Causal Relationship between Australian Commodity Prices and Macroeconomic Variables

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Abstract

This study uses Granger's (1969) causality technique, given this vector error correction Granger causality / block exogeneity to understand the causal interactions between Australian commodity prices and other fundamental macroeconomic variables in different time horizons. Seasonally adjusted monthly time series from January 2000 to December 2015 were selected as benchmark. The study shows that the real interest rate (rr) and resources stock prices Granger causes Australian commodity prices in the short-run. But commodity prices Granger causes the real exchange rate (rer) and the industrial production (ip). Moreover, the long-run causality test results show current and past information of the adjustment speed of the cointegrating vector of the long-run commodity prices model helps improve forecasts of its prices in almost every time horizon in Australia. Further cross countries studies would add valuable discussion and analysis to understand the causal relationships among the commodity prices as well as these fundamental macroeconomic variables.

Keywords: Commodity prices, Macroeconomic variables, Granger causality, Block exogeneity

1. INTRODUCTION

The fluctuation in commodity prices during recent times has conveyed new momentum to ample discussion between academics and policy makers in Australia. Short-term supply shocks are the main focus points when researchers think about the trend of commodity prices. On the other hand, the long run movements in commodity prices are thought to be related with the demand in China, India and other fast-growing parts of the developing world. Interest rates stay as an ignored factor in many cases. Moreover, the nature of the relationships among commodity prices as well as real exchange rates, economic activities and prices of equities are also need to be considered very carefully to have a sound economic policy for such a commodity dependent economy. For that reason, the present study attempted to investigate the long-run as well as short-run causal interactions between commodity prices and the above Australian fundamental macroeconomic variables, especially the interaction of the monetary policy and real exchange rates with Australian commodity prices.

Commodity price fluctuations influence world's commodity exporting nations and these consequences are major concerns of the policy makers without any doubt. The policy makers of such commodity dependent economy need to know the interactions among the commodity prices and macroeconomic variables to adopt efficient as well as effective policies. Therefore, the main focus on this article is given on assessing the causal relationships among fundamental macroeconomic variables and Australian commodity prices to observe their long-run as well as short-run interactions.

2. DATA AND METHODOLOGY

This study uses a simple competitive market model as the commodity price model which assumes a vector of g variables (here, g = 5) and four of which are $I(1)$ to assess the dynamic interactions among the variables:

$$Y_t = [rci, rr, rer, ip, spr] \quad (1)$$

where, rci denotes real commodity price, rr represents real interest rate, rer shows the trade weighted real exchange rate of Australia, ip denotes industrial production index over time and spr shows S&P/ASX 200 resources index in real form. These variables are chosen for this model after following Akram (2004; 2009), Bloch, Fraser, and MacDonald (2012), Cashin et al. (2004), Frankel and Rose (2010), Rossi (2012) and the references therein. This research uses seasonally adjusted monthly time series from January 2000 to December 2015. The presence of the significant cointegrating vector in the model, would ensure the existence of the vector error correction (VEC) terms to show the short-run dynamics among the variables. The VEC model can be written by the following equations:

$$\Delta rci_t = \gamma_1 + \sum_{i=1}^{k-1}\delta_{1i}\Delta rci_{t-i} + \sum_{i=1}^{k-1}\zeta_{1i}\Delta rr_{t-i} + \sum_{i=1}^{k-1}\eta_{1i}\Delta rer_{t-i} + \sum_{i=1}^{k-1}\theta_{1i}\Delta ip_{t-i} + \sum_{i=1}^{k-1}\lambda_{1i}\Delta spr_{t-i} + \alpha_{11}ETC_{t-k} + \varepsilon_{rci} \quad \text{--------- (2)}$$

$$\Delta rr_t = \gamma_2 + \sum_{i=1}^{k-1}\delta_{2i}\Delta rci_{t-i} + \sum_{i=1}^{k-1}\zeta_{2i}\Delta rr_{t-i} + \sum_{i=1}^{k-1}\eta_{2i}\Delta rer_{t-i} + \sum_{i=1}^{k-1}\theta_{2i}\Delta ip_{t-i} + \sum_{i=1}^{k-1}\lambda_{2i}\Delta spr_{t-i} + \alpha_{21}ETC_{t-k} + \varepsilon_{rr} \quad \text{---------- (3)}$$

$$\Delta rer_t = \gamma_3 + \sum_{i=1}^{k-1}\delta_{3i}\Delta rci_{t-i} + \sum_{i=1}^{k-1}\zeta_{3i}\Delta rr_{t-i} + \sum_{i=1}^{k-1}\eta_{3i}\Delta rer_{t-i} + \sum_{i=1}^{k-1}\theta_{3i}\Delta ip_{t-i} + \sum_{i=1}^{k-1}\lambda_{3i}\Delta spr_{t-i} + \alpha_{31}ETC_{t-k} + \varepsilon_{rer} \quad \text{---------- (4)}$$

$$\Delta ip_t = \gamma_4 + \sum_{i=1}^{k-1}\delta_{4i}\Delta rci_{t-i} + \sum_{i=1}^{k-1}\zeta_{4i}\Delta rr_{t-i} + \sum_{i=1}^{k-1}\eta_{4i}\Delta rer_{t-i} + \sum_{i=1}^{k-1}\theta_{4i}\Delta ip_{t-i} + \sum_{i=1}^{k-1}\lambda_{4i}\Delta spr_{t-i} + \alpha_{41}ETC_{t-k} + \varepsilon_{ip} \quad \text{---------- (5)}$$

$$\Delta spr_t = \gamma_5 + \sum_{i=1}^{k-1}\delta_{5i}\Delta rci_{t-i} + \sum_{i=1}^{k-1}\zeta_{5i}\Delta rr_{t-i} + \sum_{i=1}^{k-1}\eta_{5i}\Delta rer_{t-i} + \sum_{i=1}^{k-1}\theta_{5i}\Delta ip_{t-i} + \sum_{i=1}^{k-1}\lambda_{5i}\Delta spr_{t-i} + \alpha_{51}ETC_{t-k} + \varepsilon_{spr} \quad \text{---------- (6)}$$

The causal relationship between the variables in this study can be tested with VEC Granger causality tests to determine the relationship between Australian commodity prices and the other considered macroeconomic variables.

3. ECONOMETRIC RESULTS

As the present study has one cointegrating vector in the model; therefore, a VAR-based Granger causality would be misleading (Enders, 2008; Granger, 1988; Parsva & Lean, 2011). Thus, the sources of causality could be identified from the significance test of the coefficients of independent variables in the vector error correction model (VECM). The current study divided the results for both short-run

(Table 1) and long-run (Table 2) causality. The null hypothesis was that the lagged explanatory variables of the model and also their joint significance do not Granger cause the dependent variableThe current study divided the results for both short-run (Table 1) and long-run (Table 2) causality. The null hypothesis was that the lagged explanatory variables of the model and also their joint significance do not Granger cause the dependent variable.

Regarding the causality of the short run, this study tested the nullity of the parameters associated with independent variables in each equation of VECM (Equations 2, 3, 4, 5 and 6) using the χ^2 – Wald statistics. Gujarati (2009) showed that the direction of causality might depend critically on the number of lagged terms included; therefore, this study conducted the tests for different lagged terms as undertaken by Brahmasrene, Huang, and Sissoko (2014).

Table 1 Short-run Granger Causality Tests

Sources of Causation → Dependent Variable	**Number of Lags**	**Chi-sq**
$\Delta rr \rightarrow \Delta rci$	4 months	8.033***
$\Delta rr \rightarrow \Delta rci$	5 months	12.267*
$\Delta rr \rightarrow \Delta rci$	6 months	11.774***
$\Delta rci \rightarrow \Delta rr$	1 month	5.875*
$\Delta rci \rightarrow \Delta rr$	4 months	10.044*
$\Delta rci \rightarrow \Delta rr$	5 months	10.473***
$\Delta rer \rightarrow \Delta rci$	1 month	2.997***
$\Delta rci \rightarrow \Delta rer$	2 months	5.452***
$\Delta rci \rightarrow \Delta rer$	3 months	10.088*
$\Delta rci \rightarrow \Delta rer$	4 months	8.027***
$\Delta rci \rightarrow \Delta ip$	2 months	4.488***
$\Delta rci \rightarrow \Delta ip$	3 months	7.359***
$\Delta rci \rightarrow \Delta ip$	10 months	16.036***
$\Delta rci \rightarrow \Delta ip$	11 months	19.641*
$\Delta spr \rightarrow \Delta rci$	2 months	5.911**
$\Delta spr \rightarrow \Delta rci$	3 months	7.137***
$\Delta spr \rightarrow \Delta rci$	7 months	16.060*

Notes: → Implies Granger cause, e.g. $\Delta spr \rightarrow \Delta rci$ implies stock price Granger causes commodity price index. *, ** and *** denotes statistical significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively.

Table 1 helps to analyse the causal relationships between *rci* and other variables of interest of the commodity price model. Based on the Granger (1969) approach, Granger's concept of causality does not imply a cause-effect relationship, but rather is based only on 'predictability' or 'forecastability'. Therefore, the short-run causality tests from the VECM equation (2) shows that the current and past information on interest rate helps improve the forecasts of commodity prices in four to six months. Only the four and sixth month lags had a statistical significance level of 10 per cent, while the fifth lag had a 1 per cent significance level. The null hypothesis was rejected in these months. Therefore, according to the data, interest rate Granger caused commodity price index in the short run. This finding supports the study of Frankel (2006).

Table 1 also shows that the Australian trade weighted real exchange rate's current and past information helps improve the forecasts of commodity prices immediately (one month) and this lag

has a statistical significance level of 10 per cent with $\chi^2 = 2.997$. Thus, the null hypothesis of the Granger causality tests is rejected for this VECM equation with a significant error correction term. The author also observed that commodity price index Granger caused the real exchange rate in between two and four-month lags. However, the error correction term of the VECM equation with real exchange rate as the dependent variable (Equation 4) was also significant. Our findings are consistent with Simpson and Evans (2004). This result is also consistent with Bashar and Kabir (2013) who conducted their research on Australian quarterly data for over 30 years. They showed a two-way Granger causality between exchange rate and commodity prices. However, the result of this study shows stronger causality from commodity prices to real exchange rates in the short run than the other way around.

The VECM short-run Granger causality tests also showed that the current and past information on S&P/ASX 200 resources index improved the forecast ability of commodity prices in two to three months as well as in seven months' time. The seven-month lag had a statistical significance level of 1 per cent with $\chi^2 = 16.060$. However, the null hypothesis was rejected in two months at 5 per cent and in three months at the 10 per cent level of significance. Thus, the result showed that real stock price index Granger caused commodity price index in the short run. Our findings are consistent with Rossi (2005; 2012).

Table 1 also represents unidirectional causality from commodity price to *ip* in two, three, ten and eleven months. In all these four cases the null hypotheses were rejected with significant statistics. This is consistent with the outcomes of Labys and Maizels (1993). In the present study, *ip* is the dependent variable of the VECM Equation (5), which has the significant error correction term.

The VECM Granger causality for the long run is reported in Table 2. The causality in the long run can be tested by the significance of the speed of adjustment. This study utilised the t-statistics of the coefficients of the error correction term, which indicated whether there were long-run causal effects. In Table 2 only the long-run Granger causality for Equation (2) are shown, which also has the significant error correction term with appropriate sign and shows the main objective of our research, i.e. to identify the impacts of other macroeconomic variables on Australian commodity prices.

Table 2 Long-run Granger Causality Tests

Sources of Causation → Dependent Variable	**Number of Lags**	**t-statistics**
$ECT \nrightarrow \Delta rci$	1 month	4.057 (0.5412)
$ECT \nrightarrow \Delta rci$	2 months	14.99 (0.1321)
$ECT \rightarrow \Delta rci$	3 months	22.408 (0.0975)
$ECT \nrightarrow \Delta rci$	4 months	27.8203 (0.1137)
$ECT \rightarrow \Delta rci$	5 months	39.9825 (0.0370)
$ECT \rightarrow \Delta rci$	6 months	44.0355 (0.0473)
$ECT \rightarrow \Delta rci$	7 months	68.2139 (0.0007)
$ECT \rightarrow \Delta rci$	8 months	77.6911 (0.0003)
$ECT \rightarrow \Delta rci$	9 months	82.1915 (0.0006)

$ECT \rightarrow \Delta rci$	10 months	84.0004 (0.0018)
$ECT \rightarrow \Delta rci$	11 months	82.7956 (0.0091)
$ECT \rightarrow \Delta rci$	12 months	86.8572 (0.0133)

Notes: $\nrightarrow$ implies does not Granger cause and $\rightarrow$ implies Granger cause. Parentheses show the probabilities of the relevant t-statistics.

Table 2 shows the results for the causality tests for VECM equation (2) for different lag lengths. The long-run causality test results show that error correction term does not Granger causes commodity price during the first and second months. However, the results explain that current and past information of the adjustment speed of the cointegrating vector of our long-run model helps improve forecasts of commodity prices in three to twelve months, except during the fourth month that has the statistical significance level close to 10 per cent. Thus, the result of this study can conclude that the elasticity of the cointegration vector Granger caused commodity price index in the long run.

4. CONCLUSION

This study presents the VEC Granger causality test results to show the causal relationship between the commodity prices and Australian macroeconomic variables. The research divided the results for both short and long run. It showed that the Australian interest rate Granger caused *rci* in the short run and the same was true for the opposite direction. However, the current and past information of Australian trade weighted RER helped improve the forecasts of commodity prices immediately and the opposite was true between two to four months lags. Moreover, the current and past information on S&P/ASX 200 resources index helped improve the forecast ability of *rci* mostly in the short run. Another unidirectional causality has been found from *rci* to *ip* in the short to medium term.

The VECM Granger causality for the long run was also reported in this study, which was tested by the significance of the speed of adjustment. This result in current study explained that current and past information of the adjustment speed of the cointegrating vector of the long-run model of this study helped improve forecasts of commodity prices in almost all time horizons. Thus, the research can conclude that the elasticity of the cointegration vector Granger caused *rci* in the short as well as long run. The study also shows that Australian commodity prices has the power to influence the real exchange rate and hence, the competitiveness of Australia in world trade.

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