

Australia: Selected Issues

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AUSTRALIA

Selected Issues

Prepared by A. Senhadji, E. Ginting (APD), and S. Wei (RES)

Approved by the Asia and Pacific Department

November 5, 2004

	Contents	Page
	Executive Summary	3
I.	Dynamics of the Real Exchange Rate and Impact on Trade	4
A.	Introduction.....	4
B.	Real Exchange Rate Dynamics.....	4
C.	The Impact of Real Exchange Rates on Trade.....	7
D.	Conclusion	9
	References.....	23
II.	Trade Liberalization and Economic Growth: Australia's Experience	25
A.	Introduction and Summary	25
B.	Trade Openness and Economic Growth: A Review of the Empirical Evidence.....	26
C.	Has Australia Gained from Opening Up Its Economy?.....	28
D.	Trade Liberalization and Economic Growth: A Panel Data Analysis	30
	References.....	35
III.	Disability Support Pension in Australia and the Netherlands.....	44
A.	Introduction.....	44
B.	The Disability Support System in Australia and the Netherlands	44
C.	Conclusion	48
Tables		
II.1	Studies on Trade Openness, Growth, and Productivity	38
II.2	CGE Studies on the Impact of Tariff Reduction.....	39
II.3	Structural Reform Indicators for 15 OECD Countries	40
II.4	Trade Liberalization and GDP Per Capita Growth: Panel Regressions.....	41

	Contents	Page
III.1	DSP Recipients	44
III.2	Public Expenditure on Disability-Related Programs	49
III.3	Growth in Disability Benefit Reciprocity.....	50
 Annexes		
I.1	Technical Details on Statistical Tests and Estimation	10
I.2	Data Sources and Definitions.....	22
II.1	Deviation of the Empirical Growth Equation	42
II.2	Data Sources and Definitions.....	43

EXECUTIVE SUMMARY

This Selected Issues paper is divided into three chapters, with the first two devoted to trade related issues and the third one to a comparative analysis of the Australian disability support program. The selection of topics has benefited from the authorities' input.

The **first chapter** studies the dynamics of the Australian real exchange rate and its impact on Australia's trade. The main findings are that the Australian real exchange rate is largely driven by world commodity prices and that the real exchange rate adjusts relatively rapidly to large shocks, with an estimated half-life of 16 months. The real exchange rate is a significant determinant of Australian imports, with an elasticity of one, but does not appear to have a significant impact on Australian exports.

While the benefits of free trade have long been established by economic theory, the difficulty of measuring them has kept the policy debate alive. Numerous empirical studies have found a positive effect of trade openness on economic growth, only to be challenged by other studies questioning the robustness of the results. Measurement problems, reverse causality, and the sensitivity of the results to model specification are at the core of the controversy. The **second chapter** provides a quantitative cross-country assessment of the potential gains from trade liberalization and other structural reforms. The econometric analysis finds strong complementarities between trade liberalization and labor and product market reforms. For Australia, the results show that trade liberalization and the resulting increase in the degree of openness of the economy may have lifted annual GDP per capita growth by about $\frac{3}{4}$ percentage points, and that there is scope for additional significant increases in growth from further reforms.

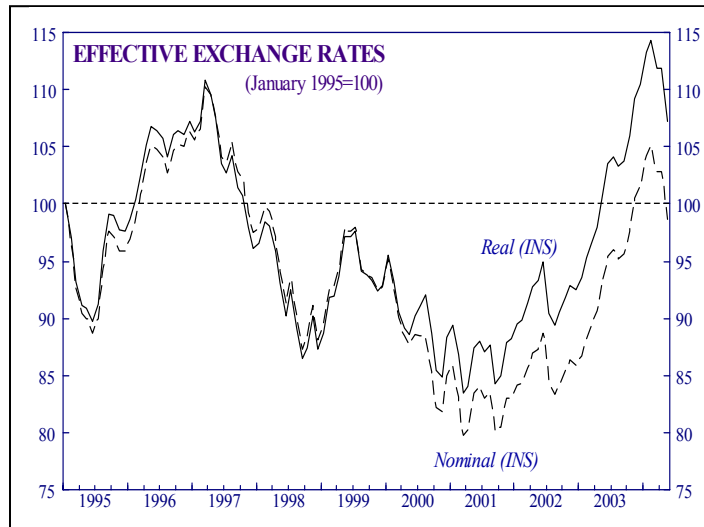
Increasing labor force participation is at the center of the government's strategy to promote growth and ease fiscal pressures associated with an ageing population. Incentives to work are affected by various elements of the income support system and ensuring that the income support system provides an adequate and well-targeted safety net without discouraging work requires careful balance. The **third chapter** focuses on the disability support system in Australia, which has grown significantly during the past decade, and compares it to that of the Netherlands, a country with one of the largest disability support programs among OECD countries. Proposed reforms in both countries are briefly discussed.

I. DYNAMICS OF THE REAL EXCHANGE RATE AND IMPACT ON TRADE¹

A. Introduction

1. The trade-weighted real effective exchange rate for the Australian dollar appreciated by 32 percent from February 2002 to February 2004, reaching a high not seen since 1997.

The strength of the Australian currency is also reflected in bilateral exchange rates vis-à-vis the currencies of the United States, Japan, China, and virtually all other major trading partners. The value of the Australian dollar has declined somewhat in recent months, but is still high relative to two years ago. The strong Australian dollar is widely thought to have contributed to Australia's rapid rise in imports and the associated widening of the trade deficit over the last two years.



2. This chapter studies the dynamics of the Australian real exchange rate, and its impact on Australia's trade. Several potential determinants of the real exchange rate are examined. Comparison is made between an unconditional convergence of the real exchange rate to a constant long-run mean, and a conditional convergence to a time-varying equilibrium defined by determinants of the real exchange rate. With regard to the impact on trade, special attention is paid to address possible biases resulting from the potentially endogenous real exchange rate and other determinants of trade. Appendices provide technical details regarding the statistical tests and estimation, and describe the data and their sources.

B. Real Exchange Rate Dynamics

3. For ease of presentation, the section starts with an analysis of the unconditional dynamics of the real exchange rate before discussing its determinants. This helps to set a benchmark on the estimated speed of convergence for the subsequent discussion. Once the potential determinants have been evaluated, the conditional convergence to an equilibrium defined by a function of the robust determinants is examined and compared with the estimates from the unconditional dynamics.

¹ Prepared by Shang-Jin Wei (RES, Ext. 35980).

Convergence to the long-run mean

4. Does the Australian real exchange rate have a tendency to converge to its long-run mean? A well recognized weakness in the analysis of a univariate real exchange rate series is low statistical power. In other words, one may fail to find evidence of convergence even if the series is truly mean-reverting. To enhance the statistical power of the analysis, this paper examines a panel of bilateral real exchange rates (BRERs) between Australia and its top 23 trading partners from 1998 to 2002, rather than a single trade-weighted real exchange rate series. The results from a variety of statistical tests suggest that these bilateral real exchange rates are stationary. This means that any deviations of the BRERs from their long-run means are transitory and tend to disappear over time.

5. Of course, even stationary series could take a long time to converge to the long-run mean. A useful concept to describe how fast the Australian exchange rates converge to their long-run means is half-life, which is the time it takes for a given deviation from the equilibrium to be reduced by half. The estimated half-life is 44 months, which means that a given deviation from the long-run mean tends to be 50 percent smaller after 44 months (if there are no other shocks to the BRER). Although this estimated half-life seems long—or, alternatively, the estimated convergence speed slow—it is well within the range of estimates (30–60 months) for other countries.

6. The assumption that large and small deviations have the same speed of convergence may be too strong. A number of economists have argued that estimates of real exchange rate persistence obtained from a linear regression are biased upward, since such estimates are essentially averages of two regimes: a very slow speed of convergence for deviations smaller than transaction costs, and a possibly much faster speed of convergence for larger deviations. The problem of lumping data from two regimes can be addressed by estimating a threshold autoregression (TAR) model. When this model is applied to Australian data, the estimated half-life for large deviations falls to 24 months, much faster than the estimate from a linear autoregressive specification.

7. One shortcoming of the analysis so far is that the definition of the “long-run mean” depends on the time period. For this reason, the next section turns to a concept of a conditional convergence to an equilibrium defined by the fundamental determinants of the real exchange rate.

Determinants of the Australian real exchange rate

8. Four possible fundamental determinants of the Australian real bilateral exchange rates are considered: (a) an index of the world market prices of Australia’s 13 most important commodity exports; (b) the difference between Australia and the partner countries labor productivity in the tradable sector relative to the nontradable sector, known as the Balassa-Samuelson effect in the literature; (c) the difference between the two countries’ real interest rates; and (d) the difference between the two countries’ net foreign asset position.

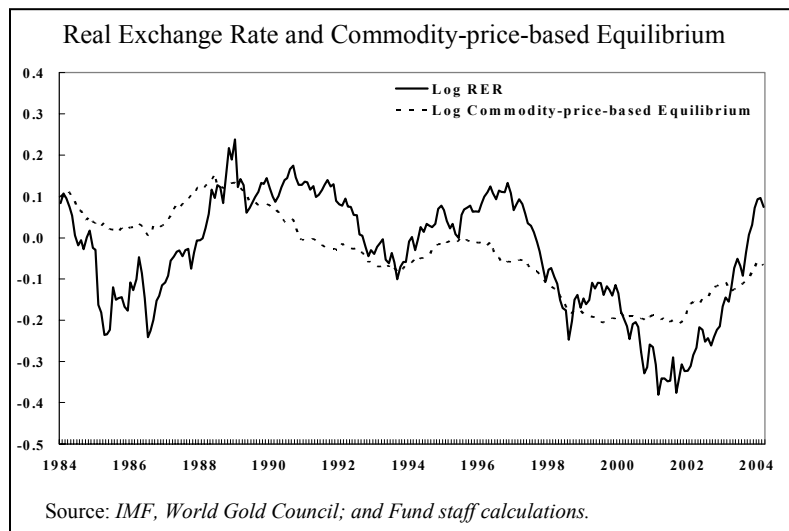
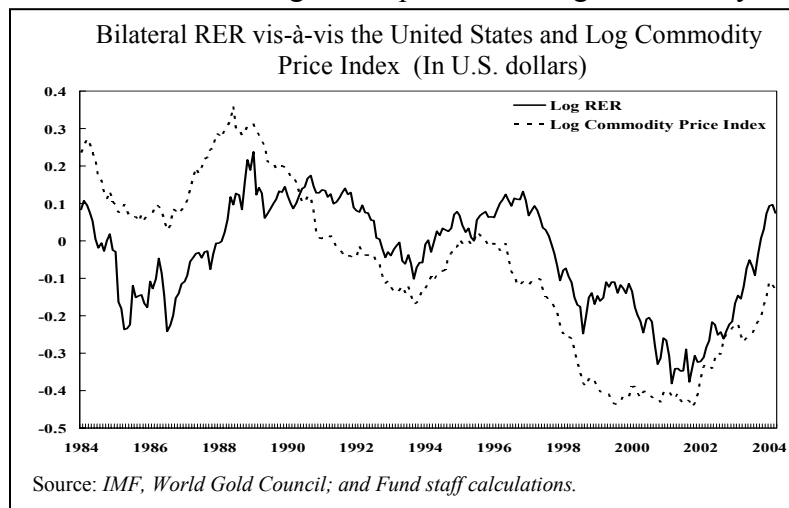
9. About 66 percent of Australian exports of goods are agricultural products, minerals, or other types of commodities. Because of this, the Australian dollar is commonly considered to be a “commodity currency,” with the real exchange rate closely following movements in the world prices of Australia’s commodity exports.² Following Chen and Rogoff (2004), this paper focuses on nonfuel commodity prices.

10. A variety of regressions were run to link the level of log RER to the levels of the four candidate determinants based on an annual sample from 1984–1998. A striking feature of these regressions is that the index of commodity prices is the only variable that can be robustly linked to the Australian real exchange rate. The Balassa-Samuelson effect (the relative productivity of the tradable to non-tradable sectors across countries) is never significant. The real interest rate differential is either insignificant or it appears with a “wrong,” i.e., negative, sign. The difference in net foreign asset positions is significant only in one out of five specifications. The conclusion is that commodity price movements are a strong fundamental underlying the Australian real exchange rate, possibly to the exclusion of other potential determinants.

11. As an illustration, the figure plots the log bilateral real exchange rate (vis-à-vis the United States) against the log index of the world prices (in U.S. dollars) of 13 nonfuel commodities most relevant for Australia. The close association between the two is clearly visible.

Convergence to equilibrium

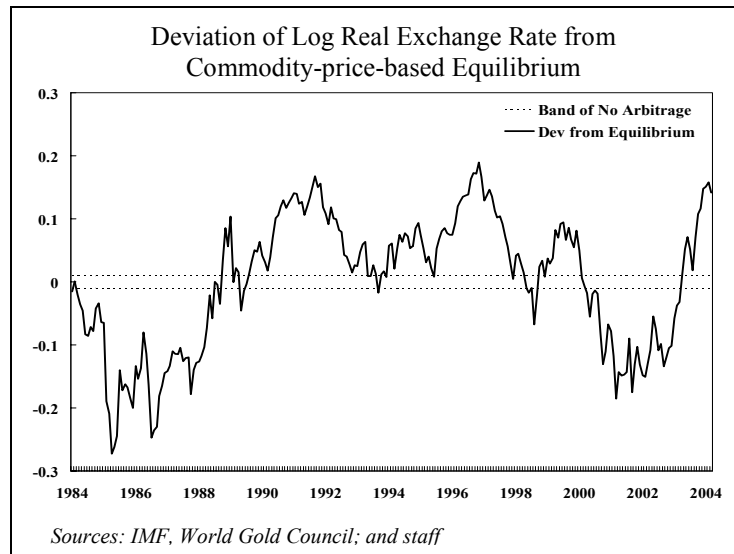
12. A time-varying equilibrium real exchange rate, which is defined as a linear function of the index of the world commodity



² See Gruen and Kortian, 1996; Chen and Rogoff, 2004; and Cashin, Cespedes, and Sahay, 2004.

prices (weighted by the commodities' shares in Australia's exports over the period 1984–2002), is represented by a dotted line in the figure. The conditional convergence of the real exchange rate to this equilibrium is estimated to have a half-life of 28 months, which is much faster than the estimated unconditional convergence to a constant mean of 44 months.

13. As is suggested by theoretical models on costly arbitrage as an equilibrating force for real exchange rate, large deviations from the time-varying equilibrium may have a different speed of convergence from small deviations. The estimated band of no arbitrage is described by two dotted lines in the figure, and the estimated half-life for large deviations is 16 months, substantially faster than the 28-month estimate generated by the linear autoregressive model.



14. To conclude, once a conditional convergence to a commodity-price-based equilibrium is examined (rather than an unconditional convergence to a constant mean), especially when large deviations are allowed to converge at a different speed from small deviations, the real exchange rate reverts to the equilibrium relatively fast. This suggests that when the Australian real exchange rate is overvalued, even without intervention in the currency market, there is a natural tendency for it to return to its equilibrium relatively quickly.

C. The Impact of Real Exchange Rates on Trade

15. This section studies whether changes in the real exchange rate has a quantitatively significant effect on Australia's trade, which is one of the primary channels through which the real exchange rate may affect the Australian economy. A natural starting point is an augmented gravity model that links Australia's bilateral imports from a trading partner with Australia's and its trading partner's GDP, trade policy, and other economic, geographic, and political characteristics; the geographic distance between the two; a possible linguistic tie, and the bilateral real exchange rate. While such a model is standard in the empirical literature aiming to explain bilateral trade, empirically estimating it poses two challenges. First, data on many potential explanatory variables are missing and, as a result, are often omitted in the empirical literature. Second, several key explanatory variables such as the real exchange rate may be endogenous. For example, the real exchange rate between Australia and New Zealand is as likely affected by the fluctuations in trade between the two countries as affecting the trade. Both the omitted variables and the endogeneity issue could seriously bias

the estimated effect of the real exchange rate on Australia's trade. Section B of a technical annex to this chapter proposes a set of innovations that can mitigate these biases.

16. Regressions with these innovations indicates that, the log real exchange rate has a significantly positive impact on Australian imports, with an estimated coefficient numerically very close to one.

17. As the financial market in Australia is sophisticated, many, and perhaps most firms, hedge against exchange rate fluctuations. The maturity of the most common hedging instruments are from one month to one year. This raises the possibility that the lagged real exchange rate could also affect Australia's imports. To check this possibility, regressions including three lags of the log real exchange rate in addition to its contemporaneous value were run. The results suggest that both the contemporaneous real exchange rate and its one period lag positively affect Australia's imports. Higher order lags of the real exchange rate do not appear to be important.

18. Similar regressions for Australia's exports give the somewhat surprising result that log real exchange rate does not have a statistically significant impact. In other words, unlike imports, Australia's total exports appear to be unresponsive to movements in the real exchange rate.

19. It is possible that Australian exporters engage in currency hedging more diligently than importers so that contemporaneous movement in the real exchange rate does not have a significant effect on exports. As noted, the terms of most currency hedging instruments rarely go beyond a year. So it is possible that an appreciation of the real exchange rate after a year or two may reduce Australian exports even if it does not do so instantaneously. To check this possibility, several regressions are performed that include three lags of the real exchange rate as regressors. As it turns out, none of the lagged values of the real exchange is statistically significantly different from zero either. Therefore, at least for aggregate exports, movements in the real exchange rate do not appear to be quantitatively important.

20. Relative to most other industrialized economies, Australia's export structure has some unique features. In particular, approximately 70 percent of its exports consist of agricultural/animal products, minerals, or other types of commodities. It is possible that the world market demand for these products is not very price-elastic. In this case, Australia's exports of these products would not be responsive to movements in the real exchange rate. If one focuses on Australia's non-commodity exports, one might be able to find a negative relationship between the exports and the real exchange rate.

21. To check this possibility, it is necessary to turn to disaggregated trade data that allow one to investigate separately the effects of the real exchange rate on different types of exports. As it turns out, for both non-commodity and commodity exports, there are essentially as many positive coefficients as there are negative ones. Therefore, even when the exports of disaggregated products are studied, there is no evidence of a strong negative effect of a real exchange rate appreciation on Australia's exports on average.

D. Conclusion

22. This paper investigates two sets of issues related to the Australian real exchange rate. First, what drives the real exchange rate, and whether the real exchange rate has a systematic tendency to revert to its equilibrium? Second, what are the effects of the real exchange rate movement on Australia's imports and exports?

23. The main findings can be summarized as follows.

- The Australian real exchange rate is found to have a tendency to converge to a constant mean over time, but at a slow speed with a half-life estimated at 44 months.
- Among several potential determinants of the Australian real exchange rate—an index of world commodity prices, real interest rate differential, the Balassa-Samuelson effect, and the difference in net foreign asset position—only the index of world commodity prices has a robust effect.
- Relative to an equilibrium defined by the relevant world commodity prices, the Australian real exchange rate converges much faster to the equilibrium, with an estimated half-life of about 28 months.
- Because arbitrage is costly, large deviations have a faster convergence speed, with an estimated half-life of 16 months, than small deviations.
- The Australian real exchange rate is found to have a statistically significant and economically robust impact on imports. The estimated elasticity is one: a one percent appreciation is associated with a one percent rise in imports, and a one percent depreciation is associated with a one percent decline in imports.
- In sharp contrast to imports, the real exchange rate does not appear to have a significant effect on Australia's exports.

Technical Details on Statistical Tests and Estimation

A. Speed of Convergence to Equilibrium

Convergence to the long-run mean

24. To enhance statistical power, the analysis is based on a panel of bilateral real exchange rates between Australia and its major trading partners, rather than a single trade-weighted real exchange rate. The top 23 trading partners are listed in Table 1.³ The (log) Australian bilateral real exchange rate (BRER) relative to country *i*'s currency at time *t* is defined as: $q_{i,t} = s_{i,t} + p_t - p_{i,t}^*$, where $s_{i,t}$ is the log price of the Australian dollar in units of foreign currency *i*, p_t is the log value of the CPI index in Australia in period *t*, and $p_{i,t}^*$ is the log value of the CPI index in the foreign country *i*. Three different types of panel unit root tests are reported in Table 2. The multivariate version of the augmented Dickey-Fuller (ADF)

Rank	Country Name	Bilateral Trade Sum over 1998–02, (billion USD)	Bilateral Trade / Partner's GDP (percent)	Bilateral Trade / Partner's Tot-Trade (percent)
1	Japan	100.5	0.66	3.33
2	United States	92.2	0.20	1.26
3	China	42.6	0.51	1.99
4	Korea	31.6	1.22	2.02
5	New Zealand	30.6	8.28	18.02
6	United Kingdom	27.5	0.50	1.18
7	Germany	22.4	0.23	0.50
8	Taiwan, Province of China	22.3	1.90	2.28
9	Singapore	19.6	5.61	1.93
10	Malaysia	16.5	2.87	2.48
11	Italy	14.6	0.23	0.61
12	Thailand	12.1	1.02	1.58
13	Hong Kong, SAR	11.9	2.27	1.33
14	France	10.4	0.14	0.38
15	Canada	9.4	0.27	0.53
16	India	7.9	0.25	1.78
17	Saudi Arabia	7.6	0.78	1.15
18	Netherlands	6.7	0.34	0.39
19	South Africa	5.6	0.44	1.33
20	Sweden	5.3	0.38	0.76
21	Philippines	5.1	1.04	2.07
22	Papua New Guinea	5.0	20.84	27.46
23	United Arab Emirates	4.4	1.28	1.40

¹ Data Sources: Trade data are from the World Integrated Trade Solution (WITS) database of the World Bank. GDP data are from the World Economic Outlook (WEO) database of the IMF.

³ Indonesia and Vietnam are excluded due to high inflation episodes.

test and the Im-Pesaran-Shin test have the null hypothesis that all bilateral RERs have a unit root against the alternative that not all of them have a unit root. The Levin-Lin-Chu test has the same null but against the alternative that all bilateral RERs are stationary. In all three cases, the null of nonstationarity is rejected comfortably at the 5 percent level. Given the result of the Levin-Lin-Chu test, with its stronger alternative hypothesis, it may be justified to treat the Australian bilateral real exchange rates as stationary. This means that any deviations of the RERs from their long-run means are transitory and tend to disappear over time.

25. To estimate the half-life, or the time it takes for a given deviation of the real exchange rate from its equilibrium to be reduced by half, the bilateral real exchange rate is specified by an autoregressive process:

$$\Delta q_{i,t} = \beta q_{i,t-1} + \text{country dummies} + \varepsilon_{i,t} \tag{1}$$

Since the CPI indices used to compute the BRERs are defined only up to a constant multiplier, country dummies are needed to allow for potentially different long-run means for different BRERs. Column 1 in Table 3 reports an estimate of β in a standard panel regression setting with country fixed effects. The value of $\hat{\beta}$ (-0.035) corresponds to a half-life of 19 months.

No. of Series= 23,	Obs of Each Series =240	No. of Lag(s) = 1	
Test	Multivariate Augmented Dickey-Fuller Test	Levin-Lin-Chu Test	Im-Pesaran-Shin Test
H ₀	All I(1)	All I(1)	All I(1)
H ₁	Not all I(1)	All I(0)	Not all I(1)
Test statistics	165.33	-8.24	-2.06
5 Percent Critical value	13.88	-	-1.81
P-value	-	0.005	0.002

26. Because the error terms for different countries in a given year are likely to be correlated, a preferred specification may be to estimate equation (1) as a system of equations using seemingly unrelated regressions (SUR). The resulting estimate of β (-0.016) is presented in column 2 of Table 3, which corresponds to a half-life of 44 months, meaning that a given deviation from the long-run mean tends to be 50 percent smaller after every 44 months (if there are no another shocks to the BRER). This estimated half-life is well within the range of the estimates (30–60 months) that studies of real exchange rates have produced for a variety of countries.⁴

⁴ See Rogoff (1996) for a survey of these studies.

Table 3. Australia: Convergence of RER to Long-Run Mean (Monthly, January 1984–March 2004) ¹			
	(1) Panel Regression with Country Fixed Effects	(2) SUR	(3) Eq-TAR
Estimated Beta	-0.035***	-0.016***	-0.028***
Standard Deviation	(0.004)	(0.002)	(0.003)
Threshold	-	-	0.016
Half-life (months)	19	44	24
N	5559	5497	5085
R ²	0.020	-	0.015

¹ *, **, and *** denote significance at the 90 percent, 95 percent, and 99 percent levels respectively.

27. The estimation so far assumes that large deviations and small deviations have the same speed of convergence. This assumption may not hold in reality. Recent research by O’Connell (1998), Obstfeld and Taylor (1997), Taylor (2001), Sarno and Taylor (2001), and O’Connell and Wei (2002) suggests that standard regressions, such as equation (1), are misspecified due to the assumed linearity. These authors have argued that estimates of real exchange rate persistence obtained from a linear regression are biased upward, since such estimates are essentially averages of two regimes: very low speed of convergence for deviations smaller than transaction costs, and possibly much faster speed of convergence for larger deviations. These authors have addressed the problem of lumping data from two regimes by estimating a threshold autoregression (TAR) model. As O’Connell and Wei (2002) have noted, if transaction costs create a band of no-arbitrage, a TAR model provides a more powerful way to detect global stationarity—even if the true price behavior does not conform to the TAR specification. For this reason, a TAR model is specified for the Australian bilateral real exchange rates:

$$\Delta q_{i,t}^* = \begin{cases} \rho(q_{i,t-1}^*) + \varepsilon_{i,t}, & \text{if } q_{i,t-1}^* > c \\ \varepsilon_{i,t}, & \text{if } -c \leq q_{i,t-1}^* \leq c \\ \rho(q_{i,t-1}^*) + \varepsilon_{i,t}, & \text{if } q_{i,t-1}^* < -c \end{cases} \quad (2)$$

where $q_{i,t}^*$ is a de-meanned version of $q_{i,t}$.

28. The TAR specification allows the real exchange rate to have a unit-root inside the transaction-cost band. Once the real exchange rate exceeds a boundary (c or $-c$) that allows for profitable arbitrage, the real exchange rate reverts at rate, $1 - \rho$, toward the center of the no-arbitrage band $[-c, c]$.⁵ Estimation of these models can be done via maximum likelihood

⁵ This specification of TAR would characterize behavior if fixed costs are an important impediment to arbitrage. An alternative specification of TAR that assumes zero fixed cost has also been considered but discarded due to poor fit with the data.

or sequential conditional least squares. Franses and van Dijk (2000) demonstrate the equivalence of the two methods. Procedurally, a grid search over possible values of c is first performed. Conditional on a given value of c , least square regressions are then conducted for observations outside the band of no-arbitrage. In the first estimation, $c = \min(q) + 0.003$. After adding 0.003 to c the model is re-estimated. The process is repeated until c equals the 75th fractile of the distribution of q . The model with the minimum residual sum of squares is reported in column 3 of Table 3. According to the TAR model, the half-time for large deviations (those that are outside the band of no-arbitrage) is 24 months, much faster than the estimate from a linear SUR equation.

Determinants of the Australian real exchange rate

29. Four candidates for fundamental determinants of the Australian real exchange rate are considered: (a) an index of world market prices of 13 commodities most important in Australia's exports, (b) the difference between Australia and the partner country in labor productivity of the tradable sector relative to that of the nontradable sector (known as the Balassa-Samuelson effect in the literature), (c) the difference between the two countries in real interest rate, and (d) the difference between the two countries in net foreign asset position.

30. Table 4a presents a set of regressions linking the level of log RER to the levels of the four determinants based on an annual sample from 1984–98.⁶ As a robustness check, Table 4b reports a different set of regressions linking the first difference in log RER to the first differenced series of the four determinants. A striking feature of these regressions is that the index of the commodity prices is the only variable that can be robustly linked to the Australian real exchange rate. The Balassa-Samuelson effect (the relative productivity of the tradable to nontradable sectors across countries) is never significant. The real interest rate differential is significant in less than half of the times. When it is significant, it appears with a “wrong,” i.e., negative, sign. The difference in net foreign asset position is significant only in one out of five specifications. Therefore, the commodity price movement appears to be a strong fundamental underlying the Australian real exchange rate, possibly to the exclusion of other potential determinants.

⁶ Data on difference in productivity between tradable and non-tradable sectors and on net foreign asset position are available at the annual frequency only.

Variable	(1)	(2)
Real non-energy commodity price index	0.843*** (0.050)	1.000*** (0.001)
Difference in productivity of tradable to non-tradable sectors	0.019 (0.082)	0.002 (0.002)
Difference in real interest rates	-0.066*** (0.013)	0.001 (0.001)
Difference in net foreign asset positions	-0.023 (0.020)	0.001* (0.0003)
Country dummies	Yes	Yes
Trend	Yes	No
Year dummies	No	Yes
N	152	152

Note: *, **, and *** denote p-value is less than 10 percent, 5 percent, and 1 percent, respectively.

Variables	(1)	(2)	(3)
Δ (Real non-energy commodity price index)	0.167** (0.078)	0.185** (0.080)	0.462*** (0.107)
Δ (Difference in productivity of tradable to non-tradable sectors)	-0.175 (0.228)	-0.175 (0.228)	0.268 (0.251)
Δ (Difference in real interest rates)	-0.028 (0.039)	-0.028 (0.039)	-0.087** (0.044)
Δ (Difference in net foreign asset positions)	0.061 (0.195)	0.076 (0.188)	-0.051 (0.148)
Country dummies	Yes	Yes	Yes
Trend	No	Yes	No
Year dummies	No	No	Yes
N	141	141	141

Note: *, **, and *** denote p-value is less than 10 percent, 5 percent, and 1 percent, respectively.

Convergence to the commodity price-based equilibrium

31. Based on these results, a (time-varying) equilibrium real exchange rate can be defined as a linear function of the index of world commodity prices (weighted by the commodities' shares in Australia's exports over the period 1984–2002). Column 1 of Table 5 reports the estimated speed of conditional convergence of a half-life of 26 months. SUR estimation of a system of equations gives a similar estimated half-life of 28 months (Column 2, Table 5). Compared with the corresponding case of an unconditional convergence to a constant mean (reported in column 2 in Table 3), this represents a much faster speed of convergence.

32. As discussed above, costly arbitrage may mean that large deviations from equilibrium have different speeds of convergence than small deviations. This can be allowed for by estimating a nonlinear threshold autoregressive (TAR) specification similar to equation 2 but where $q_{i,t}^*$ is defined as the deviation of the log real exchange rate from the time-varying equilibrium defined by the index of the world commodity prices. The estimation result is presented in column 3 of Table 5. The estimated half-life for the large deviations is 16

months, substantially faster than the corresponding TAR estimate of 24 months or the linear SUR estimate of 28 months.

Table 5. Australia: Convergence of the Real Exchange Rate to Commodity price-based Equilibrium (January 1984–March 2004)			
	(1) Panel Regression with Country Fixed Effects	(2) SUR	(3) Eq-TAR
Est Beta	-0.026***	-0.024***	-0.043***
Standard Dev	(0.004)	(0.003)	(0.004)
Threshold	-	-	0.010
Half-life (month)	26	28	16
N	5559	5497	5114
R ²	0.009	-	0.018

Notes: (1) *, **, and *** denote p-value is less than 10 percent, 5 percent, and 1 percent, respectively.
 (2) Deviation from the equilibrium $q^* \equiv q - \text{equilibrium}$,
 where: $q = \log \text{ RER}$, and equilibrium = 4.305 + 0.452 × commodity price index + country fixed effects
 (0.007) (0.006)

B. Effect of Real Exchange Rate Changes on Trade

33. The section starts with a bilateral import (or export) equation that is based on the general equilibrium theory of the gravity model of trade a la Deardorff (1996), Wei (1996), and Anderson and van Wincoop (2003). The gravity model of trade links a country’s imports from another to the economic sizes of the importer and the exporter and the distance between the two countries. Frankel and Wei (1993) have proposed an extended version of the gravity model that also incorporates level of development, linguistic linkage and other economic features of the country pairs. The “modern” version of the gravity model, based on recent theoretical developments, emphasizes the importance of including what are called “multilateral resistance” terms into the equation. These terms can be proxied by importer and exporter fixed effects, which surprisingly had rarely been included in the vast, earlier gravity model literature.

Specification and methodology to deal with a possible endogeneity bias

34. One can start with a specification that is very general in terms of possible determinants of trade and that is consistent with the recent theoretical advances on the gravity model. To be precise, the specification of Australian imports from country j may be written as follows:

$$\text{Log}(\text{Import}_{A,j,t}) = D_A + D_j + G_t + X_{A,t} \Lambda + X_{j,t} \Gamma + Z_{A,j} \Theta + \beta \log(\text{RER}_{A,j,t}) + e_{A,j,t} \quad (4)$$

Where import $A_{j,t}$ is imports by Australia from country j in year t ; D_A , D_j are importer and exporter fixed effects, respectively, meant to proxy for the “multilateral resistance” terms; G_t is a vector of common global factors such as fuel cost in transportation that could affect the level of imports of all countries in a proportional way.

$X_{A,t}$ is a vector of variables characterizing the Australian economy that is relevant for its trade. $\log(\text{GDP})$ and $\log(\text{per capita GDP})$ are the most common variables used in the literature. One, in principle, could include other variables as well such as average tariff level, nontariff barrier, or the average movement of bilateral real exchange rate between Australia and all of its trading partners in year t . $X_{j,t}$ is a vector of characteristics for the exporting country j , similar to the above, that includes $\log(\text{GDP})$, $\log(\text{per capita GDP})$ and potentially other variables.

$Z_{A,j}$ is a vector of (time-invariant) variables that characterize the Australia-exporter pair that could affect the trade. The list includes geographic distance and linguistic tie used in the literature. It could also include dummies denoting membership in a common regional trade bloc or a common currency bloc (which are time-invariant for our sample to be described below). Λ , Γ , and Θ are three vectors of parameters with appropriate dimensions. The coefficient β measures the elasticity of imports to the real exchange rate and is the key parameter of interest to this chapter.

35. It is important to note two things. First, the above specification essentially covers all regressors that have been considered in the literature that has applied the gravity model.⁷ Second, a maintained assumption in Equation (4) is that the structural parameters, β , Λ , Γ , and Θ , are invariant to the identity of the trading partners. In other words, there are no country subscripts associated with them. This is important for the methodology described below but is no less general than the existing specifications in the literature.

36. One important feature of the estimation strategy is to take seriously the possibility that many important regressors in the trade equation, including the real exchange rate variable and the GDP's of the importing and exporting countries, may be endogenous. For example, if one attempts to explain Australian imports from New Zealand, one needs to be aware of the estimation biases generated by the possibility that the regressors, namely the Australian and New Zealand's GDPs, and the bilateral real exchange rate between the two, are as likely to be affected by the trade between them as to affect the trade itself. Estimating equation (4) without addressing the endogeneity issue is likely to generate biased estimates of β and other parameters.

37. This section proposes a methodology that could mitigate this type of endogeneity bias. The methodology can be explained in two steps. In the first step, a double difference transformation is used to eliminate (potentially endogenous) Australia-specific variables and time-invariant variables. To be more precise, a first differencing of equation (4) helps to eliminate the country fixed effects and other time-invariant regressors.

⁷ Note that the real exchange rate variable subsumes terms of trade movement.

$$\Delta \text{Log}(\text{Import}_{A,j,t}) = \Delta G_t + \Delta X_{A,t} \Lambda + \Delta X_{j,t} \Gamma + \beta \Delta \log(\text{RER}_{A,j,t}) + \Delta e_{A,j,t} \quad (5)$$

38. Then, a second differencing of equation (5) between two different trading partners—that is, imports from country j relative to imports from country k—eliminates all regressors that are specific to Australia. Moreover, it converts the resulting real exchange rate variable to that between a country pair (j and k) not involving Australia directly. In other words, the resulting specification becomes

$$\Delta \text{Log}(\text{Import}_{A,j,t}) - \Delta \text{Log}(\text{Import}_{A,k,t}) = [\Delta X_{j,t} - \Delta X_{k,t}] \Gamma + \beta \Delta \log(\text{RER}_{j,k,t}) + u_{A,j,k,t} \quad (6)$$

where $\log(\text{RER}_{j,k,t}) = \log(\text{RER}_{A,j,t}) - \log(\text{RER}_{A,k,t})$ and $u_{A,j,k,t} \equiv \Delta e_{A,j,t} - \Delta e_{A,k,t}$.

39. This represents a partial solution to the endogeneity issue surrounding equation (4) in that the list of potentially endogenous Australia-related regressors, $X_{A,t}$, has been eliminated. However, the remaining regressors $[\Delta X_{j,t} - \Delta X_{k,t}]$ and $\Delta \log(\text{RER}_{j,k,t})$ could still be endogenous. For example, since Australia is a major trading partner for New Zealand and Papua New Guinea (accounting for 18 percent and 27 percent of their external trade, respectively), the real exchange rate between New Zealand and Papua New Guinea could still be endogenous vis-à-vis their respective trade with Australia.

40. Therefore, a second step is needed to deal with this remaining endogeneity issue. Here, an economic rather than a pure econometric solution is proposed. Specifically, the sample of countries (the set of j's and k's) will be restricted to those for which trade with Australia is relatively unimportant (even though their trade with Australia may be important for Australia).

41. To be precise, those Australian trading partners that satisfy two criteria simultaneously are selected: (a) their trade (exports plus imports) with Australia is only 5 percent or less of their total external trade; (b) their trade with Australia accounts for 1 percent or less of their GDP. This generates a set of 13 countries among Australia's most important trading partners. They are (in order of importance for Australia): Japan, the United States, China, the United Kingdom, Germany, Italy, France, Canada, India, Saudi Arabia, Netherlands, South Africa, and Sweden. For these economies, their GDP, per capita GDP, and bilateral real exchange rate are unlikely to be affected in any significant way by their trade with Australia. As such, for those countries, $[\Delta X_{j,t} - \Delta X_{k,t}]$ and $\Delta \log(\text{RER}_{j,k,t})$ can be treated as exogenous for the purpose of estimating equation (6). Because the key parameter of interest, β , is invariant to the identity of the trading partners, the estimated elasticity of Australian imports to the real exchange rate applies to other trading partners as well.

Estimation results

42. The estimation results are presented in column 1 of Table 6a. The trading partner’s log GDP (in double differenced form) is positive and statistically significant. The key parameter of interest for the purpose of this paper is the coefficient on the log real exchange rate, which is also positive and statistically significant at the one percent level. In fact, the point estimate is very close to one, and it is not possible to reject the hypothesis that it is exactly one at the five percent level. The subsequent columns in Table 6a check how robust this result is. Country fixed effects are added in column 2; year fixed effects in addition to the country fixed effects are included in column 3; and the regressions in columns 4–6 repeat those in columns 1–3 with trading partner’s log(per capita GDP) (in double-differenced form) included as an additional regressor. In each of these regressions, the coefficient on log real exchange rate is positive, significant at the one percent level, and numerically very close to one. In summary, the elasticity of Australia’s imports to real exchange rate is estimated to be one.

Dependent variable = $\Delta\log(\text{Australia's imports from country } j) - \Delta\log(\text{Australia's imports from country } k)$						
Variables	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\Delta \log \text{ GDP } (j,k)$	1.15*** (0.21)	1.05*** (0.23)	1.43*** (0.24)	-0.05 (0.48)	-0.25 (0.55)	0.54 (0.55)
$\Delta\Delta \log \text{ GDP per capita } (j,k)$				1.32*** (0.47)	1.41** (0.55)	0.94* (0.53)
$\Delta \log \text{ Real exchange rate } (j,k)$	1.08*** (0.23)	0.97*** (0.25)	1.19*** (0.26)	1.22*** (0.23)	1.08*** (0.25)	1.26*** (0.26)
Country fixed effects	No	Yes	Yes	No	Yes	Yes
Time fixed effects	No	No	Yes	No	No	Yes
N	216	216	216	216	216	216
R ²	0.12	0.16	0.36	0.15	0.19	0.37

43. As the financial market in Australia is sophisticated, many, and perhaps most, firms in Australia probably hedge against exchange rate fluctuations. The most common currency hedging instruments have a maturity of from one month to one year. This raises the possibility that the lagged real exchange rate could also affect Australia’s imports. To check this possibility, Table 6b presents a set of regressions that include three lags of the log real exchange rate variable in addition to its contemporaneous value. The results suggest that both the contemporaneous and the lagged real exchange rate positively affect Australia’s imports. Higher order lags of the real exchange rate do not appear to be important.

44. The estimation results for an analogously specified export equation are presented in Table 7a. The difference between these results and those of the import equation is striking

(and somewhat surprising). The coefficients on log real exchange rate are invariably statistically indifferent from zero. In other words, unlike imports, Australia's total exports appear to be unresponsive to movements in the real exchange rate.

Dependent variable = $\Delta \log(\text{Australia's imports from country } j)$ $-\Delta \log(\text{Australia's imports from country } k)$						
Variables	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \Delta \log \text{ GDP}$	0.94*** (0.25)	0.82*** (0.27)	1.23*** (0.29)	0.13 (0.52)	-0.09 (0.6)	0.55 (0.6)
$\Delta \Delta \log \text{ GDP per capita}$				0.94* (0.54)	1.02* (0.61)	0.76 (0.59)
$\Delta \log \text{ Real exchange rate}$	0.87*** (0.27)	0.74** (0.29)	0.95*** (0.31)	1.02*** (0.28)	0.86*** (0.3)	1.04*** (0.32)
$\Delta \log \text{ Real exchange rate } (-1)$	0.39*** (0.12)	0.39*** (0.12)	0.3** (0.14)	0.37*** (0.12)	0.37*** (0.12)	0.29** (0.14)
$\Delta \log \text{ Real exchange rate } (-2)$	0.07 (0.1)	0.08 (0.11)	0.02 (0.12)	0.09 (0.1)	0.09 (0.1)	0.03 (0.12)
$\Delta \log \text{ Real exchange rate } (-3)$	0.13 (0.1)	0.12 (0.1)	-0.04 (0.12)	0.13 (0.1)	0.11 (0.1)	-0.04 (0.12)
Country fixed effects	No	Yes	Yes	No	Yes	Yes
Time fixed effects	No	No	Yes	No	No	Yes
N	180	180	180	180	180	180
R ²	0.15	0.19	0.36	0.16	0.2	0.37

Dep variable = $\Delta \log(\text{Australia's imports from country } j)$ $-\Delta \log(\text{Australia's imports from country } k)$						
Variables	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \Delta \log \text{ GDP}$	0.49 (0.34)	0.39 (0.38)	0.84** (0.37)	-0.34 (0.79)	-1.11 (0.92)	-0.91 (0.86)
$\Delta \Delta \log \text{ GDP per capita}$				0.91 (0.78)	1.62* (0.91)	1.85** (0.82)
$\Delta \log \text{ Real exchange rate}$	0.19 (0.37)	0.04 (0.41)	0.49 (0.41)	0.28 (0.38)	0.17 (0.41)	0.63 (0.41)
Country fixed effects	No	Yes	Yes	No	Yes	Yes
Time fixed effects	No	No	Yes	No	No	Yes
N	216	216	216	216	216	216
R ²	0.03	0.05	0.34	0.03	0.06	0.36

45. It is possible that Australian exporters engage in currency hedging more diligently than importers so that contemporaneous movements in the real exchange rate do not have a significant effect on its exports. As noted, the terms of most currency hedging instruments rarely go beyond a year. So it is possible that an appreciation of the real exchange rate after a

year or two may reduce Australian exports even if it does not do so instantaneously. To check this possibility, Table 7b presents a set of regressions that include three lags of the real exchange rate as regressors. As it turns out, none of the lagged values of the real exchange is statistically significantly different from zero either. Therefore, at least for aggregate exports, movements in real exchange rate do not appear to be quantitatively important.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \Delta \log \text{ GDP}$	0.36 (0.37)	0.21 (0.41)	0.27 (0.41)	0.11 (0.8)	-0.66 (0.92)	-1.06 (0.83)
$\Delta \Delta \log \text{ GDP per capita}$				0.28 (0.83)	0.98 (0.93)	1.49* (0.82)
$\Delta \log \text{ Real exchange rate}$	0.1 (0.41)	-0.09 (0.45)	0.28 (0.44)	0.15 (0.43)	0.03 (0.46)	0.45 (0.44)
$\Delta \log \text{ Real exchange rate (-1)}$	-0.06 (0.18)	-0.08 (0.18)	-0.14 (0.19)	-0.07 (0.18)	-0.1 (0.19)	-0.16 (0.19)
$\Delta \log \text{ Real exchange rate (-2)}$	0.19 (0.16)	0.17 (0.16)	-0.06 (0.17)	0.19 (0.16)	0.18 (0.16)	-0.04 (0.17)
$\Delta \log \text{ real exchange rate (-3)}$	0.18 (0.15)	0.13 (0.16)	0 (0.17)	0.18 (0.15)	0.13 (0.16)	0.02 (0.17)
Country FE	No	Yes	Yes	No	Yes	Yes
Time FE	No	No	Yes	No	No	Yes
N	180	180	180	180	180	180
R2	0.04	0.08	0.38	0.04	0.08	0.39

	Mean	Median	Std. Dev.	Min	Max
Exports ²					
Commodity products	4.09	0.70	22.97	-7.27	160.22
Noncommodity products	-0.18	0.02	2.08	-5.41	5.61
Imports					
Commodity products	1.37	1.12	3.12	-10.32	10.04
Noncommodity products	1.00	1.13	1.86	-5.78	4.58

¹ Results summarized in this table are from regressions with no country and year dummies.
² For each of the four listed categories, we run the regressions for top 50 products at SITC Rev2 3-digit level where data are available.

46. Relative to most other industrialized economies, Australia's export structure has some unique features. In particular, approximately 70 percent of its exports consist of agricultural/animal products, minerals, or other types of commodities. It is possible that the world market demand for these products are not very price-elastic. If one focuses on Australia's noncommodity exports, one might be able to find a negative relationship between the exports and the real exchange rate. To check this possibility, it may be useful to turn to

disaggregated trade data that allow one to investigate separately the effects of the real exchange rate on different types of exports. In particular, 50 most important commodity exports and 50 most important noncommodity exports (ranked by value of trade) are analyzed. Rather than presenting the coefficient estimates product by product, the top panel of Table 8 presents a summary of the estimates (from the analog of equation (6)). For noncommodity exports, the coefficient estimates center around zero. For comparison, the distribution of the estimated effects of BRER on imports is summarized in the lower panel of Table 8. In a majority of cases, the estimated elasticity of imports to the real exchange rate is positive and centers around one.

Data Sources and Definitions

The definition and data sources for the variables used in this chapter are provided below.

Trade includes import and export information at both aggregated and disaggregated (SITC Rev2 3-digit) levels in current U.S. dollars. Data from 1984 to 2002. Source: WITS, World Bank.

Consumer price index from 1984:1 to 2004:3. Source: IFS and WEO, IMF.

Exchange rate includes both the bilateral information (nominal and real) of Australia and its major trading partners and the real effective exchange rate of Australia. Data from 1984:1 to 2004:3. Source: IMF and staff calculations.

GDP and GDP per capita from 1984 to 2003. Source: WEO, IMF.

Commodity price from 1984:1 to 2004:3. Source: IMF and World Gold Council.

Labor productivity index from 1984 to 2001. Source: OECD and staff calculations.

Value added from 1984 to 2001. Source: OECD.

Interest rate from 1984:1 to 2002:12. Source: IFS, IMF.

Net foreign asset position is adjusted cumulative current account balance. Data from 1984 to 1998. Source: “External Capital Structure: Theory and Evidence”, Philip R. Lane and Gian Maria Milesi-Ferretti, *The World’s New Financial Landscape: Challenges for Economic Policy*, 2002.

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II. TRADE LIBERALIZATION AND ECONOMIC GROWTH: AUSTRALIA'S EXPERIENCE⁸

A. Introduction and Summary

47. While the benefits of free trade have long been established by economic theory, the difficulty of measuring them has kept the policy debate alive. Numerous empirical studies have found a positive effect of trade openness on economic growth, only to be challenged by other studies questioning the robustness of the results. Measurement problems, reverse causality, and the sensitivity of the results to model specification are at the core of the controversy. More recent research has focused on addressing these problems and a consensus on the positive link between free trade and economic growth seems to be emerging.

48. The Australian experience with trade liberalization provides an interesting case study on the benefits of trade reform. Prior to the remarkable economic growth performance of the past decade, the Australian economy had performed poorly for more than two decades due to high tariffs, heavy product market regulation, centralized labor market institutions, and high inflation. The turn around in Australia's growth performance began with the progressive opening of the economy. The lowering of barriers to foreign competition played a catalyst role for a sustained and comprehensive reform in the labor and product markets, which has significantly enhanced the competitiveness and the flexibility of the Australian economy. As a result, total factor productivity (TFP) accelerated, lifting average growth in GDP per capita (in purchasing power parity (PPP) terms) from 1.8 percent during 1970–85—the pre-reform period—to 2.4 percent during the past 8 years. Furthermore, business cycle fluctuations have been dampened, keeping actual growth close to potential.

Labor and Productivity Indicators
(Average growth rates, in percent)

	GDP per capita			Labor Productivity 1/			TFP 2/		Labor Force Participation Rate 3/		
	1970-85	1985-95	1995-02	1970-85	1985-95	1995-02	1985-95	1995-02	1970-85	1985-95	1995-02
Australia	1.8	1.9	2.4	1.8	1.3	2.5	1.2	2.1	60.9	61.9	62.9
Canada	2.1	1.3	2.2	1.7	0.9	1.8	0.0	1.0	63.6	66.2	65.5
United Kingdom	1.7	2.3	2.2	2.7	2.0	2.0	1.2	0.9	62.0	63.0	62.8
United States	2.4	2.0	1.7	1.6	1.2	2.0	0.8	1.1	62.3	66.0	66.9

Source: OECD productivity database.

1/ GDP per hour worked.

2/ Based on 'harmonised' price indices for information and communication technology capital goods.

3/ Labor force as a percent of population aged 15–64.

⁸ Prepared by Abdelhak Senhadji (Ext. 38380) and Edimon Ginting (Ext. 38733).

49. This paper provides a quantitative assessment of the potential gains from structural reforms, with a focus on trade liberalization. It is divided into four sections. The second section briefly reviews the large literature on the link between trade openness and economic growth and the third section focuses on Australia's experience with trade liberalization. The fourth section attempts to quantify the impact of trade liberalization on economic growth by estimating a reduced form growth equation using panel data with newly constructed indicators of structural reforms.

50. The main conclusion from the literature review is that policies that eliminate barriers to trade yield economic benefits that generally outweigh their short-term costs, although there remains considerable uncertainty on the magnitude of these benefits. In the case of Australia, the econometric results show that trade liberalization and the resulting increase in the degree of openness of the economy may have lifted annual GDP per capita growth by about $\frac{3}{4}$ percentage point and that there is scope for additional significant gains from further reforms. The econometric analysis also finds strong complementarities between trade liberalization and labor and product market reforms.

B. Trade Openness and Economic Growth: A Review of the Empirical Evidence

51. A considerable body of literature has highlighted the importance of trade liberalization in facilitating economic growth. The dominant view is that trade liberalization stimulates growth. A few influential studies, however, have questioned the robustness of the relationship between trade liberalization and economic growth, generating a heated debate on the benefits of trade liberalization (Table 1).

52. More recent studies have attempted to settle the controversy by addressing measurement and endogeneity bias problems in the earlier research:

- A recent literature review by Berg and Krueger (2003) argues that recent refinements to the measurement of trade openness and model specification appear to have strengthened the robustness of the link between trade openness and economic growth. They note, however, that trade openness is only one of many determinants of economic growth, and that trade openness is likely to be highly correlated with other determinants, making it difficult to disentangle the effect of trade openness from the effect of policies that typically accompany trade reform, such as more stable macroeconomic policies and other domestic market reforms.
- By using decadal difference regressions, Dollar and Kraay (2004) find a strong correlation between changes in trade volumes and changes in economic growth.⁹ The

⁹ Caselli et al (1996) propose a specification in which a growth equation is estimated in decadal differences with the lag of the right-hand side variable as an instrument. This approach has several desirable features that address the issue of colinearity and omitted variables, and presents a natural set of instruments to control for possible reverse causation between trade and growth.

results are robust to the inclusion of variables representing the quality of institutions, suggesting that the estimated trade openness coefficient is not simply capturing the overall quality of the growth environment.

- A recent econometric study by the IMF (2004) found that trade liberalization has a positive impact on GDP per capita growth in the long term, although its short-term effect could be negative. To address the issue of omitted variables, the study includes time series of structural policy indicators in five areas—the financial sector, international merchandise trade, labor market, product markets, and the tax system—to analyze the dynamic benefits of structural reforms in OECD countries. The study corrects for the potential endogeneity bias by estimating dynamic growth equations with the Generalized Method of Moments developed by Arellano and Bond (1991).

53. Some studies have focused on the channels through which trade reform may affect economic growth. Coe and Helpman (1995) found that developed countries with higher import propensities tend to have higher productivity, reflecting a significant interaction between imports and the ability to benefit from foreign R&D. Using the same methodology, Coe, Helpman, and Hoffmaister (1997) also found similar results for developing countries. Hakura and Jaumotte (1999) examined the role of inter- and intra-industry trade in technology diffusion and concluded that intra-industry trade tends to stimulate more technology transfer than inter-industry trade.

54. Unlike econometric studies, which are based on reduced form growth equations, analyses that are based on computable general equilibrium (CGE) models allow a better understanding of the channels through which trade affects economic growth. CGE analyses also address the reverse causality problem. Moreover, by capturing inter-industry linkages, disaggregated CGE models are well equipped to assess distributional effects, adjustment costs, and other important aspects of trade liberalization. Dynamic CGE models can also differentiate between short- versus long-term productivity gains associated with a particular policy. A number of researchers have used CGE models, which of course are sensitive to model specification and parameter calibration, to quantify the impact of trade liberalization under different frameworks, including unilateral arrangements, multilateral arrangements, regional arrangements, and bilateral free trade agreements.

55. While CGE-based analyses generally find a positive impact of trade liberalization on economic growth, there remains considerable uncertainty about the size of the welfare gain (Table 2). The divergence in the findings can be attributed to differences in model structure, experimental design, and trade elasticities. Dynamic models, by capturing dynamic gains in productivity, tend to predict larger gains from trade liberalization than static models.

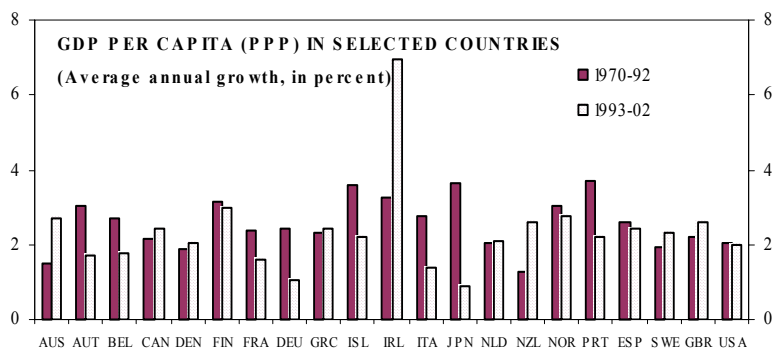
56. Overall, the empirical evidence supports a positive relationship between trade openness and economic growth. Although regression analyses suffer from some methodological limitations, including the difficulty of capturing the complex channels through which reforms affect growth, the bulk of the evidence suggests that trade openness is positively correlated with growth. Similarly, CGE-based studies generally find positive

welfare effects from trade liberalization, although the size of the gain may be quite sensitive to model specification and calibration. These studies also find that other supporting policies, such as product and labor market reforms, enhance the benefits of trade liberalization.

C. Has Australia Gained from Opening Up Its Economy?

57. Prior to the recent episode of remarkable economic growth, the Australian economy had performed poorly for more than two decades. From the 1970s through the 1980s,

economic growth rates were significantly lower than those of other OECD countries, causing Australia's income rank to slip steadily. According to the Parham (2002), Australia's GDP per capita fell from the 7th highest among OECD countries in 1960 to the 15th highest in 1990.

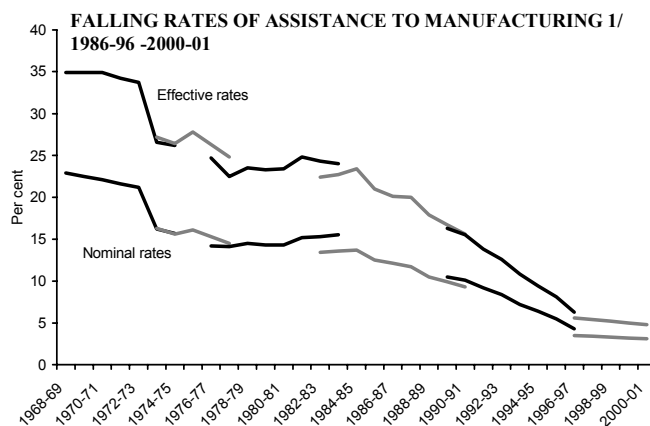


Source: OECD and Fund staff calculations.

58. High tariffs, extensive product market regulation, centralized labor market institutions, and high inflation contributed to Australia's poor growth performance. A study by the Economic Planning Advisory Council (1996) found that much of Australia's below-average growth during the 1970s and 1980s was due to poor productivity performance generated by the high-tariff regime. Historically, Australia was a less open economy than many other OECD countries.¹⁰ Together with the extensive product market regulations and the centralized wage-bargaining system, trade protection supported the growth of high-cost, domestic-oriented industries. Successive rounds of tariff increases proved necessary to maintain the competitive position of many of these inefficient industries. At the same time, the interaction between the centralized wage-bargaining system and the commodity price cycle complicated the task of managing inflation.

¹⁰ Australia's average import tariff was more than 12 percent in the mid-1970s and declined only slightly to about 10 percent by 1985. This was in stark contrast to OECD countries where the average tariff in 1985 was only 1.7 percent.

59. The improvement in Australia's growth performance began with the progressive opening of the economy. It is not surprising that Australia's economic performance improved once the failed policies of the past were reversed. The first wave of reforms began with a gradual trade liberalization in the mid 1980s, reducing almost all tariffs to a maximum of 15 percent.¹¹ Subsequently, the maximum tariff was reduced further to 5 percent by 1996, with an exception made for passenger motor vehicles and textile, clothing, and footwear. As a result, average tariff on imports declined from 10 percent in 1985 to about 3½ percent in 2001.



Source: Productivity Commission-2000.

1/ Breaks in the series reflect periodic revisions to industry input and output tables used in these estimates.

60. The lowering of barriers to foreign competition played a catalyst role for a sustained and comprehensive domestic reform program. The reform of anti-competitive business regulations and industrial relations, culminating in the adoption of the National Competition Policy in 1995¹², can be seen as a logical outcome of trade liberalization (Banks, 2003). Increased competition from overseas helped ease old antagonisms between management and labor; and, by making it more difficult for businesses to pass higher costs on to consumers, generated powerful political pressures for domestic reforms. Public enterprise reforms took place through privatization, corporatization, and changes in the regulatory framework in late 1980s. Further reforms in the product market and the state-owned enterprises were implemented in 1995 within the framework of the National Competition Policy. In the labor market, a two-tier wage setting process was introduced in 1987 under which general wage increases were determined nationally, but productivity-based increases could be negotiated at the enterprise level. To advance the move toward enterprise bargaining, the Industrial Relations Act was enacted in 1993. Further progress on the labor market reform was achieved with the passage of the Work Relation Act in 1996 and its subsequent amendments.¹³

61. Australia also laid the foundation for sound macroeconomic policy in the early 1990s by adopting an inflation-targeting framework for monetary policy and beginning the process of fiscal consolidation. Significant progress in product and labor market reforms, along with a prudent fiscal policy, contributed to the successful implementation of the inflation-

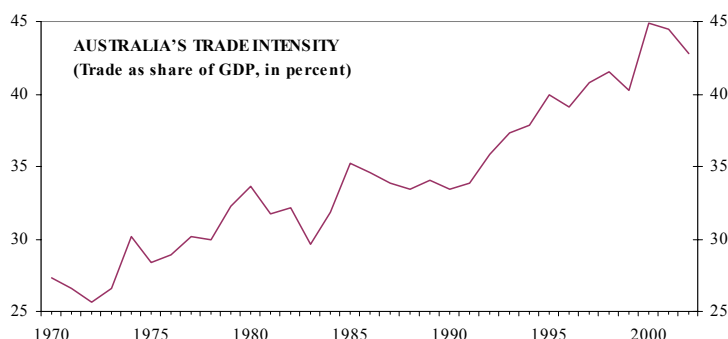
¹¹ While tariffs were cut by 25 percent in 1973, a comprehensive reform program was only launched in mid-1980s.

¹² Corresponding to the adoption of the Competition Policy Reform Act 1995.

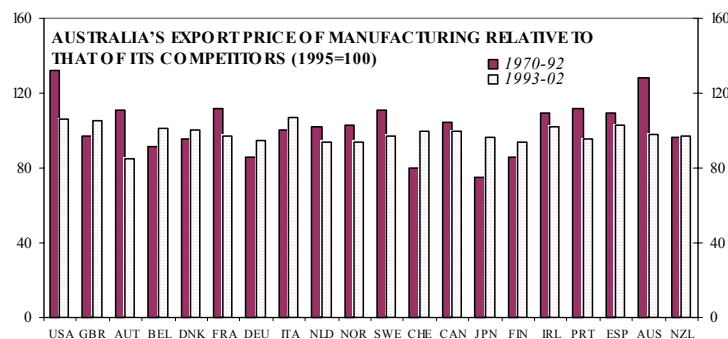
¹³ See Table 3 for the progress of domestic reforms in Australia and other OECD countries.

targeting framework, leading to a significant reduction in inflation. Inflation declined rapidly from double-digit levels in the 1970s and 1980s to below 3 percent by the early 1990s. The credibility of Australia's fiscal policy has been enhanced through the 1998 Charter of Budget Honesty, which provided a framework for the conduct of government fiscal policy by requiring that it be based on principles of sound fiscal management and by facilitating public scrutiny of fiscal policy and performance.

62. Trade liberalization and other domestic reforms have significantly enhanced the competitiveness and the flexibility of the Australian economy. As a result, Australia's trade increased markedly. After the import substitution strategies were abandoned, domestic manufacturing has become significantly more competitive, with exports of manufacturing increasing from 15 percent to 24 percent during the 1990s (Productivity Commission, 2003).¹⁴ Improved productivity and robust employment growth boosted average growth in GDP per capita to 2.7 percent during 1993–2002, compared with the OECD average of 1.7 percent during the same period. Moreover, the current expansion, now in its 13th year, has been remarkably resilient to severe negative shocks, including the Asian crisis and the global slowdown after the bursting of the tech bubble, supporting the view that the reforms have also enhanced the flexibility of the economy.



Source: OECD and staff calculations.



Source: OECD and Fund staff calculations.

D. Trade Liberalization and Economic Growth: A Panel Data Analysis

63. This section tests econometrically whether trade liberalization has had an impact on economic growth in Australia and other industrial counties; and, if so, whether the benefits of

¹⁴ The case of the Australian automobile industry clearly illustrates the benefits of trade liberalization. Notwithstanding significant reductions in tariff protection and a substantial increase in imports, local production is running close to record levels, with more than 30 percent of sales going overseas compared with less than 10 percent a decade ago (Banks, 2003).

trade liberalization are larger when implemented in conjunction with other structural reforms such as labor and product market reforms. To assess the significance of trade liberalization in the growth performance of industrial countries, a reduced form growth equation was estimated using panel data covering 15 OECD countries for the period 1975 to 1998.¹⁵

64. The reduced form equation, which can be derived from a neoclassical production function expressed in growth rates, relates output growth to a linear function of the growth of factor inputs— the stock of physical capital and total employment—and the growth of total factor productivity (TFP). The estimated growth equation is obtained by, in turn, expressing TFP growth as a function of a set of explanatory variables.¹⁶ Given the focus in this paper on the effect of trade liberalization on growth, total factor productivity growth is assumed to be determined by a trade liberalization index, its interaction with other structural reform indexes to test whether a comprehensive approach to structural reforms yields a larger growth dividend than a piecemeal approach. Another trade-related variable that has been found to be positively related to growth is the degree of openness of the economy generally measured by the ratio of exports of goods and services to GDP.¹⁷

65. In addition to a comprehensive structural reform program, Australia also implemented a wide-ranging reform of its macroeconomic policy framework centered on bringing inflation down from a two-digit to a low single-digit level, and consolidating its fiscal accounts. Consequently, inflation and the size of the government, which is measured by public consumption as a share of GDP, are additional explanatory variables in the estimated growth equation.

66. The dependent variable is the annual growth rate of GDP per capita in PPP terms (*GDPPC*, hereafter). Generalized Least Squares (GLS) was used to estimate the growth equation in order to take into account the significant heteroskedasticity of the error term. The results are given in Table 4. As discussed above, by including factor inputs in the growth equation, the coefficients on the other explanatory variables can be interpreted as their impact on growth through TFP. All variables have the expected sign and are statistically significant at least at the 5 percent level. In particular, the trade reform index is positively correlated

¹⁵ The countries in the panel include Australia, Austria, Belgium, Canada, Finland, France, Germany, Italy, Japan, Netherlands, New Zealand, Spain, Sweden, United Kingdom, and United States. The time period is constrained by data availability on structural reform variables discussed below.

¹⁶ See Annex 1 for a formal derivation of the growth equation.

¹⁷ While trade liberalization and the degree of openness are correlated, the inclusion of both variables in the growth equation is likely to better capture the benefits from trade.

with *GDPPC* growth, suggesting that freer trade tends to promote growth through higher TFP growth.¹⁸

67. Table 5 illustrates the results in Table 4 with two scenarios. The first scenario assesses the impact on *GDPPC* growth from trade, product, and labor market reforms in Australia since 1985. The second scenario measures the impact on growth from hypothetical further reforms that would bring Australia on par with the top 5 reformers—that is, by raising end-of-period Australian levels of *TRADE_ref*, *LABOR_ref*, and *PRODUCT_ref* indexes to the average of the 5 highest levels in OECD countries. According to the first equation in Table 4, trade liberalization in Australia since 1985, as measured by the change in *TRADE_ref* from 1985 to 2001, has raised annual *GDPPC* growth by 0.56 percentage points. Including also product and labor market reforms, raises the contribution of reforms to annual growth to 0.74 percentage points. To test the existence of complementarities between trade reform and labor and product market reform, interactive terms were added in the second equation. Because of multicollinearity problems, the labor and product reform indexes only enter the equation as interactive terms with the trade liberalization index. The interactive terms are highly significant, suggesting that complementarities between reforms do indeed exist.¹⁹ According to equation (2), trade reform accounted for 0.56 percentage points in Australia’s growth in *GDPPC*, with complementarity effects accounting for 43 percent of the increase in *GDPPC* growth. Further reforms could bring additional, significant gains in *GDPPC* growth. Further trade liberalization that would raise *TRADE_ref* index to the average of the top 5 levels would raise *GDPPC* growth by more than ½ percentage point. Growth could be raised by as much as 0.9 percent if all 3 indexes were raised to average of 5 highest levels.

Table 5. Impact on Australia’s Growth in <i>GDPPC</i> from Increase in Reform Indexes (in percent) ¹				
	Equation			
	(1)	(2)	(3)	(4)
Reform since 1985				
<i>TRADE_ref</i>				
Direct effect	0.56	0.32	0.67	0.34
Total effect	0.56	0.56	0.67	0.60
all 3 reform indexes				
Direct effect	0.74	0.32	0.81	0.34
Total effect	0.74	0.66	0.81	0.70
Further Reform to match top 5 countries in:				
<i>TRADE_ref</i>				
Direct effect	0.47	0.27	0.56	0.28
Total effect	0.47	0.52	0.56	0.56
All 3 reform indexes				
Direct effect	0.73	0.27	0.79	0.28
Total effect	0.73	0.83	0.79	0.88
<i>Note:</i> Using estimation results from Table 4.				

¹⁸ The reform indicators are constructed such that an increase in the index reflects a deepening of reform. For example, an increase in the trade reform index implies a reduction in trade barriers. See Annex 2 for the definition of the reform indexes.

¹⁹ See Coe and Snower (1997) for theoretical underpinnings of policy complementarities.

68. The coefficient estimate for the degree of openness is also positively related to growth and is highly significant. The degree of openness of the Australian economy increased from 14 percent in the early 1980s to 22 percent in 2002. This could have added almost 0.1 percentage point to annual GDP per capita growth. This increase in the degree of openness may have been largely driven by the trade liberalization policies that have been implemented since the 1980s. Indeed, regressing the degree of openness on the trade liberalization index using the whole panel data yields a positive and statistically significant coefficient with a *t*-statistic of 15 and an adjusted R^2 of 0.26. The total trade effect, obtained by combining the effects of the trade liberalization index and trade openness, is approximately a $\frac{1}{2}$ of a percentage point.

69. Macroeconomic reform may have also had a substantial positive effect on growth. Australia adopted an inflation targeting framework in 1993 to reduce the persistently high inflation rates of the 1970s and 1980s.²⁰ As noted, trade and other domestic reforms have contributed significantly to the successful implementation of the inflation targeting framework. Consequently, inflation was brought down from 11½ percent in the decade prior to reforms (1974–83) to less than 3 percent in the past decade. This reduction in inflation alone might have lifted Australian growth by about a $\frac{1}{4}$ of a percentage point. Following recent empirical research, inflation enters the growth equation in a nonlinear fashion to test if the effect of inflation on growth depends on whether the initial level of inflation is below or above a threshold level.²¹ The estimation results corroborate previous studies where a modest increase in inflation could stimulate growth if inflation remains below 3 percent but starts to hurt growth if inflation increases above 3 percent. The estimated coefficient implies that a one percentage point increase in inflation, when initial inflation is below 3 percent, will raise growth by almost a $\frac{1}{4}$ of a percentage point. However, an increase of the same magnitude, when inflation is already above 3 percent will reduce growth by 0.03 percentage points. Thus, a reduction of inflation from 11½ percent to 3 percent would boost growth by a $\frac{1}{4}$ of a percentage point.

70. Finally, an increase in factor inputs growth and a reduction in the size of the government promote growth in *GDPPC*. The negative and statistically significant coefficient on initial GDP per capita (*GDPPC_0*) indicates that GDP per capita across OECD countries exhibit conditional convergence.

71. The coefficient estimates obtained by GLS in Table 4 may be biased due to the potential endogeneity of the explanatory variables. Therefore, the growth equation was also estimated using GLS with instrumental variables (GLS-IV). All variables but the time trend were instrumented for. The list of instruments for each variable includes its own lag values

²⁰ Although the inflation targeting framework was adopted in 1993, the framework was not fully formalized until the 1996 Statement on the Conduct of Monetary Policy.

²¹ Khan and Senhadji (2001) estimate the threshold level of inflation above which inflation starts to reduce growth at 3 percent for industrial countries.

and a time trend. This set of instruments is only valid under the hypothesis of non-autocorrelation.²² The results are given in the third and fourth columns of Table 4. Generally, the GLS-IV coefficient estimates are relatively close to ordinary GLS estimates. The Wooldridge autocorrelation test fails to reject the null of no autocorrelation at conventional significance levels, which validates the use of lagged variables as instruments.

72. While the results need to be interpreted with caution given that the relationship between the explanatory variables and GDP per capita growth in the estimated equations is not necessarily causal, the results support the view that structural and macroeconomic reforms have had a strong positive impact on Australia's growth performance.

²² Note that estimators based on first-differencing of the growth equation such as the Arellano-Bond method are not valid here, given that the equation is not specified in its dynamic form and does not include fixed effects. Therefore, the equation should be interpreted as the long-run relationship between *GDPPC* growth and its fundamental determinants. Short-term dynamics were removed from the data by applying the HP filter.

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Table 1. Studies on Trade Openness, Growth, and Productivity

Studies	Methods	Key Findings
Sachs and Warner (1995)	OLS Panel of 79 Countries, 1970–89.	Dummy variable for trade openness is highly significant. Open economies grow, on average, by 2½ percentage points more than the closed economies.
Coe, and Helpman (1995) and Coe, Helpman, and Hoffmaister (1997)	WLS panel of 22 advanced economies and of 77 developing countries, 1971–90.	Total factor productivity is positively correlated with foreign R & D. Economies that are more open to imports derive larger benefit from foreign R & D.
Edwards (1998)	WLS and Instrumented WLS. Test 9 alternative measure of openness using panel data ranges from 38 to 87 countries and slightly different time-period.	More open economies tend to have faster productivity growth than more closed economies; results are robust to the use of different openness indicators, estimation techniques, time-periods, and functional forms.
Chand (1999)	OLS panel of 2 digit ANZSIC, Australian Manufacturing sectors, 1967–68 to 1995–95.	Using the most conservative estimate, a 1 percent drop in the nominal rate of protection leads, on average, to 0.2 percent rise in total factor productivity.
Rodriguez and Rodrik (1999)	OLS Panel of 74 Countries, 1970–89. Individual components of Sachs and Warner’s Index are used in the in a growth regression.	The black market premium and existence or absence of state monopolies in the export sector are statistically significant, whereas other components of the index—average import tariffs, tariff barriers, and whether or not the economy in question is socialist—are not. Introduction of institutional quality index reduces the value and significance of trade openness.
Frankel and Romer (1999)	OLS and IV cross-section of 98 countries, 1985.	IV estimates of the effect of trade on income are larger than OLS estimates. IV estimates imply that one percentage point increase in the ratio of trade to GDP raises income per capita by between one-half to two percent.
Rodrik, Subramanian, and Trebbi (2002)	OLS and IV cross-section of 64, 80, and 140 countries, 1995.	Once the institutional the variable is added, the estimated coefficients on geography and openness have the wrong sign. IV estimate of the effect of institutions on income is nearly three times as large as the OLS estimates.
Wacziarg and Welch (2003)	OLS; Panel of 116 Countries 1990–99 and fixed-effects regression 1950–98.	Sachs and Warner’s results break down completely for the 1990s. Countries that liberalize trade regime experience, on average, 1½ percentage points higher growth compared with pre-liberalization period.
Dolar and Kraay (2004)	OLS and IV cross-section of 187 countries, 1980s and 1990s.	IV estimate of the effect of trade on income is larger than OLS estimates. IV estimates indicate that a 100 percent increase in a country’s trade share raises incomes by 48 percent over a decade.
IMF (2004)	GMM panel of 15 OECD Countries, 1984-95.	Cumulative gains from structural reform in trade, product market, and labor market are positive, but they predominantly materialize in the long run.

Table 2. CGE Studies on the Impact of Tariff Reduction

Studies	Experiments	Model and Features	Key Findings
Dixon et al (1986)	Short-run effects of 50 percent across-the-board cut in protection in Australia	ORANI: static, single country	Significant reduction in output of import-competing sectors (textile, clothing, footwear, and motor vehicles) are more than offset by increasing output of exporting sectors (Coal, iron and meat products). The short-run net positive gain is 0.2 to 0.4 percent of GDP.
Hartel and Martin (1999)	WTO, Compare 40 percent cut in manufacturing tariffs worldwide with the same cut in agriculture tariffs	GTAP: Version 4, static, multi-countries	Total gain from tariff cuts in manufacturing is US\$380 billion, with three-quarters accruing to developing countries. Total gain of the same cut in agricultural protection is US\$69 billion, with less than one-fourth accruing to developing countries.
Productivity Commission (2000)	Removing all tariffs that are under 5 percent	MONASH: recursive dynamic, single country	Initially, the gain is A\$240 million (measured in current dollar), 0.04 percent of GDP. By 2010, the gain with productivity improvement in the affected industries is A\$480 million, 0.08 percent of GDP. Without productivity improvement, GDP gain reduces to A\$120 million.
Scollay and Gilbert (2000)	APEC liberalization in agriculture and food products.	GTAP: Version 4, static, multi-countries	Total gain ranges from US\$56 to US\$118 billion depending on liberalization scenarios. Big countries (Japan, China, and USA) receive the largest welfare gains in absolute terms. Canada experiences welfare losses in all scenarios, while Mexico, Indonesia, and Malaysia also experience losses if non-APEC members do not reciprocate.
McKibbin et al (2000)	Free Trade Area between AFTA (ASEAN Free Trade Area) and CER (The Australian and New Zealand Closer Economic Relations)	APG-Cubed: dynamic, multi-countries	Total gain of AFTA-CER FTA is US\$48 billion over the period of 2000–20, US\$26 billion for AFTA and US\$22 billion for CER. All member countries gain from the arrangements. Indonesia, the Philippines, and Thailand gain more due the size of the initial barrier and direction of trade.
Center for International Economics (2004)	Free Trade Area between Australia and the United States (AUSFTA)	APG-Cubed and GTAP	Australia's GDP increases by US\$6.1 billion per year. Investment liberalization makes the biggest contribution to overall gain.
Hartel et al (2004)	Free Trade Arrangement of the Americas (FTAA)	GTAP: Version 5, static with sensitivity analysis	Welfare effects are positive for ten of the thirteen FTAA members, but are negative for the rest of the world. In absolute terms, the United States receives the largest gain.

Table 3. Australia: Structural Reform Indicators for 15 OECD Countries

	International Trade						Product Market						Labor Market					
	1975		1985		2001		1975		1985		1998		1975		1985		1998	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank
Australia	0.11	15	0.32	15	0.69	15	0.30	5	0.30	6	0.56	6	0.50	9	0.50	6	0.50	6
Austria	0.73	10	0.89	7	1.00	1	0.15	11	0.15	11	0.27	13	0.53	8	0.41	10	0.40	10
Belgium	0.90	2	0.92	3	1.00	2	0.21	8	0.21	10	0.49	8	0.28	15	0.30	14	0.38	12
Canada	0.62	14	0.74	12	0.94	11	0.61	2	0.61	2	0.73	4	0.71	2	0.70	2	0.73	2
Finland	0.79	8	0.93	2	1.00	2	0.08	12	0.14	12	0.19	15	0.45	10	0.45	7	0.45	7
France	0.89	3	0.93	1	0.99	8	0.00	15	0.00	15	0.19	14	0.53	7	0.42	8	0.37	13
Germany	0.83	5	0.91	6	0.99	7	0.24	6	0.24	7	0.52	7	0.38	13	0.39	12	0.42	8
Italy	0.97	1	0.92	4	1.00	5	0.03	14	0.03	14	0.36	11	0.65	3	0.66	3	0.54	5
Japan	0.76	9	0.81	10	0.83	14	0.44	3	0.44	3	0.71	5	0.64	5	0.65	4	0.64	3
Netherlands	0.87	4	0.92	5	1.00	2	0.07	13	0.07	13	0.40	10	0.37	14	0.29	15	0.34	14
New Zealand	0.65	12	0.67	14	0.84	13	0.41	4	0.42	4	0.76	3	0.44	11	0.42	9	0.42	9
Spain	0.63	13	0.70	13	0.96	10	0.19	9	0.23	8	0.48	9	0.42	12	0.33	13	0.40	11
Sweden	0.81	7	0.82	9	0.99	6	0.23	7	0.23	9	0.31	12	0.55	6	0.41	11	0.00	15
United Kingdom	0.83	6	0.88	8	0.99	9	0.18	10	0.30	5	1.00	1	0.65	4	0.62	5	0.63	4
United States	0.69	11	0.75	11	0.88	12	0.73	1	0.73	1	0.77	2	0.81	1	0.82	1	0.81	1
Mean	0.74		0.81		0.94		0.26		0.27		0.52		0.53		0.49		0.47	
Top 5	0.85		0.92		1.00		0.47		0.50		0.79		0.69		0.69		0.67	
S.D. (whole sample)			0.20						0.19						0.14			

Source: Appendix I.

Table 4. Trade Liberalization and GDP Per Capita Growth: Panel Regressions

Independent Variables	Estimation Method			
	GLS	GLS	GLS-IV	GLS-IV
<i>Log(GDPPC_0)</i>	-0.0160 (-12.55)*	-0.0156 (-12.81)*	-0.0179 (-11.40)*	-0.0162 (-13.44)*
<i>Δlog(EMPL)</i>	0.4205 (10.41)*	0.4179 (10.67)*	0.4868 (11.06)*	0.4380 (11.48)*
<i>Δlog(K)</i>	0.0710 (4.99)*	0.0641 (4.55)*	0.0471 (3.16)*	0.0359 (2.64)*
<i>TRADE_lib</i>	0.0151 (12.34)*	0.0087 (3.74)*	0.0181 (20.28)*	0.0091 (3.82)*
<i>LABOR_ref</i>	0.0059 (2.50)*		0.0059 (4.36)*	
<i>PRODUCT_ref</i>	0.0069 (9.13)*		0.0054 (5.32)*	
<i>TRADE_lib*LABOR_ref</i>		0.0090 (3.13)*		0.0101 (3.73)*
<i>TRADE_lib*PRODUCT_ref</i>		0.0066 (7.39)*		0.0067 (8.29)*
<i>OPEN</i>	.0088 (3.44)*	.0094 (3.62)*	.0031 (2.24)**	.0074 (3.17)*
<i>INFL</i>	0.2412 (5.58)*	0.2287 (5.40)*	0.1464 (3.09)*	0.2021 (4.62)*
<i>D₁*(INFL-0.03)</i>	-0.2677 (-6.36)*	-0.2598 (-6.30)*	-0.1609 (-3.49)*	-0.2313 (-5.50)*
<i>Cg</i>	-0.0111 (-2.13)**	-0.0113 (-2.30)**	-0.0049 (-0.77)	-0.0050 (-1.11)
<i>TREND</i>	-0.0003 (-7.30)*	-0.0003 (-7.30)*	-0.0003 (-6.83)*	-0.0003 (-8.05)*
<i>Adjusted R²</i>	0.60	0.61	0.60	0.60
<i>NT</i>	428	428	393	393
<i>Wooldridge Autocorrelation Test</i>	1.04	0.97	0.64	1.21
<i>H₀: no autocorrelation (t-distribution)</i>				

Note: The equations were estimated using panel data for 15 countries and for 1975–1998. The dependent variable is the annual growth rate of GDP per capita in PPP terms (*GDPPC*). The independent variables are: the log of initial *GDPPC* (*GDPPC_0*), the annual growth rate of employment (*EMPL*), the annual growth rate of the capital stock (*K*), a trade liberalization index (*TRADE_lib*), a labor reform index (*LABOR_ref*), a product reform index (*PROD_ref*), the degree of openness (*OPEN*), inflation (*INFL*), the interactive term between inflation (minus the threshold of 3 percent) and the dummy variable *D₁* that takes one for inflation rates over 3 percent, public consumption as a share of GDP (*Cg*), and a time trend (*TREND*). All variables that are business-cycle sensitive have been pre-filtered with the HP filter to remove business cycle frequencies. In the GLS-IV procedure, all (but the time trend) explanatory variable are instrumented for by their respective first three lags and a time trend. The Wooldridge autocorrelation test fails to reject the null of no autocorrelation of the residuals at conventional significance levels. Superscript “*” and “**” indicate statistical significance at the 1 percent and 5 percent level, respectively.

Derivation of the Empirical Growth Equation

Following the empirical growth literature, a reduced form growth equation is derived from an aggregate production function as follows:²³

$$Y_{it} = A_{it}F(K_{it}, L_{it}) \quad (1)$$

where Y_{it} is GDP per capita on a purchasing power parity (PPP) basis, A_{it} is total factor productivity, K_{it} is the stock of capital, and L_{it} is total employment, all for country i in year t . Differentiating equation (1) with respect to time yields GDP per capita growth as a function of growth in total factor productivity, growth in the capital stock, and growth in total employment:

$$y_{it} = a_{it} + f(k_{it}, l_{it}) \quad (2)$$

where lower case variables represent the growth rate of the corresponding uppercase variable in equation (1). It is assumed that TFP growth, a_{it} , is a function g of a set of factors $x_{it}^1, \dots, x_{it}^K$ that is:²⁴

$$a_{it} = g(x_{it}^1, \dots, x_{it}^K) \quad (3)$$

Substituting equation (3) into (2) yields the final equation:

$$y_{it} = f(k_{it}, l_{it}) + g(x_{it}^1, \dots, x_{it}^K) \quad (4)$$

The set of explanatory variables $x_{it}^1, \dots, x_{it}^K$ varies across the studies in the literature. The choice mainly depends on the countries included in the sample. The larger and the more heterogeneous the sample is, the larger the set $x_{it}^1, \dots, x_{it}^K$ generally is to control for cross-country heterogeneity. In this study, limiting the sample to OECD countries reduces the high degree of heterogeneity associated with studies that include both developed and developing countries while providing a rich set of country experiences.

²³ See, for example, Barro and Sala-i-Martin (1995).

²⁴ While k_{it} and l_{it} represent growth rates of the capital stock and total employment, the variables $x_{it}^1, \dots, x_{it}^K$ are not necessarily in growth rates.

Data Sources and Definitions

The data are annual for the period 1975 to 1998. The countries included in the sample are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States. The definitions and sources for each variable are:

GDP per capita in Purchasing Power Parity (PPP) terms (GDPPC). Source: OECD.

Total employment (EMPL). Source: OECD.

Capital stock of the business sector (K). Source: OECD.

Inflation (INFL), based on CPIs. Source: OECD.

Public Consumption as a share of GDP (Cg) is used as a measure of the size of the public sector in the economy. Source: OECD.

Product market reform indicator (PRODUCT_ref). The indicator is constructed by Nicoletti and Scarpetta (2003) covering product market reforms over the 1975-98. It is based on indices for barriers to entry, public ownership, market structure, vertical integration, and price control in nonmanufacturing sector, which includes the following industries: passenger air transport, telecommunications, electricity, railways, post, road freight, and gas. The indicator is rescaled to range between 0 to 1, with increasing values indicating a less restrictive product market.

Trade reform indicator (TRADE_lib). The indicator is constructed by using average effective tariffs, calculated as the ratio of customs and import duties (from OECD, *Revenue Statistics*; and IMF, *Government Financial Statistics*) to the value of imports (from IMF, *International Financial Statistics*). The index is rescaled to range between 0 to 1, with increasing value indicating less restrictive trade regime.

Labor market reform indicator (LABOR_ref). It is based on simple average of indices of employment protection, benefits replacement rates, and benefit duration. Employment protection measures the restrictiveness of employment protection. Benefits replacement rates is the average of first-year unemployment benefits as a percentage of earnings before tax. Benefit duration is the ratio of the average benefit replacement rates in the second to the fifth year of an unemployment spell to the average benefit replacement rate in the first year of an unemployment spell. The indicator is rescaled to range between 0 to 1, with increasing value indicating more flexible labor market regime. Source: Labor Market Institutions Database developed by Nickel and Nunziata (2001). WEO extended the indicator using OECD data provided by Nicolletti.

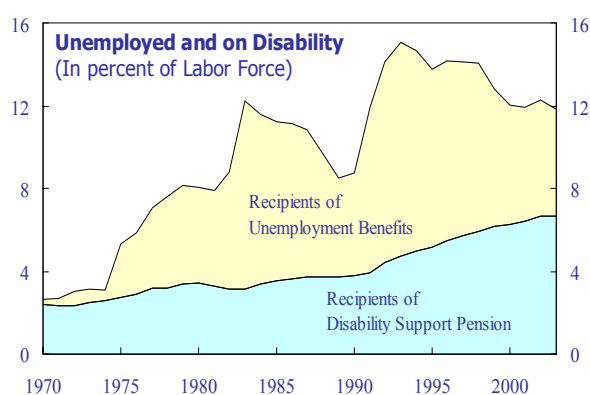
Degree of openness of the economy (OPEN) is defined as exports of goods and services divided by GDP. Source: OECD.

III. DISABILITY SUPPORT PENSION IN AUSTRALIA AND THE NETHERLANDS²⁵

A. Introduction

73. Increasing labor force participation is at the center of the government’s strategy for promoting growth and easing fiscal pressures associated with an ageing population. Incentives to work are affected by various elements of the income support system such as the maximum rates of payments, the maximum level of income and assets that allows individuals to qualify, and eligibility criteria attached to payments and obligations (such as requirements to look for work). Ensuring that the income support system provides an adequate and well-targeted safety net without discouraging work requires careful balance.

74. The Australian Disability Support Pension (DSP) program has grown rapidly, from 3¾ percent of labor force in 1990 to 6¾ percent in 2002, exceeding the unemployment rate of 5½ percent. While the overall cost of the disability program in Australia remains below the OECD average (Table 2)—almost 1½ percent of GDP in Australia compared to almost 2½ percent for the OECD average in 1999—the disability program in Australia has been growing much more rapidly than in other OECD countries (Table 3). This note compares the disability support systems in Australia and the Netherlands, a country with one of the largest disability pension programs among OECD countries. The proposed reforms in both countries are briefly discussed.



Source: Australian Treasury

	1980	1990	2002
Australia	3.4	3.8	6.7
The Netherlands	12.2	14.2	13.3

Source: Australian authorities and Statistics Netherlands

B. The Disability Support System in Australia and the Netherlands

75. The Australian DSP scheme is essentially based on medical disability or a test of whether people are able to work full time at full-award wages. Those who are permanently blind or have a permanent impairment qualify for the DSP on medical grounds. To meet the second criterion, a physician must certify that the person has a continuing inability to work, or to be re-trained within two years. Currently, qualification for the DSP is not subject to a work reintegration test, it is not taxable, and has more generous income and asset tests than

²⁵ Prepared by Edimon Ginting (Ext. 38733) and Abdelhak Senhadji (Ext. 38380).

some other benefit transfers.²⁶ For those aged 55 years and over, local labor market conditions are taken into account in determining their qualification for DSP.

76. The two most common medical conditions for people receiving DSP are muscular-skeletal (just under a third) and psychological or psychiatric (around one fifth). People aged between 45 and 65 represent two-thirds of the DSP population. Around one fifth of DSP recipients have been on the payment for more than ten years. The majority of recipients remain on pension for life and only 8 percent have income from earnings. Australia now has one of the lowest rates of employment for disability recipients.²⁷ Some have argued that the DSP system discourages work participation. To ensure that DSP remains the appropriate income support payment only for those with little or no capacity for paid work, the government proposed two changes to tighten its eligibility requirements as part of the 2002/03 Budget: The proposal makes to the DSP qualification criteria:

- to change the continuing inability to work test from 30 hours to 15 hours a week; and
- to change the special inability to work test applied for those aged 55 or more, from referring only to the local labor market to considering the overall labor market, as is currently the case for those aged less than 55.

The proposal have not passed the Senate.

77. There are different types of assistance programs available to help people with disabilities participate in the workforce. These include rehabilitation services; help to find work through specialist disability employment services; and incentive programs for employers to hire people with disabilities. Participation in these is voluntary. However, only a relatively small number of people on DSP has taken advantage of these services. As a consequence, the outflows from DSP have been relatively small leading to a sharp increase in people on the DSP since 1990.

The Reform of the Dutch Disability Support System

78. Like Australia, the Netherlands has had large inflows of disability benefit recipients. During the 1970s and 1980s, the Dutch disability scheme was used by employers as a convenient way to lay-off workers with relatively mild consequences for the member's incomes. Consequently, while unemployment rates dropped, the number of disabled rose, reaching almost one million in the late 1990s, or about 13 percent of the labor force. The

²⁶ Hon Jocelyn Newman (2003), "The Challenge of Welfare Dependency in the 21st Century," *Discussion Paper*, Ministry for Family and Community Services.

²⁷ Australian Government (2004), "Australia's Demographic Challenges," available at <http://demographics.treasury.gov.au/content/default.asp>.

outlays of the program amount to about 2.7 percent of GDP in 1999 (or 4.6 percent when including sickness benefits, which are paid by the employer, and other related costs), which is very high by international standards (cf. Table 2).

79. The problems with the scheme have been long acknowledged and various reforms have taken place over the years, with major reforms in 1985 and 1993. While reducing the generosity and cost of the scheme, the reforms did not succeed in a durable reduction of inflows. In 2001, an expert committee (the *Donner Committee*) issued recommendations for a further comprehensive reform of the system, which were subsequently discussed and modified in the Social Economic Council (*SER*), the advisory body comprising the social partners. The *SER* proposal of 2002, which is broadly the basis for the current reform plan, includes:

- The duration of sickness-benefits is extended from one year to two years. These wage-related benefits are paid by the employers and typically amount to 70 percent of the wage or more. Social partners have committed to limit benefits in the second year of sickness to 70 percent of the wage in order to increase financial incentives for reintegration (i.e., no top-ups).²⁸
- The disability scheme is restricted to only the fully and permanently disabled. The latter is defined as a loss of earning capacity of at least 80 percent, resulting from a condition from which it is not possible to recover within 5 years.
- Partially disabled for whom the loss of earning capacity resulting from their disability amounts to more than 35 percent, will be eligible for a wage subsidy amounting to 70 percent of the difference between the new and the old wage. The subsidy is meant to provide this group with incentives to keep working. Should a partially disabled person become unemployed, however, following the initial two year sickness period, he or she will first be eligible for a normal unemployment benefit, which is 70 percent of the last earned wage and has a duration of up to 5 years depending on employment history. After that, a follow-up benefit will apply, equal to 70 percent of the minimum wage multiplied by the degree of disability.
- Partially disabled for whom the loss of earning capacity is less than 35 percent will not be eligible for any disability benefit.
- A mandatory work injury insurance, through private insurers, will be introduced to provide for compensation in case of work related injuries. Such a scheme already exists in most OECD countries, and is required under ILO regulations, but was thus far absent in the Netherlands.

²⁸ In many collective labor agreements, top-ups of sickness benefits up to 100 percent of the wage have been negotiated.

- The examination process that determines eligibility for disability benefits will be tightened at various levels. First, the employer and the employee will have to show that they have made sufficient reintegration efforts in the first two years of sickness. Second, medical examinations will be tightened through the use of a standard list with normal recovery periods for various illnesses. Departures from the list in individual cases would need to be substantiated by the examining doctor. Finally, criteria for determining what type of work could still be done by a partially disabled person will be loosened.
- The new disability schemes will only apply to new entrants. Existing cases will retain their current benefits, although they may be subjected to re-examinations within the old scheme.

80. While the following table compares the reform proposals of the disability support systems in Australia and in the Netherlands:

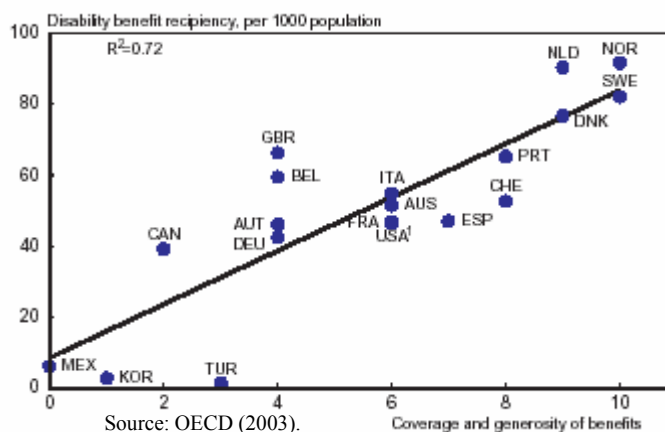
	Australia	The Netherlands
Current eligibility requirements	<ul style="list-style-type: none"> • Meet minimum level of medical impairment. • Doctor certifies that the person has a continuing inability to work 30 hours or more a week. • A second medical opinion may be required. • Income and assets tests. 	<ul style="list-style-type: none"> • A specialized physician determines the degree of disability based on the loss of working capacity. • Workers with 15 percent disability are eligible to receive benefits. • Eligibility is reexamined every 5 years. • No distinction between work-related and other disabilities. • No minimum contribution is necessary to qualify for the program. • Stricter mutual reintegration effort introduced in April 2002
Eligibility requirements in the proposed reform	<ul style="list-style-type: none"> • Change the continuing inability to work test from 30 to 15 hours a week. • Make local market conditions irrelevant in determining whether a person has a continuing inability to work. 	<ul style="list-style-type: none"> • Restrict to the fully and permanently disabled—loss of earning capacity of at least 80 percent that is not recoverable within 5 years. • Partial disability, with the loss of earning capacity of at least 35 percent, is eligible for wage subsidy. • Separate scheme for work-related and other disabilities. • Extend the duration of sickness-related benefit paid by employers, from one to two year. • Employees and employers must demonstrate sufficient reintegration effort in the first two years of sickness. • Medical examinations are tightened by specifying normal recovery periods for various illnesses. • Income limit of €43,770. • The new scheme applied to new entrant only.

81. This comparison suggests that the Australian DSP scheme may need further reform to establish its sustainability. In particular, the proposed reform on the Australian eligibility requirements—the reduction in the continuing inability to work test from 30 to 15 hours a week and the shift from local to overall market conditions in determining whether a person has a continuing inability to work—appear to be less stringent than the proposed eligibility requirement for the Netherlands where the disability support scheme is restricted to only the fully and permanently disabled.

82. In 2003, the new inflows into the Dutch disability scheme dropped by 28 percent to 66 thousand for the first time in seven years. Part of the decline is due to institutional improvements. First, a law on improved gate-keeping came into force in April 2002, introducing stricter mutual obligations on reintegration efforts for employees on long-term sickness benefit and their employers. Second, the five public debility benefit agencies were merged into a single one in January 2002, reducing the influence of sector interests on the disability benefit authority. Third, the effect of experience-rating in insurance premiums at the firm level, introduced in 1998, grew stronger as premiums became more and more differentiated for medium-size and large firms. However, part of the decline may have been cyclical. A cooling labor market usually leads to lower sickness numbers as employees fear losing their jobs. Moreover, the decline in inflow numbers may also reflect public debates on the disability problem. In any event, the inflow in 2003 remains well above the target of 25 thousand persons by 2006, after the implementation of the new reform initiatives.

C. Conclusion

83. As highlighted in a recent OECD report, the disability support systems in industrial countries should move away from a *compensation policy* to an *integration policy* approach.²⁹ A compensation policy approach stresses benefit payments as opposed to economic integration. Such an approach generates high reciprocity rates and low levels of employment: as shown in the figure, the disability benefit reciprocity rate is positively and highly correlated with the coverage and generosity of benefits. Alternatively, an integration policy encourages employment by emphasizing work incentives for partially disable individuals, providing incentives for firms to hire disable workers, and by tightening eligibility criteria for disability support programs.



²⁹ *Transforming Disability into Ability*, 2003, OECD.

Table 2. Public Expenditure on Disability-Related Programs¹
(In percentage of GDP)

	Disability Benefits (Percentage of GDP)		Broad Disability Benefits (Percentage of GDP)		All Disability-Related Programs		
	1990	1999	1990	1999	Percentage of GDP	Percentage of Expenditure on Unemployment Compensation	Percentage of Total Public Social Expenditure
						1999	
Australia	0.51	0.86	1.01	1.39	1.44	137	8
Austria	1.30	1.75	2.62	2.85	2.92	254	11
Belgium	1.32	1.06	2.21	1.61	1.72	95	7
Canada	0.46	0.67	1.19	1.23	1.28	130	7
Denmark	2.31	2.28	3.70	3.31	3.60	227	13
France	0.73	0.83	1.70	1.58	1.67	113	6
Germany	1.05	1.01	3.22	2.90	3.08	146	11
Italy	1.69	0.95	2.25	1.82	1.83	330	7
Korea	0.00	0.02	0.20	0.28	0.29	164	5
Mexico	0.09	0.20	0.15	0.29	0.29	...	3
Netherlands	3.42	2.65	5.74	4.14	4.64	178	19
Norway	2.23	2.36	4.92	4.83	5.58	1,190	21
Poland	2.39	3.28	3.15	4.42	4.60	719	20
Portugal	1.32	1.03	1.89	1.48	1.53	235	8
Spain	0.96	1.24	2.11	2.26	2.28	162	12
Sweden	2.03	2.05	5.21	4.02	4.66	292	15
Switzerland	1.05	1.83	1.58	2.21	2.40	267	8
Turkey	0.03	0.07	0.70	1.46	1.46	...	13
United Kingdom	0.88	1.27	1.39	1.52	1.54	268	6
United States	0.56	0.71	1.48	1.37	1.40	554	10
OECD (20)	1.22	1.30	2.32	2.25	2.42	217	11
OECD (17) ²	1.42	1.52	2.67	2.53	2.73	233	11
EU (11)	1.55	1.46	2.91	2.50	2.70	190	11
Non-EU (9)	0.81	1.11	1.60	1.94	2.08	326	12

Source: OECD (2003).

1/ Various definitions of disability benefits are as follows:

Disability benefits = Contributory (earnings-related) and noncontributory disability benefits.

Broad disability benefits = Disability benefits, sickness cash benefits, and work injury benefits.

All disability programs = Broad disability benefits and employment-related programs for disabled people.

Note: Sickness cash benefits included mandatory private benefits, i.e. continued wage payment.

2/ Excluding Korea, Mexico, and Turkey.

Table 3. Australia: Growth in Disability Benefit Reciprocity
(Percent Change)

	1980-85	1985-90	1990-95	1995-99
Australia	3	11	35	22
Austria	38	15	6	8
Belgium	10	6	4	1
Canada	..	..	41	11
Denmark	32	10	6	-5
France	4	11	0	2
Germany	9	-22	29	2
Italy	-15	-17	-20	-24
Mexico	..	..	15	-13
Netherlands	9	10	-6	5
Norway	13	21	-2	15
Poland	..	..	26	0
Portugal	15	1	-21	-1
Spain	39	18	-6	-6
Sweden	9	9	12	0
Switzerland	9	6	17	18
Turkey	-3	6	10	5
United Kingdom	36	22	54	2
United States	-8	15	34	7
OECD (16)	12	8	9	3

Source: OECD (2003).