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The Australian Experience”*

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# **Marginal Intra-Industry Trade and Adjustment Costs: The Australian Experience**

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## **Abstract**

The objective of this research is to investigate labour market adjustment associated with changes in Australia's trade pattern over the period 1992-2000. Specifically the focus is on the so-called smooth adjustment hypothesis (SAH) which posits that, compared with inter-industry trade, intra-industry trade (IIT) expansion is associated with relatively lower factor adjustment costs. A dynamic panel data approach (GMM-System) is employed. We find that there is a negative correlation between changes in employment and increased IIT. This result provides support for the SAH. Given the rise in IIT as a proportion of Australia's overall trade during the period under review, the adjustment in labour markets stemming from trade liberalisation at that time is likely to have been less than otherwise expected.

**Key words:** Marginal intra-industry trade, labour market adjustment, dynamic panel data

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## **1. Introduction**

Trade liberalisation and the resultant shifts in a country's trade patterns will be accompanied by significant resource reallocation effects. Transitional adjustment costs in factor markets will arise when markets fail to clear in response to changes in supply and demand conditions. More particularly, in labour markets there may be temporary unemployment and factor price disparity arising from price stickiness and the fact that resources are not freely mobile within an economy, at least in the short term. Balassa (1966) was the first to draw attention to the fact that the adjustment pressures stemming from trade liberalisation will depend on the extent to which the changes in trade which is engendered is inter-industry or intra-industry in nature. The widely held smooth adjustment hypothesis (SAH) proposes that a rising share of intra-industry trade (IIT) will be accompanied by lower factor adjustment costs, particularly in respect of labour market disruption (Brülhart, 2000). With intra-industry adjustment, workers move within rather than between industries.

While there has been increased focus in the literature on this issue of adjustment costs associated with IIT in recent years, it has tended to have very much a European focus. Very little work has addressed the Australian experience.

The results presented here tend to support the SAH which suggest that the impact of trade liberalisation policies over the 1980s and 1990s, which lead to a rising share of IIT for Australia, were relatively less disruptive of labour markets than might have been expected. This finding has implications for future policy considerations in this area.

The remainder of this paper is organised as follows. The next section addresses the theoretical issues related to adjustment and IIT. A review of recent developments in Australia's IIT trade is then given, followed by discussion of methodological issues associated with the measurement of IIT. Details of the dynamic panel data approach employed and the model specification are provided together with the empirical results and discussion.

## **2. Adjustment and Intra-industry Trade**

It has been argued that the level of adjustment costs associated with trade liberalisation will depend on the extent to which any trade expansion is intra-industry rather than inter-industry in nature (Hamilton and Kniest, 1991; Greenaway et al., 1994; Brülhart and Elliott, 2002). Adjustment costs occur when markets are slow to respond to changing supply and demand conditions and in the context of a changing trade environment are likely to be particularly important in labour markets, with unemployment arising as a result of price rigidities and switching costs due to job search, re-location and retraining (Ferto and Soos, 2010).

Given that IIT tends to be characterised by reallocation of resources within industries while inter-industry trade is more reflective of a reallocation of resources between industries, Brülhart (1994) argued that increases in exports in a particular industry over a given period matched by increases in imports will not require significant movements of factors into or out of the domestic industry in question. To the extent that workers have accumulated human capital that allows for ease of portability between firms within the same industry, adjustment costs will be expected to be relatively less for matched changes in trade compared to a situation where labour is forced to move from a contracting importing industry to a different expanding exportable industry (Lovely and Nelson, 2000). Brülhart and Elliott (2002) provide a theoretical exposition drawing on the specific factors trade model which yields the so-called "smooth adjustment hypothesis" (SAH) inferring that trade expansion that is IIT in

nature will be accompanied by relatively smooth resource reallocation. The theoretical literature, however, falls short of providing a clearly specified framework for empirical modelling.<sup>1</sup>

### 3. Policy Reform and Trade Patterns in Australia

Australia experienced significant reductions in trade protection for the manufacturing sector during the period of the mid to late 1970s and again from 1988 when a program of phased reductions in nominal tariffs was introduced. Revenue duties were also removed along with quotas for the manufacturing sector at this time. The average nominal rate of protection for Australian manufacturing had fallen from 13 per cent in the mid 1980s to 9.6 per cent in 1989-90 (Menon, 1994). By mid-2001 the rate was down to 4.4 per cent (WTO, 2002). The average rate of effective protection for manufacturing meanwhile, fell from 16 per cent in 1989-90 to 4.8 per cent in 2000-2001. The resulting increase in global competition resulted in significant increases in imports (and exports) of manufactured goods and was reflected in a sharp increase in Australia's IIT from the mid-1980s through to 2000 (Sharma, 2004; Harjono, 2002). While Gaston (1998) has observed the adverse effect on manufacturing employment arising from trade reforms in Australia, to the extent that trade expansion over the period of the 1990s was more IIT in nature, then the labour market pressures would be relatively less than might be expected, assuming the SAH. Moreover, this would have implications for the efficacy of further trade liberalisation.<sup>2</sup>

### 4. Measuring Marginal Intra-industry Trade

The Grubel and Lloyd (1975) index of IIT, or a variant, underpins much of the discussion of changing trade patterns in the literature. However, it is a static measure which captures the trading pattern at a point in time; changes in the index do not adequately reflect changes in the flow of goods traded over time (Hamilton and Kniest, 1991; Menon and Dixon, 1997). The measure also fails to address scale effects and therefore does not allow for comparisons across industries of different size. Given that adjustment costs are dynamic in nature a measure of marginal intra-industry trade (MIIT) is needed to capture changes in the structure of trade. Lovely and Nelson (2002) provide a useful survey of the various theoretical and empirical approaches that have been undertaken in this area. One particular "dynamic" measure of the share of IIT in new trade was proposed by Brühlhart (1994) and is widely used in empirical work. If  $X$  and  $M$  denote exports and imports, respectively, of a particular industry grouping, then this index is given by:

$$MIIT = 1 - \frac{|\Delta X - \Delta M|}{|\Delta X| + |\Delta M|}$$

The Brühlhart index is a transformation of the Grubel and Lloyd (1975) index and takes values between 0 and 1. A value of 0 indicates that the marginal trade in the industry is exclusively

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<sup>1</sup> Lovely and Nelson (2000; 2002) adopt a general equilibrium modeling approach which incorporates changes in domestic consumption as well as production resulting from trade liberalisation. They conclude that the relationship between MIIT and factor market adjustment suggested by theory is complex and not unambiguous in terms of net impacts.

<sup>2</sup> Marks (2010) has noted that IIT changes in response to reduced protection in Australia has differed between the textile and clothing and footwear sector and the motor vehicle industry. While it is suggested there is a correlation between changes in output and employment growth in these industries linked to the shift in trade patterns, the study stops short of developing a formal model.

of the inter-industry trade and a value of 1 represents marginal trade that is entirely of the intra-industry type. The index relates to the share of IIT in trade changes over a designated time period and the approach employed in this study is to use this index based on annual changes.<sup>3</sup>

Empirical studies in this area have differed with respect to the measures of labour market adjustment that have been used. They encompass a range of proxies including changes in employment, output and numbers of establishments, job turnover rates, unemployment duration and wage variability (Brülhart and Elliott, 2002; Lovely and Nelson, 2002).

## **5. Econometric Model**

There is no formal theoretical model which dictates a particular econometric specification in investigating the labour market adjustment associated with trade liberalisation. There is no clear suggestion as to what control variables to include in any fully specified model. Methodological approaches in empirical work have varied, for the most part looking at simple correlations or looking to control for a small set of other factors in an OLS framework. A review of recent studies in the area by Erlat and Erlat (2006) finds mixed support for the SAH.

The current study applies a dynamic panel data approach. The GMM system (GMM-SYS) estimator which is used addresses the problems of serial correlation, heteroskedasticity and endogeneity among explanatory variables which can arise in static panel data models. A system of equations in both first-differences (with lagged levels as instruments) and levels (with lagged first differences of the series used as instruments) are combined. This system estimator was developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998, 2000). While an alternative first-differenced GMM (GMM-DIF) estimator has also been suggested by these authors, the GMM-SYS estimator is considered to exhibit superior finite sample properties where there are lagged effects (Bond, Hoeffler and Temple, 2001).

The good performance of the GMM-SYS estimator has led to its wide application in applied panel data studies where series are persistent and data are characterised by relatively small number of time periods (Bun and Windmeijer, 2007). Employment changes are a dynamic phenomenon with persistent, lagged effects likely. The use of a lagged dependent variable can provide information regarding short run and long run adjustment effects (Ferto, 2009) while the introduction of a lag structure for independent variables allows for an enhanced dynamic estimation process. Little use has been made of this approach in empirical work in the trade area to date.

### **Data**

All data are obtained from World Bank Trade and Production database. The data includes the manufacturing sector and is at industry level as measured at the three-digit level of the International Standard Industry Classification in US dollars. The full sample contains 27 industries and covers the period 1993-2000.

### **Dependent Variable**

Industry level employment changes are considered as an inverse proxy for adjustment costs.<sup>4</sup> Brülhart (2000) has suggested using the absolute value of employment changes in a

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<sup>3</sup> Brülhart (2000) favors the use of this index based on annual change data when used as a proxy although there is no a priori expectation as to any preferred interval.

<sup>4</sup> Measures of adjustment cost that are used in empirical work will be constrained by the availability of data (Greenaway et al, 2002). Brülhart and Elliott (2002), for example, have looked at unemployment duration and

particular industry ( $\Delta EMPL$ ) since expected changes in total employment would be indeterminate in the specified model. According to the SAH it is expected that  $\Delta EMPL$  will be negatively related to MIIT. The variable is defined as follows:

$$\Delta EMPL = 2 \times \frac{(EMPL_t - EMPL_{t-1})}{(EMPL_t + EMPL_{t-1})}$$

### Explanatory Variables and Development of Hypothesis

Following the research literature we have proposed the following hypotheses:

**Hypothesis 1:** A positive correlation between change in apparent consumption and change in employment is expected. The variable  $\Delta CONS$  represents the change in domestic and external demand. It is the absolute value of the change in apparent consumption ( $C = Q + M - X$ ) between  $t$  and  $t - n$ , where  $Q$  a measure of industry output and  $M$  and  $X$  are imports and exports respectively for that industry.

Fertő (2009) found employment changes to be positively related to consumption changes in a study of the Hungarian food industry. Brülhart and Thorpe (2000) also found a positive relationship looking at the manufacturing sector in Malaysia.

**Hypothesis 2:** There is an ambiguous sign between change in labour productivity and change in sector employment. An increase in productivity may lead to labour substitution or alternatively it may be an indicator of an expanding industry with growing employment.

The variable  $\Delta PROD$  is the absolute value of the change in labour productivity at industry level. In a study of Turkey Erlat and Erlat (2006) found a negative relationship, while Fertő and Soós (2010) looking at Hungary and Poland and Brülhart and Thorpe (2000) in the case of Malaysia, found the opposite effect.

**Hypothesis 3:** The marginal intra-industry trade has the lower the adjustment cost.

MIIT is marginal intra-industry trade is measured by the index of Brülhart (1994). According to the SAH (Brülhart 2000) we hypothesise a negative relationship between marginal intra-industry trade and the changes in employment.

**Hypothesis 4:** Increased trade will induce enhanced competition and hence increased structural adjustment pressures on firms (Brülhart, 2000). Consequently a positive relationship is expected between trade openness and employment changes. The variable  $TRADE$  is the absolute value of the change in exports plus imports between  $t$  and  $t - n$ . Studies by Cabral and Silva (2006) and Fertő (2009) have found significant positive relationships.

### Model Specification

Constrained by data on individual worker movement we follow Brülhart and Thorpe (2000) and Erlat and Erlat (2006) to study the relationship between marginal intra-industry trade and labour market adjustment:

$$\text{Log}|\Delta EMPL|_{it} = \beta_0 + \beta_1 \text{Log}|\Delta EMPL|_{it-1} + \beta_2 \text{Log}\Delta CONS + \beta_3 \text{Log}\Delta PROD + \beta_4 \text{Log}MIIT + \beta_5 \text{Log}TRADE + \eta_i + \varepsilon_{it}$$

All variables are in the logarithm form;  $\eta_i$  is the unobserved time-invariant specific effects;  $\delta$  captures a common deterministic trend;  $\varepsilon_{it}$  is a random disturbance assumed to be normal, and identically distributed with  $E(\varepsilon_{it})=0$ ;  $\text{Var}(\varepsilon_{it})=\sigma^2 > 0$ .

## 6. Empirical Results

Table 1 report on the GMM-System estimator. The Arellano and Bond test for Ar(2) indicates that the equation presents consistent estimates, with no evidence of second-order

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wage variability in a study which finds that adjustment costs associated with changing trade patterns in the UK reflect in large part the greater heterogeneity of labour between industries than within industries.

serial correlation and with the instruments not correlated with the residuals. The Sargan test shows that there are no problems with validity of the additional instruments used in the estimation. The Windmeijer (2005) finite sample correction is performed to address any issues due to the unbalanced panel.

The instruments in levels are  $\text{Log}|\Delta\text{EMPL}|$  (3,7),  $\text{Log}\Delta\text{CONS}$ ,  $\text{Log}\Delta\text{PROD}$  (3,7),  $\text{Log}\Delta\text{CONS}$  and  $\text{Log}\text{TRADE}$  (3,7) in the equations in first differences. For levels equations, the instruments are first differences, with all variables lagged t-2. As show in table 1, all explanatory variables are significant ( $\text{Log}|\Delta\text{EMPL}|_{it-1}$ , at 5%,  $\text{Log}\Delta\text{CONS}$ , at 1%,  $\text{Log}\Delta\text{PROD}$  at 5%,  $\text{LogMIIT}$  at 1%, and  $\text{LogTRADE}$  at 5% significance level).

Lagged changes in employment ( $\text{Log}|\Delta\text{EMPL}|_{it-1}$ ) are seen to have a significant and positive effect on changes over the current period, a result which is in accord with evidence reported by Fertö and Soós (2010) for Hungary and Poland. The coefficient of the absolute value of the change in apparent consumption ( $\text{Log}\Delta\text{CONS}$ ) has the expected positive sign. There was no *a priori* expectation regarding the link between changes in productivity ( $\text{Log}\Delta\text{PROD}$ ) and employment. The observed positive relationship is in line with results observed in some other studies (Brühlhart and Thorpe, 2000; Fertö, 2009; Fertö and Soós, 2010).

The proxy  $\text{LogTRADE}$  which captures increased openness is seen to exhibit the expected positive relationship with employment changes. There is support for the SAH given that the coefficient for the index of marginal intra-industry trade ( $\text{LogMIIT}$ ) has the predicted negative sign and is highly significant.

Table 1: Employment Changes, Marginal Intra-industry Trade, and Adjustment Costs: GMM-System Estimator

Variables	GMM-SYS	Expected Sign
$\text{Log} \Delta\text{EMPL} _{it-1}$	0,263 (2,15)**	(+)
$\text{Log}\Delta\text{CONS}$	1,13 (4,61)***	(+)
$\text{Log}\Delta\text{PROD}$	0,33 (2,40)**	(+/-)
$\text{Log}\Delta\text{MIIT}$	-1,51 (- 4,65)***	(-)
$\text{LogTRADE}$	0,59 (2,48)**	(+)
N	149	
Arellano-Bond test for Ar(2) (P-value)	0,223	
Sargan test (P-value)	1,000	

The null hypothesis that each coefficient is equal to zero is tested using one-step robust standard error. T-statistics (heteroskedasticity corrected) are in round brackets; \*\*\*/\*\*- statistically significant at the 1%, and 5% levels. Ar(2) is tests for first-order and second-order serial correlation in the first-differenced residuals, asymptotically distributed as  $N(0,1)$  under the null hypothesis of no serial correlation (based on the efficient two-step GMM estimator). The Sargan test addresses the over-identifying restrictions, asymptotically distributed  $X^2$  under the null of the instruments' validity (with the two-step estimator).

## 7. Conclusion

This paper addresses the issue of labour market adjustment in the Australian manufacturing sector following a period of significant trade liberalisation which commenced in the late 1980s. Over the 1990s Australia experienced significant structural change in response to the shift in trade patterns engendered by the policy reforms. It has been noted that during this period the share of IIT in Australia's trade rose significantly. To the extent that the share of IIT in trade changes has been rising, then it is hypothesised that the adjustment pressures in labour markets will be relatively less than would otherwise be the case. This stems from the SAH which is predicated on the notion that trade expansion which is IIT in nature entails relatively smoother resource reallocation, occurring within industries as opposed to between different industries and as a result, there are expected to be lower transitional adjustment costs. There has been only limited investigation of the evidence for the SAH in the literature, particularly in the Australian context. This study goes directly to this issue as evidenced by recent adjustments that have occurred in Australia's manufacturing sector.

The results obtained do lend support to the SAH while controlling for other factors expected to be important influences on labour market outcomes. As expected, growth in consumption and productivity are seen to positively impact on employment changes. Increased trade also has an expected influence and is found to also be directly related to greater adjustment costs as measured. Changes in employment associated with trade liberalisation and trade expansion over the period of the study are found to be inversely related to increases which are IIT in nature. This outcome conforms to the prediction based on the SAH.

There are implications for policy makers in this outcome to the extent that the adjustment pressures accompanying further trade liberalisation in manufacturing will likely be lower than expected. The results presented here are indicative and further empirical investigation in this area is suggested. Studies involving IIT have sought to separate out this type of trade into vertical and horizontal components. The implication for studies of adjustment is that factors may be relatively less mobile within vertically differentiated industries compared to horizontal differentiated industries due to differences in skill requirements. Any analysis would benefit, therefore, from such disaggregation of IIT flows. The proxies which are required of necessity to measure adjustment in labour markets are also problematic. Data limitations have been a constraint on efforts to capture fully the nature of adjustments that can arise. Further comparative work, looking at other periods for Australia, as well as the experience in other countries, will also help understanding the adjustment impacts of policies directed towards greater trade liberalisation.

## 8. References

- Arellano, M., and Bond S. (1991). "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations", *Review of Economic Studies* 58, no. 3: 277–297.
- Arellano, M., & Bover, O. (1995). "Another look at the instrumental variable estimation of error components models", *Journal of Econometrics*, 68, no.1: 29–51.
- Ballassa B (1966), "Tariff reductions and trade in manufacturers among the industrial countries", *American Economic Review*, 56, 3, 466-73.
- Blundell, R., and Bond, S. (1998). "Initial conditions and moment restrictions in dynamic panel data models", *Journal of Econometrics*, 87, no.1: 115–143.
- Blundell, R., and Bond, S. (2000). "GMM estimation with persistent panel data: An applications to production Functions". *Econometric Reviews*, 19(3), 321–340.
- Bond, S., Hoeffler A. and J. Temple (2001). "GMM Estimation of Empirical Growth Models", *CEPR Discussion Paper*, DP3048, November, Centre for Economic Policy Research.



- Brühlhart, M. (1994). "Marginal Intra-Industry Trade: Measurement and Relevance for the Pattern of Industrial Adjustment", *Weltwirtschaftliches Archiv* 130, no. 3: 600–613.
- Brühlhart, M. (2000). "Dynamics of Intra-Industry Trade and Labour Market Adjustment", *Review of International Economics* 8, no. 3: 420–435.
- Brühlhart, M. and Elliott, R. (2002) "Labour-Market Effects of Intra-Industry Trade: Evidence for the United Kingdom", *Weltwirtschaftliches Archiv*, 138, 2, pp. 207-228.
- Brühlhart, M., and Thorpe M. (2000). "Intra-Industry Trade and Adjustment in Malaysia: Puzzling Evidence", *Applied Economics Letters* 7, no. 11: 729–733.
- Bun, M. And Windmeijer, F. (2007) "The Weak Instrument Problem of the System GMM Estimator in Dynamic Panel Models", Discussion Paper No. 07/595, March, Department of Economics, University of Bristol, UK.
- Cabral, M. and Silva, J. (2006) "Intra-industry trade expansion and employment reallocation between sectors and occupations". *Weltwirtschaftliches Archiv* 142, pp. 496–520.
- Erlat, G. and Erlat, H. (2006) "Intraindustry trade and labor market adjustment in Turkey. Another piece of puzzling evidence?", *Emerging Markets Finance and Trade*, 42, 5, pp. 5-27.
- Fertő I. (2009). "Labour market adjustment and intra-industry trade: The effects of association on Hungarian food industry", *Journal of Agricultural Economics*, 60, pp. 668-681.
- Fertő I. and Soós, A, K. (2010) "Marginal intra-industry trade and adjustment costs in the first phase of transition :A Hungarian-Polish comparison", *Journal of Economic Studies*. 37 no. 5: pp. 495-504.
- Gaston N. (1998) "The Impact of International Trade and Protection on Australian Manufacturing Employment", *Australian Economic Papers*, 37, 2, pp. 119-136.
- Greenaway, D., Haynes, M. and Milner, C. (2002) "Adjustment, Employment Characteristics and Intra-Industry Trade" *Weltwirtschaftliches Archiv*, 138, 2, pp. 254-276.
- Greenaway, D, Hine, R., Milner, C. And Elliott, R. (1994) "Adjustment and the Measurement of Marginal Intra-Industry Trade" *Weltwirtschaftliches Archiv*, 127, 2, pp. 418-427.
- Grubel, H. G. and Lloyd, P. J. (1975) "*Intra-Industry Trade*" London: Macmillan.
- Hamilton, C., and P. Kniest. (1991) "Trade Liberalization, Structural Adjustment and Intra- Industry Trade." *Weltwirtschaftliches Archiv* 127, no. 2: 356–367.
- Harjono, Ay San (2002) "Intra-industry in Australia's trade: patterns and determinants", unpublished thesis, University of Queensland, Australia.
- Lovely, M. and Nelson, D. (2000) "Marginal intra-industry trade and labour adjustment", *Review of International Economics*, 8, 3, pp. 469-479.
- Lovely, M. and Nelson, D. (2002) "Intra-industry trade as an indicator of labor market adjustment", *Weltwirtschaftliches Archiv*, 138, 2, pp. 179-206.
- Marks, A. (2009) "Intra-industry Trade and Adjustment Costs in the Australian Textile, Clothing and Footwear and Motor Vehicle Industries: A Comparative Case Study Approach", *Economic Papers*, 26, 4, pp. 323-336.
- Menon, J. (1994) "Trade Liberalisation, Closer Economic Relations and Intra-Industry Specialisation", *Australian Economic Review*, The University of Melbourne, Melbourne Institute of Applied Economic and Social Research, vol. 27(2), pages 31-42.
- Menon, J. And Dixon, P. (1997) "Intra-Industry Trade: Relevance for Adjustment Costs" *Weltwirtschaftliches Archiv*, 133, pp. 164-169.
- Sharma K. (2004) "Horizontal and vertical intra-industry trade in Australian manufacturing: does liberalization have any impact?", *Applied Economics*, Vol. 36, 15, pp. 1723-1730.
- Windmeijer, F. (2005). "A finite sample correction for the variance of linear efficient two- step GMM estimators", *Journal of Econometrics* 26, no. 1: 25-51.
- WTO (2002), "Trade Report Australia", September, [http://www.wto.org/english/tratop\\_e/tpr\\_e/tp202\\_e.htm](http://www.wto.org/english/tratop_e/tpr_e/tp202_e.htm), World Trade Organization, downloaded 5 May 2011.