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New Zealand: Selected Issues

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NEW ZEALAND

Selected Issues

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Approved by Asia and Pacific Department

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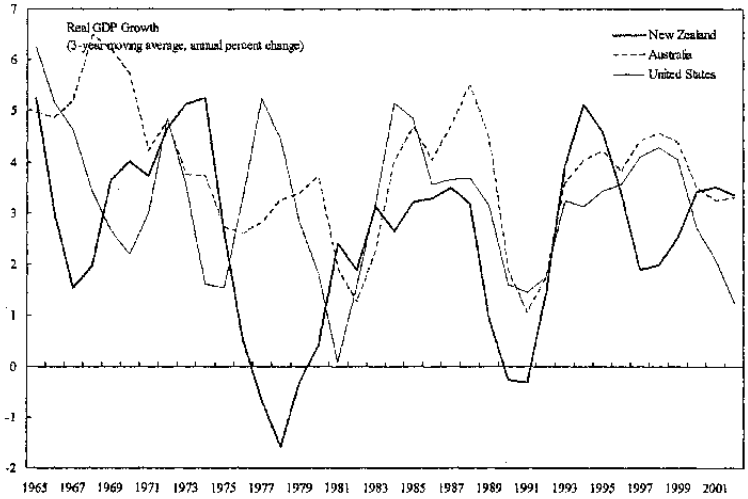
I. External Linkages of New Zealand's Economy[1]

1. New Zealand is a small open economy, whose dependence on trade and its close linkages to global financial markets tend to ensure that output performance and its volatility are closely linked to developments in the rest of the world. This significant dependence leaves New Zealand's growth prospects vulnerable to economic performance in key markets—particularly Australia and the United States. Trade flows are certainly the most observable transmission mechanism; however, financial markets are also an important channel through which the New Zealand business cycle is influenced by the Australian and the U.S. economies.



2. Over the last two decades, there has been a high degree of synchronization between fluctuations in New Zealand's economy and business cycles in Australia and in the United States. In particular, during the 1980s and the first half of the 1990s, output in New Zealand and Australia was closely correlated with the U.S. business cycle. From 1995 onward, however, the behavior of real GDP in New Zealand has differed from that in its two largest trading partners, largely reflecting the influence of New Zealand specific shocks. The Asian crisis and domestic droughts significantly slowed New Zealand's economic activity in 1998; subsequently, and despite the sluggish performance of the U.S. economy, activity rebounded on the strength of improving terms of trade and strong domestic demand.

3. Empirical results from vector autoregressive (VAR) models suggest that economic activity in Australia tends to have more of a significant direct impact on New Zealand than does activity in the United States. Fluctuations in U.S. GDP, however, appear to be transmitted to New Zealand indirectly through their effects on the Australian economy. Financial linkages also have been important components in transmitting shocks from Australia and the United States to the New Zealand economy. The analysis indicates that while Australian interest rate volatility has played an important role in explaining New Zealand real GDP fluctuations, United States equity prices has also had important effects on New Zealand economic activity.

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[1] Prepared by Eric Parrado (Ext. 3-4423), who is available to answer questions.

A. Regularities in the New Zealand Business Cycle

4. Compared to Australia and the United States, New Zealand has displayed lower growth rates and higher output volatility (Table 1). Although the output differential has been reduced in the post-reform period (1992–2002), New Zealand GDP growth still lags behind that of Australia. Similarly, the volatility of output growth in New Zealand has been lower during the post-reform period, but is still significantly higher than that observed in both Australia and the United States.

Table 1. New Zealand: Properties of GDP Growth Rates

Country	Means			Standard Deviations			Autocorrelations		
	1965-02	1965-83	1992-02	1965-02	1965-83	1992-02	1965-02	1965-83	1992-02
Australia	3.7	3.7	3.7	1.9	2.1	0.9	0.21	0.24	0.06
New Zealand	**2.5**	**2.3**	**3.1**	**2.5**	**2.7**	**1.8**	**0.30**	**0.40**	**0.13**
United States	3.2	3.1	3.1	2.1	2.6	1.2	0.18	0.12	0.24

Note: Sample moments were computed from log-differences of real GDP.
Sources: IFS and Fund staff estimates.

5. All the major expenditure components in New Zealand's GDP accounts are less volatile in the post-reform period, but volatility remains higher than in Australia and the United States. The major components with the largest volatility in New Zealand GDP have been investment, imports, and government expenditures. It is worth noting that for government expenditures the volatility is around twice that of the same component in Australia and the United States. One possible explanation is the considerable fluctuation in the national defense expenditure in New Zealand.[2]

6. Although the magnitude of output fluctuations has changed over time, the relationship among real variables within the New Zealand economy has been relatively stable. In New Zealand, similar to the business cycle regularities reported for some other industrial countries by Kydland and Prescott (1990) and Backus and Kehoe (1992), consumption, investment, and imports are strongly procyclical and contemporaneous with output (Table 2 and Tables A.1 and A.2). Government expenditure, however, since the beginning of the 1990s has become substantially less cyclical.

[2] In the 1990s, national defense expenditure growth fluctuated by more than 10 percent on average. In contrast, education and health expenditure growth rates fluctuated around 2 percent.

Table 2. Properties of National Expenditure Components

Properties by Country	1965-1983					1992-2002				
	C	G	I	X	M	C	G	I	X	M
A. *Standard Deviations*										
Australia	1.1	2.7	4.3	5.5	7.3	1.0	1.3	5.6	3.1	4.5
New Zealand	**3.6**	**5.3**	**11.9**	**4.3**	**9.8**	**2.1**	**2.1**	**8.6**	**1.9**	**3.9**
United States	2.0	3.1	6.1	5.9	7.5	1.2	2.0	5.7	5.3	5.5
B. *Standard Deviations Relative to GDP*										
Australia	0.6	1.4	2.3	2.9	3.9	0.8	1.0	4.6	2.6	3.7
New Zealand	**1.1**	**1.6**	**3.6**	**1.3**	**2.9**	**0.9**	**1.0**	**3.9**	**0.9**	**1.8**
United States	0.8	1.2	2.4	2.4	3.0	1.0	1.8	5.0	4.7	4.9
C. *Cross-Correlations with GDP*										
Australia	0.45	0.07	0.64	0.62	0.32	0.73	0.45	0.91	-0.14	0.74
New Zealand	**0.75**	**0.58**	**0.83**	**-0.31**	**0.60**	**0.88**	**0.02**	**0.97**	**0.45**	**0.80**
United States	0.88	0.27	0.95	0.31	0.76	0.81	-0.37	0.96	0.57	0.97

Note: Sample moments were computed from detrended series using the Hodrick and Prescott filter.
Sources: IFS and Fund staff estimates.

B. Relationship Between New Zealand, Australian, and U.S. Business Cycles

7. The correlation of business cycles in New Zealand, Australia, and the United States is assessed using the methodology proposed by Kydland and Prescott (1990). GDP for the three countries are detrended using the Hodrick-Prescott filter. Cross correlations between these detrended series, which serve as proxies for the cyclical component of GDP, were then calculated.[3] The analysis suggests that the New Zealand business cycle closely follows both the Australian and the U.S. cycles during the 1980s and part of the 1990s.[4] After the U.S. recession at the beginning of the 1980s, the three economies entered into an expansion period that lasted until 1989. Correlations of cyclical GDP continued to be strong through the following recession in the early 1990s and the subsequent recovery and expansion up until around 1995. The correlation turned negative when the U.S. and the Australian economies continued growing, while New Zealand experienced an economic slowdown and brief contraction in 1998 owing to the effects of two consecutive droughts and the Asian crisis. In contrast, New Zealand GDP growth has been relatively strong in comparison to the United States since 1999, as generally favorable commodity prices and the strength of domestic

[3] The detrended series is only a proxy for cyclical GDP because no attempt was made to eliminate any irregular component in the GDP time series.

[4] Between 1980 and 1995, the correlations between cycles are around 60 percent.

demand have kept New Zealand economic activity at high levels despite the U.S. slump (Tables A.3 and A.4).

8. VAR models have been commonly used to systematically assess the major influences on fluctuations in the New Zealand business cycle. In one of the most recent and comprehensive assessments using a VAR model, Buckle et al (2002) conclude that international variables, particularly world output, world equity prices, and world interest rates, have been the key sources of volatility in New Zealand's real GDP.[5] In addition, their analysis specifically accounts for domestic climatic conditions, given the importance of agriculture in New Zealand's economy, finding significant effects, especially, during the 1998 recession. Finally, and contrary to the conventional wisdom, this analysis suggests that shocks from the exchange rate have been relatively unimportant.

9. To complement the analysis in Buckle et al (2002), VAR models were estimated to identify the geographical sources of the external shocks that have influenced the New Zealand business cycle during the 1990s. The first model gauges direct economic linkages between New Zealand and Australia and the United States. The VAR model is estimated over the period 1991:Q1 to 2002:Q3, and captures the historical time series relationships between U.S., Australian and New Zealand GDP growth rates.[6] The econometric structure for the VAR model imposes the restriction that both Australian and New Zealand GDP growth do not influence U.S. GDP growth.

10. To evaluate the impact on the New Zealand economy of international economic fluctuations, the model is used to estimate impulse-response functions for Australian and U.S. GDP growth shocks. The results suggest that only the shock to Australian GDP growth has a significant direct impact on New Zealand economic activity (Figure 1). In particular, the peak impact from an Australian shock to New Zealand GDP growth occurs with a lag of two quarters and lasts one year; while there is no statistically significant effect in the case of a U.S. GDP shock.

11. A variance decomposition analysis suggests that Australian GDP growth explains a large share of New Zealand output volatility (Table 3). After two years, an Australian shock explains almost 25 percent of the fluctuations in New Zealand's output. By contrast, a U.S. GDP growth shock has relatively little direct impact on New Zealand output. Indirect

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[5] The effects of export and import price shocks to real GDP fluctuations have varied over time. The former shock has tended to have a relatively long cycle, while the latter, at least until the mid-1990s, has tended to be more volatile.

[6] The hypothesis of a unit root in the process generating the series in first differences, based on standard unit root tests, is rejected.

effects are likely to be significant, however, since Australia's GDP tends to be heavily influenced by developments in the U.S. economy (Figure 1).[7]

Table 3. New Zealand: Variance Decomposition of GDP

Forecast Horizon	*Std. Error*	*Proportion of Forecast Error (Percent)*		
		U.S. GDP	*AUS GDP*	*NZ GDP*
1	0.01	2.23	2.07	95.70
2	0.02	4.86	2.92	92.22
3	0.02	8.14	6.61	85.25
4	0.02	10.38	11.88	77.74
5	0.02	11.49	16.91	71.60
6	0.02	11.98	20.67	67.34
7	0.02	12.27	23.07	64.66
8	0.03	12.53	24.43	63.04

Source: Fund staff estimates.

12. The second set of VAR models introduces financial variables. Separate VAR models are estimated to gauge the influence of the Australian and the U.S. economies on New Zealand. The econometric structure of both models is identical, so results are directly comparable. These models use seven variables (in the same recursive order in the VARs): Australian (or U.S.) GDP, a commodity price index, Australian (or U.S.) short-term interest rate, Australian (or U.S.) equity price index, New Zealand equity price index, New Zealand GDP, and the New Zealand short-term interest rate.[8] The sample period runs from 1994:Q2 to 2002:Q3.

13. The results confirm the importance of the Australian business cycle in explaining the New Zealand business cycle. In particular, real domestic activity in Australia plays the most important role in explaining New Zealand GDP fluctuations (over 20 percent in the first year, Table 4). On the other hand, in line with the other results reported here, changes in U.S. GDP have relatively little direct impact on New Zealand output during the forecast horizon (Table 5).

[7] See also Cardarelli (2002).

[8] The VAR is estimated using four-quarter log differences for all variables, except interest rates, which are in levels. In terms of optimal lags, different tests recommend a diverse number of lags. For example, the likelihood ratio test (LRT) and the Akaike Information Criterion (AIC) and the Hannan-Quinn Criterion (HQC) suggest the use of two lags; while the Schwarz Bayesian Criterion (SBC) advises the use of one lag. The models estimated are specified with two lags. The unit root hypothesis for every series in the models is rejected at conventional confidence levels. Parameter stability tests across various subsamples suggest that the parameters of the models are stable.

Table 4. New Zealand and Australia: Variance Decomposition of New Zealand GDP

		Proportion of Forecast Error (Percent)						
Forecast	Std. Error	Commodity	Australia			New Zealand		
Horizon		Price	Equity Prices	GDP	Int. Rate	Equity Prices	GDP	Int. Rate
1	0.011	4.64	0.95	8.49	7.01	0.83	78.08	0.00
2	0.014	3.06	4.40	16.01	5.49	1.52	68.43	1.09
3	0.016	2.77	5.70	19.55	4.29	1.75	63.87	2.07
4	0.018	2.86	5.86	23.45	7.16	1.38	56.32	2.97
5	0.021	4.05	6.92	28.94	11.01	1.20	44.62	3.28
6	0.022	4.85	7.60	29.81	13.07	1.23	39.65	3.80
7	0.023	4.73	7.77	29.13	14.66	1.83	37.87	4.01
8	0.023	4.66	7.86	28.66	15.22	2.30	37.29	4.01

Source: Fund staff estimates.

Table 5. New Zealand and the United States: Variance Decomposition of New Zealand GDP

		Proportion of Forecast Error (Percent)						
Forecast	Std. Error	Commodity	United States			New Zealand		
Horizon		Price	Equity Prices	GDP	Int. Rate	Equity Prices	GDP	Int. Rate
1	0.011	0.21	12.63	0.03	0.11	5.85	81.16	0.00
2	0.013	0.44	13.59	3.70	3.55	4.10	73.77	0.84
3	0.016	5.86	21.28	3.16	3.91	3.01	59.46	3.32
4	0.019	7.57	27.71	2.31	3.45	4.34	45.42	9.21
5	0.021	8.15	33.32	1.96	3.04	4.32	36.88	12.34
6	0.023	7.97	39.73	1.96	2.75	3.78	30.92	12.89
7	0.025	7.23	43.91	2.23	2.79	3.34	28.22	12.28
8	0.026	6.57	45.98	2.67	3.15	3.21	27.18	11.24

Source: Fund staff estimates.

14. Both VAR models corroborate the importance of international financial linkages. In particular, together with Australian output, an Australian interest rate shock is one of the major sources of New Zealand real GDP fluctuations. In the case of the United States, real equity prices have played an important role in explaining New Zealand business cycle since the late 1990s. In general, New Zealand equity prices are more responsive to U.S. equity price shocks than to the Australian ones.

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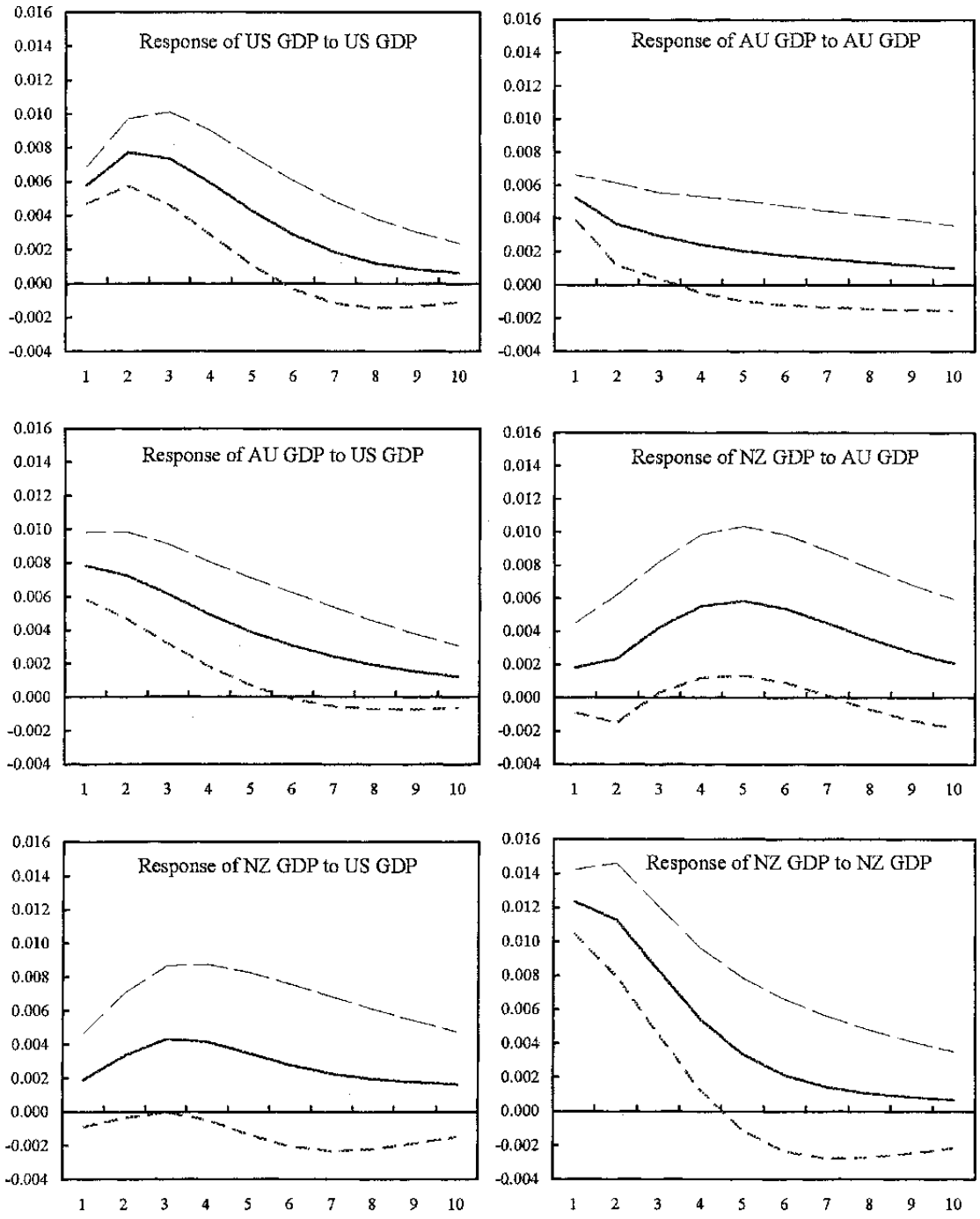
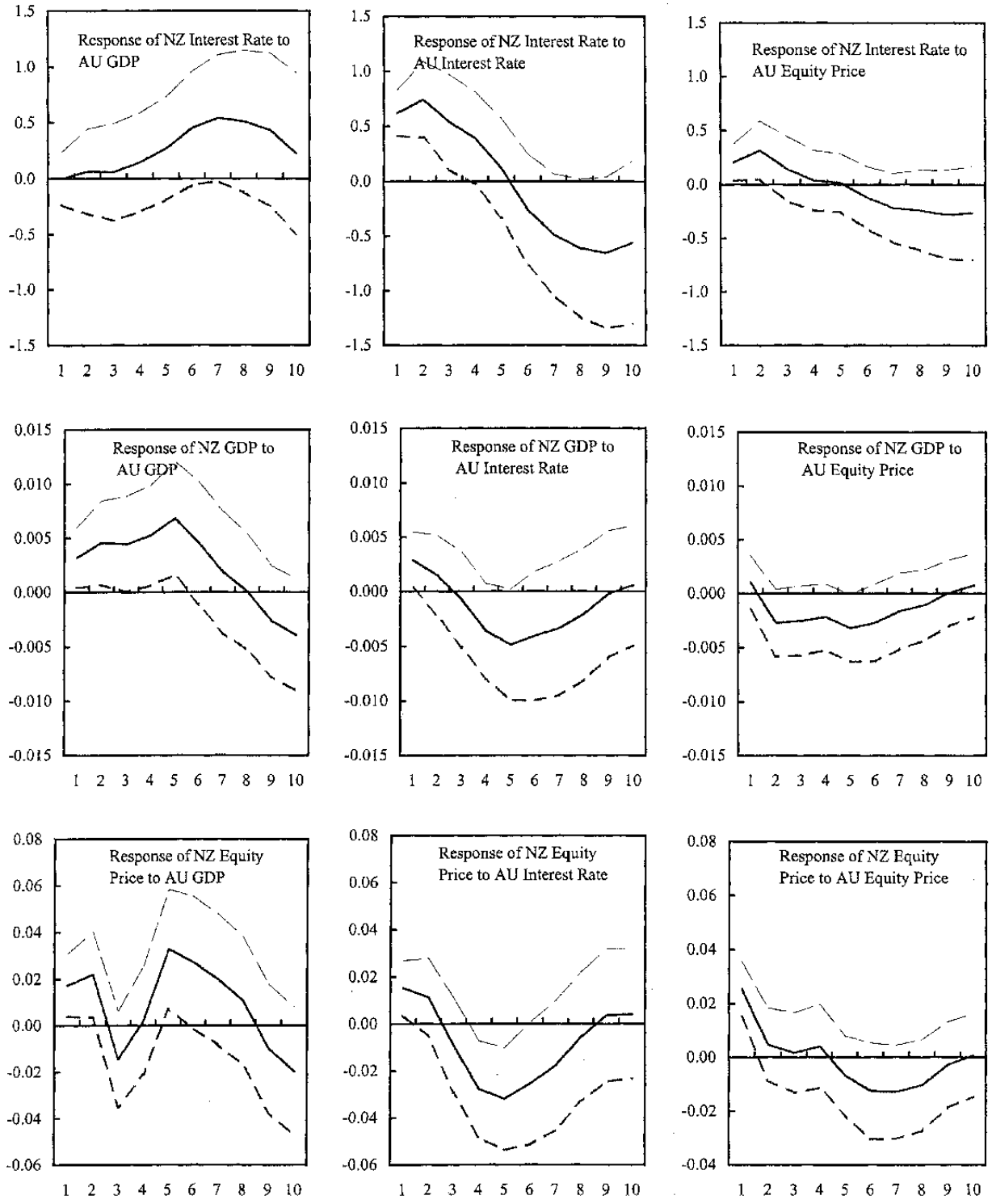
Figure 1. New Zealand: Impulse-Response Functions, GDP Shocks



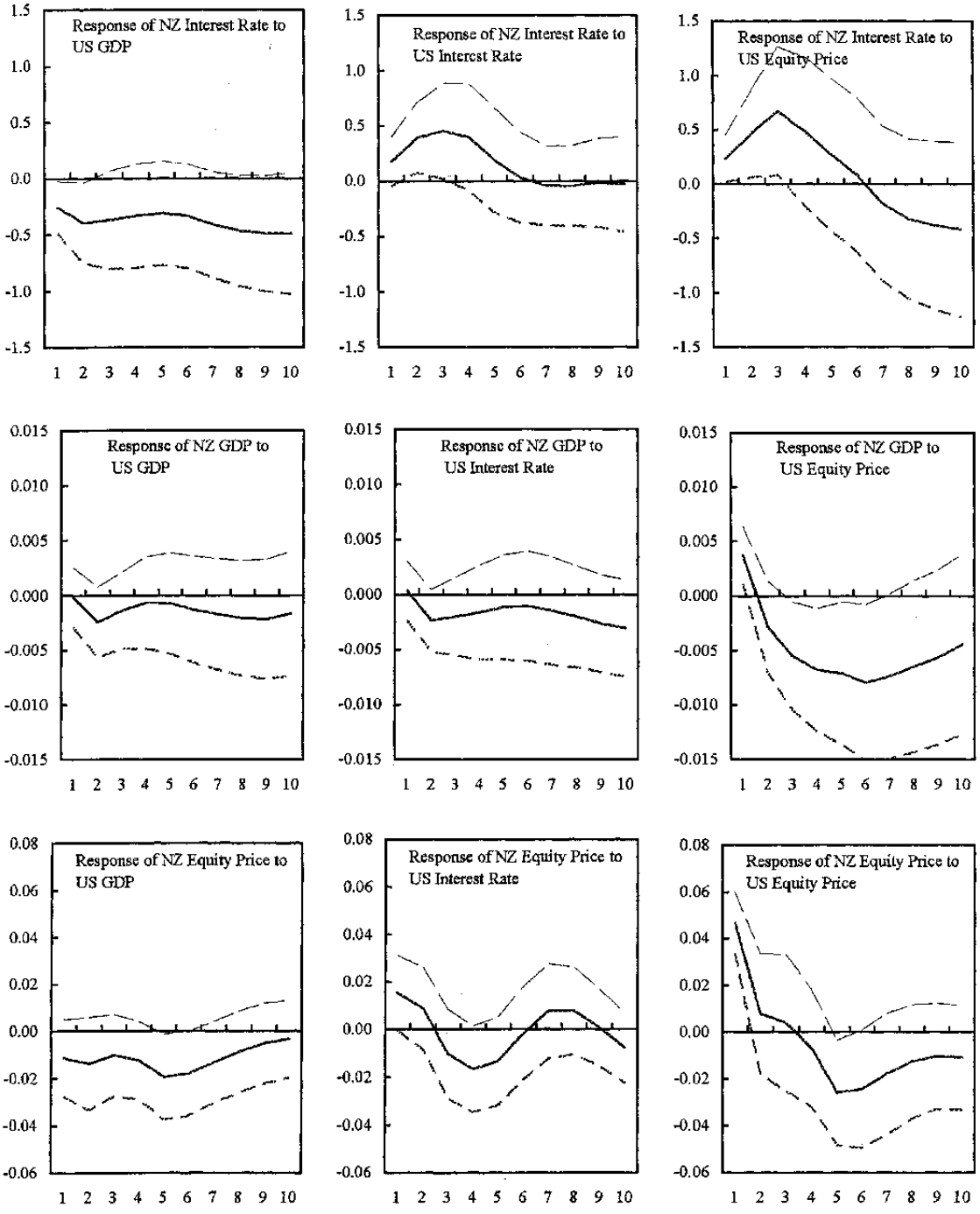
Source: Fund staff estimates.

Figure 2. New Zealand: Impulse-Response Functions, Australian Shocks



Source: Fund staff estimates.

Figure 3. New Zealand: Impulse-Response Functions, U.S. Shocks



Source: Fund staff estimates.

Table A.1. New Zealand: Properties of National Expenditure Components,1965–1983

	Cross-Correlation of GDP with								
	t-4	*t-3*	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
Australia									
GDP	-0.18	-0.10	0.05	0.46	1.00	0.46	0.05	-0.10	-0.18
C	-0.01	0.06	-0.11	-0.02	0.45	0.36	0.32	0.28	0.22
G	0.27	0.27	0.02	0.19	0.07	-0.27	-0.11	0.00	0.19
I	0.13	0.10	-0.15	-0.04	0.64	0.27	-0.03	-0.22	-0.44
X	-0.21	-0.03	0.32	0.40	0.62	0.26	0.09	0.06	-0.19
M	0.04	0.07	-0.12	-0.33	0.32	0.11	-0.24	0.05	0.00
New Zealand									
GDP	-0.49	-0.29	0.01	0.53	1.00	0.53	0.01	-0.29	-0.49
C	-0.17	0.21	0.53	0.75	0.75	0.40	0.03	-0.19	-0.31
G	-0.44	-0.29	-0.16	0.18	0.58	0.70	0.69	0.52	0.16
I	-0.12	0.28	0.56	0.82	0.83	0.46	-0.11	-0.46	-0.59
X	0.68	0.45	0.22	-0.07	-0.31	-0.37	-0.23	0.04	0.05
M	-0.06	0.20	0.42	0.63	0.60	0.21	-0.30	-0.30	-0.20
United States									
GDP	-0.38	-0.35	-0.05	0.51	1.00	0.51	-0.05	-0.35	-0.38
C	-0.31	-0.24	0.09	0.67	0.88	0.23	-0.30	-0.36	-0.14
G	0.02	-0.06	0.04	0.14	0.27	0.37	0.32	0.19	0.04
I	-0.35	-0.47	-0.19	0.45	0.95	0.45	-0.19	-0.40	-0.25
X	0.10	-0.14	-0.54	-0.35	0.31	0.49	0.14	-0.27	-0.49
M	-0.38	-0.33	0.04	0.48	0.76	0.24	-0.26	-0.25	0.01

Sources: IFS and Fund staff estimates.

Table A.2. New Zealand: Properties of National Expenditure Components, 1992–2002

	Cross-Correlation of GDP with								
	t-4	*t-3*	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
Australia									
GDP	-0.08	0.06	0.25	0.64	1.00	0.64	0.25	0.06	-0.08
C	-0.21	-0.12	0.04	0.38	0.74	0.84	0.45	0.23	0.11
G	-0.24	-0.20	-0.11	-0.06	0.45	0.89	0.59	0.27	0.13
I	0.01	0.18	0.40	0.70	0.91	0.43	-0.08	-0.13	-0.20
X	0.09	0.29	0.40	0.05	-0.14	-0.17	-0.44	-0.54	-0.52
M	0.08	0.25	0.41	0.51	0.74	0.44	-0.23	-0.41	-0.35
New Zealand									
GDP	-0.35	-0.34	-0.12	0.43	1.00	0.43	-0.12	-0.34	-0.35
C	-0.33	-0.39	-0.24	0.28	0.88	0.62	0.22	-0.03	-0.25
G	0.06	-0.05	-0.20	-0.26	0.02	0.36	0.69	0.42	0.04
I	-0.32	-0.34	-0.12	0.41	0.97	0.51	-0.03	-0.32	-0.44
X	-0.22	-0.04	0.19	0.36	0.45	-0.16	-0.81	-0.36	-0.08
M	-0.26	-0.29	-0.10	0.39	0.80	0.39	-0.05	-0.26	-0.44
United States									
GDP	-0.31	-0.13	0.10	0.61	1.00	0.61	0.10	-0.13	-0.31
C	-0.24	-0.30	-0.19	0.31	0.81	0.80	0.55	0.24	-0.02
G	-0.27	-0.45	-0.50	-0.50	-0.37	0.21	0.75	0.70	0.48
I	-0.21	-0.00	0.25	0.67	0.96	0.55	-0.03	-0.26	-0.38
X	-0.05	0.29	0.32	0.36	0.57	0.07	-0.57	-0.56	-0.51
M	-0.19	0.01	0.14	0.56	0.97	0.55	-0.02	-0.20	-0.34

Sources: IFS and Fund staff estimates.

Table A.3. New Zealand: International Correlations, 1965-1983

New Zealand	Cross-Correlation of Australia GDP with								
Cycle Fluctuations	*t-4*	*t-3*	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
GDP	0.20	0.12	-0.12	-0.11	0.16	0.28	0.37	0.34	0.31
Investment	0.18	0.04	-0.18	-0.17	0.07	0.33	0.48	0.36	0.21
Exports	0.08	0.22	0.41	0.54	0.41	0.18	-0.04	-0.17	-0.24
Imports	-0.20	-0.15	-0.29	-0.22	0.29	0.40	0.24	0.28	0.09
Prices	0.09	-0.11	-0.34	-0.71	-0.37	-0.19	-0.19	-0.11	-0.19
Nominal Exchange Rate		0.60	-0.19	-0.84	-0.41	-0.02	0.29	0.26	
Real Exchange Rate		0.24	0.10	-0.71	0.22	0.28	-0.04	0.19	
			Cross-Correlation of U.S. GDP with						
GDP	0.36	0.59	0.29	0.03	-0.08	-0.14	-0.18	-0.15	-0.08
Investment	0.43	0.41	0.13	-0.20	-0.28	-0.24	-0.16	-0.03	0.04
Exports	-0.19	-0.11	0.00	0.09	0.11	-0.16	-0.03	0.29	0.30
Imports	0.23	0.21	-0.08	-0.33	0.02	0.08	-0.15	-0.19	-0.14
Prices	-0.17	-0.01	0.14	-0.02	-0.21	-0.10	0.04	0.27	0.07
Nominal Exchange Rate		0.46	0.26	-0.55	-0.72	-0.40	0.31	0.41	
Real Exchange Rate		0.08	0.21	-0.34	-0.26	0.22	0.08	0.40	

Sources: IFS and Fund staff estimates.

Table A.4. New Zealand: International Correlations, 1992-2002

New Zealand	Cross-Correlation of Australia GDP with								
Cycle Fluctuations	*t-4*	*t-3*	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
GDP	0.32	0.50	0.35	0.33	0.45	0.14	-0.16	-0.28	-0.29
Investment	0.35	0.53	0.43	0.39	0.45	0.06	-0.26	-0.39	-0.34
Exports	0.39	0.17	-0.09	-0.33	-0.09	-0.13	-0.57	-0.37	-0.08
Imports	0.38	0.50	0.30	0.27	0.45	0.05	-0.49	-0.49	-0.35
Prices	-0.28	-0.22	-0.12	-0.19	-0.08	0.37	0.79	0.70	0.36
Nominal Exchange Rate	0.28	0.57	0.55	0.42	0.22	-0.20	-0.45	-0.43	-0.48
Real Exchange Rate	0.26	0.58	0.57	0.44	0.25	-0.12	-0.38	-0.42	-0.49
			Cross-Correlation of U.S. GDP with						
GDP	0.48	0.67	0.32	0.24	0.19	-0.04	-0.12	-0.15	-0.17
Investment	0.46	0.70	0.45	0.35	0.22	-0.14	-0.25	-0.26	-0.22
Exports	0.55	0.34	-0.32	-0.35	-0.02	-0.26	-0.37	-0.16	-0.09
Imports	0.51	0.53	0.31	0.44	0.23	-0.23	-0.37	-0.40	-0.27
Prices	-0.30	-0.17	-0.12	-0.30	-0.23	0.35	0.81	0.64	0.38
Nominal Exchange Rate	0.36	0.75	0.58	0.43	0.03	-0.47	-0.51	-0.43	-0.34
Real Exchange Rate	0.34	0.77	0.62	0.45	0.07	-0.39	-0.47	-0.42	-0.34

Sources: IFS and Fund staff estimates.

Data Sources and Definitions

Annual data

All data are in logarithmic form, seasonally adjusted. Source: International Financial Statistics (IFS).

Quarterly data

Real output: logarithm of real GDP, seasonally adjusted. Source: International Financial Statistics (IFS).

Real short-term interest rates: official cash rate (New Zealand), cash market (Australia), and the federal funds rate (U.S.) less the contemporaneous inflation rate derived from the consumer price index. Sources: Reserve Bank of New Zealand, Reserve Bank of Australia, and Federal Reserve Bank of St. Louis.

Commodity price index: logarithm of the ANZ commodity price index in New Zealand dollars. Source: ANZ.

Real equity returns: defined as

$$\log(rer_t) - \log(rer_{t-1}) = \left[\log(ner_t) - \log(ner_{t-1})\right] - \left[\log(p_t) - \log(p_{t-1})\right]$$

where *rer* denotes a real equity return index, *ner* is a nominal equity return index, and p is the consumer price index of the corresponding country. The nominal return is the total return (capital gain plus dividends) on the NZSE 40 index (New Zealand), the all ordinaries index (Australia), and the S&P 500 index (U.S.).

II. Explaining New Zealand's Savings Behavior[1]

1. The persistence of current account deficits (averaging about 4½ percent of GDP over the past decade) and the unfavorable comparison of New Zealand's average national savings rate to the OECD average (15½ percent versus 21 percent) have prompted concerns that New Zealand has a "savings problem". With rising government saving over most of the last decade, the main culprit is alleged to be private savings, particularly household savings. However, it is not clear whether savings in New Zealand can be characterized as "low". Cross-country comparisons of savings rates can be misleading because such factors influencing savings as institutional arrangements, financial market development, and societal preferences (especially time preference) may vary sharply between countries. A better test of the existence of a "savings problem" in New Zealand's case would be whether private and household savings behavior can be adequately explained by their fundamental determinants.

2. The analysis presented here based on econometric estimates of savings equations suggests there do not appear to be significant impediments or distortions in New Zealand that would give rise to a saving problem. A trend decline in the savings rate of New Zealand households is reasonably well explained by such fundamentals as higher public saving (i.e., partial Ricardian equivalence holds), higher government pension and income support transfers to individuals, increased household wealth, and improved access to credit. The long-term behavior of the private savings rate in New Zealand also is relatively well explained by its fundamental determinants, including higher net private foreign liabilities. However, the analysis illustrates the important effect that government pensions and income support transfers have on the level of savings. The government also has a significant effect on saving through the public provision of health care services.[2] Hence, it could be the case that some kind of "savings problem" might exist if households were mistaken in their expectations that future pension and health care costs would be met by the government without major increases in taxes or reductions in benefits.

A. Recent Trends in Savings

3. Throughout the period since 1980, New Zealand's gross national saving rate has been substantially below the average for OECD countries, with the differential widening during the 1990s (Figure 1). New Zealand, however, has not been the only important outlier from the OECD average. During the 1990s, in particular, both Australia and the United States had gross national saving rates significantly below the OECD average, although these countries managed to raise national savings over the period, in contrast to New Zealand. The key difference among the three countries was the behavior of public savings. New Zealand

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[1] Prepared by Uma Ramakrishnan (Ext. 3-5413), who is available to answer questions.

[2] In the absence of publicly provided health care, savings would generally be expected to be higher, as households would have to save more for precautionary purposes.

managed to raise the level of the public saving rate faster and to a higher level than Australia or the United States in the first half of the 1990s. Through the end of the 1990s, while the public saving rate leveled off in New Zealand, it continued to grow in Australia and the United States. Meanwhile, throughout the decade, all three countries experienced a somewhat similar trend decline in the household saving rate, which was offset in large part by some improvement in corporate savings. Although cross country comparisons of savings are fraught with difficulties owing especially to differences in institutional arrangements, financial market development, and time preferences, the similarities in the trend in the household saving rate in New Zealand, Australia, and the United States is interesting and may suggest that these trends reflect the influence of similar factors.

4. The private saving rate in New Zealand exhibited no significant trend over the period since 1980; however, as noted above, this masks sharp differences in the behavior of households and corporations. Household savings as a share of GDP has fallen throughout the period, declining from some 7 percent of GDP in 1980 to –1 percent of GDP in 2000 (Figure 2). In contrast, the corporate saving rate has been gradually increasing during this period, with a sharp spike upward between late 1980s and early 1990s during the period when major economic reforms were being implemented. Overall, the gap between the household and corporate saving rates has been increasing over time.

5. Part of the explanation for the decline in household saving may relate to measurement issues. Household saving based on the National Income and Outlay Accounts (NIOA) is derived as a residual of current income and expenditure, and consequently, may be subject to substantial bias.[3] Income and expenditure are very large components; therefore, measurement errors in each of these will be transmitted to and can be potentially magnified in the savings measure. There is also a potential bias owing to the classification of certain household expenditures as consumption and not investment. For example, expenditures on education and durable household goods are treated entirely as consumption, when they might be better classified as investment. Certain investments in land and natural resources, particularly by unincorporated businesses which are considered to be part of the household sector, are treated as expenditures, biasing household saving downward.[4]

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[3] For detailed discussions of potential bias in measuring household savings, see Joint Working Group (1999), Claus and Scobie (2001 and 2002).

[4] Another technical factor contributing to the low level in household savings is the definitional change in national savings between the 1968 System of National Accounts (SNA) and the revised 1993 version of the SNA. However, comparison of available data by both definitions (for the period from 1987 to 1999) indicates that the savings level shifted but the underlying trend did not change. In this paper, the 1968 SNA definition is used since a longer time series is available.

6. Household saving can be defined more broadly to capture the change in real net wealth. Accordingly, an alternative savings measure can be derived from the household balance sheet accounts. On this basis, the saving rate expressed as the change in household net wealth as a share of disposable income is significantly larger than the NIOA measure (Figure 2). However, the balance sheet measure of household saving is also subject to significant measurement bias. As noted in Thorp and Ung (2001), New Zealand household liabilities are likely to be exaggerated since some portion of home mortgages effectively are used to fund small businesses.[5] This measure of household savings may also be biased downward because: (i) real assets do not include household durables, (ii) investment in non-financial assets—such as forestry—are not captured, (iii) net farm wealth is not included, and (iv) the value of household investment not priced through the stock exchange are excluded.[6] Nevertheless, both measures of the household saving rate suggest a similar trend decline over the period 1980-2001.

B. Determinants of Savings

7. An empirical test for the existence of impediments or distortions that may affect savings is whether the savings rate can be adequately explained by its long-term fundamental determinants. Empirical models of household savings are typically based on some form of life-cycle hypothesis.[7] Generally, the household saving rate is expected to be positively correlated with such determinants as inflation and possibly with real interest rates. It is negatively correlated with the budget balance (or government savings, reflecting some degree of "Ricardian equivalence"), pension and other income support transfers from government, household net financial wealth, innovations in the financial markets that improve household access to credit, and an aging population. A model for private savings can be seen as an extension of the household model. Accordingly, the private saving rate could be specified as being related to most of the same variables as the household savings rate, plus some additional ones such as net foreign liabilities of the private sector (to capture access to credit of the corporate sector).

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[5] Some 85 percent of household liabilities are housing loans. Estimates of household loans used for business purposes are in the range of 10-20 percent of housing loans (whereby the business borrowing is secured on residential property).

[6] For 2000, the estimated net real farm wealth was about 17 percent of current net wealth (around NZ$40 billion).

[7] See Edwards (1996) and Masson, Bayoumi, and Samiei (1998) for a review of the literature. Choy (2000) provides the most recent empirical estimates for New Zealand.

8. Separate equations were estimated to explain New Zealand's household and private saving rates applying cointegration theory.[8] These equations were estimated using annual data for the period 1982–2001.[9] The estimation results suggest that the fundamental determinants adequately explain the long-term behavior of the household saving rate (Table 1 and Figure 3).[10] The results indicate that tighter fiscal policy, increased government transfers to households through pensions and other income support programs, improved access by households to credit, higher household net financial wealth, and higher housing value explain most of the trend decline in the household saving rate.[11]

9. The equation for the private savings rate also adequately explains its long-term movements. The equation suggests that private sector net foreign liabilities act as a fairly significant substitute for domestic savings. Coefficients for the variables for pension and other income support transfers to the private sector, dependency ratio, and easier access to credit from financial innovation have the expected signs and are statistically significant. Inflation has a positive effect as the private sector tries to offset a decline in the real value of non-indexed assets and to compensate for the increased uncertainty regarding future income. The estimated values from the equation suggest that there remains some short-term noise in the movements in the private saving rate, particularly during the period from the late-1980s to the early-1990s—when economic reforms were underway. The fitted values are lower than the actual saving rates during this period which could suggest that corporations were spending more cautiously given the uncertainties associated with the reforms.[12]

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[8] The equations were estimated using the Phillips-Hansen fully modified OLS (FMOLS) procedure. This method estimates the long-run parameters by correcting for serial correlation in the residuals without having to explicitly specify the dynamics of the model. It is a valid procedure when there exists a single cointegration equation and when the explanatory variables are not themselves cointegrated. For details, see Phillips and Hansen (1990).

[9] Explanations on the derivation of the variables used and sources for the data are provided in the Annex.

[10] Inflation and the real interest rate variables were dropped in the final specification of the household savings equation because they were statistical insignificant, to keep a parsimonious specification.

[11] The pension and income support variable is defined in a manner that the dependency ratio is effectively imbedded in it.

[12] Another explanation could be that corporate profits may have been "overstated" in periods of high inflation from larger depreciation allowances and inventory valuation. This might also explain why inflation is a significant determinant of private savings but not household savings.

10. The empirical evidence points to the significant influence on savings stemming from government pension and other income support transfers. Government financed health care also can be thought of as having a significant impact on household savings, but it cannot be easily modeled empirically. Thus, current household savings decisions can be seen as being heavily conditioned on the expectation that the government will meet its pension and health care obligations without significant changes in the future burden of taxation or a reduction in benefits.[13] Hence, although the empirical evidence indicates that household and private saving behavior are well explained by their long-term determinants, a significant distortion could exist and savings could be "too low" if the government were not to meet its future pension and health care obligations on the terms that households expect.

[13] Gibson and Scobie (2001) find that savings behavior varies across households and a very large share of total household savings comes from a small number of high-income households. There is also some preliminary evidence in the paper that the tax and benefit system has treated different cohorts differently which may partly explain low savings rates among some cohorts.

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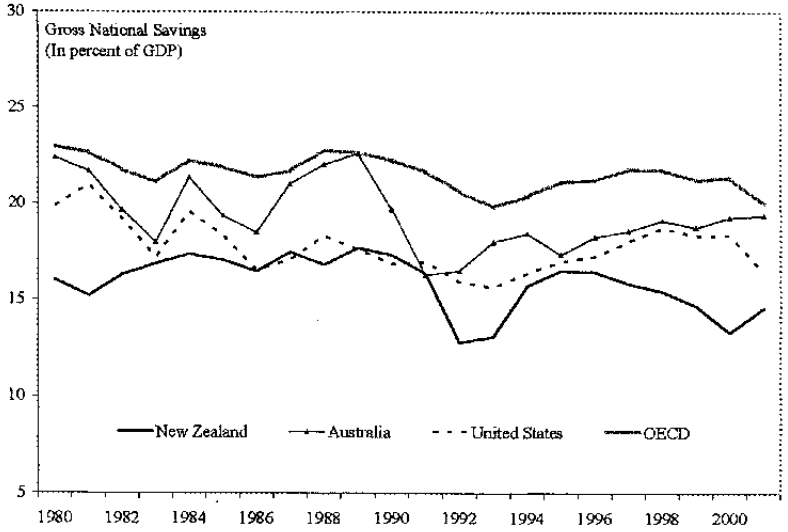
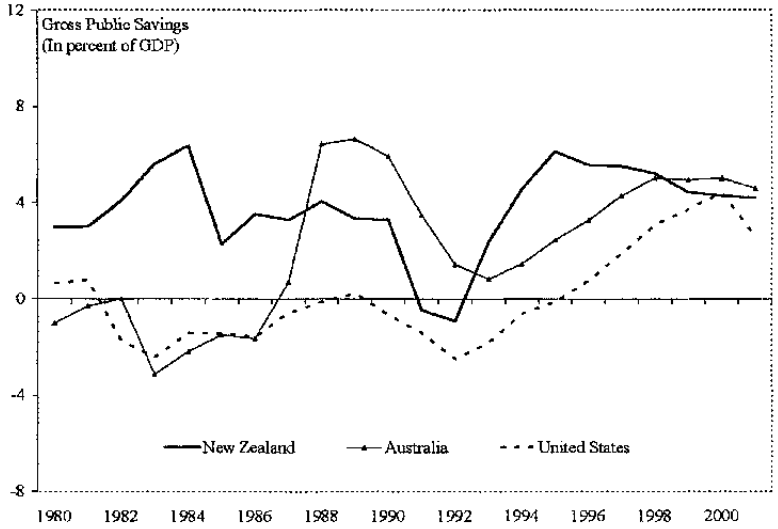
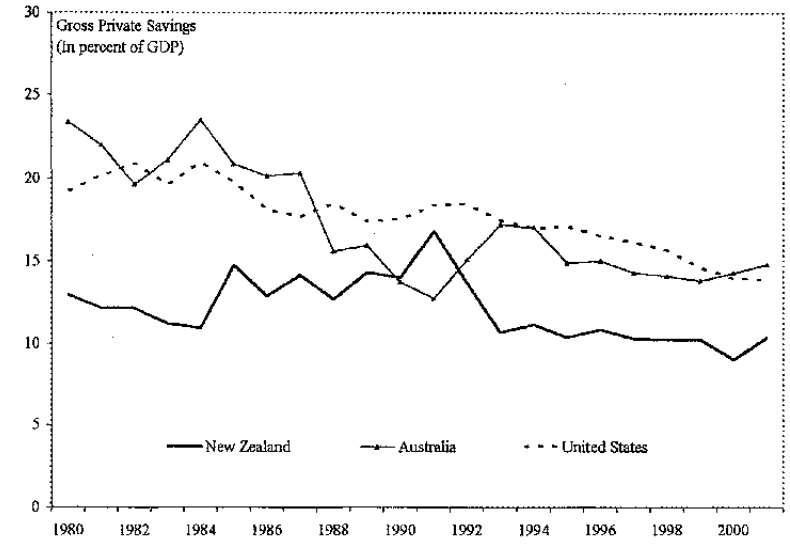
Figure 1. New Zealand: International Comparison of Savings







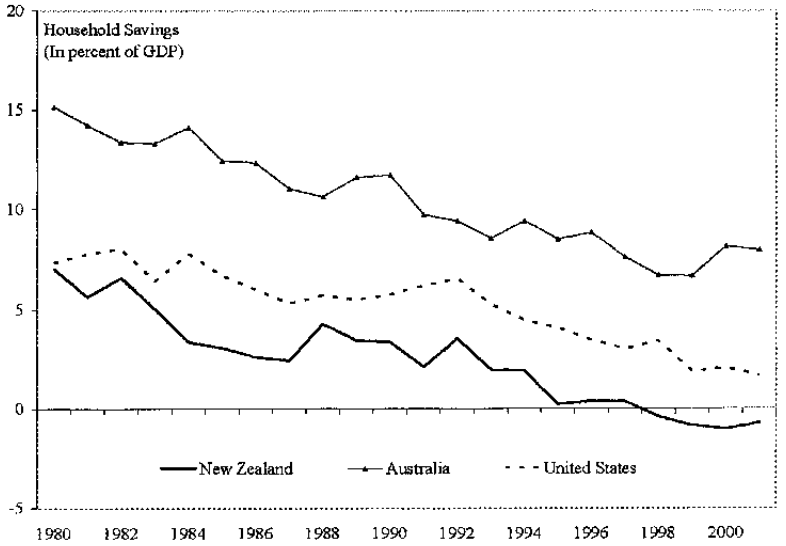
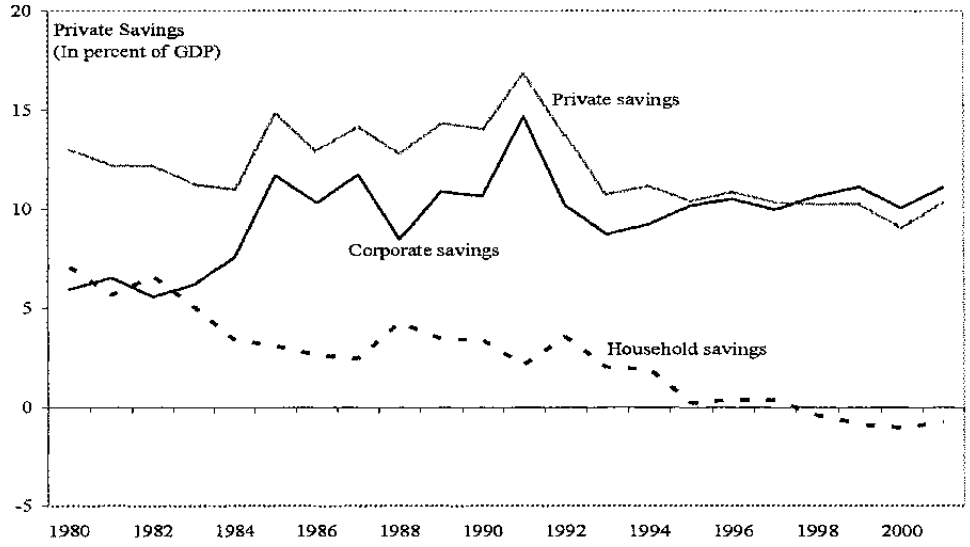
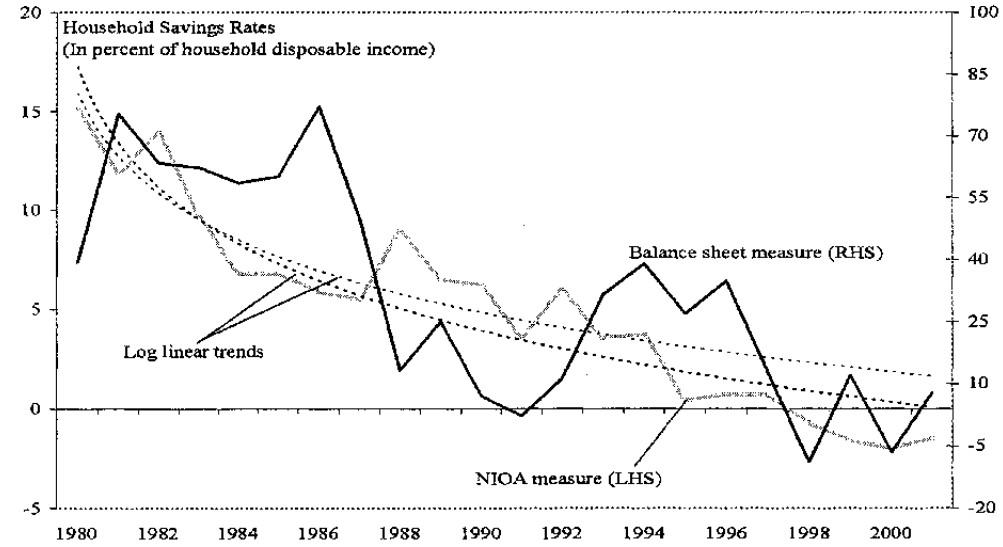


Figure 2. New Zealand: Household Saving Rates





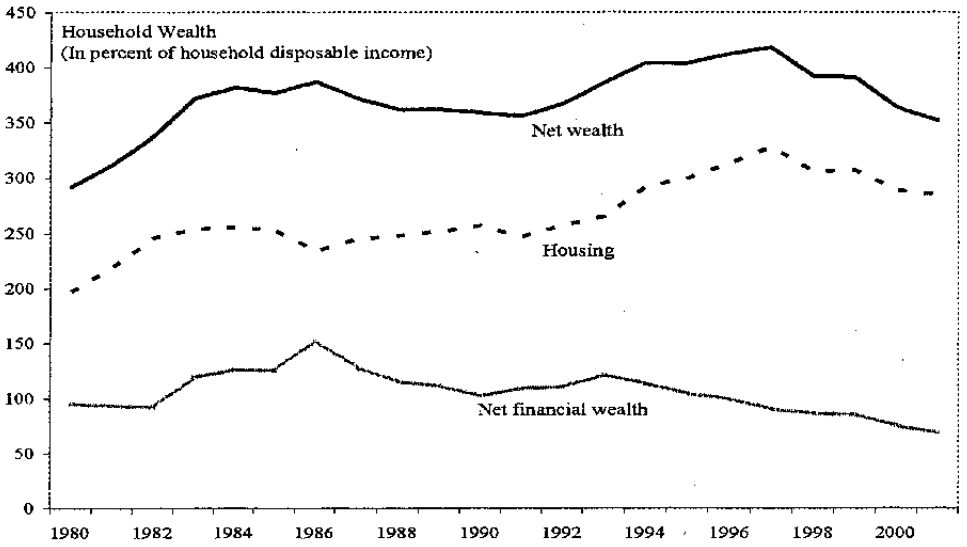
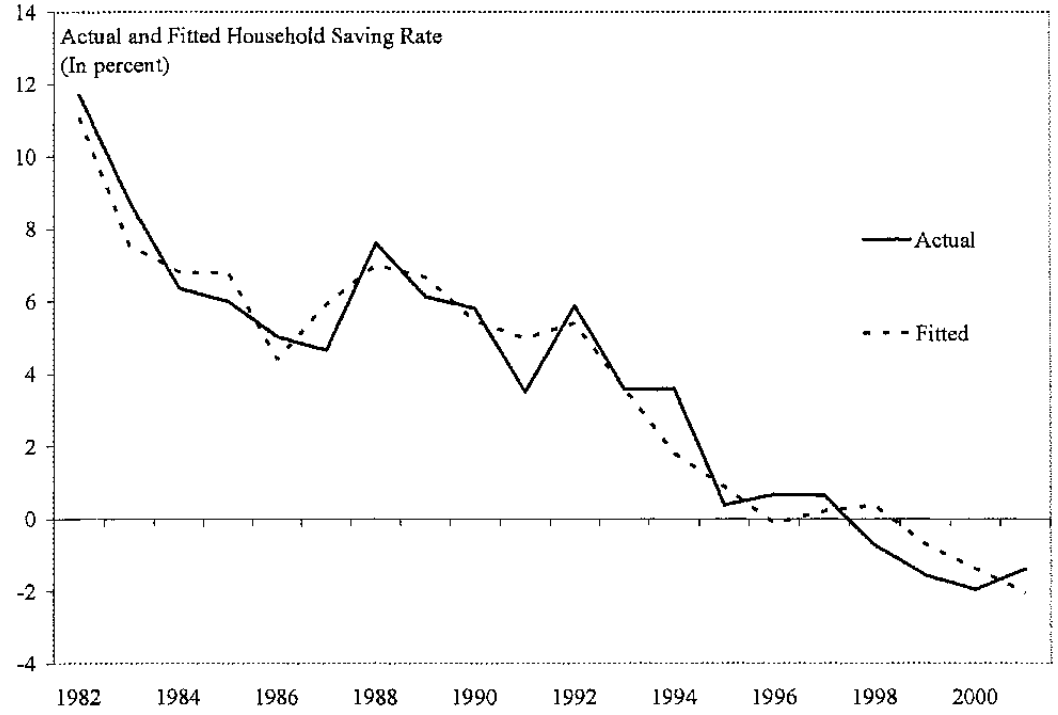


Figure 3. New Zealand: Estimates of Saving Rates



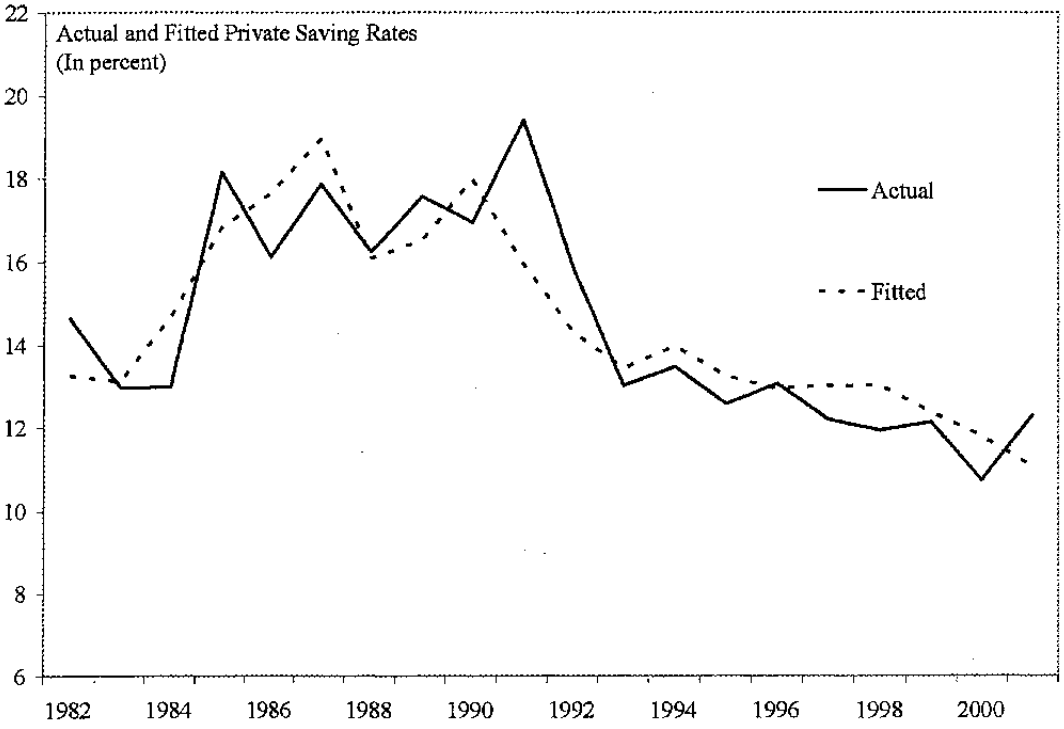


Table 1. New Zealand: Savings Equations

Estimated Equation for the Household Saving Rate
Estimation period: 1982–2001

	Coefficient	Std. error	Prob. Value
Intercept	30.820	2.252	0.000
Government balance	-0.283	0.089	0.007
Pension and income support	-0.062	0.011	0.000
Household net financial wealth	-0.082	0.009	0.000
Housing value	-0.020	0.009	0.041
Credit card debt outstanding	-0.033	0.002	0.000

Estimated Equation for the Private Saving Rate
Estimation period: 1982–2001

	Coefficient	Std. error	Prob. Value
Intercept	123.99	14.117	0.000
Pension and income support	-0.622	0.157	0.001
Dependency ratio	-1.567	0.230	0.000
Inflation	0.083	0.043	0.074
Private sector net foreign liabilities	-0.096	0.049	0.072
Credit card debt outstanding	-0.036	0.013	0.012

Source: Fund staff estimates based on Phillips-Hansen Fully Modified OLS.

Data Sources and Definitions

The sample period for the estimations is from 1982 to 2001. The definition and sources for each variable are as follows:

Household saving rate is the ratio of household savings to personal disposable income. Sources: National Income and Outlay Accounts, Statistics New Zealand, New Zealand Treasury.

Private saving rate is the ratio of private sector savings (gross national savings minus public savings) to private sector disposable income which is derived as the sum of household disposable income and net of tax operating surplus plus subsidies. Sources: National Accounts, Statistics New Zealand, New Zealand Treasury, and staff estimates.

Government balance is the ratio of central government balance to GDP. Source: IMF World Economic Outlook database.

Pension and other income support is the ratio of social security and welfare payments per recipient to the per capita household disposable income. In the private savings equation, it is computed as a ratio to total government current expenditure. Sources: Social Welfare Benefits, Statistics New Zealand, and IMF Government Financial Statistics database.

Household net financial wealth is the ratio of household financial assets less liabilities to household disposable income. Source: Thorp (2002).

Housing value is the ratio of the value of housing to household disposable income. Source: Thorp (2002).

Credit card outstanding is the ratio of credit card debt outstanding to disposable income. For households, the credit card debt outstanding was estimated by applying the average ratio of household credit card debt outstanding to total credit card debt outstanding during the period for which such data are available (from June 2000 to October 2002). Source: Monetary aggregate data, Reserve Bank of New Zealand.

Dependency ratio is the ratio of population under 15 years and over 65 years to the working age population. Sources: Statistics New Zealand, New Zealand Treasury.

Inflation equals the percentage change in the consumer price index. Source: Statistics New Zealand.

Private sector net foreign liabilities equals the cumulative current account balance net of government overall balance as a ratio to GDP. Sources: Statistics New Zealand, IMF Government Financial Statistics database, and staff estimates.

III. The Determinants of Interest Rate Spreads in New Zealand[1]

1. Historically, New Zealand has relied heavily on foreign borrowing to finance its investment, as reflected in recurrent current account deficits and a relatively large external debt. This has raised some questions regarding the adequacy of domestic saving and the factors affecting the cost of external borrowing. The issue of borrowing cost is particularly relevant as part of the growth debate in New Zealand. A reduction in the premium paid on foreign borrowing (typically measured as the differential between yields on New Zealand and foreign government bonds of comparable maturities) by lowering the cost of borrowing could contribute to raising investment and growth. The focus is on the sovereign spread because it defines the "underlying" interest rate on foreign borrowing paid by domestic entities with additional premiums reflecting the default risk of non-government entities relative to that of the government. The sovereign spread can also be affected by government policy actions.

2. Since the mid-1980s, yield spreads on New Zealand government bonds relative to both U.S. and Australian government bonds have narrowed sharply and currently they are at relatively low levels (Figure 1). Results from econometric analysis of the determinants of interest rate spreads suggest that much of the decline in spreads can be attributed to the improvement in New Zealand's fiscal position.

A. The Determinants of Interest Rate Spreads

3. Figure 1 illustrates the evolution of the yield spreads between New Zealand and U.S. and Australian government bonds of different maturities. For all maturities, the spread between New Zealand and U.S. government bonds narrowed significantly over the period from the mid-1980s to the mid-1990s. Since that time, these spreads fluctuated in a relatively narrow range around a level of 100 basis points until early 2001, before widening out to around 225 basis points at the end of 2002, reflecting monetary policy differences. Spreads between New Zealand and Australian government bonds also declined sharply from the mid-1980s to the late 1980s, and they were negative (New Zealand yields were lower than Australian yields) during the first half of the 1990s, owing in part to New Zealand's relatively better fiscal performance. Subsequently, spreads have shifted back to positive as relative fiscal positions have switched, but they have remained in a relatively narrow range around a level of about 50 basis points.

4. A more formal approach to evaluating the determinants of interest rate spreads can be derived from an augmented version of the *uncovered interest parity* (UIP) equation. Applied to bond yields, it states that, given that bonds in other countries are generally imperfect substitutes for New Zealand's bonds, investors will set bond yields such that risk-adjusted

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[1] Prepared by Abdelhak Senhadji (Ext. 3-8380), who is available to answer questions.

returns are equalized across bonds in New Zealand and other countries.[2] From the UIP equation, the spread between the yield on New Zealand government bonds and bonds in the United States or Australia can be expressed as:

$$i_t - i_{jt} = E_t(\Delta e_{jt+1}) + P_{jt} = f(X_{jt}) \quad (1)$$

where i_t is the yield on New Zealand bonds at time t, i_{jt} is the yield on government bonds in country *j*, where *j* is either the United States or Australia, P_{jt} is the aggregate risk premium on New Zealand government bonds relative to government bonds in country *j* (including *currency risk premium*, *liquidity premium*, and *default risk premium*); and $E_t(\Delta e_{jt+1})$ is the expected change in the currency of country *j* in terms of the New Zealand dollar. In turn, the expected change in the exchange rate and the aggregate risk premium can be expressed as a function of fundamental determinants represented by X_{jt} in equation (1).

5. The determinants of the yield spread include: the differential in short-term interest rates, which captures the difference in the monetary policy stance in the two countries; the differential in expected inflation; the expected percentage change in the bilateral exchange rate, defined as the price of the New Zealand dollar in foreign currency; the volatility of the exchange rate which is a proxy for the exchange rate risk premium; the difference in the variability of a country's bond yields in a portfolio of global bonds, referred to as "β" (the higher the coefficient β for a given country, the lower the diversification benefit for a foreign investor); and the difference in the ratio of net public debt to GDP, which represents the threat of future saving imbalances and/or future inflation.

B. Estimation Results

6. Table 1 provides the Augmented Dickey-Fuller unit root test for all the variables entering the equation to be estimated. All yield spread variables, as well as most potential explanatory variables, fail to reject the unit-root hypothesis at conventional significance levels. The variables that do reject the unit-root hypothesis at the 10 percent significance level or less are the expected change in the bilateral exchange rate between the New Zealand and the U.S. dollar, and its volatility (σ_{ER_US}); the differentials in inflation between

[2] An augmented UIP equation could also be expressed in terms of real interest rate spreads, assuming that purchasing power parity holds. In this paper, the analysis is focused on nominal interest rates spreads because of difficulties in measuring real interest rates and because prices of financial assets tend to adjust much faster than goods prices, making it more likely that nominal UIP holds than real UIP.

New Zealand and the United States and between New Zealand and Australia; and the difference in the net public debt-to-GDP ratio between New Zealand and the United States.[3]

7. To take into account the nonstationarity in the data, the cointegration framework of Phillips and Hansen (1990) was used. In addition, the Phillips-Hansen Fully-Modified Estimation method has the attractive feature of correcting for bias that may arise from potential endogeneity of the explanatory variables and/or serial correlation of the error term.

8. Table 2 reports the estimation results for the yield spreads between New Zealand and the U.S. government bonds of 1-, 5-, and 10-year maturities. The 1-year yield spread between New Zealand and U.S. government bonds is mainly driven by the differential in the 90-day interest rates. Indeed, the yield spread on 1-year government bonds increases by 82 basis points for every 100 basis points increase in the 90-day interest rate differential. Relative differences in net public debt-to-GDP ratios are also highly significant with the correct sign. A relative increase in New Zealand's net public debt by 10 percentage points of GDP would lead to an increase in the spread by 22 basis points.[4] While the variables for inflation differential and expected change in the exchange rate have the right sign, they are not statistically significant in the 1-year equation.

9. As the maturity of the New Zealand and U.S. government bonds increases, the effect of short-term interest rate differential on the yield spread between them weakens as expected. Only 35 and 19 basis points of a 100 basis points change in the short-term interest rate differential pass through to the 5- and 10-year yield spreads, respectively. Expected inflation differentials become highly significant for the 5- and 10-year spreads. The difference in the β coefficients also become significant for longer maturities. The results also suggest that the relative net public debt-to-GDP ratio has a more pronounced impact on yield spreads at longer maturities. A relative increase in the net public debt-to-GDP ratio of 10 percentage points increases the yield spreads on the 5- and 10-year government bonds by 33 and 47 basis points, respectively.

10. Table 3 provides estimation results for yield spreads between New Zealand and Australian government bonds. There are no data on yields on 1-year government bonds in

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[3] Perhaps, a more relevant variable would be total net external debt as a share of GDP. However, the latter is not available for an adequate time span.

[4] This is significantly higher than the results in Orr and Conway (2003). They find effects that range from 3½ basis points (for initial low levels of debt) to 13¼ basis points (for initial high levels of debt) for an increase in the relative net public debt-to-GDP ratio of 10 percentage points. The difference is likely due to: (i) differences in the specification of the spread equations in the two studies, (ii) difference in the nature of the data used in the estimation—Orr and Conway (2003) use panel data in their study, and (iii) difference in the estimation method.

Australia, therefore the analysis is restricted to the 5- and 10-year yield spreads. Interestingly, the impacts of 90-day interest rate differentials on yield spreads for different maturities are almost identical to their counterparts in Table 2. Expected appreciations of the New Zealand dollar against the Australian dollar lowers the yield spread vis-à-vis Australia, while higher expected inflation in New Zealand and higher volatility in the foreign exchange market increases it. The effect of the relative net public debt position on the yield spread is even stronger in these equations. A relative increase in New Zealand's net public debt-to-GDP ratio by 10 percentage points would increase New Zealand's risk premium by 58 basis points for the 5-year bond and 72 basis points for the 10-year bond.

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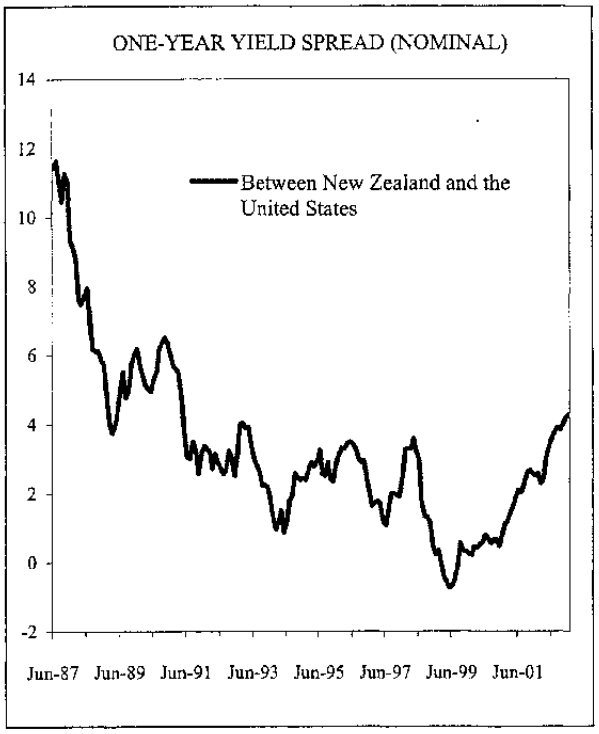
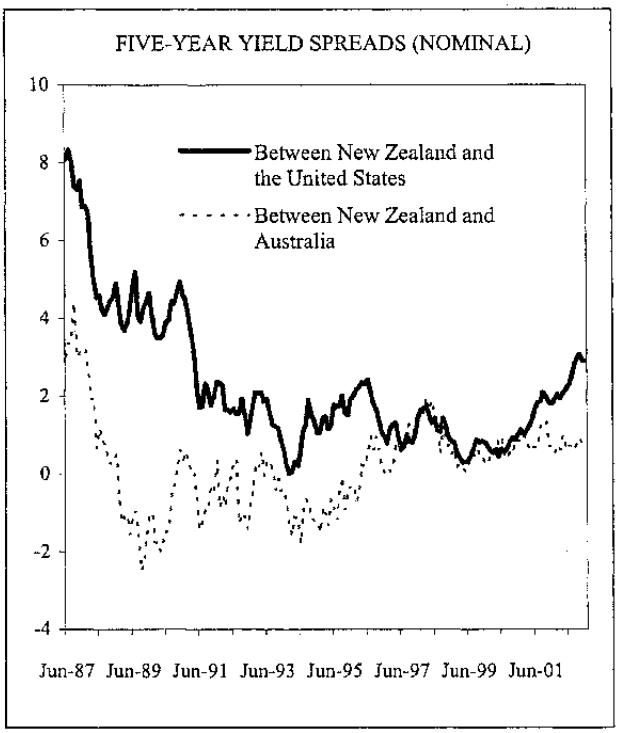
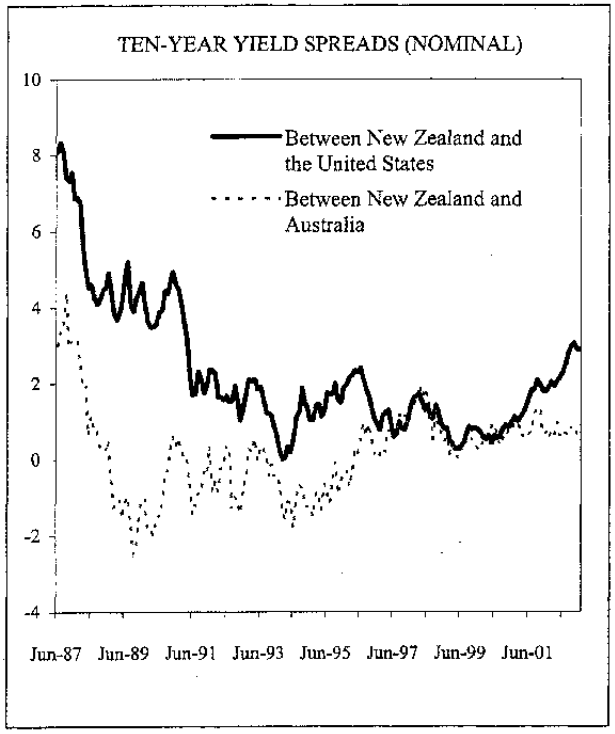
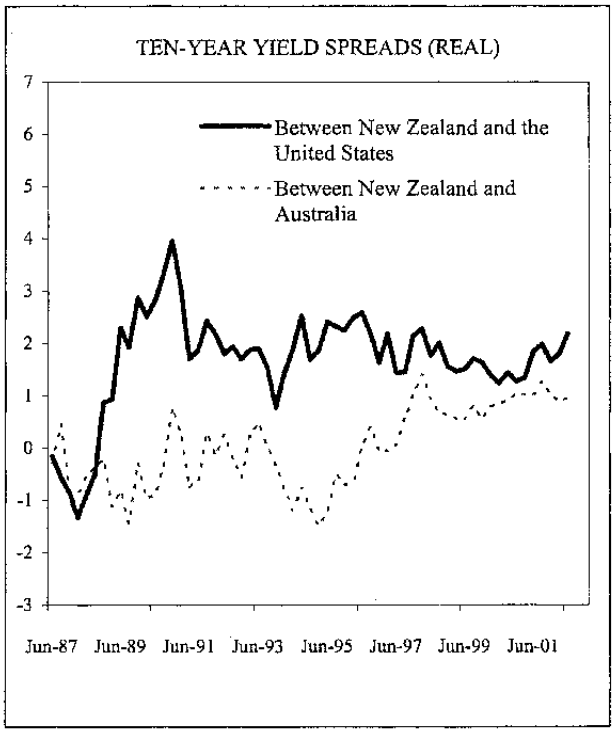
Figure 1. Yield Spreads on Government Bonds
Between New Zealand and the United States and Australia









Sources: Reserve Bank of New Zealand; Reserve Bank of Australia; the Federal Reserve Board; and Fund staff estimates.

Table 1. New Zealand: The Dickey Fuller-GLS Unit Root Test

Variables	DF-GLS Statistic
SP_US1	-1.81
SP_US5	-1.30
SP_US10	-1.18
SP_AU5	-1.82
SP_AU10	-1.69
i90_NZ-i90_US	-2.10
i90_NZ-i90_AU	-2.48
ER_US	-3.79[a]
ER_AU	-1.68
σ_{ER_US}	-3.02[c]
σ_{ER_AU}	-2.72
INFL_NZ-INFL_US	-6.18[a]
INFL_NZ-INFL_AU	-6.03[a]
β_NZ-β_US	-2.72
β_NZ-β_AU	-2.46
DEBT_NZ-DEBT_US	-7.21[a]
DEBT_NZ-DEBT_AU	-1.93
N	60

Notes: The variables are: the yield spreads between New Zealand and U.S. government bonds at 1-, 5-, and 10-year maturity *(SP_USj , j*=1,5, and 10); the yield spreads between New Zealand and Australia government bonds at 5-, and 10-year maturity (*SP_AUj , j*=5, and 10); the difference in the 90-day interest rates (*i90_NZ-i90_US* and *i90_NZ-i90_AU*), the U.S. dollar price and Australian dollar price of the New Zealand dollar (*ER_US* and *ER_AU*); the standard deviation of the *ER_US* and *ER_AU* (σ_{ER_US} and σ_{ER_AU}); the differential in the inflation forecasts (*INFL_NZ-INFL_US* and *INFL_NZ-INFL_AU*); the difference in the beta coefficients (*β_NZ-β_US* and *β_NZ-β_AU*); the differential in the net public debt-to-GDP ratio *(DEBT_NZ-DEBT_US* and *DEBT_NZ-DEBT_AU*). The asymptotic critical values for the DF-GLS test are –3.73, -3.16, and –2.86 for the 1 percent, 5 percent, and 10 percent significance level, respectively. The superscript "*a*", "*b*", and "*c*" indicate rejection of the unit root hypothesis at the 1, 5, and 10 percent significance levels, respectively.

Table 2. New Zealand: Determinants of Yield Spreads Between New Zealand and U.S. Government Bonds

	Dependent Variables		
Independent Variables	1-Year Spread	5-Year Spread	10-Year Spread
Constant	0.507 (2.46)[b]	1.644 (4.81)[a]	2.180 (4.77)[a]
i90_NZ-i90_US	0.823 (20.89)[a]	0.372 (5.30)[a]	0.186 (2.31)[b]
ER_US	-0.048 (-1.51)	-0.131 (-1.98)[b]	-0.042 (-0.69)
β_NZ-β_US		0.382 (1.96)[b]	0.685 (3.13)[a]
INFL_NZ-INFL_US	0.043 (1.21)	0.401 (2.39)[b]	0.522 (8.23)[a]
DEBT_NZ-DEBT_US	0.022 (4.42)[a]	0.080 (7.32)[a]	0.047 (4.58)[a]
Adjusted R^2	0.979	0.917	0.867
Shin's Cointegration Statistic	0.0095	0.0066	0.0039
N	60	60	60

Notes: The equations are estimated using quarterly data for the period 1988:1–2002:4. The dependent variables are the yield on 1-, 5-, and 10-year New Zealand government bond minus the yield on U.S. government bonds of comparable maturities. The independent variables include: the difference in the 90-day interest rates *(i90_NZ-i90_US)*, the U.S. dollar price of the New Zealand dollar (*ER_US*), the difference in the beta coefficients (*β_NZ-β_US*), the differential of the inflation forecasts (*INFL_NZ-INFL_US*), and the differential in net public debt-to-GDP ratio (*DEBT_NZ-DEBT_AU*). The superscript "*a*", "*b*", and "*c*" indicate statistical significance at the 1, 5, and 10 percent level. The critical values for the Phillips-Ouliaris cointegration tests are –3.84, -4.16, and –4.64 for the 10 percent, 5 percent, and 1 percent significance levels, respectively. The corresponding critical values for Shin's cointegration test are 0.184, 0.121, and 0.097. Shin's test fails to reject the null hypothesis of cointegration at 1 percent significance level for all three equations.

Table 3. New Zealand: Determinants of Yield Spreads Between New Zealand and Australian Government Bonds

Independent Variables	Dependent Variables	
	1-Year Spread	Independent Variables
Constant	-3.132 (-5.74)[a]	-3.616 (-6.86)[a]
Trend	0.059 (6.03)[a]	0.069 (7.43)[a]
i90_NZ-i90_AU	0.352 (11.57)[a]	0.192 (4.70)[a]
ER_AU	-0.081 (-1.76)[c]	-0.089 (-1.72)[c]
σ_{ER_AU}	50.407 (2.36)[b]	42.537 (1.89)[c]
INFL_NZ-INFL_AU	1.139 (8.21)[a]	1.551 (6.78)[a]
DEBT_NZ-DEBT_AU	0.058 (4.62)[a]	0.072 (5.91)[a]
Adjusted R^2	0.843	0.782
Shin's Cointegration Statistic	0.0068	0.0057
N	60	60

Notes: The equations are estimated using quarterly data for the period 1988:1–2002:4. The dependent variables are the yields on the 5- and 10-year New Zealand government bonds minus the yields on the Australian government bonds of comparable maturities. The independent variables include: the difference in the 90-day interest rates (*i90_NZ-i90_AU*), the Australian dollar price of the New Zealand dollar (*ER_AU*), the standard deviation of the *ER_AU* (σ_{ER_AU}), the differential of the inflation forecasts (*INFL_NZ-INFL_AU*), and the differential in net public debt-to-GDP ratio (*DEBT_NZ-DEBT_AU*). The superscript "*a*", "*b*", and "*c*" indicate statistical significance at the 1, 5, and 10 percent level. The critical values for the Phillips-Ouliaris cointegration test are –3.84, -4.16, and –4.64 for the 10 percent, 5 percent, and 1 percent significance levels, respectively. The corresponding critical values for Shin's cointegration test are 0.184, 0.121, and 0.097. Shin's test fails to reject the null hypothesis of cointegration at 1 percent significance level for both equations.

Data Sources and Definitions

The data are quarterly for the period 1987:1 to 2002:4. The definition and sources for each variable are as follows:

The yield spreads on government bonds for different maturities are constructed as follows: (i) the 1-, 5-, and 10-year yield spreads between New Zealand and the United States are the difference between New Zealand's secondary market bond yields and U.S. Treasury bill yields of comparable maturities; (ii) the 5- and 10-year yield spreads between New Zealand and Australia are the difference between New Zealand's secondary market bond yields and Australia's Commonwealth Treasury bond yields of comparable maturities. Sources: Reserve Bank of New Zealand, Federal Reserve Board, and Reserve Bank of Australia.

The differential in short-term interest rates is the 90-day interest rate differential between New Zealand and the United States and between New Zealand and Australia. The 90-day interest rates used are the bank bill yield for New Zealand, the three-month interest rate on constant-maturity government securities for the United States, and the three-month Treasury note yield for Australia. Sources: Reserve Bank of New Zealand, Federal Reserve Board, and Reserve Bank of Australia.

Expected future inflation differential is proxied by the difference between New Zealand and the United States (or Australia's) trend component of the HP-filtered series of inflation. Provided by Adrian Orr. For further information, see Orr and Conway (2003).

The expected percentage change in the bilateral exchange rate, where the exchange rate is defined as the price of New Zealand dollar in terms of foreign currency (the U.S. dollar or the Australian dollar). The expected change in the bilateral exchange rate is proxied by the 12-quarter moving average of percentage changes in the bilateral exchange rates. Sources: Reserve Bank of New Zealand, Federal Reserve Board, Reserve Bank of Australia, and Fund staff estimates.

The volatility of the bilateral exchange rate measured by the 90-day standard deviation of the bilateral exchange rate. Sources: Reserve Bank of New Zealand, Federal Reserve Board, Reserve Bank of Australia, and Fund staff estimates.

The difference in the "β" estimate, the relative variability of a country's bond yields in a portfolio of global bonds. The higher the β coefficient for a given country, the lower the diversification benefit for a foreign investor. Provided by Adrian Orr. For further information, see Orr and Conway (2003).

The difference in the net public debt-to-GDP ratio. Provided by Adrian Orr. For further information, see Orr and Conway (2003).