a set of rules (ie in an institutional environment) whose payoffs depend upon the choices made by other players (Rasmussen, 1989). Office markets clearly meet this definition: The outcome of an office investment decision depends very substantially upon what others in the market choose to do. It appears, for example, that in the Perth market in the late 1980's the

payoff for not building was superior to that for building, but only because of the decisions others made to build too much. Had others chosen not to build, the best outcomes would have been had by building.

Many games have been analysed by mathematicians following the pioneering work of Von Neumann and Morgenstern (1944). Some games are one time choice/payoff situations, others are repeated, in which case optimum strategy may take into account “learning” by the other parties in the game in response to earlier choices. An important issue is whether payoffs are fixed or variable. If total payoffs available are fixed, the game is a “zero sum” game, that is, an increase in one player’s payoff means an equal decrease in the other players’ payoffs. Office markets are not precisely zero sum games, but the payoffs cannot be expanded infinitely. A given market can generate aggregate office rents up to only some particular (admittedly fuzzily defined) maximum level at a point in time dependent upon the size of the local economy and the local derived demand for office accommodation. In this sense then, if your building gets the tenant, my building may go vacant--resembling a zero sum game. A zero sum game scenario has been visible in recent Australian office markets between classes of office buildings as leasing incentives emptied lower grade buildings to fill new buildings. The new building’s gain is the old building’s loss. In fact, the sum may be less than zero in a market with falling rents.

Clearly “rules matter” in games, for example, are players allowed to collude or cooperate? Information available to players at the time they make choices is also decisive. If we knew in advance the other player’s response to our move, we could choose a more favourable outcome. Normally in a game, the other player’s response is not known--players act simultaneously, or in sequence. In either case, one does not know what the other players will do next move. When rules are known, but other players behaviour is unknown, a player is said to have “imperfect information.” When both rules and other players’ behaviour are unknown, the player is said to have “incomplete information.”¹³

¹³ Dominique Achour provided this distinction between imperfect and incomplete information games.

In this case, the best one can do is try to work out what is the best course of action based on the likely course of action of the other parties. If, when all parties do this, a particular solution results where each strategy q_i^* is the best reply to all other strategies, then the joint solution $q^* = (q_1^*, q_2^* \dots q_n^*)$, is referred to as a “Nash Equilibrium” after John Nash, a major early figure in the development of game theory. Such a solution is said to “dominate”, that is, offer higher payoffs than alternatives regardless of what other players choose. No player has an interest to change a Nash equilibrium solution unilaterally.

Office markets are an example of a prisoner’s dilemma game. In the prisoner’s dilemma, two prisoners have been captured and accused of a crime. Both will go free if neither confesses, one will get a light sentence and one suffer a severe punishment if one confesses and the other doesn’t, and if both confess both will be convicted and given severe sentences. Representing this in terms of a “payoff table” showing the outcomes for each (call them Waylon and Willy, with their payoffs, respectively, in years jail sentence) under these various choice combinations:

Table 4-3 Prisoner’s dilemma game example

	Waylon confesses	Waylon doesn’t confess
Willy confesses	10,10	20,1
Willy doesn’t confess	1,20	0,0

Absent cooperation, the result of this game will be that both confess and thereby achieve an outcome worse than if neither confesses. Yet, in the event, both have an incentive to confess because to do so gives a better outcome than if they don’t and the other does. This game, by the way, assumes that the payoffs for the different choices are known with certainty--an assumption that may not be true in all games, including the office market. With known payoffs, each player then can examine his payoffs given the other player’s choice. If Waylon decides to not confess, he knows that he will get either 0 years or 20 years, depending upon whether Willy confesses.

If he does confess, he knows he will get either 10 years or 1 year, depending on whether Willy confesses. Knowing Willy faces the same payoff table, he knows Willy will be likely to confess to get a lighter sentence. Which then means that when each player makes his individually “rational” choice, the collective outcome is suboptimum. This is the essence of the prisoner’s dilemma game--collective loss because of individual rationality.

Mancur Olson (1971) has described this problem as *The Logic of Collective Action*, arguing that cooperation is needed, enforced by institutions, in cases ranging from labour markets (labour unions as a form of cooperation), fisheries (common property resources subject to over exploitation), and international relations. In office markets, when a feasibility study shows demand for one building, the tendency is for three buildings to be constructed, with payoffs very similar to the prisoners all confessing.

What does the payoff table look like in an office market? We could express it in terms of net present value of an investment in office district land in Perth, for example, with outcomes varying based on supply and resulting rents. If the market is oversupplied, rents fall, resulting in lower present value of an investment. On the other hand, if rents are high, holding undeveloped land represents an opportunity loss. Suppose, simplifying slightly, that we segment the Perth CBD office sites contemplating development, into three segments. QVI and Central Park, two 60,000 m² buildings completed in Perth in 1991 and 1992, and half a dozen additional projects completed in 1989-1992 which I will call “Other projects” with a total lettable area of some 200,000 m². The analysis would be similar if more players were included rather than lumping “other projects” together. Looking at the market in 1986, just prior to groundbreaking on QVI, its developer, Bob Williams, might have gone through a calculation something like this:

Table 4-4 Payoff to QVI venture:

	Central Park, Other projects no	Central Park, Other projects yes
QVI no	-15 m.	-25 m.
QVI yes	+100 m.	-100 m

Payoffs in the table are for QVI. When a project developer doesn't build, it incurs a substantial negative payoff due to the costs of holding undeveloped land. Here I've arbitrarily guessed \$25 million as the cost of delaying until the next building cycle, say \$50 million in land at 10% p.a. for 5 years, quite a conservative figure and with no compounding.¹⁴ Losses if the other projects do not proceed are smaller, assuming rents and land values rise in an under supplied market (I have chosen an arbitrary capital gain of \$10 million to offset part of the holding costs.)¹⁵ For the project to make a \$100 million capital gain we have only to assume a \$100/m² rent increase above the rent which just recoups costs, capitalised at 6% for a 60,000 m² building. Since rents rose by even larger amounts during the 1980's boom (while capitalisation rates went even lower for premium buildings), it would have been plausible to project such gains, if the market were favourable and no one else built to satisfy growing demand. Similar reasoning would lead to a \$100 million loss on a QVI sized building if rents fell by \$100/m². In the event, Perth rents fell from about \$350 to about \$65, and have now recovered to about \$200, still too low to justify the cost of projects begun in the late 1980s. Other developers would, of course, face similar uncertainties and payoffs. In the event, too many chose to hope for the positive payoff by proceeding and all lost heavily.

In office markets, of course, the payoffs are uncertain. Neither the actions of competitors, nor future demand, nor rent responses to market conditions are known.

¹⁴ An oversimplified example adequately demonstrates the prisoners dilemma. Actual numbers would depend upon holding costs for undeveloped land, including cost of capital, and on changes in the market price of land, as well as on the NPV (based on rents) of office buildings.

These uncertainties allow for wishful thinking and optimistic assumptions to avoid the negative payoffs which are certain if one does not build after acquiring land at prices which assume office building potential. It seems that the predicted solution for all parties tends to be "build" even though this results, as in the prisoners dilemma, in the worst outcome for all.

The game theory aspect of office oversupply suggests that better information about competitive projects and perhaps some institutional arrangements for queuing projects would be helpful. A decision to proceed or not proceed cannot be evaluated in isolation, but only in the context of what others in the market are doing. Unfortunately, the solution to the prisoners' dilemma game, absent cooperation, is a suboptimum outcome.

Chapter 5 Office Market Modelling Literature Review

5.1 Introduction

5.1.1 Aims of this chapter

This chapter presents an overview of office market modelling literature. The objective is to identify methods, candidate variables (and proxies), lag structures, and other insights useful in creating forecasting models for Australian office markets. Office market papers reviewed can be classified as addressing the following concepts and topics: Natural vacancy rate, rent adjustment, demand models, supply models, models of yields and values, office market cycles, hedonic models for pricing individual buildings and relationships between office markets and the macroeconomy. Papers include both simultaneous and single equation models. Most aim for explanation, a few address forecasting. Any classification scheme is somewhat arbitrary and some of the articles belong in several of the above categories. This chapter is a synopsis of 100 single spaced pages of notes on some 80 articles. The information explosion is such that future literature reviews might evolve into a list of data bases and keywords. I do not attempt to review relevant literature on time series econometrics--too big a task--but draw upon a few selected sources for guidance on methods.

5.1.2 Modelling Strategy and Tactics

Models are based on assumptions about "how the system works." Hendry calls this the "data generating process" (Hendry, 1993) Aspects of time series modelling strategy and tactics include:

Speed of adjustment. Some models assume instantaneous adjustment to equilibrium, others adjustment over several periods, including future periods through expectations.

Reliance on theory. Some models are strongly grounded in economic theory, others are *ad hoc*, based on properties of the sample.

Auxiliary assumptions. An important issue is the attention span, accounting stance, or scope of the model, by which I mean where it stands in a analytical or reductionist versus “holistic” continuum—that is, how many auxiliary conditions are treated. Are latent variables or variables that do not vary during the sample period considered? Even the most general specification assumes many side conditions which may be necessary for relationships in the model to hold. Mellor (1995) and Gordon (1991) discuss consequences of omitting aspects of complex systems from explanatory models.

Simultaneity. Some models attempt to look at systems of equations and simultaneity, others are single equation models focusing on a subset of variables with single direction of causation. In simultaneous systems, endogenous variables explain each other. Variables that are assumed to be exogenous, but are in fact endogenous will lead to biased estimates.

Functional form, interactions, threshold effects. Many modellers test only linear models or simple transformations (ie. logs). But other functional forms are probably common (inverse, polynomial, etc.) as well. Functional relationships may vary across the variables’ ranges as well, or change over time. Interactions between variables may also occur, as well as threshold effects. In biology, for example, it is common to find that, for example, growth rates would increase with some variable (eg. temperature) until a limit is reached and the organism dies--the maximum temperature being the threshold. In office markets, rents may increase for some time without effect upon supply until projected IRR of a proposed new building exceeds the current discount rate, another example of a threshold effect.

Stability over time. Time invariance is the implicit assumption of most econometric models. Yet we know office markets change dramatically over time--they are human historical, cultural creations, not time invariant physical processes (Simon, 1969; Makridakis & Wheelwright, 1989).

Simple to general versus general to specific. Omitted variables bias coefficient estimates and standard errors. Therefore Hendry recommends a “general to specific” strategy where all candidate variables and lags are included in the original specification allowing one to “test down” to a simpler model. Unfortunately, this is not feasible with small data sets so some version of a strategy beginning with simple models is unavoidable.

Stationarity and spurious relationships. The “unit root revolution” in time series econometrics pointed out that variables containing deterministic or stochastic trends will be found to have high R^2 even if they are unrelated. This led to now standard procedures of testing time series variables for unit roots indicative of stochastic trends (Hamilton, 1994).

Diagnostic testing. Ordinary least squares estimates are valid only if residual errors are independent and identically distributed around zero. Violations of OLS assumptions are found by comparing test statistics to critical values. Testing residuals for serial correlation, normality, and Heteroscedasticity are standard procedure. It is also a good idea to examine plots of residuals visually. Additional tests detect outliers and influential points, and changes in coefficients over time (process instability)(Gujerati, 1996).

A listing of issues to consider in evaluating applied econometric literature might include:

Citation: Author, date, publication information

Title: Topic of the study

Candidate variables considered

Included variables

Omitted variables

Variables omitted for lack of data

Variables tested and not significant

Span of data (range of variation)

Time series or cross sectional or pooled

Years or categories covered (range of data)

Annual, semi-annual, quarterly, or monthly

Seasonal adjustment?

Order of integration tests (unit root tests)

Cointegration tests

Models tested

Models selected
Fit—usually R^2 , likelihood ratios, or information criteria
Significance—T ratios of included explanatory variables or F test
Diagnostic tests of model assumptions
Serial correlation of errors
Heteroscedasticity of errors
Normality of errors
Data transformations or functional forms (logs, differences, levels, Box-Cox powers)
Subsets of data used for estimation, tests of structural stability
Interaction terms
Tests of structural stability
Validation by checking forecast errors in a withheld sample subset
Dynamics—leads and lags tested
Restrictions tested
Restrictions adopted
Causality/endogeneity, exogeneity tests
Simultaneity, methods for dealing with simultaneity
Estimation methods

Meta-analysis adds statistics to allow meaningful comparisons of model results across studies. Obviously thorough discussion of all these issues would take much more space than allowed for in journal articles, so authors face a dilemma of adequate treatment versus brevity. In this review and the following chapter I attempt to keep these issues in mind, but an exhaustive treatment of all of them in every case would be not only tedious, it would also require violating my dissertation page limit. These (and no doubt other issues I've failed to mention) are with us, nevertheless, in every attempt to extract information from data. The more attention is paid to these issues, the more likely results will be valid.

5.1.3 General comments on the office market literature

Most published articles in the office markets literature reviewed below do not report diagnostic statistics. Most authors in real estate and other applied fields are not specialist econometricians and our knowledge lags the econometric literature. The norm, until recently, has been to report T-ratios (or probability values or standard errors of coefficients) and R^2 (not always adjusted R^2), and possibly a Durbin-Watson statistic, with no other diagnostic tests. But, McAleer emphasises that a high R^2 , indicating high degree of “fit,” can occur in a model in which “everything is

wrong” so diagnostic testing is essential.¹ Hendry has recommended “model destruction” or “test, test, test” as the only way to separate econometrics from “alchemy.” (Hendry, 1993)²

Published research usually contains limited information on the number of models tested on the way to arriving at the published results. “Data mining” can lead to excellent models in terms of accommodating the sample, but generates misleading T ratios and invalidates other tests. Inferences (hypothesis tests and forecasts) from such models are not justified and are unlikely to be correct (Charemza and Deadman, 1992). My own work reported in the following chapter is also subject to this caveat.

Another major difficulty with many of the office market papers is lack of testing for order of integration in time series data. Models reported may be spurious when variables are not stationary. Gary MacDonald summarises the “unit root revolution” in time series analysis by saying “Most of the papers published before the mid-1980’s report spurious models.”³ In applied fields like real estate where work is often done by non-specialists in econometric techniques (again, myself included), econometric innovations are adopted over a period of time and may lag “best practice.” Papers published as late as 1996 fail to test for stationarity of variables and therefore may report spurious results. Very few pre-1990 papers in real estate test time series variables for stationarity, although a majority present models in differences which may be presumed stationary.

5.1.4 Data, Candidate Variables, and Results

In many papers inadequate proxies are asked to support questionable theory without adequate attention to lags, expectations, stationarity, or diagnostic tests. Lack of data and measurement errors plague this literature, some papers using as few as 5 years or nine sample points to estimate equations. One should constantly be asking

¹ Comment in lectures, University of Western Australia, 1996. See also Sherlock Holmes paper, McAleer, 1994.

² McAleer (forthcoming, *Journal of Applied Econometrics*) remarks that because Hendry’s “test, test, test” really in practice means “estimate, estimate, estimate”, that is, failed diagnostics lead to respecification and reestimation, “it is still alchemy” in the sense that the data is being “mined” and therefore statistics are given too many chances to show significance.

³ Curtin University School of Economics and Finance—Specialist in time series econometrics.

“Is this result due to chance in a small sample? Would this insignificant variable have become significant with a larger sample or cleaner data? How robust would these results be to respecification or additional data?” The pernicious incentives of “publish or perish” reward structures for academic researchers and short length of journal articles prevent these questions being asked as often as they should be.

Mile Miles, using a 20,000 observation data base told me that the proprietary models he estimated for Fidelity Investments could detect effects on office supply of, for example, the 1982 and 1986 U.S. tax law changes.⁴ Other investigators, using small samples, do not detect these effects. Given that most investigators used small samples, one suspects that failure to detect relationships could merely be due to lack of tests' power.

Investigators find less comfort in theory than they would have hoped. A number of candidate variables that seemingly should be related by theory are not. Construction costs and interest rates did not explain supply in some samples. Rents do not explain demand and even have wrong signs in many equations. One problem, undoubtedly, is that these variables are all strongly associated with macroeconomic cycles, so signs are reversed due to the effects of non-included variables. Demand and rents both increase with economic growth, so (contrary to theory and spuriously) rent increases are associated with demand increases. Another problem is simultaneity--demand increases cause rent increases so higher rents are positively related to demand.

We can turn this around and find effects from variables that should not be causally related. Office markets are procyclical, so *any* variable associated with macroeconomic cycles (ie hundreds of variables) will “explain” office market variables. So we could probably get relatively high R^2 in a model explaining office demand with nonsense variables--say sales of washing machines or visits to Disneyworld, even if the models are properly estimated. Some such spurious models would undoubtedly pass all diagnostic tests. In these circumstances it is

⁴ Miles, formerly a professor at North Carolina, currently is a portfolio manager for Fidelity Investments, personal communication, November, 1996.

difficult to sort out which variables are truly causal and which are simply along for the ride. The spurious relationships exist, but they are not causal. All the econometrics can be right and the model still wrong. Substantive consideration of mechanisms of causation may help sort out which relationships are spurious.

Relationships between non-stationary time series variables comprise only a subset of spurious models. Any situation where a non-included causal variable is associated with an included non-causal variable leads to a spurious model. In non-stationary time series the non-included confounding variable is time or something associated with time. All models exclude variables which could result in biased coefficients and T statistics. This is the price of elegance and simplicity in models. Recognising that all models are misspecified is an important empirical observation that will help us avoid misusing econometric results and lead towards improved models.

Bruno and Tsolacos (1995) review U.K. and European papers on office markets. Some "findings" and authors they cite are mentioned here:

Commercial property was about half of U.K. equity market, 6% of GDP directly, 20% of financial institutions assets, of 25% listed company assets (Currie & Scott, 1991).

Regional GDP was the most significant demand measure (also tested were regional service sector employment, unemployment, average income (Gardiner & Henneberry, 1988; 1991).

Employment in banking, insurance and finance did not effect real office rents (Dobson & Goddard, 1992, UK data.)

GDP is more important than service sector employment in explaining quarterly real rents 1977-1991 data (Guissani & Tsolacos, 1993).

Real GNP affects office demand, but local unemployment was not significant (Hekman, 1985, 14 U.S. cities, 1979-1983 data).

Change in office employment affects demand (Kelly, 1983; Shilton, 1994).

Demand is influenced by cyclical office employment growth (Wheaton & Torto, 1988).

Productivity growth was lower in offices (2.8%) in U.K. 1979-1985 than in manufacturing (4.7%) (Mayes, 1987).

Office stock quality varies so use of stock variables as a rent predictor are problematic. (Guissiani & Tsolacos, 1993).

Rosen (1984), Shilling (1987), and others use the concept of natural (equilibrium or structural) vacancy rate analogous to a structural unemployment rate, so rents rise if vacancies are less than this rate, fall if vacancy is higher than the “normal” rate.

Lagged rents appear in preferred specifications for office rents (Gardiner & Henneberry, 1991; Dobson & Goddard, 1992).

Growth in rents varied widely between European cities. Levels in 1991 ranging from 13.5 £ /psf to 47.50 £ /psf, suggesting different variables at work in different markets or different behaviour of variables in different markets. (G&T, 1995).

Other literature supports these general views: Office demand is explained by economic activity, rent changes by vacancy rates. Supply is more problematic in that it responds not only to office market variables, but also to financial market conditions (Fisher, 1992). The following sections discuss some of the proposed specifications for office market models in more detail and attempt to draw conclusions relevant to creation of forecasting models.

5.2 Topics in the Office Market Literature

5.2.1 Equilibrium vacancy rates

Much attention was given to vacancy rates and determinants of equilibrium vacancy rates in early office market modelling papers. Clapp (1993) called equilibrium vacancy “the most important concept of the last fifteen years in the office market literature.”

But mathematically, equilibrium vacancy rate only makes sense if all other variables do not change. Any change in other variables affecting rent adjustment must result in a change in the vacancy rate at which rent change, ΔR , is zero. For example, suppose, following Crone (1989) that rent change depends upon vacancy and rate of demand change:

$$\Delta R = f(V, \Delta D)$$

Obviously, for each level of demand there must be a different equilibrium vacancy rate. Hendershott (reviewed below) incorporates this idea in his rent adjustment models.

There is some doubt in my mind that one should expect at any given time a single equilibrium vacancy rate in:

1. Rental markets
2. Markets for office buildings
3. Capital markets.

There may instead be a number of equilibrium rates. One “natural” vacancy rate is the amount of “frictional vacancy” required for smooth functioning of rental markets--the inventory of space on offer and empty due to tenants in transition, remodelling, etc. This figure may be about 5% on average and would probably rise with frequency of turnover (shifting of tenants).

Hendershott and Haurin (1988) argue that the natural vacancy rate is a profit maximising exercise whereby landlords graph rent against proportion of year the property is vacant and pick a maximum point. Higher rent levels may result in higher vacancy, but if rent increases faster than vacancy losses caused by higher rents, maximum rent collections may occur at some rent above that which leads to 100% occupancy.

But would that necessarily equal the vacancy rate at which a building could be expected to return the risk adjusted cost of capital which is another notion of equilibrium vacancy related to the building construction market? If so, does the landlords equilibrium vacancy rate and hence asking rent then change with each change in market interest rates? Due to leases, this would be impossible--rents are too sticky compared to interest rates for the two to move in lockstep.

Wheaton and Torto (1988) found a doubling in equilibrium vacancy rates from the 1970's to 1980s which may be driven by investment or capital markets changes (perhaps due to tax policy changes effects on after tax returns) rather than frictional vacancy considerations such as increased tenant mobility.

Kummerow, 1995, in an unpublished consultancy report estimated a simple OLS equation of rent change on vacancy rate and an unrestricted constant for 5 Australian capital cities. Data were annual real net effective rents with leasing incentives amortised over the lease term, vacancy rates, and other office market series as reported by a major property firm covering 1970-1993 for Melbourne and Sydney, early to mid-1980's to 1993 for other capital cities. This work suggested:

1. Log transforms of rent and vacancy were not helpful in improving fit.
2. Generally two lags of rent change are significant regressors.
3. Percent vacancy explains about half the variation in rent change in Sydney, Melbourne, Perth, and Adelaide, but not in Canberra where vacancy rates were low and steady through the sample period.
4. Adding completions, or net additions to stock (ΔS), or net absorption (ΔD) explained an additional 10-20% of variation, but including more than one of these did not add much. These three were similar in their contributions to \bar{R}^2 . Net additions to stock (supply change) was best of the lot by a negligible margin.
5. Robust techniques did not offer much satisfaction. Outliers could be identified and down weighted or omitted, certainly. But the fit of these

simple models is poor enough that I did not find one line drawn in the middle of a scatter of points more appealing than another slightly different line. The menu of robust techniques is large, so that many different lines can be drawn--but with little reason to pick one or another as "best fit." In truth, none fit very well.

6. I concluded there are three possible explanations/treatments of outliers: a) mistakes/ omit or correct, b) unusual period, temporary aberration in process due to unusual shock/ down weight, use robust technique, c) tail of distribution, typical process/ include without downweighting. In this data, it is difficult to know which is correct, when in doubt, c) seems the best option.
7. Diagnostics were not run in my 1995 analysis, but residual plots are included. A later check showed serially correlated errors in the simple models. This can be eliminated by inclusion of one or two lags of the dependent variable as regressors.
8. "Equilibrium" vacancy rates, calculated from b_0/b_1 (ie setting rent change =0 and solving for vacancy rate) were from 7% to 11% in the different cities.

"Equilibrium vacancy rate" without further qualification therefore describes a one variable, misspecified model which will yield biased coefficients and hence biased equilibrium vacancy estimates. Probably any model including only three or four variables will be misspecified and yield biased (conditional on other non-included variables) equilibrium vacancy rate estimates.

Economists assume a single equilibrium rate simultaneously holding in all of three markets--office space, office buildings, and office finance markets--while in fact, probably all these markets are not at equilibrium most of the time and may deviate from equilibrium in different ways, with each deviation exerting effects on the other markets. This whole complex soup would mean it would be very difficult to get all the markets to the same equilibrium at once. And it would be possible for one to be at equilibrium and others not at equilibrium, so forcing adjustments away from

equilibrium! This is no more than saying that an existing building's owner and tenants may be happy with rents and occupancy at a time when capital markets are desirous of financing new supply.

Fisher (1992) in an issue of the AREUEA journal *Real Estate Economics* largely devoted to commercial property market issues, argued for integration of research on space markets and capital markets noting that most previous research had implicitly examined equilibrium in one market or the other as if they were not related.

Voith and Crone (1987) and Wheaton (1987) calculate "natural" vacancy rates for a number of U.S. cities, as do Shilling, Sirmans, and Corgel (1992). The latter use three specifications including expenses (cost of holding vacant inventory) and vacancy to explain rent change, solving for equilibrium vacancy rate in each case. Correlation coefficients between cities, using the same equations range from 0 to 0.57, using the five different models (3 by Shilling et al., one each by Voith & Crone, and Wheaton). The latter suggests a national equilibrium rate explains much of office rent variation, the former purely local equilibria. Variation between cities is large and inconsistent estimates are produced by different models.

Table 5-1 Equilibrium vacancy rates calculated from estimated equations

City	S,S&C Eqn. 2	Wheaton
Atlanta	6.3	13.2
Chicago	4.1	8.2
Denver	12.3	8.3
Philadelphia	9.5	8.7

There are wide disparities and rankings are not the same. Even wider disparities would be seen in a complete table of equilibrium vacancy estimates from the five models. Shilling, despite his earlier studies, or perhaps because of complexity and

difficulty of interpreting results, told the author during an interview in 1995 that “Perhaps equilibrium vacancy rate is not a useful concept.”

Similar instability across samples appears in Wheaton and Torto’s (1992) model to predict office rent indices. Estimated for five cities using lagged demand change (net absorption), lagged rent, and lagged vacancy rate to predict current rent change, the coefficients for absorption ranged from 7.3 to 59.1 and for vacancy from -0.04 to -0.16. R^2 ranged from 0.36 to 0.75 across the five cities. This is hardly a stable model. We must conclude either that the model is seriously misspecified or different cities’ office markets are quite different.

This model can be used to calculate equilibrium rents at various vacancy rates and absorption rates. Given any initial rent, the model allows calculation of the speed of adjustment to that equilibrium value. Speed of rent adjustment varied greatly in their samples: 0.33 in six months in Cincinnati, 0.12 in six months in Washington.

I suspect these results are more likely to be meaningless artefacts of misspecified models than market behaviour. Are we really to believe that speed of adjustment varies between markets or that speed of adjustment remains constant in particular markets over time? Nevertheless, this is an important model, representing a plausible theory of rent adjustment as a function of negotiations between tenants (demand change) and landlords (vacant space), with adjustment not instantaneous, but taking one period:

$$\Delta R = a + b_1 \Delta D(-1) + b_2 \Delta V(-1) + b_3 R(-1)$$

This model was estimated in semi-log form. The dependent variable is a hedonic rental index calculated in a previous stage.

Grenadier (1995) analyses office vacancy from the perspective of finance theory, noting that since vacant space constitutes a call option on leased space, greater demand volatility would increase the value of the option and hence desired holdings of vacant space. Shorter leases, more frequent moves also increase desired inventory, as would greater building and tenant heterogeneity. Grenadier models the

normal (equilibrium) vacancy rate as a function of errors in the previous four time periods. He finds shocks are persistent and speed of adjustment slow. Grenadier represented the natural vacancy rate as a function of a time invariant city specific constant, plus a national factor. I find this implausible as his own argument suggests local components of natural vacancy rates should vary with changes in local conditions. Using a fourth order polynomial to represent the lag structure of national shocks effects on vacancy rates also seems arbitrary.

Grenadier's results for fifteen U.S. cities were: Average $V^* = 9.35\%$, range 2% (New York) to 15% (Dallas). Persistence parameter ρ averaged 0.81 (range 0.69 Seattle to 0.93 New York). Grenadier tested for structural stability and found no change in structure in his semi-annual 1960-1991 data.

In summary, the equilibrium vacancy rate concept has considerable appeal, but requires care in use because equilibrium varies over time and between cities. A three step process is required: 1) Estimate local equilibrium vacancy rate at time t . 2) Compare to actual vacancy rate to determine deviation from equilibrium. 3) Use deviation from equilibrium to estimate rent change.

As stylised facts we might say something like:

1. Normal vacancy rates seem to vary from about 2% (or less) to 20% (or more), averaging about 8-9% for U.S. and Australian cities during the 1970-1990 period.
2. Normal vacancy rates seem to have increased (about doubled) in the U.S. from say 1970 to 1985 (Wheaton and Torto, 1987).

5.2.2 Speed of adjustment--Cycles, lag structures and expectations

Pyhrr, Born, and Webb (1990) extend "cash flow" pro forma modelling by adding a sine wave inflation assumption, which in turn is assumed to be related to cash flow outcomes and rate of return requirements. While on the right track in proposing to add empirically observed cycles to investment analysis, the assumption that inflation follows a regular sine wave may be overly optimistic. More likely, the timing and

amplitude of changes in inflation is uncertain. This paper may be the most elaborate statement of advice to “buy low, sell high” in the property literature.

Wheaton (1987) makes the following assertions about U.S. office markets:

1. There were three ten year cycles between 1960 and 1986 (“too long to be accounted for by construction lags”)
2. Office markets do not clear quickly taking several years before rents, supply and demand return to equilibrium.
3. Supply responds more to rents than demand.
4. Supply and demand may reflect expectations of builders and tenants.
5. Amplitude of cycles increased over the 1960-1986 period. Ten city averages: 4.9%-11.5%, 4.1%-18.8%, 3.4%-17%. for the three cycles respectively.
6. Office employment and office demand both dropped sharply in recessions, but did not always move together.
7. Less than 10% of space is on the “spot market” each year due to long term leases and high costs of relocation.
8. 85% of U.S. space was rented, 15% owner occupied

“Expectations about future economic growth and office market conditions” may lead to firms leasing more or less space than they currently occupy or need. Landlords in a falling market may try to get tenants at any price.” (Wheaton, 1987)

Absorption (ΔD) was estimated by employment, rent, and a ratio of this year’s employment over last year’s employment, ie an employment change variable. Construction (ΔS) is estimated as a function of the same employment change ratio, current supply, and vacancy two and a half years earlier. Wheaton admits the equations are a “result of considerable experimentation.” The ratio of employment over employment_{t-1} is meant to represent expectations of future employment change.

Abelson and Cooper (1990) modelled the Sydney CBD office market for Jones Lang Wootten and later presented the paper to a conference of economists. This model is

particularly interesting as it describes the same market I have attempted to model and because it proposes similar single equation models for supply, demand, and rents, each of which includes a lagged dependent variable. By estimating the models in logs, A&C's coefficients become elasticities. They calculate short run and long run impacts based on the coefficients of the lagged variables.

Abelson and Cooper conclude demand is price inelastic: "Coefficients of -0.08 on rents and 0.24 on employment represent short run (one year) demand elasticities. If real rents were to fall by 10% within a year demand for office space would rise by 0.8%. From the coefficient of 0.58 on the lagged dependent variable, it is possible to conclude that $1-0.58=0.42$ of the long run adjustment occurs in a year. Also, the long run real rent elasticity is $-0.08/0.42=-0.19$. The long run employment elasticity is $0.24/0.42=0.57$. So long run impact of a 10% fall in real rents is a 1.9% increase in demand, while a 10% fall in employment would reduce demand by 2.4% in one year and 5.7% in the long run." In the rent equation, "estimated long term employment and stock elasticities are both quite high and suggest that real rents are fairly volatile." (Abelson & Cooper, 1990: 20) They estimate five different versions including a rent on vacancy and squared vacancy terms. Estimating in logs of levels and taking the derivative they find rent change due to an increase in vacancy from 1% to 2% to be -6.46%, while when rents increase from 9% to 10%, rent decrease is -0.83%.

Unfortunately, Abelson and Cooper do not test for stationarity. Clearly some of their variables contain trends and they, in fact, found the most significant regressor to be a time trend. Employment and demand and supply in logs would all contain deterministic trends related to log linear growth in the economy. For unexplained reasons, they omit the highly significant trend variable from some of their equations. They also do not discuss simultaneous equations bias.

I have been told that rent forecasts from their equations proved quite wide of the mark within two years (on the order of 30% error). In a 1996 interview, staff at JLW expressed scepticism about econometric methods that may be based on this experience. But all forecasts using economic variables like employment as

predictors are conditional and therefore would of course be “out” if economic conditions are not as predicted. Practitioners tend to look to quantitative methods for certainty that may not be a feature of the system. Econometricians should point out that users should sometimes blame the system not the model for forecasting errors and always emphasise that forecasts are conditional upon variables whose outcomes are uncertain.

Hendershott has published a number of papers looking at office markets as systems controlled fundamentally by cost. V_t/RC_t , the ratio of value (discounted current rents) to replacement cost (land, construction, and other costs less depreciation) determines, in Hendershott’s view, whether or not it is feasible to build at a point in time.(1994) This leads Hendershott to propose including the deviation from equilibrium rent $g-g^*$ as a regressor in a rent adjustment equation. In this paper he also includes a lag of vacancy and a forward lag of vacancy change (VAC(+1)-VAC).

In later papers (Hendershott, 1996) he also includes excess vacancy, the deviation of current from equilibrium vacancy.

$$\frac{\Delta g_{t+j}}{g_{t+j-1}} = \lambda (v^* - v_{t+j-1}) + \beta (g^*_{t+j} - g_{t+j-1}) + \gamma \Delta v_{t+j}$$

This model requires assuming that either rent or vacancy is at equilibrium at some point in order to allow a solution for the equilibrium value of the other. In another paper (Hendershott, 1994) Hendershott substitutes a lag of vacancy rate for the lead in vacancy change in the model above.

The rent variable is expressed as gross rent per dollar of replacement cost, or a yield percentage. Hendershott defines this as gross rent, subtracts expenses and depreciation, but does not include the change in property value due to expected rental growth that would be required to find total return. Nor does he solve the problem that land values may change, so the denominator of the rent-as-yield per dollar of investment variable is not constant between time periods. Simultaneity is lurking under the surface here as rent change will cause land value changes.

What Hendershott's way of looking at office market rent adjustments gives us, with the above caveats, is connections between cost and equilibrium rents. And a way of connecting office market outcomes with capital market rates of return. If the required rent (defined as a yield) is looked at from the point of view of "what rate of return is required to attract capital into office investments" than the answer would be something like "risk free rate+project specific risk premium+depreciation rate." So with capital market return requirements and replacement cost figures at hand, it is possible at any point in time to calculate what rent will call forth new construction. Comparing current rents to equilibrium rents so calculated gives a fairly convincing way of predicting short term rent adjustments--markets must at least return to equilibrium, given plausible assumptions like "there will be economic growth."

Moreover, shifting to valuation, Hendershott sees current value V_t/RC as $1 - BER_t/RC$, where BER_t is present value of future expected below equilibrium rents. By iterating forward, Hendershott is able to predict the path of recovery of rents and values through time as they return to equilibrium.

Without discussing his model in cointegration terms, Hendershott includes levels information in a specification resembling an error correction model. He clearly has in mind a long run equilibrium relationship between vacancy (joint supply/demand) and rents. An agenda item for research would clearly be to test for stationarity and cointegrating relationships to translate Hendershott's equation into ECM format.

Hendershott points out the appealing behaviour of his return to equilibrium models: Rents will stabilise (at a low figure) with vacancy above the long run equilibrium vacancy rate because rents below equilibrium offset the impact of high vacancy on the rent adjustment. This is more in accord with reality than a model only including vacancy rates. In his equation there is a different equilibrium vacancy for each rent level. Equivalently one can say there is a different equilibrium rent for each level of vacancy. Specifications of rent change models using vacancy rates only without rents as predictors means the model provides no guarantee that R^* and R_t will be equal at equilibrium. In Hendershott's specification, $R^* = R_t$ is a necessary condition for no rent change (ie equilibrium).

Hendershott makes two other points about equations regressing rent change on vacancy that omit rent levels as regressors. First such equations guarantee that vacancy must overshoot before corrections can occur. Second, with multi-period leases, current rents should anticipate future market conditions. This is questionable given periodic rent reviews to adjust rents to market levels. But as rent review clauses are themselves a function of current and future anticipated market conditions I think Hendershott is essentially correct. With multi-period leases, Hendershott maintains, rents should turn upwards in anticipation of future vacancy decreases *before* the vacancy rate returns to equilibrium. Therefore another variable (eg. rent levels or deviation from equilibrium rent level) is required to continue the move towards equilibrium.

What is the relationship between Hendershott's proposed model and an error correction specification? First, Hendershott's dependent variable, rent change, is the same as would appear in an ECM. And a lag of the dependent variable is common in an ECM. $V^* - V(-1)$ is a constant minus lagged vacancy. This is an error correction term, in effect, a way of expressing the impact of vacancy in terms of a desired or target state (V^*) such that the variable increases rents when vacancy last period is less than V^* and vice versa. $g^* - g_t$ is a similar variable except that g^* varies through time as the prime rate changes. It seems to me that one would find a stationary linear combination of g^* and g_t (coefficients, as in H.'s equation 1,-1) where the linear combination is expected to be zero and deviations (the excess vacancy or deviation of rent from equilibrium) are the errors, u_t , that would appear in an ECM model and similarly for V^* and V_t . So I end up concluding that Hendershott includes, in effect, two error correction terms in his rent adjustment model.

An important point in another Hendershott paper is that taxes matter (1996: 51-67) Decisions by taxable investors should be made on an after tax basis. This brings institutional changes and differences between countries into models explaining office market behaviour.

5.2.3 Forecast Errors

Green, Malpezzi, and Barnes (1996) "Developing Confidence Intervals for Office Market Forecasts" examine effects on forecast errors of errors in predicting regressors. Because their concern was to demonstrate a method for calculating forecast errors, they settled for simple specifications of models for net absorption (ΔD), completions (ΔS), and office employment growth. Using ADF tests, they found completions and employment were "clearly not stationary." ΔD , however, did reject the unit root null. They found a cointegrating relationship between the three variables (employment, ΔD , ΔS) at the 0.1 level but not at 0.05 level.

Candidate regressors were three lags of the dependent variables, and a time trend (T). Using 26 years of semi-annual data and SURE regression, they found only most lags insignificant. Using a method following Feldstein, 1971, they found forecast errors reached 100% of forecast values within five years. Three sources of forecast errors are variance of the forecast variable, errors in regression coefficients, and conditioning errors, that is, errors in the forecast regressors. (I would add process instability and misspecification biases to this list, as well as measurement errors in the data used to estimate the model.)

Another area for future research is clearly quantification of forecast errors. We need to understand better the distribution of forecast errors at various forecast horizons and under different conditions.

I did not explore the copious forecasting literature very extensively. Suffice it to say that business forecasting sources include both qualitative methods (examples: Delphi technique or combing expert forecasts) and quantitative techniques. The latter might be partitioned into smoothing or extrapolation methods, theoretical time series or Box-Jenkins ARIMA models, and causal models. See Makridakis and Wheelwright (1989), Migliaro and Jain (1987). Another important distinction in the forecasting literature, as in econometrics generally, is between Bayesian and frequentist approaches.

There is also a literature on combining forecasts. According to the purist econometrician's religion, combining forecasts is nonsensical--one should simply find the best model given the data and produce the best possible forecast. Bayesian perspectives are more sympathetic to combining forecasts, given that with all probabilities unknown, your subjective method might include information unknown to my subjective method and vice versa, and therefore combining the two might encompass more information. A frequentist rationale for combining forecasts would be that all forecasts are subject to errors. The standard error of a parameter estimated from a sample of forecasts would be expected to decrease with increasing sample size (increasing number of forecasts), by the central limit theorem. Clemen (1989) reviews literature on combining forecasts and concludes that empirical evidence supports reducing forecast errors by combining forecasts. In a world of uncertainty, even if there is a "true" model (Box asserts that all models are misspecified, Kennedy, 1993), one will not be able to tell which is the true model. Like results of investment strategies followed by mutual funds managers, performance of forecasting models depends upon states of nature--there is not likely to be "one best" model for all possible outcomes.⁵

Combining forecasts is of interest in office market forecasting because there are likely to be diverse forecasts by various property companies, academic modellers, forecasting firms, and government agencies. Moreover, there are some incentives for biased forecasts, possibly even for opposite biases. An analyst speaking for building owners might forecast lower rents to preclude oversupply, while an analyst for agents might want to "talk up" the market to increase sales and prices. So combining forecasts might average away biases as well as random errors if forecasts are from diverse sources.

Measurement errors remain a daunting problem in office market research. Davidson (1988) in a discussion of commercial lease negotiations states that "The stipulated rent is not necessarily the most important aspect of a real estate lease. The lease is

⁵ For example, a portfolio strategy heavily weighted in bonds will do well if interest rates fall. A model including a forward lag of employment might do well if employment dramatically changes in the forecast period but not if some other variable moved the office market (eg. financial deregulation).

not merely a document setting the price of occupancy (rent), it also lays out various aspects of use of the property and allocates risks of various future occurrences or hazards. When terms other than rent change, the price of the property changes. This means it is not always easy to determine the price of space, especially in international comparisons because customary lease terms may vary.

5.2.4 Demand Models

An early study of office demand (Alderson & Sessions, 1950) used Census data disaggregated into categories classified on the basis of percent of employment in offices, forecasting office demand in planning sub-areas of Philadelphia by a regression based forecast using GDP projections. (Equations not reported.) That is, past growth in disaggregated sectors was updated using an aggregated GDP forecast.

This is a forerunner of David Birch's "corporate demographics" approach which uses large data bases disaggregated to the firm level and projects future employment in offices by projecting recent experience forwards. Like Birch, Alderson and Sessions used size of establishments as well as SIC codes as predictors of growth. Essentially if an area has a high percentage of fast growth type firms, we project fast demand growth in that area. This study is of historical interest as it discusses a major trend in U.S. cities--the exit of manufacturing operations from central cities and their replacement with white collar operations, initially, during the 1950's largely in small, buildings.

Howland and Wessel (1994) combined U.S. Census "TIGER" files with a local inventory of office space for a suburban Maryland county allowing a disaggregated examination of office employees at each address by type of firm. Simple extrapolations based on this detailed data, according to these authors, were superior to econometric estimates of aggregate demand change.

In contrast to the above two papers, and Birch's "Cognetics, Inc." forecasting, most academic literature uses more aggregated data to explain and forecast office demand. Wheaton and Torto (1988) found that "in the short run, cyclic movements of the economy can effect net absorption of office space far more than the simple changes

in employment would suggest.” Long run service sector employment--office using employment--has increased faster than employment in manufacturing (virtually unchanged since World War II).

Benchmark descriptive statistics are quite useful in understanding office markets: It is pretty easy to see that if absorption is 4% while construction is 6% of stock, vacancy will increase. Markets should use key ratios ($\Delta S/\Delta D$, $VAC/\Delta D$, $VALUE/COST$, etc.) more in assessing and tracking market conditions.

Malizia (1991) mentions a “less than outstanding” demand forecasting effort by the U.S. Bureau of Economic Analysis (OBERS). They forecast 2.3% employment growth during 1985-1990 in 93 U.S. metropolitan areas. Actual growth was 3.6%, 1.5 times greater, while standard deviation of the series during the forecast period was 2.5 times the forecast standard deviation. Correlation between actual and predicted growth was 0.53.

Malizia maintains that using aggregate national growth forecasts to predict demand growth in metropolitan areas may be reasonable in the short run (1-2 years) but fails in the longer term to account for different regional outcomes. Analysis of the factors contributing to metropolitan growth is required for demand forecasts with time horizons useful for office market developments (4-5 years). He suggests “diversity, productivity, innovation, resilience, and centrality” as factors contributing to regional comparative advantage. Such factors can be proxied by variables such as educational levels of workforces, etc. However, even after addition of regional dummies (rustbelt, sunbelt) these cross sectional models explained less than half of the variation in regional employment growth rates.

Perhaps the important point is that different cities “make their livings” in different ways, so that a local scenario analysis or case study approach is helpful. Graaskamp’s idea of using time and space specific analysis helps one make more

powerful forecasting models, although such historical economics approaches can not be generalised to other situations.⁶

Nourse (1992), in a qualitative study, surveyed firms regarding their office space selection process. He found time lags and ad hoc decisions, suggesting firms did not do a very good job of anticipating space needs and leasing space on a “just in time” basis. The processes Nourse documented would seem to disconnect space acquisition (leasing) from employment changes so that these would come at different times. Demand side lags in office markets are a topic that deserves further research.

Archer and Smith (1992) found segmentation between suburban and downtown Florida office markets. They also describe a “filtering” process. As buildings age their rents and types of tenants shift downwards. Rents for twenty year old structures were less than half rents in new structures. Location, building age, and building quality all contribute to segmentation of supply, with corresponding association to demand market segments.

In a 1992 paper, Clapp, Pollakowski, and Lynford examine intra-metropolitan location decision’s impact on office demand. They summarise previous work at the national or metropolitan level as:

“New office construction depends on the lagged vacancy rate and lagged indicators of expected demand.”

“Absorption depends on employment, rent or lagged vacancy rates, and expected demand.”

“Change in rents depends on the deviation of the vacancy rate from its optimal or natural value.”

Although the theory is unarguable, I am not sure that these are so unambiguously demonstrated by empirical work.

⁶ Graaskamp operated a consulting firm which undertook individual project feasibility studies and valuations by means of time and space disaggregated models.

With respect to intra-metropolitan location (read CBD vs Suburban) issues are “agglomeration economies (notably face to face contact), transportations linkages, access to employees, building characteristics, property taxes, lease terms and architectural amenities.” (Note: I would add “prestige” and “access to clients” and “parking” based on surveys of Perth tenants.)

Clapp, Pollakowski, and Lynford add “zone variables” to demand, supply, and rent equations and subscript the dependent variable to reflect different zones in the metropolitan area. Using Boston area data they find much faster growth (13.4% p.a. vs 5.7% p.a.) in suburban locations in comparison to the central city. Their models did not have high R^2 (less than 0.50). They found clustering of industry types in particular areas.

Analyses of submarkets and relationships between submarkets in terms of rent differentials, willingness of market segments to shift to different locations or grades of buildings is an area for more research following the lead of this paper.

Clapp (1993) argues that employment must be closely related to demand in the long run, but that in the short run demand can be pent up by lack of space or future demand can be accommodated by leasing extra space. These adjustments show up as changes in space per worker. He reports that FIRE employment is housed 95% in offices and comprises 40% of office demand. Shilton (see below) however, points out that the latter figure is variable across cities. Rosen (in Clapp, 1993: 163) reports that U.S. office employment grew by 6.4% annually from 1970-1980, by 2.9% from 1980-1990, by 2.8% from 1985-1990, and projected at 2.0% from 1990-2000. Rosen also says space per worker declines with growth and increases in recessions, a function, no doubt, of leases not allowing employers to change space held as quickly as number of employees.

BOMA office market conditions reports document negative demand growth during recessions in Australian cities as well, particularly during 1990-1992. A practitioner’s article (Powers and Hunter, 1994) mentions that Florida non-farm employment declined 5.6% during the 1975 recession, leading to negative absorption

of office space. They also report that “Once capital market sources accepted 5-6% vacancy before “allowing” another round of construction, while by the 1990s “that tolerance level is closer to 10-12%.” They point out that investors consider income (cash flow), appreciation, and alternative opportunities (tax benefits omitted from mention). They note that in Florida a new category of space “low grade office-industrial “flex space” was having a significant effect on office markets. This is an example of an innovation that may change market structure, in this case by reducing costs and hence equilibrium rents.

McClure (1991) compared demand forecasting results for Boston. He found Wheaton’s model predicting demand growth from vacancy (lagged 2.5 yrs), office employment growth (lagged 1 year), interest rates, and office supply outperformed simple extrapolations based on average recent experience then in use by Boston planning agencies. However, this was not a fair test because he used ex post known predictors rather than forecasts of predictors in the Wheaton model. I do not understand why vacancy rates two and a half years ago should create office demand so this model seems a spurious result of data mining to me.

Shilton (1994) documents some of the difficulties in use of employment data to predict office demand. Percentage of office employment in the Census FIRE category varies between cities and over time. Office employment by county ranged in the U.S. from 17% to 46%--total employment does not drive office employment. Vacancy figures reported by different firms differ. Varied age of office inventory means different amounts of existing space will be retired in different cities. And differing patterns of lease expiry will also effect demand. And individual properties (leased during strong markets) will have returns quite different from average portfolio returns.

Shilton (1995) using ARIMA methods found “wide divergence in office employment trends across 51 U.S. cities and time.” Some cities’ employment showed cyclical patterns of expansion and contraction (AR2 processes), others “structured” short term predictability but no long term cycle, while others were

random walks. On a national aggregate basis, employment growth was stationary and cyclical.

Economic base was not related to type of employment growth pattern, but certain industry groups tended to show faster growth during the period. Of course, these are historical events that may not be repeated (growth in automobile manufacturing employment was high during the 1920s, for example, but not during the 1980s). Space per worker and construction responses differed between cities. Average supply lags ranged from 0 to 4 years in different cities, functions, Shilton speculates of developer conservatism, public approval processes, and finance availability.

Shilton estimated equations to explain mean vacancy rate as a function of standard deviation of total employment, standard deviation of change in office worker employment, and square feet per worker (adj. $R^2= 0.93$, df 22, cross sectional data from U.S. cities). Standard deviation of vacancy rate was explained by standard deviation of total employment change, standard deviation of office worker change, and lag in supply response. In each case several other variables were tested and found not to be significant. (See appendix.)

The upshot of Shilton's two papers is to see office market processes as varying across time and space with no inevitable structure or pattern. As Shilton puts it "the vista of cycles reveals a blurred Monet like landscape."

Malizia and Howarth (1995) also advocate a disaggregated approach to market analysis, mentioning segmentation, local economic outlook, regulatory issues, and specific market conditions such as re-leasing requirements, etc. Project characteristics must be compared against competing projects. Supply is heterogeneous.

Mike Miles (personal communication, Nov. 1996) suggests that we should think about "What can go wrong with forecasts at three different levels, national, regional, and individual project." The point is that different issues affect demand at these three levels: Macroeconomic outcomes and tax policies at the national level. Particular industry sectors, commodity prices, or location decisions (Microsoft

chooses Seattle) at the regional economy level. Demand for individual projects depends on national and regional demand influences (the tide that raises or lowers all ships), and upon its own quality and price, competitive supply, marketing and management.

Hargreaves (1996) surveyed a panel of experts to provide a leading indicator of leasing intentions and property results. Surveys of decision maker and expert perceptions of current trends may prove to be an important way to look ahead for a year or two through the forecasts of those active in the market. JLW uses a survey of leasing intentions or confidence as a predictor in its Sydney office market forecasting models.

Hanink (1996) examined national versus local effects on office vacancies with the important addition of suburban versus CBD data for each of 31 U.S. cities, quarterly data from March 84 to March 89. In the 1980s suburbanisation was a major U.S. trend with 2.5 times as much space constructed in suburbs as in central cities. There was also a major construction boom--half of all U.S. office stock was constructed in the 1980s. Hanink regressed local (CBD and suburban) vacancy rates on a lag of vacancy, national vacancy, and a city dummy. National coefficients were significant, while local dummies varied. When a spatially weighted (inverse distance) regional vacancy rate was included, the national variable disappeared and the regional effect was significant. Coefficients for suburbs differed from CBDs.

Surprisingly, this is the only paper I encountered that used spatial statistics. Hanink also mentions that the national component of office markets may have to do with national firms, while local components arise from local economic activities. This suggests one could sort out which cities would be more linked to the national economy by examining their economic bases.

Winger (1996) repeats a comment made by Shilton and Clapp, namely that face to face communication is a key factor in office demand that will not be made obsolete by new technology. The implication is that one should not expect a collapse in office demand due to technology.

In "Did Office Market Size Matter in the 1980s", Pollakowski, Wachter, and Lynford (1992) compared model specifications using pooled data for 10 years from 21 U.S. cities (210 observations). They concluded "for demand, rent-adjustment, and supply relationships, it is inappropriate to impose a single structure on all markets." Smaller markets were less easy to model as particular supply or demand issues could have a big influence. "The stage of the real estate cycle is clearly not uniform across markets." (p. 323)

5.2.5 Supply Models

A 1960 Real Estate Research Corporation "Central Area Office Space Study: Chicago, IL" makes clear how much office markets have changed since the 1950s. They report that 2/3 of office stock growth from 1945-1960 was from conversions and only four speculative offices were built. As in the Philadelphia planning study cited above, Chicago really did not recover from the building boom of the 1920s until the 1950s. Space built in the 1920s was not fully occupied until the 1950s. Having been burned so badly, there was little speculative construction before 1960 in U.S. markets. However, there were 29 "built for users" offices constructed during the period (R.E.R.C., 1962). This is a major difference from the post 1970 period which is dominated by construction of large speculative office buildings. These two older studies document structural changes in office markets that preclude using older data, even if it could be found.

Detoy and Rabin (1972), San Francisco market research consultants, pointed out that developers wish to build regardless of market research results or quality. Their demand forecasting method essentially sets forth identities based on employment forecasts, space per worker estimates, stock additions and removals, with some complications for temporary withdrawals for refurbishment.

A mystery in U.S. office markets is why huge amounts of construction took place in the late 1980s despite rising vacancy rates and falling rents. Kling and McCue (1987) cite tax laws, financial deregulation, and foreign investment as explanations. Supply lags also play a role. And expectations of inflation make construction

feasible despite current conditions. Because cities have different employment structures and growth rates, they second other authors (eg. Hekman) in the position that office markets are primarily local, not national.

The authors say in a footnote that “substantial time commitments and expense are generated even before a project begins construction...an investor may be reluctant to cancel a project regardless of forecast conditions.”

Ellson (1987) discusses one aspect of supply lags, zoning approvals delays, arguing that developers hold two kinds of land inventory--with approval and pre-approval land with different lags associated with bringing each into construction. Moreover, time lags are uncertain in each case, meaning the lag is stochastic.

Kling and McCue estimated a VAR including logs of office construction (monthly series), money supply, nominal interest rates, output, price levels, and two dummies representing tax law changes and financial deregulation. Monthly data covered the 1972-1985 period. Interest rates and the policy dummies were not significant, money supply, output, and prices were significant. They estimated a restricted VAR to test expectations 12 months ahead. No mention is made of unit root testing and one has to ascribe the results more to chance association with economic cycles rather than causation, in my opinion. Lag structures were not explored enough to build a convincing case for their model. On the other hand, if we believe that office construction is mainly driven by supply of finance as many experts assert, their model confirms this view. If so, one would seek to explain office supply independently of office demand through macroeconomic variables having to do with the amount of capital seeking investment opportunities.

Anthony Downs, a respondent at an Urban Land Institute conference panel on office oversupply in Europe and Japan, held in 1993 (ULI 1993), stated that lenders imperative to earn a spread on invested funds leads to office oversupply because underwriting standards slip as financial intermediary capital grows during a period of profitable operations. In essence, capital supply grows faster than office demand

(perhaps 8% versus 2%), leading eventually to more capital seeking investment opportunities than can be supported by the level of demand.

Eppli and Shilling (1994) use capital stock of commercial property as their dependent variable and estimate a stock adjustment model, $K_t - K_{t-1} = \delta(K_t^* - K_{t-1})$, with K^* estimated from quarterly employment data: $K^* = \text{employment}$. Substituting, their stock adjustment model becomes: $K_{it} = \delta b_0 + \delta b_1 \text{EMP}_{i,t} + (1-\delta)K_{i,t-1} + \delta e_{it}$. For office markets they found the adjustment parameter (δ) to be 27% per quarter. From this they conclude that quantity adjustments to demand shocks take about two years in office markets. Slow quantity adjustment suggests volatile prices or boom and bust cycles.

March (1988) notes that developers may have “learned” to be risk takers due to successes of previous projects.

Graaskamp (unpublished lectures on feasibility analysis, 1988) emphasised several important aspects of what he called “the real estate process.” Development proceeds under institutional and market constraints which developers negotiate through a series of decisions and contracts. Contrary to a finance point of view that risk and reward must be traded off, developers seek through contracts to obtain rewards while allocating risks to others. Moreover, each project expenditure is a potential profit centre to developers, so they frequently profit even from projects that fail financially. Obviously developers incentives differ from investors.

Whipple (1988) outlines procedures for “evaluating development projects.” Essentially no parsimonious representation is possible because many details can prove decisive as to whether a project proceeds. At a project level of analysis, details matter in the search for positive net present value. Sivatanidou and Wheaton confirm this point of view with respect to land prices by demonstrating how spatially varying parameters and their interactions create much complexity in understanding land prices.

Brueggeman (1993) found that lenders are unlikely to recommence commercial lending until existing portfolios of problem loans have worked their way through

balance sheets. The adjustment process is relatively slow perhaps 2 to 5 years. This leads to an undersupply scenario if a major property bust is followed by a brisk recovery.

Keogh, McGough, and Tsolacos (1995) review earlier papers including Barras (1983) who suggested development cycles based on accelerator approach to building investment, combined with construction lags. Length of delay between order and completions, rate of adjustment to user demand, and rate of depreciation of buildings would generate the cycle. In several papers cited (Rosen, 1984, Wheaton 1987) interest rates and construction costs were not significant in supply equations. Pollakowski, et al. (1992) however, found supply explained by operating and construction costs lagged three years. Keogh et al. (1995) found “there are institutional factors which may result in the use and investment markets in property tracking independent paths.”

Keogh et al. (1995) assert that supply is not equal to new additions to stock, nor to total stock, but rather is “space on the market.” (They do not say, but by analogous reasoning, demand is not space takeup or leased space, but tenants looking for space.) However, they end with an equation using change in office investment as a proxy for supply change, regressed on rent lagged one quarter and capital values lagged two quarters.

Lusht (1988) titled an article “the real estate pricing puzzle” claiming lower risk and higher return than alternative investments. He says non-systematic risk may be higher in property, with attention to individual leases and tenant quality required to evaluate risk. Since price setting involves “different expectations and sequential bidding” price setting is “a probabilistic exercise, with some degree of inefficient pricing.” I believe subsequent events and research have convinced investors that real estate does not have higher returns and lower risk (variance of returns).

JLW Advisory authored a 1992 report on forecasting office market yields as a function of inflation rate, lag one year 10 year bond rate, interest rate differential (10 year bond minus 90 day T bill rate, a proxy for inflation expectations), all industrials

dividend yield (lagged one year, annual real rental growth (negative coefficient), and lagged yield (lagged six months). Lagged yield and real rental growth were most important regressors. Perceived risk, they argue, is related to inflation rate. Rental growth expectations reduce required yield and therefore raise property prices.

Ling and Naranjo (1995) identify growth of real per capita consumption, the real T-bill rate, the term structure of interest rates, and unexpected inflation as fundamental variables that affect real estate returns. This multi-factor asset pricing model uses return on the i th asset in excess of the risk free rate (eg. the risk premium) as the dependent variable. Risk factors are unanticipated components of the state variables listed above. This is one of the papers that does not find abnormal returns in real estate.

Grenadier (1995) combines game theory and options theory to assert that oversupply of offices is a rational outcome of developers' profit maximising behaviour. This point of view conflicts with explanations of oversupply due to mistakes--poor forecasting or prisoner's dilemma--or malfeasance (agency conflicts). Grenadier begins with the idea that each building owner has an existing income stream plus an option to redevelop. Value of each depends upon development decisions of other owners. When a development proceeds, rents will fall on existing buildings while the new property may earn monopoly profits due to higher quality. Correct amount of construction is an "equilibrium in stochastic stopping time game." (p. 3). Development cascades are more likely in volatile local economies (eg Houston), with newer stocks of existing property. It pays a developer to proceed in a "recession induced construction boom" in order not to be pre-empted. Grenadier cites Wheaton's estimate of construction lags as 2.5 to 5 years, depending upon speed of planning approvals.

Although the mathematics is lovely, there is no data used to test these models and the assumptions seem arbitrary to me. A finance colleague informs me that one never invests intending to lose money, regardless of option values. One would prefer to be pre-empted from losing money. Grenadier's assumptions seem to add up to: developers decide to lose hundreds of millions. Grenadier's game theory

framework does not explicitly define the rules of the game--that is, when actors know others actions and payoffs. It strikes me as difficult to argue that these markets remained near equilibrium and everyone acted rationally--regardless of what one assumes about option values. And what about demand side strategic behaviour. Pre-emptive building to obtain monopoly profits can surely be foiled by firms choosing to wait to lease until competing buildings are finished--as they did in Perth in 1990-91.

My own 1995 paper (chapter 3 is a revised version) is a qualitative study of Perth, Australia's most recent oversupply cycle. A list of 16 explanations were collected from office market participants. These included "capital market driven," prisoner's dilemma, agency ("fee driven deals") or moral hazard, institutional changes (financial deregulation), and poor forecasts. I suggest that all of these may have played a role, with some synergy between them. An important insight was that projects achieve so much momentum in their early stages that, like docking ocean liners, it is hard to stop them. The project manager for a major project put it this way: We knew there would be oversupply but by that time we had \$108 million in the ground and it would have cost \$20 million to "cap" the project. Given these certain losses if we didn't get ahead, we had to ask "When would be a better time to proceed?"

Cole and Eisenbeis (1986) studied principal-agent conflicts in the 1980's savings and loan losses in America. Their data gave evidence of three types of principal agent conflicts which contributed to the approximately US \$150 billion in taxpayer funding of deposit guarantees to failed S&Ls. They cite several other papers drawing similar conclusions.

Hendershott (1996) provides evidence of a bubble in the Sydney office market. He calculates equilibrium or "fundamental" values of properties from rents estimated from his rent adjustment equation and vacancy rate estimates. Valuing properties with these equilibrium rents gave values about 1/3 below market values during the late 1980s. Hendershott concludes there was a speculative bubble in the Sydney

office market. The rent adjustment equation used is his deviation from equilibrium rent and vacancy plus a lead of vacancy rate change mentioned above.

5.2.6 Hedonic Models

Brennan, Cannaday, and Colwell (1984) present an hedonic model of Chicago office rents incorporating 10 variables. Individual leases, with rents adjusted for presence of various clauses, are the source of independent variable (rent) observations. Variables explaining rent are size of leased premises, "stop" (the level of expenses above which tenant is required to pay increases), CPI, vertical location in building, size of building, loss of space due to building design (unusable space), base year rent escalation, distance from LaSalle street along east-west axis, distance from Madison St. along north south axis, dummy for properties east of LaSalle. Several other variables were tested and not found significant. This equation "explains more than 90% of variation in the log of rent." One wonders about issues like market segmentation--do all tenants share the same hedonic preferences? How stable are these preferences over time? During the past three decades about 3 million people have moved to Chicago's Northwest Corridor with considerable office development outside the CBD. Does this model explain Sears' move to the suburbs, for example?

Peiser (1987) estimated determinants of non-residential land values as site characteristics (size, slope, soils, etc), macrolocation (location in urban area), microlocation (location on block), development expectations (use and density), neighbourhood characteristics (income, median rent, etc), and macroeconomic and financial conditions. Average prices for office land ranged from \$9/sq. ft. to \$85/sq. ft. in his sample. With 21 candidate variables, and 4 specifications reported only 68% in land price variation was explained. This suggests pricing is necessary at a more disaggregated individual parcel level due to heterogeneity of product.

Frew and Jud (1988) present models providing some conceptual linkage between hedonic models at the individual building level and the market aggregate models in other papers. They see vacancy rate in a particular building as a function of rent, characteristics of buildings and sites X, and other economic and demographic

factors, Z. At the individual building level, with tenants able to shift to competing buildings, demand is extremely sensitive to price--in contrast to the earlier aggregate papers that find aggregate demand to be price inelastic. Frew and Jud's rent prediction model includes: vacancy rate, distance from CBD, age of building, number of floors, commonspace (a measure of building amenity), location adjacent to a major highway.

While this list of variables sound like a reasonable list for Greensboro, NC, like all of the other hedonic models, it seems to me the method is backwards. One should find out from tenants what they look for through surveys or other qualitative methods, then estimate. What hedonic modellers tend to do is find countable items to put in models, regardless of whether tenants care about them.

A 2sls method was used and linear, semi-log, log linear, and square root transformation were tested. White's heteroscedasticity adjustment was used in estimation. A square root specification with two stage least square was their preferred model. The log transformations were rejected by a likelihood function test.

The authors tell a story about new building owners setting rents high at first to test the market (thus explaining high vacancies in new buildings). I do not find this credible after seeing new building owners cut prices to obtain tenants in Perth. A more credible account of new building vacancy is to simply recognise that there is a time lag involved in leasing a new building.

A 1992 article by Posner points out the diversity of rents and rent variances between U.S. cities. It discusses how landlords and tenants attempt to hedge against risks of getting locked into above or below market rents by means of various lease provisions to escalate rents, etc. In a sense, one does not know the true cost of such provisions *ex ante* because their value is conditional upon subsequent market conditions.

Shilton (1993), in what must have been a slightly tongue in cheek modelling effort, explained 61% of the variance in disparities between reported vacancies from

different firms, through a model based in information theory. Since information is perceived as both a cost and a benefit, firms may be more forthcoming with information under some market conditions in comparison to other market conditions. The bottom line “less divergence should be expected in larger markets with lower vacancy rates” is less important than the fact that the data problem in real estate is not merely a matter of finding technical solutions that will give greater precision. Good information requires institutionalising unbiased means of collecting and disseminating information.

Archer and Clapp (1995) estimate hedonic rent and vacancy equations using cross sectional data on individual buildings. Rent is estimated as a function of demand factors: structure characteristics (S), location characteristics (L), tenant features (X, and a “risk allocation index” (p) summarising lease provisions allocating risks to landlord or tenant. Vacancy in a building is estimated as a function of landlord’s assessment of market conditions (MV), landlord’s assessment of future period rental opportunities (F), and landlord’s assessment of quality of space (Q) (ie user willingness to pay).

5.2.7 Office Markets and the Macroeconomy

It seems possible that macroeconomic cycles are due, in some cases and in some measure, to commercial property market cycles, just as in most cases it is clear that property cycles ride upon economic output and finance market cycles.

Hendershott and Kane (1992) provide a good description of the extent of office oversupply in America during the 1980s. \$470 billion (U.S. 1991\$) of commercial construction was put in place during the 1980s, compared to \$300 billion in the 1970s. This led to office vacancy rates over 20% in most major cities. Direct losses, calculated based on present values of below equilibrium rents are were estimated at \$130 billion. The problem is ascribed to “lender frenzy” brought on by misguided government policies (deregulation and tax laws favourable to real estate).

Ghosh, Guttery, and Sirmans (1995) demonstrate that the collapse of Olympia and York, the world’s largest office developer, brought about through failure of the \$5

billion Canary Wharf development in the London docklands, affected the shares of banks directly exposed, and by contagion, all banks. Assuming approximately a 10% minimum capital ratio, \$1 of capital writedowns due to non-performing real estate assets means a \$10 contraction of the banks assets (ie reduced lending). This means the \$3 billion capital writedowns due to non-performing property investments in the portfolio of a single Australian private bank during 1992-94 would have accounted for removing \$30 in loans from the economy. Australian average GDP growth averages on the order of \$30 billion per year.

A question which I did not have time to examine carefully but which is quite important to models assuming office markets are driven by exogenous macroeconomic growth, is the accuracy of macroeconomic forecasts needed to drive conditional forecasts of office markets. West and Fullerton (1996) found macro forecasters using regional structural models driven by national macro models did considerably better in quarters 1-5 compared to four other methods, and errors were still 90% or less of other methods in quarters 6-10. Historical mean and ARIMA methods were the runners up. But this comparison does not answer the interesting question of the absolute magnitude of forecasting errors or percentage errors in forecasts. This issue is left for future research, but is quite important for practical applications.

I have omitted from this review over a hundred sources such as newspaper clippings, property company reports, State Planning Agency projections, consultants reports, economic forecasts, and so forth collected over 1992-1997. Much more emphasis would be placed on this ephemeral literature in a specific market forecast.

5.3 Summary and Reflections

The following seem to summarise the “received view” of a simple set of office market equations (R=rent, S=supply, D=demand, V=vacancy, EMP=employment, CONST=construction cost, INT=interest rate):

$$V = S - D$$

$$V^* = \Delta D, -\text{CONST}, -\text{INT}$$

$$R = V, \Delta D, -\Delta S$$

$$S = R, -\text{CONST}, -\text{INT}, V$$

$$D = \text{GDP}, \text{EMP}(\text{especially office employment}), -R$$

In all these equations, lags of the dependent variable are among the better regressors. Heterogeneity of buildings, cities, time periods, and macroeconomic cycles as well as the low quality and quantity of data makes econometric modelling difficult to relate to the industry practitioner's problem of whether to invest in a particular office project at a point in time. In hindsight, for example, one can suggest three different causes for the three office cycles since 1970. The first oversupply, in about 1975-77, may have come from the 1973 oil price shock which pushed world growth down. The second oversupply in 1983-84 could perhaps be traced to the U.S. Federal Reserve's anti-inflation, monetarist oriented tightening in 1980 which raised interest rates to record levels in the U.S. and raised unemployment. The late 1980's construction boom, leading to the oversupply of 1990-96, probably was exacerbated by financial deregulation during the 1980s. If each cycle had different causes, this suggests that ahistorical equations like the above cannot predict system behaviour very well. Upon reflection, several criticisms can be made of this literature's paradigm of inquiry.

1. Implicit assumption of process time invariance. As just noted, changing historical circumstances mean that these "designed systems" as Simon calls them, may not be well approximated by time invariant parameters and specifications.
2. Simple models may not capture the complexity of system relationships. Gordon (1991), Forrester (1991), Senge (1990), Casti (1993), and others point out that human behaviour is complex. Certainly institutional structures which influence office market outcomes are complex and change over time.

3. Overreliance upon or mis-use of “theory.” Economists use the word “theory” differently than other investigators. To scientists from the time of Sir Francis Bacon, “theory” means generalisations supported by empirical evidence and established by inductive proofs. Economists, on the other hand, use “theory” in a more pre-scientific or Aristotelian sense of “first principles” or axioms from which everything can be proved deductively regardless of empirical evidence. No economist will abandon the negatively sloped demand curve just because office demand increases when rents rise.⁷ Because economic theory is not closely tied to evidence, there is little reason to expect such “theory” to be empirically valid. A second reason for theory’s impotence is the ubiquitous lags on both supply and demand sides of office markets which disconnect fundamentals from market responses in time. Even if we were sure that a vacancy increase would reduce price, we would not know exactly when and we could imagine “when” changing as markets learn from experience.
4. And all models are underspecified due to difficulties of measurement and lack of data. This problem, in my opinion, is impossible to solve because of process time variance which means longer samples may not be relevant and because so many variables are difficult to measure.

With a few exceptions (Grenadier, 1995), the literature does not ask why office oversupply occurs, and so does not provide insight into solving this problem. System redesign to improve market efficiency is not an explicit issue in the literature. The positivist empiricist paradigm aims to observe and understand, not to change and improve. Nevertheless, rapid progress is being made and there are several directions indicated for future research:

There are few papers so far that incorporate modern time series techniques. Since equilibrium relationships must hold true (my core belief shared with economists), error correction specifications are likely to be fruitful. This would help a) solve

⁷ Lakatos, 1970, called such beliefs “core propositions” and claimed every paradigm is forced to begin with certain such unverifiable assumptions. When core propositions clearly fail empirical tests, a paradigm shift may occur if a more successful approach can be found.

misspecification problems, b) avoid spurious models, and c) eliminate simultaneous equations bias.

One shortcut to improving data is to use these equilibrium relations to quantify the connection of office demand and supply to macroeconomic variables for which there is ample data. Supply models could probably make more use of financial markets data, particularly issues related to the supply of capital for office investments. Demand models could be linked more cleverly to macroeconomic data such as employment and output. Perhaps the best forecasting models of office markets could be estimated without using office market data but instead the fundamental labour market and capital market variables from which office demand and supply are derived.

Perhaps the Census Bureau should collect information more specifically designed to answer office market questions as another solution to data limitations. Institutional changes have already taken place in Australia to provide better data. Vacancy data now provided by the Australian Property Council has been improved. Increased research by major property companies, notably Jones Lang Wootten, required creating new entities (ie JLW Advisory, Knight Frank Independent, et al.), hiring staff with quantitative analysis skills, and supporting data gathering efforts. More thinking is needed on new data generating institutional structures because there is still no unbiased data source with sufficient resources to assemble good office market data.

Forrester (1991) says we have more information in our minds than appears in numerical data. He recommends mustering “mental, written, and numerical” data. Obviously qualitative methods are required for the first two. There should be more dialogue between qualitative and quantitative methods, as each may inform the other and they are complementary. Qualitative research identifies hypotheses, quantitative research confirms or falsifies hypotheses. Qualitative methods or decision sciences methods may also be helpful for reintegrating the “bits and pieces” of quantitative research (Ken Lusht’s term) into a holistic pattern needed for decision making.

Dealing with simultaneity is another major theme for future research. Simultaneous equations methods (2sls, SURE, etc.) may prove informative as these are certainly simultaneous equations systems. Pooled time series data on different cities could be especially helpful in identifying national or international influences on office market behaviour. As mentioned VAR and ECM specifications also cope with simultaneity. System dynamic models (illustrated in chapter 7) are another means of tracking a mutually adjusting set of variables through a forecast period.

Use of simulation methods may be useful to examine effects of changes in system design (especially information flows) on office cycles. Simulation methods are especially helpful given the paucity of data which restricts the use of econometric estimation, and the importance of both supply, demand, institutional, and information lags in the system. These lags make it more difficult to apply economic theory to real data sets. Expectations similarly complicate life for the econometric modeller who wishes to rely on theory. A more useful result might be obtained by building a simulation model consistent with theory and ignoring the data from markets which may be out of equilibrium and irrational. Simulations can also help test the "system re-design" issues that seem likely to be keys to improving market efficiency.

Senge (1990), an MIT Sloan School of Management systems modeller, provides another important conclusion. He maintains that there is now too much information for any individual to master, so we must all specialise. The penalty is that we become too narrow to solve practical problems which cut across disciplines. If there is any single conclusion that seems most compelling to me after dabbling in the time series literature it is that office market research should ideally be a team effort with the team including at least three kinds of members: 1) practitioners, who will be able to tell us when our specifications are ridiculous or missing important features of the system, are the only source of data, and who must be able to understand the model for it to have effect in the real world, 2) real estate academics, who play translator, interpreter, and organiser roles, and 3) specialist econometricians, to get the statistics right. The rapid growth and change in the econometric literature and the real estate markets makes it very difficult to envision any other way to obtain

state of the art models of complex changing systems. Unfortunately, the next chapter contributes still more evidence for this conclusion.

Chapter 6 Econometric Models of the Sydney CBD Office Market

A pragmatist is willing to doubt everything, but not all at once.

Kevin Hoover

It is ok to let the data speak, but sometimes the data should be told to shut up.

Peter Schmidt¹

6.1 Introduction

Forecasts of rents during initial leasing are key information for office building commencement decisions. Long term leases crystallise market conditions during initial leasing into project cash flows for 5-10 years.² Vacancy losses due to lower than expected initial occupancy and slow leasing can never be recovered. Cash flows during early years of the investment weigh most heavily in determining the overall financial outcome due to discounting of later income.

Major Australian office buildings have required a 4-5 year planning and construction lag between land acquisition and project completion (see chapter 4). Framing the question as “what will rent be 4-5 years from now” simplifies forecasting. Rent level in year five serves as a proxy for “net discounted cash flows over the economic life of the investment” which is a better theoretical benchmark for decisions, but more difficult to estimate.

¹ Both quotes from “Pictures at an Exhibition: The Experiment in Applied Econometrics Conference, Tilburg, The Netherlands, 1996, a conference review by Michael McAleer, forthcoming in the *Journal of Applied Econometrics*.

² Typical office leases in Australia have been for 10 years. As moving is expensive, initial tenants are likely to remain in place beyond the lease term as well.

6.2 Theory

Supply, demand, and rents depend upon one another as endogenous variables in a simultaneous system. But irrational behaviour due to institutional defects in the system may divorce market adjustments from economic fundamentals. We have already seen (chapters 3,4, 5) that agency and game theory issues make it uncertain that markets will respond rationally. Expectations and multi-period (lagged) adjustments also divorce supply and demand responses from current fundamental conditions. Markets were clearly out of equilibrium during most of the last 25 years. This chapter therefore focusses on rent changes which probably do more closely reflect current market conditions.

Office vacancy rates are identified in the literature as a key variable affecting rent adjustments (Clapp, 1993; Wheaton, 1988; Hendershott, 1995). Vacancy proxies for relative supply and demand saving one degree of freedom through the identity $V=(S-D)/S$, where V is percent vacant, S is supply (lettable area) and D is demand (leased space). Landlords manage vacant space as “inventory for sale.” Tenants manage stocks of vacant space to accommodate growth as a factor of production. Both supply and demand sides may adjust their desired inventory holdings, thereby muddying the relationships between employment and current leasing activity (demand change) or new construction (supply change). The literature, however, finds so much variation in estimated equilibrium vacancy rates over time and between cities that James Shilling suggested “Maybe equilibrium vacancy is not a useful concept.”³

Office demand is a derived demand dependent upon exogenously determined employment and economic activity. Office demand depends upon variables such as incomes, the regional economy, the structure of employment (office using vs other employment), technology of workplace design, workspace ratios, information and communications technology. Dynamics of relationships with these fundamentals

³ Jim Shilling heads the real estate program at the University of Wisconsin and has published several papers on office markets which estimated equilibrium vacancy rates. The opinion quoted here was offered in a personal communication in 1995.

are confused by market expectations and by adjustment lags (between demand changes and lease expirys) which respectively advance or delay demand responses. There are both local and national components of office demand, supply, and rents (Hanink, 1996).

Office supply increases due to new construction net of demolitions, withdrawals for refurbishment, or conversion to other uses. Commencement decisions depend upon, in theory, expectations of positive net present values which are a function of land, constructions and other costs, finance costs, investor preferences, and assessments of project specific risk, as well as demand and prices--rents and property values (Graaskamp, 1981; Miles et al., 1996).

Rents for individual buildings vary from the local market index rent due to location, quality, management, tenants, and other idiosyncratic characteristics of particular buildings (Glascok, Sirmans & Corgel, 1989). Commencement decisions therefore are taken "one at a time" based on project specific projections of cash flows and evaluation of project specific risks. It is these individual project decisions which aggregate to oversupply, so improvement of system performance requires improving information for individual decisions.

Wheaton's "rent setting through negotiations" (Wheaton, 1988) view of market adjustments sees vacancy as a proxy for the relative number of tenants versus spaces on offer. When vacancy is low, tenants have few choices and must bid more to obtain space, while when vacancy rises, landlords cut their prices. There must be at each point in time an equilibrium or "normal" vacancy rate at which rents would not change. Wheaton found adjustments to equilibrium are not instantaneous, so a model including lags of vacancy is required.

6.3 Rent and Vacancy rate descriptive statistics and graphs

The data used here are Sydney Central Business District (CBD) annual data 1970-1995 from industry sources. The rent proxy is real net effective rent reported by property industry sources with leasing incentives amortised over the lease term. Hendershott explored rent measurement issues with Jones Lang Wootten (JLW) and

concluded that Australian rent figures are some of the most accurate obtainable, comparing favourably with U.S. data which do not take leasing incentives into account.⁴

Property companies take rents from a “basket” of Premium and A grade properties (top quality properties) and average among buildings, in some cases using leases from particular floors (eg. top 3 floors, bottom 3 floors) to standardise quality of lettable space. Net effective rents are found by calculating present value of leasing concessions, converting this to an equivalent annuity over the lease term and deducting from face rent. Leasing concessions were quite important during the early 1990s --Jones Lang Wootten estimated Sydney peak concessions equivalent to 56 months rent free for a ten year lease.

Hedonic models to account for quality changes over time and between buildings were not used in estimating the rents used here,⁵ nor were rents adjusted for option values and risks inherent in the numerous provisions of commercial leases such as renewal options, rent reviews, or for heterogeneous building locations and quality.

Reported vacancy rates are the percentage of the office stock not under lease at a point in time. Statistics are provided by the Australian Property Council (APC). APC figures are compiled annually and updated quarterly through the cooperation of property agents who provide information on leases.

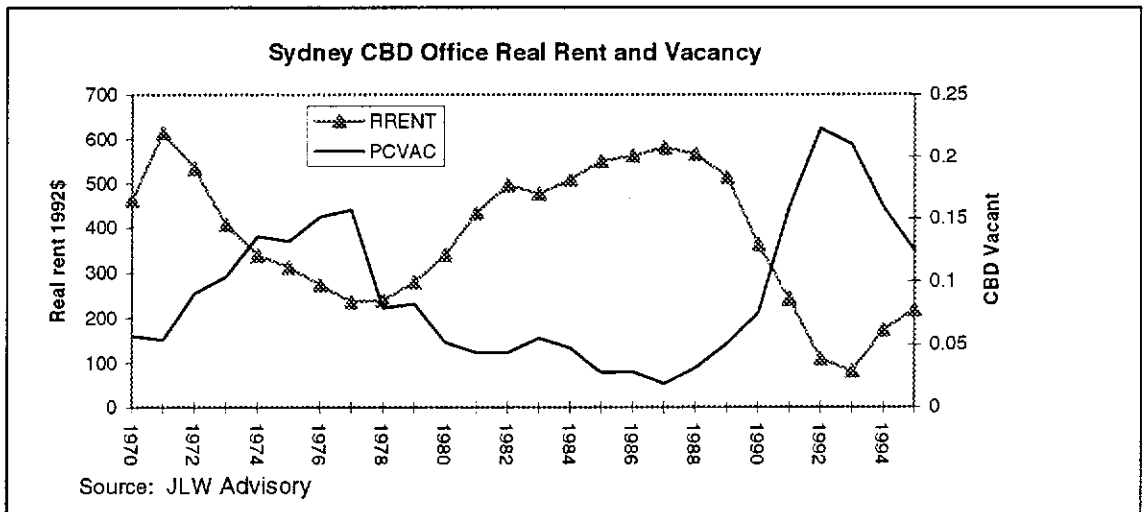
Leased space may not be fully utilised at times. BOMA surveys found up to 20% under-utilisation of Sydney leased space during the early 1990's recession. Customary office lease terms in Australia have been around 10 years, so companies may find themselves holding excess leased space during recessions when staff have been laid off. Companies may also choose to hold large inventories of unused space during boom times--especially if rising rents and rapid employment growth are considered likely.

⁴ Patric Hendershott is Galbreathe professor of Finance at Ohio State University. Some of his papers on Sydney office markets are cited in the literature review. Our discussion of JLW's rent index took place at the Pacific Rim Real Estate Society meetings in 1996.

⁵ Hedonic models of office rents are found in Brennan, Cannaday, and Colwell, 1984; Free and Judd, 1988; and Glascock, Sirmans, and Corgel, 1989.

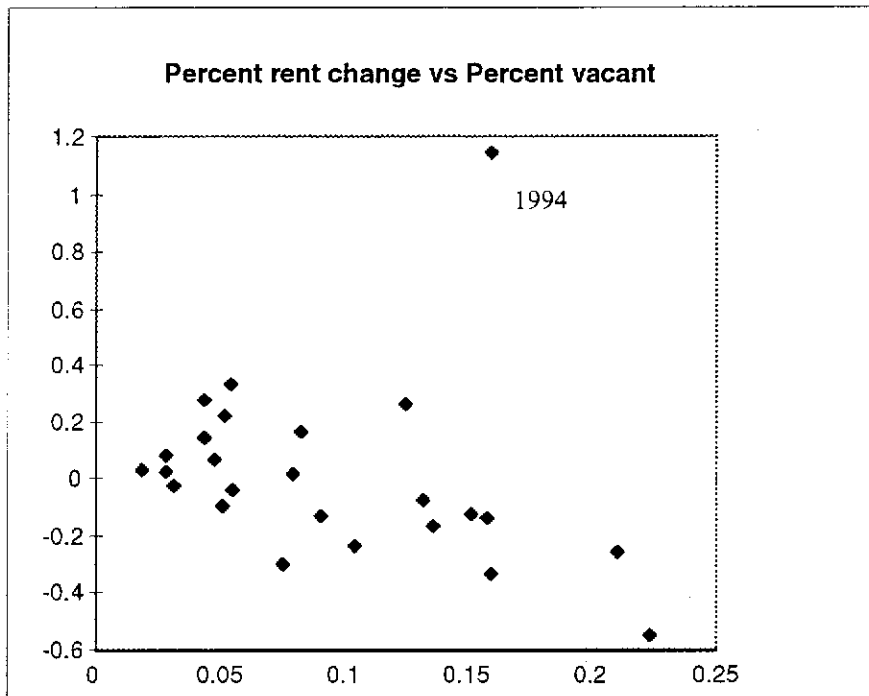
Sydney rent levels and vacancy rates have been strongly inversely related since 1970 (Figure 6-1). Rent levels may lag vacancy rate levels (inversely) slightly in time, but the relationship seems essentially contemporaneous--when vacancy increases, rents fall almost immediately. Major supply pulses coinciding with recessions raised vacancy rates and led to rent collapses in 1975-77 and 1990-1992. About two and a half office market cycles occurred during this sample period (Figure 6-1).

Figure 6-1 Sydney CBD Rent and Vacancy



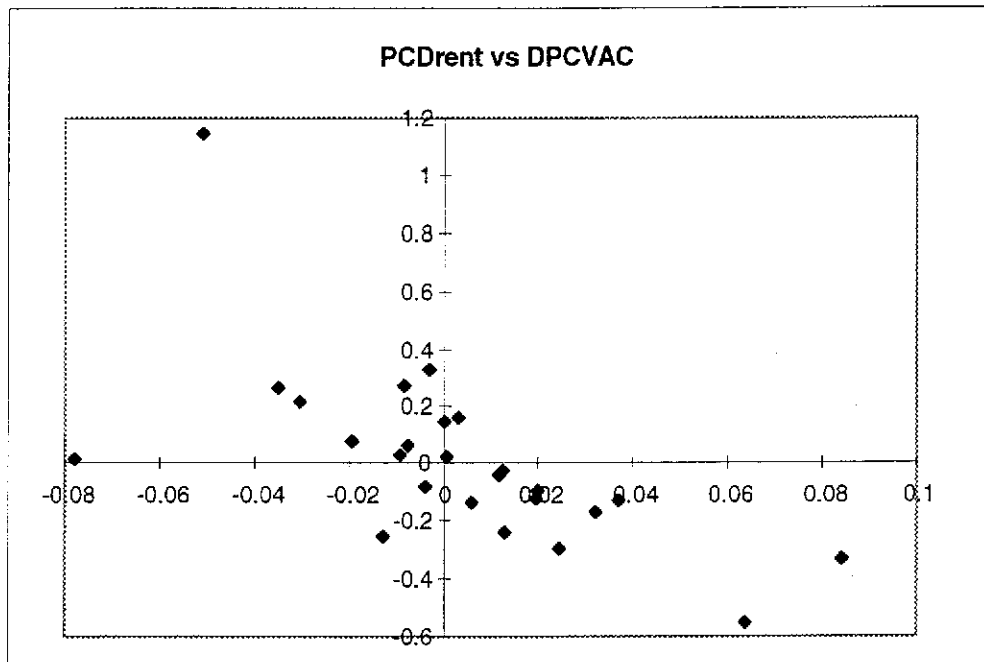
Percent rent change versus vacancy rate shows a generally linear negative relationship, with an outlier in 1994 when rents jumped a big percentage, but from a very low level (Figure 6-3).

Figure 6-2 Percent rent change vs percent vacant



A scatterplot of percent rent change versus change in percent vacant shows that in 25 years, there were only a few violations of the general principle that when vacancy rates are falling, rents are rising (Figure 6-4, quadrant II) and vice versa (Figure 6-5, quadrant IV). There were only 2 years when vacancy and rents both fell and 3 years when rents rose although vacancy was either unchanged or rose slightly. All of these "exceptions to the rule" were cases of points falling near the origin--ie small changes were involved.

Figure 6-3 Percent change in rent versus change in percent vacant



Average real net effective premium grade CBD rent (in 1992\$) for Sydney over this period was \$378. Average vacancy rate was 0.094. During 1970-1995 Sydney Central Business District (CBD) vacancy ranged from less than 2% to 22%, while real rent varied from \$80 per square metre per year to \$615.

Table 6-1 Descriptive statistics for rent and vacancy

Variable(s)	RENT	DRENT	PCRENT	PCVAC	DPCVAC
Sample period 1971 - 1995					
Maximum	615	152	.533	.223	.084
Minimum	80	-152	-1.24	.019	-.078
Mean	378	-9.77	-.074	.094	.003
Std. Deviation	158	77.2	.334	.059	.033
Skewness	-.192	-.070	-1.59	.648	.076
Kurtosis - 3	-1.15	-.538	4.19	-.654	.985

Real rents varied during the sample period from 1.6 times mean rent to 0.22 times mean rent. Vacancy varied from 2.4 times average to 0.20 times average. The

Sydney office market apparently spent much of the sample period far from equilibrium.

Average real rent over the 10 year period to 1995 was \$341. Average rent over the 10 years to 1990 was \$505. Even with 20 years of data, shifting from a sample ending in 1990 to one ending in 1992, for example, reduces mean rent by \$40 (Figure 6-6). Such shifts may represent samples from different parts of the office cycle (eg. ending at a cyclical low in 1992), or could show a permanent shift in mean rents.⁶

6.3.1 Testing Real Rent and Vacancy for Stationarity

An Augmented Dickey-Fuller (ADF) test of the real net effective rent series rejected the unit root null is at lag one, but not when additional lagged terms are added. ADF statistics are similar with and without trend, so a deterministic trend is not present.

Table 6-6 Unit root tests for RENT

Statistic	Observations	Without trend	With trend
Sample period		1971 - 1995	
DF	25	-1.04 (-2.98)	-1.18 (-3.60)
ADF(1)	24	-3.23 (-2.99)	-3.00 (-3.61)
ADF(2)	23	-2.01 (-3.00)	-1.94 (-3.62)
ADF(3)	22	-2.65 (-3.00)	-2.50 (-3.63)
ADF(4)	21	-2.47 (-3.01)	-2.28 (-3.64)

95% critical values in brackets.

The ADF1 regression (1972-1995) passes diagnostic tests (Table 6-7). Coefficient t-statistics and probability values are reported, p-values only are reported for diagnostic statistics.

⁶ Why do we use language like "permanent" in markets where nothing is permanent? From a developer's point of view, a temporary cyclical low for two or three years will be enough to cause bankruptcy in most office developments. Discussion of series behaviour at $t=\infty$ seems overly idealistic.

Table 6-7 ADF1 regression: DRENT on Rent(-1) and DRENT (-1)

	DRENT
INTERCEPT	79.8
	2.67 (.01)
RENT (-1)	-23
	-3.23 (.00)
DRENT (-1)	.64
	4.43 (.00)
\bar{R}^2	.48
Serial correlation	(.108)
Functional form	(.223)
Normality	(.441)
Heteroskedasticity	(.900)

Some readers may appreciate some explanation of the statistics reported in this table.

\bar{R}^2 is adjusted R^2 , the coefficient of determination, a measure of “fit” between model and data which ranges from 0 to 1. It is the percent of variation in the dependent variable “explained” (accounted for) by the independent variables, so higher (nearer to 1) mean better fit. The “adjustment” corrects for number of coefficients in the model (See Griffiths, Hill, and Judge, 1993: 343). Similar measures of fit (reported in some cases below) are the Akaike (AIC) and Swartz Bayesian Information Criteria (SBIC). The best fit is indicated when comparing models when these are minimised. It should be emphasised that “fit” is a sample property and does not guarantee external validity of the model.

The serial correlation, functional form, normality of errors, and heteroscedasticity diagnostic statistics test the validity of OLS assumptions required for model validity. Probability values (reported here, I omit the actual test statistic) less than .05 indicate rejection of the null, meaning there is a violation of the assumption tested by the diagnostic. Such models may have biased coefficients or less efficient estimates of

coefficients than would otherwise be the case. See Gujerati (1995) or Kennedy (1993) for discussion.

Statisticians define “stationary” time series to mean time invariant mean, variance, and covariances between lags $t, t-k$ (for all k) for all elements of the series from $t=0$ to ∞ . The meaning of “stationary” rent and vacancy in the office market context deserves further thought. Valuation theory (Whipple, 1996) suggests that long run equilibrium rents depend partly upon replacement costs of buildings and upon land costs which depend upon rents (a circular reference, not computable). Preferences, incomes, prices of other goods and services, and technology of production (in offices) influence the real price of office space. Increasing size of office buildings--a trend over the sample period--creates economies of scale, but also certain construction dis-economies (ie need for expensive faster lifts and heavier steel framing, footings, etc.). The few commencements since 1990 in Australia are all no more than 2/3rds the size of the largest 1980s projects so the trend to bigger buildings may not have persisted.

Rents collapsed during the 1989-1993 period and have been recovering since then. Probably the process mean, variance, and serial correlations are not constant across any particular five year forecasting horizon we might pick. Even twenty year rolling mean rents are not constant over time. Yet because we do not know the direction of changes in mean or variance, and statistical tests suggest there is probably not a trend in the data, stationarity can be adopted as a not exactly correct assumption.

One might model the processes as if they were stationary, given the likelihood of the process being “approximately stationary.”⁷ We can specify models that fit the historical data quite well. Violations of forecast error confidence limits are common, however, due to process changes. I do not see why one would not expect changes in the mean of the differenced series as well. But parameters and structure

⁷ The idea that a human designed process “is” one thing or another strikes me as a philosophical error arising from borrowing a metaphysics from the natural sciences--where processes do seem to “be” time invariant. Humans, on the other hand, if they do not like the way a process works, can choose to redesign it.

normally change only slowly across time as the economy evolves (barring major breaks like a nuclear war).

Percent vacancy unambiguously contains a unit root according to the ADF test (Table 6-8). However, although the unit root null is not rejected at any lag, with or without trend, vacancy rate cannot escape the bounds 0% to 100%. A negative vacancy rate is meaningless--0% vacant means space is fully occupied. And 100% vacant means all space is empty--so no more can be vacant. The mean of vacant is bounded, which could not be true of a unit root process. So, again, we may have a misleading small sample result indicating low test power rather than order of integration. This position is supported by inability to reject a unit root in the differenced PCVAC series as well. Certainly the graph of vacancy resembles behaviour very much like the inverse of rent.

Table 6-8 Unit root tests for variable PCVAC

	Sample 1971-1995		
Statistic	Observations	Without trend	With trend
DF	25	-1.43 (-2.99)	-1.42 (-3.60)
ADF(1)	24	-2.39 (-2.99)	-2.31 (3.61)
ADF(2)	23	-2.55 (-2.80)	-2.48 (-3.62)
ADF(3)	22	-2.42 (-3.00)	-2.30 (-3.63)
ADF(4)	21	-2.01 (-3.01)	-1.68 (-3.65)

95% critical values in brackets.

Graphs, the literature, and economic theory strongly suggest that rent and vacancy are strongly inversely related, despite the results of the ADF tests--rent I(0), percent vacant I(1)--which indicate there could be no long run relationship between the two.

The question is whether the process has a long memory. As a process gets noisier and sample size smaller, it becomes more likely the unit root test result is a matter of chance. Such processes should be called "disorderly" with process change expected over time. Makridakis and Wheelwright (1989:28) classify processes in this

fashion: "Forecasting a situation that is constant over time is very different from forecasting one that is in a state of flux. ...In changing circumstances, ...what is needed is a method that can adapt continually to reflect the most recent results and the latest information." The most reasonable conclusion is probably that both RENT and PCVAC should be thought of as I(0) but "slowly changing" structurally despite ADF test results.

Small samples mean any test statistic might be a result of chance. Were this an econometrics dissertation, additional unit root testing would be appropriate, including tests for structural breaks which have been shown to make it more difficult to reject unit roots (Perron, 1989). I take a different approach, modelling in both levels and differences and comparing forecast errors.

6.4 Rent Equations in levels

If rent and vacancy in levels are not stationary, models in levels may be spurious. But, even a spurious model may be useful for forecasting. In the 1970-1995 Sydney CBD sample, PCVAC explains .76 of rent variation but the residuals have serially correlated errors. ($p=.001$). Adding a lagged dependent regressor lifts adjusted R^2 to .91, does not suffer serial correlation, but has non-normal errors. Table 6.12--1. **Rent** shows that adding a second lag of rent raises \bar{R}^2 to .95 and, at the 0.05 level, the model passes diagnostic tests of regression assumptions.

Table 6-9 Rent models in levels

	1. RENT	2. RENT	3. RENT	4. SMRENT
Sample	1972-1995	1972-1994	1972-1995	1972-1993
INTERCEPT	257	233	237	166
	6.61 (.000)*	6.33 (.000)	6.7 (.00)	8.4 (.00)
PCVAC	-1067	-491	-978	
	-5.30(.00)	-1.71 (.105)	-5.38 (.00)	
PCVAC(+1)		-594		
		-2.45 (.025)		
PCVACSM (+1)				-1065
				-12.8 (.00)
SDUM			-49	
			-2.53(.020)	
RENT (-1)	.814	.822	.77	
	5.61 (.00)	6.06	5.96 (.00)	
RENT (-2)	-.253	-.193	-.16	
	-2.11 (.048)	-1.52 (.15)	-1.45 (.16)	
RENTSM (-1)				.79
				21.7 (.00)
\bar{R}^2	.95	.96	.96	.98
Akaike IC	-120	-113	-118	-98
SBIC	-123	-116	-121	-99
Serial correl. (F)	.33	.36	1.0	.27
Functional form	.10	.20	.07	.88
Normality	.10	.52	.49	.50
Heteroskedasticity	.94	.08	.77	.76

*T-statistic (p value)

A positive lag 1 coefficient and a somewhat smaller negative coefficient on lag 2 of the dependent variable creates a cyclical pattern from this AR2 specification.

6.4.1 Lead of vacancy as a regressor

Adding PCVAC(-1) to equation 1. **Rent** showed a lag of vacancy to have little effect and a very low T statistic (.04). On the other hand a lead, PCVAC(+1), was significant ($t = 2.4$, $p = .02$, Table 6.12--**2. Rent**). Market participants could use one year ahead vacancy expectations in setting current rents--it is easy to "count cranes" for projects under construction.⁸ As PCVAC and RENT(-2) are significant when PCVAC(+1) is not included, I would be inclined to prefer including them in a forecasting model despite low T statistics shown in the **2.rent** specification.

6.4.2 Rent on Supply Dummy

A dummy variable set to 1 for 1989-1992 is significant (T statistic -2.5, $p = 0.02$) in explaining rent (**3. RENT** in Table 6.12). Rationale for this dummy would involve financial deregulation from 1985 which turned on a flood of investment capital with the licensing of 20 foreign banks. The money was shut off from about 1989 by increasing vacancy rates and impending oversupply. Construction lags move the finance shock effects to 4 years after the policy changes.

6.4.3 Smoothing Rent and Vacancy

Equations using averages of three data points of rent and vacancy, that is $((t+1)+t+(t-1))/3$ show a high degree of fit. However, serial correlation of errors and functional form tests are failed by an equation with smoothed rent on smoothed vacancy and two lags of smoothed rent.. Equation **4. SMRENT** in Table 6.12 shows a simpler version (only one lag) with acceptable diagnostics and high \bar{R}^2 .

6.4.4 Forecasts

The effects of small sample errors and misspecification are shown by the instability of the parameters when five years are dropped from the sample and the equation re-estimated to allow a forecasting test. In the **1. RENT** equation, the PCVAC coefficient remains stable, -1058 in the full sample versus -1067 in a sample with the last five points (1991-1995) omitted. However, in the **2. RENT** model (which

⁸ Hendershott, 1996, provides Sydney estimates of forecast vacancy rates. The estimates during the early 1990s were not very accurate, but at least correctly forecast the direction of change.

includes a lead of vacancy rate) the PCVAC coefficient shifts from -837 to -491 when five points are omitted.

Table 6-10 Two forecasting equations for rent in levels

REGRESSOR	1. RENT	2. RENT
Sample	1972-1990	1972-1989
INTERCEPT	237	218
	5.39 (.00)	6.52 (.00)
PCVAC	-1058	-837
	-4.30 (.00)	-2.60 (.02)
RENT (-1)	.88	.82
	5.35 (.000)	6.83 (.00)
RENT (-2)	-.27	-.15
	-1.84 (.08)	-1.34 (.20)
PCVAC (+1)		-270
		-.93 (.37)
\bar{R}^2	.91	.96
Akaike IC	-96.34	
SBIC	-.98	-88.00
Serial correlation	.22	.46
Functional form	.318	.93
Normality	.045	.56
Heteroskedasticity	.83	.12

Despite the instability of the vacancy coefficient mentioned above, the forecast errors and standard deviation of errors are smaller in the model which includes a lead of vacancy (Compare Tables 6-11 and 6-12).

Table 6-11 Rent level forecasts on two lags and PCVACANT

Rent level on INTERCEPT, PCVAC, RENT(-1), RENT(-2)				
Sample - 1972 - 1990				
Observation	Actual	Prediction	Error	S.D. of Error
1991	242	245	-3.24	41.7
1992	108	116	-8.56	66.0
1993	80.5	49.7	30.8	80.0
1994	173	80	92.6	82.6
1995	218	162	56.5	82
Mean Prediction Errors				33.6
MAPE				38.3
SSPE				2561
RMSE				50.6
Predictive Failure				.63
Structural stability				.53

After 5 years, the **1.rent** model (two lags and pcvac) was out \$56 with st. dev. of forecast error \$82, while the **2.rent** model (two lags, pcvac,pcvac(+1)) was out \$72 with st. dev. of forecast error \$32. These results are not strictly comparable, of course, because the forecasts begin in different years due to the lag structures and hence begin and end in different years. I suspect that--like the results of mutual fund managers with different investment strategies--which model actually forecasts better in a given instance would depend upon which model's variables happened to be changing during the forecast period.

Table 6-12 Rent level forecasts on two lags, PCVAC and PCVCAC lead

Rent level on INTERCEPT, PCVAC, RENT(-1), RENT(-2), PCVAC(+1)				
Sample 1972-1989				
Observations	Actual	Prediction	Error	SD of Error
1990	361.86	447.44	-85.60	34.71
1991	241.62	243.32	-1.69	36.18
1992	107.93	118.06	-10.13	33.22
1993	80.53	51.26	29.27	33.35
1994	172.61	100.86	71.75	31.61
Mean prediction error				.72
Mean absolute prediction error				39.68
Sum of squared prediction error				2686.6
Root mean square prediction error				51.8
Predictive failure test				.085
Structural stability test				

Five years ahead the **1.RENT** model is out by \$56 and the standard deviation of the error is \$82 compared to \$158 standard deviation from the rent series mean during the 1970-1995 sample period. **2.RENT** claims a much smaller standard deviation of forecast errors, \$32. Either model would be superior to a naive forecast.

Reported forecast errors understate the true variation of the forecast series. Errors will be increased due to misspecification, measurement errors, process instability and conditioning errors (errors in forecasts of regressors). (See Green, Malpezzi & Barnes, 1996) It is easy to fit an equation to sample data, but hard to predict outside the sample. Offsetting this is the fact that 5 more points (a 20% increase) would be available to estimate the model with the full sample, which will increase precision of the estimates, assuming the model is specified properly and the process stable. The first two years' forecasts are quite good and the general pattern of the forecasts is reasonably close to reality, ie dip followed by recovery.

Given the dramatic rollercoaster ride experienced by rents, perhaps an error of about 26% of the rent level (\$56/218 in 1992\$) is not bad. Standard deviation of the year 5 forecast is about 2/3rds of the standard deviation of rent. Nevertheless, the (real

1992\$) rent-upon-completion estimate for 1995 has a 95% confidence interval \$328 wide!

If this confidence interval seems overly wide, consider that expert opinion includes even bigger ranges of forecasts. In early March 1997, within a week, one experienced expert predicted Sydney gross office rents could rise to \$1000 over the next few years (*Australian*, March,1997), while another respected expert raised the spectre of vacancy rates as high as 30%, which would imply rents lower than the current level near \$400.⁹ (*Australian*, March,1997) This difference of rent forecasts (ie difference of *mean forecasts*) is wider than the *confidence interval* of the above regression equations.

The regression forecasts look worse in hindsight than from an *ex ante* perspective which would necessarily leave out things like Sydney winning the Olympics and becoming more of a world city than predicted. With positive random shocks apparent in hindsight, a “good” forecast *should* be low compared to the outcomes.

6.4.5 Rolling coefficients

In a changing process, a major concern is the stability of results over time. Calculation of rolling regression coefficients provides estimates of coefficients for different samples which allow assessment of coefficient’s consistency over time. The vacancy coefficient over the entire 26 observations series was -1067 (see **1. Rent** in Table 6.12 above). Rolling regressions using 15 and 20 year windows beginning in 1970 and ending in 1995 showed standard error for the vacancy coefficient for the 26 year regression was \$201 and for an 18 year regression \$245 (Table 6-16).

The 15 year (OLS) vacancy coefficient in this equation moves from -815 to -1906 as the sample window changes from beginning in 1970 to beginning in 1980. There is certainly a high ratio of noise to signal and/or process instability in this data. One route to greater precision may be trying to identify through case study descriptions

⁹ Readers should not be confused by the \$218 current rent figure which is net effective rent in 1992\$ versus \$400 current rent figure which is gross current dollar rent.

situations in which responses vary in particular ways, even when data sets are too small to estimate such effects. Anecdotal accounts, theory, logic, and “telling stories” about individual year outcomes (shocks) may help increase efficiency or precision and ability to forecast. The goal is to identify issues and trends relevant to shocks and elasticities during the forecast period.

Table 6-13 Vacancy coefficients from 15 and 20 year rolling regressions

Dependent = RENT	Coeff. PCVAC	Coeff. PCVAC
Window	15 years	20 years
1986	-1095	
1987	-884	
1988	-822	
1989	-815	
1990	-838	
1991	-912	-1062
1992	-926	-853
1993	-1113	-840
1994	-1262	-792
1995	-1906	-953

(in model of rent on PCVAC, RENT(-1), RENT(-2))

Instability of results leads some to conclude that quantitative methods are inapplicable in such situations--ie small samples, unstable processes. It seems to me more sensible to acknowledge disorder in the underlying processes and continue with quantitative investigations by attempting to dig deeper to understand reasons for the variations. Blame the data generating process, not the econometric technique for instability. The model is telling us what happened. There is no method that can give precise forecasts because the process itself is not stable and random shocks will cause considerable variation in outcomes. Offices are risky investments.

If one begins with a philosophical expectation of disorder, then rather than saying “these equations predict poorly” one might say “these equations help us quantify uncertainty in an indeterminate, changing process.” Once the process is redesigned so decisions include all available information, the best model becomes a random walk and the forecast errors standard deviation will equal the process standard deviation. Of course, standard deviation of the process (departures from efficient outcomes) will be smaller in a more efficient market--this is the payoff from better forecasting. In chapters 7,8, and 9 I argue that the process itself could be redesigned to be less ill-behaved.

6.5 Rent Equations in Differences

While vacancy rate in levels explained 75% of the sample variation in rent, change of rent on change in vacancy results in $R^2=0.42$. With very small samples and noisy data one can ill afford to discard long term information by differencing the series. Four percent of the data is lost as differencing removes a sample point from the beginning of the series.

6.5.1 Rent change on vacancy rate

A model of interest is change in rent on vacancy rate, $DRENT = b_0 + b_1PCVAC$. By setting rent change equal to zero and solving for vacancy rate ($-b_0/b_1$), we seem to be solving for the equilibrium vacancy rate, V^* . However, this model has low explanatory power $\bar{R}^2 = .15$ and a low Durbin-Watson statistic indicating serial correlation of errors (See 1. **DRENT**, Table 6-14). This model therefore, omits variables which leads to biased coefficients. Therefore, the equilibrium vacancy rate indicated, 7.6% for Sydney, is biased. This comment would apply to every equilibrium vacancy rate published in the literature, given that none of them include in their models more than a few variables.

The concept of single variable causation (eg. rents determined by vacancy) has little meaning in a complex system with multiple causal variables and simultaneity. If other variables also influence rent, and certainly they do, there must, mathematically, be a different “equilibrium vacancy” for each different value of the other variables.

And, of course, the equilibrium rate would change over time due both to process changes and changes in values of other variables. These considerations--and of course different data, proxies, and equations-- explain diverse equilibrium vacancy rates between cities and over time found in empirical papers (Shilling, et al, 1987; Pollakowski, et al., 1992).¹⁰

Recall that average Sydney vacancy over the sample period was about 9.2%. Clearly, what we mean by equilibrium vacancy rate is a matter of definition and choice--specifically choice of other variables to include in a model whose coefficient on vacancy is used to calculate the equilibrium rate. Generalising this principle, estimated effects of any variable are only true assuming *ceteris paribus*, not just for included variables, but also for all other factors affecting outcomes in the data generating process, many of which may change over time in human designed systems.

Having made these complaints about our ability to calculate equilibrium vacancy rates, it remains a very useful idea. Even the single variable model estimate (rent change on vacancy rate) of equilibrium vacancy cannot be far off, given the plot of rent change versus vacancy rate in Figure 6-5. And it appears that throughout the sample period, a vacancy rate outside of a range of about plus or minus two percent from the mean would have been pretty certain to move rents in the expected direction. Equilibrium vacancy may not be precisely measurable, but it certainly exists within a range which is not very wide at a point in time.

Predicting DRENT from two lags of the dependent and one of vacancy improves \bar{R}^2 to 0.68 with acceptable diagnostics (**2. DRENT**, Table 6-14). As with levels of rent, a positive lag of vacancy had a higher T ratio in some equations than a negative lag. Equation **3. DRENT**, Table 6-16 includes both a lead and lag of vacancy. Addition of a supply dummy reflecting a pulse of supply in 1989-1992 arising from financial

¹⁰ I suspect similar comments could be made about most of the fundamental relationships of economics. For example, the relationships depicted in "one regressor" plots of the Macroeconomics 101 version of the ISLM model would probably show serious misspecification and low explanatory power. Economies are too complex and changeable for any simple model to be universally applicable through time. Accepting that may make it easier to understand and forecast historical processes.

deregulation in 1985 was also significant when added to this equation, but adjusted R^2 fell. Equation 4. **DRENT**, Table 6-14 is rent change on current vacancy and lags of rent and rent change, a simpler specification with equal \bar{R}^2 . Summarising, we have rent change on:

1. PCVAC, which can be easily solved to find a unique, but incorrect equilibrium vacancy rate.
2. DPCVAC and 2 lags of DRENT, a model in differences analogous to the **1.RENT** model in levels, but with considerably lower \bar{R}^2 .
3. DPCVAC, plus a lead and a lag of DPCVAC, plus two lags of DRENT. Adding all these variables is an attempt to increase fit in a model in differences.
4. PCVAC, RENT(-1), DRENT(-1). By including regressors in levels, a higher fit is obtained in a simpler model.

Table 6-14 Equations explaining rent change

REGRESSOR	1.DRENT	2.DRENT	3.DRENT	4.DRENT	5.DRENT
Sample	1971-1995	1973-1995	1973-1994	1972-1995	1972-1990
INTERCEPT	43.4	-3.98	-.57	257	77
	1.6 (.123)	-.46 (.653)	-.07 (.94)	6.61(.00)	1.6(.12)
PCVAC	-568			-1066	
	-2.30 (.03)			-5.3(.00)	
DPCVAC		-864.6	-684.49		
		-2.94 (.01)	-2.54 (0.2)		
DPCVAC (-1)			-575.02		-733
			-1.82 (.09)		-1.2(.22)
DPCVAC (+1)			-493.78		
			-2.02 (.06)		
RENT(-1)				-.44	-.21
				-7.15(.00)	-1.9(.07)
DRENT (-1)		.64	.50	.25	.42
		3.92 (0.00)	2.68 (.02)	2.11(.05)	1.9(.08)
DRENT (-2)		-.23	-.18		
		-1.73(.10)	-1.46 (.17)		
\bar{R}^2	.15	.69	.77	.77	.40
Akaike IC	-143.05	-119.2	-111.6	-120.4	-103.0
SBIC	-144.27	-121.5	-114.9	-122.7	-104.9
DW statistic	.89423	2.32	2.02	1.57	1.09
Durbin's h				1.29 (.20)	8.2(.00)
Serial correlation .		.219	.87	.33	.13
Functional form		.77	.24	.09	.22
Normality		.61	.72	.10	.63
Heteroskedasticity		.69	.19	.73	.94

Estimating equation 2. **DRENT** with the last five data points withheld changes coefficients somewhat, but not radically (INTERCEPT -4.04, DVAC -827.5, DRENT(-1) .85, DRENT(-2) -.25. The smaller sample reduces \bar{R}^2 from .68 to .63, diagnostics remain acceptable at .05 significance level. Forecast diagnostics also do not disqualify the model: predictive failure $p = .35$, structural stability $p = .40$.

Table 6-15 Forecasts of DRENT on two lags and DPCVAC

INTERCEPT	DPCVAC	DRENT(-1)	DRENT(-2)	
Sample - 1973 - 1990				
Observation	Actual	Prediction	Error	S.D. of Error
1991	-120.23	-189.80	69.56	54.11
1992	-133.7	-180.00	46.30	86.36
1993	-27.40	-98.64	71.24	94.31
1994	92.08	-.60	92.69	94.20
1995	45.51	49.22	-3.70	85.70
Mean prediction error				55.22
Mean absolute prediction error				56.70
Sum of square prediction error				4132.20
Root mean sum prediction error				64.28
Predictive Failure test				.35
Structural Stability test				.40

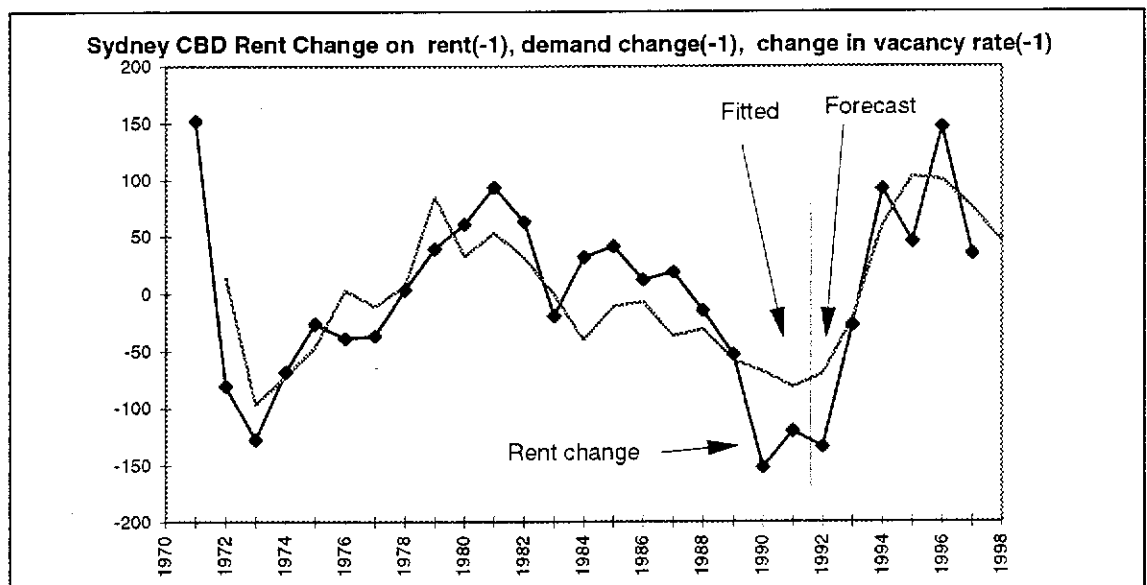
Actual real rents lost \$143 (from \$360 to \$218) during the forecast period. The forecast cumulative rent loss from the model is \$419, leading to a negative rent, an impossible outcome. This result suggests being assured of a non-spurious model through differencing is not worth the loss of precision entailed by discarding long run patterns.

6.5.2 Wheaton's rent adjustment through negotiations

Equation 5.DRENT in Table 6-16 is an approximation of Wheaton's (1987) rent adjustment through negotiations specification. The specification is an approximation because Wheaton's estimates are in semi-log form, while mine are in the original variables because some of the values for demand change are negative. Wheaton reasoned that vacancy rates and demand changes would move markets as landlords and tenants negotiate in a context of relative supply and demand. His

model used lagged demand change, lagged rent levels, and lagged change in vacancy rates to explain rent change. Fit of my (not transformed) version is not impressive and forecasting performance is only fair. Summing the 1990-1995 actual rent changes gives minus \$143 while the sum of this equation's rent change forecasts is minus \$10. Mean absolute prediction error of rent change over the five year forecast is \$39. Figure 6-6, however, shows that the pattern of rent changes matches fairly well. It is not obvious to me why this specification better represents the negotiations rent setting idea better than those using other lags, or levels such as the other equations in Table 6-16.

Figure 6-4 Rent Change on $\text{rent}(-1)$, demand change(-1), $\text{DPCVAC}(-1)$



6.5.3 Hendershott's return to equilibrium concept

Hendershott estimated a rent adjustment equation with Sydney data using as regressors a lag of rent level, and lags of deviations from equilibrium vacancy rate and rents. Hendershott's dependent variable was gross rent, that is, rent plus expenses (outgoings) paid by tenants. Adding expenses makes his dependent rent change variable equal to change in total cost of occupancy--the figure that tenants would consider in their demand/occupancy decisions. The net rents per square metre I used is the price signal of interest to the supply side of the market--the return

to capital invested. I followed Hendershott's example by using *real effective* rents, that is, rents divided by the CPI and reduced to reflect the amortised value of leasing incentives. However, Hendershott used gross rent per dollar of investment, a rate of return or yield variable, while I used rents per square meter.¹¹

Hendershott uses "replacement cost" meaning historical cost less economic depreciation as the denominator of his "rent as yield" variable. In classical income capitalisation methods of valuation, $Value = Rent/Yield$, where rent is the annual net rent and yield the ratio of rent to price in recent sales. A change in Hendershott's dependent variable means a change in the ratio of rents to replacement cost, that is, a move relative to equilibrium rates of return. Hendershott implicitly assumes that replacement cost is exogenous (function of labour and building materials), whereas in fact, land costs, a major component of replacement costs, would certainly vary with rents. Many combinations of rents and land costs with equal ratios could give the same yield. The rent in % of cost produced by this model leaves us uncertain about rent in the dollars per metre sense of the term, or alternatively it must assume a fixed land cost, whereas in a market land cost can vary. Symmetrically, rents per metre leave out information on yields, unless, again, we have information on the cost to produce a metre of lettable area.

Hendershott assumed that rents were at equilibrium in a particular year and then was able to solve for equilibrium vacancy rates, given the deviation of actual rents from this figure in other years. In the spirit of his return to equilibrium model I created excess vacancy and excess rent variables by subtracting mean from actual vacancy and rents. However, I retained rent change per metre as opposed to rent change per dollar of replacement cost as my dependent variable. Confirming Hendershott's conceptualisation, the "return to equilibrium" variables are highly significant. However, current excess vacancy was a better predictor than lagged excess vacancy in my version of the Hendershott specification. The version reported in Table 6.16 also includes GDP change.

¹¹ In the Real Estate literature, use of rents per square foot or per square metre of floor area is by far the most common rent variable used. Hendershott's variable may be of more interest to finance oriented readers.

Hendershott's model has the substance of an error correction specification in that it explicitly provides for a return to equilibrium based on deviations in time period t-1. But he has derived his model from theory, rather than empirically through testing for stationarity and for cointegrating vectors.

Table 6-16 Hendershott's return to equilibrium regressors

REGRESSOR	DRENT
Sample	1972-1995
INTERCEPT	-26.71
	-2.04(.06)
DRENT(-1)	.27
	2.34(.03)
XRENT(-1)	-4.25
	-7.07(.00)
XPCVAC	-996.43
	-4.97(.00)
DOZGDP	548.21
	1.51(.15)
\bar{R}^2	.79
Akaike IC	-119.99
SBIC	-122.94
DW-statistic	1.69
Durbin's h	.937(.35)
Serial correlation	.52
Functional form	.20
Normality	.18
Heteroscedasticity	.85

This idea of return to equilibrium seems to me a simple but powerful idea for office market forecasting. It implies that it is easier to forecast the direction of markets when they are far from equilibrium--for example, when I did my Bankwest study of the Perth office market (Chapter 7). At that time it was clear that no rational investor would build new supply when they could buy an existing building for one third of cost, so any new demand would increase rents, but not supply, so long as rents were below equilibrium rents.

6.5.4 Smoothing real rent change

Rent changes were averaged over a three year period (lags -1, 0 , +1) to produce a smoothed series. The first column of table 6-17 demonstrates the high degree of fit resulting from this strategy--only two differenced regressors explain .80 of variation in the smoothed rent change (DRENTSM) series. Adding a second lag of the smoothed rent change dependent variable to this equation increases \bar{R}^2 to .84, but worsens the heteroskedasticity diagnostic to $p=.06$, near rejection, so the simpler model is preferred.

Table 6-17 Smoothed rent and percent rent change equations

	DRENTSM	PCDRENT	SMPCDRENT
Sample	1973-1991	1971-1995	1973-1994
INTERCEPT	-1.15	-.116	-.015
	-.17(.87)	-.887(.39)	-.31(.76)
DRENTSM(-1)	.723		
	4.98(.00)		
DPCVACSM	-1498.7		
	-4.79(.00)		
PCVACANT		-1.25	
		-.40(.69)	
PCVACANT(-1)		5.64	
		4.56(.00)	
SQPCVAC		-29.29	
		-2.41(.03)	
SMPCVAC			-6.76
			-6.73(.00)
SMPCVAC(-1)			6.69
			9.58(.00)
SMPCDRENT(-1)			.50
			3.3(.00)
\bar{R}^2	.80	.67	.92
Akaike IC	-92.01	3.82	25.50
SBIC	-93.43	1.38	23.32
DW-statistic	1.42	2.28	1.6
Durbin's h-statistic	1.64		1.33(.18)
Serial correlation	.46	.44	.55
Functional Form	.42	.01	.07
Normality	.61	.15	.43
Heteroscedasticity	.12	.17	.42

Expressing rent change in percentage terms increased fit slightly, for example $\bar{R}^2 = .27$ in a percent change rent on PCVAC equation versus $\bar{R}^2 = .15$ when rent change is expressed in dollars. A squared term of PCVAC was significant in an equation explaining percent rent change and including regressors PCVAC and lagged PCVAC (Table 6-17, column 2). Column 3 of Table 6-17 reports a smoothed percent rent change equation which also has high \bar{R}^2 for a model in differences. Clearly, this smoothing restores much of the long run information lost through differencing.

6.5.5 Comments on rent/vacancy models in differences

Hendry recommends avoiding omitted variable bias by beginning with a general specification including many variables and lags, and then simplifying by removing variables whose low T-statistics indicate they do not matter. My equations above might be criticised as examples of “simple to general” modelling strategy. Because each equation omits variables shown to be significant in other equations, omitted variable bias is present in all of the equations, meaning biased coefficients. However, when all of the significant variables and lags are included in a general specification, an error message is produced by MICROFIT reading: “Matrix near singular, possible multicollinearity.” One cannot estimate a general model given the limited data and multicollinearity.

There is so much cyclical pattern in the data, that considerable explanation of the dependent variable can be obtained from *any* variable associated with economic cycles, including the lagged dependent variable, which emerges as the most useful regressor overall. Two lags of DRENT are significant at the .05 level in most equations and necessary to remove serial correlation in the errors. These results are consistent with Wheaton’s (1988) and Abelson and Cooper’s (1990) distributed lag rent adjustment specifications.

Unfortunately, the forecasting performance of some seemingly good models in differences is poor. Forecasts from similar models in levels are superior in terms of forecasting errors. However, smoothing the data restores much of the long run pattern and results in better fitting equations.

6.5.6 Small Sample Sizes and Parameter Stability

In samples too small to allow for operation of the law of large numbers, coefficients may vary widely with addition or subtraction of only a few sample points. A rule of thumb in time series is to “Have five or six times as many points to estimate a model as the number you need to forecast” to avoid instability of the estimates and forecasting failures.¹²

On the other hand, smaller subsets of a structurally unstable process would tend to be more uniform than the entire population--as time goes on the data generating process becomes more unlike the earlier process. The optimum tradeoff between minimising population variance by defining the population more narrowly (taking a shorter time period as the relevant process of interest in time series work) and reducing random variation through larger sample size is an empirical question related to the stability through time of the process. Changes over time in measurement errors also argue for smaller samples. An interview with Ian Kynneston, an analyst with the Australian Property Council, Sydney, suggested that certain errors of measurement have been corrected by the APC in its recent office market reports in comparison to pre-1990 reports. The increase in accuracy was accomplished by means of tighter definitions of occupied space and more careful accounting for space.¹³

In office markets, we would expect considerable change in processes over time periods long enough to create a reasonable sample size for time series estimation. Office markets in the 1950's represented different supply, demand, finance, and pricing processes than 1990's office markets. The 1950's building might have been a four story brick building housing bookkeepers. The 1990's building is a 40 story building housing corporate raiders and possibly owned by offshore interests who were not a factor in earlier markets. In the 1990s, a new intermediary, property trusts--an institution not yet a factor during earlier periods--finance offices using

¹² Peter Kennedy, personal communication, March, 1997

¹³ Ian Kynneston, personal communication, December, 1994.

decision criteria (IRRs from computer assisted DCF models) not yet technologically feasible in the 1950s.

These qualitative changes behind the supply and demand figures and market decision processes are probably sufficient to change the quantitative relationships among office market variables, as well as expectations and lag structures. The 1970-1996 sample is probably not a bad compromise between sample size and population change over time. Process instability suggests seeking solutions other than “more data” for small samples and multicollinearity problems. Perhaps in office market research the “population” is really only one cycle, because in each new cycle the process evolves into a new species. A point made by more than one market participant in interviews was “each cycle is different.” If so, this suggests historically time and space specific models are better than models seeking generalisations to office markets throughout time. Process change suggests respecifying and re-estimating models for each application.

6.6 Demand and Supply Equations

Office space demand derives from employment decisions and business activities. Space per worker x employment = demand is an identity. Rent contributes only 5-20% of the total cost of adding an employee.¹⁴ In a recession when staff are being laid off, taking additional space doesn't make sense at any price. On the other hand, if space is cheap during a recovery with a firm growing strongly and rents increasing, firms may speculate in office space and avoid potential growth constraints by taking space in excess of current needs. In this part of the cycle we might see rents affecting demand, but in general, decisions to take additional space are insensitive to rents.

“Space per worker” or “workspace ratio” is defined as square metres of leased space per employee. This ratio changes over time, contributing substantially to demand growth or decrease. Information technology or “process re-engineering” could lead

¹⁴ John Cushman, of Cushman and Wakefield, a major U.S. property developer and office building owner and manager, cited 8% as rent's typical share of total cost in a presentation at the ULI meetings in San Francisco, November, 1996.

to increases in office productivity--output growth without increases in employment. Changes in workspace ratios weaken connections between variables like employment or GDP and office demand. While workspace ratios tended to increase during 1970-1990, since then many fitout designs have stressed more efficient "open plans" or "workstation" rather than individual office layouts, decreasing space per worker. Concepts like "hotelling" or "hot desking," and growing use of home offices (telecommuting), also may reduce office demand in the future.

Absorption (demand change), like vacancy, has been calculated by difference as stock occupied at time t minus stock occupied at t-1. Since net absorption is a small percentage of occupied stock (averaging 2.1% over 1971-1995 in Sydney), a small percentage error, say .005 (half a percent) in measurement of occupied stock, would be magnified into a large error in net absorption, on the order of $.005/.02 = 25\%$. Therefore, errors in the historical demand change (net absorption) series are likely.¹⁵ The stock continually adjusts through removals, refurbishments, and construction, while demand changes through firms taking and giving up space through relocations, start-ups, expansions, contractions, or going out of business.

Not surprisingly, different sources (property companies, economic forecasting firms) report somewhat different space absorption figures. To some extent, these problems probably reflect timing--that is, when new leases are picked up in the data base. This issue is more complex than it might first seem. For example, when should demand be recognised?

1. Firm begins looking for space
2. Firm begins negotiations for space
3. Lease is signed
4. Space is actually occupied by firm

¹⁵ Anthony Jones, research analyst at Knight Frank Independent, Perth, has pointed out that some of the historical figures literally do not add up. There are inconsistencies between absorption figures and occupied stock figures from year to year in some of the 1980s data.

5. Employees actually occupy all space in leased premises

In calculating net absorption, should one subtract demand decreases when:

1. Tenants sign a lease for new space (implying intent to vacate old space)
2. Tenants actually vacate old space
3. Leases expire on old space
4. Employees are sacked, leaving leased space unused

Market participants point out a major problem with absorption data in the 1980s was failure to distinguish net and gross space takeup.¹⁶ These were similar in their impact on vacancy rates only so long as buildings were being demolished to create building sites so that move-outs resulted in no space per rent, but rather a construction site. Demand was overstated when gross leasing activity was reported as net new demand.

Even properly defined and measured net leasing activity and underlying demand for office space may differ significantly. Sydney net absorption as percent of occupied stock, for example, varied during 1970 to 1995 from -0.034 to 0.073, with a mean of 0.021 and standard deviation of 0.027. Percent change in Australian total employment during the same period averaged 0.018 with standard deviation 0.019 (Table 6-19). Correlation between Australian non-farm employment change and space takeup is remarkably low, 0.63, considering the two can be thought of as virtually an identity assuming no change in space per worker ratio and stable proportion of employees working in offices.

Lags and leads confuse the issue as well. Office demand change lags employment change according to the data, suggesting new leasing is partly about replenishing inventories of space rather than accommodating workers. Table 6-18 summarises

¹⁶ Eric Wilkinson, formerly manager of a major Perth office building, brought this problem to my attention in the AIVLE study group. He collected data showing that use of gross leasing activity rather than net growth in demand was a major factor in overestimating demand during the 1980s.

correlations between percent net office space absorption in the Sydney CBD and various demand variables.

Table 6-18 Correlation of Sydney CBD percent net office space absorption (PCNETABS) with demand predictors

LDGROWSM	0.18	Australian leading indicators series
COGROWSM	0.33	Australian coincident indicators series
LGGROWSM	0.53	Australian lagging indicators series
AUSGDP	0.23	Australian Gross Domestic Product
DAUSGDP	0.25	Growth in GDP
DOFEMP	0.64	Change in four office using categories

Sample period: 1971-1995

Even the correlation between change in office demand and change in office employment--virtually another name for office demand, an identity rather than a proxy--is only 0.64 in this sample. It is hard to know whether to ascribe this low correlation to measurement error or to the institutional structure of leases, slow corporate leasing decisions, or other factors tending to disconnect in time office employment from corporate space requirements.

Although I did not obtain data or attempt to model this issue, it seems to me that future research on office markets would profit by adding a second pair of vacancy figures to the specification. One would be the "normal" (or desired or equilibrium) rate of vacancy within leased premises, which we might call "firms' inventory of leased space" or "demand side inventory." This should be compared to a second number, "actual vacancy within leased premises" which might be expressed, following BOMA's Sydney conceptualisation as a "space utilisation ratio." If desired inventory were less than actual demand inventory, then we might refer to this as "pent up demand within leased space." This would be a source of new demand that could appear without any growth in employment. On the other hand, if there is

excess space or underutilised space within tenancies, there could be growth in employment without additional space takeup (net leasing activity). Within-lease demand adjustments would be reflected in space per worker changes through the identity $\frac{\text{demand}}{\text{employment}} = \text{workspace ratio}$.

Descriptive statistics on 1971 to 1995 employment change, net space absorption, vacancy, rent, and supply change series are presented in Table 6-19:

Table 6-19 Descriptive statistics for demand variables 1971-1995

PCAUSEMP	DAUSEMP	DOFEMP	PCNETABS	PCDRENT	PCVACANT	PCNETADD
Maximum	.051	379000	.074	.533	.222	.077
Minimum	-.020	-197000	-.034	-1.24	.019	.018
Mean	.018	115167	.021	-.074	.093	.027
St. dev	.019	138196	.027	.334	.059	.025
Skewness	-.40	-.08	.22	-1.58	.65	.43
Kurtosis -3	-.52	-.21	-.45	4.19	-.65	.50
Coef. of V.	1.04	1.20	1.26	4.50	.63	.94

Variables and sources are:

PCAUSEMP Percent change in Australian total employment-ABS

DOFEMP Change in 4 NSW office using SIC employment categories-ABS¹⁷

¹⁷ Categories used were Finance and Insurance ANZSIC 731-752, Property and Business Services ANZSIC 771-786, Govt. Administration and Defence ANZSIC 811-829, and Personal and other services ANZSIC 951-970, all from ABS CAT. 6203-D. Most of the changes in employment in these categories are probably office workers. The office using category series only extended back to 1984. I extended them backwards to 1970 based on the observation that both office employment and total employment showed strong deterministic trends, but with different slopes. Accordingly I estimated the slopes of indexes of both variables, and used the slope of the office employment variable together with the errors of the total employment index to create an office employment series from 1970-1983. Several other methods of backcasting the series were explored, but none came as close to matching the pattern of the actual data from 1984 onwards. The method used has the virtue of bringing economic cycles into the missing data (through the errors from the total employment series), while also incorporating the plausible idea that if employment growth in office using professions was faster during 1984-1995 it was probably also faster during 1970-1984 (through use of the slope of the office using series).

PCDNFEMP Percent change in Australian non-farm employment-ABS

PCNETABS Percent net Sydney CBD office absorption-Industry sources

PCDRENT Percent change in net effective real rents in 1992\$-Industry sources

PCVACANT Percent vacant--Sydney CBD-Industry sources

PCNETADD Percent net additions to office Stock--Sydney CBD-Industry sources

Over the 1971-1995 period, mean of the employment growth series was around 1.8%, growth in occupied space 2.1%, and office stock 2.7%. Space per worker must have increased, therefore, in the period by the ratio $2.1/1.8 = 17\%$. Vacancy must have also increased substantially, and not surprisingly, real rent change averaged -7% per year.

Note that standard deviations vary more between series than the means. The range of rent changes is most dramatic--coefficient of variation 4.4. Thinking of office markets as a systems control problem, it appears that small employment shocks were magnified into much larger changes in rents.

Occupied space (demand) is auto correlated (Table 6-20):

Table 6-20 Autocorrelations of demand

OCCUPIED			
Sample from 1970 - 1996			
Order	Autocorrelation	Standard	Ljung-Box
	Coefficient	Error	Statistic
1	.88	.19	.00
2	.75	.31	.00
3	.62	.37	.00
4	.52	.41	.00
5	.43	.43	.00
6	.33	.44	.00
7	.22	.45	.00

Difference in demand only shows strong autocorrelation at lag 1.

Table 6-21 Autocorrelations of demand change, NETABS

Sample from 1991-1995			
Order	Autocorrelation	Standard	Ljung-Box
	Coefficient	Error	Statistic
1	.62	.20	.00
2	.09	.27	.00
3	-.33	.27	.00
4	-.49	.28	.00
5	-.39	.32	.00
6	-.16	.33	.00

Rent is positively correlated with net absorption (0.39). Net additions to stock (PCNETADD) are negatively correlated with employment growth (-0.39) and almost uncorrelated with office demand (0.08). In the shorter series available for office using industry categories, correlations between percent net absorption and office employment were higher, 0.59, but so were the correlations with the broader employment measures (Australian total employment 0.51, Non-farm employment 0.63). Therefore, narrowing the employment categories to office using sectors (via SIC codes) does increase the strength of the employment/office demand relationship, but not by much.

6.6.1 ADF Tests

A number of supply and demand variables were tested for the presence of stochastic and deterministic trends. More data is needed for reliable testing and lack of data

precludes use of many lags in the ADF test as a degree of freedom is lost with the addition of each lag further reducing test power. Initially ADF tests with up to 6 lags were estimated. If the results were not consistent at all numbers of lags, smaller numbers of lags were tested and the resulting equations' diagnostics inspected to determine the minimum number of lags of the dependent variable to include in order to eliminate serial correlation. Following McAleer's suggestion of an extremely simple test for a deterministic trend, the ADF unit root coefficients were compared with and without including a deterministic trend. If the ADF test coefficients are virtually identical, it is obvious the deterministic trend adds nothing. Φ_3 and Φ_2 formalise these conclusions through an F statistic comparing the equations with and without a trend, but were not considered necessary here due to conclusiveness of the informal inspection of coefficients.

In one case, office employment change, ADF tests from a quarterly series from 1971 were compared to ADF tests from annual data. The unit root was clearly rejected for the quarterly series, while it was not rejected using the annual (four times smaller) sample. With the shorter series, even double differencing did not clearly reject the unit root. This suggests that the annual series of all variables examined here are too short to provide enough power for unit root testing except where the result is very clearcut. Failures to reject unit roots are therefore not conclusive due to low power of tests. However, some variables such as employment, supply, demand, and GDP clearly include deterministic trends.

Table 6-22 Order of integration of demand variables

Variable-Source	Name	Trend	Order of Integration
Real net effective rent in 1992\$-JLW	Rent	no	I(1) or I(0)
Percent vacant-JLW	PCVAC	no	I(2) or I(1)
Demand-JLW	OCCUPIED	yes	I(1)
Percent Δ demand-JLW	PCNETABS	no	I(0)
Supply-JLW	AVGSTOCK	yes	I(1) or I(2)
Net Absorption -JLW	NETABS	yes	I(1)
Net Additions -JLW	NETADD	no	I(1)
Leading Ind. Index ABS	LEAD	no	I(0)
Coincident Ind. Index ABS	CO	no	I(0)
Lagging Ind. Index ABS	LAG	no	I(0)
Money Market Int. Rates RB	MM	no (?)	I(1)
Sydney C P I ABS	SCPI	yes	I(1) or I(2)
Change SCPI	DSCPI	no	I(0) or I(1)
Change Aus. non-farm GNP	DAGNFP	yes	I(0)
% change Aus. employment	PCAEMP	no	I(0)
Office employment 4 SIC codes, ABS	OFEMP	yes	I(1)
Index of office employment ABS spliced ofemp/ tot. empl	INDXOFEMP	yes	I(1)
Change in office employment	DOFEMP	no	I(0)
Change in indxofemp	DINDXOFEMP	no	I(0)
NSW total employment ABS	TEMP	yes	I(1)
Chg. NSW total emp. ABS	DTEMP	no	I(0)

6.6.2 Sydney Demand on Rent

Rent is a poor predictor of demand in this sample, probably because both increase with cyclical economic activity, obscuring the negative relationship predicted by theory.¹⁸ Regressing occupied space on rent or even on rent plus two lags of rent results in negative R^2 and coefficients with “wrong” signs.¹⁹ Adding a lag of the dependent variable results in high \bar{R}^2 , rent with the wrong sign, rent(-1) with the “right” sign. Despite its fit to the data, this equation makes no sense (Table 6-23).

Table 6-23 Occupied space on rent

	OCCUPIED
Sample	1971-1995
INTERCEPT	252827
	2.11(.05)
RENT	423.20
	1.72(.10)
OCCUPIED(-1)	.97
	26.11(.00)
RENT(-1)	-665.05
	-2.65(.02)
\bar{R}^2	.97
Akaike IC	-322.79
SBIC	-325.23
DW-statistic	1.99
Durbin's h	.033(.97)
Serial correlation	.94
Functional Form	.60
Normality	.00
Heteroscedasticity	.54

¹⁸ There is an apparent inconsistency between theory, which would say that demand must decrease as price increases (the familiar downward sloping demand curve), and the unit root test which says rent is stationary and demand is not. The explanation for this apparent contradiction is that the simple price quantity relationship is subject to omitted variable bias--enough to reverse the expected sign in this case. An I(0) variable (ie rent) can partially explain an I(1) variable (demand), provided the specification also includes an I(1) regressor as well (such as GDP growth).

¹⁹ The term “wrong signs” should be eliminated from econometrics and replaced with “unexpected signs due to omitted variables bias or misspecified dynamic structure.”

6.6.3 Demand change equations

With demand change (NETABS) as the dependent variable, 66% of variation in this sample is explained by two lags, employment and employment change, a trend, and rent (Table 6-24).

A demand trend dummy attempting to locate a change in trend reflecting increased productivity due to personal computers, etc., beginning sometime in the 1980s--several starting years were tested--is not significant in this sample. This result confirms William Wheaton²⁰ who reported at the Urban Land Institute meetings in November, 1996 that so far "there is no demand shock in the data--the pattern of employment and office demand growth is similar to previous cycles." Vacancy rate and rent change were also tested and found to be not significant.

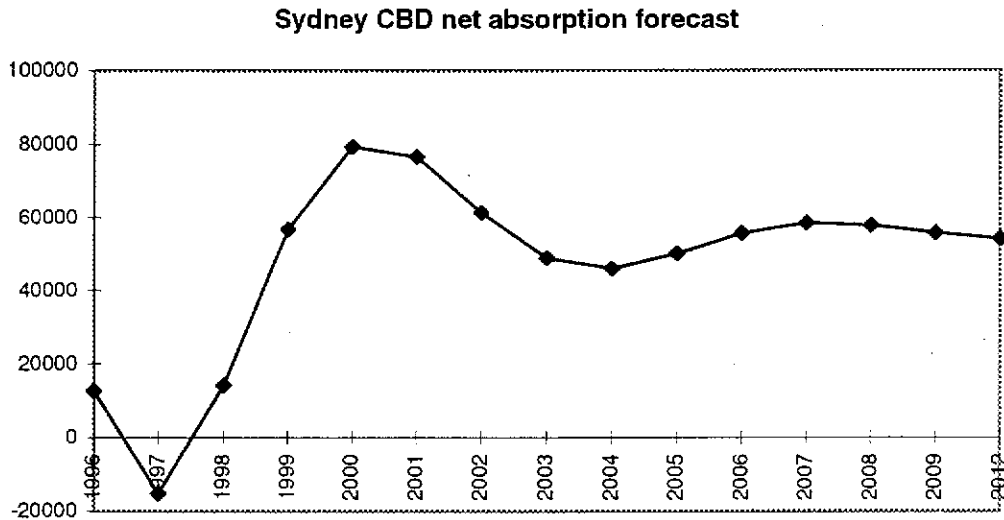
²⁰ Head of the Real Estate Department at MIT, author of several articles on office market adjustments.

Table 6-24 NETABS on employment

	NETABS	NETABS
Sample	1972-1994	1972-1995
INTERCEPT	1133830	35135.7
	3.26(.01)	2.28(.03)
NETABS(-1)	.62	.92
	3.07(.01)	4.8(.00)
NETABS(-2)	-.32	-.56
	-1.68(.11)	-2.65(.02)
NSWEMP	-539.11	
	-3.02(.01)	
PCAUSEMP	1862554	
	2.44(.03)	
T	15294.8	
	2.81(.01)	
RENT	-246.63	
	-2.96(.01)	
\bar{R}^2	.66	.48
Akaike IC	-283.35	-299.06
SBIC	-287.33	-300.82
DW-statistic	2.20	2.15
Serial correlation	.53	.25
Functional Form	.67	.46
Normality	.86	.78
Heteroscedasticity	.52	.86

Two lags of the dependent variable explained about half of the variation in demand change in the Sydney 1972-1995 data (Table 6-24).

Figure 6-5 Sydney CBD net absorption forecast



This forecast in Figure 6-7, estimated from 1971-1995 data using the two lags model (right hand column of table 6-24) is a good deal too low for 1996 and 1997, due perhaps to positive demand shocks--The Olympics, telecommunications boom, regional headquarters location decisions, Asian growth, Hong Kong handover. However, the pattern may be plausible, given past cyclical behaviour of demand growth.

6.6.4 Smoothed Demand

The demand series was smoothed by averaging two industry sources which disagreed significantly in some years, and by averaging across three years (lags -1,0,+1). If a lease was "missed" in 1990, for example, and picked up by the data base in 1991, the original estimate was too low in 1990 and too high in 1991, but the smoothed series is better, if fuzzier. Random error (noise) would also be reduced by smoothing. This series, not surprisingly, behaved better in the regressions. Note that in Table 6-25 I have switched to a demand change variable (AVGSMΔD) defined as a percentage of occupied space.

Table 6-25 Smoothed demand equation

	AVGSMAD (%)
Sample	1974-1996
INTERCEPT	.0075
	3.29(.004)
AVGSMAD2(-1)	1.37
	9.75(.000)
AVGSMAD2(-2)	-.78
	-5.39(.000)
\bar{R}^2	.83
Akaike IC	78.2
SBIC	76.5
DW-statistic	2.34
Serial correlation	.32
Functional form	.78
Normality	.87
Heteroscedasticity	.47

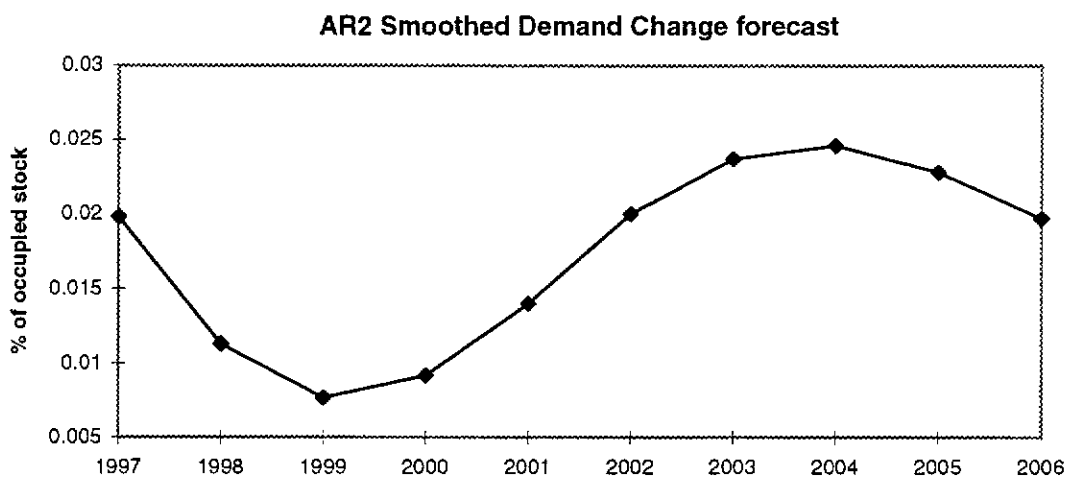
In a forecast using this equation, however, demand growth falls to near zero by the turn of the century, quite different from the preceding equation's forecast. This is a hard forecast to accept given the impending Sydney Olympics, but recall that the Olympics shock and other positive demand shocks are not yet reflected in this historical data. One should perhaps think of the applied forecaster's task as forecasting the sum of shocks during the forecast horizon, based on current non-sample information, and adjusting the forecasts generated from historical data accordingly. This is the "tuning" process found to be necessary in macroeconomic models.

Table 6-26 Smoothed demand change forecasts

INTERCEPT	AVGSMAD2(-1)	AVGSMAD2(-2)
Sample 1974-1996		
Observations	Prediction	S D of Error
1997	.0198	.0080
1998	.0113	.0141
1999	.0077	.0172
2000	.0092	.0176
2001	.014	.0172
2002	.020	.0178
2003	.0237	.0187
2004	.0246	.0189
2005	.0228	.0187
2006	.0197	.0188

Figure 6-8 plots this demand forecast.

Figure 6-6 AR2 smoothed demand change forecast



Smoothing absorption increases fit in the AR2 model considerably consistent with the idea that this series contains measurement errors which are often “picked up” or

corrected in the next period. Table 6-27 reports a re-estimate of the previous model, but with the dependent variable in square metres rather than percent of stock, and another equation with Australian GDP added as an additional regressor. Although this second equation showed GDP to have little effect (not significant at .05 level), this equation was used to generate a forecast (Table 6-27).

Table 6-27 Smoothed demand change equations

	SMABS	SMABS
Sample	1974-1994	1974-1990
INTERCEPT	30287.6	37190.3
	4.38(.000)	2.53 (.03)
SMABS(-1)	1.42	1.54
	11.83(.000)	10.03(.000)
SMABS(-2)	-.91	-.94
	-7.42(.000)	-6.33(.000)
AUSGDP		-3159.8
		-.84(.42)
\bar{R}^2	.88	.87
Akaiki IC	-241.98	-195.48
SBIC	-243.55	-197.48
DW-statistic	1.98	2.20
Serial correlation	.80	.53
Functional form	.42	.45
Normality	.63	.46
Heteroscedasticity	.22	.99

Adding GDP and withholding sample points leads to the following forecasts from the unrestricted order 2 VAR of SMABS on two lags and GDP:

Table 6-28 Forecasts of smoothed absorption

Regressors:	2 lags dep.	INTERCEPT	AUSGDP
Sample - 1974 - 1990			
Observation	Actual	Prediction	Error
1991	-44996.0	-26208.9	-18787.1
1992	2095.0	31613.9	-29518.9
1993	113259.3	100775.7	12483.6
1994	154996.3	149668.6	5327.8
1995	missing data	159991.5	missing data
		Estimation Period	Forecast Period
		1974 to 1990	1991 to 1994
Mean error	.1254E-9		-7623.6
Mean Absolute error	17373.7		16529.4
Mean Sum Squares error	3.55E+08		3.52E+08
Root Mean Square error	18854.4		18765.3

Individual errors cancel out. Cumulative demand increase from 1990-1994 was 225,354 m². The demand forecasts predicted 255,848. If one could do this well outside the sample period, one would be quite satisfied. Such good forecasts are, in my view, impossible. Nevertheless, during certain periods, it appears that demand is to some degree forecastable from the pattern in the historical data. Chapter 7 proposes an alternative demand forecasting strategy.

6.6.5 Supply Equations

Commencement decisions are taken one at a time with different variables important for different sites. Land costs, size of projects, etc differ between buildings, so all do not become feasible at the same rent--there is an upwards sloping long run supply curve. Future research might take a logit approach to predicting the probability that each individual project will commence. Following most of the literature (Keogh, McGough & Tsolacos, 1995; Kling & McCue, 1987), I take a simpler aggregate approach. The supply variable labelled "AVGSTOCK" is the average of stock (office supply) series obtained from two industry sources. I extend this series to

2002 based on projections of project completions by Knight Frank Independent, Sydney. Completions are relatively certain to 1999, based on projects under construction. Beyond 1999, completions are much less certain and conditional on future rent and demand adjustments. Knight Frank nevertheless feel they can predict which projects have sufficient momentum to proceed in the absence of major demand shocks. As we saw in the cases of the Perth projects in chapter 4, the exact date of completion is liable to slip due to unforeseen delays or soft market conditions. Positive shocks will bring more projects into development, especially in suburban locations where projects are smaller and land supplies less limiting.

For rent forecasting purposes, using these Knight Frank estimates, one could take supply changes during a five year forecast horizon to be exogenously determined and fixed. A better assumption would be that supply is predetermined for the next two years due to projects under construction certain to be completed and supply construction lags which preclude completion of additional projects. Supply in years beyond $t+2$ should be a function of rents, demand, supply, and exogenous economic variables such as interest rates.

6.6.6 Percent Change in Supply equation

The planning and construction lags documented in chapter 4 suggest project commencement decisions could be based on conditions four years before completion. So equations for supply change might include lag -4 independent variables ($t-4$) and/or expectations of future conditions at times up to date of completion (t) or beyond. Net additions to stock as a percentage of stock, PCDSUP, on two lags of the dependent variable and five rent lags, astonishingly showed all coefficients significant at the 0.05 level. While this result is plausible--certainly rents throughout a long planning and construction period might influence supply--it is surprising that this small sample detects all the effects. Bigger grounds for scepticism, however, is the fact that several of the signs are "wrong." It is hard to rationalise why lower rents would lead to more supply, and even harder to know why the signs alternate at succeeding lags (+1,-2,+3,-4,+5). The answer, again, must have to do with confounded variables and the autocorrelations in the series which

make it certain that if there is a positive relationship at some lag, there must be a negative one later, given the cyclical nature of outcomes.

Table 6-29 Percent change in supply equations

	PCDSUP	PCDSUP
Sample	1976-1995	1977-1995
INTERCEPT	.04	.03
	1.97(.08)	1.75(.11)
PCDSUP(-1)	.49	-.18
	2.69(.02)	-.94(.37)
PCDSUP(-2)	.43	.51
	2.5(.03)	2.87(.02)
RENT	-.37	-.2515E-3
	-5.27(.000)	-5.52(.000)
RENT(-1)	.61	.1957E-3
	4.54(.001)	3.44(.006)
RENT(-2)	-.44	
	-2.56(.026)	
RENT(-3)	.33	
	2.02(.07)	
RENT(-4)	-.23	
	-2.47(.03)	
DRENT(-3)		.1247E-3
		1.44(.18)
DRENT(-4)		.88
		.69(.51)
DRENT(-5)	.2107E-3	-.1506E-4
	3.36(.006)	-.174(.86)
DRENT(-6)		.1330E-3
		1.90(.09)
\bar{R}^2	.82	.80
Akaiki IC	59.15	56.29
SBIC	54.67	52.04
DW-statistic	2.40	2.25
Serial correlation	1.29(.28)	.81(.40)
Functional form	1.63(.23)	.20(.67)
Normality	1.43(.50)	1.20(.55)
Heteroscedasticity	.74(.40)	.001(.97)

When a sixth lag of rent added, signs change and variables which previously had significant coefficients become insignificant. This is due, perhaps, to small sample size--six lags means $n=19$ less 9 variables means only 10 degrees of freedom!

R^2 is 0.50 with acceptable diagnostic tests for a model of supply change on a single variable: rent lag -4--approximate time of project initiation and the sign of the coefficient is positive, as expected. Rents at project initiation may influence (perhaps mislead) lenders. Rents at project completion are the relevant decision variable through their powerful effect on project IRR. Rents in between should have lesser weight, but relevance in encouraging projects underway to continue. Lag structure should vary with size of project because construction times increase with larger projects.

It seems naive to expect a relationship like rent(-4) causes supply change to hold water. What we may be observing instead is a complex set of interacting cycles, whose relationships change over time--in other words, a spurious relationship, despite the fact that higher rents should, in theory, lead to supply increases. Applications of even simple theories can be quite complex.

Market participants quote “required rents on completion” to make projects feasible as a rule of thumb for project commencement decisions.²¹ Developers prepare elaborate discounted cash flow pro forma projections (using log linear growth assumptions) to estimate IRRs and NPVs of proposed projects. The rent at which, given assumptions about discount rates, income, and expenses, the project just becomes feasible (ie $NPV \geq 0$) could be called the “feasibility trigger rent.” Of course, many assumptions besides rent go into such calculations--for example, assumptions about capital growth and rent growth after completion. Nevertheless, participants in the market have an approximate idea of a “rent- level- required- to- make- construction- feasible” which is updated as conditions change.²² Required rates of return on capital are determined exogenously in broader capital markets, with adjustments for project specific risk. Various irrational and agency issues such as developer profit centres and developer egos also determine project commencements, making it plausible that supply models would not always find

²¹ For example, in 1996, leasing agents in Perth mentioned \$450/m² while in Sydney project feasibility analysts were using gross rents of \$650, more or less, needed to make projects feasible. The due diligence forecasts provided by property trusts for projects whose shares are listed lead to publication of “required rents” in the financial press.

²² Real estate is still based on rules of thumb which reduce complexity to simple issues, provided other issues are more or less fixed at assumed conditions.

close relationships between market fundamentals and supply changes. On both the supply and demand sides of office markets, there are complexifications which divorce market outcomes from current fundamental conditions and from theoretically expected effects. Simple specifications like those estimated here and in the office market literature, fail to account for these aspects of the real world process and hence may be far from empirically correct. Nevertheless, there is some explanatory power in simple models, especially in combination with other forward looking information.

Sydney CBD office stock contains both stochastic and deterministic trends in the 1970-1995 sample (Table 6-22), so an autoregressive model in levels produces a high degree of fit (Table 6-30).

Table 6-30 Office stock on two lags

	AVGSTOCK
Sample	1972-2002
INTERCEPT	65711.1
	1.03(.31)
AVGSTOCK(-1)	1.50
	9.222(.000)
AVGSTOCK(-2)	-.51
	-3.09(.004)
\bar{R}^2	.99
Akaiki IC	-391.81
SBIC	-393.96
DW-statistic	1.80
Serial correlation	.33
Functional form	.82
Normality	.86
Heteroscedasticity	.73

Predictions from the AR2 model in levels begin with standard deviations of errors similar to annual supply increments. Standard deviation expands over the 8 years forecast in Table 40 to about 11% of the stock estimate (Table 6-31). An 11% error is approximately equal to five years new supply requirement when compared to annual demand change on the order of 2%.

Table 6-31 Office stock on two lags, single equation dynamic forecast

AVGSTOCK (-1)	AVGSTOCK(-2)	INTERCEPT
Sample 1972-2002		
Observations	Prediction	S D of Error
2003	4918291	76925.6
2004	4984943	148296.0
2005	5049874	219882.1
2006	5113476	290739.4
2007	5175957	360908.8
2008	5237431	430697.4
2009	5297962	500432.8
2010	5357591	570390.9

6.7 Vector Autoregression Simultaneous Equations

Because rents and demand must be so important in determining supply and vice versa, we now, at last, shift to a “proper” method controlling for simultaneity. It is not clear, *a priori*, however, which form of model would win a forecasting contest, because there are tradeoffs between sources of error.

To this point all results reported are single equation models meaning they are subject to potentially serious simultaneous equations bias because endogenous variables are used as predictors. Office markets are better represented instead as a simultaneous equations system with endogenous regressors. If Rent, R, Supply, S, and Demand, D, are the key variables adjusting to each other and exogenous variables (E_i), the system should be written as:

$$R = f(S, D, E_1)$$

$$S = f(R, D, E_2)$$

$$D = f(R, S, E_3)$$

One strategy for coping with simultaneity is use of instrumental variable techniques for estimation. However, small samples make instrumental variable techniques (2SLS, etc) less appropriate because errors in estimates of instruments will be large (due to small samples). And, small samples make it impossible to estimate general models so estimates of instruments will be biased due to omitted variables.

Another strategy for estimating simultaneous systems, vector autoregressions, sidesteps the simultaneous equations bias problem by using only lagged (predetermined) variables as predictors. The cost is excluding contemporaneous endogenous variables from the model. In a vector autoregression (VAR), all the variables are assumed to be endogenous so the equation can be rearranged with any of the variables as the dependent with lags of the rest serving as predictors.

6.7.1 Sydney RENT, PCVAC second order VAR in levels

After choosing candidate variables, the next step in specifying a VAR is to choose the order of the VAR, that is the number of lags of each variable that will be included. Diagnostic statistics indicated serial correlation and normality statistics were very near rejection at the .05 level in the order 2 RENT PCVAC VAR. However, in the third order VAR, although diagnostics were more satisfactory, several coefficients were not significant and Akaike IC and SBIC both were slightly larger, indicating a preference for the second order VAR. \bar{R}^2 was similar in the rent equation between the second and third order VAR, rising from 0.89 to 0.91 with the additional lag. Coefficients changed somewhat between order 2 and order 3, suggesting misspecification in the second order VAR, but with a small sample, this may simply be random variation. There is a tradeoff between sample size and better specification because adding lags (better specification) costs degrees of freedom. Diagnostics indicate serial correlation in a first order VAR of rent and vacancy rate,

eliminating it from consideration. Ockham's razor picked the order 2 VAR (Table 6-32).

Table 6-32 Estimation of rent, unrestricted order 2 RENT/PCVAC VAR

REGRESSOR	RENT	RENT
Sample	1972- 1995	1972-1990
RENT (-1)	1.28	1.28
	6.82(.00)	5.67(.00)
RENT (-2)	-.36	-.35
	-1.86(.08)	-1.44(.17)
PCVAC (-1)	-705.16	-904.80
	-1.55(.14)	-1.42(.18)
PCVAC (-2)	940.78	1071.9
	2.2(.04)	1.89(.08)
\bar{R}^2	.89	.80
Akaike IC	-130.21	-104.25
SBIC	-132.57	-106.14
DW-statistic	1.20	1.16
Serial correlation	.08	.26
Functional form	.39	.02
Normality	.57	.53
Heteroscedasticity	.06	.10

R^2 of the vacancy equation in this second order VAR of rent and vacancy was 0.76--less than the 0.89 \bar{R}^2 of the rent equation--indicating vacancy predicts rent better than rent predicts vacancy, a plausible result. Re-estimating the VAR without the last five sample points (Table 6-32, last column) and computing forecasts:

Table 6-33 Forecasts of rent unrestricted order 2 rent/vacancy VAR

RENT	PCVAC		

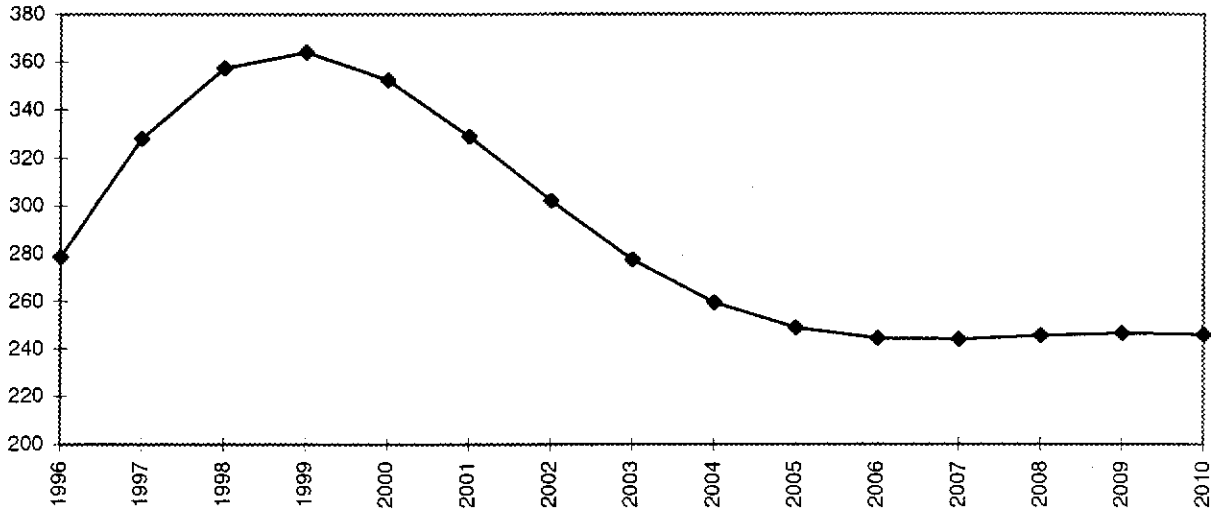
Sample - 1972 - 1990			
Observation	Actual	Prediction	Error
1991	241.63	271.11	-29.49
1992	107.93	222.40	-114.47
1993	80.53	204.08	-123.55
1994	172.61	203.17	-30.56
1995	218.12	209.86	8.26
		Estimation Period	Forecast Period
		1972-1990	1991-1995
	Mean error	2.57	-57.96
	Mean Absolute error	37.64	61.26
	Sum Squared error	2241.7	6047.7
	Root Mean Sum Squares	47.35	77.77

Aggregating errors over the forecast period, this equation predicts a net fall in rents of \$150 versus the actual 1990-1995 fall of \$142. Predicted rent does not fall as far or recover as far as actual rents on the way to this net result so there is a lot of luck in this very accurate five year forecast. I doubt whether *current* rents are measured to within \$10. It would be impossible to forecast this accurately, except by chance. At a three year forecast horizon, the error would have been -\$123. Mean absolute forecast error was \$61.

Forecasts of future rents stepping forwards using the VAR estimated over a longer period produces forecast rents for 1996-2010 plotted in Figure 6-9. As an AR2 process, the cycles “die out” towards the process mean in the long run, desirable performance assuming a stationary process.

Figure 6-7 Rent forecast from order 2 rent/vacancy VAR

Rent Vacancy Order 2 VAR Rent Forecast



This forecast is based on 24 observations from 1972 to 1995, and an order 2 VAR of rent and vacancy. By early 1997 we can see that this projection is too low, even recalling that these are 1992\$ rents. The continued strong economy in Sydney from 1995 to the present--positive demand shocks, negative supply change--leaves this forecast behind.

This makes an important point about office market forecasting. Forecasting efforts for a “real world” decision must take account of updated current information and qualitative sources. Therefore, the research reported here aims to develop methods for forecasting, but does not produce forecasts. Readers should pay little attention to specific numbers produced by forecasting models reported here. In a real world forecasting effort, more non-sample information and more up to date time series data would be used and these would change forecasts substantially.

6.7.2 DRENT PCDVAC VAR

Shifting to a rent-vacancy VAR in differences one finds that adding a second lag reduces adjusted R^2 slightly. Nevertheless the order 2 VAR in differences is reported in Table 6-34 due to superior diagnostics. Degrees of freedom are lost by differencing the variables, so limited data necessitates models with fewer regressors

in comparison to levels models. While an F test shows these models to be significant ($p < .05$), only one of the coefficients is significant at the .05 level. This is hardly a model at all.

Table 6-34 Order 2 VAR of DRENT and DPCVAC

REGRESSOR	DRENT	DRENT
Sample	1974- 1995	1974-1990
DRENT (-1)	.80	.65
	2.9(.01)	1.69(.12)
DRENT (-2)	-.22	-.24
	-.98(.34)	-.81(.43)
DPCVAC (-1)	-432.50	-646.00
	-1.01(.33)	-1.20(.25)
DPCVAC (-2)	391.08	-434.50
	.86(.40)	-.79(.45)
\bar{R}^2	.53	.46
Akaike IC	-117.60	-90.00
SBIC	-119.79	-91.67
DW-statistic	1.92	1.46
System log lik.	-60.81	-43.40
Serial correlation	.96	.67
Functional form	.47	.97
Normality	.76	.48
Heteroscedasticity	.71	.96

The equation in the second column above was used for the following forecasts.

Table 6-35 Forecast of DRENT from the unrestricted order 2 VAR

Order 2 VAR of:		DRENT	DPCVAC
Sample - 1974 - 1990			
Observation	Actual	Prediction	Error
1991	-120.23	-110.74	-9.49
1992	-133.70	-60.03	-73.66
1993	-27.40	-20.93	-6.48
1994	92.08	3.09	89.00
1995	45.51	12.01	33.51
		Estimation Period	Forecast Period
		1974 to 1990	1991 to 1995
Mean error		-4.60	6.57
Mean Absolute error		29.29	42.42
Mean Sum Squares error		1451.30	2919.90
Root Mean Sq. error		38.10	54.04

Cumulative five year rent change is -\$144 while predicted aggregate change is -\$177. Despite low \bar{R}^2 this forecast was reasonable accurate and mean absolute errors are smaller than in the order 2 VAR in levels presented above. The behaviour of the errors is probably due to chance to a significant degree--this specification is not very credible in either levels or differences.

6.7.3 Order 2 VARS of smoothed rent

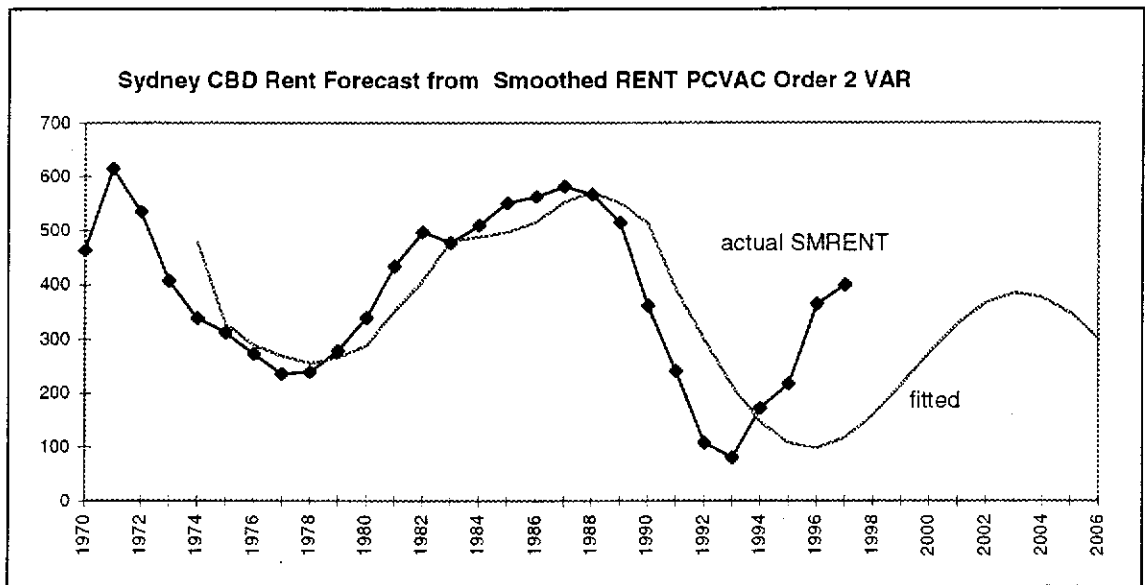
Smoothed rent equations from two VAR models, one on demand and supply changes (net absorption and net additions to stock) and the other on smoothed percent vacant each show high degree of fit, $\bar{R}^2=0.97$ in both cases.

Table 6-36 Unrestricted order 2 VAR smoothed rent and PCVAC

	SMRENT	SMRENT
Sample	1974-1994	1973-1994
Regressor	Coefficient	
SMRENT(-1)	2.11	1.89
	9.1 (.00)	10.3 (.00)
SMRENT(-2)	-1.15	-.97
	-4.8 (.00)	-5.1 (.00)
SMPCVAC(-1)		-65.51
		-1.4 (.89)
SMPCVAC(-2)		443.53
		1.0 (.32)
SMABS(-1)	82.12	
	.12 (.90)	
SMABS(-2)	-679.63	
	-1.5 (.15)	
SMADD(-1)	-489.75	
	-.70 (.50)	
SMADD(-2)	1711.7	
	2.6 (.02)	
R^2	.97	.97
Akaike IC	-98.42	-101.85
SBIC	-101.55	-104.03
DW statistic		1.37
System Log Lik.		-25.28
Serial Correlation	.21	.55
Functional form	.35	.30
Normality	.79	.20
Heteroscedasticity	.64	.40

Forecasts from the order 2 RENT PCVAC VAR do catch the rent turning point and produce a reasonable pattern of forecasts with mean prediction error \$46. However, they lag actual rents badly during the forecast period and turn downwards again without reaching what market participants cite as current equilibrium rents.

Figure 6-8 Smoothed Rent PCVAC VAR Forecast



6.7.4 VAR of Supply, Demand, and Rent

Unrestricted vector autoregressions of rent, demand, and supply were estimated with order 1, order 2, and order 3 VAR specifications. Serial correlation occurs in 1st order residuals, 2nd order residuals are barely acceptable at the 0.05 level. The 3rd order VAR pushes the boundaries of generality imposed by small sample size. Lag 1 rent coefficient has an unexpected sign in both supply and demand equations. This would be a serious defect in a causal model as it contradicts economic theory. However, one can rationalise that the model omits variables related to both rents and demand (variables associated with business cycles) and hope that the relationships evident in the data remain in effect to the forecast horizon. Recall that we are studying these markets because they are so inefficient that gluts of supply seem to be completed as rents are falling in recessions. Perhaps the variables *are* related, but with unexpected signs indicating not a spurious model but a market incapable of properly estimating future supply and demand conditions. The coefficients may be literally mistakes, but market behaviour mistakes rather than model estimation mistakes. In the next chapter, the system characteristics that lead to poor decisions are explored further through system dynamics models.

Table 6-37 Order 2 VAR of demand, supply and rent

	OCCUPIED	AVGSTOCK	RENT
Sample	1972-1995	1972-1995	1972 -1995
OCCUPIED(-1)	.97	-.15	.22E-3
	3.85(.001)	-.68 (.50)	1.5 (.15)
OCCUPIED(-2)	-.23	.10	-1.4E-3
	-1.17(.26)	.60 (.55)	-1.2 (.25)
AVGSTOCK(-1)	.63	1.27	-.10
	1.91(.07)	4.5 (.00)	1.53 (.60)
AVGSTOCK(-2)	-.40	-.23	.53
	-.99(.34)	-.65 (.52)	.23 (.82)
RENT(-1)	708.46	-245.13	1.21
	2.12(.05)	-.85 (.40)	6.2 (.00)
RENT(-2)	-606.02	420.90	-.46
	-1.82(.09)	1.46 (.16)	-2.3 (.03)
\bar{R}^2	.97	.98	.89
Akaiki IC	-309.54	-305.94	-130.82
SBIC	-313.07	-309.47	-134.35
DW-statistic	2.12	2.21	1.31
System log lik.	-720.48	-720.48	-720.48
Serial correlation	.16	.20	.11
Functional form	.71	.63	.61
Normality	.07	.28	.43
Heteroscedasticity	.60	.81	.73

A major flaw of these equations is that demand and supply are certainly not stationary. As noted, for forecasting purposes, this may be forgivable. And to argue that supply, demand, and price relationships are spurious contradicts economic theory.

6.8 Error Correction Models

Cointegration between two or more non-stationary variables means a linear combination of the variables is stationary, indicating a long run equilibrium relationship. A model in differences may therefore include an “error correction” term consisting of the lagged error term from the cointegrating relationship. This error correction term with a negatively signed coefficient, will tend to restore the system to equilibrium. The error correction term reflects long term information that would otherwise be lost in a model in differences. ECM specification avoids the possibly spurious relationships of a model in non-stationary levels because all variables including the ECM term are stationary.

6.8.1 Cointegrating relationships

A number of combinations of variables were tested for cointegrating vectors as summarised in Table 6-38:

Table 6-38 Cointegrating relationships

Variables	Johansen test CV's	Comment
rent avgstock	no	expected, I(0), I(1)
rent occupied	no	expected, I(0), I(1)
rent pcvac	no	expected both I(0)
avgstock demand	no	surprising, both I(1) should adjust to each other
avgstock pcvac	no	expected I(1), I(0)
lnavgstock lndemand	no	surprising, both I(1)
offempindex occupied	yes, 1	I(1), I(1)
rent, avgstock occupied	yes, 1	I(0), I(1), I(1)
avgstock, occupied, pcvac	yes, 1	I(1), I(1), I(0)
smrent smocc smstock smofemp	yes, 2	4 smoothed variables two cointegrating vectors

As expected, cointegrating relationships are not found between stationary and non-stationary variables. Surprisingly, avgstock (supply) and occupied space (demand) are not found to be cointegrated. I suspect they are cointegrated, but not at a lag order accessible through our small data set. Inspection of a graph of supply and demand shows that they definitely track each other--recall that the difference between the two is vacancy and vacancy explains rent, so supply cannot increase unless demand increases. The problem in detecting this effect is that it takes several years for oversupply to be absorbed and several years for supply to respond to demand. The system, as noted, does not adjust very well (See chapter 7 for simulations demonstrating how lags create these mismatches in supply and demand.).

When we add rent to the VAR as an $I(0)$ exogenous variable, however, a cointegrating relationship is found between supply, demand, and rent.

Another significant and useful cointegrating relationship found in the data is between office employment and office demand. This is an avenue for future research--it may be that office employment is a substitute proxy for office demand rather than leased space, in which case the long time series of quarterly employment data will be available for office market demand estimation.

I leave to future research the search for models to explain office supply and demand from ECM models. Preliminary work indicates that this may be more difficult than first appears due to the long lag times and difficulty distinguishing "fundamental" demand due to employment and workspace design from the "inventory holdings adjustment" aspects of office leasing. Nevertheless, the existence of cointegrating relationships indicates that supply and demand models could be improved by ECM specifications.

6.9 Comparing Forecasts

Choosing among the equations in levels, differences, and VAR versions may be approached by examining forecast errors. Using so called forecast errors from a withheld portion of the sample, ends up however, as a data mining "within sample"

technique, when repeated withheld sample forecasts are attempted with different specifications, as is the case here. We could not do this in a true forecasting situation. Therefore, results must be interpreted cautiously.

Table 6-39 Comparison of five year forecasts

<i>Model</i>	<i>Forecast</i>	<i>Actual</i>	<i>Error</i>	<i>S.D. of</i>	<i>MAPE</i>	<i>RMSE</i>
<i>ends year:</i>	<i>year 5</i>	<i>year 5</i>		<i>Error</i>		
<i>1. RENT Rent in levels on two lags and vacancy rate</i>						
1995	218	161	56	82	38	51
<i>2. RENT Rent on two lags, pcvac, and a forward lag of vacancy</i>						
1994	172	100	71	31	39	52
<i>2. DRENT Rent change on vacancy change and two lags</i>						
1995	45	49	-4	86	57	64
<i>Unrestricted VAR, order 2 Rent change, Vacancy rate change</i>						
1995	-46	5	-52		58	66
<i>Unrestricted VAR, order 2 Rent, Percent vacant</i>						
1995	218	209	8		61	78

The smallest root mean square error model is not the model with least error in year five. The year five forecast from the VAR in levels (the last model in the table) is only out by \$9, while its root mean square error, \$78 is larger than the other models. Some models may tend to have smaller cumulative “forecast horizon” errors than individual “single year” errors because their long term behaviour catches the turns in the market better. The single equation models have biased coefficients, but give

more precise estimates because they include current data, while the VAR relies on previous year data but avoids simultaneous equations bias.

Models in levels may be superior, despite possible spurious relationships. With small samples, there is a high cost to discarding information, which differencing does, both by eliminating long run information, and by loss of a degree of freedom (4% of the sample in this case where $n \leq 26$).

Root means squared error in the year five forecast of rent from the rent pcvac VAR in levels is \$78, while standard deviation of rent in the 1970-1995 sample is \$158. The models in levels reduce RMSE to half of sample standard deviation. Even given violations of assumptions and reasons for suspecting lack of external validity, estimates from the models appear to provide useful increases in forecast accuracy and precision in comparison to naive projections of trends or use of past sample means. Whether they are better than expert forecasts would require further study.

Supply lags and demand lags in office markets, driven by macroeconomic cycles, tend to create a repeated cyclical pattern which all of these distributed lag models capture in some form. Our objective, we should remember, is to change that very behaviour so markets stay closer to equilibrium and waste less social capital. Success of these models would mean their obsolescence.

6.10 Combining Forecasts

The best uses of forecasting equations may be in combination with independent forecasts using other methods. Clemens, in a 1989 review article, cites several studies which found evidence in favour of combining forecasts. Makridakis and Wheelwright comment:

“A strong finding reported in the forecasting literature needs to be recognised. In all cases when a selection decision as to the ‘best’ forecasting method is unclear, it has been shown to be beneficial to hedge by using more than one forecasting method or forecaster and then combining their predictions. This has proved to be an extremely effective way of increasing

forecasting accuracy and decreasing the variance of errors. Thus, when in doubt, managers should combine (that is, average) multiple forecasts that come from a variety of independent sources.” (Makridakis & Wheelwright, 1989: 31)

One might wish to combine econometric forecasts with expert opinion, or other forecasting methods, or other specifications of equations, or results from other estimation techniques. Extreme forecasts (and therefore extreme errors) are averaged away in a combined forecast. *Ceteris paribus*, averaging a larger sample of forecasts should decrease random error in the sampling distribution of forecast means provided forecasts are distributed around the most likely outcome. Furthermore, it seems likely that forecasts using different methods, or even different variables or lag structures amount to adding additional information to the forecasting process, which should increase precision.

Econometric results should perhaps not be used directly as forecasts, but rather as building blocks for forecasts--key information for the forecaster to evaluate and incorporate into a forecasting process. Addition of non-sample information by adjusting or updating statistical results, so called “tuning” of forecasts and combining forecasts brings one closer to the efficient market ideal of decisions incorporating all available information. A caveat is that expert forecasts (or any forecasts, for that matter) should be screened to try to identify biases. Shilton and Tandy (1993) demonstrate quantitatively that the quality of information provided by industry sources may vary depending upon the perceived interests of information sources.

6.11 Rent Forecasting Conclusions

Judge, et al. remark “Non-experimental model building is a difficult task, and our desire to try to obtain so much information from a limited set of observations is perhaps doomed from the start to some degree of failure....it is very important to know the limits of our knowledge so that we do not feel comfortable in our state of ignorance and do not continue to fool ourselves and perhaps others.” (1985:888) As

econometrics becomes more sophisticated, it is increasingly possible to distinguish empirically which of these limits can be overcome by innovations in technique versus those which must be accepted as boundaries of the knowable.

With respect to office market forecasting, we face a particularly thick wall of ignorance due to the nature of the processes themselves. Inherent limits to knowledge are imposed by process change and complexity as well as self interests of various actors and even irrationality. These problems can be boiled down, perhaps, to a single dilemma: If actors in office markets act rationally upon good information, then the markets are efficient, and we cannot forecast them. The future is a random walk. On the other hand, if market decision makers are more like the subjects in Paich and Sterman's experiment cited in the next chapter who were unable to work out the best strategy even in an oversimplified simulation of a market--then markets do not necessarily remain near equilibrium. This seems, based on the historical data, to be more true of office markets than the efficient market idea. But if so, then we know that markets are not acting rationally in response to market conditions. They are literally building more when rents are falling, failing to build new supply in time to meet new demand, etc., leading to the unexpected signs on coefficients like prices in both supply and demand equations. In that case, estimating causal models becomes a questionable search for rational behaviour in an irrational world. People, on the evidence, do not know what they are doing. They have failed to respond rationally to market fundamentals. In that case, how can one estimate a causal model from the historical record? Evidently behaviour was not caused by rational information such as price forecasts. To model such processes requires the heroic assumption that the market will get it wrong again the next time the same way they did last time! The best models of past behaviour would require specifying how people make mistakes under uncertainty! But if outcomes are not connected to causal variables--the series are essentially a sequence of mistakes based on misunderstanding of lag structures and inability to forecast demand and supply--then they must surely be difficult to model successfully. Such a model would merely represent a codification of how to screw up--the road map to bankruptcy. A forecast of the next market oversupply inefficiency would be based

on a model indicating that causal relationships have been misunderstood again in the same way as last time. Another way of saying this is that simple economic theories that higher prices should call forth more supply and the like are misspecified in a complex dynamic world. And we have little idea of what a better specification would be. This is the intellectual frontier where we find ourselves. Rather than continuing to send fresh numbers against the barbed wire and machine guns of a specification search, the next chapter shifts paradigms to attack our ignorance from another direction through system dynamics models.²³

6.11.1 Specification search results

Despite the above comments, my response to lack of data and lack of theory has been to seek very simple models consistent with basic theory and requiring little data to estimate. I think this approach works well enough given the highly patterned cycles of office markets, to provide useful information in forecasting. This is a keep it simple stupid (KISS) approach to a specification search.

The reader is referred to specifications in chapter 5 by Wheaton and Hendershott for comparison. My specification is simpler, but has higher R^2 . These authors do not report diagnostic statistics so how well OLS assumptions are met is unknown. Wheaton's use of demand change is theoretically sound, but the same effect is probably obtained more parsimoniously by using $S-D = \text{Vacancy rate}$ as a regressor. Hendershott's assumptions of equilibrium vacancy and rent add questions in evaluating his specification. I confess that I find none of these models (my own included) convincing. It seems to me the thing to do in practice is get the best data you can and estimate a rent adjustment equation that is "time and space specific" using data mining to identify the best fit to the sample. The "best" model probably varies between times and places.

²³ The World War I analogy seems apt in that even if we "win" a victory in the form of a model consistent with the data, pre-testing invalidates the result--a counterattack of invalid statistics pushes back the apparent advance.

A variety of specifications using vacancy rates and one or two dependent lags explain rent or rent change quite well within the sample. Adding exogenous macroeconomic variables such as a dummy related to financial deregulation, office employment, or GDP change add slightly to adjusted R². Narrower economic aggregates or farther removed series (ie trading partner GDP change, or commodity price index) did not seem to predict rents as well as the broader aggregates.²⁴ Smoothing also improves fit as might be expected due to noise and measurement errors. Working in percentages standardises market adjustments relative to market size, improving fit. Log transformations of rent and vacancy rate were tested, but did not seem helpful--the untransformed relationship is already inverse linear.

Models in levels appear to be superior to models in differences. Loss of information by differencing is costly with small samples. Levels are related by theory. Stationarity seems a better assumption than the contrary in the case of rent and vacancy rate. VAR specifications in levels are probably superior to equations using contemporaneous data in levels because the use of predetermined variables in a VAR eliminates simultaneous equations bias. I did not test instrumental variable techniques such as 2SLS. These are an avenue for future research, particularly for investigators with more data so as to allow more precise estimates of instruments. ECM specifications are required due to trends in predictors such as GDP and employment if these variables are added. Cointegrating relationships are found in office market VARs so ECM specifications are possible.

Recall Shilton's paper showing different lags and varying patterns of cycles in different American cities. This diversity of cyclical behaviour could also be expected within a particular city over time. It might be better to call the process "unstable" or "time varying" rather than stationary or non-stationary. For example, perhaps the last boom and bust in Australia can be seen as a function of a financial deregulation supply and demand shock in the mid-1980s. The next cycle with

²⁴ Newell and Higgins, 1996, did find relationships between certain lags of several "leading indicators" such as GDP of the OECD7 or share price indices. I remain sceptical as they tested so many candidate variables that their models could well be due to chance. I examined several less closely connected to office markets variables of this nature and found little effect, although, admittedly, my examination of lag structures was not as thorough as Newell and Higgins.

undoubtedly have different causes and different pattern. In applied work one should model historical situations “one at a time” rather than seeking timeless generalisations. If the aim is to forecast the future of the present cycle it may be easier to identify likely sources of variation in this cycle as opposed to all cycles.

Few variables can be included in the equations, due to lack of degrees of freedom. Therefore, all equations are obviously misspecified.²⁵ These equations are nowhere near the complete process by which landlords and tenants come to rent agreements, although they may be fairly good proxies under usual circumstances.

This small (n=26) office market sample does not allow precise estimates. On the other hand, persons sensitive to process change and chaos (ie the business community) might say 26 years is an eternity in office markets and the process might have changed so much that a *smaller* sample is the route to greater precision through less error due to misspecification, measurement error and structural change. Increases in precision due to a more homogeneous sample (smaller series standard deviation) could more than offset increase in random error due to smaller sample size if a process were sufficiently unstable.

Comparing an office building from circa 1970 to one completed today, the latter is five times larger, accommodating different technology and occupations, financed by different institutions and perhaps owned by persons from different countries with somewhat different motives. It is not obvious that larger time series samples will increase forecasting precision in a fast changing world. Optimum sample size is an empirical question.

An alternative way of looking at process change would be to say that theoretically, many of these changes could be modelled or made endogenous. After the fact, many issues could be added as dummies or time varying parameters or time varying specifications. But it is the nature of technology change to be unpredictable (to

²⁵ I would make the same comment about the most allegedly “general” of Professor Hendry’s consumption functions, which also do not include many institutional, cultural, and qualitative factors which are important determinants of consumption. Consumption cannot be a stable, time invariant process either. Philosophers of science call these omitted but relevant variables “auxiliary conditions” or “side conditions.” See Mellor, 1996, or Gordon, 1991.

mention only one possible source of specification uncertainty), so adding complexity to a model to increase fit to past data may worsen its performance for forecasting (Makridakis & Wheelwright, 1989:38).

Forecasts have high standard errors and errors in forecasting independent variables further increase uncertainty (Green et al., 1994). Nevertheless, even simple models appear to be competitive with expert forecasts in both validity and precision. Quantitative estimates will be even better if they are used in ways mindful of additional non-statistical information that may be available on process change or shocks, both past and forecast.

Wide confidence intervals are inevitable in the nature of the underlying process and no method can predict very well. A model with wide confidence bounds accurately represents a process whose considerable disorder makes forecasts inherently and inescapably imprecise. In other words, those who accept more precise forecasts may be appealing to superstition, not science. LaPlace's demon is dead (Gordon, 1991:516).²⁶ Deterministic worldviews have been replaced by the uncertainty principle and chaos theory.

Paradoxically, greater certainty of actual results might come from greater acknowledgment of forecast uncertainty. Better understanding of risks could make markets more cautious and attentive to improving information flows and feedback controls in the system thereby reducing variation and deviations from equilibrium. Acknowledging the reality of uncertainty and market decision makers own role in creating variation in outcomes shifts concern from defects in models to defects in processes-- "system redesign" in system dynamics language.

A much debated issue among valuers has been whether quantitative methods improve upon qualitative "expert judgement" methods? Expert opinion may be

²⁶ LaPlace postulated an omniscient demon who could predict exactly the future from complete knowledge of the present. At the beginning of the 19th century, science seemed headed in that direction. Twentieth century mathematics and physics, and most recently theories of chaos and complexity have convinced many people that LaPlace's concept is beyond human reach and probably not a possibility in that there is inherent randomness in the way the universe changes. Rather than a Newtonian physics world of determinism and predestination we live for practical purposes in a quantum physics world of probabilities, uncertainty, choice, and openness.

biased, consciously or unconsciously, but it certainly incorporates more than three variables and in that sense may be *less* misspecified than the above equations. Like expert judgement, an econometric estimate may be substantively (as well as statistically) biased. That is, a modeller might choose one or another specification known to produce low or high forecasts or use biased forecasts of independent variables based on where he wanted the result to fall.

Assuming an “honest” attempt at specification, quantitative methods give us a “most likely” mean forecast, despite wide ranges of uncertainty due to lack of data, errors, or process variation. The econometric equation is not a “black box” (unlike the “judgement and experience” of the expert) and therefore is open to improvement by further research and experience. And, like the expert’s subconscious mind, the lagged variables contain considerable “unconscious” information about the series’ past behaviour. Insofar as the same forces are at work in past and future, lagged dependent variables should produce unbiased forecasts. If the same forces are not at work, they will produce biased forecasts. But experts may do the same, for similar reasons. Perhaps we can try to find ways to tune models based on non-statistical information, qualitative, or case study approaches.²⁷

We need to take the quantitative modelling *process* more seriously and the resulting *models* less seriously. Any particular model estimated from sample data is an educated guess based on inconclusive evidence and even if we were certain the model was “right” we would also be certain the process is changing, so it cannot be right indefinitely. Theory provides limited guidance due to complicated dynamic structures, but each application provides a fresh set of data to mine for best fitting models.

If the best metaphysical assumption is that no future has probability 1.0 and many futures have non zero probabilities it follows that any particular forecast is conditional on indeterminate future states of nature and hence subject to error.

²⁷ Richard Ely, America’s first major academic real estate researcher, had been trained in the German “historical economics” school in the 1870s. These economists gathered large amounts of data on specific historical situations, a kind of case study method. So case studies have been a “paradigm” for real estate research from the beginning of academic studies in this area of applied economics.

Model parameter estimates and even specifications should be updated for each forecasting application as new information relevant to possible futures is obtained.

Since the *Iliad*, in which Homer's bronze age heroes march towards inevitable destinies, humans have sought comfort by seeking oracles and believing in forecasts of particular outcomes. Continuing this tradition, banks hire valuers to tell them what projects will be worth upon completion 3 years into the future, accepting specific estimates as reliable even though they should know that such estimates are conditional upon economic growth (which involves a reasonable amount of error at a t+3 forecast horizon) and upon competitors actions (how many other projects go ahead). Makridakis and Wheelwright discuss this tendency to seek comfort in certainty in business forecasting (1989: 267). Eastern cultures have also placed great credence in unchangeable "fate" or astrology. Science, through determinism, also looked for inevitable cause and effect mechanisms certain to lead to predictable outcomes. In forecasting office markets, it is safer to assume see through a glass darkly towards an array of possible futures changeable through our own actions.

6.11.2 Some ideas for future research

Despite the limits to forecasting ability, there are some promising routes to try in future specification searches:

1. Overcome the data limitations on the key demand side (where exogenous shocks originate) by use of employment and GDP data as proxies for fundamental office demand, rather than the limited and questionable office leased space figures. It would be possible to estimate ARIMA or ADL or cointegrating VAR ECM models using these larger data sets.
2. Build the demand and supply lag structures more explicitly into model structures. We know more now about lag structures and the research agenda should include data gathering to measure both supply and demand lags more precisely. Until this is done, unexpected signs and missing relationships will be common in incorrectly specified models.

3. Explore interaction effects. Labour productivity is known to vary with the economic cycles, rising in upturns and falling as the economy enters recessions. The productivity of office space and the elasticities of office supply and demand must also vary with the cycle. Low rent in a recession has a different effect on demand than low rent in a boom.
4. Incorporate more chaos into models by making them more time and space specific as opposed to time and space invariant. An intriguing implication of Shilton's empirical work on office cycles in U.S. cities is that cities differ in the cyclical behaviour of their office sectors. In some cities developers and lenders apparently anticipate demand, by luck or design, in others they have not. If cycles can vary across space, they can also vary over time. So our attention should be directed to a case study of the current cycle. How does it differ from past cycles, what new elements change its behaviour, what historical path does it follow? For example, the extreme depth of the early 1990's bust has implications for the cycle to follow: a) Larger amounts of vacant low grade space in comparison to earlier cycles, b) Larger inventories of occupied high grade space, c) Lenders still cautious and with wounds slow to heal, d) A possible negative demand shock due to office technology and downsizing, e) Property trusts, a new form of "stupid money" and fee driven deals, f) More caution about financial deregulation based on recent painful experience, at least in the U.S. where the S&L problems cost so much, g) Slower growth, slower inflation. Given these new factors and differences from past cycles, how can we quantitatively combine them with the past data to improve forecasts. Asking the same kinds of questions, ex post, about the 1980's cycles might give insights about why its amplitude was so great. Putting it all together, one might be able to contract the next cycle to the last cycle and find some empirical basis for forecasting the same or different patterns.
5. Better econometrics. I find in talking even to people who specialise in statistics that their areas of specialisation are often narrow, of necessity, given the explosion of literature. If this is true of specialists, it is even more

of a problem for those of us who do not specialise in econometrics. Office market forecasting therefore requires a modelling team, not an individual. Peter Senge of the MIT Sloan School of Management advocates teamwork in “learning organisations” as a solution to the dilemma of the need for both specialisation and breadth in practical problem solving. The office market modelling team should include members from the market coalface--leasing agents, property company analysts, people “in the market”, specialist econometricians, and academic real estate generalists to bridge the gap and ensure holistic treatment of the problem. With specialist econometricians participating, a bigger toolbox of techniques would be brought to bear, with more quality control throughout. The role of academic real estate researchers might be to do as I’ve done in other sections of this study--seek information leading to better specifications, integrate information from different quantitative methods, and apply results in an institutional context.

Chapter 7 Simulation Models for Forecasting Office Rents

If the system cannot be changed, it is either perfect or paralysed.

Coyle 1996

Dividing an elephant in half does not produce two small elephants.

Senge 1990

7.1 Definitions

This chapter begins with discussion of system dynamics modelling concepts and methods. This is followed by two simulation models. 1) A spreadsheet simulation of the Perth office market. 2) Three system dynamics models of the Sydney market. The SD simulations use econometric results from the preceding chapter to drive key rent adjustment relationships. Econometric modelling is positivist empiricist science--the researcher takes the role of objective observer seeking to understand and predict system behaviour. System dynamics (SD) on the other hand, means "application of the attitude of mind of a control engineer to the improvement of dynamic behaviour in managed systems." (Coyle, 1996:5) Office markets are not usually thought of as "managed systems," and they are not "managed" by any single individual in the usual sense of the term. They *are* designed and managed collectively, however, by multiple individuals and institutions.

7.1.1 System

A system is "a collection of parts organised for a purpose." or "a collection of parts which interact in such a way that the whole has properties which are not evident from the parts" (Coyle 1996: 4) Forrester asserts that "All systems within which we live have been designed. It follows that shortcomings result from defective design"

live have been designed. It follows that shortcomings result from defective design” (Forrester, 1991: 2) Within constraints, managers can change policies or system structure.

7.1.2 System Dynamics

Jay Forrester pioneered SD in business applications publishing his first SD paper in *The Harvard Business Review* in 1958. Forrester’s contribution was to use computers to apply control theory developed for electronics applications at Bell Laboratories and MIT during 1930-1950 to the complex situations described (but not quantitatively) by the Harvard Business School case study method. Forrester claims that “systems dynamics is increasingly seen as the best hope for dealing with multiple feedback loop, nonlinear systems that extend across many different intellectual disciplines.” (Foreword to Coyle, 1996:xi)

In 1969, Forrester published a complex (150 equations), model of urban growth and decline in *Urban Dynamics*. Conclusions of this model are suspect, however, as they seem to be more a product of the model’s structure and assumptions than of the urban system itself. Similar criticisms, and others, were made of the most well known SD model, published in 1970 as *The Limits to Growth*. This ambitious “world model” attracted considerable attention because it predicted collapse of the human economy and population within 100 years, conditional upon continued exponential growth of population and resource use. Forrester also claims to have produced an economic model with 2000 equations that predicts long wave economic cycles leading to major depressions every fifty years. There is reason to doubt the conclusions of these models for the same reasons that complex macroeconomic models are suspect: the mathematics of non-linear, complex, chaotic, imperfectly understood, and changing systems is virtually impossible to mimic in a model.

Nevertheless, system dynamics can contribute to better understanding of behaviour. Sources of behaviour lie beyond individual people. “Something about the structure of the system determines what happens beyond just the sum of individual objectives and actions.” (Forrester, 1991:9) Early work with corporations found causes of

problems usually internal rather than external and actions taken to correct problems frequently made them worse.

Forrester says “best system dynamics practice” places boundaries so most causal mechanisms lie inside, ie are made endogenous, adjusting to other variables in the system. Economists tend to assume near equilibrium states perturbed by exogenous shocks. SD modellers tend to see system behaviour generating deviations from equilibrium due to system design and small shocks. (Forrester, 1991:15)

A more encompassing framework for SD as a learning concept is referred to as “systems thinking,” with system dynamics seen as one of the tools for systems thinking. Advocates of this approach use a process for developing “transparent models” in cooperation with participants in a problem situation (Intrapirot, 1997:17). Another development is “soft systems thinking” emphasising qualitative relationships. Coyle says “system dynamics...supports a strategic point of view (top manager’s perspective)” (1996: xiii).

System dynamics problems have two things in common: The first is a wish to improve a situation by suggesting how people can act upon the system (hence the term managed systems). “This means we have to know what we want to achieve which may depend on circumstances. The principle of robustness says a system should always perform as well as the circumstances allow, regardless of what the circumstances are, that is, it should defend itself and recover from shocks and create and exploit opportunities.” (Coyle, 1996)

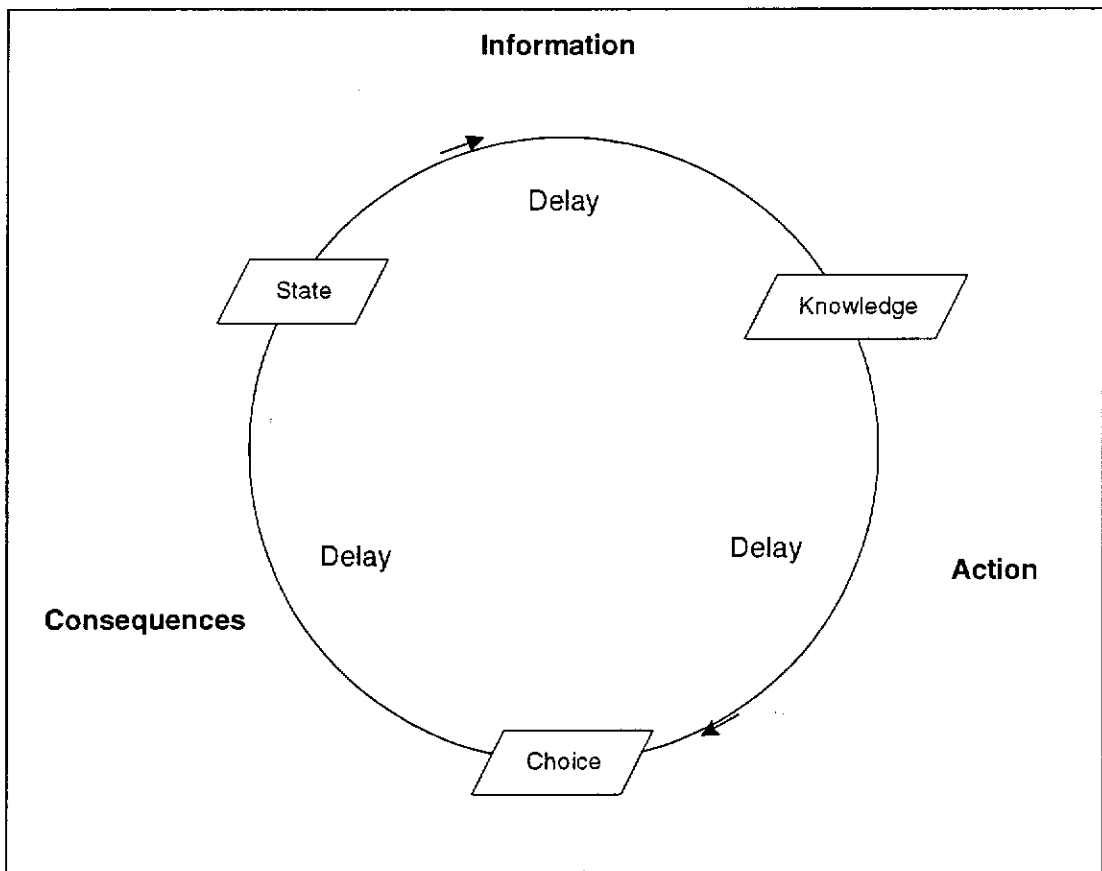
A second feature of SD modelling is the ubiquitous presence of feedback loops of two kinds:

Goal seeking or negative feedback where discrepancy from a desired state induces corrective action.

Growth producing or positive feedback, where, like compound interest, growth leads to faster growth. (Coyle, 1996:10)

The interesting insights from system dynamic models often have to do with delayed and counterintuitive effects of feedbacks. We will present the office market as an example of a feedback controlled system below. A key point is that delays mean current information may provide misleading signals--for examples, rents in an office market where a supply glut is under construction. Feedback models include "auxilliary equations" to regulate the stocks and flows in a system. System models include physical stocks and flows--eg. office inventory (the stock of buildings), and new construction, a flow which increases the stock of offices on hand. Information stocks and flows (eg. rents and rent changes) regulate the physical flows through an information structure within a system.

Figure 7-1 Coyle's Representation of System Controlled by Information



Notice also that a feedback system is goal seeking, which implies system policies. The speed with which the system reacts to discrepancies from desired states, and the speed and strength of responses (adjustment times) determine the dynamic behaviour

of the system. Information structures and policies are open to redesign by system managers.

7.1.3 Simulation

System dynamics models are a sub-set of simulation models. Websters New Collegiate Dictionary defines simulation as:

1. The imitative representation of one system or process by means of the functioning of another-- "a computer simulation of an industrial process"
2. Examination of a problem not subject to direct experimentation by means of a simulating device.
3. A sham object--counterfeit.

It is wise to keep the third meaning in mind as a caution.

Pindyck and Rubinfeld (1991:332) use the following definition:

"Simulation, as we use the word, is simply the mathematical solution of a simultaneous set of difference equations. A simulation model refers to that set of equations. A difference equation relates the current value of one variable to current and past values of other variables"

Simulation models need not be estimated from data (although they frequently obtain parameter estimates from data), so lack of data does not make modelling impossible. The price of this freedom from data is high, however, in that there are no statistical tests for model adequacy to validate a simulation model. It follows that inferences from simulation models cannot report statistically quantified probabilities. Prediction error statistics such as root mean square error are important criteria for model performance with simulation methods, but simulations do not allow for calculation of statistics like standard errors of coefficients and the like. Validation of SD simulations therefore relies heavily on how closely the "pseudo-history"

generated by the model agrees with actual outcomes and on what we know about the system.

It is desirable that models be “stable” that is produce values within reasonable bounds under a variety of conditions, rather than “exploding” to a nonsense value when input ranges are changed. The purpose of a model is important for its evaluation (Pindyck & Rubinfeld,1991:337). Different models of the same system may be preferred for different uses.

Simulation modeling has been used to represent very diverse systems (Examples in Table 7.1).

Table 7.1 Simulation Applications

African Wildlife--Species Extinctions
Aquifer management
Bank queue
Beer order
Chemical yields
Commercial fisheries and whaling
Drop of rocket fuel during a fraction of a second in a NASA rocket engine
Earthquake prediction
Emplacing and Firing a Howitzer
Flight simulators
Lake pollution
Manufacturing processes (numerous applications)
Predator-Prey
Public transport systems
Stress, wearing out, breaking in engineering applications
Testing effects of retirement income policies
War games
Weather and Climate Models

Perhaps the best known simulation is the “World Model” developed by Forrester and colleagues at MIT published as *The Limits to Growth* (Meadows, 1972). This model projected future human population, pollution, food supplies, capital, and resources, predicting a collapse within 100 years under a variety of assumptions unless population and consumption growth decrease.

There are over 50 simulation software packages.¹ Specialised simulation software can be classified as a) Primarily equation or code oriented versus b) Relying more heavily on graphical user interfaces. The latter, for example Extend and STELLA/ITHINK² allow “programming” through manipulation of icons, which automatically generate the underlying difference equation code. The equation oriented programs, DYNAMO, COSMOS, etc. require lines of code to be written. The graphical software makes it easier to learn to build models, but may have the disadvantage that checking and verification may be more difficult because the modeller has not explicitly written the code.³

Simulations are used in management or physical sciences where some of the relationships of interest may be physical processes whose functional form and parameters are well known from laboratory or field measurements. In the social sciences, we seldom have the luxury of such well established, deterministic equations to use as building blocks in system simulations.

Paich and Sterman (1993) cite several studies showing “decision making is poor where decisions have delayed, indirect, non-linear, and multiple feedback effects,” a result they confirmed in an experimental setting. (Paich & Sterman, 1993:1440) They conclude “In situations of high dynamic complexity, peoples’ mental models are grossly simplified compared to reality.” (Paich & Sterman, 1993:1456) They use the term “dynamic decision making” when decisions today alter the environment. Among the studies they cite are two which found evidence that developers start real estate projects without thinking of lags.

Subjects in Paich and Sterman’s experiment achieved two kinds of learning: about outcomes, and deeper learning about system dynamics. The latter counts most in improving performance. Paich and Sterman remark that one can not rely on *ceteris paribus* as “real situations vary in many dimensions.” Subjects showed a tendency towards “conservative demand forecasts which ensure actual capacity will be grossly

¹ This figure is from Brian Murphy, lecturer in statistics at the University of Western Australia.

² STELLA and ITHINK are essentially the same program, with STELLA packaged for the natural sciences and ITHINK aimed at business applications.

³ Coyle, 1996 provides a brief survey of the advantages and disadvantages of various SD software.

inadequate during the boom phase, causing high backlogs, long delivery delays and market share erosion.” (Paich & Sterman, 1993: 1452) Subjects failed to expand fast enough in the boom and failed to cut capacity fast enough in the bust. While some improvement occurred in repeated trials, subjects never succeeded in matching the performance of a simple decision rule. Paich and Sterman conclude decision makers need cognitive feedback in a dynamic environment through a learning cycle of observation, reflection, design, and action (Paich & Sterman, 1993: 1456).

The fact that delays, change, and complexity may make it impossible for actors to take correct decisions means that data may not conform to economic theory built on assumptions of rationality. Under an econometric paradigm we would say “signs of the coefficients did not agree with theory, therefore the model is no good.” An appropriate response to unexpected signs is to change lag structures or respecify the model. From an SD perspective wrong signs could mean the system is designed so that people are unable to make correct decisions. Forrester (1991) is willing to overrule econometrically estimated results in favour of choosing a model structure that “makes sense.”

The poor matches of supply and demand growth in office markets, suggest that this point of view probably has merit. Were we to estimate a statistical model of past supply, based on causal variables such as rents or demand, we might merely be fitting spurious equations which omit the real causal role of people’s mistakes. Attempting to forecast with such a model would amount to predicting that the market would make the same mistakes again.

Systems simulations cover a wide range from complex “spaghetti” like models with hundreds of equations and dozens of feedback loops to quite simple models with a single loop. In recent years some systems modellers have adopted “soft” modelling strategies emphasising qualitative relationships (Lane, 1992; Senge, 1990).

Forrester (1991) cites an SD national model with 2000 equations, but says the trend in its current development is to simplify by combining sectors. A trend in SD simulations has been to recognise the usefulness of readily understandable “simple

transparent” models credible to decision makers. Richardson calls this “simplifying the complex structure while preserving a behaviour of interest.” (Richardson, 1996). In discussing the question of “small models versus large models” Forrester maintains that “Clearly, a small model has advantages over a large model. Simple models used as interactive games....can ...create a dramatic impact as they reveal unexpected implications of existing mental models.” (Forrester, 1991:13) Small models align best with mental models, and thereby have the greatest effect.

7.2 System Dynamics Modelling

7.2.1 When to use SD Simulation Models

Simulation methods are useful when:

1. A system is poorly understood, to gain insight about relationships. If one’s simulation doesn’t behave like the system, the simulation is obviously misspecified and the way the model deviates may give clues about what has been left out.
2. A system is complex, so that interactions and relationships are not obvious.
3. A process is changing so that statistical results are improved by “tuning” models through addition of non-statistical information or “stepping forward” in some new way thought to be reasonable but not yet apparent in historical data.
4. To test the impact of policy interventions, decisions, or shocks quickly and cheaply through running the model under various inputs or structures.
5. Insufficient data exists for statistical methods to be valid.

7.2.2 Feedback Loops

Positive and negative feedback loops and time delays are the building blocks of system dynamics (SD) models. An example of a positive feedback would be increased bank lending for new office buildings, leading to profits from loan repayments, leading to an increase in loans and so on. It would also be a positive feedback when failures of office buildings lead to reduced bank cash flows and reduced lending. With positive feedback, the cycle amplifies itself for better or for worse.

Negative feedback or goal seeking loops are even more common--virtually all biological processes are regulated by negative feedback. Populations cycle around a level set by "carrying capacity" or a "limiting factor," usually a physical resource such as food or territory. Regulation of temperature in the human body or levels of hormones produced by endocrine glands are also examples of negative feedback control systems. The parallel between negative feedback systems and error correction models in time series statistics is obvious--the error correction mechanism is a negative feedback loop with the equilibrium state as the target or desired state to which the system returns. The essential behavioural features in Coyle's version of a negative feedback loop or control system include:

1. Sense the effects of external environment (or internal change) on the state of the system.
2. Compare the actual state with a desired state to calculate a "discrepancy."
3. Employ rules or policies to decide how the system should respond.
4. Respond using some response capability.
5. Time delays in implementation of both physical processes and information flows.
6. Information feedback then reports the effects of the adjustments and the cycle begins again.

The mathematics of simulation steps forwards through small time increments dt by means of difference equations. A systems model includes stocks (reservoirs, levels), flows (changes, differences), and “auxiliaries” or “converters” which process information used to control the physical processes. Outcomes are linked so that (with time delays) they regulate responses through feedback structures.

Statistical methods build models consistent with sample data by means of least squares or maximum likelihood estimators. Systems dynamics simulations begin with a blank piece of paper. The method uses qualitative and heuristic information in addition to quantitative data to produce quantitative output. Information used, therefore, is diverse.

7.2.3 Steps in a SD Simulation Modelling Process

Coyle (1996) recommends beginning a system modelling effort with a narrative statement of the problem as understood by “the client.” Coyle uses the word “client” broadly--it could be a firm, government agency, or society. By “problem” Coyle means a practical problem--an outcome that is unsatisfactory. Most often, because the existing system structure generates the problem system behaviour, the “solution” involves changing system “policies” or system design. The “client” may or may not understand the problem and the system correctly. Most often the client does not understand the system and that his/her own behaviour is part of the problem.

Following a narrative statement which aims to encapsulate key aspects of the system and its behaviour, the next step is to draw an “influence diagram” mapping out visually the key relationships in the system. This can be done at varying levels of complexity, including more detail as model development progresses. Understanding of the problem needs to stay ahead of model complexity. (Coyle, 1996) Layout is important, it should be visually clear and simple. Coyle advises paying attention to consistent units to help avoid confusion between stocks and flows. Plus and minus signs can indicate direction of influence.

Key concepts are: “desired state” to which the system adjusts itself (equilibrium in an economic system, perhaps), the “discrepancy” found by comparing the desired

with the actual state, and the “adjustment” which is the system’s response to reduce the discrepancy.

System boundaries, control mechanisms, policies, response capabilities, information flows, and a list of key variables are among the issues needed before the influence diagram can be assembled. Wollstenholme (1994:28) says the initial steps include identifying key variables associated with the perceived causes of concern, initial resources levels and flows.

The system is then written up into equations, stocks, and flows. ITHINK, the package used in this research, provides a graphical object user interface. The user places objects on the screen by dragging with a mouse and connects them to represent physical flows and information feedbacks. The “diagram layer” of the model is therefore a picture or map of relationships in the system. This means “how it works” is much easier to absorb visually than is the case with spreadsheet formulae. Corresponding code is created automatically by the software and made available for inspection and editing at the “equation level” of the model. ITHINK also includes a “map” layer. This allows for convenient modification of assumptions to test sensitivity and incorporate client perceptions of the system.

System dynamics is based on a distinction between “process structure---physical flows and stocks --converting resources between states” and “information structure--feedbacks, regulators, etc.” (Wolstenholme & Gavine, 1993: 34) In physical processes, levels depend upon flows, flows depend on rates. Organisation boundaries delineate extent of control in subsystems. (Wolstenholme & Gavine, 1993: 37)

The idea is to “model ways in which information, action, and consequences interact to generate dynamic behaviour, to diagnose causes of faulty behaviour, and tune feedback loops to get better behaviour.” (Coyle 1996: 5) Wolstenholme and Gavine (1993: 230) discuss the process of creating systems models, saying that system dynamics prefers aggregated holistic perspectives. User friendliness is also a goal:

“To be useful, information must be accessible...users must know it exists and how to obtain it...large volumes of information can swamp users. Moreover information must be timely and accurate. Perceptions vs true state of a variable may differ in a decision makers mind. ” (Wolstenholme & Gavine 1993: 2,3)

Lane (1994) says an SD model becomes a forum to allow participants to share understanding. Wollstenholme and Gavin (1993: 7) remark:

“An efficient market ...depends on the availability of information about products and the market place. Availability implies not simply information quantity, but also the ease of information retrieval, identifying critical sources, innovative deployment of information, comprehensive coverage of relevant areas, speed of access, relevance of the information, the form of the information, and the costs involved.”

To apply these ideas one needs to understand information resources and technology and the organisation’s business. Matching these information needs and resources is the question to solve.

Various justifications for auxiliary or rate equations are used: direct observation, accepted theory, hypothesis, assumption, belief, or statistical evidence. “As long as there is agreement between the participants as to the relationships, then the model satisfies its purpose.” (Wolstenholme & Gavine, 1993: 45)⁴

Forrester in a retrospective article on “lessons of 35 years” remarks that “the first step is to tap the wealth of information that people possess in their heads.” Forrester (1992) claims three classes of information should be incorporated in system models: mental, written, and numerical. “The management and social sciences have in the past unduly restricted themselves to measured data and have neglected the far richer and more informative body of information that exists in the knowledge and experience of those in the active working world.” (Forrester, 1991)

⁴ I disagree, and I suspect Coyle and Forrester would as well--the model is successful if it helps solve the problem. Everyone agreeing a bad model is correct does not make it a good model.

An axiom of systems modelling is that: "The behaviour of whole systems is not predictable from the behaviour of their individual components." It is therefore important to try to quantify all aspects of the system, even if some are done normatively. The shape of relationships may be more important than accuracy, in any holistic approach accuracy must often be sacrificed in order to remain problem oriented." (Wolstenholme & Gavine, 1993: 45) Coyle (1996:4) espouses a similar view.

Coyle (1996) lists the following stages in model development:

1. Recognise the problem--who cares about it and why? He says it is rare to find right answers as this stage so defining the problem should be revisited later.
2. Describe by means of an "influence diagram" or "causal loop diagram. A modeller may do a flow chart as well.
3. Qualitative analysis --try to understand the problem better by studying the influence diagram (key stage). Draw on "bright ideas and pet theories" often analogies--generic systems or archetypes. Growing systems need positive loops, while a negative feedback loop needs to refer to a desired state. Views of experts on what is wrong with the system are helpful.
4. Simulation modelling, creation of difference equations, lags, and flows in the system.
5. Policy testing and design, including sensitivity, policy design options, seeking to optimise, or testing for robustness of policies under diverse circumstances.

Robust policies may not be the same as optimum policies under certain conditions. Coyle includes chapters on quantitative optimisation techniques through hill climbing algorithms. These may mistake local maxima for global maximums, however. It may be somewhat against the spirit of systems modelling to expect unbounded rationality inherent in the idea of an optimum state. Rather, the usual

target should be system design improvements--the best that can be done in complex systems.

Coyle (1996:20) advises modellers to “think physics”--first create a skeleton of physical flows. Information is then analogous to nerves and actions to muscles. This is crucial because while information can travel quickly, perhaps at the speed of light, physical processes involve unavoidable time lags which are the key to system dynamics.

An interesting exercise is to model an economic system with purely physical flows, that is, without pricing “information” variables. This strategy was suggested by Mohammed Quaddus⁵ as a starting point for understanding office supply, demand relationships and helps highlight the lags inherent in the physical processes. The initial model presented below does so using the vacancy rate (a physical level or stock) as the discrepancy information to which supply adjustments respond. Lags in information may be more amenable to change through system re-design than a physical process. Attention to the physical process rather than the complicating issue of price changes may facilitate understanding of optimal supply response policies and information structures.

7.2.4 Validation of Simulation Models

Divorcing model structure from any explicit algorithm derived from data, means a simulation model is only as good as its assumptions. Responsible systems modellers are careful not to reify models. Models may help one learn about and form hypotheses about a system, but the system will almost certainly behave differently than the model under some circumstances.

Homer (1996) provides examples of systems models improved through iterative tests and changes in dialogue with clients and repeated testing through many versions. A simulation model is never finalised until no one can think of anything else to change and test. De Geus (1988), former head of planning for the Shell Oil companies and

⁵ Curtin University Graduate School of Business, specialist in systems modelling.

an advocate of “systems thinking,” sees simulations as a tool to aid “planning as learning” through analysis of scenarios.

Coyle lists simulation model validation techniques as:

Influence diagram must correspond to statement of the problem
Equations must correspond to the influence diagram (especially - and + signs)
Model must be dimensionally valid
Model does not produce ridiculous values
Model behaviour is plausible
Models masses should balance
Include some check variables (to make sure inflows = outflows, etc.)

(Coyle, 1996: 97)

Mean square errors or similar comparisons of model predicted values with actual outcomes are common simulation model validation techniques. Often a portion of the sample is withheld in creating the model and comparisons of model with actual outcomes made. “Backcasting” is running the model backwards to see how well it predicts past conditions from present conditions, a useful way to test realism of the model. These are called “pseudo-histories” for comparison to “reference samples.” By analogy to statistical data mining, of course, it is possible to search until one finds models that fit the sample data well but which are nevertheless invalid outside the sample.

Barlas (1996) acknowledges that system dynamics has been criticised for relying too much on informal, subjective, and qualitative model validation procedures. He maintains, however, that validation of any model (including statistical models) cannot be entirely a formal, objective process because:

1. Validity depends on purposes, which are inherently non-technical, qualitative issues.
2. Building confidence in a model is a gradual process dispersed throughout the methodology, starting with problem identification and continuing even after implementation of policy recommendations.

3. Philosophers of science have in any event not been able to define formal validation process guaranteeing validity of any theory.⁶

The problem of simulation validation is philosophically difficult because it is difficult to quantify and evaluate whether a given model structure is “close enough” to the “real” structure. Useful terminology may be “white-box” versus “black-box” models. The former are causal-descriptive, the latter correlational, data driven. See Barlas, 1996, for a discussion of “technical and philosophical” difficulties in statistical validation of simulation models. Nevertheless, the issues are similar to validation of statistical models in that model structure should agree with established “theory” and model outcomes should be reasonably in agreement with data. Modellers compare intuitions, opinions, and judgement of experts with model-generated policies.

Forrester and Senge (1980) mention three classes of tests, system structure, system behaviour, and policy improvement tests. Structure tests include:

1. Structure verification tests--consistent structure with real system so far as it is understood by diverse participants
2. Parameter verification tests--correspondence “conceptually and numerically” to real life
3. Extreme conditions tests--some systems have inherent limits, such as price cannot go below zero. Models should be consistent with such limits.
4. Boundary adequacy tests--Is the level of aggregation appropriate and does the model include all relevant structure.
5. Dimensional consistency tests--Dimensions of variables should be consistent, a diagnostic to distinguish stocks from flows, etc.
6. Statistical tests--Forrester and Senge reject statistical testing because it can be shown that failure to reject a null can occur for reasons other than lack of validity, ie measurement errors, multicollinearity, or small sample size. Citing a study where a 10% measurement error made T-statistics insignificant, Forrester (1991) notes that several possible causes can make an

⁶ I think this view is a reasonably correct characterisation of the state of play in the philosophy of science. Since Kuhn and Lakatos, science has been seen by many as a social enterprise wherein scientific truth is defined as what most scientists believe at the moment. Karl Popper was forced to retreat from his early attempts to define truth through a recipe for falsification testing by his own powerful arguments against determinism and by the failure of counterexamples to disprove generalisations in the case of stochastic processes. Burk Townsend calls this “the waning of positivism.”

hypothesis difficult to measure only one of which is that the hypothesis is incorrect. These include not enough data, multicollinearity, misspecification, and measurement errors..

Under behaviour tests Forrester and Senge list:

1. Behaviour reproduction tests--Matches with the real system including symptoms, frequencies, amplitudes, relative phasing. Does the model generate more complex multiple period cycles.
2. Behaviour prediction tests. Patterns as well as values.
3. Behaviour anomaly tests. Mismatches with real system behaviour can be shown when parts of the model are excised.
4. Surprise behaviour test. Reacts like real system to shocks
5. Extreme policy test. Changing policies to test whether system behaviour reacts plausibly.
6. Boundary adequacy tests. Change boundaries, if no changes original boundaries were adequate.
7. Behaviour sensitivity. Do parameters react similarly to system parameters.

Under the third category of tests, policy implications tests, Forrester and Senge list:

1. System improvement tests. Ultimately the purpose is to find system improvements.
2. Changed behaviour tests. Does changing structure or policies change system behaviour in desirable ways.

Reductionist logical positivists see models as an objective representation of a real system. It makes sense in this context to speak of a "true" process which the model seeks to approximate. A model may be correct or incorrect in representing the system. Philosophers of science refer to this as the "realist" position--there is an unambiguous something "out there." (See Boyd, Gasper & Trout,1991)

An opposing school, labelled "constructivist" arises from post-modernist thinking (and quantum physics) seeing all reality as constructions--one of many possible human conceptions of reality. In this view, there is no objective unambiguous truth. No representation is superior to others in an absolute sense, theories are more or less useful for particular purposes. Barlas prefers a constructivist philosophy of science where "Models are not true or false, but lie on a continuum of usefulness." (Barlas, 1996:187) In this view, formal tests are only part of a larger process of model

confidence building. Usefulness of a model depends not only on whether it generates plausible numbers, but also on whether it generates research questions, and ideas for system improvements.

De Geus (1992) observes that the future cannot be predicted, so no model can ever be a precise representation. Models play a role in helping managers to make up their own minds, as a tool for learning.

7.2.5 Evaluation of SD Simulation Models

Parsimonious representation means models always leave out part of the story. But more complicated models do not always mimic system behaviour better because it is difficult or impossible to specify all possible relationships correctly.

Modeling strategy depends upon how the model will be used--form follows function. A very simple approximate model may be superior for some purposes, because it is faster and cheaper to collect data to drive it and it may be more understandable and hence better accepted by users. Even simple simulation models sometimes make clearer the emergent properties, including uncertainty, in complex systems.

When errors are included, by driving the model with data generated by a real process or by generating random elements from a specified probability distribution, repeated simulations may give new insights into system behaviour. Renshaw (1991:4) says:

“Apparently trivial non-linear models....give rise to a surprisingly rich diversity of mathematical behaviour ranging from stable equilibrium points, to stable oscillation between several points, through to a completely chaotic regime...even aperiodic fluctuations. In biology we are often asked to infer the nature of population development from a single data set, yet different realisations of the same process can vary enormously. Where fantasy takes over is in the belief that the mathematically...fine structure of deterministic chaotic solutions might be observed...Any superimposed environmental noise, almost no matter how small, destroys it.”

Forecasters of office market dynamics face exactly the same problems. Renshaw's research is concerned to emphasise risks of species extinction through random variation when populations have fallen to low numbers. Renshaw gives an example where starting with a population of 3 individuals, each with probability of a birth = 1 and death = 0.5, in 20 simulations of only six time periods, the ending population ranged from extinct to 225! (Renshaw, 1991:3)

Much instability is due to delays in responses within the system. Renshaw again:

“Delays are likely to cause oscillations...(in ways similar to the delays that means that it is possible to alternatively freeze and scald oneself in a shower Renshaw (1991:88). This can result in “dampened oscillations, or non-dampened (expanding cycles), or two point or other cycles, or chaotic oscillations...” (Renshaw, 1991:105)

Renshaw observes,

“We sometimes can't tell for sure. If one takes the view that simple mathematical models can reflect only basic qualitative phenomena of complicated biological structures, such as chaos or limit cycles, then use of quantitative fitting techniques in non-linear systems may well be overambitious (Renshaw, 1991:113). The fascination of natural communities of plants and animals lies in their endless variety. Not only do no two places share identical histories, climates, or topography, but also climate and other environmental factors are constantly fluctuating. Such systems will therefore not exhibit the crisp determinacy which characterises so much of the physical sciences (Renshaw, 1991:223). Understanding will not generally be enhanced by employing “clever” mathematical techniques to develop large and complicated probability solutions. These are often totally opaque as far as revealing any insight into the underlying stochastic processes concerned (Renshaw, 1991:382).

Nevertheless, Renshaw considers parameter estimates to contain “valuable information.” It is just that you wouldn't be surprised if you were wrong. I belabour

these points because similar comments apply to office market forecasts. The systems Renshaw studies are in some ways quite complex (as he states), but in other ways--speed of process change or innovations, additions of "new species" to the system-- far slower to change than human societies, and hence less difficult to model. In real estate finance, for example, there are at least half a dozen new "species" of institutions that did not exist 30 years ago, not to mention major technological innovations (computers, faxes). The first office buildings as we think of them today only date from the 1870s, made possible by the invention of lifts, steel frame construction techniques, and pumps capable of servicing a loo in the upper stories of a building.⁷

The implications are profound: State of the art mathematical representation results in an indeterminate solution and one can think of very good reasons why models could never be a great deal better (as Renshaw states). Models can enhance understanding, but they cannot offer complete understanding. It is important to educate users on these points to avoid unrealistic expectations and discrediting of quantitative methods.

Senge (1990) calls SD simulations used in management "microworlds" and lists key issues to explore with models:

- Integration between microworld and real world
- Slowing down or speeding up time
- Compressing space
- Isolating variables
- Experiment
- Reflection
- Theory-based strategy
- Institutional memory

(Senge, 1990: 336)

Senge's work takes a messianic tone:

"From a very early age we are taught to break apart problems, to fragment the world. This apparently makes complex tasks and subjects more manageable,

⁷ An example of Senge's idea that major changes often come from synergism between several new technologies. He sees SD as one of five synergistic management disciplines.

but we pay a hidden, enormous price. We can no longer see the consequences of our actions; we lose our intrinsic sense of connection to a larger whole. When we try to see the big picture--to reassemble the fragments in our minds, to list and organise all the pieces...the task is futile--similar to trying to reassemble the fragments of a broken mirror to see a true reflection. Thus, after a while, we give up trying to see the whole altogether.” (Senge, 1990: 3)

Lessons listed by Senge:

1. Structure influences behaviour--different people in the same structure do similar things, systems cause their own crises, not individual's mistakes or external forces
2. Structure in human systems is subtle--structure means the basic interrelationships that control behaviour. In human systems, structure includes how people make decisions, the operating policies whereby we translate perceptions, goals, rules, and norms into actions.
3. Leverage often comes from new ways of thinking--people usually focus on their own issues, and ignore how their decisions affect others.
4. For you to succeed, others must succeed as well. (Senge, 1990: 40)
5. Natural responses make the situation worse.

The solution is to change ways of thinking (look ahead more), change information flows (let people know more quickly what other actors will do), coordinate and control or manage the entire system rather than make decisions in isolation.⁸

Leverage to solve problems comes from understanding dynamic complexity, not detail complexity. Actors need to see interrelationships rather than cause-effect, see processes of change rather than snapshots.(Senge, 1996: 72) In filling a glass of

⁸ In discussing *The Iliad* critics call this technique “foreshadowing” as when Homer mentions Achilles will not live much longer. This quote is a foreshadowing of my conclusions chapter.

water one's hand turns on the tap, but the level of water controls the hand. This is a parable for a shift to system's thinking--look for control mechanisms. Senge claims there are only a small number (16) of basic generic feedback systems or archetypes. (Senge, 1990). For example, the same negative feedback loop structure appears in systems as diverse as a predator-prey model in biology, an inventory control system in business (including office supply inventories), or adjusting temperature in a shower.

The subconscious assimilates more than the conscious mind, so to get good decisions we need to build rapport between conscious and subconscious (consult prayer, gut feelings) and focus on desired result. Clarify values to get yourself going in one direction which allows the subconscious to come to a conclusion. (Senge, 1990: 165)

Senge, "Poses systems thinking as an alternative to the pervasive "reductionism" in Western culture--the pursuit of simple answers to complex issues." (Senge, 1990: 185) "If managers believe their worldviews are facts, rather than assumptions, they will not be open to challenging those worldviews. Research shows that most of our mental models are flawed. Improving mental models is a collective enterprise. We need to reflect and re-examine mental models. Collectively we can be more insightful, more intelligent, than we ever can be individually." (Senge, 1990:203,239)

Senge describes a management training workshop using Eastern and Western philosophies and systems diagramming: "We begin suggesting feedback links.. within a half hour, we've covered the wall with circles and arrows. Everyone in the room feels overwhelmed, and yet we know that we've just begun to show the hundreds of interrelationships that exist in the real system. People gradually come to realise that no one could possibly come to figure out all these iterations.

This realisation has a remarkable impact on people. Some try to rationalise it away: 'Well, this is so obvious it's meaningless,' they say. 'What's the point' Others insist that, given enough time, they could eventually figure it out. Some diehards keep

trying to add links and loops. But those who can face the ‘un-figure-out-able-ness of it all will often sit back in their chair, laugh, and realise some spring has sprung.’ (Senge, 1990: 281) “Now I realise that nobody knows the answer to this problem, not us, not them, not anybody,” a participant concluded. (Senge, 1990: 282)

“Many people will say that once you recognize that you can never figure life out, you have denied rationality. But that’s not true. To search for understanding, knowing that there is no ultimate answer, becomes a creative process--one which involves rationality but also something more.” (Senge, 1990:282)

7.3 Spreadsheet Simulation of the Perth, Australia, office market

Where academic work on office markets has been overwhelmingly statistical and aggregated to market or even national level data, industry spreadsheets usually consider individual development projects and use naive forecasts based on recent experience. It is not clear whether introduction of spreadsheets or other real estate cash flow software applications improved real estate development decision making. In hindsight, probably not, considering the \$150 billion taxpayer bailout of S&Ls in the U.S. and billions in bank writedowns in Australia, Japan, Europe, and elsewhere due to the 1980s property boom/bust cycle. The computer in some cases gave a spurious credibility to “cooked” numbers. Numbers printed on white paper by a machine look so reliable, regardless of their veracity, that questions about precision, sources, and validity may have been slighted. Analysts spent more time crunching numbers and perhaps less time improving data. “A lot of people don’t get paid unless there is a deal,” so analysis is geared towards finding a way to make the deal look feasible.⁹

Results are sensitive to assumptions, yet even current rents and expenses are uncertain. Future cash flows often were fantasies designed raise an estimated value of the property to facilitate borrowing or attract investors. While theoretically more correct than previous “rule of thumb” methods, such as capitalisation rates or gross

⁹ Quote from a Perth property agent.

rent multipliers, the discounted cash flow models face the problem that naive log linear forecasts of rent and value increases are often unrealistic. Based on past experience, in many markets it would be more empirically defensible to assume instead that past cycles will continue into the future.

In 1993 the Perth market was at the bottom of a cycle, net effective rents having fallen from as high as \$350/m² to perhaps \$65/m². Expected timing of future demand and rent recovery made a big difference to current values in the 1993 Perth office market. Hooker Research asked me to develop a model to provide a ten year forecast of Perth CBD office supply, demand, rents, and values. A year later, in early 1994, Bankwest contracted for a second Perth market forecast, preparatory to selling a major Perth office tower which the Bank had acquired from the failing Alan Bond empire in 1989. The bank had decided to sell the 38,000 m² headquarters to rationalise its balance sheet preparatory to a share float which would privatise the state owned bank.

Both of these modelling exercises set out to simulate cycles with period and amplitude consistent with past experience. They also set out, particularly in the second iteration, to connect academic econometric techniques and market level analysis to individual project decision making. The version of the model submitted to Bankwest in April, 1994 included the following innovations in comparison to typical industry property simulation:

1. A GDP forecast is used to drive office demand growth tying office market demand explicitly to macroeconomic outcomes. Three scenarios were created: Best guess extending current trends, optimistic assuming a mining investment boom, and pessimistic scenario based on recession in major trading partners and falling commodity prices, etc. Bankwest had purchased state GSP forecasts from economic forecasters. A respected forecaster in the State Chamber of Commerce and the State Department of Development, as well as other sources, were also consulted for their GSP forecasts. Australia is a small enough country so that the forecasts of a few leading forecasters put one close to "best possible" information on macroeconomic futures. We

felt that the optimistic scenario looked more probable, given rapid Asian growth. While scenario analysis is commonplace, we put more serious effort into building plausible alternative pictures of the future than is usual.

This approach helps make clearer the conditional nature of forecasts--everyone knows GDP can not be forecast very well beyond a few quarters. If office demand depends explicitly on GDP that means office demand must be uncertain.

2. The spreadsheet forecasts adjust demand based on explicit assumptions about structural change (percentage of workers in offices), productivity growth (to relate the GDP forecast to employment effects), and space per worker (to tie employment forecasts to office demand). This means one can test sensitivity to these important changes, which would not be reflected in past data.
3. The model disaggregates the market into 3 pools; high grade CBD space (premium and A grades), low grade CBD space (B,C, and D grades), and suburban office space. We did not disaggregate to the individual building level, although we ended with a section reporting rents and values of a "typical" premium office tower resembling the Bankwest Tower. To disaggregate to the individual level with any rigour would require analysis of individual building characteristics and competitive buildings, using hedonic modelling or valuation techniques.
4. The model adjusts rent based on an econometrically estimated coefficient on vacancy rate. That is, the equation $\Delta\text{Rent}=b*\text{Vac}\%$ is used to estimate rent change. A major weakness in the model is the crude nature of this equation which does not mimic market behaviour well. Work like that reported in the previous chapter improves considerably on this version.
5. The model shifts existing demand between building grades based on recent history, adjusting for rent differentials. At the time the model was being built huge flows of tenants were occurring (on the order of three times net new

demand) from old to new buildings in Perth. Recognising this, and that such flows would cease, or even reverse as vacancy and rent conditions changed in the different submarkets, was a major improvement on market level aggregated models.

6. The spreadsheet allocates new demand (growth in demand) between top grade and suburban offices. The relative growth of suburban offices in America (Suburban supply increase was 2.5 times CBD new supply growth during the 1980s), Sydney, and Melbourne) suggested that this issue could not be ignored.
7. The model assumes a supply response based on a) demand, b) "correct" rent forecasting by developers, c) minimum rent requirement to make new construction feasible--a rent trigger for construction, and d) overresponse. The latter was implemented by multiplying an estimate of demand by a factor of 2 or 3 to create oversupply. Although this might seem arbitrary, it in fact was consistent with market behaviour over the last two Perth office cycles and international experience.
8. In valuing a property the model incorporates an adjustment of office yields (capitalisation rates) to reflect past relationships with the economic cycle--lower in booms, higher in busts, despite macroeconomic policy to the contrary.

The model began with then current--April, 1994--Perth conditions and stepped forwards ten years using the above assumptions. The model generated cyclical forecasts of office rents and values and adjustments which seemed qualitatively reasonable.

Interpretation of results included consideration of Bankwest's unique risk position as the largest Perth CBD tenant. Occupancy costs, competitive position in the market, and employee productivity may all be bigger issues to the Bank in the long run than sale price of the Tower. Discussion of the forecasts included comments on these issues.

This model's forecasts of a recovery in rents and values have proven generally correct, so far, three years on. Caveats that demand growth and rent recovery might prove a bit softer than in the last boom due to large amounts of vacant inventory, office automation, and lower costs of suburban space have also proven correct, so far.

The projections failed to anticipate the size of the current W.A. mining/energy extractive industries investment boom which raised state growth above expectations. However, the actual outcomes are roughly consistent with the optimistic scenario conditional forecast. In hindsight, no spectacular shocks have appeared in the world economy since early 1994, while Western Australia's pro-development liberal government has relaxed environmental restrictions, de-regulated energy prices, and promoted infrastructure and other development projects. These positive shocks to the state economy were sufficient to raise results towards the upper end of the forecast range.

As is often the case with simulations, the specific forecasts are perhaps less interesting than the insights about system behaviour gained from a model. In this case the following interesting observations arose from model behaviour under a variety of assumed input conditions:

"The pattern of recovering values and rents is robust across a wide range of growth assumptions." (Kummerow, 1994:8) Because new construction is not feasible until rents recover, rents must rise no matter what the specific outcome within the range of growth rates (averaging 2.5, 3.5%, and 4.5% over the next decade in the three Bankwest forecast scenarios). Higher growth resulted in earlier new construction, moderating rent increases, while slower growth delayed construction. This meant a wide range of growth scenarios led to increases of rents and values for existing buildings which were at the time of the forecast valued at well under replacement cost. The report's forecast of declining market yields as the office cycle moves from the trough towards the cycle peak has also come to pass, resulting in further value increases. Fastest growth was not necessarily most favourable for the Bankwest Tower and other existing structures as high growth would tend to lead to bigger

oversupply in the next cycle and more amplitude in the rent cycle. This would be expressed as new buildings which “demote” existing top class buildings from their preeminent ranking in the local market.

The most surprising insight to me was that methods for valuation of property in commercial markets must change if one projects cyclical cash flows. This insight, which would not have been attained without the model, is developed in chapter 8 on valuation with cyclical cash flows.

Although this model included a number of useful innovations, it suffered several serious weaknesses. First, it used a crude method for adjusting rents. The rent adjustment equation was simply a coefficient from an estimate of the Sydney office market from the Abelson and Cooper (1990) paper, applied to excess vacancy rate, specifically, excess vacancy was multiplied by -2.3. As Abelson and Cooper’s model was estimated from Sydney data and did not forecast well even in Sydney, this is an obviously misspecified model. It expresses not much more than a qualitative view that demand is price inelastic.

The model allowed arbitrary variation of the equilibrium vacancy rate as an exogenous input used to calculate excess vacancy. (See discussion of normal vacancy rate in literature review, Chapter 5.) The model would be improved by making this key variable endogenous, perhaps as a function of demand growth rate. Hendershott’s critique (see literature review chapter) of a single independent variable for rent adjustment also applies. In this model, rent does not respond quickly enough, nor is rent change responsive enough to changing conditions--both timing and amplitude of rent cycles are suspect.

The supply equation is arbitrary and perhaps unrealistic. The model performs an “if” test on rents, and if rents are high enough to make construction feasible, switches production from zero to some multiple of demand. Consistent with past oversupply, most model runs were performed assuming developers would provide 2 or 3 times the amount of new space actually needed. This oversupply shows up as soon as rents make it feasible--the model assumes developers are good rent forecasters. This assumption that effectively the supply lag is zero is also not always

true (Shilton, 1995). The assumption of oversupply guarantees a cyclical pattern of rents which will “turn on” and “turn off” new supply in a plausible manner. Not surprisingly, however, these crude market adjustment equations mean the model “blows up” if pushed very far from a particular range of inputs. Rent adjustment, as noted above, took “too long” meaning the rent adjustment equation was missing variables that make rent adjust more quickly to market conditions. In real world markets, expectations change--so called “technical” factors, as opposed to fundamental determinants of demand and supply--result in sudden big adjustments as market psychology changes. I did not solve the problem of how to model such changes. The econometric literature includes explorations of events like the stock market crash of October, 1987, which attempt to identify the timing of such adjustments in expectations. Catastrophe theory whereby a small incremental change triggers failure of a dam or breaks a camels back demonstrates how a small changes can lead to larger effects.

Given these problems, my spreadsheet model, like most forecasting methods, is perhaps reasonably good for stepping forward three or four years, and then much less reliable. Forecasts were made easier by the extremely low rents then current which virtually guaranteed fixed or declining office supply for several years. This is an important forecasting insight--at some times forecasts are much easier than at other times, based on deviations from equilibrium. If the market is at equilibrium, unless we know something about future shocks, our best guess is a random walk--not very helpful for making money. But in 1994, “return to equilibrium” was probable, so the direction of the market was fairly clear, conditional upon macroeconomic growth which at that time also seemed a good bet. It is interesting that at the very moment when market psychology was despair and banks unloading office buildings, a forecasting oriented investor would have found the greatest certainty in forecasting *above normal* returns.

Data was a problem in that allocations of demand between market segments had to be implemented by educated guesses based on anecdotal evidence. The model was based on a number of plausible, semi-informed, assumptions about system behaviour. It is better to include something about these features of system behaviour

which we know exist, but for which we lack data. For example, a model that assumes a 1% demolition rate of existing property, in a world where the true rate is somewhere between 0.5 and 5% is better than a model which has no treatment of this issue at all, thereby implicitly using a rate of 0, which is clearly incorrect. Another example: My rent adjustment equation is at least connected in a crude way to vacancy rates, a clear improvement over naive log linear growth projections of the sort that led to the oversupply debacle. In hindsight, it is inconceivable that high vacancy rates were projected without recognising concomitant effects on rents.

Additional data is needed to get a better fix on market segmentation issues. These loom very important in project commencement decisions given that vacant space has decreased in new buildings, but remains in old buildings in some markets. If tenants are content to use old buildings, or refurbished old buildings, there is less need for new supply. Appendix 7-1 is a sample of the Bankwest spreadsheet model output.

7.3.1 Use of the Spreadsheet Simulation

This section comments on the model's effectiveness in the decision process, that is, its benefits to the client. The bank might not have gotten maximum value out of the modelling effort because it kept the modelling process at arms length. This of course has the apparent advantage of adding credibility by allowing the bank to claim the model came from an outside (university) source, but I doubt this worked since the buyer would know that the bank would only present "objective" evidence favourable to their position. The buyers, in my opinion, would have placed little weight on the models' conclusions.

This suggests to me (following the recommendations of Coyle and others in the simulation modelling literature) that the bank would have gotten better value from the model by bringing the modelling process "inside" and in fact sharing it with potential buyers. If all concerned had agreed on model assumptions and structure, a degree of credibility could have been obtained that would have made the model's conclusions more convincing and effective in attaining the bank's objectives.

7.4 ITHINK Simulation of the Sydney Office Market

7.4.1 Narrative Statement of the Office Market Problem

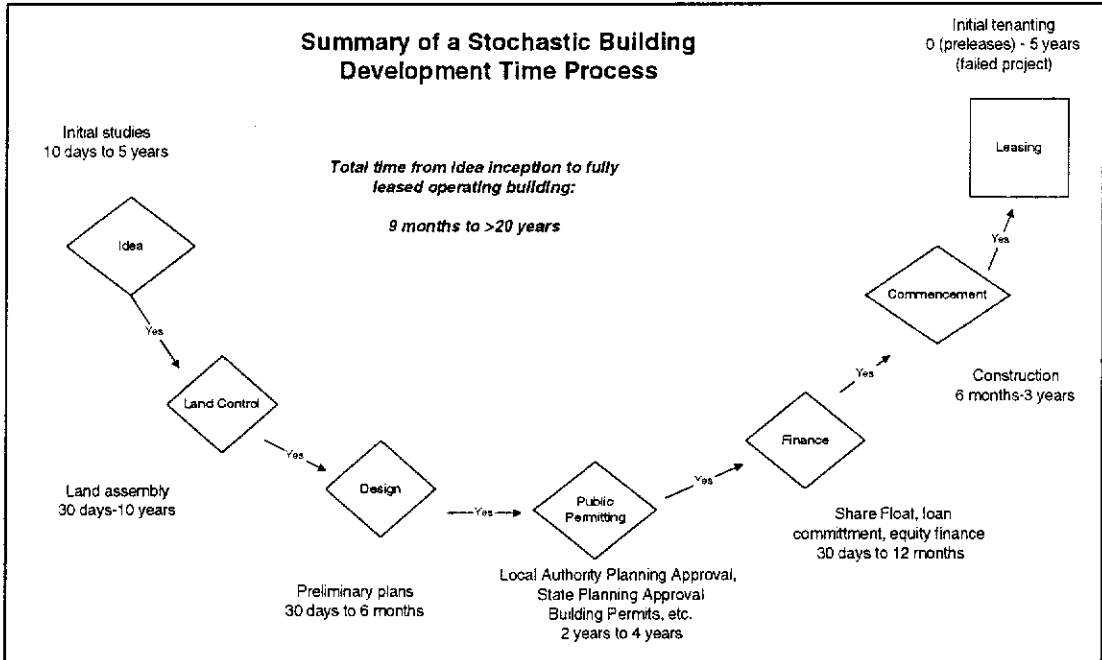
The chapters on Perth market participants' explanations for oversupply and development of the four major Perth buildings constitute lengthy narrative statements of the office market problem. The spreadsheet model discussion also adds to the picture of markets with price inelastic demand, driven by economic activity and employment, supply with fixed short term supply, but long term supply very responsive to price changes at the rent levels where projects "become feasible" (meaning $NPV > 0$). Supply is responsive to capital market dynamics--market participants cite asset allocation policies of institutional investors as a major cause of oversupply. These characteristics create a volatile rent and value cycle with periodic pulses of supply and falling rents followed by slow recovery as demand growth fills the empty space.

There are at least three kinds of lags:

1. Supply lags

Supply lags can be broken into a number of steps-- "idea stage", land assembly, etc. Miles, et al. (1996) propose an 8 stage description of property development. However, a simpler three step classification would be a) Land assembly" ranging from less than 1 to more than 10 years, b) Planning and public approvals (approximately 2-5 years), and b) Construction, which varies with size of project, planning/construction methods, and delays such as weather and labour stoppages (about 6 months to 3 years). The initial renting up period is an important fourth stage of development which may take from 6 months to 5 years or more for major projects.

Figure 7-2 Supply Lags



2. Finance lags.

Brueggeman found legal and other delays involved in taking non-performing property from borrowers in default and then cleaning it off the lender's balance sheet take 3-4 years (Brueggeman, 1993). Until this balance sheet cleanup is completed Brueggeman found that lenders can not or will not finance new projects. This is an important finding because it helps explain why forecasts of demand growth don't call forth supply in timely fashion. Undersupply due to lack of finance early in the cycle sets the stage for oversupply by driving rents up to levels that will call forth excessive production and subsequent collapse of rents. The finance lag sets up a rent oscillation.

3. Demand lags

One can identify several demand lags.

1. The Building Owners and Managers Association (BOMA), Sydney, surveyed office using firms asking current employment versus employment with

existing space used at full capacity. In the early 1990s, these surveys found up to 20% vacancy within existing tenancies. (BOMA, 1988-1995) Apparently, employment could grow, at a maximum, 20% before any derived demand for space appears. As employment growth only averages around 2%, this indicates a lot of slack within the leased space which we have used as a proxy for "demand." A lag of several years might occur while this slack is taken up before employment growth is reflected in new leasing activity.

2. Only 15% or so of leases turn over annually. When they turn over, space efficiency (space per worker through design of office layout) is likely to change. Adjustments to space per worker due to design changes, therefore, will take place in lagged fashion over a period of years as leases expire.
3. There are delays between increases in sales leading to new hiring, new hiring leading to decisions to lease additional space, and still more time to actually choose and commit to space. Nourse's paper (1992) on selecting administrative space suggests the time between decision to take space and lease signing may be on the order of six months to one year or perhaps more. In the Sydney data, correlation of office demand change is higher with the lagging indicators series than with coincident indicators and lowest with leading indicators. Office demand appears to lag the economic cycle slightly. (See correlations with leading, coincident, and lagging indicators in chapter 6.)

Lags found empirically in the statistical series would be the sum of all these lags, and perhaps others, net of expectations which could lead to leasing behaviour in advance of fundamental demand. Lags make it unsurprising that the system cycles around equilibrium. Clearly the system cannot respond expeditiously to supply or demand shocks. Recall also that firms hold inventories of leased space, which may depend on cost of space and growth expectations and that their desired inventory holdings may change over time.

7.4.2 Office Supply Analogy to the Beer Game

Because the issues are so similar, an aside to discuss a simulation archetype is in order. The “beer game” is a demand shock which cannot be met instantly, leading to a backlog and increase in orders, followed by catching up, oversupply, and cessation of orders. Adjustments in inventory levels and lack of coordination among market participants exacerbate the cycle. Extend (an Apple Macintosh system modelling software package) uses the beer game as one of its modelling examples. Senge (1990) devotes a chapter to the beer game as an archetypical system dynamics problem. Paich and Sterman (1993) present a more general “new product introduction” model with positive “word of mouth” and negative “market saturation” feedback loops driving demand. In P&S’s decision making experiment, which is essentially a slightly more complicated version of the demand shock/ supply delay/ backlog/ oversupply dynamics of the beer game system, decision makers confused by delays and feedback structures were unable to equal the performance of a simple rule.

The beer game scenario creates cyclical behaviour because initial low production capacity (or time lags in deliveries) ensures that if deliveries are ever to catch up and eliminate the backlog, production must exceed long run average production at some point. Once production gets to this high level deliveries can easily overshoot demand, so production must fall below long run average demand when these large deliveries cause unsold inventories to rise. Behaviour of the system will depend importantly on the specific delays, information flows, and expectations structures in the system. Essentially, the SD model structures I propose below are all wazzu variants of the beer game model.¹⁰ More generally, the problem can be seen as one of inventory control. Inventory in this case is vacant office space.

7.4.3 Model 1 Office Market as a Physical Process

Three system dynamics simulations are presented below:

Model 1. A “simple supply/demand” model of the office market as a physical process with a single negative feedback.

¹⁰ Thinking back to my undergraduate days at the Badger Tavern in Madison, this seems appropriate.

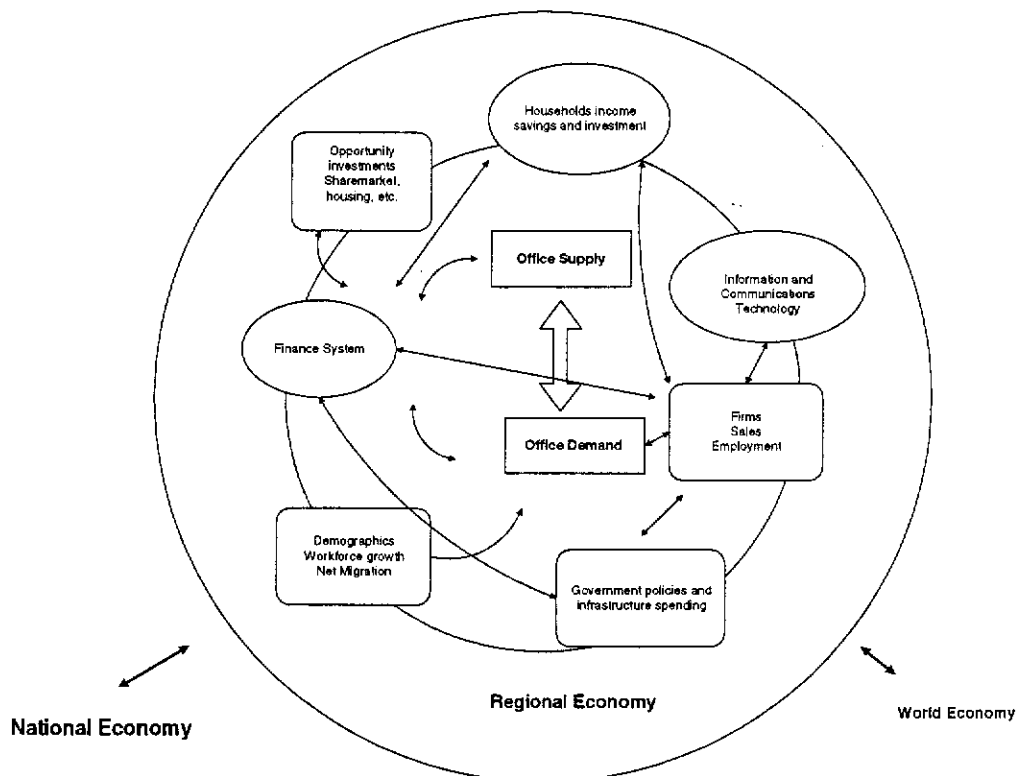
Model 2. A “simple transparent” model using econometrically estimated equations to calculate rent adjustments in response to exogenous supply and demand changes.

Model 3. The rent adjustment model (model 2) with supply made endogenous.

Appendix 7-2 is a printout of these three models map, diagram, and equations layers. The first is most useful as a means for testing system policy and redesign issues. The second allows decision makers to update rent forecasts quickly based on their own perceptions about demand and supply outcomes. This would be useful in project commencement decisions, for example to estimate effects of a competitive project on future rents. The third may improve forecasts, provided supply response is specified so as to produce outcomes similar to the market.

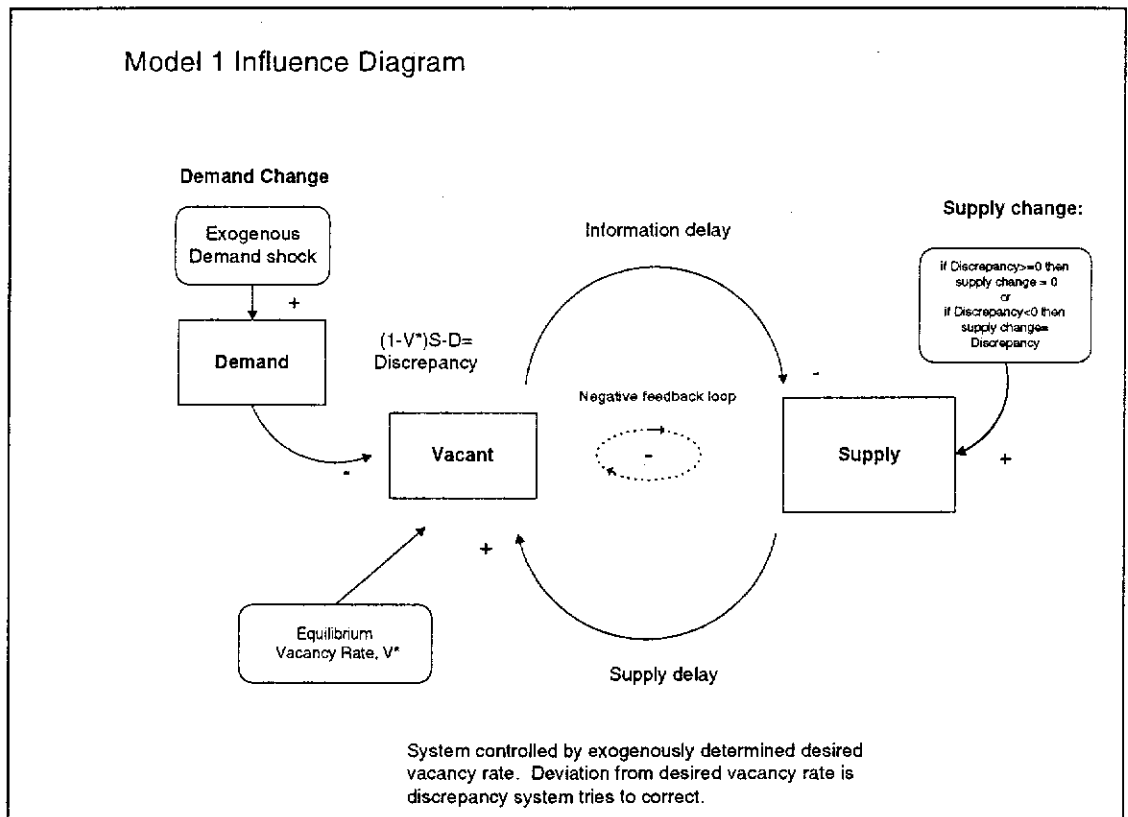
The office market system is complex and interrelated with local, national, and world economies. A partial diagram is in figure 7-3.

Figure 7-3 Schematic diagram showing office market interactions



Mohammed Quaddus¹¹ suggested looking at the office market process first according to Coyle's recommendation to "think physics." That is, in terms of physical processes without prices. In fact, this model was built after several other versions, but will be presented first due to its simplicity. The influence diagram for this model is presented in Figure 7-4.

Figure 7-4 Influence Diagram for Model 1



Shilton's paper (1995) implies that we should not be so naive as to use the physical supply lag automatically as the supply lag in the system. By looking forward (or being oblivious to market conditions¹²) developers may anticipate demand and reduce the supply lag by beginning construction in anticipation of future demand.

There may also be demand lags--or one should say "delays" in systems dynamics jargon. A demand shock may not be felt as a signal calling for new supply orders

¹¹ Curtin Graduate School of Business, specialist in information systems and system dynamics.

¹² Detoy and Rabin, 1972, argue that developers always want to build regardless of market conditions.

for some time for a number of reasons including inventory changes, delays in hiring (ie adjust workload or hours worked first and employment later), changes in workspace ratios, and lease expiry lags. The demand lag might be anything from perhaps -5 to plus 10. By minus five I mean the firm leases space five years before it needs it. Given ten year leases, this is not as outlandish a possibility as it sounds. A lag of plus ten years could result if the shock (especially a negative shock) occurs immediately after signing of a ten year lease. I have omitted demand lags from the model in order to concentrate on supply response issues.

A physical (priceless) version of an office market model is driven by:

1. Desired state is $S=D+V^*=D^*$
2. Discrepancy is $S-D^* = XV$ (excess vacancy)

The preferred state of the system is equilibrium, where $V=V^*$, that is, actual vacancy rate equals equilibrium vacancy, in which case the discrepancy (see diagram) will be zero and no space adjustment will occur. If there is excess supply, supply change is zero (buildings are not demolished in this simple version). Once a space shortage discrepancy occurs, the system adjusts by trying to eliminate the discrepancy, constrained by production capacity and supply lags. I have complicated the simplest version of the beer game by making the supply adjustment a function of three parameters, rather than simply a time delay. All three parameters seem relevant in office markets, based on historical behaviour of the system.

1. *Oversupply*. This is the multiple of the discrepancy that will be supplied and reflects the game theory or agency problems in office markets. Or, if you prefer, the herd instincts of fund managers, or Grenadier's "preemptive building cascades" behaviour. Oversupply could range from 0 (none of demand is supplied) to some positive number >1 , but probably <3 . If oversupply is set to 1, developers supply exactly the amount of space needed to eliminate the discrepancy.

2. *Adjustment time.* One can observe in the historical supply change series that supply pulses do not appear all in one year, but spread across perhaps 2-4 years.. “Adjustment time” is defined as the number of years it takes the system to respond to the discrepancy in year t . This could be understood as the lag between discrepancy appearing and the commencement of construction, expressed as percentage of the discrepancy commenced each year. If X amount of space is needed, X/j will be commenced per time period, with j being the number of time periods in the “pulse.” Recalling chapter 4, one might relate this spreading out of commencements to stochastic planning lags or other delays early in the office market development process. Adjustment time could probably range from 1 to perhaps 4 years. For example, if there is a need for 90,000 m² of new space, and adjustment time is 3, the market will commence 30,000 m² this year. Each year, of course, the discrepancy will be updated and a third of the new figure commenced.
3. *Supply lag.* Finally, there is a construction lag which I have called supply lag. Physically this may be 2 or 3 years for major projects. Anticipating future discrepancies could move the supply lag to 0, as Shilton (1995) found empirically in some cities, or even to a negative value if projects are finished early in anticipation of future demand.

A fourth system response parameter is *equilibrium vacancy rate*, V^* , the system’s desired state (see discussion in chapter 6).

7.4.4 Model 1 Simulation results Under Three Demand scenarios

System behaviour can be simulated by scenarios combining various patterns of demand growth with combinations of the four system adjustment parameters. Results from three demand scenarios are reported here:

1. Steady demand growth--arbitrarily 4% per annum.

2. Positive and negative demand spikes--4% growth increasing to 8% or decreasing to -4% for a year.
3. Actual historical demand behaviour from 1975 to 1995.

For each of these we might be interested in examining system behaviour as the parameters of the model are varied, that is at various:

1. Normal vacancy rates
 2. Oversupply assumptions
 3. Adjustment times
- Supply lags

Imbalances of supply and demand introduce inefficiencies and losses in office markets. Too little supply relative to demand constrains economic growth, too much supply causes financial losses. Both too much and too little office investment misallocate capital and reduce social returns to capital. How well the system is functioning can be proxied by how close it stays to equilibrium, the desired state of normal vacancy rates. Taking the discrepancy $(S-V^*)-D$ as the “error” in the system, we could use error statistics such as RMSE (root mean squared error) or MAPE (mean absolute percentage error) as measures of system efficiency.

Here we are interested in developing these methods, not in pursuing an exhaustive study for policy analysis. I will present only a few qualitative results from model 1 and selected model graphical output. The “base run” or “reference mode” of the system is set at:

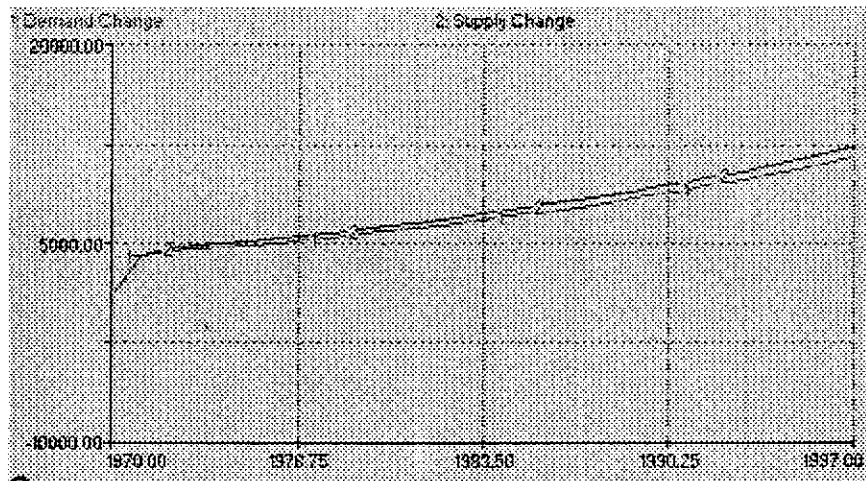
- Equilibrium vacancy 10% (near historical average of 9.2%.)
- Supply lag 0, meaning developers look ahead about 2 years in commencing projects.
- Adjustment time 1, meaning the market responds to discrepancies in one period.

- Oversupply 1, meaning the market does not overreact. New supply orders equal new demand.

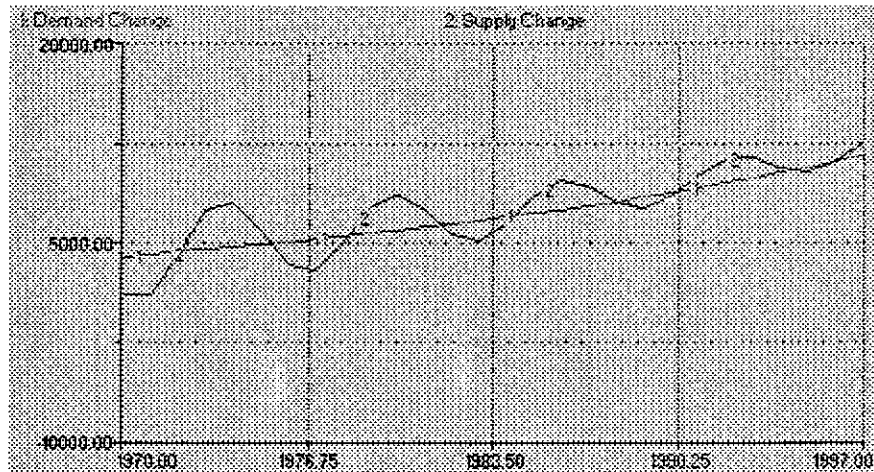
In the following comments, assume values are as above, except as noted. The choice of 1970-1997 as the x axis values is merely to give a sense of time periods, the data is arbitrary data produced by the model which begins at equilibrium.

Figure 7-5 Model 1 Supply and demand change, supply lag effect

A) Base run with supply lag 0, adjustment time 1, and oversupply 1, equilibrium vacancy .10.



B) Supply lag 1, adjustment time 1 and oversupply 1 creates a decaying cycle.



C) Supply lag 2, adjustment time 1, oversupply 1, cycle explodes.

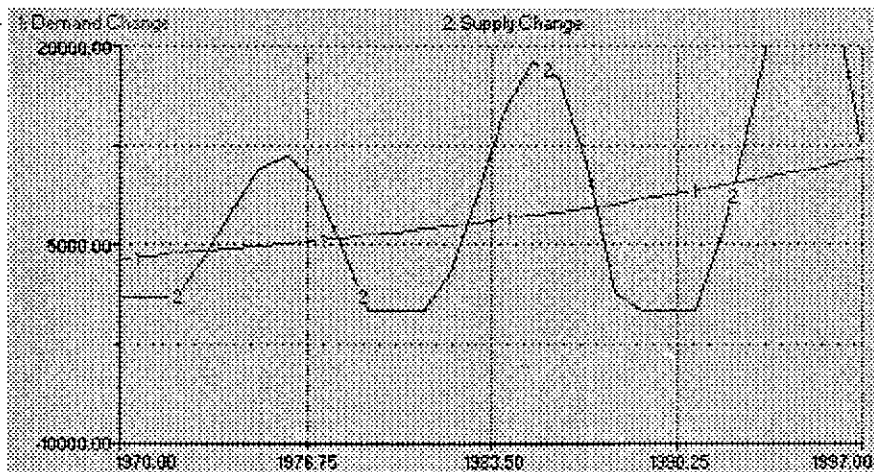


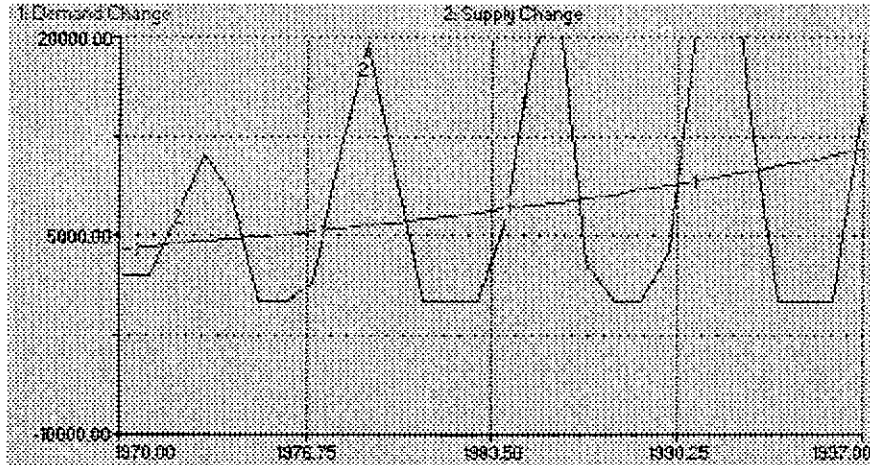
Figure 7-5 shows the effects of increasing the construction lag time. A lag of zero leads to the market staying in equilibrium. Setting the supply lag to zero means forecasting demand perfectly with a forecast horizon equal to the time required for construction. It is impossible for this ideal to be achieved because demand cannot be so accurately forecast.

With the construction lag set to 1 year, the steady four percent growth in demand leads to a decaying cycle. With the supply lag at 2 years, the cycle explodes-- successive cycles get worse. In the real world this cannot go on forever, of course-- the economy would run into some limiting factor and the process would exhibit some other behaviour--perhaps a major recession.

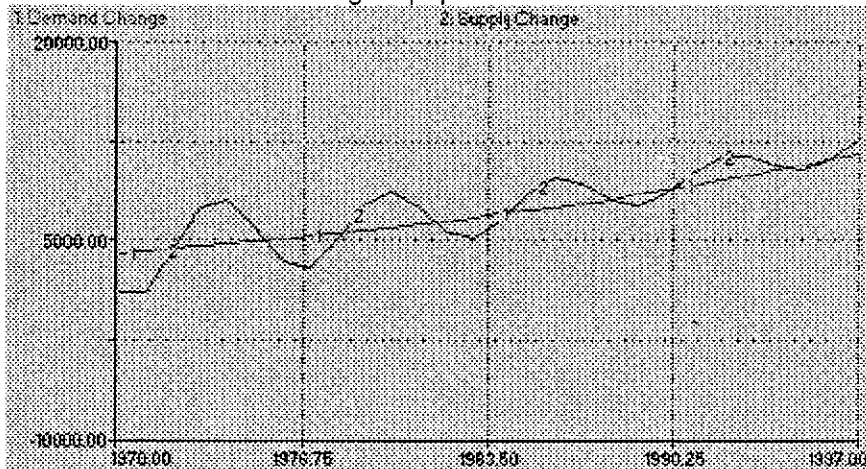
Figure 7-6 shows that (counterintuitively), adjustment times greater than 1 tend to decrease amplitude of cycles. For example, with supply lag at 1, oversupply at 2 and adjustment time at 1, a jagged pattern emerges, with large and sudden deviations from equilibrium (Figure 7-6 A). But this is smoothed and moderated if adjustment time is moved up to 2 (Figure 7-6 B). But, higher adjustment times also increase MAPE because of slower catching up to demand. In Figure 7-6 C, the cause of instability is supply lag rather than oversupply, but the same smoothing effect due to longer adjustment time is observed.

Figure 7-6 Model 1 Supply and demand changes, adjustment time effect

A. With oversupply 2 and supply lag 1, adjustment time 1, explosive cycle.



B. With oversupply 2, setting adjustment time to 2, supply lag 1 the cycle is smoothed by the longer adjustment time. This is a well known principle in system dynamics common to systems from electrical circuits to biological populations.



C. With supply lag 2, oversupply 1, and adjustment time 2, this damping effect also occurs. Thus longer adjustment time dampens cycles due to either oversupply or supply lag.

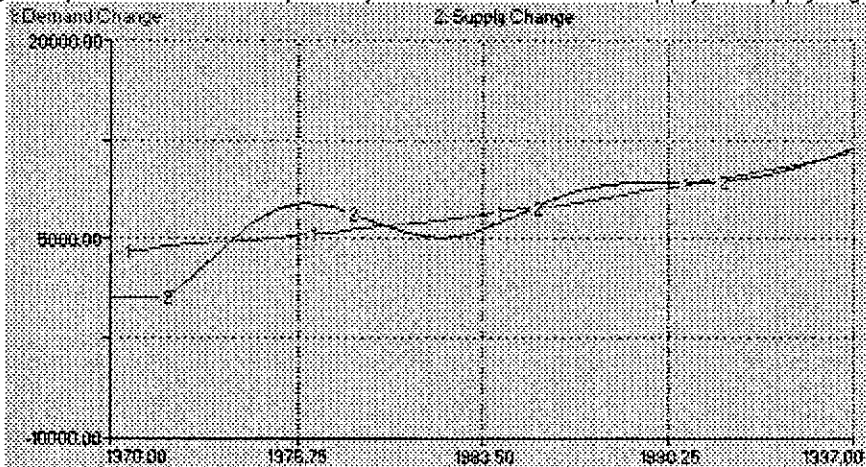
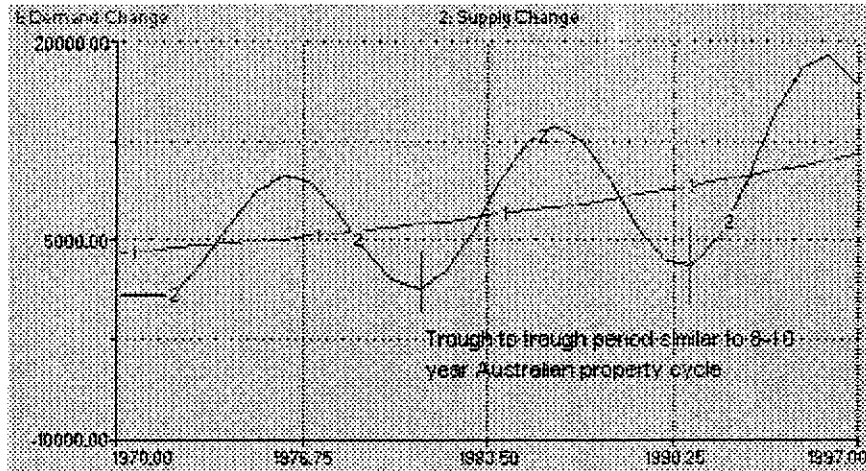
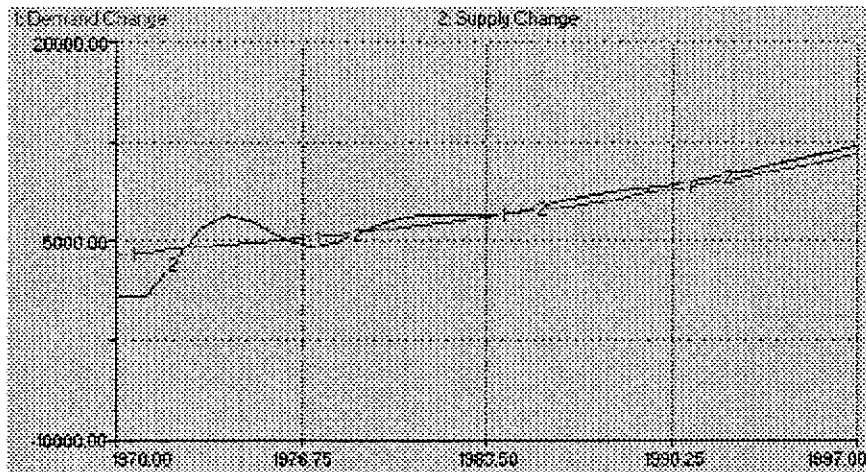


Figure 7-7 Model 1 Supply and demand changes, sensitive or offsetting cycles.

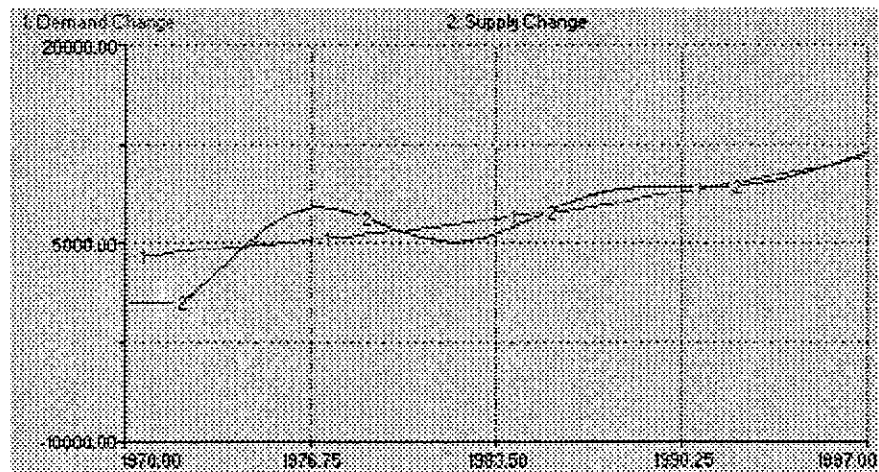
A. With supply lag 1.5, adjustment time 2, and oversupply 1.5, exploding cycle.



B. Cutting the supply lag to 1.25 (only 3 months difference) while leaving adjustment time at 2 and oversupply at 1.5 as in the previous graph, leads to dramatic reduction in cycle amplitude.



C. With all three adjustments set to 2, the cycle is also dampened. This may be an example of offsetting cycles. Explosive behaviour may result from reinforcing cycles.



Other combinations of the four supply adjustment parameters result in varied outcomes--sometimes stable cycles, sometimes chaotic cycles. Cycle parameters can reinforce each other or cancel out, depending upon frequencies (Figure 7-7 C). The graphs in 7-7 A and B reveal very interesting system behaviour. With supply lag 1.5, adjustment time 2, and oversupply 1.5, an exploding cycle results. Shifting the supply lag parameter down to 1.25 (three months less than in graph 7-7 A) leads to dramatically reduced cycles (graph 7-7 B). If the real system behaves anything like the model, this result suggests major increases in market efficiency can be had by reducing supply delays, ie by reducing planning and construction lags, or by forecasting demand and building for it, rather than waiting until demand is on hand, provided supply does not all commence at one time.

Among the interesting points here is simply that steady economic growth can cause an explosive cycle, given certain lags and adjustments assumptions. Real world growth is not steady of course, which might lead to even more chaotic cycling or dampened cycles, depending upon the particular situation. Of course, in the real finite world, an explosive cycle eventually runs into limits and stops expanding.

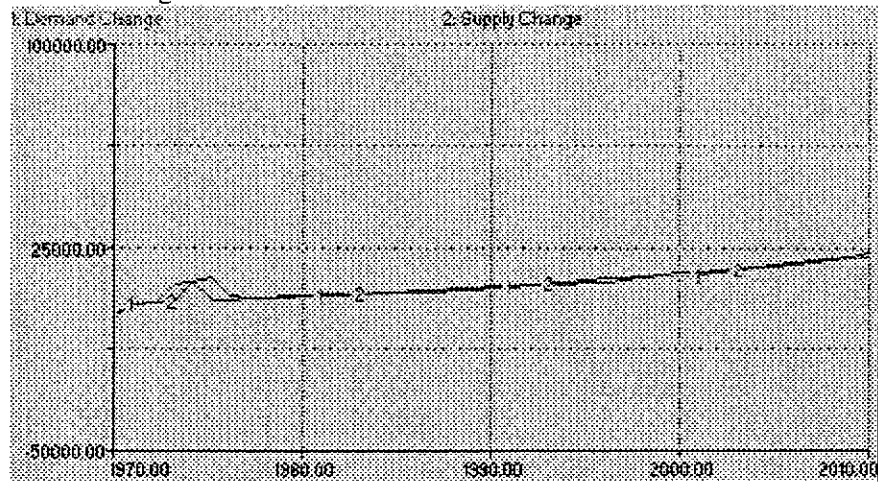
2) *Demand spikes scenario*

This output is not very interesting. Demand spikes result in supply responses which are quicker or slower, peaked or more spread out depending upon the parameters in straightforward fashion. No long term cyclical behaviour emerged from a single spike. The system must be perturbed again or it will soon settle down, given that construction will eliminate discrepancies fairly quickly--that is, the shortfall in space will be supplied and new supply will then cease. Even if supply is constrained in the short run (long adjustment time) the spike will soon be accommodated and the supply change "turned down" once the demand spike is supplied with office accommodation (Figure 7-8A).

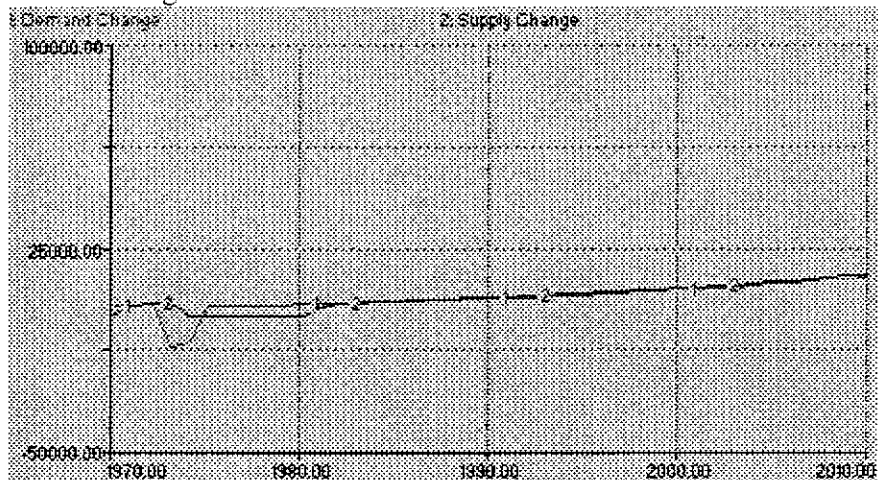
However, if the system settings are set to levels which create cycles, the effects of these is more powerful than the effects of a demand spike. It is apparently the system dynamics which create the cycles, not unusual system "errors" or shocks.

Figure 7-8 Model 1 Supply and demand changes with growth spike

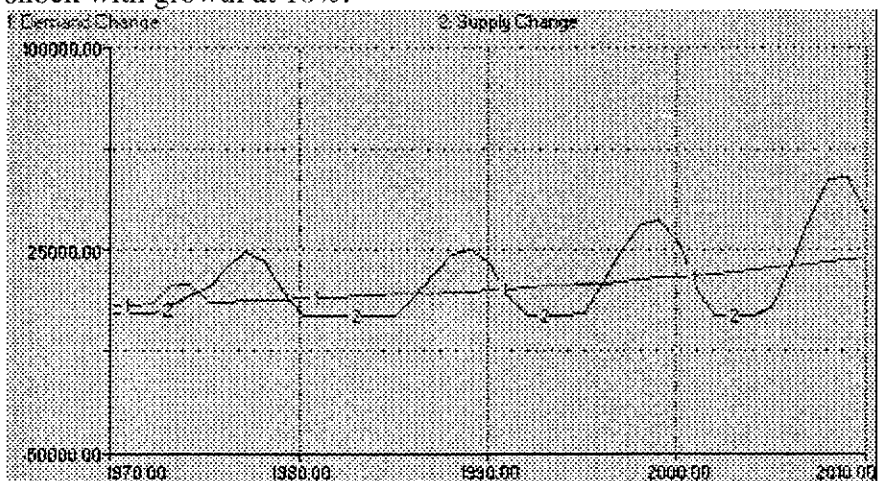
A. Adjustment time 1, supply lag 0, oversupply 1, growth 4% except for 2 year positive shock with growth at 10%.



B. Adjustment time 1, supply lag 0, oversupply 1, growth 4% except for 2 year negative shock with growth at -10%.



C. Adjustment time 2, supply lag 2, oversupply 2, growth 4% except for 2 year positive shock with growth at 10%.



3) Historical demand growth scenario

The actual historical office demand growth figures produced interesting results. Historical demand change figures show a very large spike in 1978 (possibly exaggerated by measurement error), a smaller series of positive takeup years in the mid-1980s, negative demand in the early 1990s, and reasonably strong demand recovery beginning in 1992. Anecdotally, the large demand growth in 1977 is explained as being a result of high vacancy and low rents in a strongly recovering and inflationary economy with very low rents which encouraged firms to take extra space.

Demand patterns are not reflected in supply--indeed, that is the reason for this study. It would be virtually impossible to create the pattern of historical supply response, based on demand and the delays and adjustment factors used in Model 1. It appears that either demand does not drive supply or that explosive dynamics originating farther back than 1975 have created the pattern of supply response.

Figure 7-9 Historical supply and demand change versus supply change estimated by Model 1

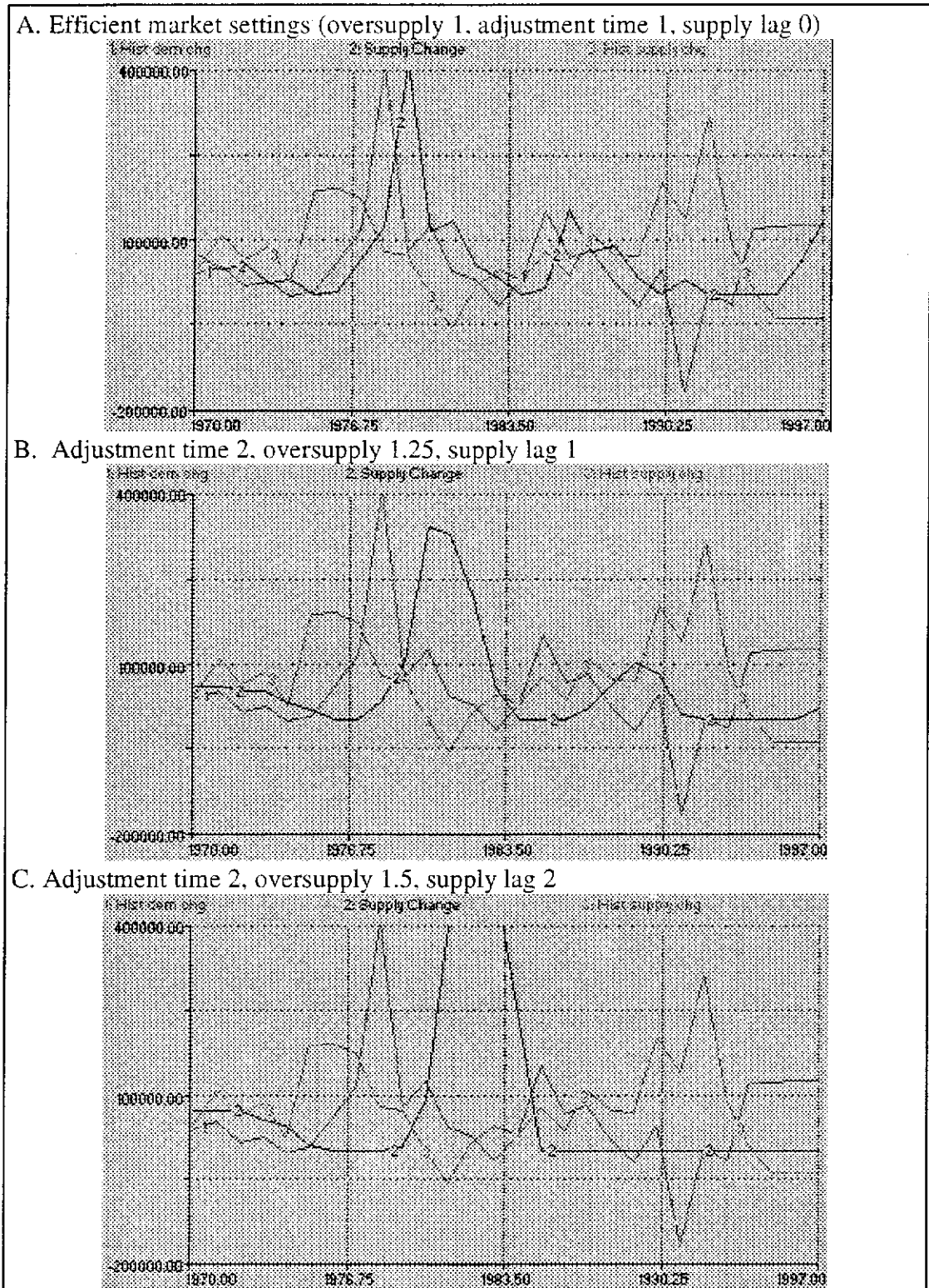


Figure 7-9 A shows the model doing much better than the market--demand shocks are anticipated through forecasting and supplied with the correct amount of office space within one year. Figure 7-9 B shows a less efficient model response with longer adjustment time (two years) and a modest over building relative to demand (oversupply 1.25). This produces peaks in supply similar in magnitude to real world peaks, but timed better. Figure 7-9 C shows that the market is not doing as badly as it might. With less ability to anticipate demand (2 year adjustment time and 2 year lags) and oversupply of 1.5, the model produces a bigger supply glut than the market has yet produced, which shuts off further supply for the duration. Probably oversupply (building more than demand justifies) is not a common feature of office markets--it cannot be in the long run. Rather, the timing of supply is the usual problem--too much demand backlog accumulates during the adjustment time and supply lag periods, resulting in supply pulses that would not be unreasonable if more spread out in time and better timed to meet economic growth.

Overall, however, the most important insight is simply how poorly the market has done in matching supply and demand during this period. Many model settings will improve on market outcomes. This negative finding--the lack of connection between supply and demand in the real world data--should be regarded as a major fault in the office market system. These results direct our attention towards redesigning the system to create a closer connection between supply and demand.

This simple supply demand model would be quite useful, I think, in studies to design policies for optimum system functioning. It is interesting, and somewhat counterintuitive (except to electrical engineers and others familiar with system dynamics), that increasing adjustment time may help reduce cycle amplitude. Decreasing supply lags and oversupply are obviously also helpful in increasing efficiency. Decreasing supply lags can be accomplished by moving decisions forwards in time--through decisions based on forecasts rather than current information. Oversupply can be addressed by attention to the prisoners' dilemma and agency problems in office markets, perhaps through planning controls as discussed in Chapter 9.

Another important test for this model left for future research would be to use stochastic demand errors as another pattern of demand against which to test system supply response patterns. I have not addressed validity of this model through analysis of similarity to actual data because we can assume the model comes closer to equilibrium than the market. This is a goal seeking, policy oriented model. Whether the actual system would behave as the model does if lags and oversupply could be adjusted through policy changes and system redesign is not certain. More validation would be required, and perhaps experiments. It is my impression that Singapore may have reduced office cycle amplitude by cutting adjustment times through faster government sponsored land assembly and planning approvals. The strongest argument for whatever validity this model may have is the plausibility of its mathematics--clearly if one delays building a demand backlog develops. The adjustment equations describe observable processes which are, at each step, simple identities that most observers would find plausible and recognise as similar to what must occur in a real world market.

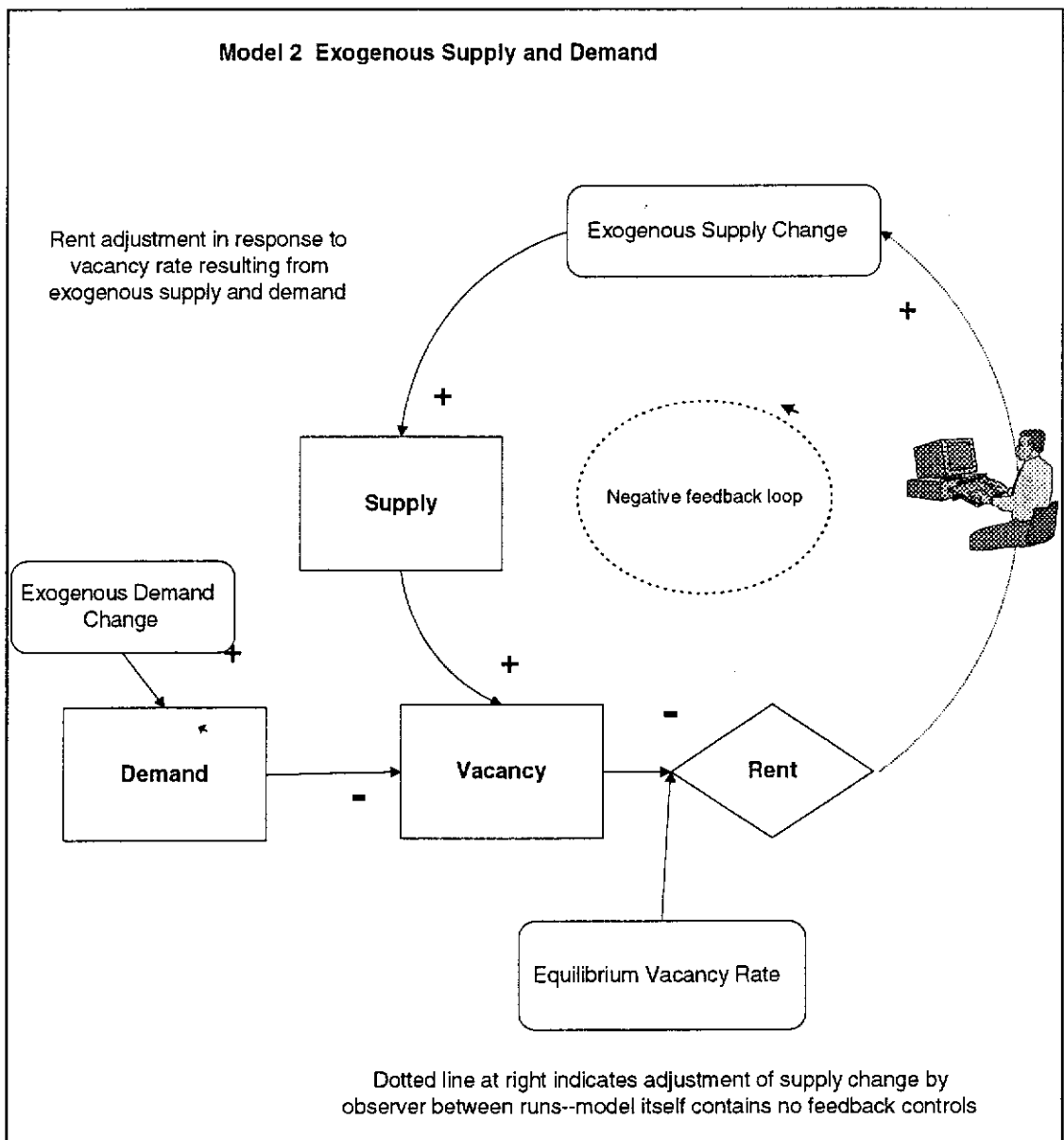
7.4.5 Model 2 A "Simple Transparent" Exogenous Supply Model

In this second ITHINK model, both supply and demand are supplied exogenously. The rationale for exogenous demand is, as in model 1 above, that the economy determines office demand, not vice versa. Supply is left exogenous because property industry sources (Knight Frank Independent, the Australian Property Council, and others) feel able to predict which projects will proceed to completion over the next few years. Knowing developer characteristics, sources of finance, and so on, market participants can make good guesses as to which projects (assembled sites) will proceed. Because property industry people often have friendships or working relationships with people in other firms they have many opportunities to discuss how each other's projects are going forward.¹³ Model 2 simply calculates the vacancy rates will result from these assumptions and adjusts rent accordingly. Strictly speaking, this is not an SD model because there is no feedback loop in the equations. However, as the dotted line and picture of a man at a computer suggest, there is in

¹³ This is an example of an "expert judgement" forecasting technique (See Makridakis and Wheelwright, 1989: Chapters 12 and 18).

effect a negative feedback loop exterior to the model itself. The user runs the model and obtains a rent figure. If the user does not find that rent acceptable, then the supply assumption should be modified--in effect, a goal seeking feedback control system with the model user in the loop and feedback steps corresponding to runs under different assumptions. I think this "hands on" aspect would tend to stimulate thinking and enhance credibility of the model.

Figure 7-10 Influence Diagram, Model 2



The key element of the model is a rent adjustment equation. The equation I have used is one from chapter 6 estimated from the Sydney CBD office market time series data. Regressors are lags of rent and vacancy rate forecasts derived from the exogenous supply and demand estimates. Use of a statistically estimated equation in a simulation model could cause problems, if the range of the explanatory variables strays outside the range used in estimating the model. If x variable values went out of range, functional form might change or parameter estimates become invalid.¹⁴

Allowing supply and demand as well as other model parameters to be varied exogenously by the model user, makes this version very participatory which should add to its credibility. Recall that credibility is an essential feature of simulation models, because responsible managers cannot rely upon what they do not understand. Presumably its simplicity will enable users to understand model structure. Presumably users will be interested in trying out the consequences of their own assumptions about future supply and demand conditions. Therefore, the model in use could integrate expert knowledge of market conditions with empirical estimates of adjustment parameters.

Unfortunately, a model which treats endogenous variables as exogenous may produce inconsistent results, particularly if values of input assumptions deviate from reasonable ranges. With supply and demand both exogenous, for example, it is possible for the model to generate nonsense results such as negative vacancy rates. Other things being equal, this would decrease model credibility. Perhaps before taking this model to clients “stops” should be installed to prevent impossible results in model output.

Compared to model 1 this model adds more detail to estimates of demand, so as to allow users, as in the spreadsheet model reported above, to “drive” the model using GDP or GSP forecasts from independent sources and adjust demand estimates depending upon their opinions on structural change, space per worker, and productivity issues. The logic is similar to the spreadsheet model:

¹⁴ Harry Bloch pointed out this caveat.

1. $\% \Delta \text{GDP}$ less productivity growth = employment growth
2. Employment growth times a "structure of employment index" = office employment growth
3. Office employment growth * space per worker index = %office demand growth

With supply exogenous, the question of supply lags is answered exogenously by expert judgement.

This model is suitable for sensitivity analysis regarding supply and demand assumptions. It allows the user to answer "what if" questions quickly and easily. Questions like:

1. What will rents be like five years ahead if GDP growth falls off to 2% in years 3,4, and 5, rather than the 4% of our baseline projection?
2. If our competitors commence an additional 100,000 m² of office space for completion in the year 2000, what impact will that have on rents in 2002 when our project will be completed?

Explicit questions about impacts of changes in economic forecasts and supply forecasts can be answered in seconds. Such tools could lead to an important redesign of the information control structure of office market systems and therefore to dramatic improvements in their efficiency. For example, in the Perth major projects scenario, suppose that decision makers had all placed credence in such models. In the real market it appears that it took the *event* of oversupply to educate the market as to the effects on rents of too many buildings. This model could have produced rent *forecasts* immediately upon commencements of projects, and thereby provided a powerful argument against creating oversupply by commencing still more projects. Thinking of decisions to finance projects as an on/off switch which should go on when rents justify costs and off when rents fall to a point where NPV is less than zero, the model shifts the receipt of explicit information on rents from two years in the future when the rival project is completed, to five minutes after word is

received of a competitive project receiving finance. The model eliminates a two year information lag. The price is that the information quality drops--we substitute a forecast for the actual outcome. Further research should explore the tradeoff between the costs of reacting to real world information--ie current rents--versus the costs of reacting to forecasts of rents upon completion. Current rents are known more accurately, but may be irrelevant to results in three years time when the project is leasing. It may be that rather than moving the response to information ahead two years, for example, one year forecasts might be the optimum, given higher quality of one year ahead forecasts. Using tenant leasing intentions surveys or leasing agents opinions offer means of looking ahead with more certainty.

Table 7-2 summarises results of several runs under various assumptions. The pattern of future rent change varies with each set of assumptions, but I simplify by reporting here only rents and vacancy projections for year 2001. **These results should not be used for commercial purposes.** Unfortunately, a serious forecasting exercise requires, in my opinion, more updated information and closer involvement with the market than was possible during this research. What the results do, however, is demonstrate how even a very simple equation estimated from data can help provide a quantitative estimate of the impact of market decisions and outcomes.

Table 7-2 Summary of Model 2 year 2001 Sydney CBD office forecasts*

Scenario Demand Supply	Vacancy 2001	Rent 2001**	Change from base
Run 1 Base Case 4% GDP from 1998 KFI supply projection	.10	625	0
Run 2 Increase GDP 1%	.05	722	97
Run 3 Decrease GDP 1%	.14	531	-94
Run 4 Increase year 2000 supply 100,000m ²	.12	596	-29
Run 5 Decrease year 2000 supply 100,000m ²	.08	655	30
Run 6 Decrease year 2000 supply 100,000 m ² + Increase GDP 1%	.03	753	128
Run 7 Increase year 2000 supply 100,000 m ² + Decrease GDP 1%	.16	503	-122

*Indicative only, not for commercial use--these figures have not been validated

**Estimated, net, nominal, Premium/A grade

7.4.6 Model 3 A Simple Model Making Supply Endogenous

This model is similar to model 2, except that supply is made endogenous, a function of demand as in model 1. This is not done until two years into the future, however, because any projects to be completed during the next two years will already be commenced, so their addition to stock is nearly certain, barring major calamity.¹⁵ Again, the rent adjustment equation was estimated from historical time series data.

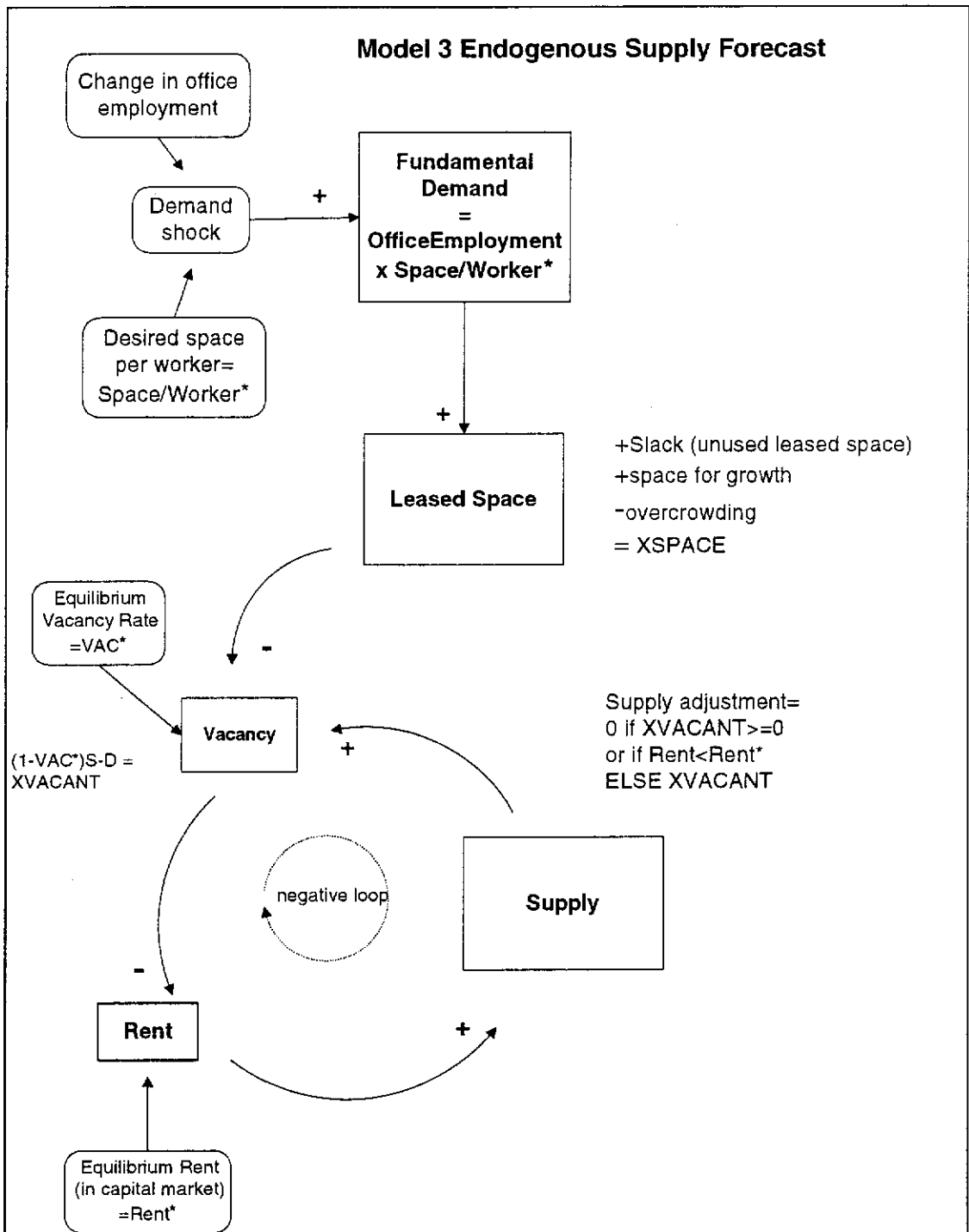
Historical supply/rent relationships may not be particularly helpful in a search for an efficient supply response equation. I do not feel the work in Chapter 6 led to a defensible supply equation and blame this on the irrational (at least in hindsight)

¹⁵ In Latin America, extreme economic disruptions have sometimes left the skeletons of half completed buildings to languish until demand recovers and new finance can be obtained. But cessation of projects under construction is quite rare in developed countries, even if the developer goes broke. Lenders usually prefer to put enough money into the project to complete it. A half completed project can not generate revenue and weather will cause costly damage to unenclosed structures.

nature of office supply changes during the sample period--due in large part to prisoners' dilemma and principle/agent conflicts. Our objective is not to forecast based on these past mistakes, but rather to search for a more efficient rule or policy regarding supply adjustments. If we assume that the planning lag can be set to zero, that is, institutional mechanisms adjusted so that when projects should commence, approvals are in place, we are left with the construction lag of, let us say, 2 years. In an ideal world, the rule would then be: Commence a future project if projected rent (two years ahead at date of project completion) results in $IRR \geq k$, the project risk adjusted discount rate, subject to $\Delta D * \text{market share} \geq \text{project size}$, where ΔD is total demand change in year of completion and market share is the portion of that demand captured by the project. In short, projects should expect rents high enough to ensure positive net present values and enough demand to fill the building. In an academic exercise we can assume away hedonic comparisons among diverse projects required for project specific rent and market share, simplifying by looking at market aggregates. We must do this in order to escape from the indeterminacy of a game theory prisoners dilemma problem (see chapter 9). With perfect information and socially rational behaviour, the rules of the game would not necessarily lead to prisoners dilemma, but under current system design, prisoners' dilemma is a problem.

For the moment, then, let us adjust future supply by a method similar to model one with the parameters at ideal settings. This means supply lag 0, that is, markets anticipate demand so as to finish construction with "just in time" inventory. I set adjustment time to 2, so as to spread out commencements, but set oversupply to 1, that is, markets would build only what is needed. It will simplify matters to leave rent out of the supply adjustment at this stage, building only to meet physical demand for space required to restore the market to equilibrium vacancy rates.

Figure 7-11 Model 3 influence diagram, endogenous supply adjusts to demand



With these idealistic assumptions, model three produced nominal gross 2001 rents of \$723 under a 3% GDP growth assumption, \$842 with 4% growth, and \$929 with 5% growth. Construction during 2000-2001 was 0 under the low growth scenario,

87,800 under the medium growth (4%) assumption, and 280,000 with 5% growth. These values are not the relevant issue--in fact these figures are undoubtedly not the best forecasts one could produce with more current information. Further "in the market" research would refine the estimates and, as emphasised previously, this is a model building exercise, not a forecasting exercise. However, the model is at least producing a pattern of estimates consistent with what one might expect. It is perhaps surprising to see the extent to which differences in growth rates within the bounds of possible outcomes lead to quite different appropriate supply responses.

In practice, performance could not be this good because future shocks cannot be known. Only one example will be provided of the sort of policy testing that could be done with this model: let us set the supply lag back to 2 and the oversupply response to 2. In this case, slow growth and medium growth (3%, 4%) mean no construction and rents in 2001 of \$723 and \$842 respectively, while with high growth 216,000 m² of new space are constructed during 2000-2001 and rents are \$941. Obviously demand forecasts and system supply response policy assumptions both have considerable influence on outcomes.

7.5 Conclusions

Most research in leading real estate journals during the past three decades adopts a positivist empiricist epistemology and econometric methods. This chapter reports on efforts to combine positivist paradigm econometric information on office markets and qualitative methods research with the more activist, managerial, policy oriented SD paradigm. G.P. Box (Box, 1982) stressed the importance of integrating statistical work into the real world decision making structure of firms. Acceptance by users has been a major theme in information systems literature, leading, in fact, to adoption of qualitative research paradigm methods which stress the mental states and interpretations of actors in the system. Makridakis and Wheelwright (1989:29) comment:

“Only methods that are understood get used over time by decision makers. This is particularly true in the area of forecasting. Managers will not base

decisions for which they are responsible on forecasts they do not understand or in which they have no confidence.”

Qualitative research provides a picture of the system in words. Most people can relate to such accounts, but these reports tend to lack precision, clarity, and interobserver reliability.

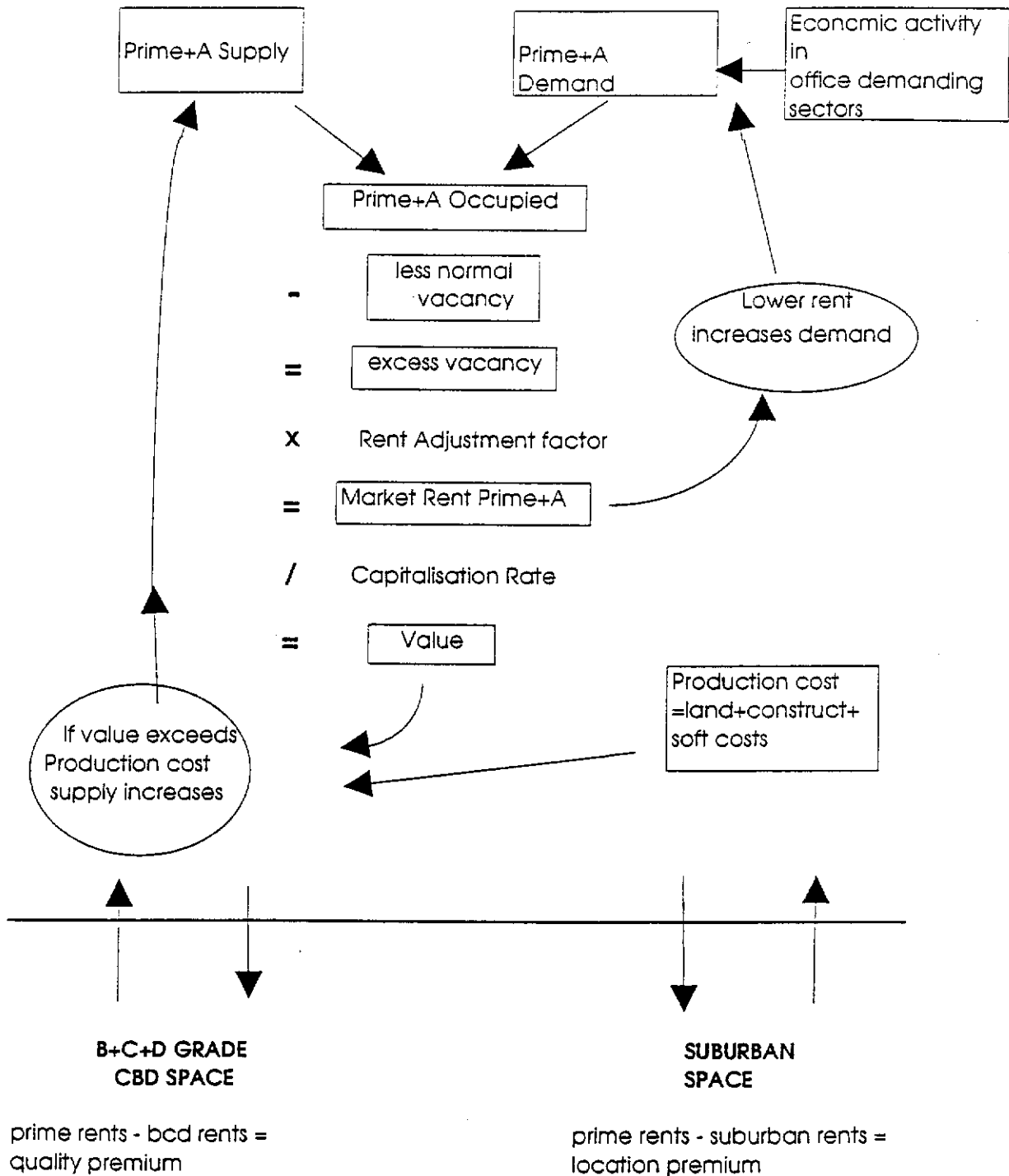
Econometric methods provide representations of the system in equations. These offer what appear to be quantitative answers, based in empirical data. Unfortunately, in changing systems with limited data, misspecification is inevitable, so the precision of quantitative estimates is illusory and estimates are biased. Within sample “description” of the process can be excellent, without the true causal structure of the system having been identified. Generally information from outside the sample helps in judgements about the out of sample validity of econometric results, at least to the extent of eliminating coefficients with unexpected signs. Despite these caveats, econometrics is an extremely powerful toolkit for summarising data and obtaining information on causal relationships. Having a possibly biased parameter estimate estimated by an unambiguous and replicable statistical procedure is probably better than having no parameter estimate at all, or making one up out of whole cloth.

Simulation models allow users a “hands on” experience. Senge (1990) calls this “microworlds” experience--the user acts by taking the same kinds of decisions that would be taken in the real world, but in an artificial system. Users may study system behaviour and outcomes by varying assumptions with instant feedback, without specialised knowledge of software or statistical techniques. This should prove to be an excellent way to educate participants about system behaviour. Senge lists a number of ways in which such “microworlds” can be used to speed up or slow down processes in time, to examine alternative policy responses, test various assumptions or scenarios, and to test redesigns of the system. Systems models help make the following very important points for office market decisions:

1. All forecasts are conditional and results will vary widely depending upon unpredictable, indeterminate, unknowable outcomes. Risk is inescapable and should be understood and quantified through consideration of alternative scenarios. Future outcomes are a probability distribution, not a point estimate.
2. Individual outcomes depend upon actions of oneself and others. Oversupply is an emergent property of the collective decisions of the market, not a result of any single decision. Good (rational, well informed) decisions can lead to bad outcomes because of subsequent mistakes by others.
3. Decisions based on forecasts can dramatically improve system dynamic behaviour, provided the forecasts are reasonably accurate. For that reason, despite uncertainty about forecasts quality, it is probably wise to bring decisions forwards in time through use of forecasts. Despite forecast inaccuracy, current information almost certainly gives even more misleading price signals than forecasts.
4. System re-design has the potential to greatly improve market efficiency. The system dynamics models suggest ways to pursue improvements through shortening lag times, dispersing supply responses in time, and improving information flows to enable more timely decisions and decisions which take account of other actors in the market and forecasts of future market conditions.

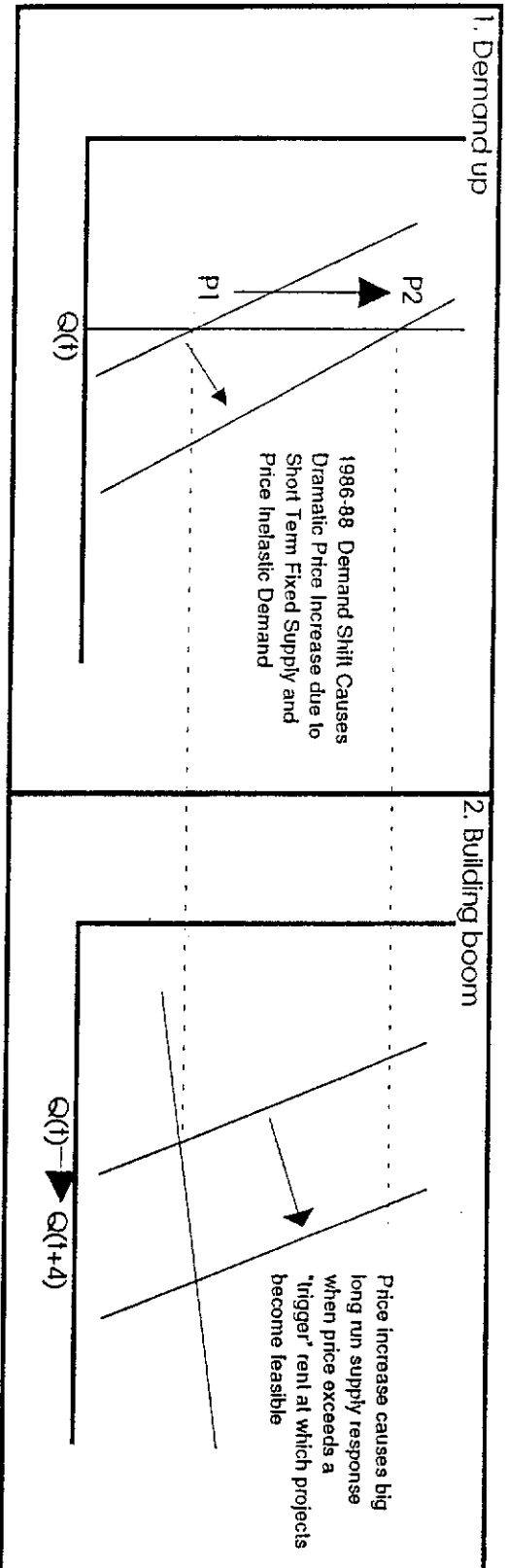
Appendix 1 Bankwest Spreadsheet Model

ADJUSTMENTS IN CBD OFFICE MARKET

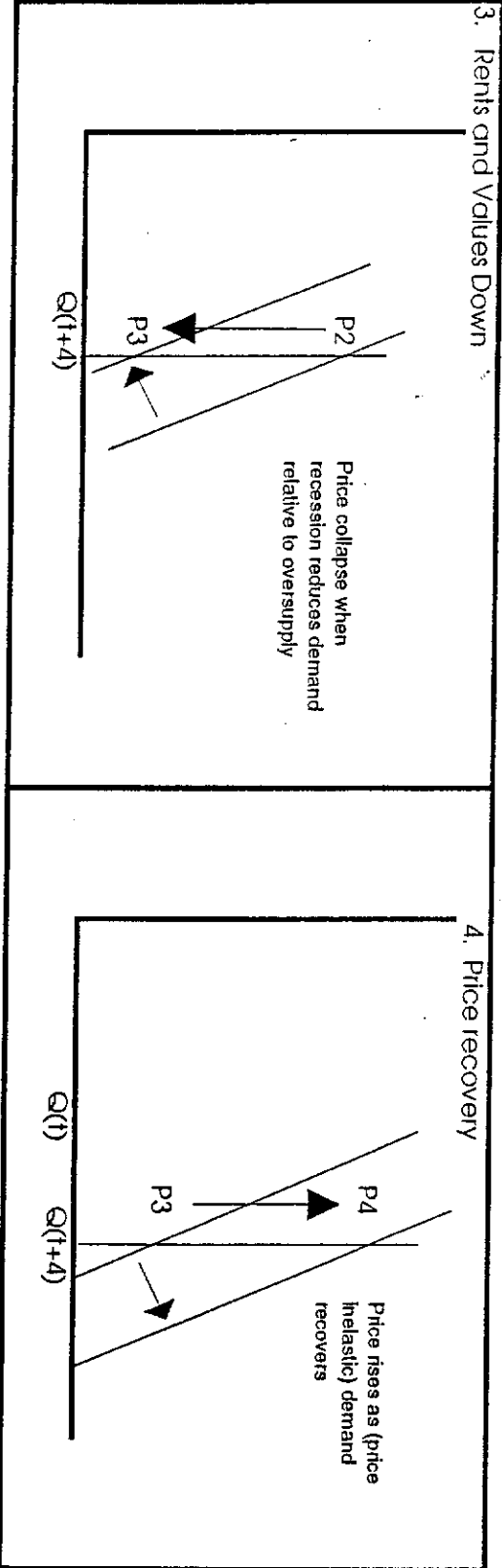


When prime rents drop to less than normal, tenants move to prime space
 When prime rents recover, tenants move back from prime space

The Office Cycle Part One: Demand and Price Increases Lead to Oversupply



The Office Cycle Recovery Phase: Recovering Demand with Supply Shut Off So Rents Bounce Back



RENTS

Medium growth Normal Vacancy = 14%

Comment: \$500 trigger rent, 90,000 supply response, less demo+convert

PERIOD COMMENCING	Jan-1992	Jan-1993	Jan-1994	Jan-1995	Jan-1996	Jan-1997	Jan-1998	Jan-1999	Jan-2000	Jan-2001	Jan-2002	Jan-2003	Jan-2004
Premium & "A" Grade Space													
Percent Rent Change P+A	-26.67%	-20.00%	-18.74%	8.28%	23.08%	26.20%	32.91%	-11.63%	16.90%	-15.49%	16.69%	-18.26%	14.98%
Gross rent per m ² (P+A)	\$275	\$220	\$250	\$271	\$333	\$420	\$559	\$494	\$577	\$488	\$569	\$465	\$535
Less Outgoings per m ²	\$125	\$125	\$125	\$125	\$125	\$125	\$125	\$125	\$125	\$125	\$125	\$125	\$125
Net rent P+A (Gross-Outgoings)	\$150	\$95	\$125	\$146	\$208	\$295	\$434	\$369	\$452	\$363	\$444	\$340	\$410
"B", "C" and "D" Grade Space													
Percent Rent change B+C+D	-20.00%	-12.50%	-10.00%	-3.66%	-3.48%	-2.96%	-2.23%	-1.59%	-1.02%	-0.92%	-0.16%	-0.22%	0.44%
Gross rent B+C+D	\$200	\$175	\$140	\$135	\$130	\$126	\$124	\$122	\$120	\$119	\$119	\$119	\$119
Less Outgoings per m ²	\$100	\$100	\$40	\$100	\$100	\$100	\$109	\$100	\$100	\$100	\$100	\$100	\$100
Net rent B+C+D (Gross-Outgoings)	\$100	\$75	\$40	\$35	\$30	\$26	\$24	\$22	\$20	\$19	\$19	\$19	\$19

OUTPUTS

SCENARIO :

Medium growth

Normal Vacancy =

14%

\$500 trigger rent, 90,000 supps

PERIOD COMMENCING	Jan-1994	Jan-1995	Jan-1996	Jan-1997	Jan-1998	Jan-1999	Jan-2000	Jan-2001	Jan-2002	Jan-2003	Jan-2004
CBD Totals											
Net Lettable Area	1,320,300	1,310,816	1,295,067	1,279,555	1,264,265	1,250,191	1,235,141	1,219,257	1,206,368	1,190,625	1,174,856
Net Take-up	36,000	34,853	25,504	26,129	26,763	27,406	28,357	29,345	30,372	31,439	32,549
Percent Vacant	27%	24%	20%	17%	13%	16%	13%	16%	12%	16%	12%
Premium & "A" Grade Space											
Net Lettable Area	693,100	693,100	686,169	679,307	672,514	665,799	640,131	732,730	806,403	798,339	871,355
Net Take-up	45,800	44,140	25,882	19,245	14,222	10,423	19,625	25,512	16,594	31,011	20,909
Percent Vacant	27.00%	20.20%	12.08%	7.35%	3.52%	11.29%	8.97%	14.85%	10.80%	16.37%	11.93%
New Construction P+A	0	0	0	0	0	90,000	0	90,000	0	90,000	0
Real dollars (1992):											
Rent per m ²	125	146	208	295	434	369	452	363	444	340	410
Five year future average rent	242	290	352	383	412	394	402	376	381	355	363
Average rent, completion 1989	213	227	233	242	258	249	452	363	444	340	410
Average rent, completion 1989, option to re-lease	213	227	233	233	295	369	452	363	444	340	410
Capitalisation Rate	9.50%	7.94%	6.60%	5.81%	5.17%	6.46%	6.08%	7.06%	6.38%	7.31%	6.57%
Cap Rate Value, market rent	1,316	1,834	3,156	5,087	8,387	5,706	7,440	5,142	6,961	4,657	6,241
Cap Rate Value, Five Year Future Average Rent	2,543	3,655	5,332	6,587	7,972	6,091	6,612	5,329	5,971	4,860	5,523
DCF Value, market leases, 5 year reversion	5,225	4,030	5,182	4,150	5,229	3,955	4,826	4,723	4,747	4,638	4,670
DCF Value, Five Year Average Rent, 5 year reversion	5,410	4,568	4,943	4,309	4,647	4,027	4,348	4,300	4,281	4,281	4,289
DCF Value, completion 1989, 5 year reversion	5,047	4,102	4,513	3,946	4,432	3,951	4,453	4,351	4,374	4,285	4,297
DCF Value, compl. 1989, 5 yr. rev., re-lease option	5,188	4,334	4,777	4,248	4,714	4,070	4,453	4,351	4,374	4,285	4,297
Normal Dollars:											
Building value, Cap Rate, market rent	60,000,000	86,561,750	152,766,163	254,337,480	432,754,355	407,734,736	407,734,399	290,016,664	403,746,750	277,563,433	383,104,327
Building value, Cap Rate, five year average rent	115,879,127	172,529,616	258,091,249	329,374,291	411,380,321	324,034,599	300,576,785	346,300,535	289,635,399	339,058,765	286,655,649
DCF Building value/market leases	238,261,927	190,225,913	250,815,457	207,524,194	269,796,152	264,464,836	266,400,161	275,324,051	276,401,524	263,274,272	263,274,272
DCF Building value/five year average rent	246,697,684	215,616,165	239,223,925	215,455,372	239,804,559	214,234,755	238,274,058	243,188,116	249,404,557	255,144,452	254,191,927
DCF Building value, completion 1989	230,131,726	193,602,761	218,426,022	197,318,240	228,666,838	210,169,114	244,043,932	245,383,025	253,710,685	254,191,927	263,779,764
DCF Building value, completion 1989, re-lease option	236,579,271	204,547,949	231,220,761	212,386,425	243,252,611	216,521,784	244,043,932	245,383,025	253,710,685	254,191,927	263,779,764
"B", "C" and "D" Grade Space											
Net Lettable Area	627,200	617,716	608,898	600,248	591,751	592,402	585,010	586,527	579,966	582,286	576,500
Net Take-up	(13,000)	(9,287)	(378)	6,884	12,540	16,983	8,731	3,833	13,777	429	11,640
Percent Vacant	2%	30%	29%	27%	24%	21%	18%	18%	15%	15%	12%
Rent per m ²	40	35	30	26	24	22	20	19	19	19	19
Capitalisation Rate (2)	11.50%	11.58%	12.57%	12.41%	12.05%	11.52%	11.06%	10.65%	10.57%	10.03%	10.07%
Capita Value per m ²	346	301	240	212	195	187	184	180	180	187	192

Appendix 2 Three System Dynamics Models

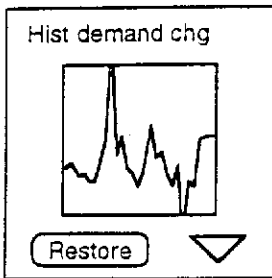
Model 1 Physical discrepancy between supply and demand Historical demand growth

Adjustment time =
 0.0 5.0

Oversupply =
 1.0 3.0

Supply lag =
 0.0 5.0

Equilibrium vacancy rate =
 0.05 0.15



Exogenous Demand Change

?

Demand

Demand

Supply

Supply

Summary Statist...

Summary Statistics

System Adjustment Assumptions

Graph 3

Market adjusts to equilibrium vacancy rate

Discrepancy/adjustment time = projects initiated

Graph 4



Projects initiated x oversupply = commencements

Graph 5



Commencements completed after supply lag time delay

Inputs

System Performance Summary

Output

Discrepancy = Average excess vacancy

Average supply and demand changes

Root mean square error--square root of squared excess vacancy divided by number of time periods

Mean absolute percentage error--puts less emphasis on large errors than RMSE

Model 1 Historical demand change

Equilibrium vacanc...	0.09
Adjustment time	1.0
Oversupply	1.0
Supply lag	0.0

Avg demand chg	65,044
Avg supply chg	59,867
MAPE	2.72
RMSE	118,203

12:11 PM 18/06/97		Output					
Years	Demand	Supply	Discrepancy	Hist dem chg	Supply Change	Sum disc sq	PC disc abs
1976	2,207,500.00	2,417,886.50	7,223.28	61,000.00	7,223.28	11,716,521,176	0.30
1977	2,268,500.00	2,425,109.79	61,650.10	117,200.00	61,650.10	11,768,696,978	2.54
1978	2,385,700.00	2,486,759.88	122,748.51	407,300.00	122,748.51	15,569,431,238	4.94
1979	2,793,000.00	2,609,508.39	418,347.37	76,500.00	418,347.37	30,636,627,598	16.03
1980	2,869,500.00	3,027,855.76	114,151.26	124,000.00	114,151.26	205,651,146,047	3.77
1981	2,993,500.00	3,142,007.02	134,273.61	41,900.00	134,273.61	218,881,656,873	4.27
1982	3,035,400.00	3,276,280.63	53,984.63	26,600.00	53,984.63	236,711,060,199	1.65
1983	3,062,000.00	3,330,265.26	31,458.62	-17,300.00	31,458.62	239,625,399,960	0.94
1984	3,044,700.00	3,361,723.87	-14,468.72	26,800.00	0.00	240,615,044,498	0.43
1985	3,071,500.00	3,361,723.87	12,331.28	152,700.00	12,331.28	240,824,388,488	0.37
1986	3,224,200.00	3,374,055.15	153,809.81	65,200.00	153,809.81	240,976,448,842	4.56
1987	3,289,400.00	3,527,864.96	79,042.88	80,300.00	79,042.88	264,633,907,968	2.24
1988	3,369,700.00	3,606,907.85	87,413.86	22,800.00	87,413.86	270,881,685,374	2.42
1989	3,392,500.00	3,694,321.71	30,667.25	-20,700.00	30,667.25	278,522,868,206	0.83
1990	3,371,800.00	3,724,988.95	-17,939.95	45,600.00	0.00	279,463,348,267	0.48
1991	3,417,400.00	3,724,988.95	27,660.05	-171,000.00	27,660.05	279,785,189,992	0.74
1992	3,246,400.00	3,752,649.01	-168,510.60	3,100.00	0.00	280,550,268,483	4.49
1993	3,249,500.00	3,752,649.01	-165,410.60	-17,500.00	0.00	308,946,089,210	4.41
1994	3,232,000.00	3,752,649.01	-182,910.60	118,200.00	0.00	336,306,754,246	4.87
1995	3,350,200.00	3,752,649.01	-64,710.60	122,100.00	0.00	369,763,040,118	1.72
1996	3,472,300.00	3,752,649.01	57,389.40	125,000.00	57,389.40	373,950,501,262	1.53
Final	3,597,300.00	3,810,038.41	130,165.05			377,244,045,034	

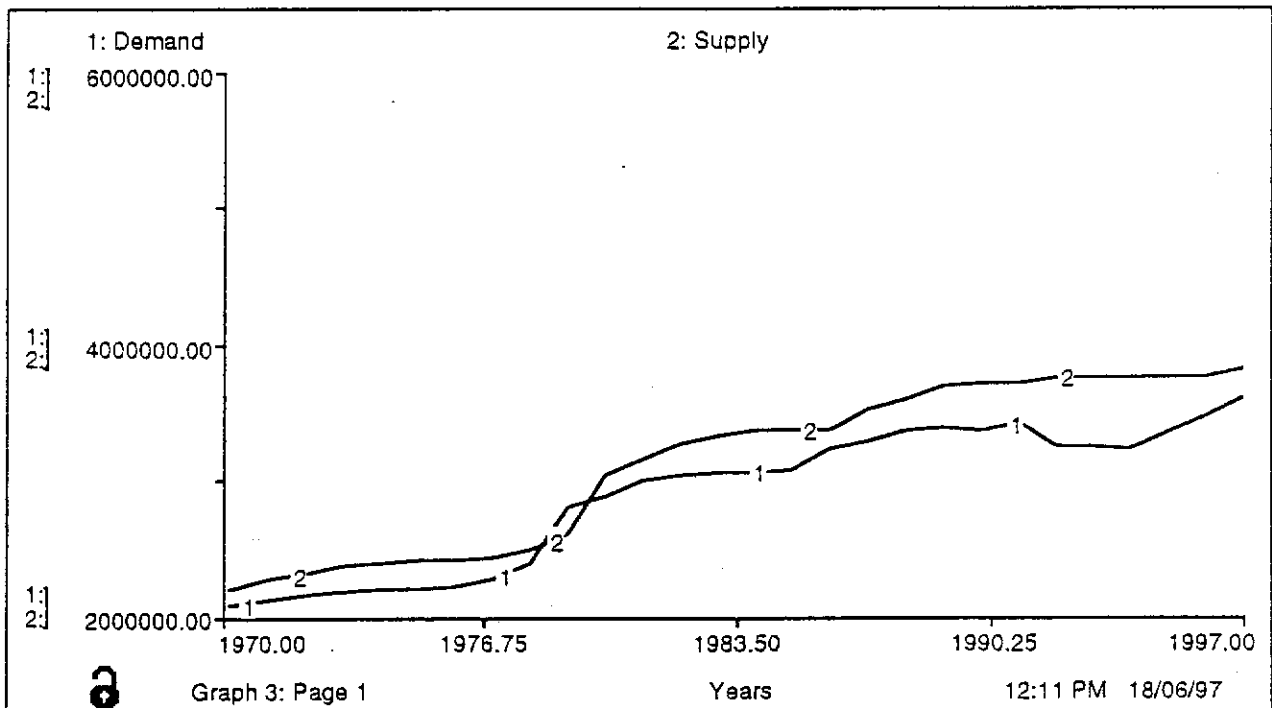
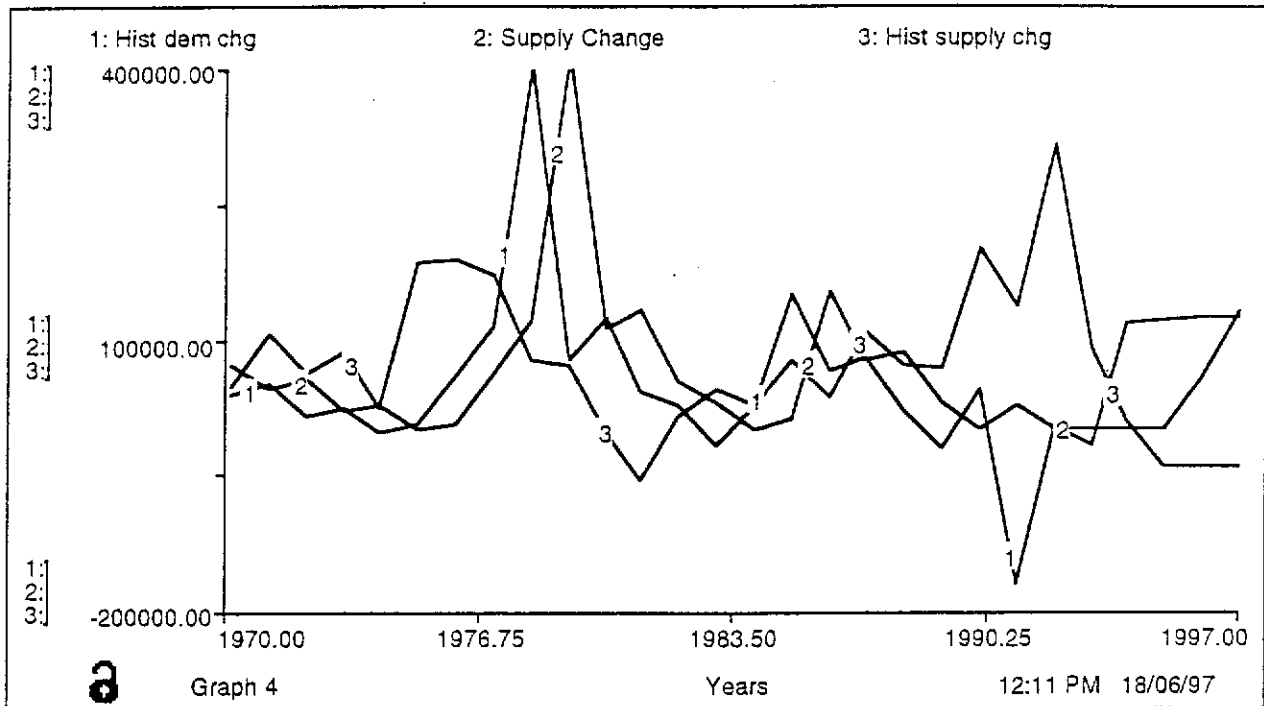
Scenario : Historical Demand Change

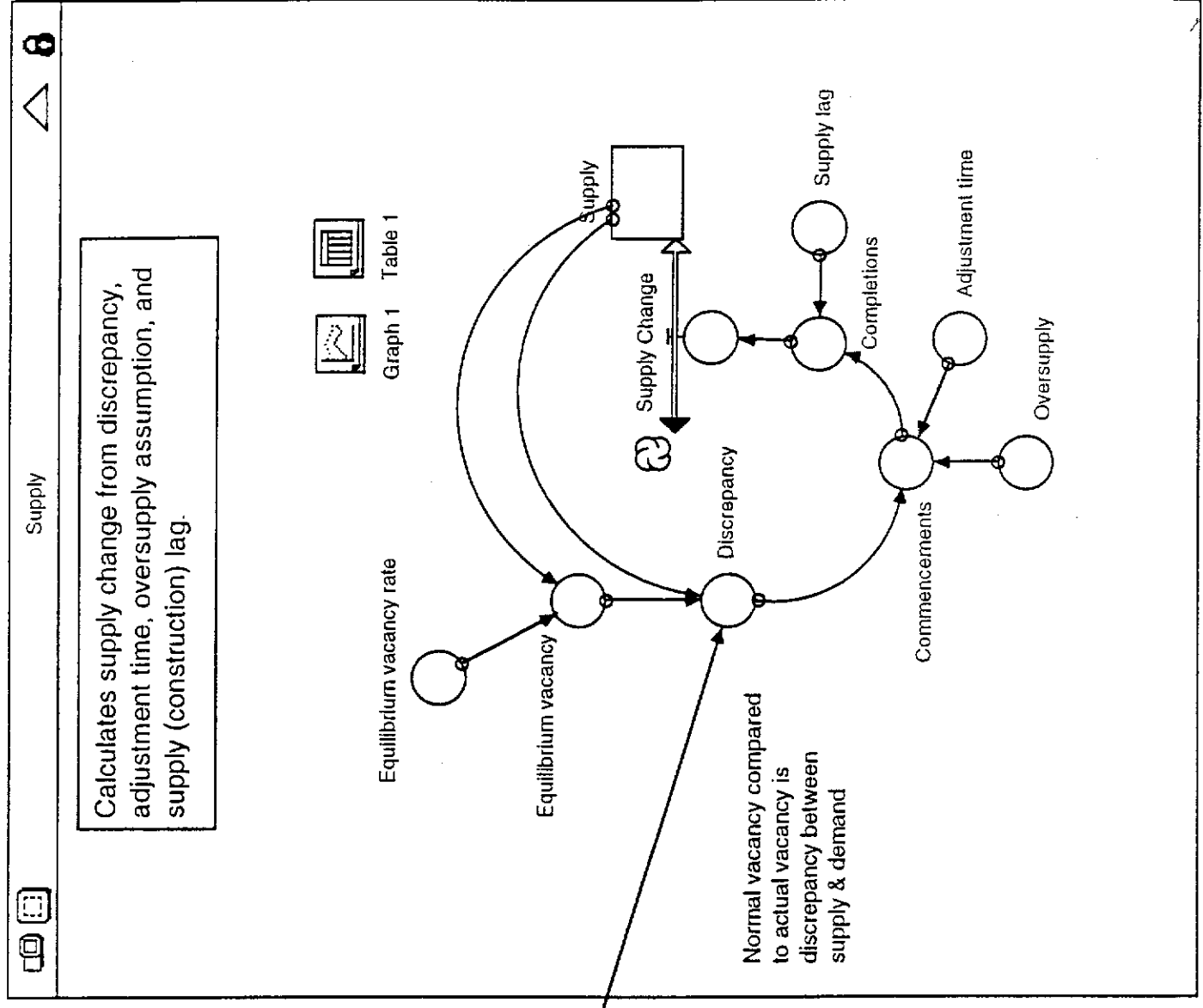
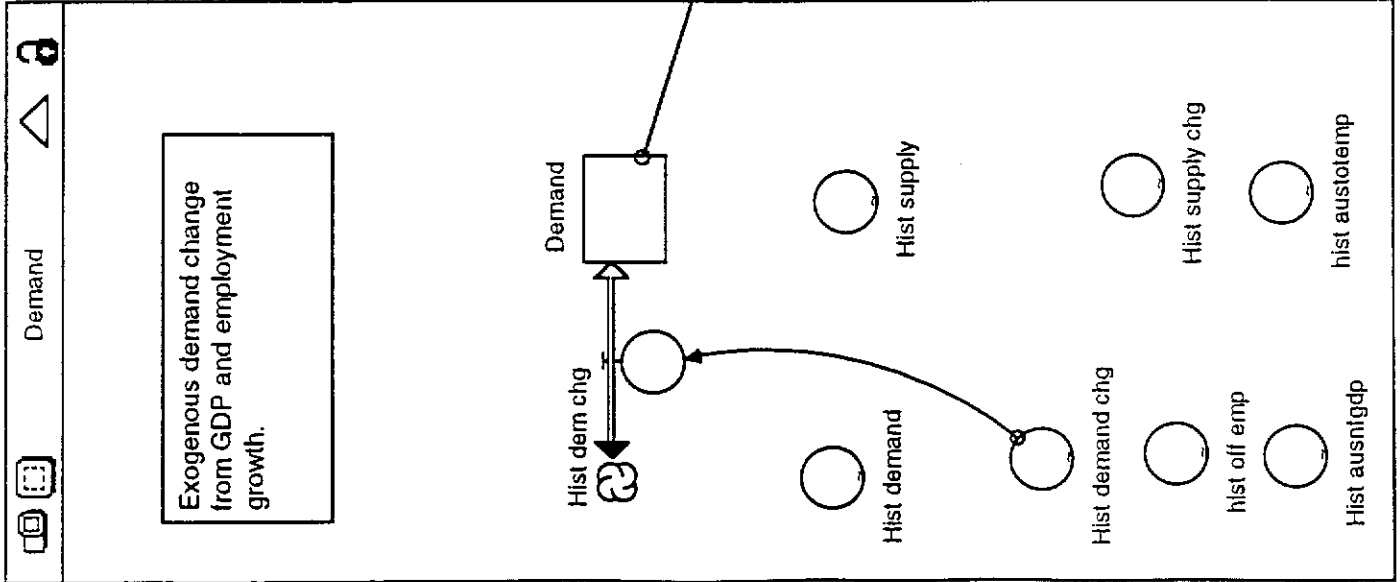
Assumptions

Equilibrium vacanc...	0.09
Adjustment time	1.0
Oversupply	1.0
Supply lag	0.0

Output Summary

Avg demand chg	65,044
Avg supply chg	59,867
MAPE	2.72
RMSE	118,203



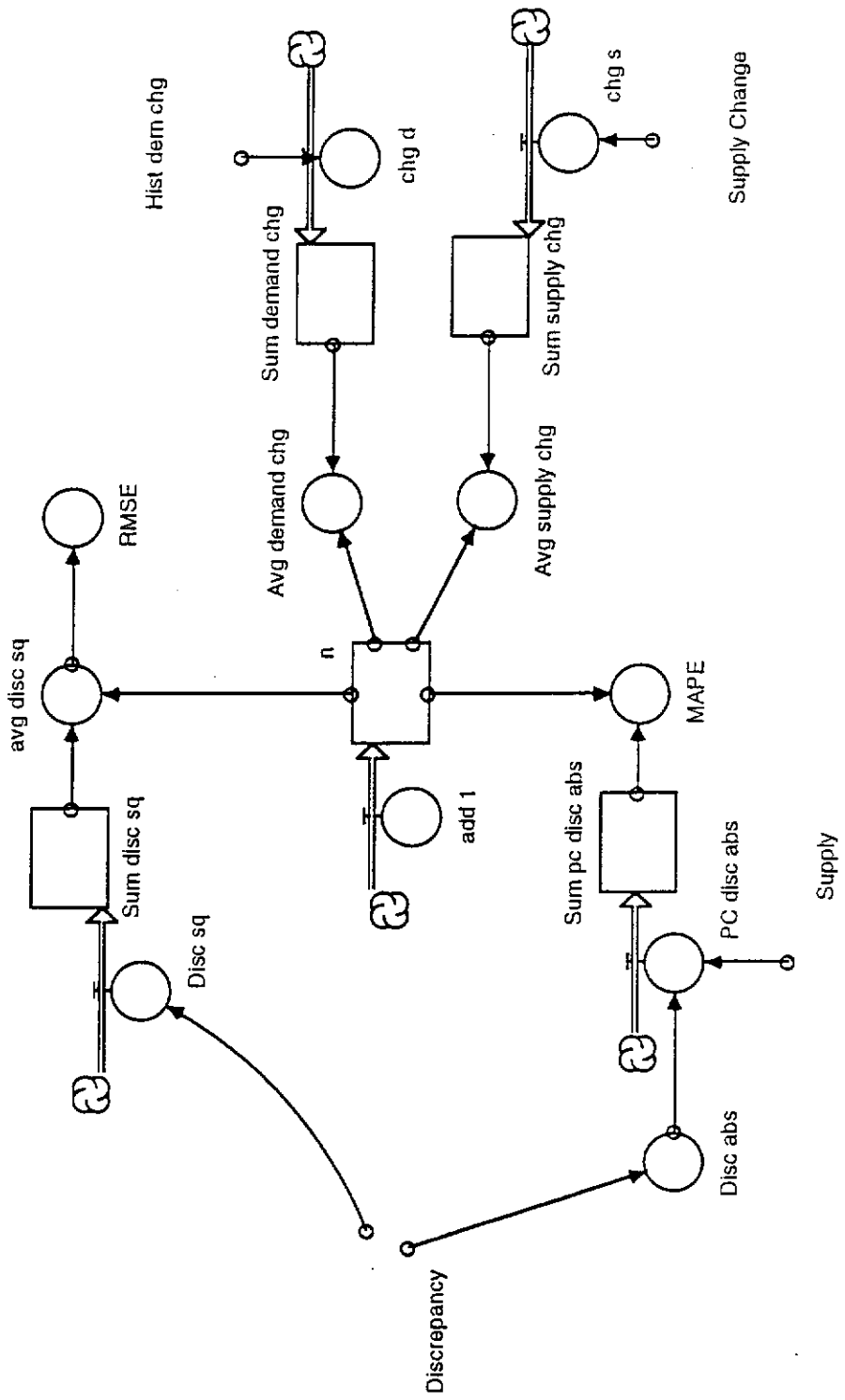




Calculates:
 Average supply and demand changes
 Root mean squared error (RMSE)
 Mean Absolute percentage error (MAPE)



Table 2



Model 2 Office Market Adjustments Simulation

Exogenous Demand Ch...

Exogenous Supply Chan...

Vacancy Rate

Rent Levels 1

Run Label: Base run
 Supply as forecast by KFI
 Demand at 4.0% from 1997

Productivity =

Employ % in offices index =

Space per worker index =

GDP FCST

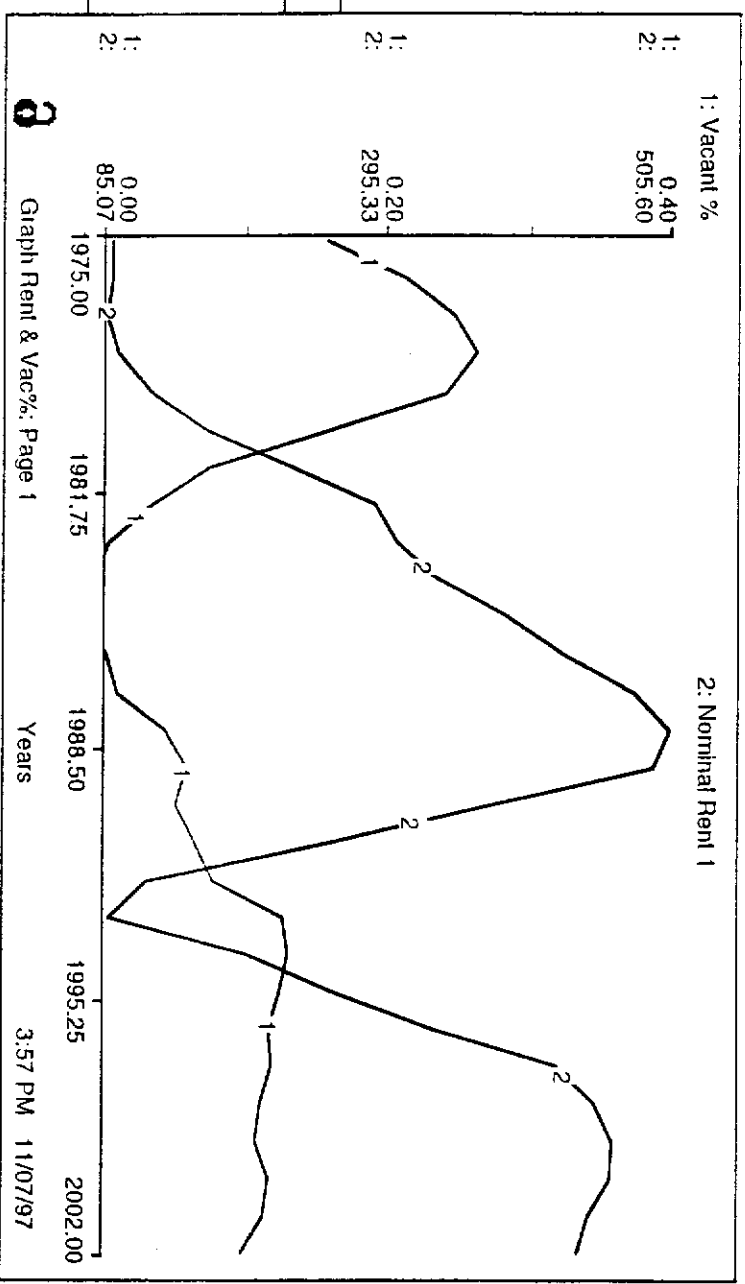
Restore

Supply chg prof...

Demand	4,532,532
Supply	5,027,133
Sum demand chg	667,965
Sum supply chg	638,781
Avg GDP fcst	4.00
Vacant %	0.10
Nominal Rent 2	625

Model 2 Map Layer

Graph Rent & Vac%

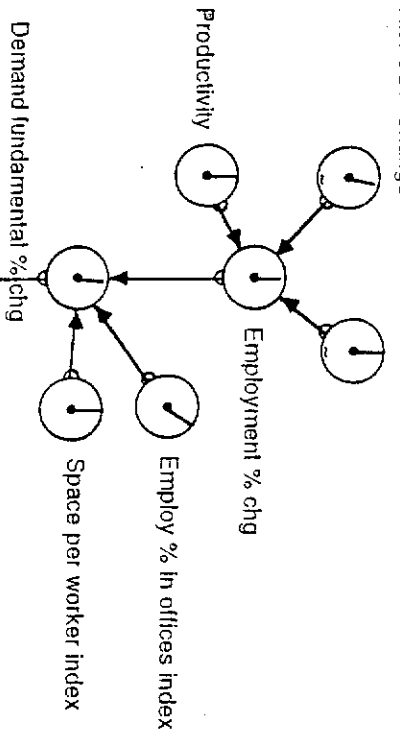


Graph Rent & Vac%: Page 1

Years	Demand	Supply	Demand change	Supply change	Vacant %	Nominal Rent 1	GDP FCST
1980	3,028,568	3,258,381	279,248	-1,818	0.07	224	4.00
1981	3,108,132	3,214,180	79,565	-54,201	0.03	286	4.00
1982	3,219,874	3,228,512	111,742	14,332	0.00	302	4.00
1983	3,309,445	3,275,166	89,571	46,654	-0.01	332	4.00
1984	3,349,865	3,302,700	40,419	27,534	-0.01	383	4.00
1985	3,379,919	3,379,675	30,055	76,975	0.00	428	4.00
1986	3,386,694	3,415,018	6,774	35,343	0.01	480	4.00
1987	3,375,084	3,526,603	-11,610	111,585	0.04	506	4.00
1988	3,393,348	3,597,167	18,265	70,564	0.06	493	4.00
1989	3,481,068	3,665,770	87,719	68,603	0.05	373	4.00
1990	3,619,655	3,866,311	138,587	200,541	0.06	256	4.00
1991	3,698,968	4,003,718	79,313	137,407	0.08	115	4.00
1992	3,771,961	4,320,457	72,994	316,739	0.13	87	4.00
1993	3,841,132	4,410,981	69,171	90,524	0.13	191	4.00
1994	3,871,352	4,421,839	30,219	10,858	0.12	253	4.00
1995	3,870,297	4,380,157	-1,055	-41,682	0.12	329	4.00
1996	3,864,568	4,388,352	-5,729	8,195	0.12	422	4.00
1997	3,989,780	4,484,066	125,212	95,714	0.11	450	4.00
1998	4,119,049	4,617,633	129,269	133,567	0.11	463	4.00
1999	4,252,506	4,810,633	133,457	193,000	0.12	462	4.00
2000	4,390,287	4,954,133	137,781	143,500	0.11	446	4.00
2001	4,532,532	5,027,133	142,245	73,000	0.10	437	4.00

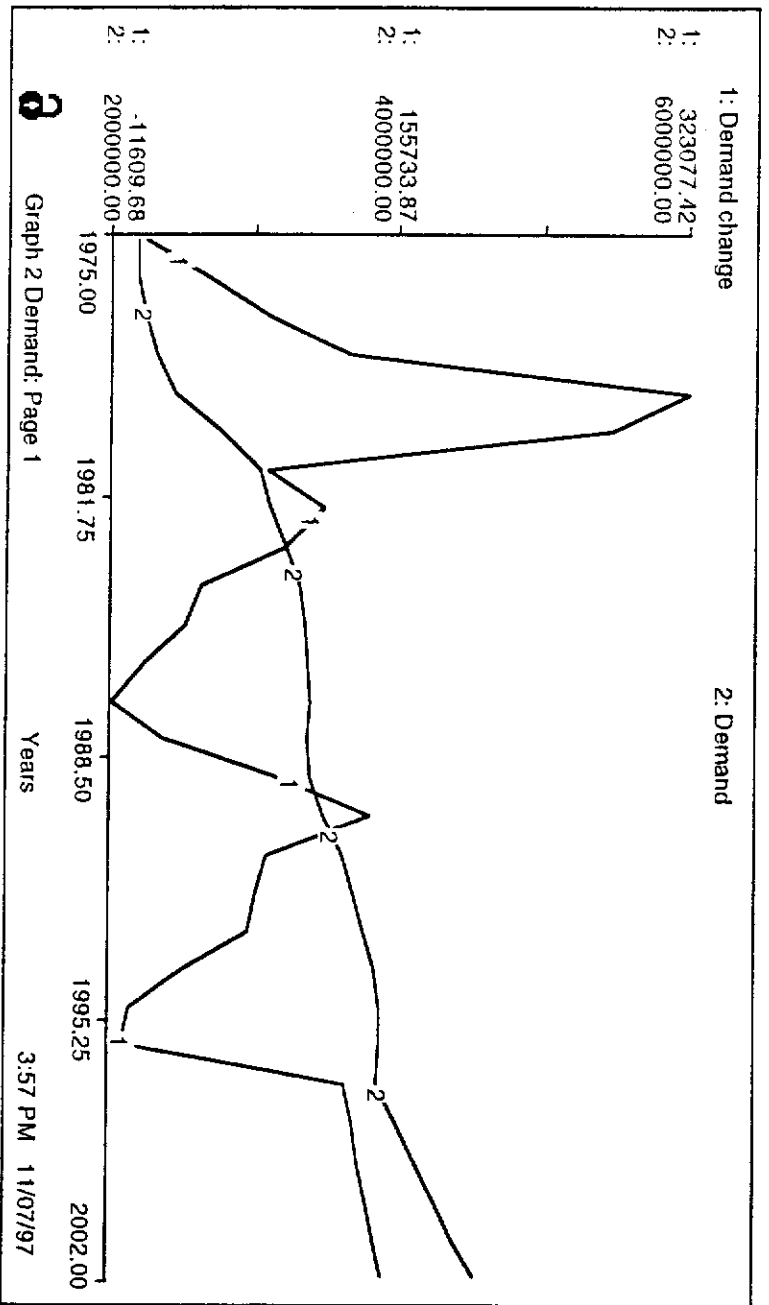
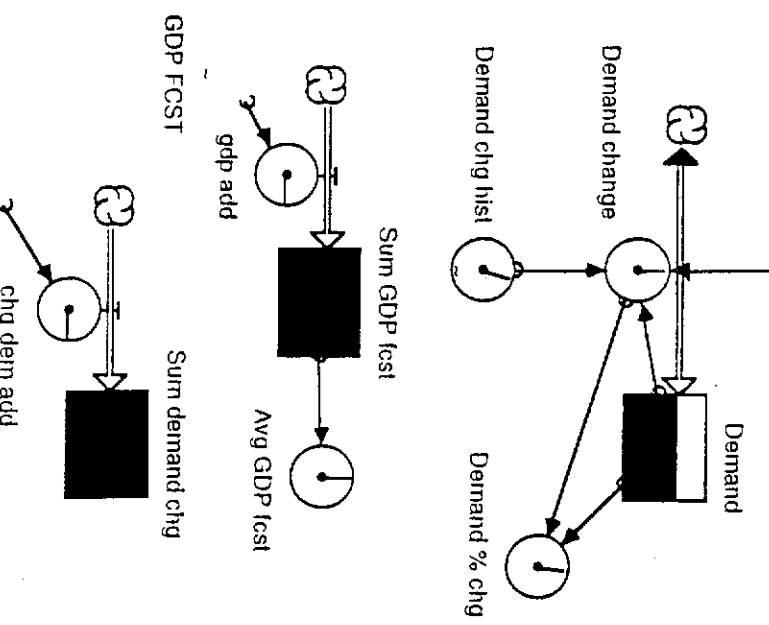
Hist GDP Change

GDP FCST



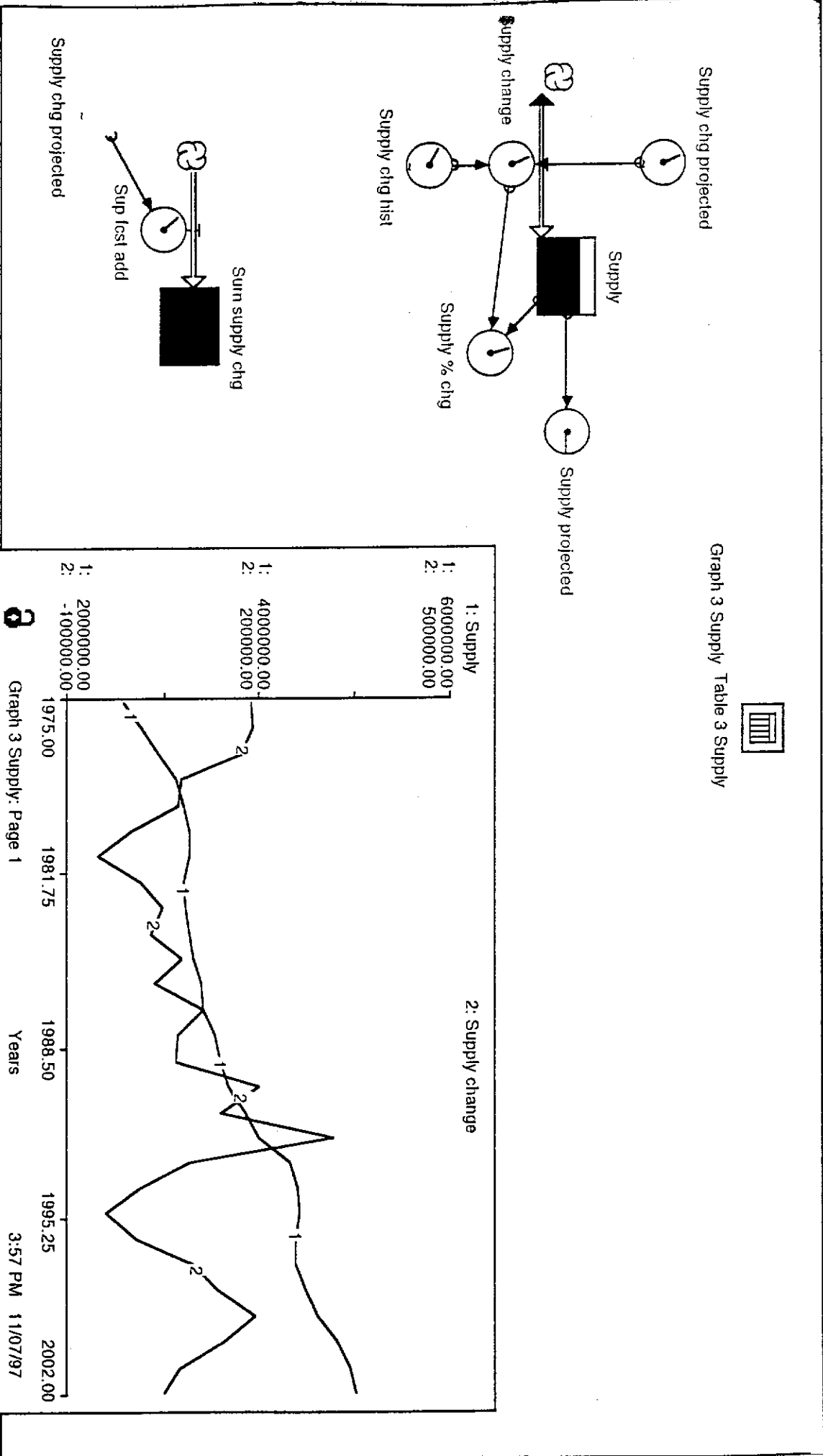
Graph 1 Growth Table 1 Growth

Graph 2 Demand Table 2 Demand

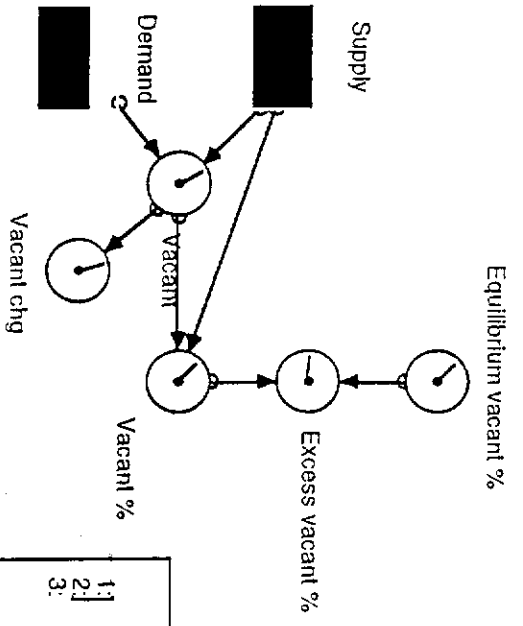




Graph 3 Supply Table 3 Supply



Vacancy rate calculation

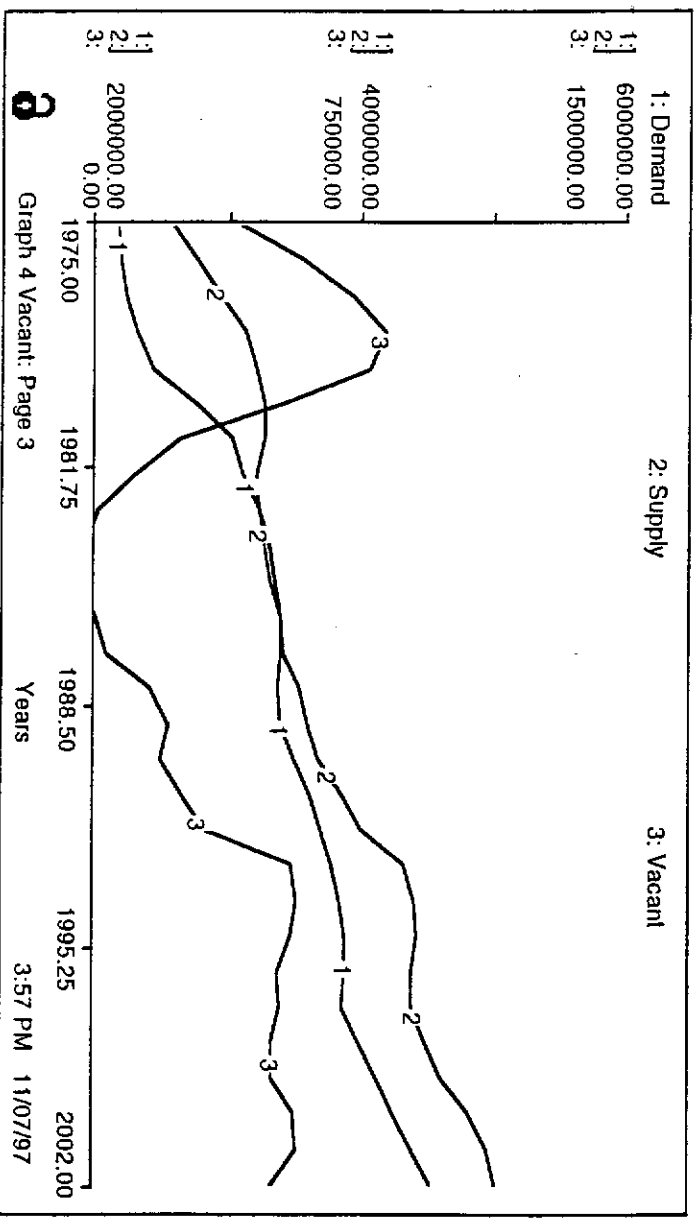
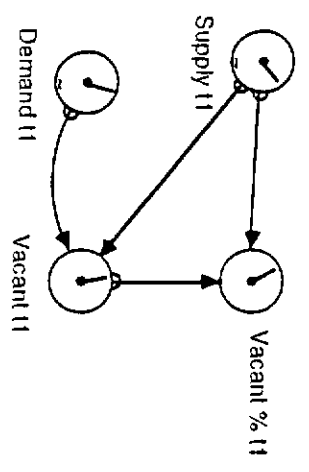


Equilibrium Vacant %

Table 5 T and T1

Graph 4 Vacant Table 4 Vacant

Vacancy one period ahead (lead t+1)



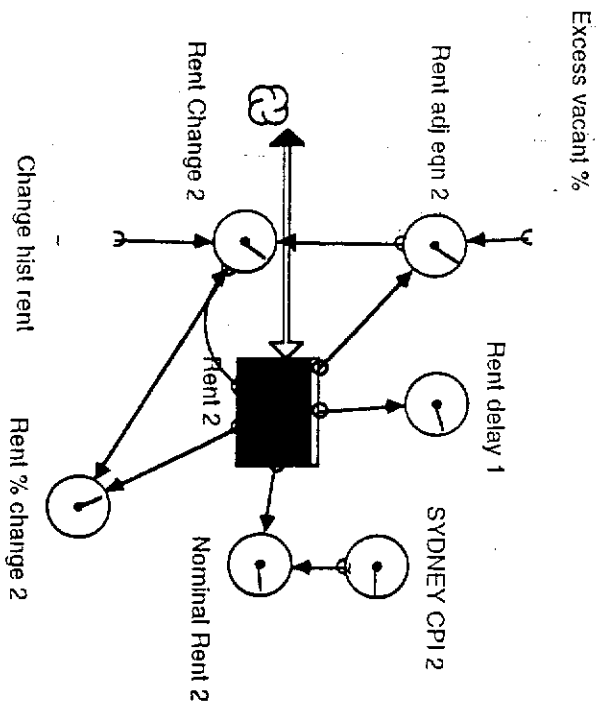
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Graph 4 Vacant: Page 3

Years

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Table 11



Chapter 8 Recommendations for Improving Office Markets' Efficiency

8.1 Institutional Economics

This chapter proposes institutional remedies for the problem of office market oversupply cycles. Institutional changes come about through what Bromley (1989) calls "institutional transactions." These involve collective decision processes with institutions and individuals contributing to question framing, research, conflict, and negotiation of outcomes. For example, it would be an institutional transaction for a municipality to change its land use regulatory processes so as to create a "warehouse" of approved projects antecedent to demand in order to reduce the planning lag in office supply. Another example would be for a bank to change its organisational structure, remuneration methods, and training of property lending staff. Detailed institutional solutions are not proposed here, merely a list of general ideas and issues for debate.

Ken Lusht commented on an earlier draft: "Seemingly conflicting observations are not resolved. For example, while a continuing theme is the benefits of better forecasting, the case is also made that incomplete information about competitors' strategies and a less than friendly institutional environment will tend to undermine the best of forecasting efforts. What are we to conclude? Is forecasting really worth it? Under what circumstances?" This concluding chapter addresses these issues by discussing the institutional economics context which constitutes the "circumstances" under which better forecasting might be possible. The rules of the game need changing in order for forecasting to succeed better.

As to Lusht's questions about forecasting effectiveness, it seems to me my most honest response should be: That is beyond the scope of this dissertation, perhaps beyond anyone's ability given complexity and uncertainty. If one assumes process time invariance the ratio of forecast errors to standard deviation of the series gives a

quantitative idea of the percentage reduction in uncertainty achieved through the forecasting model at each forecasting horizon. But we know the world changes, in ways too complex and inconstant for time invariance of the data generating process to be a viable assumption. Moreover, any model we can propose is undoubtedly misspecified--any parsimonious representation of a complex process cannot encompass the full range of system behaviour. Therefore, we cannot quantify exactly how much the forecasting models reduce uncertainty. Graaskamp once advised me "If you want certainty, become a Jesuit."

One might ask: Improvements compared to what? Forecasting efforts similar to those in chapters 6 and 7 are probably better than looking at chicken entrails. Also probably better than current valuation methods which resemble the chicken entrails technique.¹ But we can not know for sure whether or not, or how much, more attention to forecasting will improve results. In any event, forecast effectiveness will differ in each case--there are no general rules in a complex, evolving system. That we cannot know for sure is a major theme in the worldview presented in chapter 2. The argument, rather, is that given wide experience of the present system having performed so poorly in so many places and times, it is worth experimenting with something new. New methods are best presented as hypotheses for long term experimentation, not as certainties. While it is true that structural change in the data generating process and complexity (misspecification) make it impossible to exactly quantify reduction of errors due to forecasting models, it is also true that the economy does not change completely overnight (barring an unlikely major shock like nuclear war) and relationships observable in past data are likely to continue into the future. It is valuation dogma that leads in part to the current mispricing problem so the last thing needed is a new dogma. That said, I find the deterministic logic of the system dynamics analysis convincing in suggesting that reducing lags and oversupply parameters through system re-design should decrease the amplitude of cycles. The mathematics makes this inevitable if the model is anything like reality.

¹ Destruction of current valuation methods is achieved as follows (as discussed in chapter 8): Oversupply cycles (bubbles and busts) indicate that markets misprice. Valuations are based on market prices, therefore valuations misprice. Continue around the circle of folly.

It is the institutional context which will determine whether or not markets act collectively rationally enough for forecasting to be successful. The situation is somewhat paradoxical in that the ideal situation would be an *inability* to forecast--that is, a strong form efficient market whose future is a random walk. It is the deviations from equilibrium that make forecasting feasible, so a market that was better at staying in balance would be harder to forecast. However, efficient markets would mean that all errors possible had been eliminated, so investing would not be so risky because returns would be more steady and predictable.

8.1.1 Definitions of market efficiency

The preceding paragraph uses the term “market efficiency” in a “finance” sense. As I have used the term in this dissertation, it usually means instead “allocative efficiency” or “equilibrium” as these terms are used in economics. In particular, efficiency implies optimum allocation of capital investment. Too much investment in offices (oversupply) means that capital invested in offices will earn inferior returns and net present value of these projects will be less than zero. This form of inefficiency destroys wealth in the amount of these negative project NPVs. Thinking of the economy as a set of production functions, allocative efficiency means all of the inputs in the production functions are at optimum levels so as to maximise output in terms of aggregate utility of products.

Confusion is possible because the finance literature uses the term efficiency with quite a different meaning, that is, informational efficiency of prices. A finance efficient market reflects all knowable information in market prices. The result is that future prices are a random walk and forecasting is impossible. The finance literature distinguishes between strong, semi-strong, and weak forms of efficiency. Strong market efficiency means no information can improve upon the random walk forecast. Semi-strong means insider information can improve results, but all public information is already priced. Weak efficiency means historical information contains no way to improve forecasts. The key to these definitions of market efficiency is information--information moves prices.

Ex ante, there is no way to distinguish between the finance version of efficiency and the economics version. The best allocation knowable *ex ante* depends upon the same information that moves market prices. However, *ex post*, one can see how well the market priced and it is meaningful to talk about mis-pricing, given investment results. What this dissertation is about is attempting to gain increased understanding of office market processes so as to reduce the disparity between the *ex post* observable allocative optima and the *ex ante* guesses which lead to market outcomes.

Information is not a given or a fixed quantity. It is always possible, for a cost, to increase information. Therefore, it is only meaningful to define the finance efficiency concept with respect to a given information technology and level of information cost. There are therefore infinitely many finance market efficient solutions, depending upon the amount of information, which depends in turn on expenditure for research and information technology. The lenders, for example, whose information set included the rule “expand market share at any cost,” did more poorly in the 1980’s than those whose information set said “cycles have not been abolished.” As the perspective here is concerned with long term, *ex post* social costs and benefits, the concept of allocative efficiency given *improved* information is the target or definition of efficiency the analyst seeks to approach. It is quite plausible that better forecasting technology (ie use of system’s dynamics and econometrics) might lead to better results than naive rent extrapolations. Given a particular information technology, one would acquire a level of information that would set marginal benefits of more information equal to marginal costs. In practice, benefits (and to some degree costs) of information are uncertain and information technology changes rapidly. An analogy between navigation using a compass and dead reckoning versus a global positioning system comes to mind. Better information technology can probably improve forecasting results in some kinds of applications. The difference is that we know GPS technology works while the effectiveness of new quantitative methods of forecasting office markets remains to be seen and probably cannot ever be measured precisely. My subjective guess, based on comparison of historical forecast errors to standard deviations of the

historical series is that some improvement through quantitative methods (econometrics/system dynamic modelling, etc.) seems plausible, but precise forecasting is certainly impossible. The amount of improvement, as noted, may vary with circumstances.

Attention to institutional economics issues would enhance the benefits of any forecasting improvements that might result from the methods outlined in previous chapters. It is not possible for each decision maker to “get it right” individually unless the market as a whole stays in balance.

8.1.2 Leverage points

In Senge’s (1990) language, we need to think about redesigning the system which shapes individual actions. The systems perspective sees managers as researchers and designers. Redesigning systems is the essence of making organisations work better. Integration is the key management skill. The essence of a leader’s task is to design learning processes. A leader has a “purpose story” to tell which “defines reality” focussing their and the organisation’s attention, making for creative tension between vision and the current situation. (Senge, 1990: 342-357)

“Evidence is overwhelming that humans have “cognitive limitations.”we can deal only with a very small number of separate variables simultaneously. Our conscious information processing circuits get easily overloaded by detail complexity, forcing us to invoke simplifying heuristics to figure things out.”

“Today the primary threats to our collective survival are slow, gradual developments arising from processes that are complex both in detail and dynamics. The spread of nuclear arms is not an event, nor is the “greenhouse effect,” the depletion of the ozone layer, malnutrition and underdevelopment in the third world, the economic cycles that determine our quality of life, and most of the other large scale problems in our world. Learning organisations may be a tool not just for the evolution of organisations, but for the evolution of intelligence.”

I have quoted Senge at length because it seems to me his perspective fits real estate problems very well. The answers are not all “out there” but also “in here” in the mental maps of the participants. The oversupply problem is an emergent or collective problem resulting from many individual decisions. Senge calls the incremental system changes that managers can implement “leverage points”--the manager seeks changes that will be small and feasible to implement, but which will lead to considerable improvement in system outcomes.

A purely positivist perspective will miss key elements of the system--the meanings assigned to events, and the motivations of the actors in the system, as well as the role of uncertainty or bounded rationality. Moreover, if the institutional framework is in fact part of the problem, then taking system structure as “given” will mean that improvements in information may not find application. Let me state this more clearly: If the primary purpose of a deal is to earn fees for a decision maker, one could expect objective information to be suppressed rather than acted upon. Chapters 3 and 4 and the literature demonstrate principle/agent conflicts and prisoners’ dilemma games in office markets. Institutional re-design of the system must therefore be part of addressing the problem of office oversupply. Choice must be a part of problem solving, so learning--value and preferences discovery--as well as quantitative techniques, are required to solve the problem.

The list of institutional issues includes:

1. Lags due to public approvals and other development processes.
2. The prisoners’ dilemma game in commencement decisions.²
3. Finance institutions for office projects and their underwriting methods.
4. Agency problems, individual decisions that are socially sub-optimal, or lack of alignment of the interests of agents and investors in office projects.

² Game theory is a branch of the “new” institutional economics in that the rules and information structure of the game are institutions.

5. Institutional aspects of information flows in controlling the system dynamics of office markets.
6. Valuation methods, standards, and institutional context.
7. Roles and reward structures motivating academic researchers.

For each of the above, a brief exposition of the institutional problem will be followed by a suggested general direction for research and institutional transactions to remedy the problem. Detailed proposals are beyond the scope of this study and are left to future research. It is not, as stated above, certain that implementation of such changes could make forecasts perfect, but it is likely that without attention to such issues, forecasting might be less effective and certainly market outcomes less rational in the allocative efficiency sense.

Coyle (1996:349) comments:

“To bring about change to a system, a situation or a point of view is essentially a *political* act, not a scientific one. This line of reasoning suggests that the first consideration in a successful application is identifying the client for the work and discovering the reasons why that person or group should want to be a client. Unless the study can be conducted in such a way as to satisfy their demands, its results are, at best, likely to be ignored.

“Getting on the wavelength of the client is as important in academic research as in consultancy practice. 80% of one’s thinking during the time when one’s brain is at full throttle should be spent thinking about why this problem is important, who thinks it is, and why they care about it... then 20% for clever programming.”

It seems to me that changes to corporate cultures, decision making procedures, and institutional structure of office markets--as well as better forecasting technology--all have a role to play in solving the office market inefficiency problem. Coyle’s advice is very relevant in directing us towards asking who will make such changes and why.

To set the stage for understanding the synergism between institutional reform and improved forecasting, let us first review quickly how far the preceding chapters have taken us. Three research paradigms are combined in previous chapters: qualitative research, econometric modelling, and systems dynamics modelling. The sum is greater than the parts, each supplying information missing in the others.

Qualitative research, by identifying issues important to market participants, increases certainty that quantitative models are correctly specified. Understanding how the system works in some detail and depth comes only from the “prolonged engagement” or “multi-ocular” methods of qualitative approaches (Denzin & Lincoln, 1994). A major issue in all markets is expectations, that is, mental states of decision makers, which are best measured by qualitative methods. Interpretivist paradigms explore these mental states and meanings of behaviour. Through the AIVLE study group, consulting work, and my University of Wisconsin contacts, I was able to get an insiders view of office market decision processes which supplemented the perspectives offered by the academic literature.

Econometric approaches summarise data efficiently and objectively. Coefficients in estimated equations are the mathematically optimum ways of summarising information contained in past realisations of time series processes. Although change occurs, reducing ability to estimate valid models for forecasting, there is also considerable stability over time in data generating processes--the economy changes but many relationships remain reasonably invariant over the 5 years horizons we are concerned with here. Therefore, econometric equations' forecasts can, under some circumstances, probably reduce uncertainty about future outcomes. Context matters--it is not possible to forecast if markets are globally efficient (in finance strong market efficiency terms) and all relevant variables are at equilibrium. Fortunately for the forecasting business, that does not seem to describe the present situation in office markets which often exhibit obvious deviations from equilibrium.

Simulation models, informed by econometric results, take over where data leaves off. With simulations, one can add anecdotal information about relationships believed to be present, but for which no data are available. We can also use

simulation models to explore outcomes if systems are redesigned. Lags, interactions, and information feedback structures in system dynamics models provide quantitative solutions for complex systems and a solution to the problem of simultaneity through the ability to make dt small. Moreover, scenario analysis, sensitivity analysis, or conditional forecasts help us understand risks and enable us to tell a more internally consistent and logical story about the future. Strictly speaking, such models are not precisely correct or true representations--they are oversimplifications--but they are often informative and useful.

By representing a system in diverse ways--qualitative narrative accounts, econometric models, and simulation models incorporating the qualitative and econometric results--one can achieve more understanding of system behaviour and better forecasts. Office market decisions will nevertheless remain ill structured problems with unavoidable uncertainty and indeterminacy.

Uncertainty in future office supply, demand, and prices interacts with institutional defects in the process. Biased decision making is far easier to perpetrate in a climate of uncertainty. In a world of certainty, it would not be possible to fiddle the numbers as easily. With institutional defects, on the other hand, even good information may not prevent folly.³

8.2 Institutional Re-design to Increase Office Market Efficiency

8.2.1 Lags structures in office market institutions

From the systems dynamics perspectives of a "control engineer" as Coyle (1996) puts it, we would look to the lags in physical, economic, and information processes as the fundamental reasons for cycles of oversupply. There are many lags involved in office markets:

1. *Demand lags*

³ Historian Barbara Tuchman's *The March of Folly*, recites many historical examples where leaders chose disastrous courses of action despite good advice to the contrary.

Economic activity.....Employment change

Employment change.....Filling existing space to full capacity

Full existing space....Leasing additional space

Changes in growth expectations...Level of desired space inventory
adjustment

Demand change.....Lease expiry

2. *Price lags*

Demand change.....Price adjustment

Supply change....Price adjustment

Expectations changes.....Price adjustment

3. *Capital market lags*

Failure of projects---Foreclosure and sale of loan security (clearing lender
balance sheets of assets acquired during the last oversupply cycle)

Improved prospects for offices.....Up weighting of asset allocations to offices

Capital market liquidity increases.....Increases in development project finance

Increase in loanable funds supply.....Disbursement of funds after
underwriting and commencement of construction

4. *Supply lags*

Demand change.....Site assembly

Site assembly....Project planning

Project planning.....Public approvals

Public approvals....Finance approvals

Finance approvals....Groundbreaking (commencement)

Project commencement....Project completion

Project completion....Leasing to full occupancy

Decrease in demand....Removal of excess stock

These lags, singly or in combination, tend to make it more difficult for markets to react efficiently to information and shocks, and therefore lead to wide deviations from equilibrium. Lags mean markets must look ahead to future uncertain conditions in making present decisions. Current decisions apply to future situations. Institutional changes can shorten most of these lags, reducing the required forecasting horizon. As shorter forecasts are prone to much less error, decreasing lags will have a more than proportionate effect in improving market efficiency.

It might be feasible to adjust expectations used in price (rent and value) changes to shorten the price adjustment process by perhaps a year. Rather than waiting for supply shortages and rent increases to appear, for example, markets might raise property values earlier, or drop them earlier with a glut of supply impending.

Planning/design/construction institutional changes could probably reduce supply lags by a year or more as well. If these institutional changes succeeded in reducing the time to respond to a demand shock from four years to two years, deviations from equilibrium would be much more than halved. Given increased errors of forecasts as the forecast horizon lengthens, we can forecast conditions in two years much more precisely than in four years.

With a four to five year supply lag, Perth suffered 32% CBD office vacancy in 1993. If the supply lag had been 2 years, half as long, initial projects from 1980s mineral boom would have been completed in time to moderate rents and prevent so many starts. And when a downturn became apparent the market would not have had so many projects irrevocably committed to going ahead to meet estimated demand four

years hence. Inflationary pressures on land and building costs would have been moderated (by earlier completions of new supply), so less would have been invested per square metre of space created, further reducing costs of errors. Vacancy would have probably peaked at less than half of the 32% actual figure, which would have meant much less diminution of capital values, less constriction of bank lending due to non-performing assets, and a quicker recovery from recession. Altogether a more efficient, smoother, less cyclical process.

Singapore, a model in so many aspects of economic development management, seems to offer a case study in the benefits of shorter planning and construction lags. As the Singapore Urban Redevelopment Authority serves as a major land banker and assembler of sites, releasing sites as demand increases, it appears that early stages of office market development are in place sooner and on a coordinated basis better tuned to aggregate demand. With Singapore's top down philosophy and strong central planning, there is little controversy and less time spent on plan reviews. Planning reviews that would take two years in Australia are a 9 month process in Singapore.⁴ Other things being equal, this shorter lag should make demand forecasting much easier.

A site designated as an office site in the Singapore plan has more certainty of outcomes than in Australia or America where a more "bottom up" approach to planning allows a longer time for public comment and planning agency review of private sector proposals. American or Australian land use regulatory institutions, due to weaker public sector planning efforts up front, require more time to sort out private initiatives impact on other landowners and the public interest. Each system has advantages--certainly the bottom up method appears more democratic. But clearly the Singaporean system, dealing with only one level of government (national) instead of two (state and local) is faster.

Planning is no panacea: Singapore's office oversupply of 25% in the mid-1980s appears to have been due to a combination of recession and too many land releases by the central planners. Since then, a more cautious approach seems to have kept

⁴ Michael Liew, Jardine-Matheson, personal communication.

supply and demand in better balance. My impression from graphs of Singapore rents and vacancy rates is that recent data show office cycles have been cut to about six years (compared to 10 years in Australia) and with smaller amplitude relative to Australian cycles (URA, 1996, Knight Frank, Singapore, 1997). A multi-national or multi-city comparison of planning lags and extent of oversupply (controlling for the size of demand shocks and finance availability) would be an avenue for future research on office cycles.

Again taking a systems dynamics perspective, note that different aspects of the system interact to produce deviations from equilibrium. Longer planning delays would matter little if demand growth were slow and steady (ie forecastable and less change required). A combination of long delays and volatile growth (the Australian reality) creates the deviations from equilibrium that cause major economic damage.

Lacking consensus regarding development, Australian cities might have difficulty shortening planning delays without a politically unacceptable short circuiting of public input and debate--and consequent loss of the benefits of a long planning consideration period which does sometimes result in better planning outcomes through public comment, debate, and compromise. Nevertheless, perhaps Australian cities should study Singapore's example to try to find ways to anticipate development requirements so that when office space is needed, they can quickly approve already debated and resolved plans for pre-assembled sites in appropriate locations. Why wait for office demand to appear before deciding what is allowable on a site? The planning process could be changed to anticipate demand and promote early stages of development planning sooner in the cycle rather than merely reacting to proposals during boom times. In other words, ways could probably be found to combine the quick response of the Singapore system with the democratic virtues of the Australian system through more proactive planning.

Application of research on forecasting and market adjustments could reduce lags in the office market by helping decision makers to understand likely future market conditions and hence move their decisions forwards in time, thereby accounting better for lags. Lags can be reduced by forecasting. This is true even of physical

process lags that cannot be reduced, like construction lags. Construction may take the same amount of time, but by anticipating demand and starting sooner the lag between demand and supply can nevertheless be reduced, even to zero or less as pointed out in chapter 7.

8.2.2 Agency problems

Graaskamp insisted that “most of the cash flows in real estate come above the bottom line” and “every project outlay is a profit centre for someone.” Finance and management literature on principle/agent conflicts, especially the divergence of shareholder and management interests are analogous to the conflicts between the interests of property developers and property investors. One of the main reasons developers nearly always want to build whatever can be financed is that their profits are assured above the bottom line in many cases.

Detoy and Rabin (1972), San Francisco office market research consultants, reached the same conclusion in proposing a tongue in cheek, but empirically accurate table showing that developers prefer to build regardless of market conditions. Many office market participants have told me that developers will build if they can get finance, regardless of market conditions.

Table 8-1 Developers’ Conclusions Depending Upon Quality and Recommendations of Market Studies

	Recommend build	Recommend not build
Competent market study	build	build
Poor market study	build	build

Source: Detoy and Rabin, 1972

A property lender explained an office project near Chicago as a case study. "There might be a little fluff in this land price," he remarked.⁵ This means that by buying the land cheaply and selling it to the project for a profit, the developer may already have an assured profit when the original draws for land acquisition are made against the property development loan. Additional profits are possible for some firms or at least key decision makers in those firms (depending on the functions they undertake) for project management, construction, design, leasing, mortgage brokering or syndication or floating shares, or long term management and maintenance. Literally millions in development fees were earned by consultants on projects like Perth's Central Park tower, although the state superannuation board probably lost over \$100 million on this investment. Successful damage suits against accountants and valuers indicate culpability of some professionals who earned substantial fees from developments that failed to find tenants.

A particularly serious problem is the practice of including incentives to write business in the employment contracts of financial institution staff. If a bank loan officer will earn a substantial bonus for "doing a deal" the capital of shareholders is likely to be abused. Such incentives still exist. One current transmogrification of the agency problem is the large fees (millions of dollars) earned by organisers of Australian property trusts. With increasing securitisation of property investment, due diligence work under the control of those earning large fees, and shares owned ultimately by investors without property expertise and with no first hand information about the property (which might be in a different state or country), the agency problem is still with us. Sykes concludes "Financial regulators start every new cycle with stone axes."(Sykes, 1996: 675)

The general principle for institutional reform is to try to better align investor and developer, professional services, and lender staff interests. Those making the decisions should share in the risks their decisions create. Due diligence and advice

⁵ John Okarenko, G.E. Capital

must be independent, not provided by those earning fees from the deals. We are still far from this ideal and the results are predictable.⁶

Valuers and market research consultants should be engaged by investors, not by developers, to ensure their independent judgement. But it is not clear who this wazzu will be, given that shares are marketed through firms that earn fees proportional to sale of shares. Clearly employees of these firms responsible for due diligence could face pressures for biased analysis. Firms responsible for marketing property shares should pay particular attention to the incentive structures, formal and informal, faced by those responsible for due diligence and marketing of the property shares. Loan officers should not be paid substantial bonuses tied to size of loans underwritten. Developers who do not take ownership positions in their properties should pay more for finance. The property industry needs to do a better job of pricing and controlling risk, with a major issue being institutional structures to avoid potential principle/agent conflicts.

8.2.3 Escaping the Prisoner's Dilemma game

The Nash Equilibrium of the prisoner's dilemma game, imperfect information, principle/agent conflicts, and exogenous forces from finance markets all distort efficient market outcomes leading to oversupply cycles. It is tempting to propose a Mancur Olson (1971) or Bromley (1989) type solution, some form of collective decision making about office commencements. The obvious place for this would be the municipal planning authorities, who could, through the police powers, prevent building commencements likely to lead to oversupply. Less obvious, but perhaps better, would be a representative decision making regulatory body like those often used in fisheries management. An office development "limited entry" committee representing the major stakeholders might include representatives of tenants, building owners, developers, investors, government, and the public. Its charge

⁶ The only return I have yet received on a small investment made a decade ago in a Stamford, Connecticut office building limited partnership is \$100 received in a class action out of court settlement from the share broking firm that misled investors. Things are getting better though--the building is up to 70% occupancy 8 years after its completion. Sykes (1996) lists similar Australian experience where investors were misled by inaccurate financial statements.

would be to attempt to adjust office investment in the metropolitan area near allocative efficiency--ie keep vacancy rates near equilibrium levels.

This kind of proposal faces a number of difficulties, despite its solid foundations in economic theory. First, it faces a political problem: The culture of the property industry, especially in Australia and the U.S. is one of individual entrepreneurship and "deal making" in "free" markets.⁷ When I mentioned diffidently to a commercial property agent that perhaps a queue system for office projects would be constructive he responded instantly, "Life wouldn't be worth living." Real estate industry players thrive on risk and make money from taking risks. If things became too predictable, some would see it as nothing more than the loss of an opportunity to make super-normal profits from markets out of equilibrium and de-valuing of their specialist insider information. Those in the property industry who extract substantial fees from projects destined to fail economically--that is, almost the entire property industry--would not at first thought be expected to favour limiting the number of opportunities to do so. They tend to forget, however, the several years of unemployment or substandard income inherent in the boom bust cycles resulting from over-exuberant and inefficient market outcomes. The key to persuading the industry to support such an institutional change would clearly be an appeal to self-interest--in the long run, a more efficient market would produce more benefits certainly for society and probably for most individuals in the industry as well. In the long run, less allocative efficiency means less property industry revenue. Markets correct periods of overinvestment through periods of underinvestment.

Second, there is a pervasive and well founded distrust of public sector administration and decision making. There is potential for corruption in processes where millions of dollars are to be made based on public sector decisions. Recent history of Australia (and many other countries) confirms this problem is real and serious. Public officials are accused of taking bribes with disturbing frequency. Many believe markets less corruptible than governments because in a market decisions are

⁷ Never mind that the deals are made with regulated currencies, in a context of legal institutions defining property rights and obligations (eg. tax liabilities), land use and building regulations, and regulated currencies and financial institutions. Bromley, 1989, discusses institutional contexts.

supposed to effect one's own financial outcomes. Unfortunately, it is arguable whether these capitalist ideals are relevant in property markets which operate on OPM (other peoples' money) and deal-dependent fee income. There are examples of private sector financial institutions coming under the influence of corrupt or unwise individuals--Rothwells Bank in W.A., Lincoln Savings and Loan in the USA for examples, (Sykes, 1996. Adams, 1990), which match in venality the public sector debacles like W.A., Inc.

Thirdly, even absent corruption, there are administrative and forecasting problems. Would public agencies be quick enough and accurate enough in their forecasts to properly release office development approvals in measured amounts appropriate to demand growth? Would public controls merely replace the prisoners' dilemma of a market outcome with bad decisions of a process driven by political considerations? For example, Singapore's release of too much land during the mid-1980s.

Other difficult issues are equity and the related issue of development quality. How does the public agency decide whose project shall proceed? Admittedly markets do not always give us the best projects, but at least in theory the best projects--those best located, most cost efficient, most in demand--are more likely to proceed if markets make the decisions. At the moment it is really bankers and investors--the sources of capital--that decide which projects are built. Do we think planners would be better at picking winners? A public sector queue system would have to include criteria for deciding whose project would proceed if more developers wanted to build than was warranted by demand. Perhaps these quality issues are best avoided by a simple first come first served queue.

The above comments seem to suggest that while we need collective decision making to avoid economic inefficiency, more efficient solutions are hard to implement successfully. I think it better to regard implementation as a solvable problem in institutional design, recalling that the objective is not perfection but merely improvement of the present poorly performing system. A complete study of the vitally important implementation details issues is well beyond my scope here, but the following are important principles:

1. Start with total demand forecasts.

In regulations limiting access to fisheries, a key number is the total production estimate produced by fisheries biologists which must be independent, unbiased, and fairly precise. The harvest rate must be adjusted so as not to exceed this "maximum sustainable yield" fishing rate, or the resource will be destroyed and the fishery ruined (Clark, 1990). In office markets, the obvious analogy to fish production (called "recruitment" in fisheries biology jargon) is net absorption. Supply should be set to match demand. So a key aspect of administering the "queue" of office projects is to get the net demand change forecast figure right.

This is not an insurmountable problem, but the present source of occupancy data, the Australian Property Council, would have a vested interest in producing a low demand figure, if supply were dependent on their demand change (net absorption) estimate. Perhaps a combination of industry and public sector expertise, with some independent data gathering ability, would be needed. Or perhaps the APC could find ways to ensure that its numbers were credible bases for adjusting supply. Information could be much improved if there were a requirement that leases must be publicly recorded, in the same manner as property sales. That single step would do a great deal to improve commercial property market data, leading in turn to better forecasts. Institutional means and sources of funding to create objective net absorption estimates are required. Given the extent of losses due to oversupply, it would seem, given the state of present information technology, extremely cost effective for society to implement objective sources of property data.

2. Forecasting methods based on multi-year outcomes.

Single year figures can be aberrations as we have seen in past data. Econometric models of demand and smoothing of demand estimates could be part of producing aggregate demand forecasts based on multi-year historical series. It might be preferable to use a simple formula with less scope for abuse: For example, perhaps the sum of projects under construction at any one time should not exceed average net absorption summed over the past six years. It should be possible to design a

workable objective formula to relate office approval “releases” to demand. Starting the mean of the past series every year would probably give more allocative efficiency (better investment results) than the present system. This is analogous to Paich and Sterman’s finding that “a simple rule” performed better than decision makers in a system with lags and feedback control.

3. *Forecast volatility as well as levels.*

Volatility of demand (standard deviation of the past series) would also be a factor in setting reasonable objective criteria with the goal of allowing adequate construction to accommodate demand while preventing major oversupply.

4. *Use the equilibrium vacancy rate concept.*

Another benchmark could be to compare projected vacancy rate to equilibrium vacancy rate in the year of project completion. If projected vacancy rate were to be greater than 2 times equilibrium vacancy, or perhaps even 1.5 times equilibrium vacancy, project commencements should be delayed.

5. *Use simple objective criteria rather than complicated or judgemental methods.*

Whatever the exact formula, the idea is to use an objective benchmark based in the supply/demand objective situation rather than rely on (suspect) planner discretion or the chaos of a market driven prisoners dilemma game. The devil is in the details so research, debate, and experiment are all essential steps in designing successful cycle smoothing institutions and policies.

6. *Seek to err on the side of too much supply.*

Policies should probably aim to err on the side of allowing a little too much office space to be built, rather than too little. The former would result in low rents and capital losses for investors, but would promote economic activity, employment, and regional competitiveness in terms of occupancy costs. The latter would constrain economic activity and impose high occupancy costs on tenants throughout the

market. The external costs and benefits seem to be more favourable to slight oversupply than to undersupply.

By increasing efficiency, reducing risk, and reducing costs of capital, a better balance of supply and demand (markets closer to equilibrium) would mean lower occupancy costs in the long run. Low rents created by office busts may appear to favour tenants interests, but only in the short run, and perhaps not even then if non-performing assets reduce macroeconomic activity, penalising tenants' business outcomes. In the long run, periods with no new projects occur to offset oversupply. So we might expect an averaging out of employment and incomes in the property industry, rather than a reduction in fee incomes if cycles were reduced in amplitude. If the economy took less damage from property cycles, the end result should be a more prosperous real estate industry.

The above paragraphs address the "why limit entry," "how much to allow" and "how to be objective" decisions, but do not address the very important "which projects" question. A simple, market oriented solution would be for the public sector to auction off rights to develop to the highest bidder. But that might have unintended negative effects such as reducing the diversity of developments and the quality of the built environment. Money that would otherwise go into projects (or profits) would be diverted to the public. The public would capture the economic rents created by urban growth, but at a cost to the quality of the built environment.

It seems more sensible to me to use some kind of queuing concept to create more certainty of outcomes for developers and capital sources, rather than less certainty. Such a system would recognise that development of a major project is an expensive and risky process requiring several years to bring to fruition. Given increasing investment as a project advances from stage to stage, it seems reasonable for developments to gain in priority over time as investors spend more to take them from concept to reality. As a development firm commits increasing amounts of time and money to early stages of development, it should expect increasing certainty of timely approval from government. For some relatively nominal fee, developers controlling sites should be able to place them in a development queue, and maintain

their place in line by reaffirming annually or quarterly that the project still is progressing. An important point for how the market functions resulting from limitations in amount of space built, would be that the risk of these early investments in projects would be much reduced. This would have the effect of reducing costs of capital for the planning stages of projects.

Some municipalities might choose to provide subsidies for early stages of project planning to get more projects into the queue if an impending supply shortage were forecast. A side benefit of a queue would be better information on mooted supply. The information provided by developers with projects in the queue should include current stage in the development process, estimated quarter of project construction commencement, and estimated quarter of project completion.

To prevent developers trying to push forwards in the queue by projecting unrealistic completion dates, projects that fail to commence construction on the dates projected should be pushed back in the queue or pay a penalty to maintain their priority or "place in line." If more projects are ready to break ground than demand justifies, those in the queue first would have priority. Presumably rational developers would not put waste their money putting far more projects in the queue than could be approved. Perhaps an annual "queue membership" or "development approval processing" fee would be helpful to prevent entry of frivolous projects. Getting projects in the queue earlier should mean that public sector approvals would be quick and certain when the time comes to proceed which would dramatically reduce developer risks. If the public sector can decide to approve a project at time t , why not at time $t-2$? The public sector should know in advance which projects meet criteria. Of course, other planning controls and reviews would still apply, but these would be "gotten out of the way" earlier in the process. Why could not a developer obtain plan approval for commencement at a future date--say within the next three years or even five years? At present, developers have incentives to wait until the last minute because capital costs are high for the risky early stages of development and there are few benefits to beginning earlier. A queuing system would create a benefit (really a kind of entitlement or property right) in the form of "queue position" that would give a positive incentive to start planning earlier. This would

mean that the city would have more chance of projects “ready to go” when demand shocks materialise. Knowing how many projects are in the queue would allow developers to adjust their activities accordingly, resulting in less money wasted on early stages of projects for which there is insufficient demand and which have little hope of proceeding. A queue should reduce the number of vacant (unproductive) sites waiting for redevelopment.

The negatives might be additional cost and delay in project early stages. And if projects were delayed too long, building designs might become obsolete. So provision should be made for easy, cheap, and quick updating of approvals to reflect new design, technology, and office market developments for projects delayed by the regulatory process due to lack of demand. But Model 1 of Chapter 7 suggests that much of the benefit of “smoothing” supply is obtained by setting adjustment time to a fairly small number (for example, 2), so delays would not be prolonged unless demand truly collapsed. Best management of the system would start by pushing commencements ahead in time--the cycle is generated by projects starting too late. The objective of the queue is not to delay projects but rather to spread them out over time, starting some earlier, but not allowing oversupply to develop. Reducing the risk of subsequent oversupply through a queue should help induce capital to enter markets sooner. If there is one single recommendation to reduce the amplitude of office market cycles, it would be for sources of finance to commit to new projects earlier in the cycle.

The benefits to developers and investors from a queue would seem to far outweigh any negatives. A queue would provide much more certainty of income from the development. Developers’ risk of ruin due to oversupply from late entering competitors would be reduced considerably. Reducing risk and variance of returns from the project through rationalisation of institutions for matching supply and demand should result in a considerable reduction in risk adjusted cost of capital. Certainty that excess supply will not be forthcoming--reducing the anarchy of the current supply free for all--would considerably reduce the biggest risk faced by speculative office building investors--namely oversupply at time of project completion. One would think that office market investors would be very happy to

find an institutional escape from the prisoners' dilemma which has cost them so many billions of dollars in the recent past. It must be emphasised that if the rules of the game create a prisoners' dilemma game, then the logic of collective action will, in an unregulated market, guarantee suboptimal investment returns (misallocation of capital). If institutions like those proposed here are enacted, the impetus will probably have to come from capital sources insisting that they will properly price risk in chaotic markets. Once it becomes clear to the real estate industry that the cost of capital would be lower in a market more immune to oversupply risk, those in favour should become a clear majority.

Particularly with the internationalisation of capital markets, any metropolitan market might be overwhelmed with office investment unrelated to local supply and demand conditions. The phrase "flavour of the month" is used regarding the herd instinct in asset allocation or portfolio weighting decisions. With the globalisation of world capital markets, it becomes quite likely that the unco-ordinated investment decisions of fund managers looking at similar asset allocation models would lead to prisoners' dilemma overinvestment in particular hot markets. The potential for oversupply may be worse than ever due to increasing mobility of capital in global capital markets.

In the 19th century it was found to be necessary to prevent banks from printing money, lest the money supply explode and destroy the banks. Property lending seems to have analogous prisoners' dilemma system characteristics and behaviour which require an institutional remedy. This debate echoes 19th century history of economic thought when Richard Ely and other founders of the American Economics Association concluded that abandoning *laissez faire* capitalism for more pragmatic approaches was essential to prevent monopoly and the collapse of market capitalism. All markets operate within institutional structures. If one believes in market mechanisms, the correct institutional structure is not *laissez faire* but rather an institutional framework which leads to more efficient market outcomes.

8.2.4 Finance institutions for office projects

Anthony Downs, Brookings's Institution real estate researcher, was asked at an Urban Land Institute session in 1993 "What is the explanation for office oversupply?" The session's speakers had just described oversupply problems in London, other European capitals, and Japan. Downs replied emphatically that the problem stems from oversupplies of capital. Lenders who must invest large amounts of money in order to earn required "spreads" may cut underwriting standards when few good opportunities present themselves. Lender's staff may rely too heavily on current market conditions, ignoring lags and future likely outcomes.

Brueggeman's (1993) paper shows that institutional issues related to foreclosure and disposition of non-performing properties delays institutions' re-entry into property lending in recovery stages of office market cycles. Institutional changes to speed this process might not help much, however, because they could not repair the damage to lender's balance sheets which may be the key to discouraging new lending. Damage caused by poor underwriting cannot be repaired until market demand recovers. However, changes to improve the lending expertise and institutional memories of property lenders would probably be very constructive. For example, it is only recently (post 1992 office market collapse) that Australian banks have set up specialised property lending departments with trained property professionals making lending decisions. It seems astonishing to think that decisions regarding hundreds of millions of dollars were routinely made during the 1980s by bank executives and staff without property expertise.

My informants at ULI and Sydney were nearly unanimous in singling out project finance approvals as the key step when an office project shifts from mooted to irreversible. Projects which receive financing commitments are almost certain to go to completion and to commence construction almost immediately.⁸ At a minimum lenders should create an online data base showing the finance status of competitive projects. It should be possible for lenders to reduce the "window of opportunity" for new projects to the correct length which is "until enough competing projects

⁸ This conclusion about property finance as the key decision step has probably been made obsolete by growth of institutional investment and entity finance. Now, projects which might have access to finance could be delayed by negative findings during due diligence or share market reactions to development proposals.

obtain finance to meet demand.” The system should adjust its information flows so they are quick enough to prevent excess project approvals. By the time the ink is dry on a loan approval, every other institution that might be considering an office development in that market should know not only about the competitive project receiving the go ahead, but also the likely impact on demand and rents for any projects they may be considering. The use of models like Model 2 in chapter 7 makes it possible to estimate the rent upon completion consequences of rival project approvals. This means that a project might literally be feasible one morning at 10 am but not feasible half an hour later if another closely competitive project’s finance received approval at 10:15. Re-adjusting assessments of individual project feasibility based on market aggregate competitive supply changes in a manner of minutes, rather than a matter of years (the apparent situation in the 1980s) would be a major improvement in system design and policies.

The problem of excess money seeking too few opportunities is a problem of macroeconomic management. It may arise from governments forgetting “the second half” of Keynesian economics. Keynes recommended running fiscal surpluses during high growth periods to cool the economy. Monetary policy could also be used to cool overheating. Financial regulators in Japan at least, realised belatedly that asset price inflation may be as important in assessing monetary policy as consumer price inflation (Ito, 1992). When times are good, if governments could find the courage to raise taxes (especially wealth taxes) to pay for infrastructure, reduce public debt, and redistribute income (thereby increasing demand--the missing element in the office market at the end of the boom) they might take some of the money out of the coffers of the investors and institutions who over finance office market supply.

What seems to happen instead is that underwriting standards fall as funds managers seek to maintain rates of return in markets that no longer offer attractive opportunities based on real needs for investment. Moderating growth rates would help prevent over-exuberance in property markets. Supply of investment capital and consumer demand may be out of balance in the entire economy. Oversupply of office space, corporate raids, and bull market bubbles in the stock exchanges are three inimical consequences. The money has to go somewhere. Rather than accept

falling yields, some investors choose to increase risk in a search for higher yields. A queue for office project approvals from local planning authorities would not address this macroeconomic imbalance--the money would just seek some other speculative outlet unjustified by demand and economies would face a recession due to a share bubble collapse rather than office oversupply.

8.2.5 Institutions for collecting primary data on office markets

Initiation in Australia (and worldwide) of “independent” sources of information like JLW Advisory, Knight Frank Independent and similar property industry research enterprises created an appearance and a reality of much improved property information in recent years. BOMA also greatly upgraded the quality and scope of their property information research. More sophisticated university research also added to the potential information resources of the property industry, although these methods have not yet become widely used in Australia. But there remains a major dilemma regarding information resources that the property industry has not yet resolved, to their cost in the long run. This dilemma has three facets:

1. *Those with access to primary data are usually interested parties and hence may not be reliable sources of unbiased data and analysis.*

The primary data in the property industry can only come from agents, property managers, and building owners and investors. Each has an axe to grind, that is, each has a position that might be enhanced, at least in the short term, by providing misleading or incomplete information. Those of us at universities might seem to be a source of unbiased property research, but unfortunately, we must rely on the property companies for data, so our work is no less open to question than theirs. And to pretend that academics do not have interests is naive. It is impolite to bite the hand that feeds you, even if you are a university consultant to a private firm.

2. *Information is the stock in trade of real estate, therefore information is a tool for competitive advantage.*

To provide advantage, one's competitor must not know the same insider information. Therefore, there is an incentive not to reveal information openly (Shilton, 1993). This is also true of results of academic style econometric models--if everyone knew and believed the model's prediction, they would react and destroy the truth of the model's predictions. The problem is that decisions made absent information can destroy the value of good information--so secrecy also fails as an information strategy.

3. Information has the problem common to many intellectual property assets of being difficult to market.

A firm might spend six months and \$100,000 studying an issue, only to have its competitor realise most of the benefits of the information by spending \$2 and ten minutes xeroxing the report. There are no institutions in place whereby research firms can realise the value of their work, while at the same time making the research public. Yet for the market to become efficient, information must be public.

Property firms offer the opposite of lifetime employment--the industry is highly cyclical. Intellectual property in the heads and files of key employees frequently ends up serving a competitor's interests. Perhaps headhunting is so common precisely because it is a way to buy competitors' information resources.

Some economic forecasters "solution" to the "public good" aspect of information is to sell numbers from "black boxes" that is to ask their clients to accept information on faith without knowing the methods by which it was calculated. But this is alchemy. The only way to detect errors and improve methods is to open the black box, let others examine its contents and criticise procedures--the scientific method.

It remains for us to discover how to solve these dilemmas. Singapore may have done so by a major public quarterly data gathering effort reporting supply, demand, and price information for major property categories by geographical districts. This level of public information would be an innovation in the U.S. or Australia. JLW Advisory has found a way to finance production of reports on markets through sales of periodic market information and analysis to corporate subscribers for \$10,000

annual fees. Institutional support for this effort is the key to JLW Advisory's research operation. However, the supporters of this effort must feel somewhat uneasy that their information source is wholly owned by a firm that makes most of its money through agency fees. This is like saying: "I will give you a million dollars if I buy this building. Now I'll pay you \$10,000 to tell me whether I should buy the building." I am not accusing JLW Advisory of bias or of abusing their responsibilities--on the contrary, they appear to have done a very good job as evidenced by the success of the market reports product. Nevertheless, the institutional structure suggests that problems could occur in the future.

Creating independent information sources may be impossible, given the sources of primary data. So long as different companies offer independent market assessments, regardless of how inefficient this may seem, investors at least have some protection through competitive market forces. And, like all professionals who sell information, JLW Advisory and similar firms have an incentive to maintain their credibility and the market value of their product by protecting its integrity.

What does seem feasible is for primary data gathering to be made more efficient, perhaps through cooperative or collective data gathering efforts in the industry. It might be helpful for several firms to combine to support an "independent" research agency, perhaps with participation from government agencies, trade associations like the APC, universities, or economic forecasting firms. A team approach would almost certainly improve the expertise that could be devoted to forecasting, as well as the budget available for data assembly and analysis. At present there is considerable duplication and extra cost at the data gathering stage. It would probably be more efficient and give better coverage to gather data collectively. One complete data base checked by many rather than many data bases with little independent checking. Use of new technology such as web sites and Internet data bases could also be a decisive factor in improving market information.

8.2.6 Valuation Methods

In recent years, Australian valuers' credibility, incomes, and professional indemnity insurance premiums suffered major harm as a result of inaccurate valuations which led to investor losses and subsequent lawsuits for damages. Thinking of valuation methods, valuation standards, and the valuers' instructions (engagement letter) as institutions, reforms are needed if valuers are to retain their role as reliable experts in the property development process. I will discuss briefly only three issues: a) Alignment of valuer's interests with investors' interests b) The "face rent" and the "confidentiality clause" problem, and c) Revising valuation methods to cope with cyclical cash flows.

Alignment of valuer's interests with investors' interests

Graaskamp (1992) and others have discussed the problem of "advocacy" valuations where valuers receive pressure (subtle or overt) to produce values that favour client's interests. Lenders are very naive if they accept valuations paid for by developers, or others who want to "do the deal." Valuers conditions of employment should not create incentives to bias valuations. The bias may be achieved through the details of instructions to the valuer that may artificially limit the scope of the valuer's inquiry, by biased selection of evidence, or by other means.

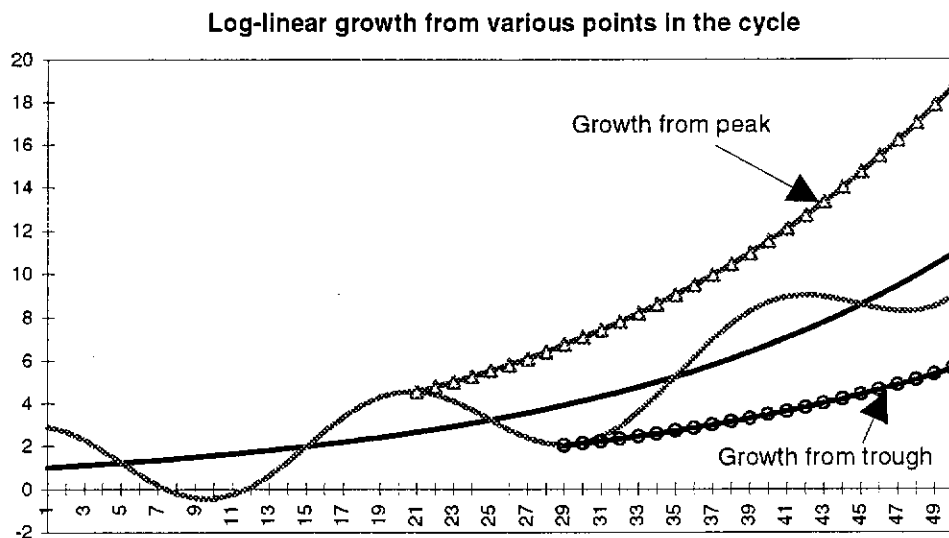
"Face rent" versus "effective rent" and the "confidentiality clause" problem

As rents collapsed during the early 1990's, courts upheld "market rent review" clauses that took no account of leasing incentives. Thus market rent in the sense of the rent that would be struck between two parties bargaining at arms length--the normal understanding of a market--was replaced in law and in leases by artificially inflated "face rents" with leasing incentives concealed by promises of confidentiality. This game allowed owners and lenders to maintain a fiction that rents and capital values had not fallen, when in fact, they had. An institutional reform that would be very helpful in allowing valuers to do a better job would be banning confidentiality clauses in leases. Certainly calculation of net effective rent, that is face rent net of leasing incentives (on a present value basis), is essential.

Revising valuation methods to cope with cyclical cash flows

During the 1980s proposed projects got the go ahead based on overly optimistic value-upon-completion estimates derived from naive log linear rent growth assumptions. Figure 8-1 presents a plot of a cycle generated by a cosine function superimposed on a log linear trend. The cycle approximates historical rent and value patterns in many commercial property markets. It should be intuitively obvious that capitalisation rate methods or a DCF assuming log linear growth will price accurately when rents are near equilibrium rents, but will overprice if rents are above the long term trend and underprice if they are below equilibrium.

Figure 8-1 Extrapolating rents with log-linear growth from various points in the cycle



Hendershott (1996) concluded, assuming rational investors, that values should start downwards while rents are still headed upwards, due to expected future lower rents at a later stage in the cycle (and vice versa). He suggests moving the valuation horizon forward in time--using forecasts of future rents as a basis for current values--lowering values at the rent cycle peak and raising them at the trough.⁹ The benchmark suggested by Hendershott for determining whether rents are above or below long term equilibrium levels is a comparison with cost to create new space. This is calculated as the ratio of current values (PV of discounted projected rents) to replacement cost.

⁹ Hendershott has authored several papers developing ideas of fundamental value and price adjustments in Australian office markets.

Markets sometimes seem to have little idea how to price office properties. For example, Bankwest Tower, Perth, sold for the equivalent of \$200 million in 1989 and was resold for \$125 million in 1994 (PV, nominal Australian dollars). Surely both these transactions' prices can not correspond to market fundamentals, since one could argue that fundamentals were better in 1994 than in 1989! Valuation methods based on current (mispriced) market transactions are error prone in the sense that projected cash flows and target rates of return may not be achieved when the bubble bursts. Valuations, as Whipple has pointed out, based on recent sales do not answer the question of interest to investors, so clarifying the purpose of valuations is helpful.

Investment valuations should start with cash flow forecasts based on fundamentals and solve for price, rather than accepting current price as the "best possible" value for investment decisions. The resulting figure is sometimes called "long term value," or "fundamental value" or "investment value" to distinguish it from value estimates based on recent sales. If markets were efficient, current market value and investment value would be identical.

Forecasting techniques allow development of a new generation of valuation models which incorporate forecasts into cash flow projections, rather than using static capitalisation rate methods or DCFs based on naive growth assumptions. Table 2 outlines some of the features of three generations of valuation models.

Table 8-2 Three generations of valuation methods: Cap rate, DCF with log linear growth assumption, DCF with cyclical forecasts

	Cap Rate	DCF/Loglinear	DCF/Forecasting
Data	Current rents Recent sales	Current cash flows Discount rate Growth assumptions	Current cash flows Current market conditions Expected future conditions Past market time series data
Method	Divide rent by yield	Generate future cash flows by incrementing current flows by an assumed growth rate	Build a model to forecast future cash flows. Adjust to reflect non-sample information and

		Discount cash flows	expectation Discount forecast flows
Output	Current value	Current and future values based on naive projections	Current and future conditional values based on a forecasting model, investor time horizon, and expectations, with error estimates

DCF's based on non-linear cash flow forecasts require that additional issues receive explicit treatment as part of the valuation process. First the appraiser must address the difficult problem of forecasting future cash flows--the amplitude and timing of the future cycles expected during the projection period--rather than simply choosing a growth rate.

Second, if we use log linear projections from current rent levels as a basis for a DCF valuation, value estimates will change, depending upon where in the cycle one begins the projection. With cyclical cash flow forecasts on the other hand, values will be more stable regardless of where in the cycle the valuation date is placed. In an example using actual Perth *ex post* rents (which were very cyclical), DCF value estimates from different points in the cycle range from 89% to 152% of the initial value, while with the linear growth assumption, the range of valuations was from 22% to 240%. Cyclical forecasts (somewhat counterintuitively) produce more stable price estimates through time. Prices at the top of the cycle are closer to prices at the bottom. Differences in values would not be so extreme in most cases because rents in year of project completion/rent-up will normally be locked in through long term (10 year) leases.

A third point for valuers is that when one shifts from linear growth to cyclical forecasts, holding period assumptions become more important. Using actual Perth rents starting in 1986, a five year holding period DCF valuation estimated value at \$3200/m² compared to \$1612/m² from a ten year DCF (discount rate=.12, end value cap rate=.09 in both cases). This difference is fairly astonishing considering that both value estimates are based on the same actual, *ex post* rents. The differences in

the valuation are entirely due to choice of holding period--the cash flows are identical.

Moreover, expectations of future rents also matters. Values would move up earlier in response to improved expectations, but expectations of future increases (ie in 1988) would no longer be as high once the expected increase has already have been factored into current rents and values. Valuations should therefore vary depending on the valuer's judgement about how many years the market looks ahead in setting current rents and in pricing properties. These valuation assumptions become crucial when rent forecasts are cyclical rather than linear. The fact that rents began to rise in Perth when CBD vacancy rates were still well above equilibrium in late 1993 suggests that expectations did play a role in rent adjustments. If so, this suggests why rents may have been flatter than expected during the next year or two despite improving fundamentals. The market may have anticipated these improvements and already bid them into rents in advance. These ideas are not new of course--share market news often emphasises distinctions between expectations and fundamentals "markets fell on good news because better news was expected."

Implementation of non-linear discounted cash flow assumptions introduces a variety of new difficulties for valuers. Forecasting errors, reading rational expectations in the market, and uncertainty as to buyer and seller time horizons complicate choice of valuation assumptions. And it takes considerable fortitude to forecast falling future rents when current rents are rising.

At times, prices probably don't move in cycles, but instead could shift to a new level. In such cases, the advantages claimed for forecasting cycles would become disadvantages. If we know nothing about the future, if markets are efficient and all information that can be known is incorporated in current prices, then a cyclical forecast could be very far from correct, even opposite to actual outcomes. However, there does seem to be strong evidence for cycles, to the point that ignoring them seems to make one even more prone to error.

If the real world contains complexity, cycles, rational expectations, market psychology, changing fundamentals, market segments, and random shocks, it is better to admit these truths, rather than try to hide them under a blanket of false certainty supported only on the misleading foundation of recent sales--the blind leading the blind. Recent sales can be very misleading during booms or busts when bubbles distort values relative to the longer term and markets are far from equilibrium. As markets become more sophisticated in these matters and improve forecasts, cycles of oversupply and rental collapse may smooth as supply, demand, and prices stay closer to equilibrium.

8.2.7 Roles and reward structures motivating academic researchers

Jim Graaskamp achieved considerable influence in the U.S. property industry through consulting activities, speaking to industry groups, testimony before legislative bodies and the courts on property issues, as well as through activities of his students. This suggests that perhaps academic standards are too narrow and should be diversified. The ivory tower of the university is a poor place from which to try to understand and influence office markets.

If academic researchers are to be rewarded only for publishing in academic journals, that is what they will concentrate upon. The end result is academics writing for other academics, not for the industry they should be serving. If academics are to contribute to solving practical problems in applied fields, they will have to be rewarded for consulting activities, for developing software, for activities in professional organisations, policy debates, or other activist roles. It is astonishing that society would set up rewards structures likely to isolate some of its most highly trained thinkers from applications of their work.

Academic research suffers greatly from this isolation from real world problems. The flow of information between academic research and industry practice should be a two way flow. Issues of implementation and application are among the most difficult and deserving of research, yet are assumed away in most academic

simplifications of problems. Industry is a rich source of data and ideas for research and there is nothing to test a theory like a real world application.

The exhortation that research should be connected to applications is not new--Sir Francis Bacon made the same appeal during the reign of James I. (Peltonen, 1996). Universities face a considerable challenge learning how to avoid irrelevance while at the same time not selling out their independence and important roles as social critics or representatives of the public interest.

Research paradigm diversity and social role diversity are both important and these can only be implemented if institutional structures allow survival of diverse academics. Present university structures do not encourage real world problem solving.

8.3 Synergy and Pragmatism

Improvements to market efficiency of various kinds are more than additive. For example, if streamlining institutions to regulate development and improving design and construction processes could cut a year off the necessary forecasting horizon, say from four years to three years, application of improved forecasting methods would have much more potential to improve efficiency due to the shorter forecast horizon than would be the case without the institutional changes.

If one added to this a public sector queuing system to try to better match supply to demand, thereby mitigating the game theory or prisoners dilemma problem, forecasts would be further improved. We do not have to forecast what we can control. And it is extremely difficult to model an irrational supply response that does not remain connected to fundamentals of demand. A queue would mean that conditional forecasts would be made with much more certainty regarding supply additions. This would improve forecasts, which in turn could further improve the queuing policy.

Better macroeconomic management clearly improves ability to match supply and demand through providing less volatility in the demand growth that office supply

growth must cater to. Better institutional structuring of deals--through contracts, ownership structures, and incentives for lenders' employees--to remove incentives for financing, overvaluing, and developing unnecessary projects--would help reduce incentives for bias in the figures used as the basis for decisions. Communication among lenders and modelling to update feasibilities based on competitive project approvals would improve information and change the parameters of the system in positive ways, mitigating the prisoners' dilemma. Applications oriented or "problem solving paradigm" academic quantitative modelling could add objectivity and empirical content to forecasts.

The sum of reforms to the system which we can think of could lead to a considerably more efficient office market system. Rather than the regular and rather high amplitude cycles of recent Australian experience, a better regulated market system would follow a path more like a random walk, with irregular ups and downs related to unforeseen shocks, while remaining closer to equilibrium with quicker adjustment back to equilibrium. Such a system could probably avoid much of the present system's persistent tendency to oversupply cycles resulting from demand, finance, planning, and construction lags and backlogs.

Any proposed solution to a problem is likely to create fresh problems. The "solutions" proposed above to the problems this dissertation addresses--office oversupply cycles and attendant financial losses, and the lack of integration of econometric style academic work into real estate decisions--may or may not be workable or implementable. As Sir Francis Bacon suggested as he outlined the beginnings of science, we need to experiment and apply the results to improving outcomes.

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