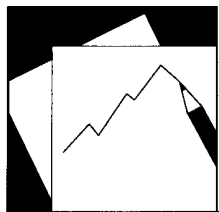


# Working Paper

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INTERNATIONAL MONETARY FUND



# IMF Working Paper

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## From West to East: Estimating External Spillovers to Australia and New Zealand

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**IMF Working Paper**

Asia and Pacific Department

**From West to East: Estimating External Spillovers to Australia and New Zealand**

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Authorized for distribution by Ray Brooks

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**Abstract**

This paper examines the size and source of external spillovers to Australia and New Zealand based on a structural vector autoregression (VAR) approach. It finds that during the last decade shocks from emerging Asia have become more important than those from the United States in affecting Australia's business cycle. A 1 percent shock to emerging Asia's growth is found to shift Australian growth by about  $\frac{1}{3}$  percent. Furthermore, there is evidence that commodity prices dominate the transmission of shocks from emerging Asia to Australia. The influence of emerging Asia on New Zealand is found to come indirectly through Australia, with Australian shocks transmitting almost "one-on-one" to New Zealand, largely through financial factors.

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**This Working Paper should not be reported as representing the views of the IMF.**

The views expressed in this Working Paper are those of the author and do not necessarily represent those of the IMF or IMF policy. Working Papers describe research in progress by the author and are published to elicit comments and to further debate.

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## I. INTRODUCTION

**The last decade has witnessed fast growing links between Australia and New Zealand and their emerging Asia neighbors.** Robust demand for commodities from emerging Asia has helped boost commodity prices, sending Australia's terms of trade to record highs. A glimpse of the two countries' direction of trade statistics also reveals that emerging Asia has become a top market of their exports dominated by commodities during the last decade. At the same time, emerging Asia has supplied about half of Australia's imports and 40 percent of New Zealand's by 2010 (Figure 1).<sup>2</sup> This transformation is more pronounced for Australia than New Zealand.



**This paper quantifies the nature of external shocks to Australia and New Zealand, considering both size and source.** It attempts to investigate if and how an increasingly intimate economic relationship with emerging Asia has led to business cycle synchronization. We employ the vector autoregressive (VAR) approach introduced by Bayoumi and Swiston (2008 and 2009) that allows one to take account of interactions among major regions in determining the external linkages of Australia and New Zealand. The approach also allows for a decomposition of real growth spillovers into various transmission channels including trade, financial, and commodity prices. However, our analysis is constrained by a relatively small sample (1991–2010) due to the unavailability of some emerging Asia data prior to the 1990s.

**We find that, during the last decade, shocks from emerging Asia have overtaken those from the United States to be the most important external factor influencing Australia's business cycle.**

- For the whole sample period of 1991–2010, a 1 percent shock to U.S. GDP is found to move Australian growth by around 0.4 percent. In contrast, shocks from emerging Asia have an almost negligible impact on Australian growth. This result changes dramatically when limiting the sample size to 2000–10. During the last decade, a 1 percent shock to emerging Asia's growth is found to shift Australian growth by  $\frac{1}{3}$  percent, while the impact of U.S. shocks on Australia is no longer statistically significant.

<sup>2</sup> See C. Becker and M. Davies (2002) and V. Zhang (2009) for discussions on the changing trade patterns of Australia and New Zealand.

- In contrast, shocks from emerging Asia are found to not have much of an impact on New Zealand's business cycle. Rather, New Zealand's GDP is most responsive to shocks from Australia, its single most important trade and financial partner. The responsiveness has strengthened to almost "one-to-one" during the last decade.

**The decomposition of transmission channels confirms the importance of commodity prices in transmitting shocks from emerging Asia to Australia.** We find that commodity prices can explain half of the total spillovers from emerging Asia to Australia, while trade and financial channels play similar roles. We also find that financial factors have accounted for most of the spillovers from the United States to Australia and from Australia to New Zealand. Further research in this area is clearly warranted, given our small sample size and rather simple treatment of transmission channels.

**This paper contributes to the growing literature on international spillovers from a rising economic power house of emerging Asia, including notably China.** Arora and Vamvakidis (2010) estimated that China's growth spillovers to the rest of the world, both short term and long term, have increased in recent decades. Hunt (2010) found that roughly 25 percent of Australia's growth over the last decade came from emerging Asia's growth differential over the world average. Australia's growth dividend going forward is likely to remain sizeable should growth in emerging Asia remain strong. Developing a world input-output table, Gillmore and Briggs (2010) demonstrated the importance of Chinese and Australian demand for New Zealand.

**The rest of the paper is organized as follows:** Section II discusses methodology and data, Section III analyzes external spillovers to Australia and New Zealand, and Section IV discusses transmission channels. The last section concludes.

## II. METHODOLOGY AND DATA

**We employ a standard VAR framework containing quarterly real GDP growth to analyze external spillovers to Australia and New Zealand.** External shocks to the two countries in question could originate from major economies in the world or global shocks. The VAR framework allows for interactions among these potential candidates of shocks, thus pinning down the effects of each shock to its appropriate source.

**The VAR system includes three major economies in addition to Australia and New Zealand.** The three regions are: (i) the United States; (ii) emerging Asia (including China, India, Indonesia, Malaysia, Philippines, Thailand, Hong Kong SAR, Korea, Singapore, and Taiwan Province of China); and (iii) the rest of the world (including the Euro area, Japan, U.K., and all other economies in the IMF's Global Projection Model).<sup>3</sup> The aggregate growth rate of emerging Asia is calculated using PPP-based GDP as weights. The rest of the world ("ROW" thereafter), which covers a set of countries with large economic and geo-political

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<sup>3</sup> These countries are Latin America (Brazil, Chile, Mexico, Colombia, and Peru), Argentina, Bulgaria, Canada, Denmark, Estonia, Israel, Norway, Russia, South Africa, Sweden, Switzerland, Turkey, and Venezuela.

diversity, captures global shocks that do not originate from either the United States or emerging Asia and controls for the possibility that business cycle co-movement between two regions may well reflect their similar responses to global shocks rather than spillovers between themselves. PPP-based GDP weights are also used to construct the aggregate growth rates of ROW.<sup>4</sup>

**Cholesky decompositions (i.e., standard recursive ordering) are used to identify sources of contemporaneous correlation among the five regions and countries.** While it is reasonable to put Australia and New Zealand as the last two, relative orderings among the United States, emerging Asia, and ROW are not straightforward. Therefore, this paper investigates all six ordering possibilities.<sup>5</sup> As shown below, different orderings among the three large economies do not change much estimated spillovers from each major economy to Australia and New Zealand,<sup>6</sup> although the orderings do affect estimated spillovers across the three regions themselves. Discussions below focus on external spillovers to Australia and New Zealand averaged across six VARs.<sup>7</sup> This “averaging” approach is supported by an emerging consensus that no single model outperforms an average across a range of models, unless the “preferred” single model happens to capture the true data generation process.

**As quarterly GDP series for China are available only from the 1990s, data in this paper span from 1991 to 2010.** Since various lag criteria tests suggest one lag to be sufficient, results shown below are based on a single lag. Similar results hold with four lags (a conventional choice for quarterly data), although their statistical significance is reduced owing to limited sample period and decreased degrees of freedom.<sup>8</sup>

### III. EXTERNAL SPILLOVERS TO AUSTRALIA AND NEW ZEALAND

#### A. Full Sample Period of 1991–2010

**Spillovers from the United States to Australia are found to be of economic and statistical significance.** Figure 2 shows that Australia’s accumulated impulse responses to 1 percent shocks of the United States, emerging Asia, and ROW are quite similar across different VAR orderings. Notably:

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<sup>4</sup> Using equal weights does not affect much of the paper’s results. Furthermore, limiting the coverage of ROW to a few small industrial countries, as done in Bayoumi and Swiston (2007), yields similar results. These results are available upon request.

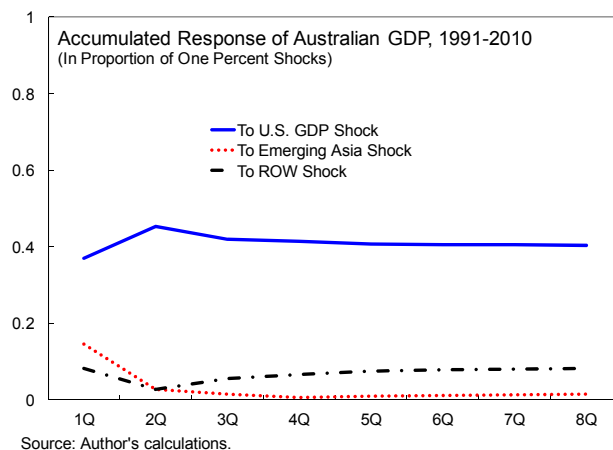
<sup>5</sup> They are: (1) USA, EAS, ROW; (2) USA, ROW, EAS; (3) EAS, USA, ROW, (4) EAS, ROW, USA; (5) ROW, USA, EAS; and (6) ROW, EAS, USA.

<sup>6</sup> This could be a natural result of the decomposition and ordering method.

<sup>7</sup> Owing to the lag effects of Australia and New Zealand on emerging Asia, the United States, and ROW, our analysis could potentially over-estimate the spillovers. However, these over-valuation effects should be minor as we already control for the source of contemporaneous shocks and the lag effects are small.

<sup>8</sup> Results are available upon request.

- The response of Australian growth to a 1 percent U.S. shock is about 0.4 percent.
- The impulse response of Australian growth to a 1 percent shock from emerging Asia is only statistically significant and sizeable at the first quarter. The accumulated response quickly becomes negligible from the second quarter. The response of Australian growth is only one-sixth of the original shock for the first quarter.
- A 1 percent shock to ROW growth has negligible impacts on the growth of Australia—accumulated impulse responses are not statistically different from zero for all eight quarters.



**As expected, the most important external factor for New Zealand is found to come from Australia.** Spillovers from growth shocks in the United States, emerging Asia, or ROW to New Zealand are estimated to be statistically insignificant (Figure 3). In contrast, New Zealand's response to a 1 percent shock of Australian growth rises from 0.3 percent initially to 0.6 percent over two years.

**The variance decomposition of Australian and New Zealand's growth disturbances averaged across six VARs is presented in Table 1.** About a quarter of Australia's growth variability can be attributed to external factors,  $\frac{2}{3}$  of which stem from the United States. External factors only explain about 10 percent of New Zealand's growth volatility, with shocks from Australia accounting for close to half of the total external variability.

Table 1. Average Variance Decompositions of Real GDP

Forecast variable	Share explained by	Share explained after eight quarters	
		1991-2010	2000-2010
Australia	United States	15.7	5.7
	Emerging Asia	5.4	13.9
	Rest of world	1.6	1.3
	Australia	77.3	77.0
	New Zealand	0.0	2.1
New Zealand	United States	2.4	4.4
	Emerging Asia	2.1	1.0
	Rest of world	1.8	4.9
	Australia	4.6	16.0
	New Zealand	89.0	73.7

Source: author's calculations.

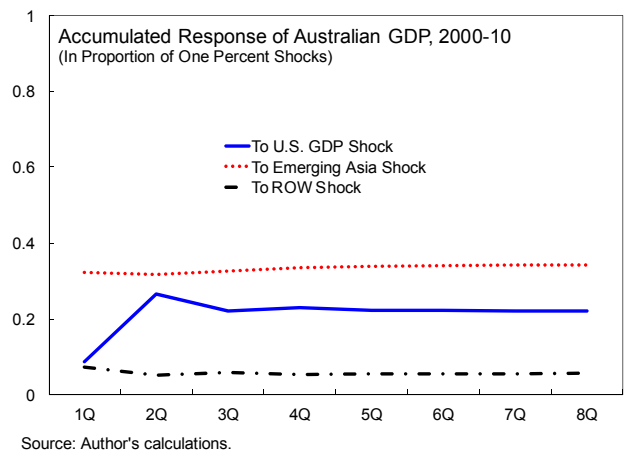


## B. Sub-Sample Period of 2000–10

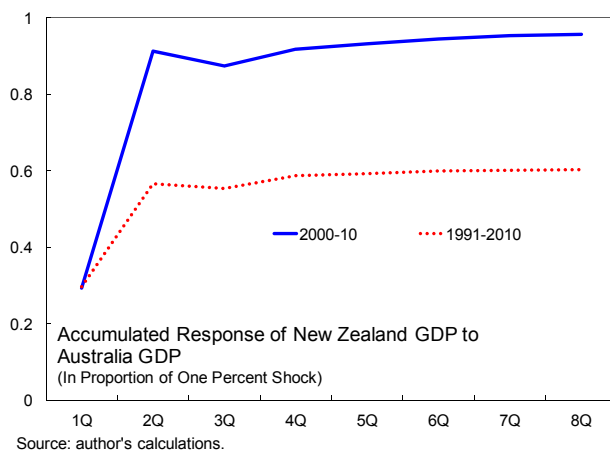
**The fact that emerging Asia’s economic rise accelerated during the last decade carries with it a presumption that emerging Asia’s external spillovers to Australia and New Zealand may have increased.** To test this hypothesis, the VAR system is estimated for a sub-sample period of 2000–10.

**Shocks from emerging Asia have become more important than those from the United States in explaining Australia’s growth variability (Figure 4).**

- GDP shocks of emerging Asia have an immediate and sizeable impact on Australia’s growth regardless of the VAR orderings. The accumulated impulse responses of Australia’s growth to a 1 percent shock from emerging Asia are statistically significant for all eight quarters, with the average response across the six VARs at  $\frac{1}{3}$  percent. This response is bigger and lasts longer than estimated above for the full sample period.
- The importance of U.S. shocks in explaining Australian growth volatility drops well below that of emerging Asia. Moreover, the significance of U.S. spillovers depends on the VAR orderings. Only when the United States is ranked before emerging Asia and only for the first three quarters are spillovers from the United States to Australia statistically significant.
- GDP shocks of ROW have negligible impacts on Australia’s growth variability.



**Australia’s importance to New Zealand is estimated to have become even more pronounced in recent years.** New Zealand’s accumulated response to a 1 percent Australian shock is estimated to be almost “one-to-one” (Figure 5). This response is larger than estimated above for the whole sample period, suggesting Australia’s growing importance for New Zealand. Spillovers from the other three major economies are found to remain



insignificant for New Zealand.<sup>9</sup> This suggests that emerging Asia's spillovers to New Zealand may have come indirectly through Australia, the dominant trade and financial partner for New Zealand. Using a factor augmented VAR approach, Karagedikli and Thorsrud (2010) found that Oceania regional activity and price shocks are important for some of New Zealand's main economic variables such as short-term interest rates. But they also found that world shocks have significant effects on both the Oceania region and New Zealand economy.<sup>10</sup>

**The sub-sample may not capture increasing spillovers from emerging Asia to New Zealand, given that trade integration between the two has accelerated recently.** In particular, New Zealand exports to China have almost doubled in the past two years since a 2008 free trade deal between the two countries. Should this trend continue going forward, one would expect shocks from emerging Asia to become more relevant for New Zealand's business cycle.

**Variance decomposition for the sub-sample period suggests a few interesting developments** (Table 1). First, it confirms emerging Asia's increasing importance for Australia in recent years. External factors still account for about ¼ of Australian growth variability.<sup>11</sup> However, compared to the full sample period, the importance of shocks from the United States vs. those from emerging Asia flipped, with emerging Asia's shocks now explaining 60 percent of Australian total external volatility. Second, external shocks have contributed to about ¼ of New Zealand's growth volatility, up from 10 percent for the whole sample period. Australian shocks dominated the external factors with a contribution of 60 percent, up from the 50 percent estimated for the whole sample period.

**Given likely co-integration among the five regions' GDP paths, a VEC model is used to cross check the above results obtained from the VAR system containing growth rates.** For both full sample and sub-sample, tests suggested one co-integration equation. We found similar results as in the VAR.<sup>12</sup>

#### IV. TRANSMISSION CHANNELS

**This section attempts to examine how external shocks are transmitted to Australia and New Zealand.** We focus on three potential channels: trade, commodity prices, and financial

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<sup>9</sup> Even when Australia is excluded from the VAR, shocks from emerging Asia are not found to have much of an impact on New Zealand.

<sup>10</sup> Using a time-series analysis of New Zealand growth over 120 years, Bordo and others (2009) found that global factors such as shocks to U.S. real GDP and shocks to the terms of trade have significant impact on New Zealand's medium-term growth.

<sup>11</sup> P. Liu (2010) found that international factors contribute to over half of the output forecast errors for Australia. Other studies show a wide range of estimates from 5 percent to over 50 percent.

<sup>12</sup> Results are available upon request.

conditions. The basic VAR system containing growth rates is augmented by adding exogenous variables representing each channel.<sup>13</sup> Assuming that the three channels are independent from each other and given our limited sample period, variables representing different channels are added separately to the base VAR.<sup>14</sup> The difference between the response of growth excluding (i.e., the base VAR) and including each channel (i.e., the augmented VAR) is used to calculate spillovers through one particular channel. The sum of spillovers from three channels is not constrained to equal to the total spillovers estimated in the base VAR, hence providing a cross check on the estimated magnitude of total spillovers.

**The three transmission channels are measured as follows.** All variables enter the base VAR with contemporaneous and one-lagged values. To save degrees of freedom and given that shocks from ROW are found to have negligible spillovers to Australia and New Zealand, ROW is excluded from the VAR system in this section.

- The export contribution to GDP growth of each economy is used to represent the trade channel.<sup>15</sup>
- The financial channel is captured by short-term nominal interest rates, long-term nominal interest rates (10-year government bond yields), and equity prices (deflated by a country's GDP deflator and expressed in quarterly percentage changes). New Zealand's financial variables are not included in the augmented VAR because they are not expected to affect other regions' financial conditions. As Australia has limited amount of government debt outstanding, its 10-year swap rates are used to represent long-term interest rates.
- The quarterly percentage changes of the real ANZ Commodity Price Index and RBA Commodity Price Index are used to represent the commodity price channel.

**A few caveats are warranted.** First of all, our analysis on transmission channels is not meant to be comprehensive. Given that the economic structure of emerging Asia has been changing rapidly, channels for transmitting shocks from emerging Asia to Australia and New Zealand could shift over time. Moreover, there may be other possible transmission channels that are not captured here but are correlated to the three channels. Third, as the augmented VAR approach does not do a good job at identifying sources of domestic disturbances, this paper focuses on international transmission channels. For example, Buckle and others (2007) found that climate shocks are an important source of New Zealand business cycle

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<sup>13</sup> This paper closely follows Bayoumi and Swiston (2008 and 2009), where detailed discussions of this approach can be found.

<sup>14</sup> While the possible collinearity among various channels tends to overstate the total spillover, the results can be seen as a gauge of the relative importance of each channel.

<sup>15</sup> Both trade and financial aggregates for emerging Asia are calculated using PPP-based GDP as weights.

fluctuations.<sup>16</sup> But our analysis does not include weather-related shocks given the focus on international spillovers. As discussed in Bayoumi and Swiston (2009) and also confirmed in this paper, the augmented VAR approach fits better for spillovers across regions, particularly where spillovers are of economic and statistical significance. Finally, there is a question whether the three transmission channels can enter the VAR as exogenous variables. But the small sample size in this paper makes treating them as endogenous variables difficult. More work needs to be done on identifying the sources of growth shocks to each major region so as to better pin down different spillover channels.

**For the full sample period, our decomposition yields a fairly good fit in explaining spillovers from the United States to Australia and from Australia to New Zealand.** The three channels—trade, financial, and commodity prices—can explain almost 100 percent of the total estimated spillovers.

- The U.S. spillovers to Australia are transmitted mostly through financial variables, given the dominant influence of the United States in global financial markets and Australia’s status as a net “capital” importer (Figure 6). The share of Australia’s exports to the United States in total has dropped from 10 percent in 2000 to below 5 percent in 2010. Despite Australia being a major commodity exporter, commodity prices are not found to be an important source of spillovers from the United States to Australia. Coincidentally, Bayoumi and Swiston (2008) did not find commodity prices to be a main transmission channel for spillovers from the United States to Mexico, an oil exporting country. They also found that spillovers from the United States are mostly transmitted through financial variables.
- Spillovers from Australia to New Zealand are also found to transmit mostly through the financial channel (Figure 7). This likely reflects the correlation of financial conditions in the two countries, given that they are both inflation-targeting countries with flexible exchange rates and open capital accounts subject to swings in capital flows. New Zealand’s financial system is also dominated by the four subsidiaries of Australian parent banks.

**There is evidence of the dominance of commodity prices in transmitting shocks from emerging Asia to Australia during the last decade.** Given the small sample size and limited degrees of freedom, our decomposition results for the sub-sample period should be seen as tentative and further research in this area is warranted.

- The three channels can explain about 85 percent of the estimated spillovers from emerging Asia to Australia, with trade, commodity prices, and financial variables each accounting for 25 percent, 40 percent, and 20 percent respectively (Figure 8). This result is consistent with developments during the last decade—emerging Asia

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<sup>16</sup> See Nimark (2007) for a structural model on Australia.

has become the largest export market for Australia and its ever rising commodity demand has significantly boosted Australia's terms of trade.

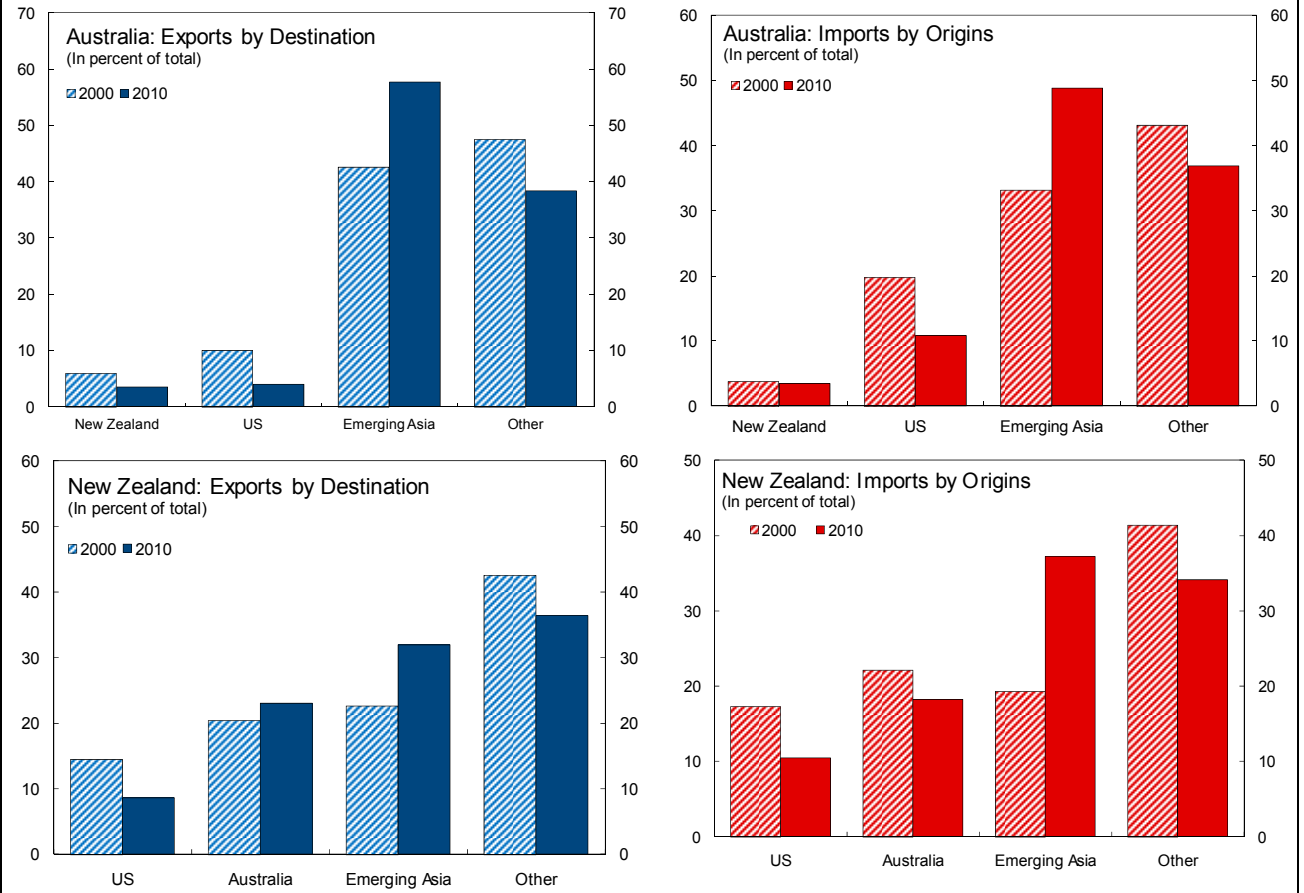
- Financial variables still dominate the transmission channels, explaining half of the spillovers from Australia to New Zealand (Figure 9). However, the analysis does not generate a fit as good as for the full sample period—the three channels explain only  $\frac{2}{3}$  of the estimated spillovers from Australia to New Zealand. In other words, our decomposition does not do a very good job explaining the increase in spillovers from Australia to New Zealand during the last decade.

## V. CONCLUDING REMARKS

**This paper finds that shocks from emerging Asia have become more important than those from the United States in affecting Australia's business cycle.** Furthermore, commodity prices are found to dominate the transmission of shocks from emerging Asia to Australia. The influence of emerging Asia on New Zealand is found to come indirectly through Australia, with Australian shocks transmitting almost “one-on-one” to New Zealand, largely through the financial channel. However, further analysis to quantify increasing integration and shock transmission between emerging Asia and Australia and New Zealand is warranted, given this paper's small sample constraint and ongoing structural changes in those economies.

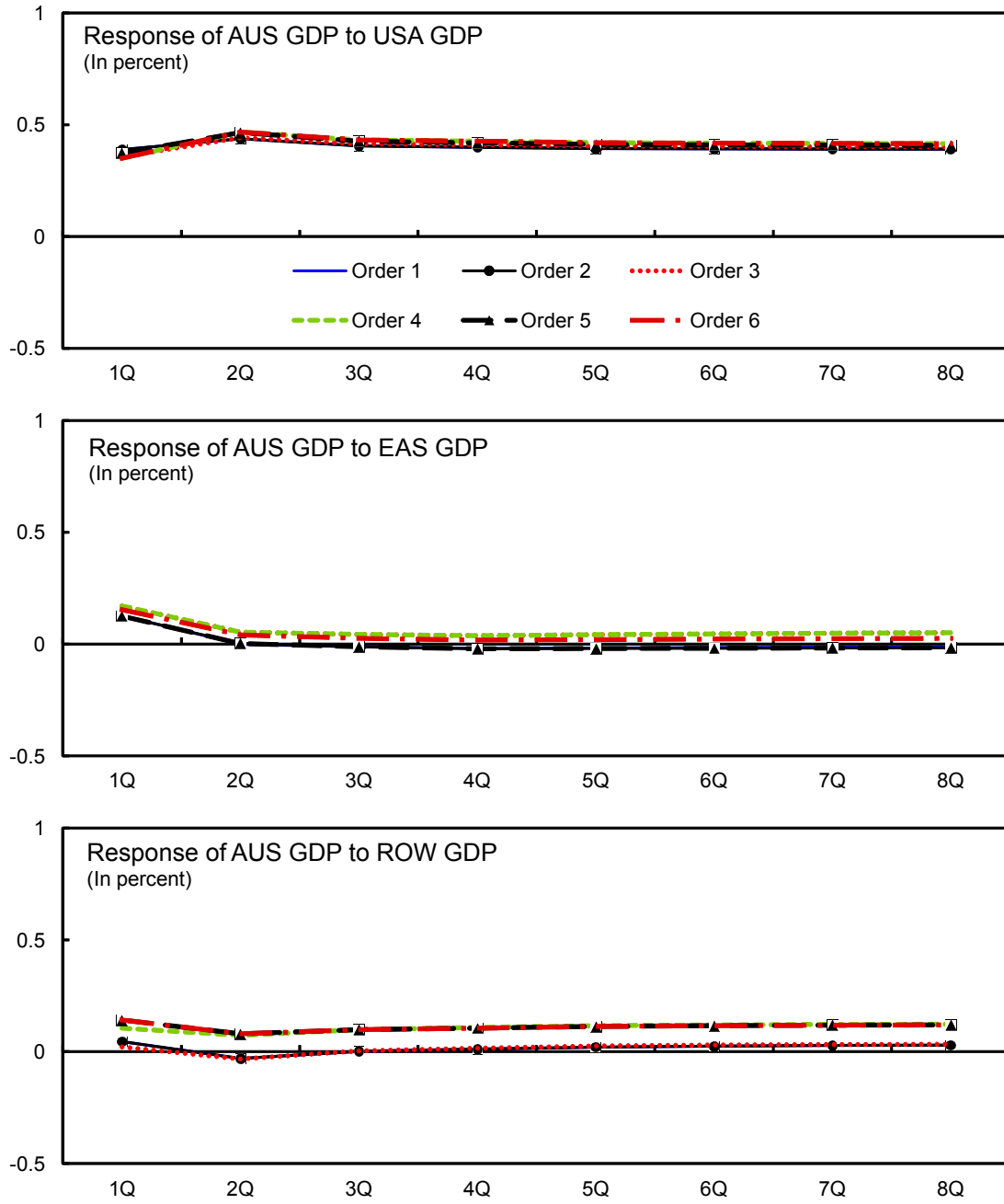
**The increasing ties with fast-growing emerging Asia present both opportunities and challenges.** This implies higher long-run growth as well as larger exposure to cyclical swings, particularly related to commodity prices and terms of trade. To reap the benefits while minimizing potential pitfalls, policymakers in both countries should be conscious of the need to support market-based domestic resource re-allocation and to continue implementing counter-cyclical policies to maintain macroeconomic stability. This implies more government saving during boom years to build a buffer for future shocks, including a possible sharp fall in commodity prices. Given the evidence of New Zealand's increasing business cycle synchronization with Australia, continued close policy coordination between the two countries, particularly in the financial sector such as supervision and crisis management, will also be helpful.

Figure 1. Australia and New Zealand Direction of Trade



Sources: Haver; and author's calculations.

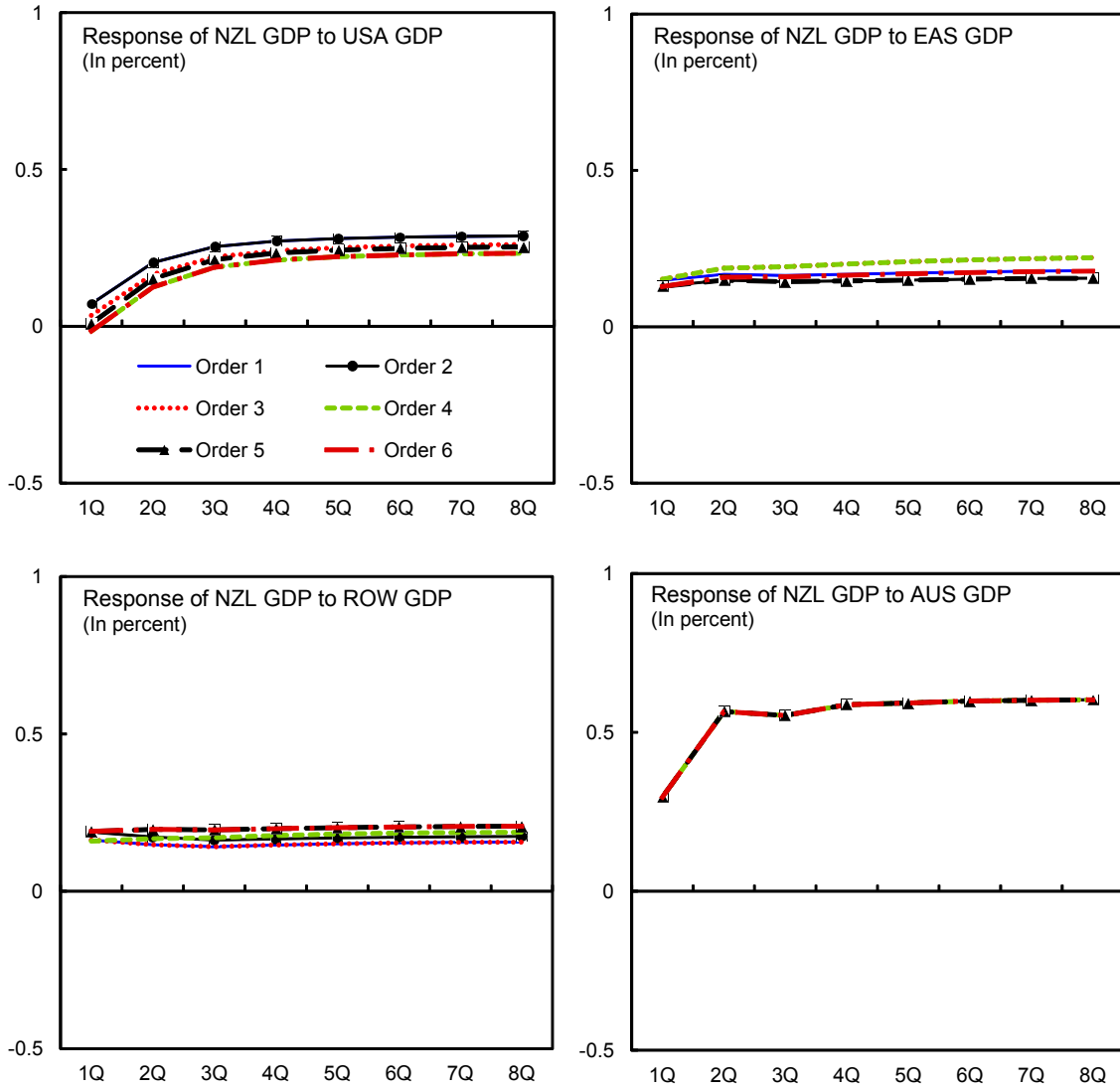
Figure 2. Australia: Spillovers Across Six VARs (1991-2010) 1/  
 (In response to one percent shocks)



Source: Author's calculations.

1/ VAR orders are defined as follows: (1) USA, EAS, ROW; (2) USA, ROW, EAS; (3) EAS, USA, ROW, (4) EAS, ROW, USA; (5) ROW, USA, EAS; and (6) ROW, EAS, USA.

Figure 3. New Zealand: Spillovers Across Six VARs (1991-2010) 1/  
 (In response to one percent shocks)

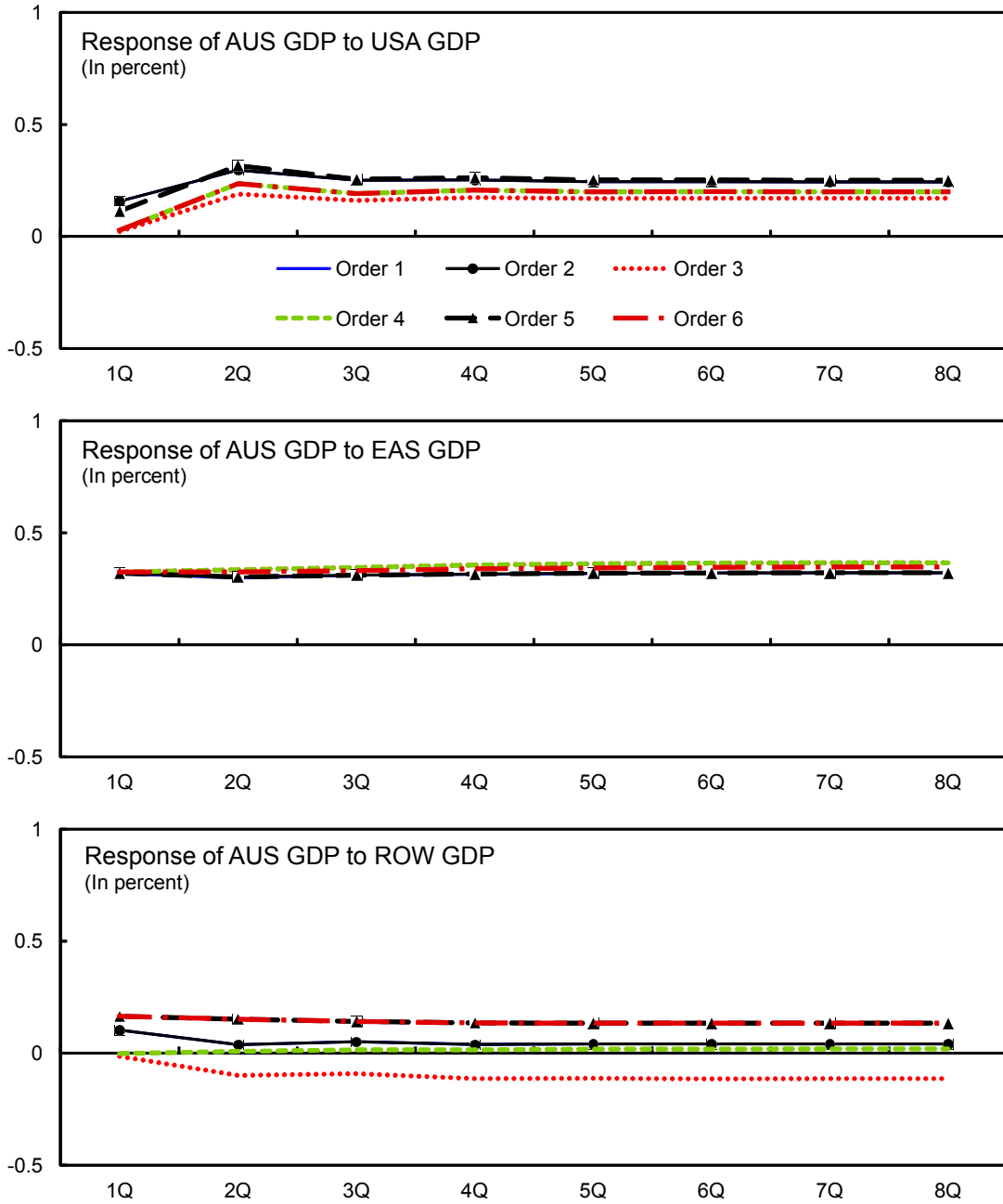


Source: Author's calculations.

1/ VAR orders are defined as follows: (1) USA, EAS, ROW; (2) USA, ROW, EAS; (3) EAS, USA, ROW, (4) EAS, ROW, USA; (5) ROW, USA, EAS; and (6) ROW, EAS, USA.



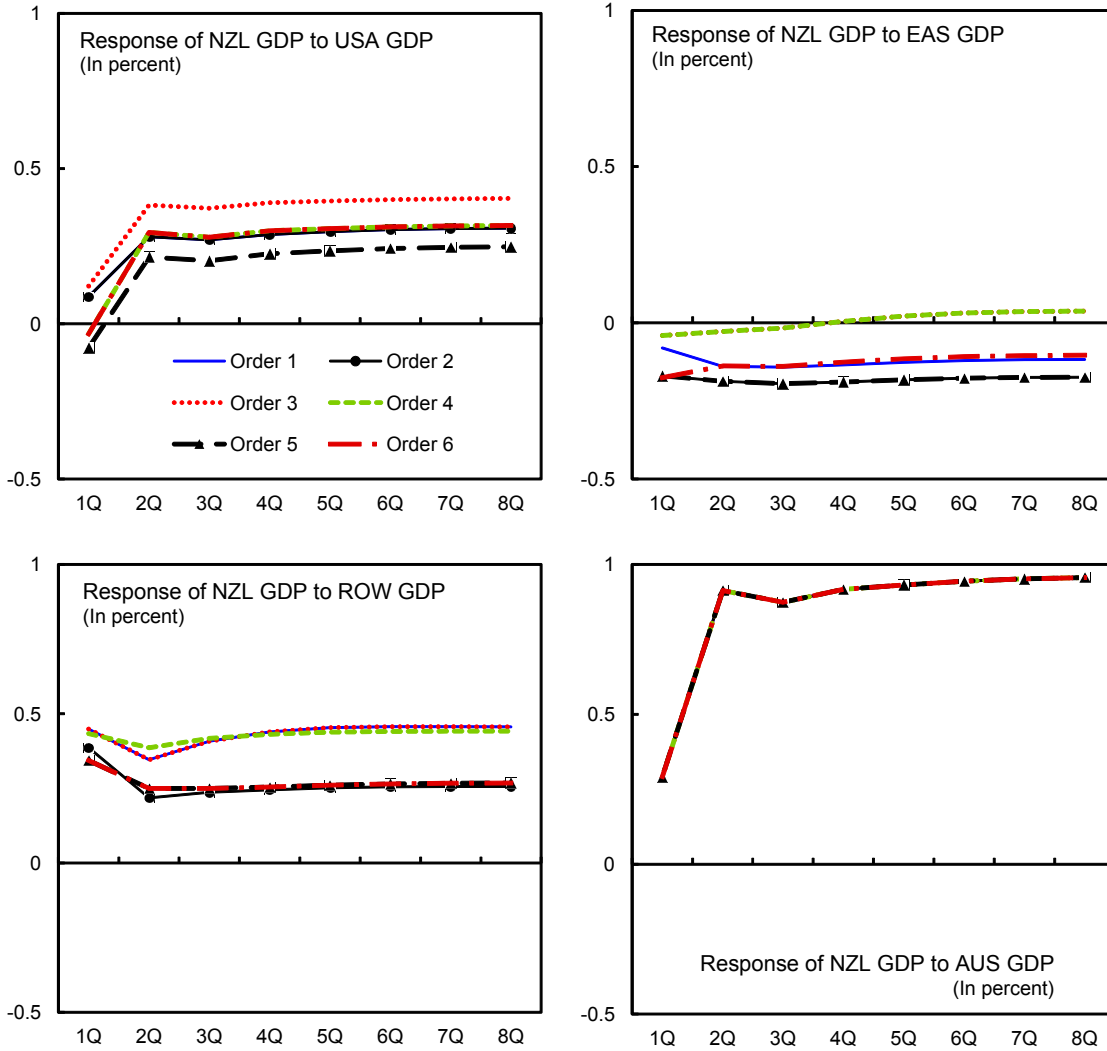
Figure 4. Australia: Spillovers Across Six VARs (2000-10) 1/  
(In Response to One Percent Shocks)



Source: Author's calculations.

1/ VAR orders are defined as follows: (1) USA, EAS, ROW; (2) USA, ROW, EAS; (3) EAS, USA, ROW, (4) EAS, ROW, USA; (5) ROW, USA, EAS; and (6) ROW, EAS, USA.

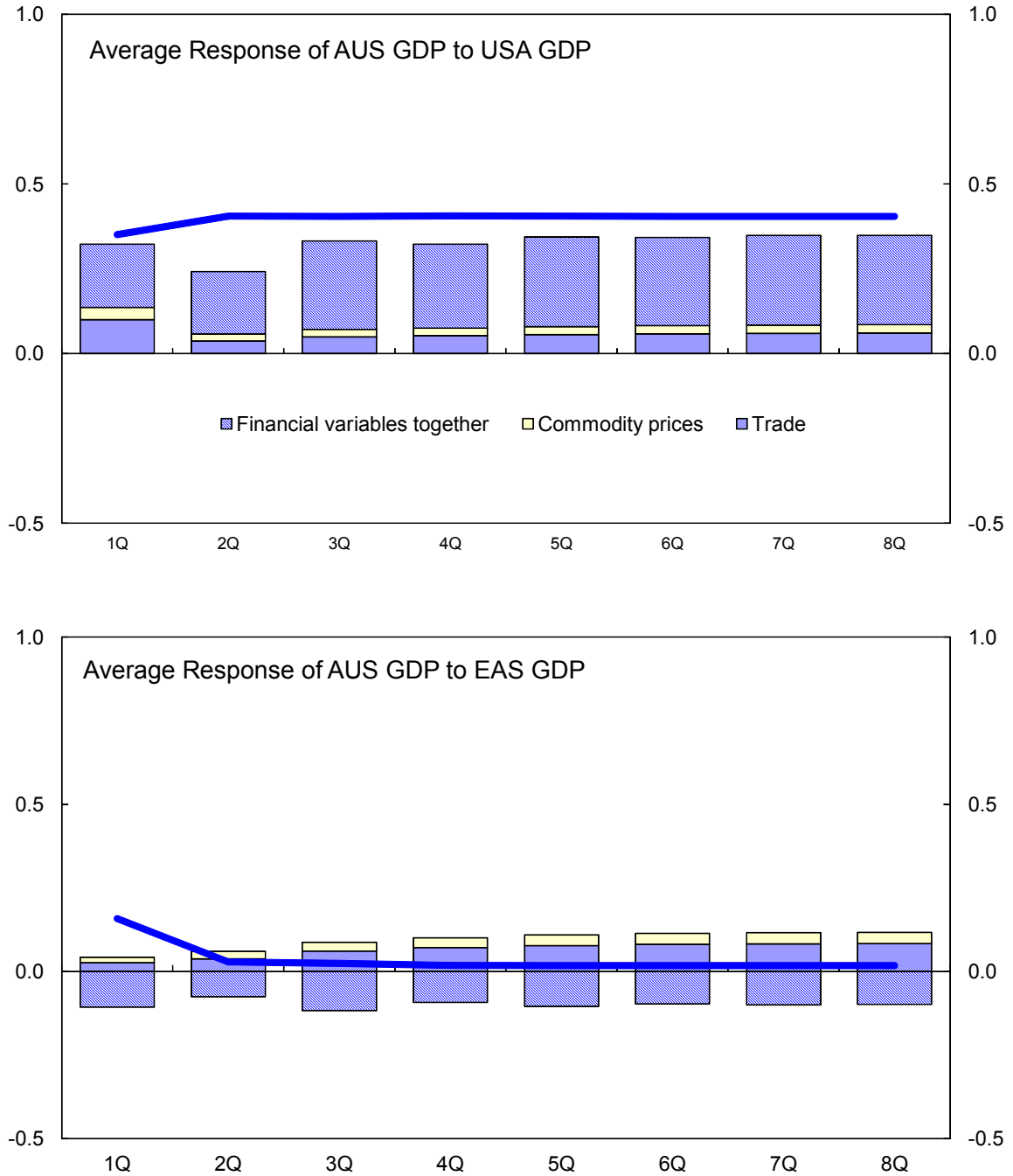
Figure 5. New Zealand: Spillovers Across Six VAR (2000-10) 1/  
 (In Response to One Percent Shocks)



Source: Author's calculations.

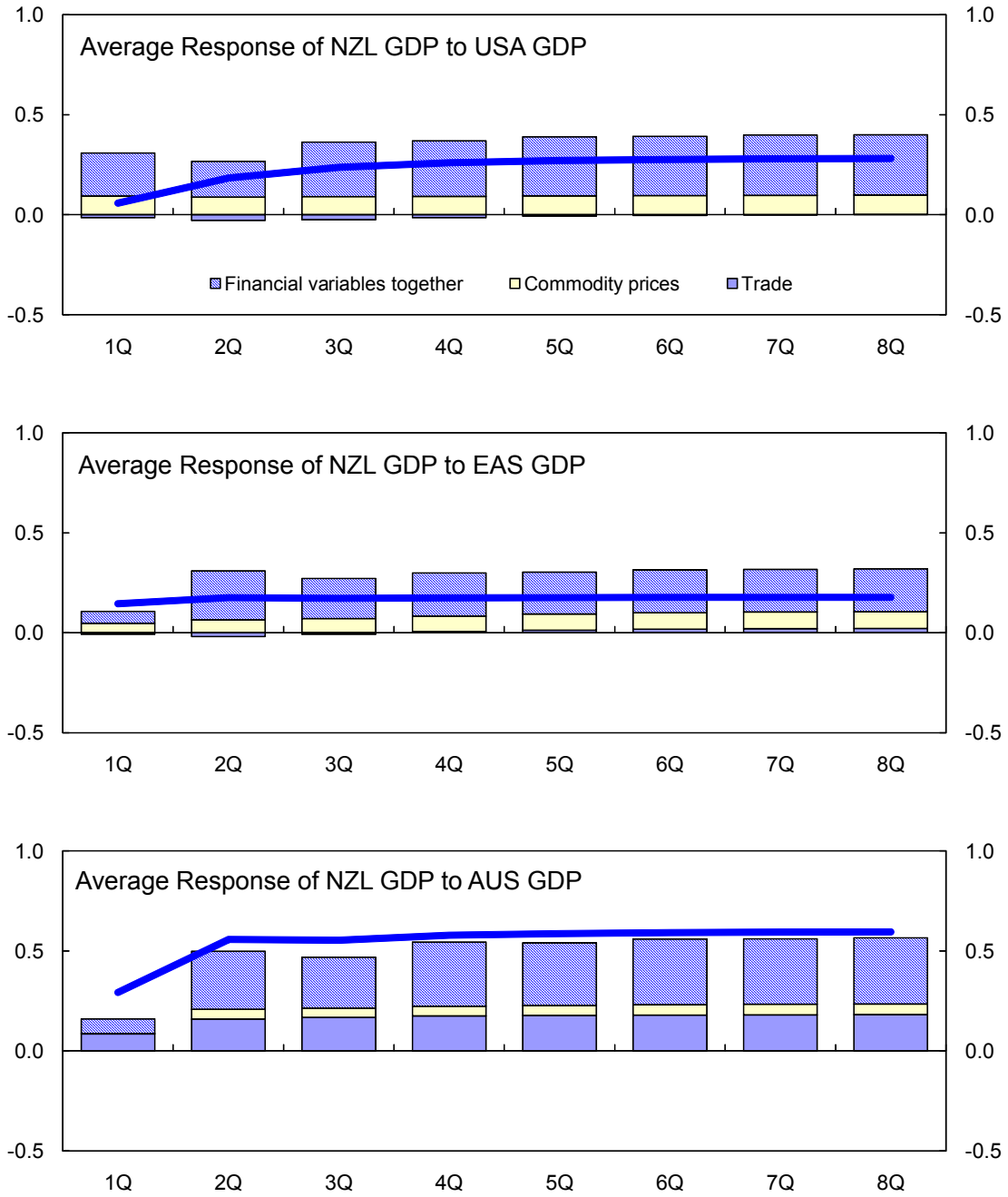
1/ VAR orders are defined as follows: (1) USA, EAS, ROW; (2) USA, ROW, EAS; (3) EAS, USA, ROW, (4) EAS, ROW, USA; (5) ROW, USA, EAS; and (6) ROW, EAS, USA.

Figure 6. Australia: External Spillover Channels (1991-2010)  
(In response to one percent shocks)



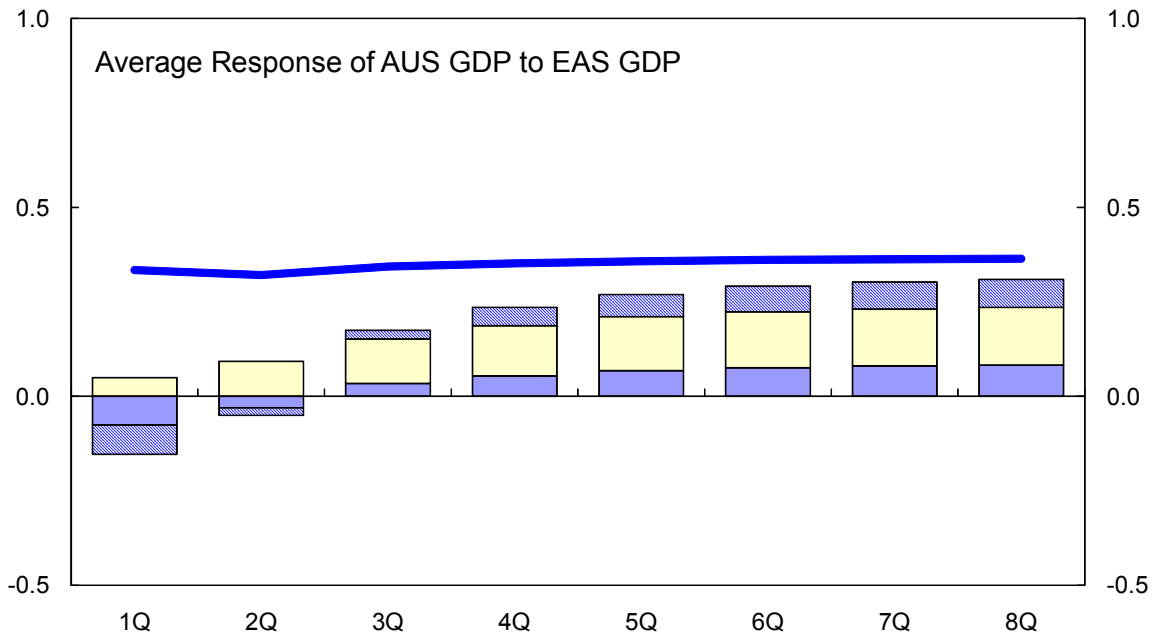
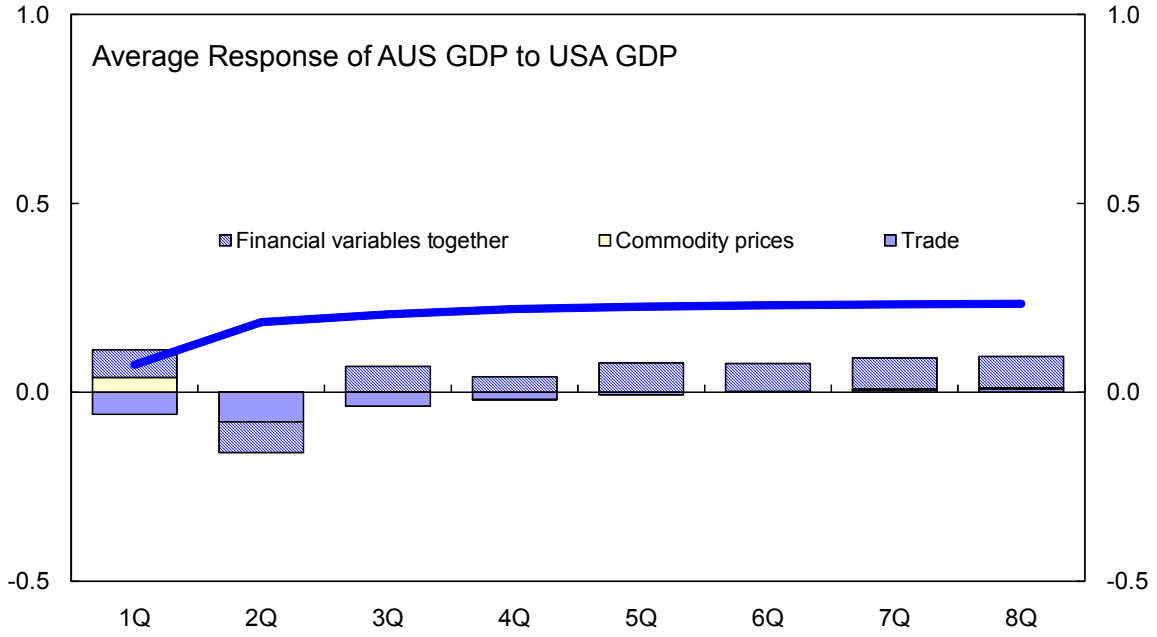
Source: Author's calculations.

Figure 7. New Zealand: External Spillover Channels (1991-2010)  
(In Response to One Percent Shocks)



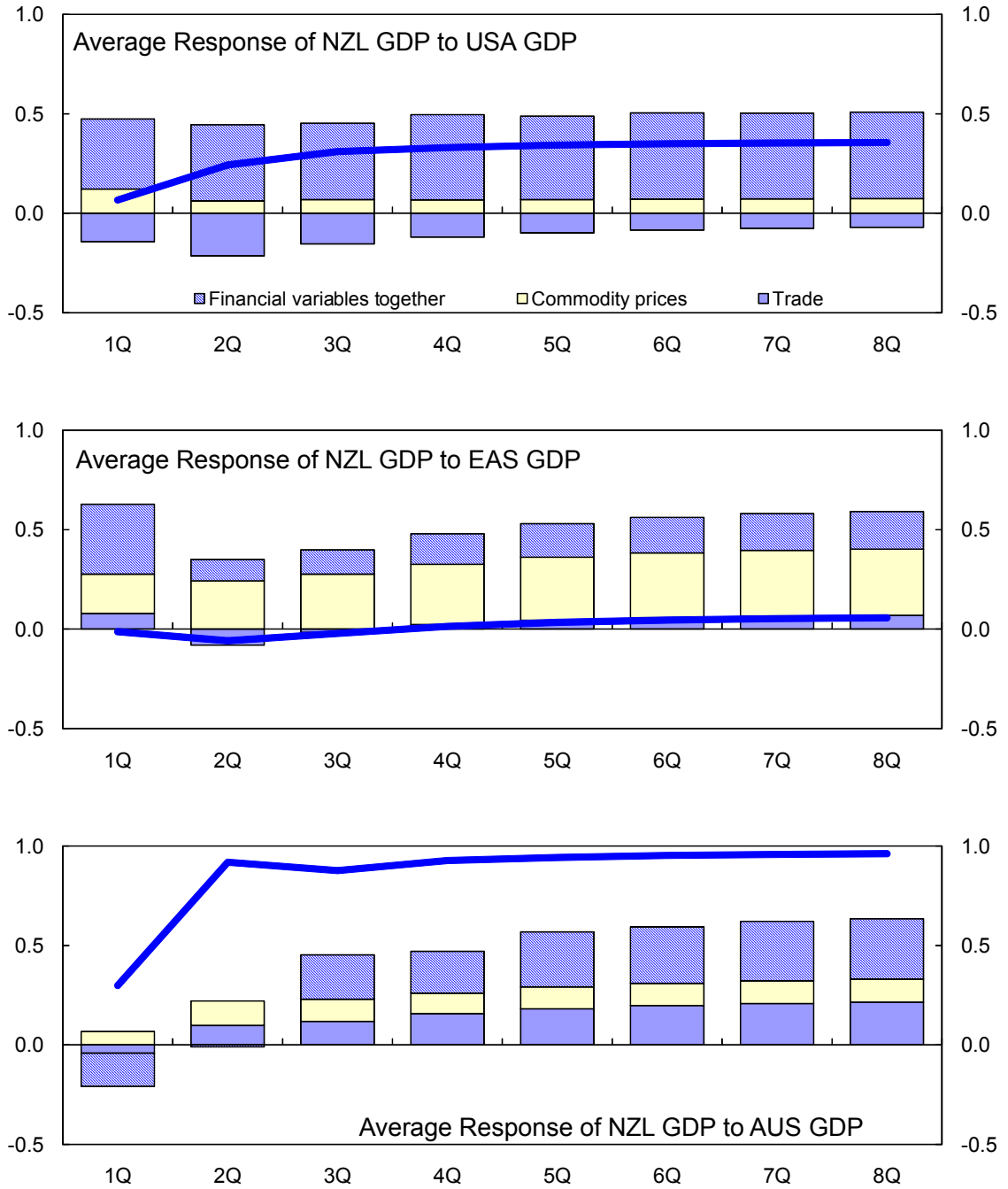
Source: Author's calculations.

Figure 8. Australia: External Spillover Channels (2000-10)  
(In Response to One Percent Shocks)



Source: Author's calculations.

Figure 9. New Zealand: External Spillover Channels (2000-10)  
(In Response to One Percent Shocks)



Source: Author's calculations.

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