Is there any Link Between Commodity Price and Monetary Policy? Evidence from Australia

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Abstract: The aim of this paper is to examine whether the commodity prices predict inflation, unemployment and short term interest rate in Australia. Advanced time series econometric modeling such as vector autoregressive model, cointegration and granger causality are used for this purpose. The empirical results show that three commodity prices (COMRL, COMNRL and COMBSMTL) precede inflation. However, no evidence of reverse causation is found. These findings have important implication for monetary authority. Inflation targeting experience has so far been hit by positive supply shocks. In case of negative supply shock, commodity price may be useful in singling out the likely direction of inflation.

I. INTRODUCTION

There have been a good number of studies pondering over the role of commodity price in formulating or at least in conducting monetary policy. In other words, the role of commodity price has been examined as a monetary policy target variable as well as an information variable. The discussion of commodity price in connection with monetary policy surfaced in the 1980s when the growth of monetary aggregates as an intermediate target variable became less dependable. Commodity price is thought to be a significant variable in conducting monetary

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policy because of the belief that it conveys information about the future movements in general price level. There are mainly two arguments that are forwarded to support this belief: first, because primary commodities are used as important inputs into production of manufactured goods, any change in commodity price directly affects production cost and the general price level (Garner 1989, Kugler 1991). Bloch *et al*. (2007) find that rise in primary commodity prices on world markets increases costs for manufacturers in all countries that lead to increased finished goods prices. So any movement in commodity price may signal the probable direction of the future price level. Second, as commodities are traded in continuous auction market, they provide instantaneous information about the state of the economy (Cody and Mills 1991) and they are more responsive to the demand and supply shocks in the economy than most consumer goods and services (Garner 1989, Kugler 1991). These features of commodity price have stimulated researchers to examine its suitability as an information or indicator variable in the conduct of monetary policy.

Primary commodities play a very significant role in Australian economy. Its role in the economy has given a special name to its currency, *commodity currency*. Australia's terms of trade is largely affected by the commodity prices as export of commodity constitutes the largest single share in total exports accounting for over half of goods exports (IMF 2006). An increase in commodity price implies improvement in terms of trade, which is equivalent to the transfer of income from the rest of the world. For example, the projected increase in terms of trade because of increase in commodity prices was equivalent to an increase in Australia's real income of around 2 per cent of GDP (RBA 2005). Thus commodity prices play an important role in affecting income, employment and production. Despite this important role of commodity price in the Australian economy scant attention has been given to examine its role in operating monetary policy. Although commodity price has been subjected to research in a number of studies in the context of Australian economy, such as Sapsford (1990), Fisher (1996), Bloch *et al*. (2006) and so on, its role in the operation of monetary policy has not yet been examined. The present paper attempts to utilize this research gap and investigate if commodity price can be of any use in the conduct of monetary policy in Australia.

The rest of the paper is organized as follows. Section II provides a critical review of earlier literature and rationale for the present study. While section III provides analytical framework. Section IV checks the validity of the relationship between various commodity prices and some macroeconomic variables such as inflation, interest rate and unemployment by investigating the time series properties of the data and establishing the cointegration relationship between these variables. Summary of findings and policy implications are given in final section.

II. REVIEW OF LITERATURE

The relationship between commodity price and monetary policy is not new. In the gold standard regime, monetary policy was tied with a single commodity, gold. However, in recent history, as mentioned in Boughton and Branson (1988), the proposal to base the US monetary policy on a commodity standard, with commodities chosen based on their closeness with inflation, comes from Hall (1982). Having experienced high and volatile inflation in the 1970s, policymakers in the US were concerned about reforming monetary policy. One set of reform proposal forwarded,

among others, was to set commodity price as policy target. Since then a number of studies have examined the suitability of commodity prices as an instrument of monetary policy. However, most of the studies are related to the US economy. For example, Garner's (1985) analysis of the advantages and disadvantages of using commodity prices as target variable suggest that commodity prices are not a feasible policy target, as they cannot be adequately controlled by the central bank, rather, at best, it can be used as one of several information variables in designing and conducting monetary policy. Garner's (1989) econometric study concludes the same, that is, controlling commodity price index will not guarantee stable price level, as they are not cointegrated. However, an index of industrial commodity prices may provide useful information to the policymakers but cannot constitute a target variable. Furlong's study (1989), based on VAR model that includes quarterly data on monetary aggregate, commodity price index, consumer price index and an indicator of the strength of economic activities relative to potential over the period 1965:1 to 1987:4 on US economy, arrives at a different result and concludes that commodity prices can be used as a guide for monetary policy and it will improve inflation forecast. Cody and Mille's (1991) study, build on Furlong (1989), also finds that the use of commodity prices in formulating monetary policy would improve the performance of the US economy.

Some studies find changing relationship between commodity prices and inflation and inappropriateness of commodity prices in conducting monetary policy. Blomberg and Harris (1995) find that commodity price index performed well in predicting inflation in the 1970s and early 1980s in the US, however, after early 1980s commodity price index loses this power. They argue that this poor performance is primarily due to the declining importance of commodities, both as a share of final output and as a source of exogenous shocks to the economy. Furlong and Ingenito (1996) also come to the same conclusion that commodity prices were relatively strong and statistically robust leading indicator of inflation in the 1970s and early 1980s. Evidence showing redundancy of commodity prices as an indicator of inflation keeps coming. For example Polley and Lombra (1999) conclude that commodity price along with two other information variables, namely interest rate spread and exchange rate does not provide the kind of useful information required to improve the policymakers' economic forecast.

The role of commodity prices in the conduct of monetary policy fell out of favor in the late 1980s and 1990s. However, recently commodity prices have been "re-surfaced in discussions of inflationary outlook for western economies, with oil price developments, in particular, being seen as a source of current inflationary pressures" (Browne and Cronin, 2007:7). Findings of recent empirical studies show that commodity prices provide information useful for the monetary policymakers. Awokuse and Yang's (2003) five variables VAR (money stock, federal fund rate, consumer price index, industrial production index and commodity price index) estimation on US economy with monthly data from 1975:1 to 2001:12 indicate that commodity prices are useful in predicting future inflation rate.

Studies that looked into the issue in the context of countries other than the US include Boughton and Branson (1988), Hamori (2007) and Ocran and Biekpe (2007). Boughton and Branson (1988) investigate if commodity price indexes contain information about the future movements in consumer price inflation in G-7 industrial countries. However, they do not find any support in favor of the notion that there is a long run equilibrium relationship between

commodity prices and consumer price inflation. Their study fails to accept the hypothesis that these two variables are cointegrated.

Bank of Japan (BOJ) introduced a zero interest rate policy in February 1999. This policy exerted significant impact on the link between commodity price and inflation. Hamori (2007) estimates a six variable VAR that includes BOJ commodity price index, consumer price index, industrial production index, money supply, interest rate, and exchange rate. He splits the sample period into two parts; before (January 1990–January 1999) and after (February 1999–December 2005) the zero interest rate policy is introduced. The study finds that the commodity price index performs fairly well in predicting inflation before the zero interest rate policy is introduced, however, this connection ceases to exist thereafter. Failure of the commodity price index as a leading indicator of inflation after the introduction of the zero interest rate policy is natural. The BOJ introduced the zero interest rate policy when the Japanese economy was in severe depression. In the face of strong deflationary pressure, the responsiveness of inflation to the movement in commodity prices is impaired and the result is break down of the link.

South Africa is one of the major commodity exporting countries. It is the world's largest producer of the platinum group of metal and gold. Therefore, it is obvious that prices of these commodities will have significant impact on its overall economic performance. Ocran and Biekpe (2007) examine this issue in VAR framework over the period 1965:1 to 2004:4. Their causality test suggests that average gold price and metal price index contain valuable information about interest rate, money, exchange rate, and inflation and therefore, it would be helpful for the monetary authority to use these commodity prices in formulating monetary policy.

Commodity prices in Australia have mainly been brought into analysis due to their shares in export and thereby their influences on terms of trade. For example, Gillitzer and Kearns (2005) examines the long term pattern of Australia's terms of trade over a period of 135 years (1870-2004) to see if the long term terms of trade trend can be explained by Prebisch-Singer hypothesis, which states that the countries that primarily export commodities and import manufactures experience a decline in terms of trade. However, they find that Australia's terms of trade declined by less than the decline in the ratio of world commodity prices to world manufactures prices, which was mainly caused by faster price growth of Australia's commodity export and also by the diversification of export base toward commodities that experienced relatively faster price growth. A study close to the present one is Bloch *el al* (2006). In this study the impact on domestic inflation of world commodity prices are examined in the context of Australia and Canada, two major commodity exporting countries. They find that commodity prices have a positive impact on aggregate price level that comes from the use of commodities in the production of industrial goods. In this paper, they do not cover the issue of causality between inflation and commodity prices, which is necessary to comment on the usefulness of commodity prices in the conduct of monetary policy. Moreover, the impact on inflation of commodity prices for a major commodity exporting country should come through the income channel, because higher commodity prices increase real income, which put upward pressure on aggregate demand, price level, production, and employment. As barely there has been any study on the role of commodity prices in monetary policy, it remains a prospective area of research and thus it provides the motivation for this paper.

Given the satisfactory performance of inflation targeting in Australia, one may question the relevance of this research, because policymakers and researchers generally look for alternative tools for the operation of monetary policy when the existing mechanism does not yield the desired results. The objective of this paper is not to suggest any alternative to the existing inflation targeting policy. Under the current arrangement, Reserve Bank of Australia (RBA) announces a numerical value of inflation to be achieved or maintained over a certain periods to come. In order to steer the inflation in the desired path the RBA uses the 'cash rate' as its monetary policy instrument. The aim of this paper is to examine if the commodity price can act as an additional indicator of inflation. The relevance of this research lies in the potential challenge of dealing with adverse supply shocks that the RBA may face in the future. Inflation targeting has generally been coincided with favourable supply shocks, that is, positive surprise on productivity, which has pushed output up and price level down. Stevens (2003) describes it as 'a very benign environment in which to operate monetary policy', which may not always be the case. However, commodity price may well be useful for the monetary authority faced with adverse supply shocks if there is a casual relationship between commodity price and other target variables like inflation, output, and unemployment, provided commodity prices precede the target variables.

III. ANALYTICAL FRAMEWORK

In order for commodity price to be a useful variable in the conduct of monetary policy, it should have a significant relationship with the variables that are monitored or controlled by the monetary authority, such as, inflation, unemployment and economic growth (Furlong, 1989). Moreover, commodity price will have to contain information about the future movements of these variables. Commodity price with these features will be able to signal the monetary authority about the potential effects on the ultimate target variables of their policy stances. To test if the commodity price possesses these features, this paper examines the causal relationship between commodity price and two macroeconomic variables, namely, inflation and unemployment. Due to unavailability of monthly data on output, GDP growth is excluded from the analysis.

Commodity prices have a considerable impact on Australia's macroeconomic performance. Commodity exports constitutes around half of Australia's total export. Therefore, any change in export income caused by a change in commodity prices affects its national income. Changes in national income changes aggregate demand and employment, that is, an increase in commodity prices increases income, which in turn, increases aggregate demand. Higher aggregate demand boosts production and employment, which also pushes up the price level. Thus, commodity prices should contain information about the future movements of these key macroeconomic indicators.

While most of the studies in the literature focus on commodity prices' role in affecting monetary policy variables, recently Frankel (2006) argues that commodity price itself may be affected by monetary policy actions. According to Frankel high interest rate reduces the demand for storable commodities or increases the supply, which reduces the market price of commodities. If this is the case, then a causal link from interest rate to commodity prices can be expected. To examine these links between commodity prices and inflation, unemployment

and interest rate this paper makes use of standard time series econometric procedures that begins with unit root test as follows.

Unit root test: Unit root test is a pre-requisite of testing long run relationship between two or more time series data. Although Dickey-Fuller (DF) and Phillips-Perron (PP) tests are widely used in empirical research, they are known to have low power against the alternative hypothesis that the series is stationary or trend stationary (DeJong, *et al*. 1992). Elliot, Rothenberg and Stock (ERS) (1996) develop a feasible point optimal test that relies on local GLS de-trending to improve the power of unit root tests, hereafter $\text{ERS D}^{\text{GLS}}$. Another problem with ADF and PP tests is that when the series has a large negative moving average (MA) root they suffer from severe size distortion toward over-rejecting the null (Schwert 1989). Perron and Ng (1996) and Ng and Perron (2001) suggest modification of PP test to correct this problem (hereafter Ng-Perron test). They extend the work of Elliot, Rothenberg and Stock (1996) and develop modified versions of the PP test that have much better size properties and also retain the power of $\text{ERS D}^{\text{GLS}}$ test. These unit root tests are based on local GLS de-trending method and use an autoregressive spectral density estimator of the long run variance (Kellard and Wohar 2003). Although it is claimed that these tests are improvements over the ADF and PP tests, there is no comprehensive comparative research on these tests (Maddala and Kim 1998). So, this paper still relies on ADF and PP tests, however, it also uses $\text{ERS D}^{\text{GLS}}$ to confirm the results obtained from ADF and PP tests.

Cointegration test: Cointegration test is applied to examine if there is a long run equilibrium relationship among the underlying variables. When two variables, say x_t and y_t, are individually I(1), but their first difference is I(0), then it is possible that some linear combination of these variables, say $z_t = x_t - \beta y_t$, is I(0) and in that case these variables are said to be cointegrated. This paper employs the cointegration test procedure developed by Johansen (1991, 1995). To make inference regarding the cointegrating relationship, the trace and maximum eigen-value are compared with tabulated in Osterwald-Lenum (1992).

Causality test: While cointegration is concerned with long-run equilibrium, Granger causality is concerned with short run predictability. If two variables x_t and y_t are cointegrated and each variable is individually I(1), then either x_t must Granger-cause y_t, or y_t must Granger-cause x_t. After examining stationarity and cointegration, the paper will examine if macroeconomic variables are caused by commodity prices.

Sources of data: Monthly data spanning from July, 1982 to December, 2007 are used. Commodity price index data are obtained from *Reserve Bank of Australia* (RBA) web site. Four different commodity price index data are used: (i) the overall index of commodity price (COM) (ii) commodity price index for rural commodities (COMRL), (iii) commodity price index for non-rural commodities (COMNRL), and (iv) commodity price index for base metal commodities (COMBSMTL). Inflation (INFL), unemployment (UNEMPLMNT) and short term interest rate (STINT) data are obtained from *Datastream Advance*, *version 4*.

VI. ANALYSES OF EMPIRICAL FINDINGS

This section examines the stationarity of data series in question by using ADF, PP and ERS DF^{GLS} tests and the results are reported in *Table1*. ADF and PP test results show that all variables are non-stationary at level and stationary at their first differences, that is, they are I(1). The INF variable is stationary at 5% significance level when the regression does not include a trend, but non-stationary at 1% significance level. ERS DF^{GLS} test results also give the same conclusion as those of ADF and PP tests, that is, the variables are I(1). Only the UNEMPLMNT variable is stationary at 5% level when the regression does not contain trend, but non-stationary at 1% significance level.

Table 1: ADF, PP, DF-GLS Unit Root Tests

Variables	Augmented Dickey-Fuller (ADF) unit root test			
	Level		First difference	
	Constant	Constant & trend	Constant	Constant & trend
COM	-0.018(1)	-1.243(1)	-13.228(0)*	-13.261(0)*
COMRL	-1.773(1)	-2.842(1)	-13.945(0)*	-13.925(0)*
COMNRL	-0.026(1)	-1.194(1)	-12.888(0)*	-12.940(0)*
COMBSMTL	-2.164(5)	-2.999(5)	-5.034(4)*	-4.983(4)*
INFL	-3.049(2)**	-3.035(2)	-6.873(1)*	-6.900(1)*
STINT	-2.145(1)	-2.378(1)	-12.891(0)*	-12.914(0)*
UNEMPLMNT	-2.192(6)	-2.523(6)	-5.170(5)*	-5.037(5)*
Phillips-Perron (PP) unit root test				
COM	0.062(5)	-1.139(5)	-13.264(1)*	-13.194(2)
COMRL	-1.599(4)	-2.578(2)	-13.732(9)*	-13.712(9)*
COMNRL	-0.110(7)	-1.235(7)	-12.917(4)*	-12.943(3)
COMBSMTL	-1.234(10)	-2.140(10)	-15.402(10)*	-15.370(10)*
INFL	-2.717(11)	-2.652(10)	-9.782(7)*	-9.856(7)*
STINT	-1.943(0)	-1.938(1)	-12.555(7)*	-12.576(7)*
UNEMPLMNT	-1.046(12)	-2.424(13)	-20.255(12)*	-20.360(12)*
DF-GDL unit root test				
COM	1.297(1)	-1.470(1)	-13.016(0)*	-12.920(0)*
COMRL	0.130(1)	-2.559(1)	-13.696(0)*	-12.683(0)*
COMNRL	0.968(1)	-1.308(1)	-11.204(0)*	-12.171(0)*
COMBSMTL	-0.965(5)	-2.946(5)	-5.052(4)*	-4.616(4)*
INFL	-1.670(2)	-2.240(2)	-6.603(1)*	-6.900(1)*
STINT	-0.518(1)	-2.112(1)	-12.770(0)*	-12.952(0)*
UNEMPLMNT	-2.480(6)**	-2.635(6)	-5.103(5)*	-4.971(5)*

Note: * and ** indicate significant at 1% and 5% levels respectively. Figures in the parentheses in ADF test indicate optimum lag length determined by the SIC. Figures in the parentheses in PP test indicate Newey-West bandwidth.

Table 2: Johansen Cointegration Test

Variables	Null Hypothesis	Trace statistic	Max-Eigen Statistic
COM, INFL	r = 0	14.176**	12.168**
	r ≤ 0	2.007	2.007
COMRL, INFL	r = 0	12.320***	10.295***
	r ≤ 0	0.822	0.822
COMNRL, INFL	r = 0	12.919**	11.563**
	r ≤ 0	1.355	1.355
COMBSMTL, INFL	r = 0	11.090***	10.884***
	r ≤ 0	0.205	0.205
COM, STINT	r = 0	6.062	3.286
	r ≤ 0	2.775	2.775
COMRL, STINT	r = 0	4.716	3.878
	r ≤ 0	0.838	0.838
COMNRL, STINT	r = 0	4.806	3.217
	r ≤ 0	1.589	1.589
COMBSMTL, STINT	r = 0	4.028	3.875
	r ≤ 0	0.152	0.152
COM, UNEMPLMNT	r = 0	4.876	3.822
	r ≤ 0	1.054	1.054
COMRL, UNEMPLMNT	r = 0	3.073	2.992
	r ≤ 0	0.080	0.080
COMNRL, UNEMPLMNT	r = 0	3.740	2.911
	r ≤ 0	0.828	0.828
COMBSMTL, UNEMPLMNT	r = 0	7.421	6.282
	r ≤ 0	1.139	1.139

Note: ** and *** indicate significant at 5% and 10% levels respectively.

Given the first difference stationarity of the variables, the next issue of interest is to examine if there is any long run equilibrium relationship among the variables. The Johansen cointegration test shows that there is one cointegrating relationship among the variables (result not reported). It indicates that all variables are not cointegrated. To identify the cointegrated variables pair wise cointegration test is performed and the results are reported in *Table 2*. The results show that only inflation has a cointegrating relationship with all four indices of commodity price.

The usual extension of cointegration analysis is to examine the speed of adjustment of disequilibrium between the cointegrated variables in the short run through error-correction model (ECM). Given the cointegrating relationship between inflation and three indices of commodity price, short run adjustments of these long run relationships are examined. The ECM results are reported in *Table 3*.

Table 3: Error Correction Estimation Result

Pairs of variables	ECM estimation output
COMR vs INFL	$\Delta INFL = -0.0057 + 0.0089 \Delta COMR - 0.018 \hat{u}_{t\_1}$
	$(-0.26) \qquad (1.17) \qquad (-2.04)^{**}$
COMNR vs INFL	$\Delta INFL = -0.013 + 0.036 \Delta COMR - 0.020 \hat{u}_{t\_1}$
	$(-0.65) \qquad (3.97)^{*} \qquad (-2.25)^{**}$
COMBSMTL vs INFL	$\Delta INFL = -0.008 + 0.011 \Delta COMR - 0.022 \hat{u}_{t\_1}$
	$(-0.42) \qquad (2.95)^{*} \qquad (-2.33)^{**}$

Note: * and ** indicate significant at 1% and 5% significance levels.

ECM results show that the magnitudes of speed of adjustments are not substantial; however, all three equilibrating errors are statistically significant. Given these long run and short run associations between the variables, the paper next follows the route of Granger causality test to examine whether commodity prices can effectively be used as predictor of inflation. A cointegrating relationship between inflation and commodity price indices implies that there must be some causal link between them. The Granger causality result reported in *Table 4* shows that there is unidirectional causal effect running from three commodity price indices (COMRL, COMNRL and COMBSMTL) to inflation. It implies that any change in these commodity prices are subsequently followed by movements in inflation rate.

Table 4: Granger Causality Test

Null hypothesis	Lags	F-Statistic	Probability
INF does not Granger cause COM	4	1.22	0.30
INF does not Granger cause COMRL	4	1.88	0.11
INF does not Granger cause COMNRL	4	1.54	0.18
INF does not Granger cause COMBSMTL	2	0.39	0.67
COM does not Granger cause INFL	4	0.75	0.55
COMRL does not Granger cause INFL	4	2.74	0.02^{**}
COMNRL does not Granger cause INFL	4	3.38	0.01^{*}
COMBSMTL does not Granger cause INFL	2	3.24	0.04^{**}

Note: * and ** indicate significant at 1% and 5% levels respectively.

Absence of significant relationship between commodity prices and unemployment is not surprising. Indeed, this result corresponds with long-run Phillips curve analysis, *i.e.* in the long run there should not be any significant relationship between inflation and unemployment. Although the variables do not have any long run relationship however, they may have relationships in the short run. These short run relationship is described by their first differences, which must be stationary if the variables are I(1). As commodity price indices and unemployment are

first difference stationary and not cointegrated, Granger causality test is performed on their first differences to examine whether there is any causal relation in the short run. Results (not reported to save space, however, will be available upon request) show that there is no causal link between these variables. This appears to be consistent with the operation of inflation targeting monetary policy that aims at keeping inflation within a target without affecting output or employment. Granger causality on first difference is also performed on commodity price indices and short term interest rate. In this case as well, no causal link is evidenced (results not reported). This finding indicates that monetary policy has no influence on commodity prices, that is, storability of commodity is not sensitive to the fluctuations in short term interest rate.

V. CONCLUSION AND POLICY IMPLICATIONS

This paper examines the role of commodity price indices in predicting inflation, unemployment, and short term interest rate in Australia. Four types of commodity price indices are used in order to examine whether any specific index is useful in predicting the variables under consideration. Econometric analyses indicate that three commodity price indices (COMRL, COMNRL and COMBSMTL) precede inflation. However, evidence of reverse causation is not found. These results correspond to those found in Hamori (2007), Bloch *et al*. (2006), Browne and Cronin (2007), Sephton (1991) and Garner (1989). Notwithstanding this, our results contradict to those of Ocran and Biekpe (2007). The findings of this study have important implication for monetary authority. The suspected role commodity prices play in determining some monetary variables indicate that non-monetary information variables may be useful for monetary policy. Further, Inflation targeting experience has so far been hit by positive supply shocks. In case of negative supply shock, commodity price may be useful in singling out the likely direction of inflation. All these clear the way for further research in this area. Future research may involve in the development of structural modeling estimating the magnitude of the effects of commodity prices have on monetary variables to enable forecasting to occur.

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