



New Zealand

Selected Issues

New Zealand: Selected Issues Paper

This selected issues paper on New Zealand was prepared by a staff team of the International Monetary Fund as background documentation for the periodic consultation with the member country. It is based on the information available at the time it was completed on April 25, 2011. The views expressed in this document are those of the staff team and do not necessarily reflect the views of the government of New Zealand or the Executive Board of the IMF.

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**International Monetary Fund
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INTERNATIONAL MONETARY FUND

NEW ZEALAND

Selected Issues

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April 25, 2011

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I. HOW WELL DO STANDARD MODELS EXPLAIN AUSTRALIAN AND NEW ZEALAND SAVING BEHAVIOR?¹

A. Introduction

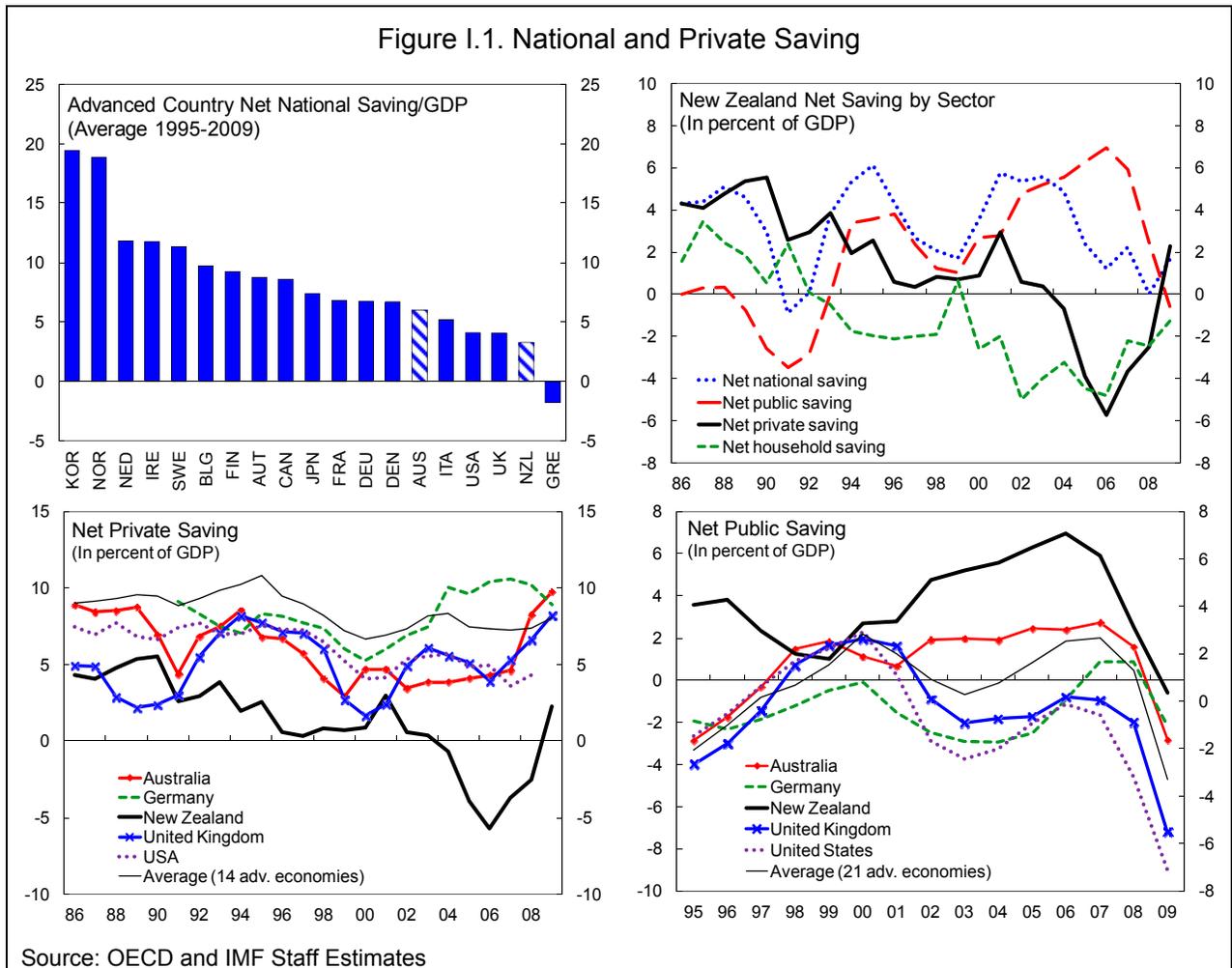
1. Net national saving in New Zealand has been much lower than in most other advanced countries over the past 15 years while net national saving in Australia has been just below average. This has contributed to persistent and sizable current account deficits and a buildup in net foreign liabilities to relatively high levels, especially in New Zealand. The vulnerability stemming from high net foreign liabilities and low national saving led the New Zealand government to establish a Savings Working Group in 2010 to recommend ways to raise national saving.
2. This paper assesses how well standard models explain Australian and New Zealand private saving behavior, in an effort to draw some policy implications. The models suggest that a rise in the old age dependency ratio together with an increase in public saving and household wealth are associated with the fall in the private saving rate in New Zealand over the past 20 years. For Australia, the same factors influenced saving, but an important difference with New Zealand is that the large increase in the terms of trade in recent years is positively associated with a rise in the private saving rate.
3. The Savings Working Group in New Zealand presented recommendations in February 2011, and suggested raising national saving by 2–3 percent of GDP, primarily through an increase in public saving and tax policy changes. The policy implications of the models presented in this paper are consistent with the key recommendation of the Working Group and suggest that the surest way of increasing national saving would be to raise public saving. An increase in public saving of 1 percent of GDP is associated with a rise in national saving of about $\frac{1}{3}$ – $\frac{1}{2}$ percent of GDP in Australia and $\frac{1}{2}$ – $\frac{2}{3}$ percent of GDP in New Zealand. In addition, there is also some evidence that higher government spending on social protection and health care, which have increased substantially in New Zealand in the past five years, are associated with lower private saving.
4. The cross-country models suggest that higher real GDP growth per capita is associated with higher saving. This implies that policy efforts to raise productivity in Australia and New Zealand may help raise national saving.
5. Other policy options to influence saving behavior, including tax reforms, government incentives to save, or compulsory schemes, are not assessed in this paper because of the difficulty of modeling these factors across countries.

¹ Prepared by Ray Brooks, with research assistance from Kessia De Leo and Mousa Shamouilian. The author is grateful to Roberto Guimarães, Meral Karasulu, and Papa N'Diaye for sharing cross-country databases prepared for earlier studies. The paper also benefited from comments by the Australian and New Zealand authorities.

6. The aging of the population over coming years in Australia and New Zealand, as in most advanced countries, will put downward pressure on the private saving rate, as a growing share of the population begins to draw on their savings to fund retirement. This implies that a sizable increase in public saving may be needed to raise national saving.

B. Australia and New Zealand Saving Compared with Other Advanced Countries

7. Net national saving in New Zealand was about 5 percent of GDP below the average for advanced countries over the past 15 years, while Australia's net national saving was just 2½ percent of GDP below the advanced country average for the same period (Figure I.1). Net national saving has fallen since the late 1980s in New Zealand. This reflects a fall in private saving over time, offset in part by a rise in government saving (until recently). By 2009, New Zealand's net private saving was below the average of the late 1980s, while Australia's net private saving had recovered to be above the average for the late 1980s. Net public saving was consistently higher in Australia and New Zealand than in most other advanced countries.



C. Regression Estimates

8. To analyze the factors influencing private saving in Australia and New Zealand, we estimate panel regressions for 19 advanced countries over the period 1980–2009. The empirical models follow numerous earlier studies (including three recent IMF studies summarized in Appendix I.1) that specify saving as a function of the old-age dependency ratio, the young-age dependency ratio and life expectancy (to assess the impact of demographics); public saving (to assess the extent of the “Ricardian offset”); real stock and real house prices (to assess wealth effects); domestic credit (to assess the impact of financial liberalization); and other factors such as the real interest rate, real GDP growth per capita and the terms of trade.

9. Pooled least squares and generalized method of moments (GMM) estimates are presented for the net private saving rate in Table I.1. The results are broadly consistent with the earlier IMF studies, despite narrower country coverage in these regressions:

- A 1 percent of GDP increase in government saving is associated with a $\frac{1}{3}$ – $\frac{1}{2}$ percent of GDP decline in private saving, implying a less than full Ricardian offset.² This is consistent with other studies summarized in Röhn (2010) that suggest the Ricardian offset is around 0.3–0.9.
- Demographic variables have a significant impact on saving. A 1 percentage point increase in the old-age dependency ratio is associated with a $\frac{1}{3}$ – $\frac{2}{3}$ percentage point decline in the saving rate. An increase in life expectancy is also associated with a rise in net private saving in the GMM model. The young-age dependency ratio is statistically insignificant.
- An increase in the terms of trade is associated with a rise in the saving rate, suggesting that the private sector views part of any change in the terms of trade as temporary and does not adjust spending fully to the change in income.
- A rise in domestic credit is associated with a small fall in the saving rate, although this was only significant in the pooled model. Including the change rather than the level of domestic credit is not significant.
- Faster growth in real GDP per capita is associated with higher saving rates.
- Higher inflation is related to higher net private saving in the pooled model only.

² A similar result is found if the general government structural balance is used rather than the net public saving rate (not reported here).

- Proxies for wealth, such as real stock prices and real house prices are not statistically significant in level or change terms. In addition, the real deposit interest rate is not statistically significant.
- Including the output gap to control for the economic cycle is not statistically significant.
- Finally, an alternative model including government spending on social protection, health care and education suggests a negative link between spending in some of these areas and private saving. Higher spending on social protection and health care are negatively correlated with private saving, while spending on education is not statistically significant in the model (third column of Table I.1).^{3,4}

Table I.1. Regression Results for 20 Advanced Countries

Dependent Variable	Pooled FE 1/ Net Private saving/GDP	GMM Net Private saving/GDP	Pooled FE 1/ Net Private saving/GDP (shorter sample)
Private saving/GDP (lagged)	...	0.5 ***	...
C	2.88	...	5.77
Old age dependency ratio	-0.64 ***	-0.32 **	-0.4 ***
Life expectancy	...	0.21 ***	...
Public saving/GDP 2/	-0.45 ***	-0.36 ***	-0.58 ***
Social protection spending/GDP 2/	...	...	-0.37 ***
Government Health spending/GDP 2/	...	...	-1.43 ***
Terms of trade (log) 2/	4.4 ***	3.58 ***	5.63 ***
Inflation 2/	0.1 **	...	...
Domestic credit/GDP 2/	-0.024 ***	...	-0.01 *
Change in log of real GDP per capita 2/	29.1 ***	17.4 ***	8.96
R ²	0.81	...	0.81
Observations	501	511	309
Countries	19	19	19
Sample period (unbalanced pool)	1980-2009	1980-2011	1989-2008

* Significant at 10 percent level.

** Significant at 5 percent level.

*** Significant at 1 percent level.

1/ Cross country and period fixed effects

2/ Lagged one year in the pooled equations to reduce endogeneity.

³ Baldacci and others (2010) found similar results for household saving, see Appendix I.1.

⁴ Data on government spending is only available from the mid-1990s for most advanced countries.

D. How Well Does the Model Fit Australia and New Zealand?

10. According to the pooled model above, the main factors influencing net private saving in Australia and New Zealand over the past two decades are the old-age dependency rate, the terms of trade, domestic credit, and net public saving (Table I.2). The rise in the old-age dependency ratio is associated with a 1½–2 percent of GDP fall in the net private saving rate over the period 1990–2009, as a greater share of the population began to draw on their savings to fund retirement. For Australia, the old-age dependency rate rose slightly faster than for New Zealand, reaching almost 20 percent of the working age population by 2009, compared with just over 19 percent in New Zealand.

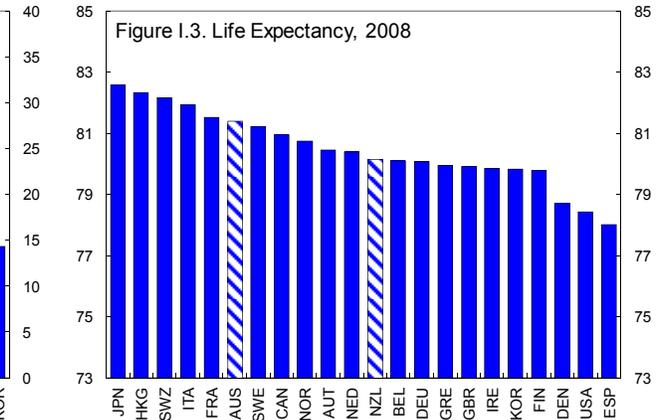
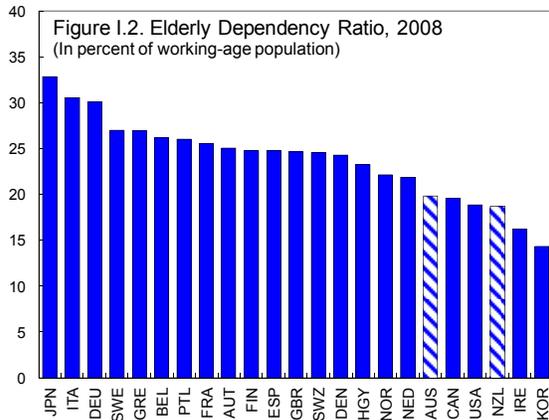
Table I.2. Australia and New Zealand: Decomposition of Change in Net Private Saving Rate, 1990-2009

	Australia	New Zealand	Difference AUS less NZL
	(change 1990 to 2009)		
Elderly dependency ratio	-2.0	-1.5	-0.5
Net Public saving/GDP	-0.6	-1.4	0.8
Terms of trade	2.5	0.6	1.9
Inflation	-0.3	-0.2	-0.1
Domestic credit/GDP	-1.7	-1.8	0.1
Real per capita growth	-0.7	-0.3	-0.5
Fixed effect (over time)	4.8	4.8	0.0
Fitted change	1.9	0.2	1.7
Actual change	2.8	-3.3	6.0
Residual	0.8	-3.5	4.3

Source: IMF staff estimates.

1/ Using coefficients from the pooled model in Table 1.

11. Demographics, however, do not explain why private saving in New Zealand was lower than elsewhere given that New Zealand has a lower elderly dependency ratio than most other advanced countries (Figure I.2). Also, life expectancy, which showed up as significant only in the GMM model, is around the average for advanced economies (Figure I.3).

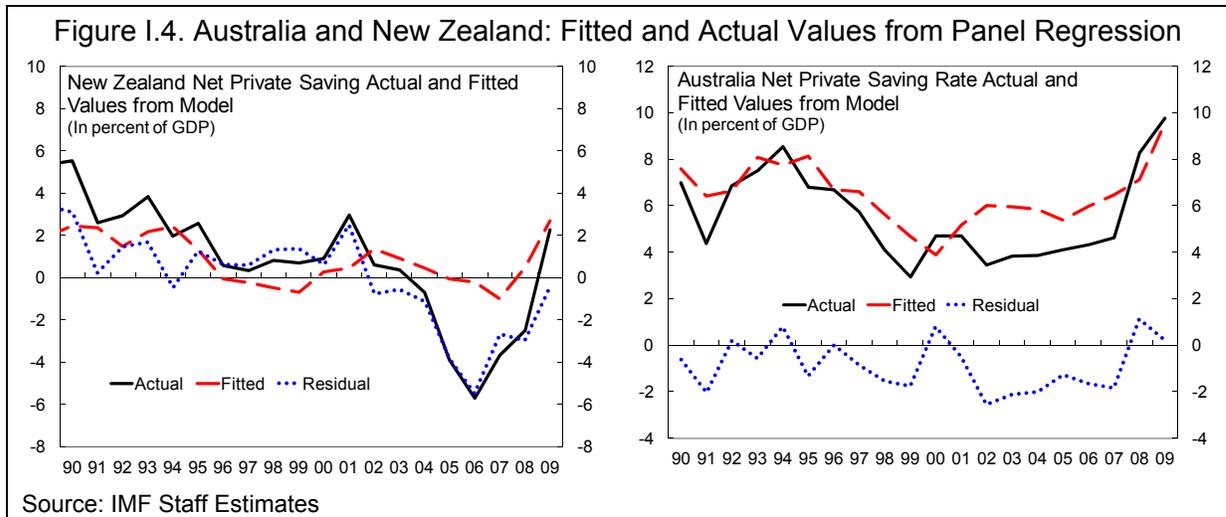


12. The improvement in the net public saving rate in New Zealand is another factor associated with the decline in the net private saving rate. The increase in net public saving in New Zealand, to a higher level than in most advanced countries, explains part of the reason for lower net private saving in New Zealand. Net public saving in New Zealand was about 3 percent of GDP above the average of advanced countries for the past 15 years. Assuming a Ricardian offset of 0.45, New Zealand's higher public saving may explain about 1½ percentage points of the 8 percentage point gap between the net private saving rate in New Zealand and the average for advanced countries over the past 15 years.

13. Financial liberalization also appears to have been played a role in saving behavior. The increase in credit to the private sector by about 70–75 percent of GDP over the past two decades in both countries is related to a fall in the net private saving rate by about 1¾ percent of GDP. Domestic credit to the private sector in 2009 stood at just over 150 percent of GDP in both countries. While this was slightly above the average for advanced countries of about 145 percent of GDP, the difference is not large enough to explain the lower saving in New Zealand.

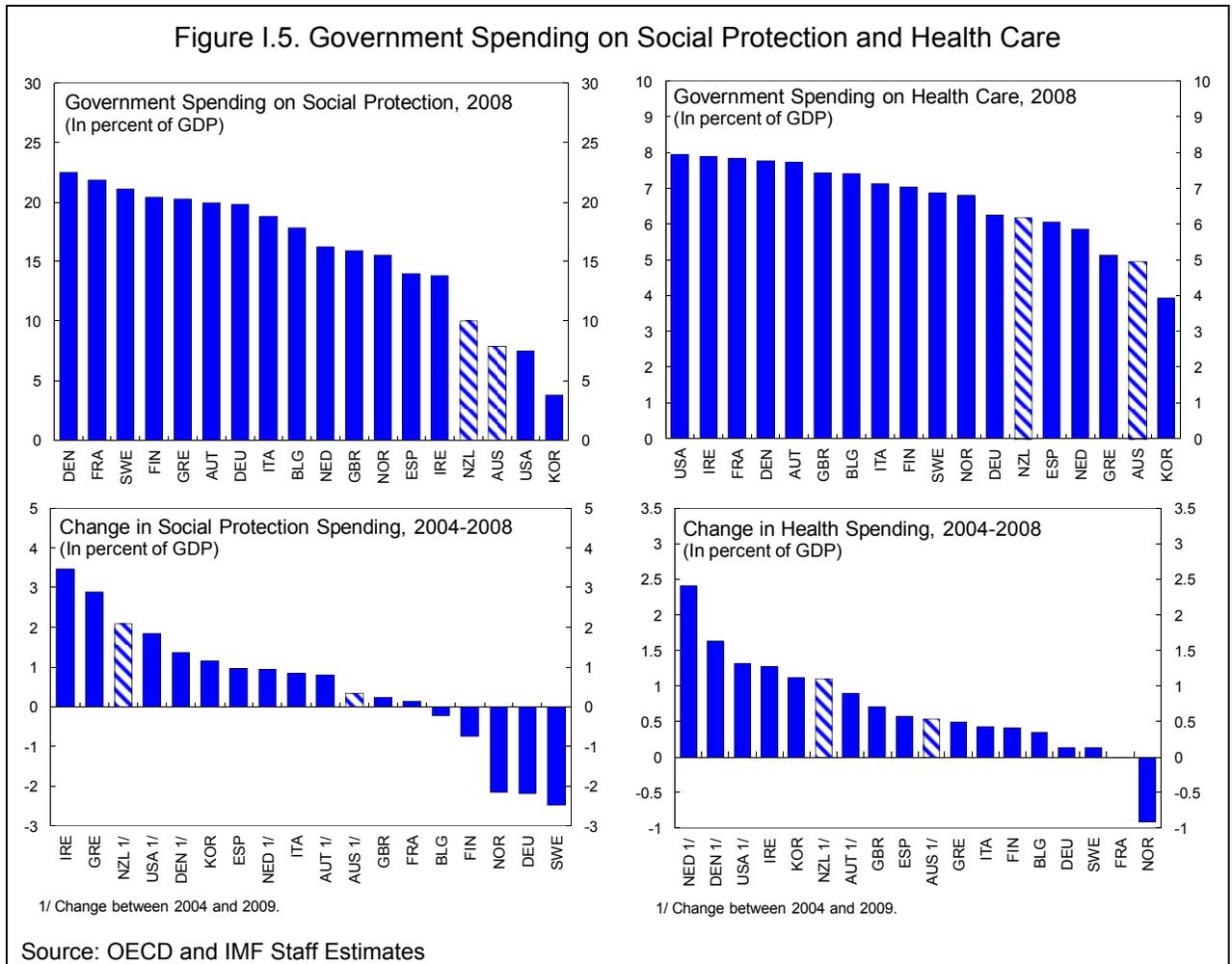
14. For Australia, the model suggests that a 2½ percent of GDP increase in the net private saving rate from 1990–2009 was related to the rise in the terms of trade. The terms of trade rose much less in New Zealand and the model suggests it contributed only a ½ percent of GDP increase in private saving.

15. While the cross-country analysis gives some insight into the factors affecting saving over time in Australia and New Zealand, the equations do not provide a very good fit, especially for New Zealand during the housing boom of 2003–07 (Figure I.4). Moreover, the country fixed effects in the pooled model show a large negative fixed effect for New Zealand of about 8 percent of GDP, suggesting the model does not explain well the reasons for private saving being lower than the average for other advanced countries. The period fixed effect also shows a large contribution to the change over the period 1990–2009, as this fixed effect jumped in 2009 indicating that the model does not explain well the increase in saving in many countries in that year.



16. The alternative model that includes spending on social protection and health care also provides a poor fit to the New Zealand data. Given the negative link between social spending and saving in the model, the lower-than-average spending on social protection and health care as a share of GDP in New Zealand cannot explain New Zealand's lower saving rate. (Figure I.5, upper panels). Nonetheless, social protection and health care spending have risen more in the past five years than in most other countries and the model implies that this growth weighed on private saving (Figure I.5, lower panels).

17. The models above do not take account of the impact on private saving of tax policy, saving incentives, an increase in the age of eligibility for pensions, or compulsory saving schemes. For Australia, there is some evidence from micro data that the superannuation guarantee scheme increased household saving and wealth (Connolly 2007), while in New Zealand changes to the tax treatment of pensions and superannuation in 1988 and an increase in the eligibility age for New Zealand superannuation may have impacted saving behavior.



E. Single Equation Estimates for Australia and New Zealand

18. In an attempt to better explain the factors behind the fall and subsequent recovery in the private saving rate in Australia and New Zealand, we estimate single equation models for private saving. The results of the ordinary least squares (OLS) and error correction models (ECM) are presented in Tables I.3 and I.4 and support some of the findings from the cross-country regressions. The variables are nonstationary over the sample period, so we estimated the equation in levels and tested for co-integration.⁵ The null hypothesis of no co-integration is rejected for all the OLS equations shown. A caveat to the results is that they are

⁵ Tests for unit roots in the data suggest that the net private saving rate, net public saving rate, terms of trade, household net wealth and demographic variables are nonstationary, implying that a co-integration approach is appropriate. We would not expect saving rates or the terms of trade to be non-stationary over the longer run. To take account of this, we estimated an alternative specification with household net wealth in difference form and the saving and terms of trade terms in levels. However, the net wealth term is not statistically significant, and the equation provided a poorer fit to the data.

based on just over 20 observations, because of constraints on data availability. The main findings are:

- The coefficients on net public saving are around negative $\frac{1}{2}$ – $\frac{2}{3}$ for the OLS and ECM equations for Australia and about negative $\frac{1}{3}$ – $\frac{1}{2}$ for New Zealand, which is close to the coefficients found for the 19 advanced countries above. The ECM shows a short run coefficient of about negative $\frac{1}{2}$ for both countries.
- The coefficient on the terms of trade is larger for Australia than for the 19 advanced countries estimated in the cross-country equations and is significant, whereas it is not significant for New Zealand. For Australia, the model suggests that the 62 percent rise in the terms of trade from 2000–2009 was associated with a $3\frac{3}{4}$ percent of GDP rise in the net private saving rate.
- Household net worth is negatively associated with private saving in Australia and New Zealand.⁶ In the ECM for Australia, the change in net worth rather than the level was statistically significant. The results of the OLS equation show that the 50 percent rise in household's perceived net wealth in New Zealand from 1990 to 2009 is associated with a 5 percentage point fall in the net private saving rate, while in Australia the 43 percent rise in household net wealth over the same period is linked to a 3 percentage point fall in the net private saving rate.
- Demographic variables are not significant in the regressions. Typically, demographic variables show up as significant over longer periods and in cross country models.
- GDP growth rates, domestic credit (in level and difference form) and government spending on social protection, health and education are not statistically significant.

19. The simple OLS models provide a better fit for Australia and New Zealand than the cross-country model (Figure I.6). In particular, the residuals for the New Zealand equation are much smaller than for the cross-country model, which is likely because of the inclusion of household net wealth in the OLS model which is clearly negatively correlated with saving (Figure I.7). The sharp jump in net private saving in Australia and New Zealand in 2009 is not fully captured by the OLS models and may relate to increased uncertainty stemming from the global financial crisis. However, the inclusion of measures of uncertainty, such as the Chicago Board Options Exchange Market Volatility Index (VIX) and the unemployment rate, is not statistically significant.

⁶ Household net worth data is not available for a wide range of advanced countries so was not used in the analysis for the 19 advanced countries above.

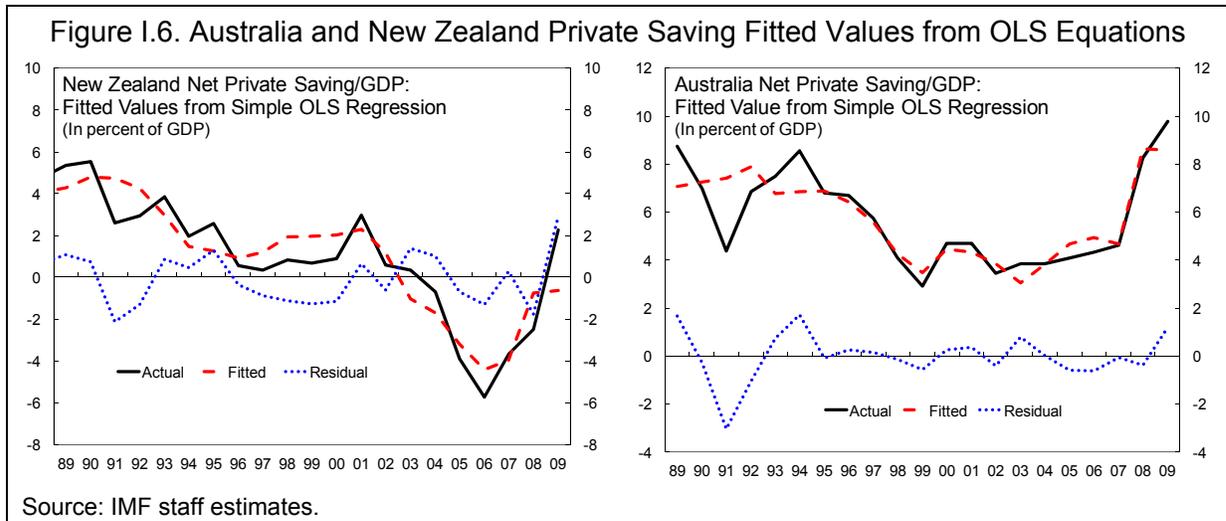


Table I.3. OLS Regression Results for Australia and New Zealand

Dependent Variable	Australia Net Private saving/GDP	New Zealand Net Private saving/GDP
Constant	-21.2 ** (6.1)	2.62 (23.3)
Public saving/GDP	-0.5 *** (0.13)	-0.39 *** (0.12)
Household net worth/GDP	-0.027 *** (0.008)	-0.043 *** (0.009)
Log of Terms of Trade	7.64 *** (1.56)	2.31 (5.34)
R^2	0.75	0.83
D.W. statistic	1.46	1.71
Observations	22	24
Sample	1988-2009	1986-2009
Unrestricted cointegration rank (Johansen test)	0.86 ***	0.93 ***

Standard errors in parathensis
 * Significant at 10 percent level.
 ** Significant at 5 percent level.
 *** Significant at 1 percent level.

Table I.4. Private Saving Error Correction Regression Results for Australia and New Zealand

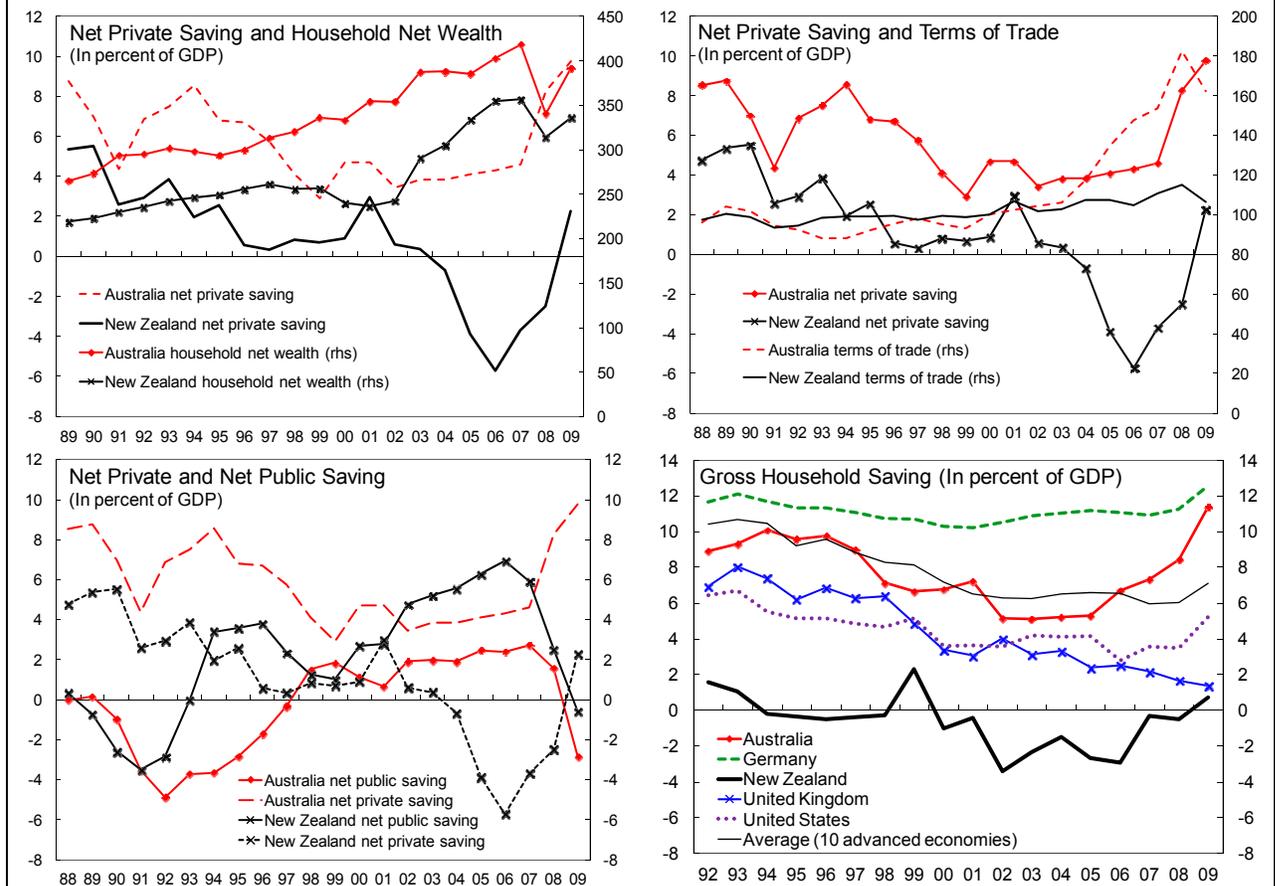
Dependent Variable	Australia Net Private saving/GDP	New Zealand Net Private saving/GDP
Long-run relationship:		
Public saving/GDP	-0.66 ***	-0.30 ***
Household net worth/GDP	...	-0.07 ***
Log of Terms of Trade	4.72 ***	...
Error correction term	-0.82 ***	-1.25 ***
Short-run dynamics:		
Change in public saving/GDP	-0.47 **	-0.53 ***
Change in log of terms of trade	...	10.0
Change in household net worth/GDP	-0.026 **	...
Change in private saving, lagged	0.29	0.39 *
R ²	0.76	0.72
D.W. statistic	2.65	1.65
Observations	22	22
Sample	1988-2009	1988-2009

* Significant at 10 percent level.

** Significant at 5 percent level.

*** Significant at 1 percent level.

Figure I.7. Australia and New Zealand: Private and Public Saving, Wealth, and Terms of Trade



Source: OECD and IMF staff estimates.

F. Policy Implications

20. The models presented above suggest that if the public policy goal is to raise national saving, the surest way of achieving this goal would be to increase public saving. An increase in public saving of 1 percent of GDP would likely raise national saving by $\frac{1}{2}$ – $\frac{2}{3}$ percent of GDP in New Zealand and about $\frac{1}{3}$ – $\frac{1}{2}$ percent of GDP in Australia (based on the Ricardian offset coefficients estimated in the OLS and ECMs). The negative link between spending on social protection in the cross-country model implies that reversing the rise in social protection spending in New Zealand since 2004 by better targeting transfers to households could raise both private and public saving. In addition, the positive link between real GDP growth per capita and saving in the cross-country models suggests that structural reforms to raise productivity may help increase national saving.

21. Demographic projections imply that fiscal policy may need to work harder in coming years to raise national saving. The aging of the population in Australia and New Zealand, as in most advanced countries, will put downward pressure on the private saving rate over time, as a growing share of the population begins to draw on their savings to fund retirement. This

may be offset in part by a rise in life expectancy that will encourage greater saving for retirement. Overall, however, the demographic influences imply that a sizable increase in public saving would be needed to raise national saving, as illustrated by the projected change in national saving based on IMF staff estimates, demographic trends and an assumption of no change in household net wealth in Table I.5.

Table I.5. Illustrative Projection of National Saving
(Change 2009 to 2016, in percent of GDP)

	Australia	New Zealand
National Saving	0.8	0.6
Public saving	3.3	3.0
Private saving	-2.5	-2.4
of which:		
Public saving offset	-1.7	-1.2
Terms of trade	0.7	0.3
Elderly Dependency Ratio	-1.8	-1.7
Life Expectancy	0.2	0.1

Source: IMF staff estimates.

22. The terms of trade and household wealth in Australia and New Zealand in coming years may not evolve as in the above projection, with implications for the goal of raising national saving. For instance, the models imply that a 10 percent decline in the terms of trade in Australia could lead to a fall in private saving by around $\frac{3}{4}$ percent of GDP. However, a fall in household net wealth by 10 percent could lead to a rise in private saving by 1 percent of GDP in Australia and $1\frac{1}{2}$ percent of GDP in New Zealand. The fall in household wealth could come from a decline in house prices that appear moderately overvalued in both countries (see Tumbarello and Wang, 2010).

Appendix I.1. Summary of Recent IMF Cross-Country Studies of Saving

Author:	Karasulu (2010)	Baldacci et al. (2010)	Guimarães (2010)
Dependent Variable:	Household saving rate	Household saving rate	Private saving / GDP
Logged private saving rate	...	...	0.272 **
GDP per capita	0.000 **	-84.90 ** 1/	1.280
GDP growth per capita	...	-0.35	0.190 ***
Old age dependency ratio	-0.257 **	-0.46	-0.570
Young age dependency ratio	0.214 **	-0.71 ***	0.180 *
Life expectancy at birth	...	-0.21	0.137
Public saving/GDP	-0.464 ***	-0.33 ***	-0.512 *
Coporate saving/GDP	-0.472 **	...	...
Public social spending	...	-2.14 ***	...
Inflation	0.529 ***	...	-0.002 ** 2/
Real interest rate	0.332 ***	...	-0.070 ***
M2/GDP	...	...	-0.003
Domestic credit to private sector/GI	...	-0.88	-0.031 **
Household credit/GDP	-0.045 ***	...	...
Terms of trade	0.052 ***	...	0.028 * 4/
Effective retirement age	-0.534 ***	...	...
Real household disposable income	0.310 ***	...	...
Real stock prices	0.001 ***	...	...
Unemployment rate	0.177 *	...	...
Business cycle fluctuation	...	...	0.157 **
Inflation volatility	...	...	-0.0016 ***
Country coverage:	30 advanced and	24 OECD countries	130 countries
Obs.	280	68 3/	2544
R2	...	...	0.76
Sample	1980-2008	1990-2008	1970-2008

* Significant at 10 percent level.

** Significant at 5 percent level.

*** Significant at 1 percent level.

1/ Log of initial GDP per capita.

2/ Volatility of inflation.

3/ Panel consists of four 5-year periods for 24 countries.

4/ Change in terms of trade.

Data Appendix

Net national saving	From OECD database.
Net public saving	Government net saving, from OECD database.
Net private Saving	Net private saving derived as net national saving less net public saving, from OECD database.
Old age dependency ratio	Ratio of population greater than 64 years old to working-age population (15–64 years old), from World Bank World Development Indicators.
Young age dependency ratio	Ratio of population less than 15 years old to working-age population (15–64 years old), from World Bank World Development Indicators.
Life expectancy	Life expectancy in years at birth, from World Bank World Development Indicators
Terms of trade	Ratio of export to import prices, from WEO database.
Inflation	Year on year consumer price inflation, from WEO database.
Domestic credit to private sector	Domestic credit of banking system to private sector, from WEO database.
House net wealth	Estimates for Australia, from Australian Bureau of Statistics, and New Zealand, from Reserve Bank of New Zealand.
Government spending on social protection, health, and education	From OECD, Australian Bureau of Statistics, and New Zealand Treasury.
VIX	Chicago Board Options Exchange Market S&P 100 Volatility Index

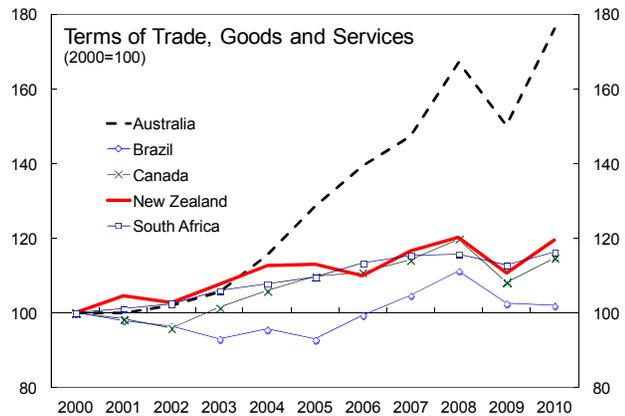
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II. FROM WEST TO EAST: ESTIMATING EXTERNAL SPILLOVERS TO AUSTRALIA AND NEW ZEALAND⁷

A. Introduction

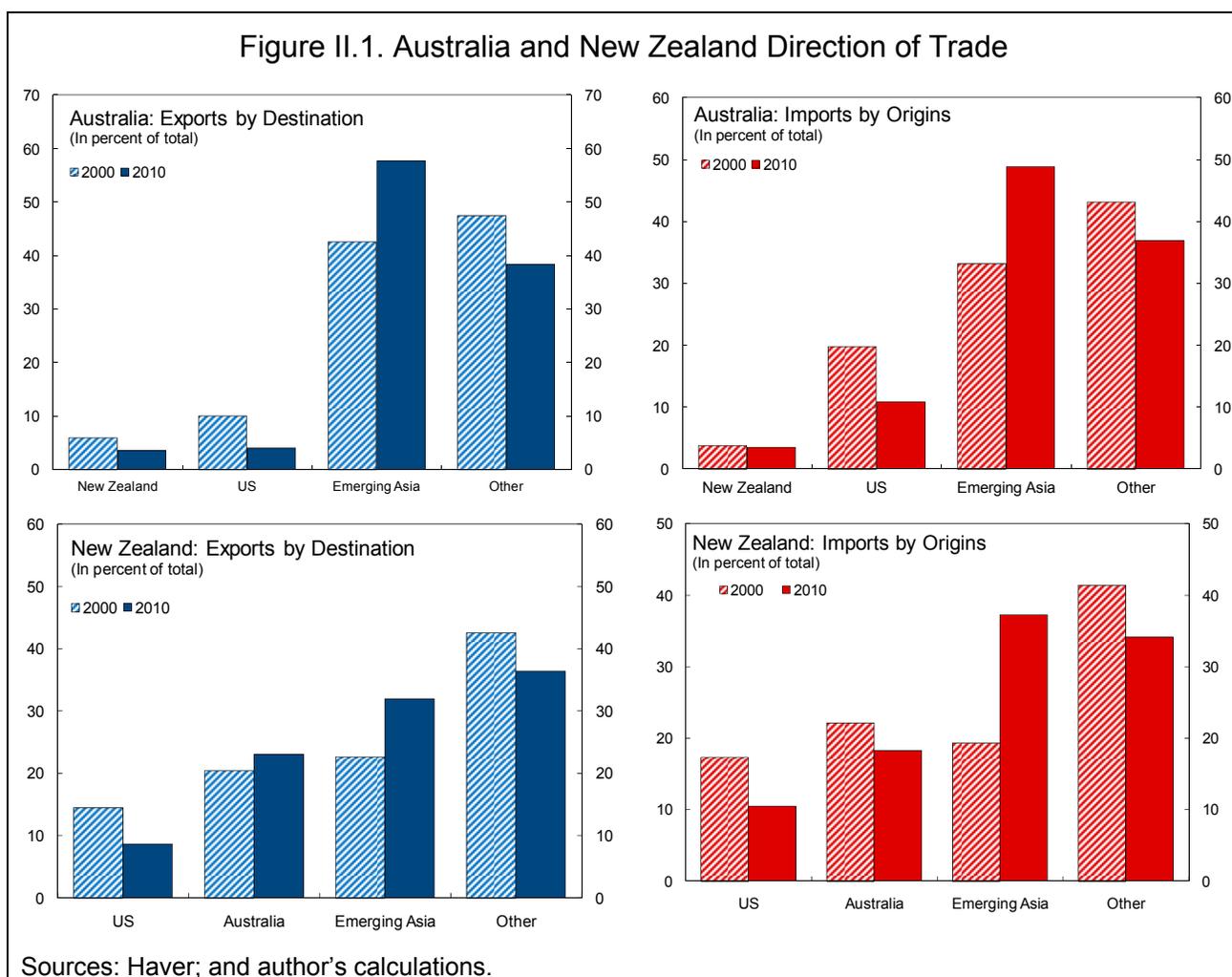
23. **The last decade has witnessed fast growing links between Australia and New Zealand and their emerging Asia neighbors.** Robust demand for commodities from emerging Asia has helped boost commodity prices, sending Australia's terms of trade to record highs. A glimpse of the two countries' direction 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 II.1).⁸ This transformation is more pronounced for Australia than New Zealand.



24. **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.

⁷ Prepared by Yan Sun. The author would like to thank Sam Ouliaris for helpful discussions and comments and Andy Swiston for generously sharing his work. The paper also benefited from comments by Chris Becker, Ray Brooks, Patrick Conway, Mario di Maio, David Galt, Tim Hampton, Philip Liu, Simon McLoughlin, Oscar Parkyn, Reserve Bank of Australia, and participants at the seminars in New Zealand Treasury. Mousa Shamouilian and Kessia De Leo provided excellent assistance. All errors are the author's.

⁸ See C. Becker and M. Davies (2002) and V. Zhang (2009) for discussions on the changing trade patterns of Australia and New Zealand.



25. **We find that, during the last decade, shocks from emerging Asia have overtaken those from the U.S. 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.
- 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.

26. **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 U.S. 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.

27. **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.

28. The rest of the paper is organized as follows. Section B discusses methodology and data. Section C analyzes external spillovers to Australia and New Zealand and Section D discusses transmission channels. The last section concludes.

B. Methodology and Data

29. **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.

30. **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).⁹ The aggregate growth rate of emerging Asia is calculated using PPP-based GDP as weights. The rest of world ("ROW" thereafter), which covers a set of countries with large economic and geo-political diversity, captures global shocks that do not originate from either U.S. or emerging Asia and controls for the possibility that business cycle co-movement between two

⁹ 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.

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.¹⁰

31. **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 U.S., emerging Asia, and ROW are not straightforward. Therefore, this paper investigates all six ordering possibilities.¹¹ 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,¹² 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.¹³ 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.

32. **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 1 lag to be sufficient, results shown below are based on a single lag. Similar results hold with 4 lags (a conventional choice for quarterly data), although their statistical significance is reduced owing to limited sample period and decreased degrees of freedom.¹⁴

C. External Spillovers to Australia and New Zealand

Full Sample Period of 1991–2010

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

- The response of Australian growth to a 1 percent U.S. shock is about 0.4 percent.

¹⁰ 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.

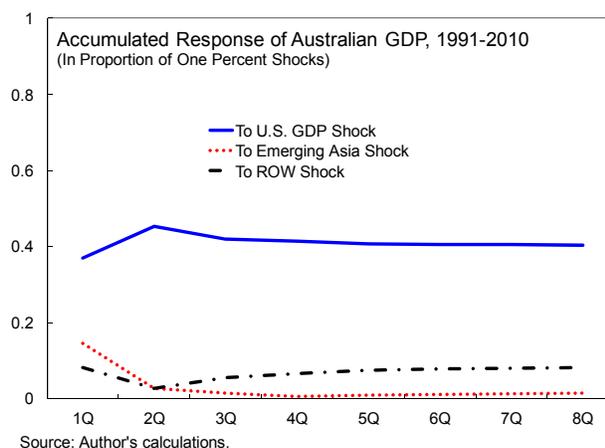
¹¹ They are (1) USA, EAS, ROW; (2) USA, ROW, EAS; (3) EAS, USA, ROW, (4) EAS, ROW, USA; (5) ROW, USA, EAS; and (6) ROW, EAS, USA.

¹² This could be a natural result of the decomposition and ordering method.

¹³ Owing to the lag effects of Australia and New Zealand on emerging Asia, the U.S., 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.

¹⁴ Results are available upon request.

- 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.



34. **As expected, the most important external factor for New Zealand is found to come from Australia.** Spillovers from growth shocks in U.S., emerging Asia, or ROW to New Zealand are estimated to be statistically insignificant (Figure II.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.

35. The **variance decomposition of Australian and New Zealand's growth disturbances averaged across six VARs is presented in Table II.1.** About a quarter of Australia's growth variability can be attributed to external factors, $\frac{2}{3}$ of which stem from U.S. 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.

Sub-Sample Period of 2000–10

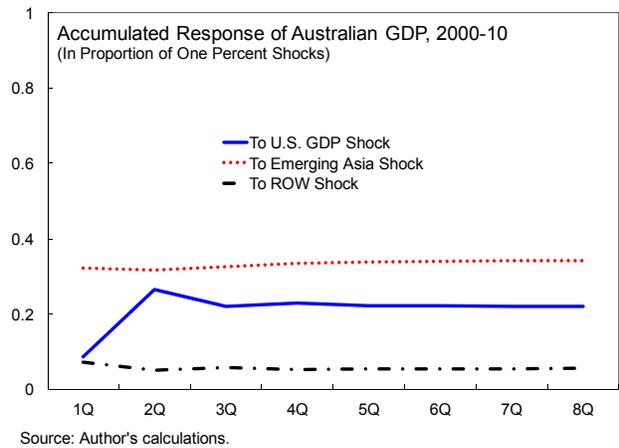
36. **The fact that emerging Asia's economic rise accelerated during the last decade carries with it a presumption that emerging Asia's external spillovers to Australia and New Zealand may have increased.** To test this hypothesis, the VAR system is estimated for a sub-sample period of 2000–10.

37. **Shocks from emerging Asia have become more important than those from the U.S. in explaining Australia's growth variability** (Figure II.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

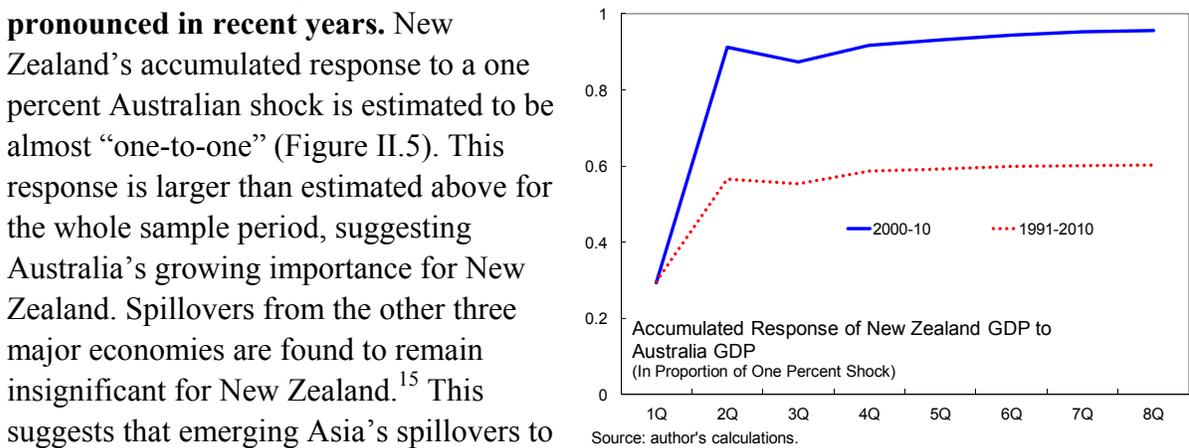
$\frac{1}{3}$ percent. This response is bigger and lasts longer than estimated above for the full sample period.

- 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 U.S. is ranked before emerging Asia and only for the first three quarters are spillovers from the U.S. to Australia statistically significant.



- GDP shocks of ROW have negligible impacts on Australia's growth variability.

38. Australia's importance to New Zealand is estimated to have become even more pronounced in recent years. New Zealand's accumulated response to a one percent Australian shock is estimated to be almost "one-to-one" (Figure II.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.¹⁵ 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.¹⁶



¹⁵ Even when Australia is excluded from the VAR, shocks from emerging Asia are not found to have much of an impact on New Zealand.

¹⁶ 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.

39. **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.

40. **Variance decomposition for the sub-sample period suggests a few interesting developments** (Table I.1). First, it confirms emerging Asia's increasing importance for Australia in recent years. External factors still account for about $\frac{1}{4}$ of Australian growth variability.¹⁷ However, compared to the full sample period, the importance of shocks from U.S. 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 $\frac{1}{4}$ 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.

41. **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.¹⁸

D. Transmission Channels

42. **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 conditions. The basic VAR system containing growth rates is augmented by adding exogenous variables representing each channel.¹⁹ 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.²⁰ 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.

¹⁷ 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.

¹⁸ Results are available upon request.

¹⁹ This paper closely follows Bayoumi and Swiston (2009), where detailed discussions of this approach can be found.

²⁰ 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.

43. **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.²¹
- The financial channel is captured by short-term nominal interest rates, long-term nominal interest rates (ten-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.

44. **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 fluctuations.²² 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.

45. **For the full sample period, our decomposition yields a fairly good fit in explaining spillovers from U.S. to Australia and from Australia to New Zealand.** The

²¹Both trade and financial aggregates for emerging Asia are calculated using PPP-based GDP as weights.

²² See Nimark (2007) for a structural model on Australia.

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 U.S. in global financial markets and Australia's status as a net "capital" importer (Figure II.6). The share of Australia's exports to U.S. 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 U.S. to Australia. Coincidentally, Bayoumi and Swiston (2008) did not find commodity prices to be a main transmission channel for spillovers from U.S. to Mexico, an oil exporting country. They also found that spillovers from U.S. are mostly transmitted through financial variables.
- Spillovers from Australia to New Zealand are also found to transmit mostly through the financial channel (Figure II.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.

46. **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 $\frac{1}{4}$, 40 percent, and 20 percent respectively (Figure II.8). This result is consistent with developments during the last decade—emerging Asia 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 II.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.

E. Concluding Remarks

47. **This paper finds that shocks from emerging Asia have become more important than those from the U.S. 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.

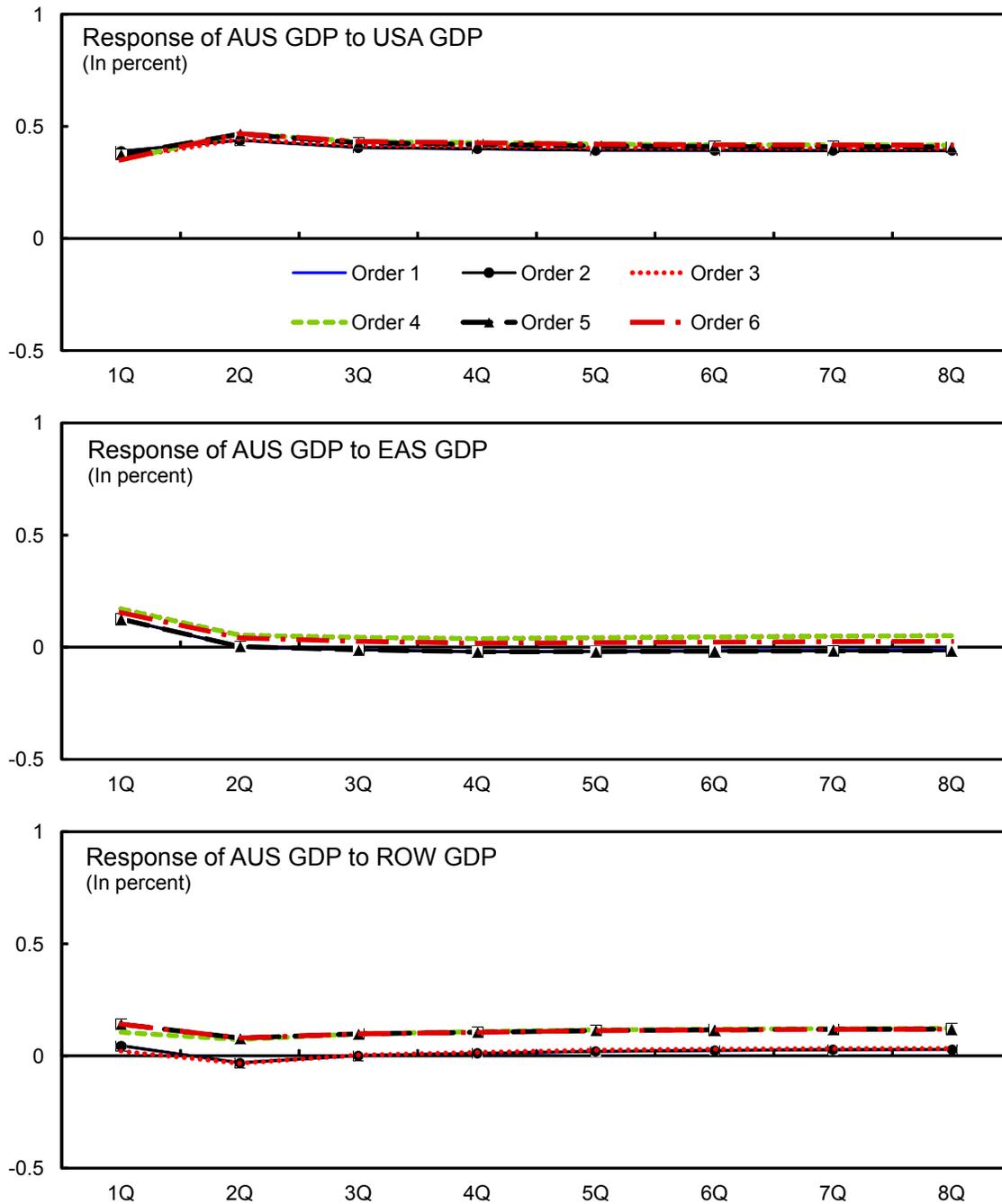
48. **The increasing ties with fast-growing emerging Asia present both opportunities and challenges.** This implies higher long-run growth as well as larger exposure to cyclical swings, particularly related to commodity prices and terms of trade. To reap the benefits while minimizing potential pitfalls, 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.

Table II.1. Average Variance Decompositions of Real GDP

Forecast available	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.

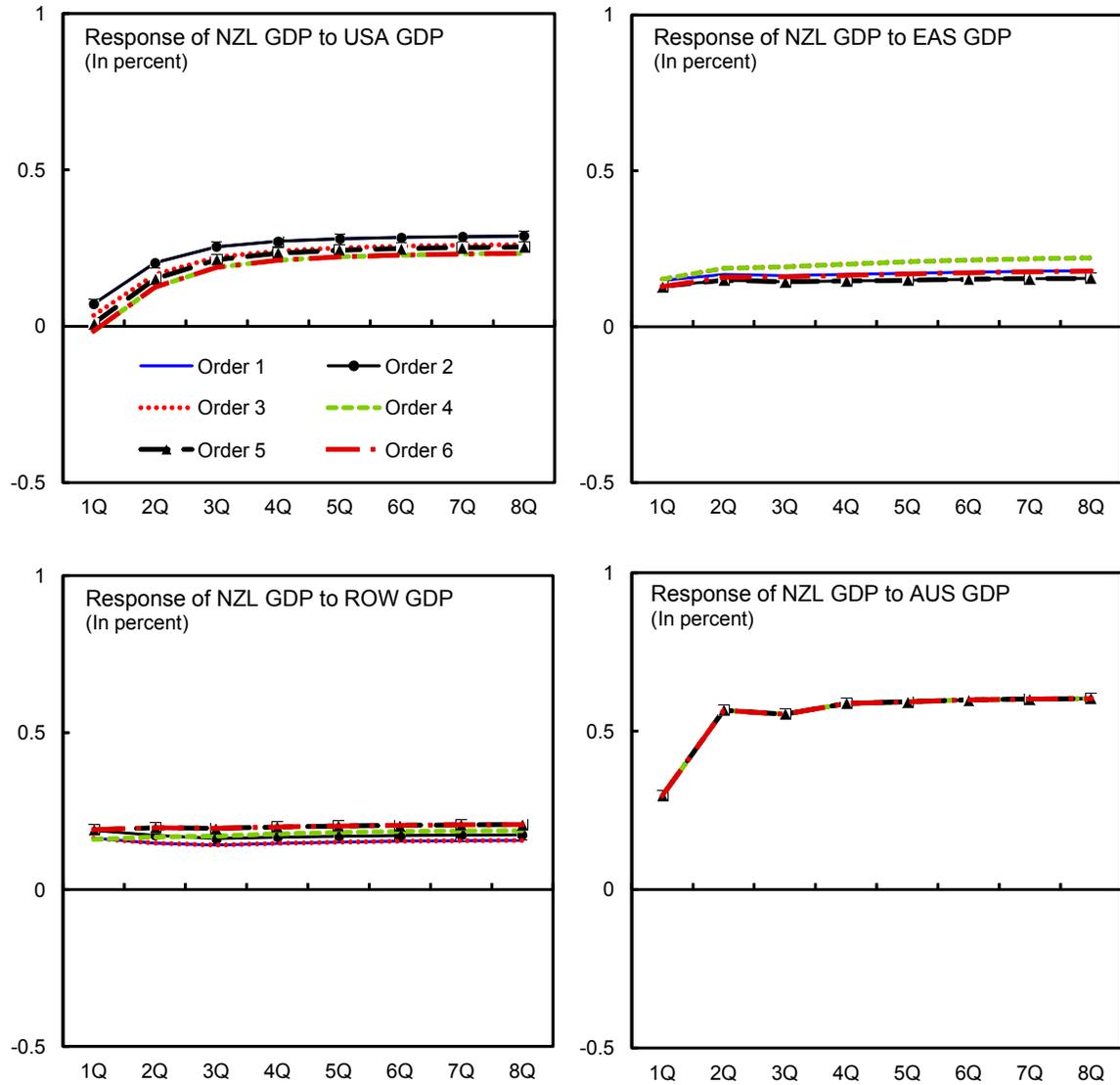
Figure II.2. Australia: Spillovers Across Six VARs (1991-2010) 1/
(In response to one percent shocks)



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.

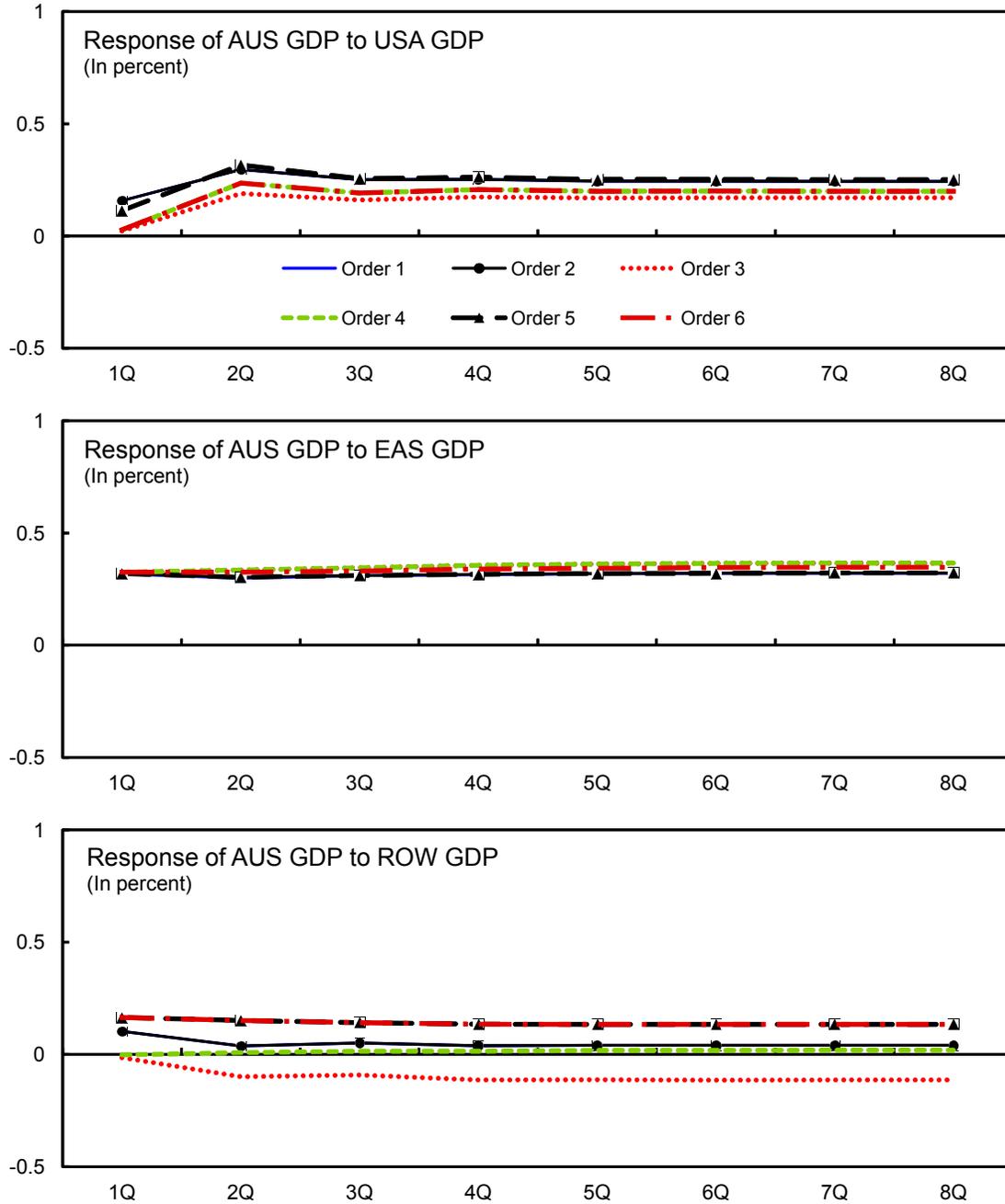
Figure II.3. New Zealand: Spillovers Across Six VARs (1991-2010) 1/
(In response to one percent shocks)



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.

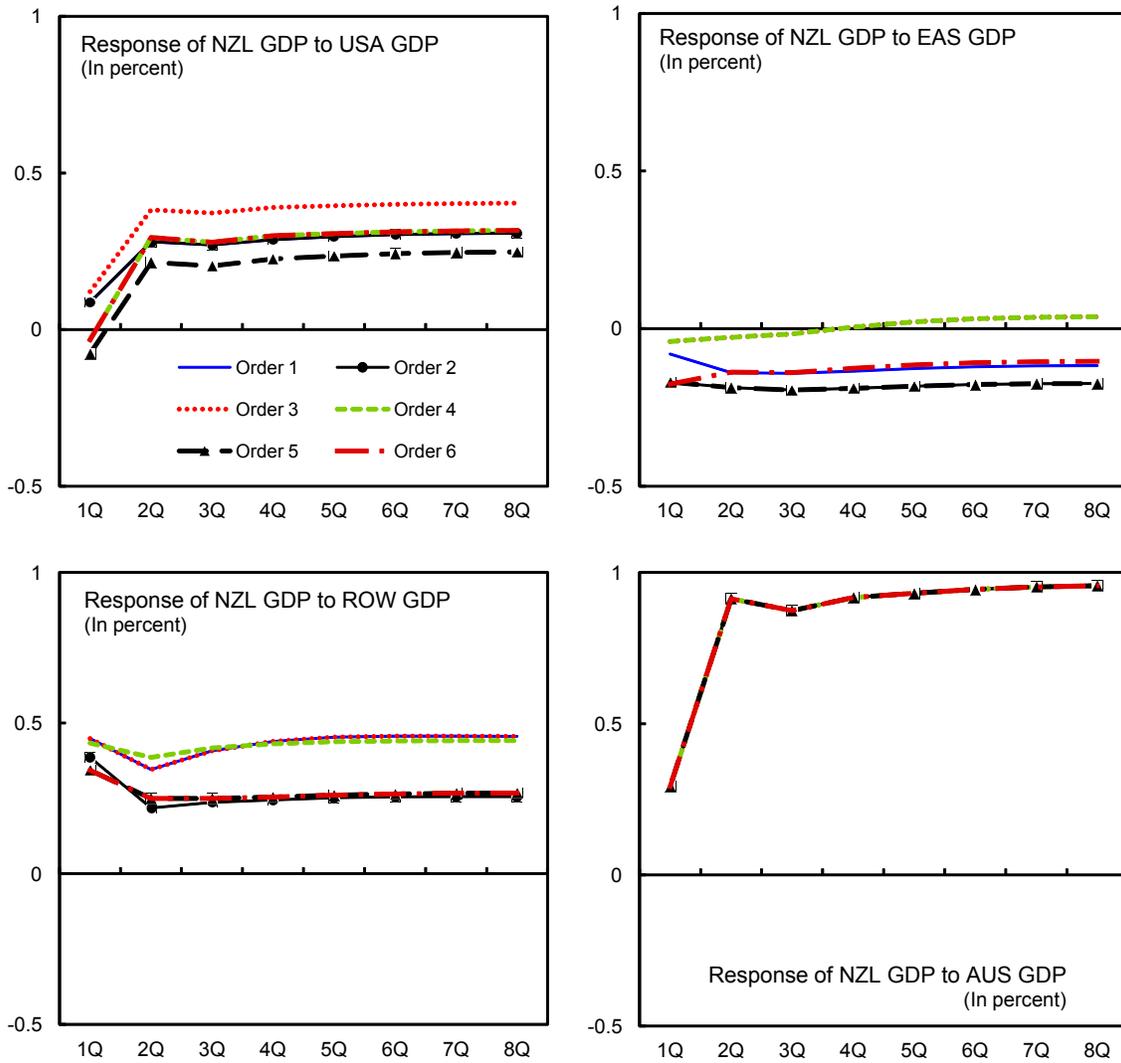
Figure II.4. Australia: Spillovers Across Six VARs (2000-10) 1/
(In Response to One Percent Shocks)



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.

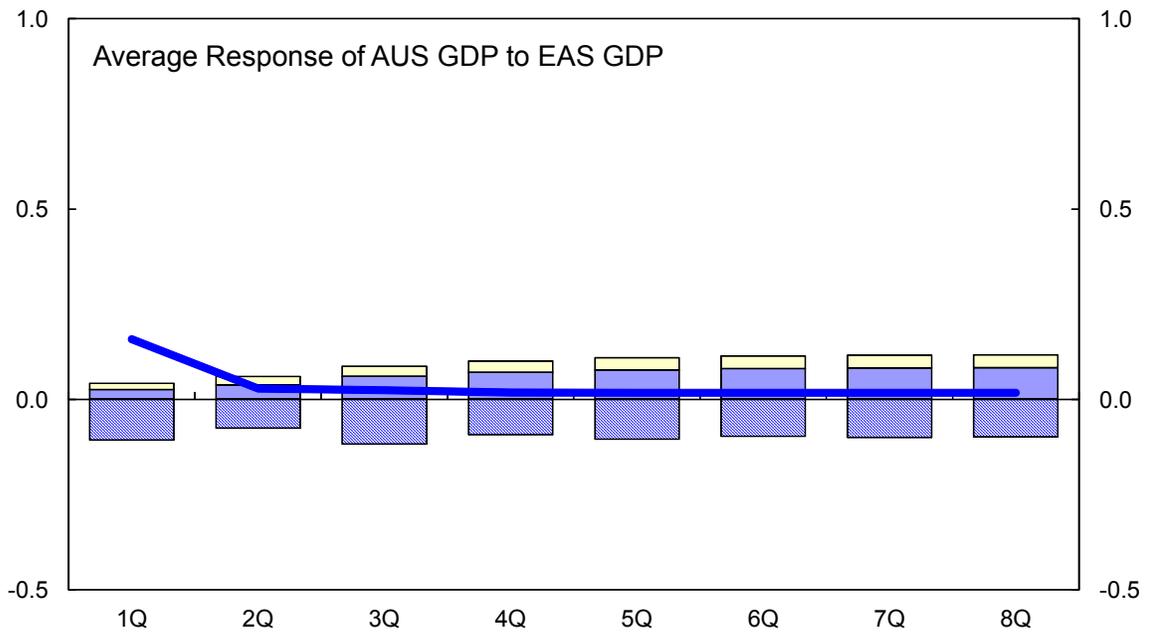
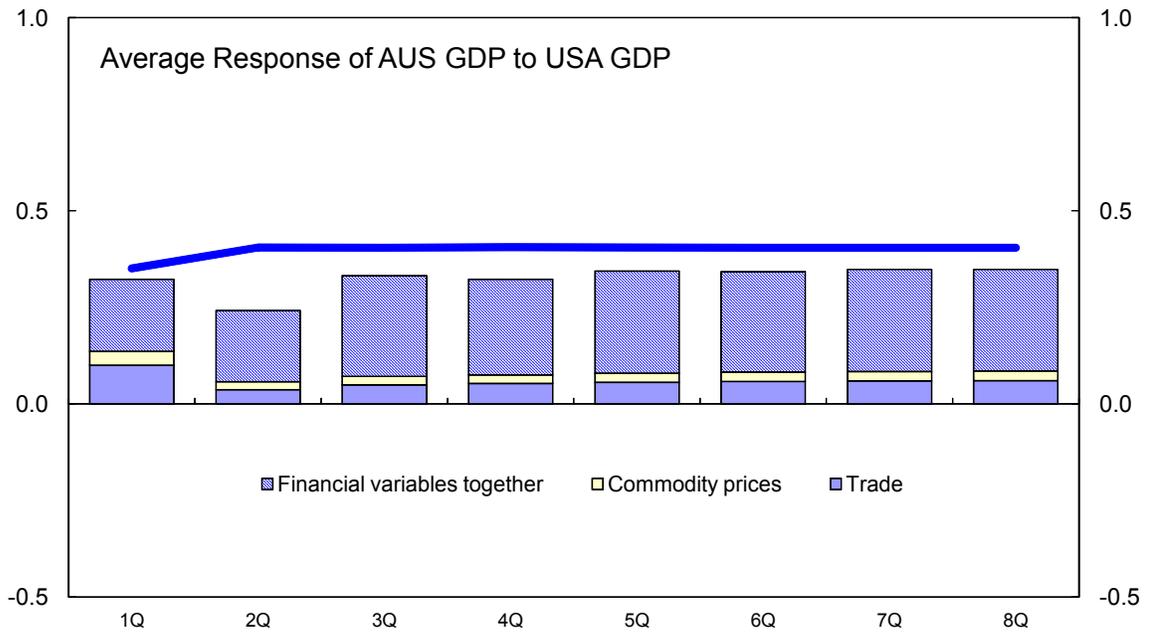
Figure II.5. New Zealand: Spillovers Across Six VAR (2000-10) 1/
(In Response to One Percent Shocks)



Source: Author's calculations.

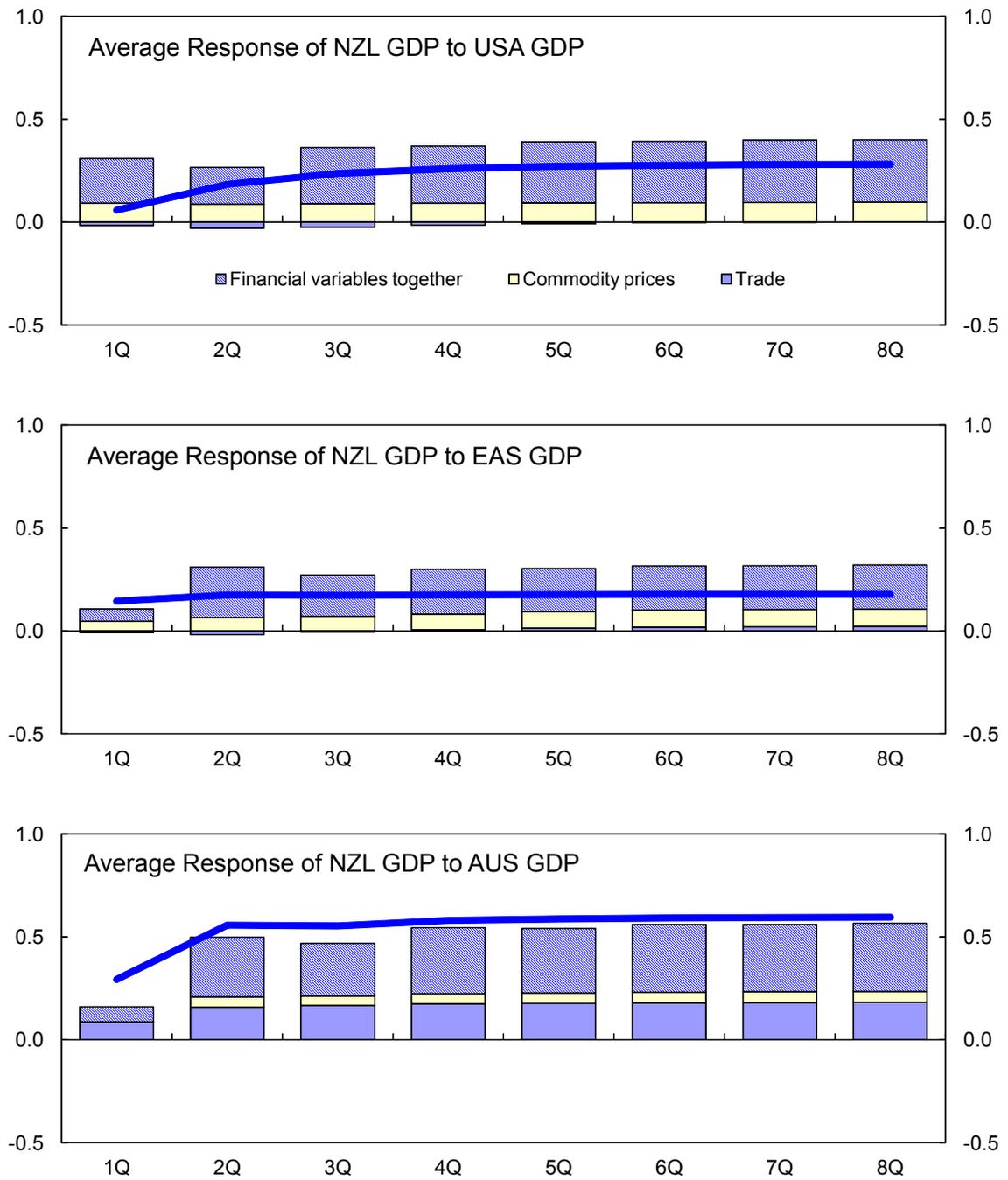
1/ VAR orders are defined as follows: (1) USA, EAS, ROW; (2) USA, ROW, EAS; (3) EAS, USA, ROW, (4) EAS, ROW, USA; (5) ROW, USA, EAS; and (6) ROW, EAS, USA.

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



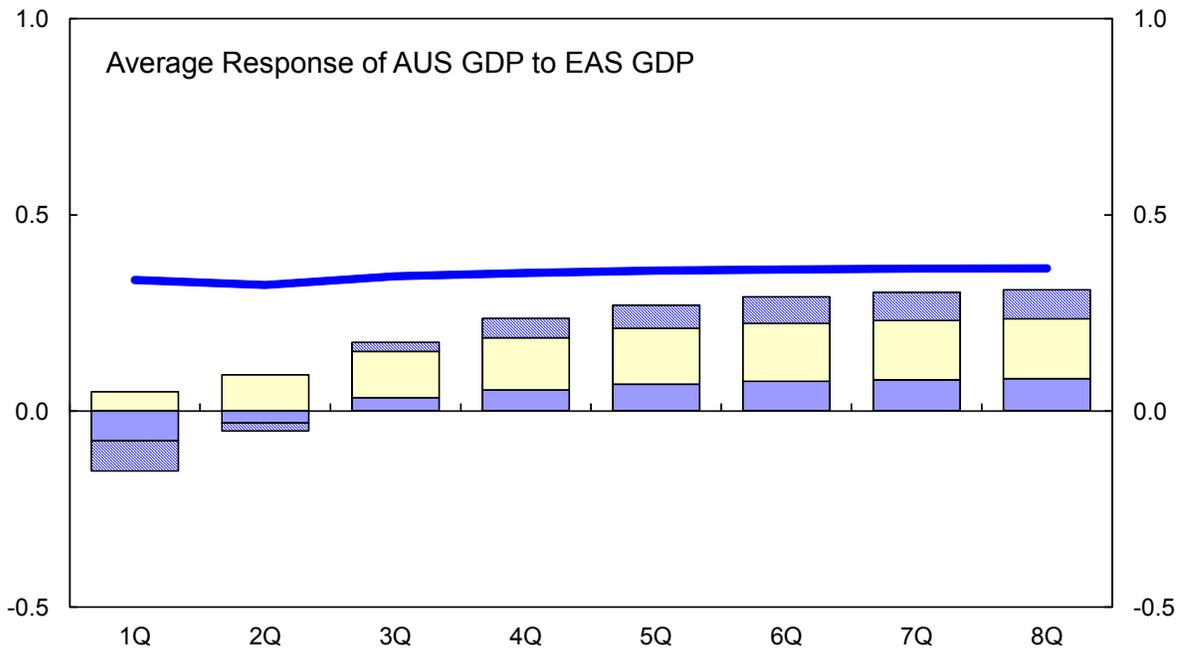
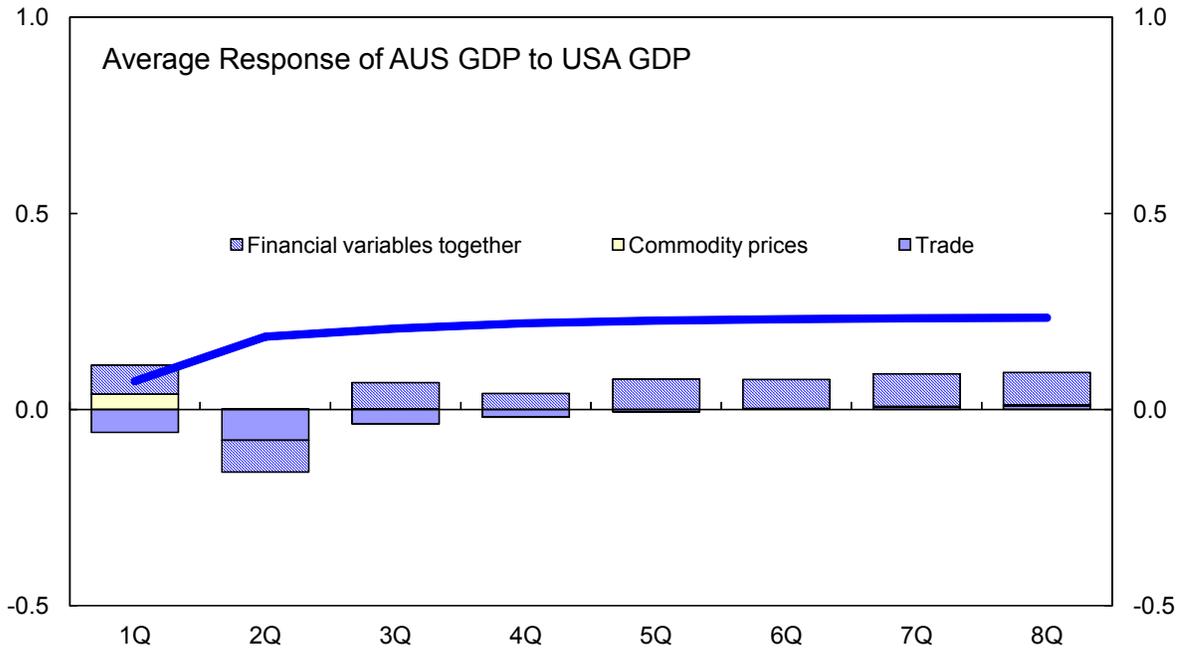
Source: Author's calculations.

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



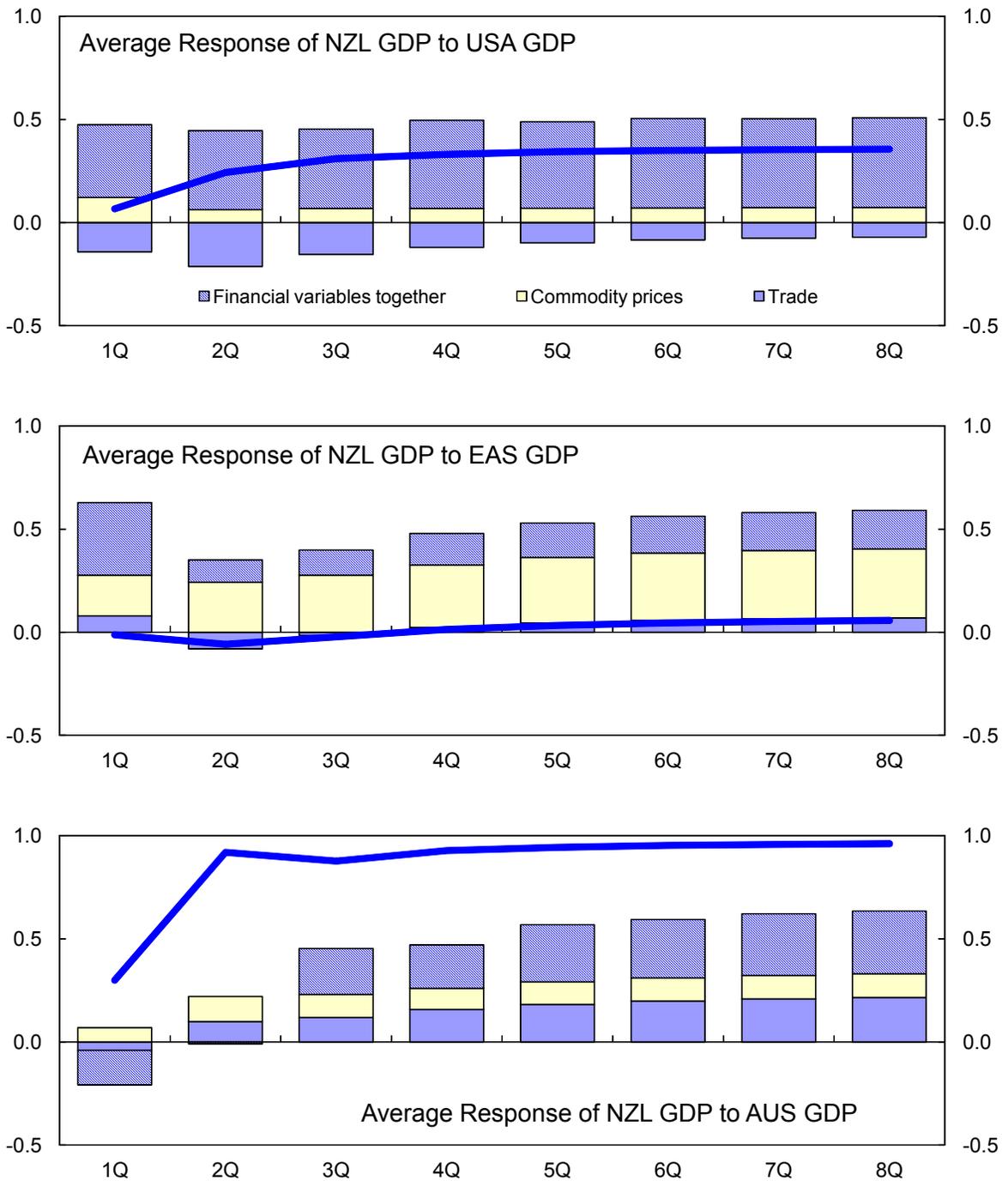
Source: Author's calculations.

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



Source: Author's calculations.

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



Source: Author's calculations.

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