

**Macroeconomic Interdependence between Mainland China and Taiwan: A Cross-Strait Perspective
on Globalization**

Richard C. K. Burdekin and Hsin-hui I. H. Whited*

Claremont McKenna College and Colorado State University-Pueblo

May 2007

Abstract

Macroeconomic interdependence between mainland China and Taiwan is assessed in terms of an array of output, price, money and stock price measures for each economy. Sizeable simple correlations between these variables are accompanied by significant bi-directional Granger-causality in many cases. Further evidence of interdependence arises from impulse response and variance decomposition analysis. The effects of mainland China variables on Taiwan appear to be stronger than the reverse. Consistent responses of each M2 money supply measure to developments in the other economy are particularly noteworthy as M2 was generally the target variable for each central bank over our sample period.

JEL Codes: F42; F36

Keywords: globalization; China; Taiwan; international transmission; integration

* The authors thank Ramkishen Rajan and Tom Willett for helpful comments and are grateful to Nancy Tao for valuable research assistance.

Contact: Richard C. K. Burdekin, Jonathan B. Lovelace Professor of Economics, Claremont McKenna College, 500 E. Ninth Street, Claremont, CA 91711. E-mail richard.burdekin@claremontmckenna.edu; fax (909) 621-8249; phone (909) 607-2884.

Macroeconomic Interdependence between Mainland China and Taiwan: A Cross-Strait Perspective on Globalization

1. Globalization and Cross-Strait Linkages

Since mainland China began to reopen its economy to foreign trade and foreign investment in 1978, the nation's increasing integration into the world economy has drawn a lot of attention in the west. As with the rapid growth spurts enjoyed by other Asian economies, including Hong Kong and Taiwan, in the 1970s and 1980s, openness has allowed mainland China to capitalize on high-quality human capital while acquiring advanced technology from abroad.¹ Notwithstanding calls by US policymakers for mainland China to make further strides towards opening up its markets to foreign competition, China is already ranked amongst the top twenty five countries in the world in terms both of its overall globalization level and its level of 'economic globalization' -- as reflected in the importance of trade, foreign direct investment, portfolio investment and income flows (see Lockwood and Redoano, 2005).² An important element of mainland China's increased globalization has been growing economic ties with Taiwan, helped, of course, by geographical proximity as well as common heritage and language. A newfound common emphasis on export promotion (cf, Chow, 2007, pp. 58-59), coupled with the gradual easing of government restrictions on Cross-Strait trade, has set the stage for a considerable degree of economic interdependence despite continuing political ambiguity (and animosity).

Taiwan's unusual political relationship with respect to mainland China is, in fact, nothing new. No sooner were fifty years of Japanese control of the island ended by the peace treaty of 1945 than the exodus of Chiang Kai-shek's Nationalist regime to Taiwan (then known as Formosa) drove a new wedge

¹ See Chow (2006; 2007) for comparative analysis and detailed discussion of the overall importance of globalization to mainland China's economy.

² One concern with mainland China's rapidly increased globalization is that it has been accompanied by increased inequality, however, as manifested not only across individual income levels but also rural-urban income differentials and regional income differentials (cf, Siddique, 2006).

with the mainland, where Communist forces emerged victorious at the end of the 1940s.³ For most of the intervening years, Taiwan and mainland China followed entirely separate paths with Taiwan promoting exports and ties with the west and mainland China largely withdrawing from world markets – the share of the nation’s trade with non-communist countries having quickly dropped from 74% in 1950 to just 28% in 1952 (Durdin, 1953, p. 14). Forced isolation of Taiwan from the economy of mainland China continued even after 1978 and it was not until Taiwan’s government announced a policy of non-interference with indirect exports to the mainland in 1985 that economic ties were allowed to develop in the face of continuing liberalization measures. Estimated total trade between mainland China and Taiwan rose from \$1,102.7 million in 1985 to \$76,369.6 million in 2005 – with the 2005 figures comprising \$56,275.9 million flowing from Taiwan to mainland China and \$20,093.7 million in exports from mainland China to Taiwan (see Table 1). Cross-Strait trade volumes have increased by over 150% since World Trade Organization membership in 2001, by 2005 accounting for just over 20% of Taiwan’s total foreign trade and for just over 5% of mainland China’s total foreign trade (Table 2). Taiwan’s overall positive trade balance in recent years has, in fact, been very much dependent upon its surpluses with mainland China. In 2005, for example, Table 2 shows that Taiwan’s estimated trade surplus with mainland China via Hong Kong was \$36,182.2 million while its overall surplus was just \$15,818.6 million – implying a deficit of \$20,363.2 million with the rest of the world.

World Trade Organization membership has been accompanied by further liberalization of mainland China-Taiwan trade. Should this eventually allow direct trade and transport ties to replace indirect shipping via Hong Kong or, to some extent, Japan, the reduction in shipping costs would significantly add to the attractiveness of Cross-Strait trade. Transshipping goods via a third area may have added as much as \$1.51 billion to annual Cross-Strait transportation costs in 2001, or just over 5% of the total trade value (Lardy, 2002, p. 166). By no means all Taiwan’s current trade with Hong Kong is

³ See Burdekin and Whited (2005) on the initial exporting of inflation from mainland China to Taiwan in the midst

indirect, however. At the beginning of 2006, mainland China accounted for 27.64% of Taiwan's total exports and 12.23% of Taiwan's total imports. If trade with Hong Kong is added to these figures, we then have 37.67% of Taiwan's total exports and 13.24% of Taiwan's total imports (Mainland Affairs Council, 2006, p. 15). Mainland China itself accounts for over 90% of Taiwan's total foreign investment, with \$US551 million being approved in January 2006 alone, up 11.28% year on year (Mainland Affairs Council, 2006, pp. 16, 33). Flows of funds between mainland China and Taiwan have certainly risen dramatically in recent years as shown in Table 3. Remittances from Taiwan to mainland China reached \$US18,184 million in 2005, up 70% from 2004 and up more than tenfold since 2001. Remittances from mainland China to Taiwan have also soared, reaching \$US23,846 million in 2005, up 62% from 2004 and up more than tenfold since 2002.

Official Chinese statistics show Taiwan accounting for 12.74% of all foreign direct investment (FDI) projects in mainland China over the 1979-1999 period, second only to Hong Kong – while Taiwan's 7.76% share in the realized value of mainland China FDI ranked fourth, just behind the United States and Japan (Zhang, 2005).⁴ Taiwan's official share of realized FDI remained at 7.2% over the 1979-2005 period as a whole but has evidenced a declining trend since 2002 – falling from 7.53% in 2002 to 6.31% in 2003, 5.14% in 2004 and just 3.57% in 2005 (Mainland Affairs Council, 2006, pp. 49-51). These figures not only do not fully account for re-exporting from Taiwan to mainland China via Hong Kong but also ignore substantial Taiwanese investment via holding companies in tax-exempt counties like the British Virgin Islands and the Cayman Islands, however (Tung, 2004). And the British Virgin Islands actually became mainland China's second most important reported source of realized FDI over the 2002-

of the Nationalist migration in the late 1940s.

⁴ Taiwan also has been the fourth largest contributor of intraregional FDI in the East Asian and South-East Asian regions as a whole in recent years (United Nations Conference on Trade and Development, 2006, pp. 54-57).

2005 period (after Hong Kong & Macau), rising from a 11.60% share in 2002 to 14.96% in 2005 – thereby registering an increase close to the size of the decline observed in the official figures for Taiwan.⁵

Although the Taiwanese government has continued to ease restrictions on economic relations with mainland China since 1985, an overall cap on mainland investments remains in place. Reform of this overall limit on Taiwan's mainland investment began to receive serious consideration in 2006, however (Hille, 2006). Despite the disallowance of direct trade links, mainland China became Taiwan's second largest export market by 1993 and has been its top export market since 2002 (Tung, 2004). The importance of this relationship to mainland China is reflected in the fact that Taiwan became China's fourth largest trading partner over the 1990s. Meanwhile, increasing financial integration between mainland China and Taiwan appears to be reflected in shrinking interest rate differentials and Cheung, Chinn and Fujii (2005) also find some suggestions that integration between mainland China and the economies of Hong Kong and Taiwan over the 1996-2001 period was proceeding more rapidly than mainland China's integration with non-Chinese economies such as the United States and Japan.

This paper attempts to shed some light on the extent to which the growing economic interdependence between mainland China and Taiwan may have been reflected in co-movement between key macroeconomic variables in the two economies. We find that not only have mainland China and Taiwan experienced broadly similar economic trends in recent years but also there is substantial evidence of actual linkages between their respective output, money growth, price and share price performances. While stronger influences generally extend out from mainland China to Taiwan, evidence of at least some degree of mutual interdependence arises in most cases. Although it is possible that some of the indicated effects of mainland China on Taiwan reflect China's influence on world markets generally in addition to direct transmission effects (Yang and Shea, 2005), the empirical results generally seem consistent with the ties between the two economies suggested in trade and capital flow data. The idea of a unified

⁵ China's possible displacement of FDI that would otherwise have gone elsewhere remains a controversial issue (see,

“Greater China” region including Taiwan as well as mainland China and Hong Kong indeed seems to be emerging economically in spite of the remaining political impediments.

With the exception of the interest-rate linkages examined by Cheung, Chinn and Fujii (2005), most prior studies of interactions between mainland China and Taiwan have been limited to either trade relationships or stock market interdependence. Significant linkages between mainland China and Taiwan stock markets, as well as with Hong Kong, have been consistently identified in such studies as Bahng and Shin (2004), Cheng and Glascock (2005) and Chi, Li and Young (2006). Notwithstanding significant short-run effects of US markets on the Greater China group (Wang and Firth, 2004), there is little evidence of longer-run integration, or cointegration, with the US market (Cheng and Glascock, 2005; Chi, Li and Young, 2006). It seems important, however, to allow for a broader range of potential interactions, and interdependence, between mainland China and Taiwan as reflected in output, money growth and inflation variables in addition to stock market indices.

2. Trends in Output, Price, Money and Stock Market Data in Mainland China and Taiwan Since 1994

Mainland China experienced declining inflation after 1994, a year marked both by monetary tightening and the unification of the old internal settlement rate for foreign exchange and the official rate in January.

While most other Asian currencies depreciated against the US dollar at the time of the Asian financial crisis, in many cases dramatically so, mainland China’s fixed exchange rate with the US dollar was maintained with the help both of the nation’s large foreign exchange reserves and, perhaps more importantly, capital controls that sheltered the renminbi from speculative attack. Scope for domestic monetary loosening was severely curtailed, however, and the rate of economic growth slowed despite extensive fiscal pump priming. Deflation set in during 1998 and persisted until 2002. Money supply

for example, Fung, Iizaka and Siu, 2005).

growth declined steadily, with M2 growth falling from 42.8% in 1993 to 12.3% in 2000. Burdekin and Siklos (2008) suggest that, while Chinese monetary policy typically remained too tight until around 2001, the People's Bank subsequently loosened policy too much as capital inflows began to surge in 2003-2004 – just prior to the change in the exchange rate regime in 2005.

Prior to the slide into deflation after the Asian financial crisis, Taiwan had generally enjoyed both low levels of inflation and low variability of inflation since the switch from a fixed exchange rate to a managed float in 1978. Inflation has generally been kept below 5% since the end of the 1979-1980 oil price shock, and central bank policy responsiveness to inflation is implied by such recent reaction function studies as Chang (2005) and Huang and Lin (2006). Chang (2005) also identifies a significant response to stock prices. Although neither study finds a significant response to output fluctuations, Cover, Hueng and Yau (2002) argue that actual performance of the Taiwanese economy in terms of both output and price variability compares favorably to simulated performance under a variety of hypothetical central bank policy rules over the 1978-1999 period – including a nominal output target. None of these studies consider central bank responses to mainland Chinese variables, however. Given the high level of openness of Taiwan's economy (the share of exports and imports being close to 100% of GDP) and dependence on China, both direct policy responses to Chinese variables, as well as indirect responses via the effects of mainland China variables on domestic economic indicators, seems plausible. Indeed, the relationship between Taiwan and its much larger main trading partner and neighbor bears some basic similarity with that between Canada and the United States – a case where such direct and indirect responses to developments in the larger partner are known to have been of considerable importance (cf, Burdekin and Burkett, 1992).

Taiwan's central bank, like mainland China's, emphasized M2 growth during the 1990s.⁶ While the link between M2 growth and CPI growth in Taiwan has not always been consistent over the post-1961 period (Shen, 2002), both M2 and the CPI trend downward over the 1990s. As with mainland China, these declines accelerated with the coming of the Asian financial crisis and culminated in outright deflation. Although Taiwan's strong foreign reserve position and low external debt helped protect against the Asian financial crisis and limited the depreciation faced by the New Taiwan dollar,⁷ more serious setbacks followed in 2001 -- a year when Taiwan recorded negative economic growth and a sharp increase in the unemployment rate from just under 3% in 2000 to 4.57% in 2001. The New Taiwan dollar also depreciated by over 6% against the US dollar in 2001. Although this depreciation was considerably smaller than the 18.7% depreciation in 1997 in the face of the Asian financial crisis, Taiwan's economy was more exposed than mainland China's to the global slowdown that accompanied the bursting of the Nasdaq bubble in 2000 and the terrorist attacks of September 11, 2001 -- with political frictions likely also exacerbating the 2001 weakness (see Yang and Shea, 2005). An ongoing concern is that excessive flows of Taiwanese investment capital to the mainland may have left domestic producers starved of capital -- leading Lin (2005), for example, to strongly argue against any creation of a "cross-strait common market" that would further integrate Taiwan into mainland China's economy. Chen (2006), however, attributes economic slowdown to a transition phase from a traditional export-orientated economy to a more

⁶ The People's Bank's monetary targets were, in practice, frequently missed over the post-1994 period. While Geiger (2006) suggests that the central bank relied upon wage and price controls and window guidance to contain inflation in spite of these misses, the fact remains that the lowered money growth targets after 1996 were accompanied by *both* sharply declining rates of money growth and declining inflation. Indeed, actual M2 growth rates tended to be *lower* than the targets over the 1997-2001 deflationary period -- and likely represented an overly-tight monetary policy that helped facilitate the outright declines in prices that emerged over this interval (see also Burdekin and Siklos, 2008).

⁷ Taiwan's relatively robust weathering of the Asian financial crisis not only contrasted sharply with most other East Asian economies but also broke the high degree of commonality previously observed between Taiwan and Korea (Hsiao and Hsiao, 2001).

advanced intensive economy and sees the capital outflow as a positive factor allowing Taiwanese firms to benefit from a cheaper manufacturing base and an expanded market.⁸

While declines in Taiwan's GDP deflator and CPI ended in 2004, wholesale prices recovered earlier, generally trending upward from 2000. Yang and Shea (2005) attribute this divergence between wholesale and consumer price performance in Taiwan to the influence of mainland China's demand for raw materials and capital goods in boosting global prices of such goods and thereby boosting Taiwan's import prices as well. Expansionary policy by the central bank was reflected in successive reductions of the discount rate from 4.75% in June 2000 to 1.375% in June 2003 (Yang and Shea, 2005). Meanwhile, the seeming undervaluation of Taiwan's currency has been accompanied by foreign reserve accumulation that, in percentage terms at least, rivals that enjoyed by mainland China. Central bank foreign exchange reserves increased by nearly 100% from 2000-2003, for example, rising from \$US106.7 billion at the end of 2000 to \$US206.6 billion at the end of 2003 (Yang and Shea, 2005).

The fortunes of Taiwan and mainland China certainly diverged somewhat at the beginning of the twenty-first century, with Taiwan's downturn in 2001 coming at a time when mainland China's own deflationary pressures had ended and pressures for renminbi devaluation were abruptly replaced by pressures for revaluation. This revaluation pressure followed the reversal in the trend of the US dollar against other world currencies since 2001 (Burdekin, 2006).⁹ The People's Bank of China raised its money growth rate target to 18% in the first quarter of 2003 and growth in foreign exchange reserves subsequently shot up to \$US 207 billion in 2004 before increasing by a further \$US 209 billion in 2005. He et al. (2005, p. 5) estimate that the People's Bank's sterilization measures offset 42% of the overall domestic liquidity effects of the foreign reserve growth in 2004, up from 25% in 2003. Econometric

⁸ The situation varies by industry, however, and Chen (2006) offers some specific suggestions as to how Taiwanese industries may seek to maintain competitive advantage and long-term operations.

⁹ Interestingly, such appreciation pressures have a parallel in Taiwan's own prior experience in the 1980s (Hon, 2004).

modeling by Ouyang, Rajan and Willett (2006) suggests a considerably higher degree of sterilization, however, reaching 90% in 2004-2005.

Even though mainland China's move towards inflationary pressures after 2001 contrasts with continued deflation in Taiwan, industrial production in both economies accelerated after 2001.¹⁰ The extent to which Taiwan's growth acceleration after 2002 may be linked to the turnaround in mainland China's economic position is addressed empirically below. We also examine the behavior of money growth and inflation in the two economies. An upward trend in both consumer price indices prior to the Asian financial crisis was followed by a leveling off in both series prior to renewed increases in 2003-2004. The exact timing of the deflation differed somewhat, however, with mainland China entering and exiting deflation earlier than Taiwan. We also take into account possible commonalities between money growth rates in mainland China and Taiwan, considering year-to-year growth rates in both M2 and M1 money supply measures – and in Taiwan's case an extended M1 money supply definition (M1B) that includes passbook savings deposits.¹¹ Finally, we consider respective stock market performances based on the value of the Taipei stock market and the Shanghai A Share index.¹²

3. Empirical Analysis of Interactions between the Mainland China and Taiwanese Series

We begin by examining simple correlation coefficients between our mainland China and Taiwan variables. These data are all monthly series from January 1994 through March 2005. Given that each series features a unit root when specified in levels, we convert the data into growth rate form.¹³

Seasonality has been removed from the raw data by employing the Holt-Winters exponential smoothing

¹⁰ All mainland China data are drawn from the Great China Database (<http://www.finasia.biz/tejonline/tejonline.htm>) and the Taiwan data are from the Republic of China Statistical Database and the Central Bank of Taiwan.

¹¹ Taiwan's M1A contains currency held by the public plus checking accounts and passbook deposits of enterprises and individuals (includes non-profit organizations) in monetary institutions. M1B is defined as M1A plus Passbook Savings Deposits of Individuals (includes non-profit organizations) in monetary institutions.

¹² We cannot directly incorporate Cross-Strait trade variables and investment flows in the empirical testing as, unlike the macroeconomic and share price series, such data are generally not available on a monthly basis.

method.¹⁴ Table 4 shows sample correlations between the mainland China and Taiwan series pairs to be 0.24 for industrial production growth, 0.73 for consumer price inflation, 0.54 for M2 growth, 0.44 and 0.43 for mainland China M1 growth vs. Taiwan M1A and M1B growth, respectively, and 0.42 for the stock market series. The mainland China PPI vs. Taiwan WPI correlation of 0.10 is the lowest of the group.

The Table 4 correlations also suggest high degrees of co-movement between M2 growth and consumer price inflation in both mainland China and Taiwan, with M2-CPI correlations of 0.79 for mainland China and 0.71 for Taiwan. Furthermore, there is a correlation coefficient of 0.49 between mainland China M2 growth and Taiwanese consumer inflation and a correlation of 0.65 between Taiwan's M2 growth and mainland China's consumer inflation. This suggests possible mutual sensitivity of inflation performance to monetary policy on the other side of the Taiwan Straits. There are also some high correlations between money growth and industrial production growth and share price movements. Chinese industrial production growth exhibits a 0.25 correlation with own M1 growth and a 0.62 correlation with Taiwan M1A growth but no positive correlation with either M2 measure. Taiwanese industrial production growth has a 0.36 correlation with mainland China M1 growth and a correlation of 0.68 with Taiwan M1A growth but only minimal positive correlations with the M2 measures. Finally, Shanghai share price growth has a 0.37 correlation with mainland China M1 growth and 0.36 with respect to Taiwan M2 growth while Taiwanese share growth has a correlation of 0.52 with mainland China M1 growth and even higher correlations with Taiwan M1A and M1B growth.

Granger-causality testing, with the data still specified in growth rate form, generally suggests that significant, bi-directional relationships underlie the correlations noted in Table 4 above.¹⁵ Table 5 shows significant bi-directional causality between mainland China and Taiwan industrial production, mainland

¹³ Cointegration between these I(1) variables is explicitly incorporated in the following impulse response analysis.

¹⁴ The choice between multiplicative and additive terms for removing seasonality in the Holt-Winters forecasting function is based on the sum of squared residuals for the forecast errors.

China and Taiwan consumer prices, and each pair of narrow and broad money supply measures. The producer price/wholesale price indices and share price measures do not significantly Granger-cause each other, however. Results for other significant combinations of mainland China and Taiwan variables are also reported in Table 5 and these findings suggest that increased money growth in one economy tends to be followed by increased industrial production in the other economy. Additional significant causal effects are seen running from the mainland China PPI to Taiwanese industrial production and from the Taiwanese CPI to mainland China industrial production.

The correlations and causality tests suggest that money supply growth in the two economies seems to be linked and the results also suggest international transmission of money supply growth across the Taiwan Straits. Wholesale and producer price indices seem to exhibit considerably less interdependence than consumer prices, however. In analyzing how the bidirectional effects may evolve over time, we examine impulse response functions for these same series (all of which are $I(1)$) that detail how each variable in turn evolves following a one-standard deviation shock to both domestic and foreign variables in the system. Estimation of the vector error correction model required to produce these results requires us to choose a single price series and a single money supply series for each economy, however. In light of the above findings, we employ consumer prices as the price measure for both mainland China and Taiwan. Meanwhile, alternative estimation with the different money supply measures in practice produces quite consistent results. The discussion below focuses on the results for M2, which was the monetary aggregate given greater emphasis by both the mainland China and Taiwan central banks over our sample period. The results with the narrow money supply measures are available from the authors upon request.¹⁶

¹⁵ A lag length of two is imposed throughout based on the Schwartz criterion. (Additional allowance for an extended lag length of three was seen to have little impact on the results.)

¹⁶ Prior testing using the MacKinnon-Haug-Michelis (1999) critical values revealed the presence of four cointegrating equations for each of the alternative specifications with all variables specified in levels.

The Cholesky ordering for the impulse response analysis has Chinese CPI followed by, in order, Chinese industrial production, Chinese M2, Chinese share prices, Taiwanese CPI, Taiwanese industrial production, Taiwanese M2 and Taiwanese share values.¹⁷ We examine the adjustment of each variable over 12 periods following a one-standard deviation shock to each of the eight variables in the system. The full set of impulse responses for this formulation is presented in Figure 1. Figure 1 shows that mainland China CPI initially responds primarily to itself but that effects of a shock to domestic industrial production become the most important once four periods have passed. There is also a consistently positive response of mainland China CPI to a shock to Taiwanese industrial production but this effect remains smaller than the impact of a shock to domestic industrial production. The largest influences on mainland China industrial production, meanwhile, appear to emanate from shocks to itself and shocks to the domestic M2 money supply. Mainland China M2 money supply is most heavily influenced by shocks to itself but also evinces consistent positive responses to shocks to domestic CPI and domestic share prices. There is a strikingly consistent negative reaction to a shock to Taiwanese share values. Chinese share prices react primarily to own-shocks but also feature consistent smaller positive responses to Taiwanese M2, Taiwanese share prices and Taiwanese industrial production as well as domestic industrial production.

Like mainland China CPI, Taiwanese CPI features a positive response to a domestic industrial production shock. Domestic M2 shocks also have a positive effect once three periods have passed. Positive effects of mainland China industrial production on Taiwan's CPI emerge after six periods. Taiwanese industrial production itself appears relatively insensitive to shocks to the other variables but there are generally positive responses to shocks to domestic M2 and domestic share values. Taiwanese M2 features consistently positive responses to domestic CPI and domestic industrial production in addition to own shocks. Effects of a mainland China industrial production shock on Taiwanese M2 are

¹⁷ Experimentation showed the results to be very robust to allowance for alternative orderings of the variables. The

actually larger than those of a domestic industrial production shock, however, and mainland China M2 and share price shocks also exert consistently positive effects. Finally, Taiwanese share values react positively to all domestic variable shocks other than industrial production and negatively to all mainland China shocks except for the mainland China share price series.

Overall, it seems that Taiwanese M2 is the most consistently driven by mainland China shocks, suggesting also that that any relationship with mainland China industrial production likely runs primarily from mainland China to Taiwan. Amongst the mainland China variables, share prices seem most consistently responsive to shocks emanating from the other economy, perhaps reflecting the sensitivity of demand for Shanghai shares to conditions elsewhere in the Greater China region. The positive reaction of both mainland China and Taiwan shares to shocks in the other market is itself consistent with prior empirical work on the co-movement of share prices within the Greater China region. The impulse response analysis also offers evidence that industrial production shocks are transmitted across economies, based on the response of mainland China CPI as well as mainland China share prices and Taiwanese M2.

A more general assessment of the importance of macroeconomic interactions between mainland China and Taiwan is provided by decomposing the variance of each of the eight variables assessed in the preceding impulse response analysis. This variance decomposition assesses the relative importance of fluctuations in domestic variables relative to the effects of their counterpart variables in the other economy. The total effect of the other-economy variables provides a possible yardstick as to the overall sensitivity of each economy to the other. As before, we focus on representative results using the M2 money supply measures in mainland China and Taiwan.¹⁸ Over the same 12 period window as that utilized in the impulse response analysis, the average sensitivity to Taiwanese variables ranges from

lag lengths themselves were selected by the Schwartz criterion consistent with the Granger-causality analysis above.
¹⁸ Full details of the M2 results, as well as the (again similar) results obtained using the narrow money supply measures, are available from the authors upon request.

21.38% for mainland China CPI to 12.41% for mainland China share prices.¹⁹ As would be expected, Taiwanese variables generally reveal stronger responsiveness to developments in the other economy. The only exception to this is Taiwanese CPI, for which the average contribution to total variance arising from mainland China variables is 20.91%, almost identical to mainland China CPI's 21.38% overall sensitivity to the effects of Taiwanese variables. Elsewhere the overall contribution from the mainland China variables reaches an average of 52.18% for Taiwanese industrial production and is 29.35% for Taiwanese M2 and 13.97% for Taiwanese share values.

4. Conclusions

Given the growing ties between mainland China and Taiwan, some degree of economic integration between the two neighboring economies is to be expected. While a number of prior studies have identified stock market linkages between mainland China and Taiwan, surprisingly little attention has been paid to broader macroeconomic interdependence, however. The present empirical work confirms that mainland China and Taiwan industrial production, consumer price and money growth measures as well as share prices are quite highly correlated. Additional analysis suggests that Taiwanese macroeconomic variables as a group meaningfully contribute to the overall variation in the mainland China variables and that a still stronger contribution is made by the mainland China variables on the Taiwanese side. Causality-testing and impulse response analysis consistently suggests that the M2 money supply in both mainland China and Taiwan is quite responsive to developments in the other economy. While this cannot be proven to reflect deliberate policy responses, M2 did generally represent the target variable for both central banks over our sample period. To the extent that the reactions do represent planned policy actions, however, there is still no way to reliably separate direct responses to movements

¹⁹ The average sensitivities for the remaining mainland China variables are 19.41% for industrial production and 13.81% for M2.

in the other economy form indirect reactions whereby fluctuations abroad induce movements in domestic variables that the central bank is seeking to stabilize.

Given the apparent broad-based extent of the macroeconomic interdependence between mainland China and Taiwan, further research may well be warranted to better identify the extent to which this pattern reflects underlying economic integration as opposed to policy maker reactions. There are also some ambiguities as to the dependence of price and output measures on developments in the other economy that cannot be adequately resolved within the empirical work conducted so far. Granger-causality testing, correlations and variance decomposition analysis all point to strong bilateral ties between mainland China and Taiwan industrial production, for example, and yet no such sensitivity is evident in the impulse response analysis. This impulse response analysis did still suggest that transmission of industrial production shocks from one economy to the other took place – but these effects were being channeled through other variables. A more structural analysis of macroeconomic interdependence would be required to properly distinguish the linkages that underlie the pervasive, and significant, interactions identified in the present reduced-form analysis.

REFERENCES

- Bahng, Seungwook and Seung-Myo Shin (2004) "Interactions of Stock Markets within the Greater China Economic Bloc." *Global Economic Review* 33: 43-60.
- Burdekin, Richard C. K. (2006) "China and the Depreciating US Dollar." *Asia Pacific Issues*, No. 79, January [<http://www.eastwestcenter.org/stored/pdfs/api079.pdf>].
- Burdekin, Richard C. K. (2008) *China's Monetary Challenges: Past Experiences and Future Prospects*. New York: Cambridge University Press (forthcoming).
- Burdekin, Richard C. K. and Paul Burkett (1992) "The Impact of U.S. Economic Variables on Bank of Canada Policy: Direct and Indirect Responses." *Journal of International Money and Finance* 11 (April): 162-187.
- Burdekin, Richard C. K. and Pierre L. Siklos (2004) *Deflation: Current and Historical Perspectives*. New York: Cambridge University Press.
- Burdekin, Richard C. K. and Pierre L. Siklos (2008) "What Has Driven Chinese Monetary Policy Since 1990? Investigating the People's Bank's Monetary Rule." *Journal of International Money and Finance*, forthcoming.
- Burdekin, Richard C. K. and Hsin-hui I. H. Whited (2005) "Exporting Hyperinflation: The Long Arm of Chiang Kai-shek." *China Economic Review* 16: 71-89.
- Chang, Hui S. (2005) "Estimating the Monetary Policy Reaction Function for Taiwan: A VAR Model." *International Journal of Applied Economics* 2 (March): 50-61.
- Chen, Yongjun (2006) "Taiwan Cross-Strait Economic Relations in the Era of Globalization." In Shuming Bao, Shuanglin Lin and Changwen Zhao (eds.) *The Chinese Economy after WTO Accession*. Burlington, VT: Ashgate, pp. 335-350.

- Cheng, Hwahsin and John L. Glascock (2005) "Dynamic Linkages Between the Greater China Economic Area Stock Markets—Mainland China, Hong Kong, and Taiwan." *Review of Quantitative Finance and Accounting* 24 (June): 343-357.
- Cheung, Yin-Wong, Menzie D. Chinn and Eiji Fujii (2005) "Dimensions of Financial Integration in Greater China: Money Markets, Banks and Policy Effects." *International Journal of Finance and Economics* 10 (April): 117-132.
- Chi, Jing, Ke Li and Martin Young (2006) "Financial Integration in East Asian Equity Markets." *Pacific Economic Review* 11 (December): 513-526.
- Chow, Gregory C. (2006) "Globalization and China's Economic Development." *Pacific Economic Review* 11 (October): 271-285.
- Chow, Gregory C. (2007) *China's Economic Transformation*, Second Edition. Malden, MA: Blackwell Publishing.
- Cover, James Peery, C. James Hueng and Ruey Yau (2002) "Are Policy Rules Better than the Discretionary System in Taiwan?" *Contemporary Economic Policy* 20 (January): 60-71.
- Durdin, Tillman (1953) "China and the World." *Headline Series*, No. 99 (May 20): 3-49.
- Fung, K. C., Hitomi Iizaka and Alan Siu (2005) "The Giant Sucking Sound: Is China Diverting Foreign Direct Investment from East Asia and Latin America?" *HKCER Letters* (Hong Kong Centre for Economic Research), Vol. 81 (January-February) [<http://www.hku.hk/hkcer/letters.htm>].
- Geiger, Michael (2006) "Monetary Policy in China (1994-2004): Targets, Instruments and their Effectiveness." Würzburg Economic Papers, No. 68, April.
- He, Dong, Carmen Chu, Chang Shu and Amy Wong (2005) "Monetary Management in Mainland China in the Face of Large Capital Inflows." Hong Kong Monetary Authority Research Memorandum 07/2005, April.

- Hille, Kathrin (2006) "Taiwan Liberalises some Links with China." *Financial Times*, August 1
[<http://www.ft.com>].
- Hon, Chu Kam (2004) "Reflections on the New Taiwan Dollar Appreciation in the Mid 1980s." *HKCER Letters* (Hong Kong Centre for Economic Research), Vol. 79 (May-June)
[<http://www.hku.hk/hkcer/letters.htm>].
- Hsiao, Frank S. T. and Mei-Chu W. Hsiao (2001) "Capital Flows and Exchange Rates: Recent Korean and Taiwanese Experience and Challenges." *Journal of Asian Economics* 12 (Autumn): 353-381.
- Huang, Ho-Chuan (River) and Shu-Chin Lin (2006) "Time-Varying Discrete Monetary Policy Reaction Functions." *Applied Economics* 38 (March): 449-464.
- Lardy, Nicholas R. (2002) *Integrating China into the World Economy*. Washington, DC: Brookings Institution.
- Lin, Hwan C. (2005) "On Trade, Look East Instead of West." *Taipei Times*, June 30, p. 8
[<http://www.taipetimes.com>].
- Lin, Kenneth S. and Hsiu-Yun Lee (2002) "The Political Economy of Exchange Rate Regimes: Evidence from Hong Kong and Taiwan." *Asian Economic Journal* 16 (March): 1-15.
- Lockwood, Ben and Michela Redoano (2005) "The CSGR Globalisation Index: An Introductory Guide." Coventry, England: University of Warwick, Centre for the Study of Globalisation and Regionalisation, Working Paper 155/04.
- MacKinnon, James G., Alfred A. Haug and Leo Michelis (1999) "Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration." *Journal of Applied Econometrics* 14 (September-October): 563-577.
- Mainland Affairs Council, Executive Yuan (2006) *Cross-Strait Economic Statistics Monthly*, No. 158, January (Taipei, Taiwan).

- Ouyang, Alice Y., Ramkishen S. Rajan and Thomas D. Willett (2006) "China as a Reserve Sink: The Evidence from Offset and Sterilization Coefficients." Mimeo, Claremont Graduate University, October.
- Shen, Chung-Hua (2002) "The Choice of Intermediate Targets – Money or Interest Rate: The Case of Taiwan." In Gerald P. Dwyer, Jr., Jin-Lung Lin, Jia-Dong Shea and Chung-Shu Wu (eds.) *Monetary Policy and Taiwan's Economy*. Northampton, MA: Edward Elgar, pp. 147-166.
- Siddique, Abu (2006) "Globalization and Economic Development." In Yanrui Wu (ed.) *Economic Growth, Transition and Globalization in China*. Northampton, MA: Edward Elgar, pp. 214-238.
- Tung, Chen-Yuan (2004) "Economic Relations between Taiwan and China." UNISCI Discussion Papers (Madrid, Spain: Research Unit on International Security and Cooperation), No. 4, January [<http://www.ucm.es/info/unisci/TUNG4M.pdf>].
- United Nations Conference on Trade and Development (2006) *World Investment Report 2006—FDI from Developing and Transition Economies: Implications for Development*. New York and Geneva: United Nations [http://www.unctad.org/en/docs/wir2006_en.pdf].
- Wang, Steven Shuye and Michael Firth (2004) "Do Bears and Bulls Swim Across Oceans? Market Information Transmission between Greater China and the Rest of the World." *Journal of International Financial Markets, Institutions and Money* 14 (July): 235-254.
- Yang, Ya-Hwei and Jia-Dong Shea (2005) "Deflation and Monetary Policy in Taiwan." NBER Working Paper 11244 [<http://www.nber.org/papers/w11244>].
- Zhang, Kevin Honglin (2005) "Why Does So Much FDI from Hong Kong and Taiwan Go to Mainland China?" *China Economic Review* 16 (2005): 293-307.

Table 1: The Level of Cross-Strait Trade between Taiwan and Mainland China

	Taiwan Exports to Mainland China	Mainland China Exports to Taiwan	Total Bilateral Trade
1985	\$ 986.8	\$ 115.9	\$ 1,102.7
1986	811.3	144.2	955.5
1987	1,226.5	288.9	1,515.4
1988	2,242.2	478.7	2,720.9
1989	3,331.9	586.9	3,918.8
1990	4,394.6	765.4	5,160.0
1991	7,493.5	1,125.9	8,619.4
1992	10,547.6	1,119.0	11,666.6
1993	13,993.1	1,103.6	15,096.7
1994	16,022.5	1,858.7	17,881.2
1995	19,433.8	3,091.4	22,525.2
1996	20,727.3	3,059.8	23,787.1
1997	22,455.2	3,915.4	26,370.6
1998	19,840.9	4,110.5	23,951.4
1999	21,312.5	4,522.2	25,834.7
2000	25,009.9	6,223.3	31,233.1
2001	24,061.3	5,902.0	29,963.3
2002	31,528.8	7,968.6	39,497.4
2003	38,292.7	11,017.9	49,310.6
2004	48,930.4	16,792.3	65,722.7
2005	56,275.9	20,093.7	76,369.6

Notes: Figures are in \$US millions and are based on estimates by Taiwan's Mainland Affairs Council that include transit trade between Taiwan and Mainland China via Hong Kong

Source: *Cross-Strait Economic Statistics Monthly* (Taipei, Taiwan), No. 158, January 2006, p. 26.

Table 2: Cross-Strait Trade Relative to Taiwan and Mainland China's Overall World Trade

	Taiwan's Trade Balance with Mainland China	Taiwan's Trade Balance with the Rest of the World	Cross-Strait Trade as Share of Total Taiwan Trade	Cross-Strait Trade as Share of Total Mainland China Trade
1985	\$ 870.9	\$10,623.7	2.17%	1.58%
1986	667.1	15,680.0	1.49	1.29
1987	937.6	18,695.3	1.71	2.06
1988	1,763.5	10,994.6	2.47	2.65
1989	2,745.0	14,038.6	3.31	3.51
1990	3,629.2	12,498.4	4.23	4.47
1991	6,367.6	13,420.7	6.17	6.35
1992	9,428.6	9,769.7	7.55	7.05
1993	12,889.5	8,564.0	9.24	7.71
1994	14,163.8	8,602.5	9.93	7.55
1995	16,342.4	9,330.5	10.36	8.02
1996	17,667.5	14,658.6	10.79	8.21
1997	18,539.8	9,214.8	11.03	8.11
1998	15,730.4	7,365.6	11.00	7.39
1999	16,790.3	12,537.3	11.00	7.16
2000	18,786.6	11,217.8	10.67	6.60
2001	18,159.3	18,343.7	12.79	5.88
2002	23,560.2	22,070.2	15.89	6.36
2003	27,274.8	22,590.3	17.70	5.79
2004	32,138.1	13,613.5	18.72	5.69
2005	36,182.2	15,818.6	20.04	5.37

Notes: Figures in the first two columns are in \$US millions and the third and fourth columns are in percentages. Bilateral trade statistics are based on estimates by Taiwan's Mainland Affairs Council that include transit trade between Taiwan and Mainland China via Hong Kong

Source: *Cross-Strait Economic Statistics Monthly* (Taipei, Taiwan), No. 158, January 2006, pp. 27-29.

Table 3: Taiwan Remittances to and from Mainland China, 1997-2005

	Taiwan Remittances to Mainland China	Growth Rate	Mainland China Remittances to Taiwan	Growth Rate
1997	\$ 758.8	14.03%	\$ 210.8	123.57%
1998	729.2	-3.90	293.7	39.32
1999	843.5	15.68	509.0	73.34
2000	1,208.6	43.29	770.3	51.33
2001	1,700.1	40.67	1,250.0	62.27
2002	2,519.9	48.22	2,254.5	80.36
2003	6,076.5	141.14	6,022.2	167.12
2004	10,677.3	75.71	14,656.7	143.38
2005	18,183.9	70.31	23,846.4	62.70

Notes: Figures in the first and third columns are in \$US millions and the second and fourth columns are in percentages.

Source: *Cross-Strait Economic Statistics Monthly* (Taipei, Taiwan), No. 158, January 2006, p. 34.

Table 4: Means, Standard Deviations and Correlations with Data in Growth Rate Form

Chinese variables:

	C_IP	C_CPI	C_PPI	C_M2	C_M1	C_S
Mean	14.99	3.22	-1.52	18.95	16.88	11.91
Standard Deviation	10.38	5.80	4.05	6.15	4.48	29.82

Taiwanese variables:

	T_IP	T_CPI	T_WPI	T_M2	T_M1A	T_M1B	T_S
Mean	4.92	1.19	1.34	7.36	5.98	9.44	12.88
Standard Deviation	7.63	1.37	4.80	2.58	9.02	7.96	27.69

Correlation Table:

	C_IP	C_CPI	C_PPI	C_M2	C_M1	C_S	T_IP	T_CPI	T_WPI	T_M2	T_M1A	T_M1B	T_S
C_IP	1												
C_CPI	-0.19	1											
C_PPI	0.66	-0.34	1										
C_M2	-0.20	0.79	-0.52	1									
C_M1	0.25	0.33	0.12	0.40	1								
C_S	-0.27	0.06	-0.16	0.01	0.37	1							
T_IP	0.24	0.02	0.24	0.01	0.36	0.12	1						
T_CPI	-0.39	0.73	-0.47	0.49	0.00	0.24	-0.07	1					
T_WPI	0.27	0.46	0.10	0.14	0.26	-0.13	0.19	0.23	1				
T_M2	-0.46	0.65	-0.39	0.54	0.19	0.36	0.06	0.71	0.11	1			
T_M1A	0.62	-0.07	0.51	-0.10	0.44	0.00	0.68	-0.23	0.35	-0.13	1		
T_M1B	0.40	-0.13	0.36	-0.04	0.43	0.04	0.67	-0.33	0.14	-0.14	0.90	1	
T_S	0.11	0.02	0.01	0.15	0.52	0.42	0.59	-0.02	-0.06	0.22	0.66	0.75	1

Notes:

- C_Y and T_Y refer to mainland China and Taiwan industrial production
- C_CPI and T_CPI refer to mainland China and Taiwan consumer price indices
- C_PPI and T_WPI refer to mainland China and Taiwan producer price and wholesale price indices
- C_M1, T_M1A and T_M1B refer to mainland China and Taiwan narrow money supplies
- C_M2 and T_M2 refer to mainland China and Taiwan broad money supplies and
- C_S and T_S refer to mainland China and Taiwan stock market indices

Data sources are noted in the body of the paper and all series are expressed as year-to-year growth rates

Table 5: Granger-Causality Between Taiwan and China Variables

Null Hypothesis:	F-Statistic	Probability
T_Y does not Granger Cause C_Y	5.43293	0.00545
C_Y does not Granger Cause T_Y	28.76580	5.00E-11
T_CPI does not Granger Cause C_CPI	12.56710	10.E-05
C_CPI does not Granger Cause T_CPI	5.60818	0.00463
T_WPI does not Granger Cause C_PPI	0.01298	0.98710
C_PPI does not Granger Cause T_WPI	1.095670	0.33745
T_M1A does not Granger Cause C_M1	17.02400	2.80E-07
C_M1 does not Granger Cause T_M1A	9.11325	0.0002
T_M1B does not Granger Cause C_M1	15.20790	1.20E-06
C_M1 does not Granger Cause T_M1B	5.58614	0.00473
T_M2 does not Granger Cause C_M2	7.35183	0.00095
C_M2 does not Granger Cause T_M2	6.65427	0.00179
T_S does not Granger Cause C_S	0.98484	0.37622
C_S does not Granger Cause T_S	0.77853	0.46126
T_M2 does not Granger Cause C_M1	8.41077	0.00037
C_M1 does not Granger Cause T_M2	10.58760	5.60E-05
T_M1A does not Granger Cause C_M2	15.06900	1.30E-06
C_M2 does not Granger Cause T_M1A	7.25695	0.00104
T_M1B does not Granger Cause C_M2	10.07000	8.70E-05
C_M2 does not Granger Cause T_M1B	4.91217	0.00881
T_CPI does not Granger Cause C_M2	18.77680	7.20E-08
C_M2 does not Granger Cause T_CPI	1.77745	0.17325
T_Y does not Granger Cause C_M1	0.03866	0.96209
C_M1 does not Granger Cause T_Y	18.94300	6.30E-08

T_Y does not Granger Cause C_M2	10.95710	4.10E-05
C_M2 does not Granger Cause T_Y	5.40058	0.00561

T_M1A does not Granger cause C_CPI	2.98119	0.05429
C_CPI does not Granger Cause T_M1A	0.96619	0.38331

T_S does not Granger Cause C_PPI	2.55097	0.082
C_PPI does not Granger Cause T_S	0.49896	0.60834

T_Y does not Granger Cause C_PPI	0.13960	0.86984
C_PPI does not Granger Cause T_Y	7.67532	0.00071

T_CPI does not Granger Cause C_Y	6.17693	0.00275
C_Y does not Granger Cause T_CPI	2.64906	0.07462

T_M1A does not Granger Cause C_Y	88.9482	7.00E-25
C_Y does not Granger Cause T_M1A	0.5796	0.5616

T_M1B does not Granger Cause C_Y	40.95010	1.90E-14
C_Y does not Granger Cause T_M1B	0.12004	0.88698

T_M2 does not Granger Cause C_Y	33.06100	2.80E-12
C_Y does not Granger Cause T_M2	0.44482	0.64194

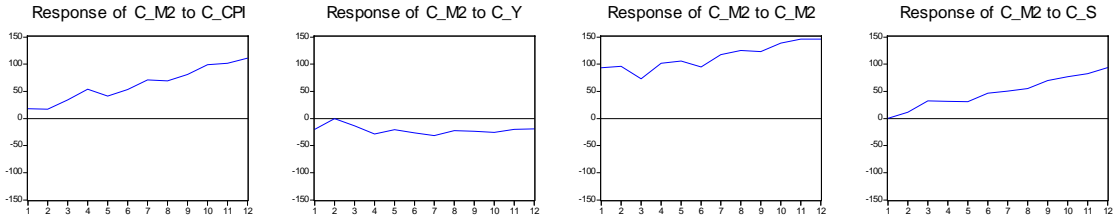
Notes:

All data series are in percentage change form to assure stationarity

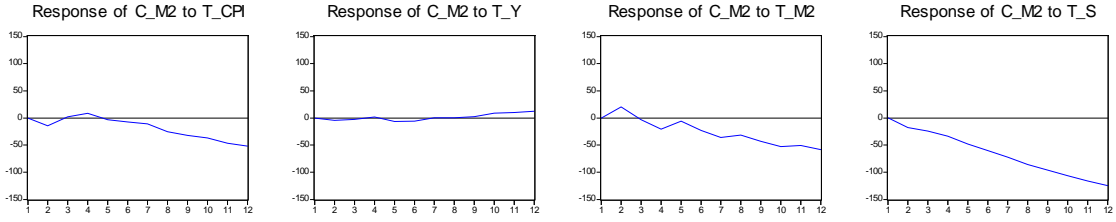
Figure 1: Plots of Impulse Responses



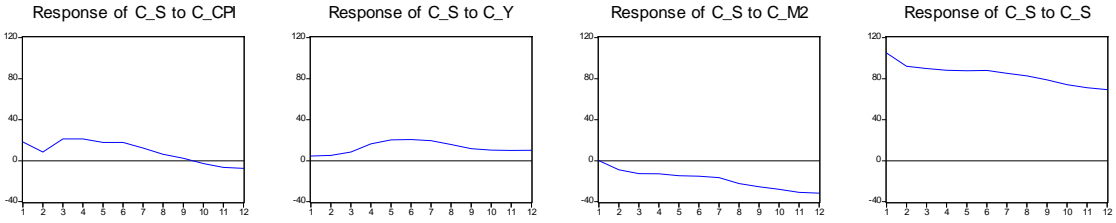
Response to Cholesky One S.D. Innovations



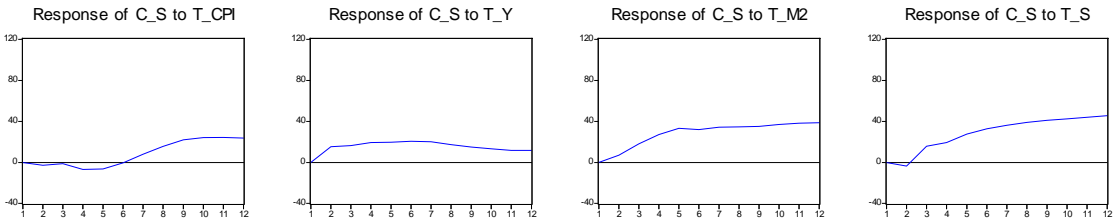
Response to Cholesky One S.D. Innovations



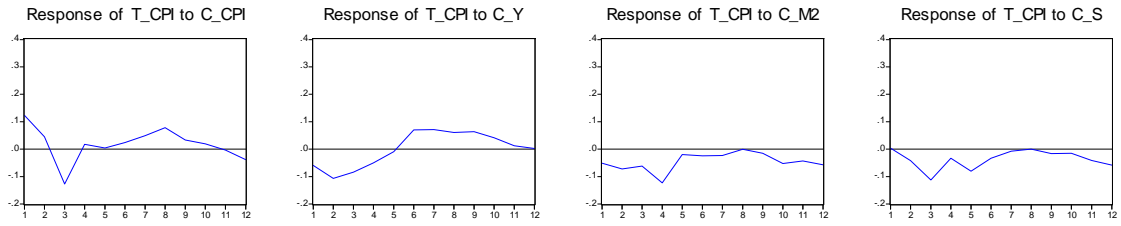
Response to Cholesky One S.D. Innovations



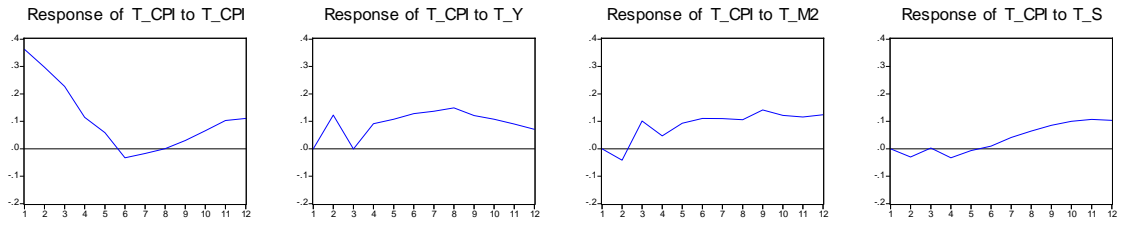
Response to Cholesky One S.D. Innovations



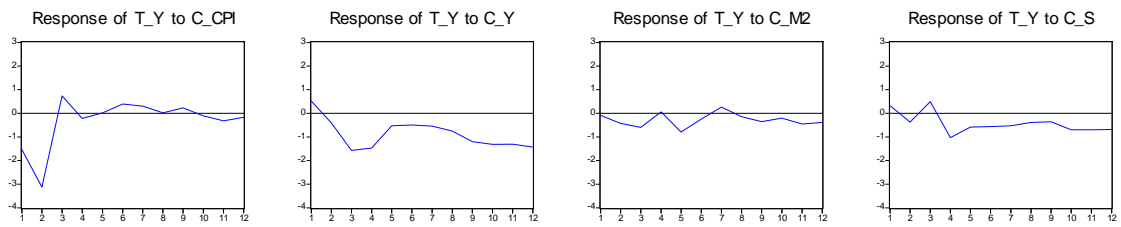
Response to Cholesky One S.D. Innovations



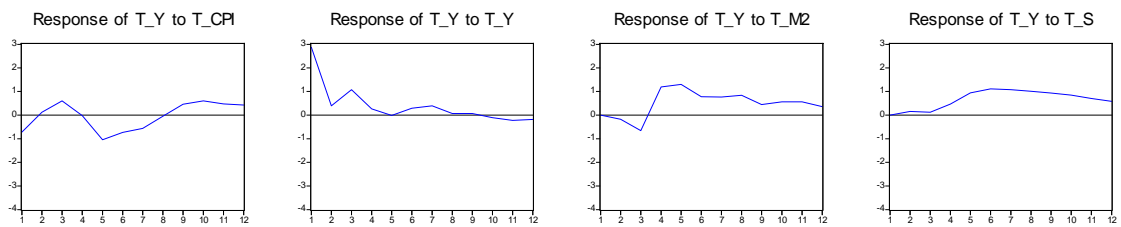
Response to Cholesky One S.D. Innovations



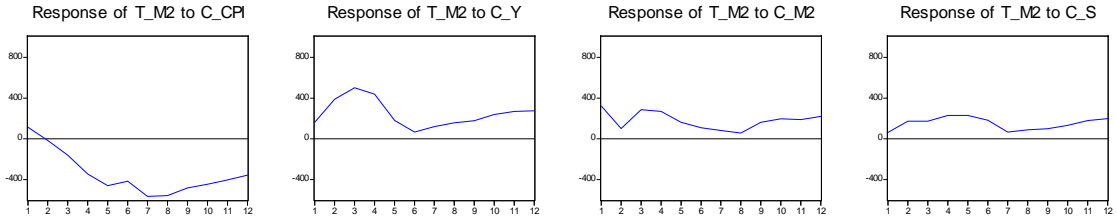
Response to Cholesky One S.D. Innovations



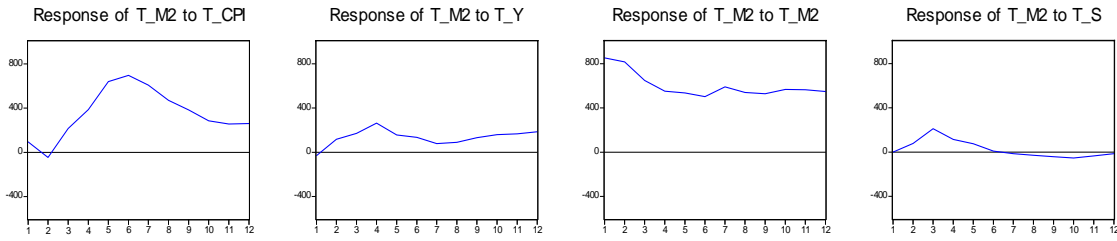
Response to Cholesky One S.D. Innovations



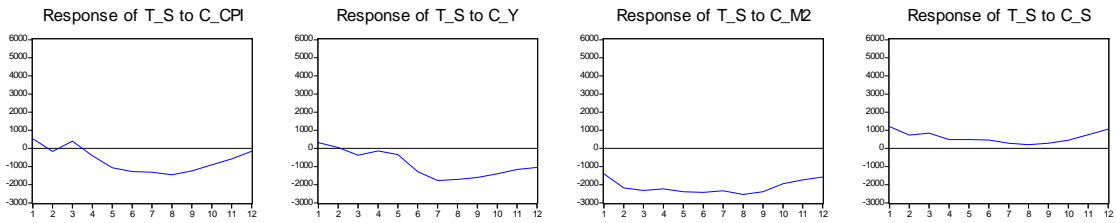
Response to Cholesky One S.D. Innovations



Response to Cholesky One S.D. Innovations



Response to Cholesky One S.D. Innovations



Response to Cholesky One S.D. Innovations

