The exchange rate regime in Papua New Guinea—getting it right

Xinpeng Xu

This paper provides new theoretical discussion and empirical evidence on the controversial issue of the choice of exchange rate regime in Papua New Guinea. It is motivated by the theory of optimal currency areas which argues that the appropriate domain for a single currency for two or more regions depends on the extent to which the regions share common external shocks. An error-components model is used to examine empirically to what extent Papua New Guinea shares common external shocks with its major trading partner, Australia. The econometric results suggest that industry-specific disturbances common to both countries play a dominant role in explaining the variations of sectoral output growth rates in Australia and Papua New Guinea. It is argued that there may be a case for a currency board arrangement in Papua New Guinea with a fix to the Australian dollar, both as a short-term and medium-term strategy.

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Exchange rate policy is at the heart of open economy macroeconomic management. Changes in the exchange rate are endogenous to the economic system and can be the cause and the result of external and / or internal imbalances. The exchange rate is an important channel through which external shocks are transmitted to the domestic economy, and vice versa. There may be different views of economic performance in Papua New Guinea after the floating of the exchange rate in late 1994, especially in relation to the choice of exchange rate regime, but the economic turmoil after 1997 is evident. The following sets out one interpretation of developments in the economy over this period.

Papua New Guinea's macroeconomic performance after 1994 had the following four distinct features

- excessive exchange rate volatility
- low growth with high inflation
- poor fiscal discipline
- loss of investor confidence as a result of the above.

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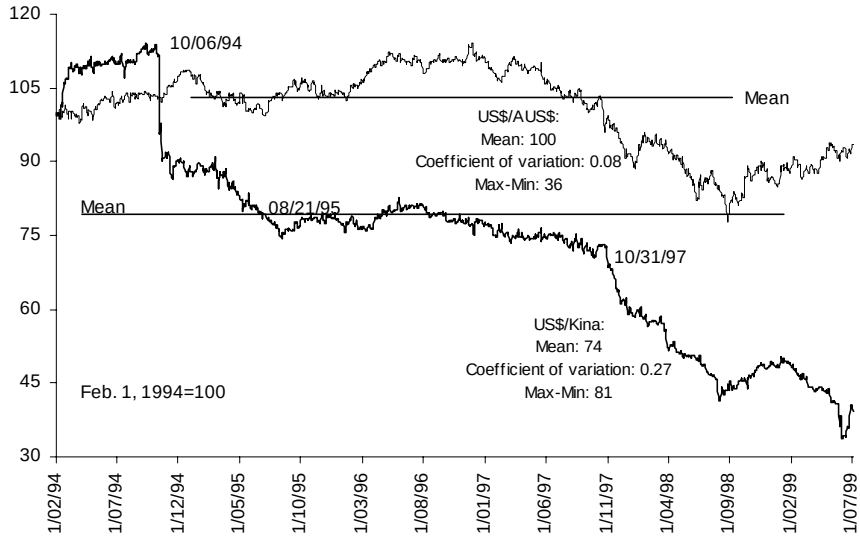
Exchange rate management before the float of the exchange rate was the so-called 'hard kina policy' in the period 1975–93, during which the coefficient of variation of the kina was 0.14. A comparison of the exchange rate volatility between the Australian dollar and the PNG kina following this period (1994–99) is set out in Figure 1. To simplify the interpretation, exchange rates are normalised on 1 February, 1994 at 100 for both countries. During this period, the Australian dollar fluctuated with a coefficient of variation (CV) of 8 per cent around its mean of 100. While Papua New Guinea is 76 times smaller than Australia in terms of GDP (1996), its currency was three times as volatile as that of Australia's with a coefficient of variation of 27 per cent around its indexed mean of 74. This 'excessive' volatility is destructive, especially for a small open economy.[1] We observe that there was a period of up to two years in which the exchange rate was quite stable but it was not able to be sustained. Since 1994, the kina has depreciated by more than 50 per cent against the US dollar.

The period 1994 to 1999 was also a period with low real GDP growth rates and high inflation. Figure 2 reveals that average annual real GDP growth between 1994 and 1998 was less than 1 per cent while the average annual inflation rate was as high as 11.2 per cent, and in 1998 it reached 20 per cent. This is in sharp contrast to the period 1985–93 in which average real GDP growth was 5.3 per cent and the average inflation rate was 5.1 per cent.

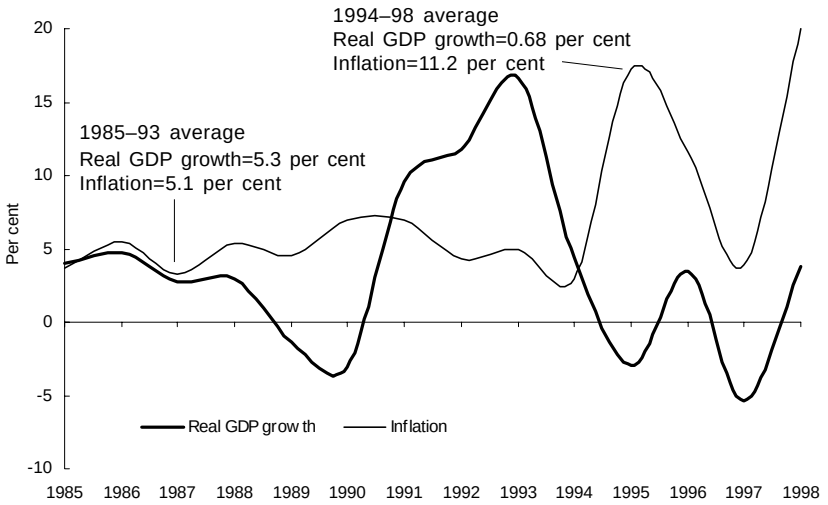
If economic growth, inflation and exchange rate changes are viewed as endogenous, fiscal discipline is often regarded as an exogenous variable that is in the hands of the government. Figure 3 charts two indicators, the ratio of outstanding public debt to GDP and the ratio of international reserves to imports.

Figure 1 **Exchange rate volatility: the Australian dollar vs the kina, daily, 1994–1999**



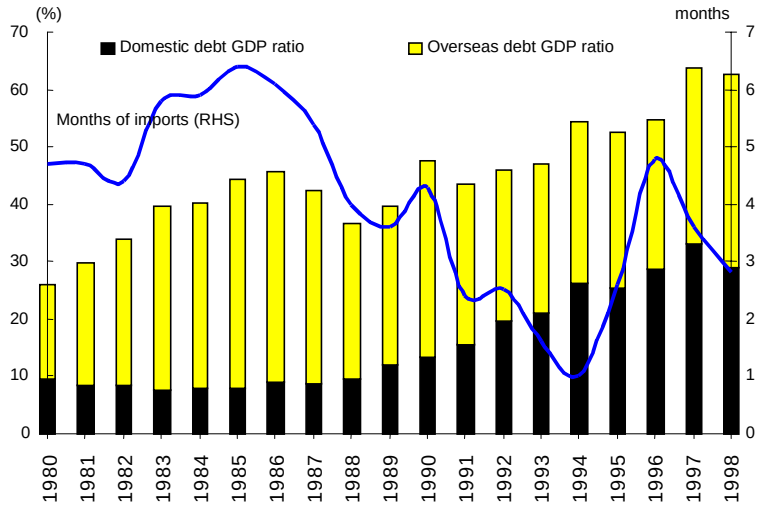
Source: Author's calculations based on data from Datastream.

Figure 2 **Real GDP growth and inflation in Papua New Guinea, 1985–98** (per cent)



Note: Data for 1998 are estimates.
Source: Author's calculations based on data from World Economic Outlook Database, International Monetary Fund, May 1999.

Figure 3 **Public debt to GDP ratio vs international reserves to imports ratio in Papua New Guinea, 1980–98** (per cent)



Note: Data for 1998 are for September 1998 from Bank of Papua New Guinea 1999, *Quarterly Economic Bulletin*, Vol. XXVI No. 3, September.
Source: Author's calculations based on data from the South Pacific Economic and Social Database available at the National Centre for Development Studies, The Australian National University, Canberra.

Domestic debt and overseas debt make up public debt. Overseas debt remained stable, perhaps partially reflecting Papua New Guinea's inability to borrow funds from international organisations such as the World Bank and IMF, especially in the last two years. However, the growth of outstanding domestic public debt has accelerated since 1992. Of course, the government had to opt for domestic debt if overseas funds were not available. International reserves fell close to zero in 1994. While the government had been trying to prop up this ratio since 1994, the rapid accumulation of public debt over this period made such an exercise unsustainable. The international reserves to imports ratio plunged again to 2.8 months in September 1998 while the outstanding public debt to GDP ratio reached a record high, exceeding 60 per cent of GDP in September 1998.

Although later statistics on international reserves and the fiscal deficit are not available, the kina fell as low as US$0.28 in June 1999 indicating that matters continued to worsen. As a result of Papua New Guinea's macroeconomic disarray, there was widespread loss of confidence both among domestic and foreign investors.

Papua New Guinea's macroeconomic problems are closely related. It is not just a problem of exchange rate policy. However, the argument here differs from that in the existing literature in two ways. First, the exchange rate is not viewed as a single policy that can be chosen independently, without taking into account the institutional framework, international trade links, the size of the country, and so on. The choice of exchange rate regime implies a choice of a package of macroeconomic management strategies.

Second, it has been popular to use a 'criteria counting' (a listing of the advantages and disadvantages of each regime) approach in discussing the choice of exchange rate policy. There are five exchange rate regimes which might be considered as options, namely, a pure floating rate, real exchange rate targeting, a nominal exchange rate anchor, a currency board, and adoption of an anchor currency (see Duncan et al. 1998). Each regime has its advantages and disadvantages. It is therefore not surprising that there are many views about the choice of an appropriate regime.

A comprehensive discussion of the different exchange regimes is beyond this paper. We take the result of a recent conference as a starting point (IMF 1999). In the conference summary, Frenkel indicated that over the next 10 years 'the trend in exchange rate regimes will probably be towards very fixed or very flexible regimes. In-between regimes will disappear'(IMF 1999:196). This discussion is therefore confined to whether a flexible exchange rate regime or a fixed, currency board regime, is appropriate for Papua New Guinea.

The case for a currency board regime is essentially an extension of the case for a fixed exchange rate. However, there are some minor differences, especially when it comes to considering the credibility of a commitment not to increase the money supply or to devalue. Under a pure currency board arrangement, the commitment not to devalue is close to absolute (Frankel 1995). The choice between a fixed and a flexible exchange rate depends on

- the need to have an independent monetary policy
- the effectiveness of monetary policy
- the volatility of exchange rates under flexible regimes (Kwan 1998).

There are two great challenges to be met if a flexible exchange rate regime is chosen. The first is the 'monetary policy ineffectiveness'[2] problem stressed by Kydland and Prescott (1977) and Barro and Gordon (1983). This result undermines

greatly the importance of an independent monetary policy which is one of the central arguments in favour of a flexible exchange rate. Furthermore, if wages and prices are flexible, adjustments in their levels will help maintain internal and external balance. Changes in exchange rates would do little to help external balance but would be harmful to price stability. Second, currency boards may deter self-fulfilling runs and other undesirable multiple equilibria (Davies and Vines 1995). If an independent monetary policy is ineffective, and / or if two countries share symmetric shocks which can be offset by a similar stance of monetary policy (anchor country) so that the need to pursue an independent monetary policy is small, there may be a case for a single currency. It is therefore of interest to examine to what extent Papua New Guinea shares common shocks with its major trading partner—Australia.

The literature on the theory of optimal currency areas

A theory of optimal currency areas was first proposed by Mundell (1961) and further developed by McKinnon (1963) and many others. Its primary concern was the appropriate domain of a currency area. The literature has since then been extended to cover topics such as the eligibility of a monetary union.

As surveyed by Tavlas (1993) and Kwan (1998), at least nine preconditions have been identified as relevant for choosing the likely participants in an optimal currency area. These include the mobility of factors and goods, price and wage flexibility, openness, and political factors. Mobility of factors and goods, and flexibility of prices and wages are seen as substitutes for exchange rate flexibility. An open economy, on the other hand, tends to prefer fixed exchange rate arrangements since 'if we move across the spectrum from closed to open economy, flexible exchange rates become both less effective as a control device for external balance and more damaging to internal price level stability' (McKinnon 1963:719). Papua New Guinea's openness has been high since 1975 but remained unchanged while Australia has experienced increasing openness during the last two decades (Table 2).

The primary concern, as first proposed by Mundell, is how to deal with asymmetric shocks when factors are not mobile between regions.

> If labor and capital are insufficiently mobile within a country then flexibility of the external price of the national currency cannot be expected to perform the stabilisation function attributed to it, and one could expect varying rates of unemployment or inflation in the different regions (Mundell 1961:664).

To put it another way, if two regions experience asymmetric shocks and factors are not mobile between regions, a single currency domain may not be appropriate for these two regions.

Although the direct implication of this theory is not of interest in this study, we ask a question that is a corollary to this theory, that is, to what extent do two regions, namely, Papua New Guinea and Australia, share common external shocks. If Papua New Guinea and Australia experience, to a large extent, asymmetric shocks, and factors are not mobile, there is not likely to be a case for a single currency. However, if Papua New Guinea and Australia share, to a large extent, common external shocks, although factors are not mobile, there may still be a case for a single currency or a currency board.

Decomposing the variation of output —an error-components model

This section presents the econometric methodology that we employ to identify the source of variation of industry output. The error-components model used here is in the spirit of Stockman (1988), Costello (1993) and Marimon and Zilibotti (1998). This model is appropriate for our purpose since it enables us to attribute the variation of output to factors that are industry-specific and factors that are country-specific. Examples of country-specific shocks include market organisation, institutional structures or economic policy. Industry-specific shocks may include disturbances such as commodity price changes or sectoral technological trends that are common to a specific industry irrespective of its geographical location.

There are significant co-movements of growth in sectoral output across Australia and Papua New Guinea which can be ascribed to sector-specific effects.[3] On the other hand, the data generating process is affected by country-specific factors such as changes in macroeconomic policy so that the pattern of sectoral growth in the two economies reveals differences (Figure 4). We therefore seek to determine what fraction of the variation of industry output can be explained by industry-specific shocks which affect industries across all regions or countries (common to both countries) and what fraction can be attributed to country-specific shocks which affect all industries within a given region or country. If the main factors driving the variations of sectoral outputs can be attributed to industry-specific shocks, it would suggest that to a large extent the two countries share common external shocks.

The model is specified as follows

$$y(i,n,t) = f(i,t) + m(n,t) + u(i,n,t) \quad (1)$$

for sector i = 1, 2 and 3 which represents agriculture, industry and services sectors respectively, country n = 1 and 2 which are Australia and Papua New Guinea, and time t = 1, 2, …., 23, from 1976 to 1995. In particular,

- $y(i, n, t)$ is the growth rate of sector i's output, in country n at time t.
- $f(i, t)$ is the interaction between a fixed industry and a time effect. It is a vector of dummy variables specific to industry i and to time t but common to all countries. More precisely, $f(i, t)$ is a vector of coefficients of these dummy variables multiplied by the dummy variables themselves. It captures any variation in sectoral output growth due solely to changes in factors that are specific to the particular industry at time t, such as international commodity prices and / or technical relationships between inputs and outputs in a particular industry regardless of the location of the industry.
- $m(n, t)$ is the interaction between a fixed country and a time effect. It is a vector of dummy variables (multiplied by their coefficients) for each country n at each time period t, but is common across industries within each country. It is intended to represent the effects of country-specific shocks such as changes in monetary or fiscal policies that lead to different variations in sectoral output in different countries.
- $u(i, n, t)$ is an idiosyncratic disturbance to industry i in country n at time t, assumed to be an independently and identically distributed, normal random variable with mean zero.

The specification in Equation 1 is unidentified because some linear combinations of the dummy variables are perfectly collinear. This apparent 'dummy

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variable trap' requires that one industry and one country be eliminated from the set of dummy variables to identify the model. It is known that the choice of the omitted industry and country does not affect tests of the significance and explanatory power of the industry or country effects. Since the industry-specific and country-specific dummy variables are orthogonal by construction, the explanatory power of these variables can also be calculated from the reduction in the R^2 statistic caused by excluding them from the original regression (Bayoumi and Prasad 1997).

To explore whether different initial conditions or comparative advantages due to factor endowment differences are important in explaining the variation of sectoral outputs, we experiment with a time invariant constant term specific to industry *i* in country *n, g(i, n)*. The alternative model is as follows

$$y(i,n,t) = g(i,n) + f(i,t) + m(n,t) + u(i,n,t) \quad (2)$$

The data

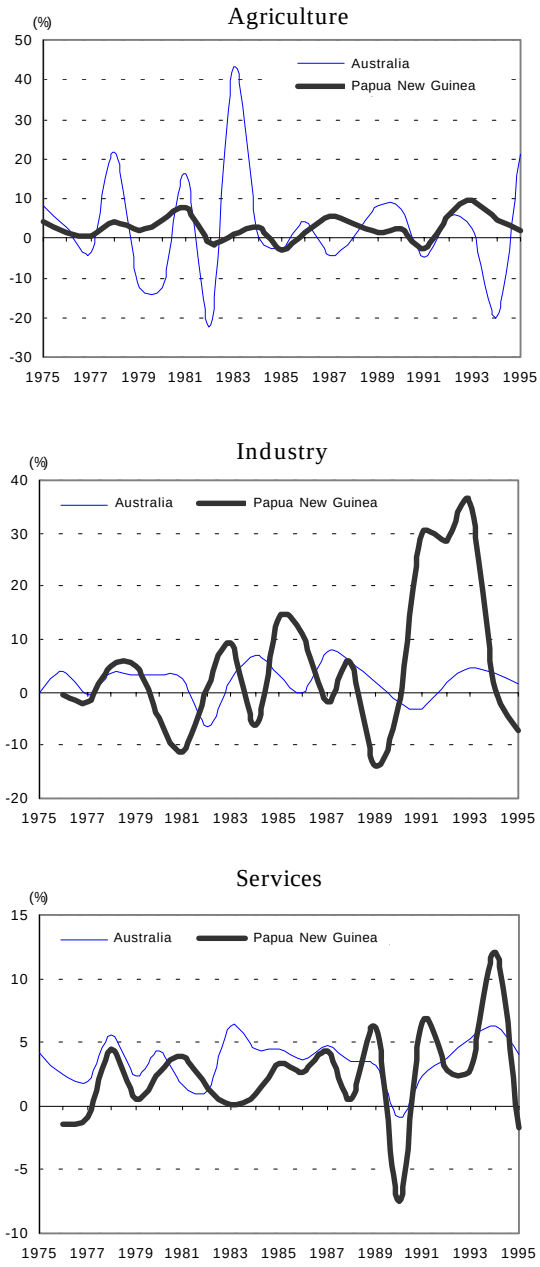
In general, the more disaggregated the level of activities analysed, the better the results we can expect. However, time series data for disaggregated industry activities that are comparable between Australia and Papua New Guinea are generally not available. This constrains us to perform the decomposition at the level of the basic areas of economic activity, namely, agriculture, industry and services.

Real valued-added annual data for agriculture, industry and services is used for Australia and Papua New Guinea. The time period is 1975–95. All data are given in real 1987 local currency, and from them, annual growth rates are computed. Data is extracted from the World Bank's *World Development Indicators* available from the International Economic Databank of the Australian National University. However, data for Papua New Guinea from 1976–80 are generally not available. Estimates for these are based on data from Garnaut and Baxter (1984:47) and Papua New Guinea (1981a, 1981b).

To understand the evolution of both countries' production structure and provide a background to the subsequent output variation analysis, we first examine the changing sectoral composition in these two countries (Table 1). Variations in sectoral output for the two countries over the last two decades are then compared. There are important differences in the structure of GDP between Australia and Papua New Guinea (Table 1). While Papua New Guinea has a relatively large agricultural sector, the services sector accounts for two-thirds of Australia's GDP. This is not surprising given that the two countries are at different stages of development. But what is less obvious is the implication of this production structure for trade, which is less remarked upon. It may suggest that international trade is more important to Papua New Guinea than to Australia.

Table 2 presents a measure proposed recently by Irwin (1996) and Feenstra (1998) of openness for Australia and Papua New Guinea. The indicator is the ratio of merchandise trade to merchandise value-added. It is argued that this ratio is superior to the merchandise trade to GDP ratio since the latter includes non-tradable goods that experience increasing shares for various reasons (Feenstra 1998). Two important features are revealed in Table 2. First, the ratio of merchandise trade to merchandise value-added is higher in Papua New Guinea than in Australia. Second, Australia's openness has increased significantly during the last two decades while PNG's openness remained largely unchanged. Discussion of trade policy is beyond this

Figure 4 **Real sectoral value-added growth rates for Australia and Papua New Guinea** (per cent)



Source: World Bank, *World Development Indicators*, available from the International Economic Databank, The Australian National University. Data for Papua New Guinea from 1976–80 are author's calculations based on data from Garnaut and Baxter (1984); Papua New Guinea (1981a, 1981b).

paper. However, it is worth pointing out that a significant proportion of PNG's output is affected by the international trade environment.

Although the production structures of the two countries reveal distinctively different patterns, casual inspection of the variations of sectoral output, as in Figure 4, suggests that Australia and Papua New Guinea may share common 'business cycles', especially in the agricultural sector. The variation of industry output growth rates in Papua New Guinea, especially after the 1980s, follows closely that of Australia, with a one to two year lag. In Papua New Guinea, the large fluctuations in industry and service outputs in the 1990s are also an important feature.

The statistical decomposition

The statistical model is estimated using a dummy variable regression method for the panels of data. The regression results are presented in Table 3. Two models are estimated. Model 1 decomposes variations in real sectoral output growth rates into industry-specific effects and country-specific effects. Model 2 further includes a time-invariant constant term to capture any sector-and-country-specific effects.

Model 1 explains 70 per cent of the variations in sectoral output growth rates while Model 2 does only marginally better (Table 3). To simplify the interpretation, we normalise the model sum of squares to 100. To the extent that the variation in output

Table 1 **Sectoral GDP: Australia vs Papua New Guinea, 1975–95**

	Australia			Papua New Guinea		
Year	Agriculture	Industry	Services	Agriculture	Industry	Services
1975	5.1	33.6	61.3	n.a.	n.a.	n.a.
1976	5.1	33.9	61.0	30.5	28.1	41.4
1977	4.9	33.4	61.7	36.5	25.8	37.8
1978	5.6	32.7	61.6	36.4	25.7	37.9
1979	4.8	33.2	62.0	35.1	30.1	34.8
1980	4.1	33.2	62.7	35.0	27.9	37.1
1981	4.7	33.3	62.1	30.1	32.1	37.8
1982	3.7	31.8	64.4	32.4	28.4	39.2
1983	5.0	30.6	64.3	31.8	28.6	39.6
1984	4.8	31.2	64.0	31.2	30.3	38.5
1985	4.5	31.1	64.4	32.3	28.6	39.1
1986	4.6	30.3	65.1	30.1	31.3	38.7
1987	4.1	31.1	64.8	29.1	33.1	37.8
1988	4.0	31.6	64.4	29.9	31.7	38.5
1989	4.2	31.3	64.5	30.0	32.4	37.5
1990	4.5	31.0	64.5	31.0	28.4	40.6
1991	4.3	29.9	65.8	32.7	28.6	38.8
1992	4.4	29.5	66.1	28.9	33.7	37.5
1993	4.3	29.4	66.3	27.2	38.5	34.3
1994	3.3	29.2	67.5	25.4	44.5	30.1
1995	3.8	28.6	67.6	25.3	42.6	32.1

Source: World Bank, *World Development Indicators*, World Bank, Washington, DC, various issues; International Economic Databank, The Australian National University, Canberra.

Table 2 **Ratios of merchandise trade to merchandise value-added, 1975–95** (per cent)

	Australia	Papua New Guinea
1975–79	28.5	58.9
1980–84	31.6	62.9
1985–89	36.9	61.9
1990–94	44.7	61.3
1995	50.0	64.2

Note: Merchandise trade is measured as the average of imports and exports. Merchandise value-added combines agriculture and industry.
Source: Author's calculations based on trade data from *Direction of Trade*, International Monetary Fund and value-added data from *World Development Indicators*, World Bank. All data are from the International Economic Databank, The Australian National University, Canberra.

Table 3 **Parameter estimates for error-components model**

Model 1: $y(i,n,t) = f(i,t) + m(n,t) + u(i,n,t)$

Model 2: $y(i,n,t) = g(i,n) + f(i,t) + m(n,t) + u(i,n,t)$

Model	(1)		(2)	
	Variation	per cent	Variation	per cent
Total sum of squares	10,585		10,585	
$g(i,n)$			202	2
$f(i,t)$	5,901	77	5,901	75
$m(n,t)$	1,805	23	1,805	23
Model sum of squares	7,706	100	7,908	100
Residual sum of squares	2,879		2,677	
R^2	0.70		0.72	
F-statistic*	F(88,50)=1.52		F(93,45)=1.43	
Significance level (per cent)	5		10	

Note: *The F-statistic for a hypothesis test in which under the null the effect has no explanatory power.
Source: Author's calculations.

growth rate can be explained by Model 1, 77 per cent can be attributed to industry-specific effects while less than one-third of the variations of output growth rates explained can be attributed to country-specific effects. This indicates that more than two-thirds of the fluctuations in sectoral output growth rates have an industry-specific origin that is common to both countries. The time series of residuals from the estimation show little evidence of autocorrelation. The F-statistic for a hypothesis test in which under the null hypothesis both industry-specific and country-specific effects have no explanatory powers is rejected at the 5 per cent level.

The estimation of Model 2 suggests that, after the normalisation, 75 per cent of the variation in output growth rates can be attributed to industry-specific effects while only 23 per cent is attributable to country-specific disturbances. The inclusion of a time-invariant constant term to capture industry and country-specific effects turns out to be marginally significant at only the 10 per cent level. Both models suggest that industry-specific disturbances that are common to both countries play a dominant role in explaining the variations in sectoral output growth rates in Australia and Papua New Guinea. Australia and Papua New Guinea, to a large extent, share common external shocks.

The results point to the optimal exchange rate policy being use of a single currency. Thus, a case can be made for 'dollarisation' (adoption of the Australian dollar) as well as for a currency board for Papua New Guinea. However, there are at least three factors that need to be taken into account when considering dollarisation. First, there is the question of the political willingness to give up the national currency, often regarded as a symbol of national identity. Second, the issue of seigniorage revenue has to be considered. The seigniorage revenue expressed as a percentage of GDP would be the base money to GDP ratio multiplied the interest rate earned from holding foreign reserve assets. For example, if the base money to GDP ratio is 10 per cent and the interest rate is 4.5 per cent, dollarisation would imply a loss of seigniorage revenue as much as 0.45 per cent of GDP. Of course, this issue can be resolved by mutual negotiation between governments. Third, there are exit problems once the economy has been fully dollarised (that is, in being able to move to another regime). A currency board system may be more appropriate given the above considerations.

Conclusion

This paper provides new empirical evidence on the controversial issue of the choice of exchange rate regime in Papua New Guinea. It is motivated by the theory of optimal currency areas which argues that the appropriate domain for a single currency for two or more regions depends on the extent to which the regions share common external shocks. An error-components model is used to examine empirically to what extent Papua New Guinea shares common external shocks with its major trading partner, Australia. The econometric results suggest that industry-specific disturbances that are common to both countries play a dominant role in explaining the variations of sectoral output growth rates in Australia and Papua New Guinea. It is argued, therefore, that there may be a case for a currency board arrangement in Papua New Guinea with a fix to the Australian dollar, both as a short-term and medium-term strategy.

Notes

1 Consider the following. Assume that income for country *i*, Y_i, from the aggregate of tradable goods is the product of its price times the quantity, pQ_i. If income volatility is measured by the variance of the logarithm of income, then for a small country, the price is taken as given so Cov (log *p*, logQ_i) can safely be assumed to be zero. Therefore, price variability acts like additional 'noise' and can be destructive of economic activity.

2 This refers to the 'time consistency' problem suggested by Kydland and Prescott (1977) and Barro and Gordon (1983) who agree that a policy that would be optimal if it could be made credible by a binding commitment, would not be credible in the absence of such a commitment. This could form an argument for having a currency board, rather than a central bank, if a fixed exchange rate has been decided. The reason is simply that the commitment to the fixed rate is more credible under the currency board, because the government has (largely) given up the power to alter the exchange rate. Although this point looks irrelevant theoretically when choosing between a fixed exchange rate defended by a currency board and a flexible exchange rate defended by a central bank with the necessary independence and statutory duties, it does make a difference in practice since central banks in most developing countries are not able to maintain an independent status so that a credibly binding monetary policy is difficult to achieve. I thank George Fane for pointing this out to me.

3 Although the composition of each sector may be quite different between Australia and Papua New Guinea, what is important here in terms of external shocks is whether the fluctuations in output of each sector are highly correlated. Since Australia and Papua New Guinea are both commodity-based economies, and co-movement in primary commodity prices is substantial, the extent of co-movement in sector output can be highly significant. I thank Ron Duncan for clarification on this point.

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