OPTIMAL CHOICE OF AN EXCHANGE RATE REGIME: THE CASE OF AUSTRALIA*

Jamus Jerome Lim

Institute of Southeast Asian Studies

Abstract

As the global economy moves towards greater financial and economic integration, the exchange rate regimes of individual nations have become an important policy issue. National choices have provided little consensus about which of the different regimes is preferred. The onus has been on academic research to provide a tractable solution to an optimal exchange rate arrangement to assist policymakers in their choices. This paper aims to provide an answer to the choice of exchange rate regime through the estimation of the optimal degree of exchange rate intervention, with respect to minimising output variance, for the Australian economy, utilising tools such as the calculated variances of shocks experienced, the optimal intervention parameter, the degree of wage indexation and the interest sensitivity of spending. The results show that, for Australia, the freely floating exchange rate regime first introduced in 1976 and fully implemented in 1983 is not the optimal arrangement when the objective is to minimise the volatility of output. With such an objective, a managed float regime with a degree of intervention biased towards 'leaning with the wind' is optimal. The results also show that the Reserve Bank has in fact been engaging in a 'leaning with the wind' policy that is close to optimal.

Keywords: exchange rate regime, exchange rate policy, optimal intervention, Australian economy, free float

JEL Classification: E52, F33

* Based on the author's honours thesis at the University of Southern Queensland. Acknowledgements to Dr. Jim Longmire, Associate Professor Rod St. Hill, Mr. Richard Temple-Smith and Mr. Dominic Pansiero for invaluable discussion and advice. All remaining errors, of course, are mine alone.

1. Introduction

As the wave of globalisation and integration of the world's economy continues its relentless march, changes in the economic structure and policy orientation of nations have resulted in much closer international trade and financial linkages. With little exception, exchange rate arrangements and policies have continued to occupy premium position on the macroeconomic agenda. The impacts of exchange rate fluctuations have been demonstrated dramatically time and again, by 1994 Mexican peso crisis and the more recent 1997 Asian financial crisis. This has renewed the call for the search for the elusive 'perfect' exchange rate regime – one that would provide the bulwark of stability in uncertain economic times.

This desire is not unimportant. National choices, unfortunately, reveal a lack of consensus on which regime is superior. Over the past two decades, the spread of exchange rate arrangements among different countries has changed significantly, with a general move in the direction of more open foreign exchange markets.

Most major industrial nations have, after the early 1970s with the collapse of Bretton Woods, moved to a system of floating exchange rates. Of the G-10 leading industrial nations, however, only half are engaged in a freely floating regime while the other half continue to maintain an arrangement of limited flexibility (International Financial Statistics 1997).

The trend among developing nations has been clearer. The proportion of developing countries maintaining a fixed regime has withered continually from 89 percent in 1976 to 61 percent in 1986 to the present 39 percent. Table 1 shows the progress of these arrangements in developing countries for the period 1976-1996. The decision of an increasing number of developing countries to switch to flexible arrangements is clearly evident.

Among economies in transition, the choice has been mixed. Some economies have adopted pegged exchange rates while others have chosen to float[1]. There has been evidence, however, that some nations who initially adopted a fixed regime are now moving towards a more flexible exchange rate arrangement once the high-inflation problems crippling these economies have been eliminated (Sachs 1996).

The primary objective of the present study is to discover the optimal choice of an exchange rate regime for the Australian economy, with respect to minimising output variability. This will be based mainly on the estimation of the optimal intervention parameter, under various simplifying assumptions concerning the nature of shocks to the economy, but will also include the consideration of various other factors, such as the variances of shocks experienced by the economy and other structural parameters. The study then attempts to test the hypotheses that a freely floating exchange rate regime is the optimal exchange rate regime, with regard to minimising output volatility; as well as determine the optimal degree of intervention in the foreign exchange market with the aim of reducing output variability lies between a rigidly fixed and freely floating exchange rate regime, for Australia.

The paper is structured as follows. In section 2, the theoretical literature pertaining to the economics of exchange rate regimes is reviewed, with a particular focus on the research on the optimal choice of exchange rate regimes. Section 3 is devoted to a detailed discussion of the theoretical model used in the present study. The following section then proceeds with an exposition of the empirical model that was applied to the data, as well as presenting the estimates obtained for model. The section will move on to calculations of the optimal intervention parameter under various shocks. The next section is concerned with the theoretical and practical implications of the research, providing both theoretical conclusions as well as policy recommendations, before the last section summarises the results and limitations of the current research as well as explores avenues for future research.

[1] Notably, Czechoslovakia, Estonia, Hungary and Poland adopted a fixed regime while Kygyzstan, Latvia, Russia and Ukraine adopted a free float.

2. Choice of an exchange rate regime[2]

There is no unambiguously right answer regarding the optimal choice of alternative regimes for an economy. Early debates (Friedman 1953; Kindleberger 1969) focussed on analytical arguments between a fixed and flexible regime; later research (Quirk 1994) does not provide conclusive evidence either way. Choices depend on the economic objectives of policymakers, the source of shocks to an economy, the structural characteristics of the economy and the influences of political factors. Furthermore, alternative assumptions about these factors can be expected to alter the optimality decision.

2.1 Structural characteristics

The choice of regime according to the structural characteristics of an economy evolved mainly from the Optimum Currency Area literature. This conceptual framework has been used to obtain, *a priori*, an optimal choice based on the various characteristics, with relation to their stabilising properties.

The openness of an economy – measured as the ratio of tradeable to non-tradeable goods – is a key determinant of regime choice. As openness increases, "flexible exchange rates become both less effective as a control device for external balance and more damaging to internal price level stability" (McKinnon 1963, p. 719). This would imply that a higher degree of openness would favour greater fixity of regime.

Related to openness is the size of an economy. Openness is expected to be greater, the smaller the economy; therefore, the larger the economy, the stronger is the case for a flexible regime (Mundell 1961). Further, larger economies are both less likely to be price takers (and as a result are less susceptible to price shocks) and more diversified (and so experience less exchange rate volatility). This obviates the need for a fixed regime (Heller 1978).

The degree of factor mobility is another determinant of the optimal choice of exchange rate arrangement. This includes both capital and labour mobility. A higher degree of capital mobility is expected to impose greater adjustment costs in the trade account if sustaining a fixed regime (Flood 1979; Mundell 1961; Heller 1978), while a greater degree of labour mobility will make it costlier to adjust to external shocks with a flexible regime (Caramazza & Aziz 1997).

The degree of product diversification is another factor that influences the regime choice. The more diversified a country's exports are, the more stable its foreign exchange earnings and hence also its currency (Holden, Holden & Suss 1979; Kenen 1969). The greater the degree of product diversification, therefore, the more feasible is a regime of flexible exchange rates.

Inflation rate differentials also play a role in exchange rate arrangement decisions. A higher divergence of a country's inflation rate to that of its main trading partners would necessitate frequent exchange rate adjustments (Fleming 1962; Harberler 1970; Savvides 1990). As such, a higher inflation rate differential would favour a more flexible regime.

The degree of economic/financial development works on the assumption that the efficiency of a country's domestic product and capital markets increases with economic development, as market participants are better able to insulate themselves against shocks through portfolio diversification (Holden, Holden & Suss 1979; Savvides 1990). Thus, the greater the degree of economic and financial development, the more suitable is a flexible exchange rate regime.

The degree of financial integration also influences the choice of an exchange rate regime. Highly integrated financial markets mean that domestic and foreign interest rates and exchange rates are linked (through interest rate parity), and the high degree of asset substitutability that results exacerbates the effects of shocks (Mundell 1982; Mathieson & Rojas-Suarez 1990). Therefore, with a higher degree of financial integration, there is a greater need to consider the sources and nature of shocks to the economy.

---

[2] It is both unfair and unwise to even try to cover much ground here, for the literature on the choice of regime is truly prolific. Argy (1989), Genberg (1989) and Isard (1995) have all produced very good surveys of the key issues.

An additional factor that influences regime choice is the degree of wage and price indexation. When wage (price) indexation is low, the effect of a change in the nominal exchange rate on real wages (prices) will be large, and vice versa (Aizenman & Frankel 1985; Flood & Marion 1982; Marston 1982). Therefore, the greater the degree of wage and price indexation, the more desirable is a flexible exchange rate regime.

A final point to note is that recently, greater recognition has been given to arguments suggesting that structural characteristics are not exogenous but are instead endogenous to the choice of the regime (Isard 1995). As such, it should be understood that these structural characteristics might in fact be the result of exchange rate regime choices. The various strands of literature are summarised in table 1.

Table 1 Theoretical literature of structural characteristics

Structural Characteristic	***Preferred Regime***	***Literature***
High Openness	Fixed	McKinnon (1963)
Large Size	Flexible	Mundell (1961); Heller (1978)
High Capital Mobility	Flexible	Flood (1979); Mundell (1961); Heller (1978)
High Labour Mobility	Fixed	Caramazza & Aziz (1997)
High Product Diversification	Flexible	Holden, Holden & Suss (1979); Kenen (1969); Savvides (1990)
High Inflation Differentials	Flexible	Fleming (1962); Harberler (1970)
High Financial/Economic Development	Flexible	Holden, Holden & Suss (1979); Savvides (1990)
High Financial Integration	Dependent on nature & source of shocks	Mundell (1982); Mathieson & Rojas-Suarez (1990)
High Wage/Price Indexation	Flexible	Aizenman & Frankel (1985); Flood & Marion (1982); Marston (1982)

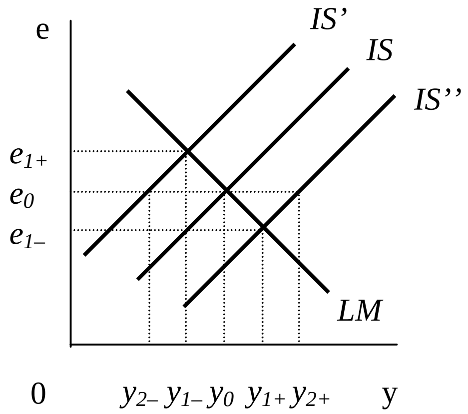
Empirical work that attempts to determine the choice of regime according to structural characteristics has been sparse. Honkapohja & Pikkarainen (1992) took a large sample of 140 countries and determined through regression their expected choice of regime. They conclude that "…the country characteristics studied here do not help very much to explain the choice of exchange rate regime and… in some cases the observed choices are opposite to the predictions of conventional theory" (Honkapohja & Pikkarainen 1992, p. 20).

2.2 Insulation properties

The early literature on the insulation properties of alternative exchange rate regimes with respect to short-run stabilisation of the macroeconomy can be summarised by Boyer's (1978) seminal article on shocks to the open economy. Building on the distinction made by Poole (1970), Boyer demonstrated that if only real shocks are present, a floating exchange rate (with a fixed money supply) is better; if only monetary shocks occur, then a fixed exchange rate is preferable.

This is geometrically represented in a modified *IS-LM* framework in figure 1, with the vertical axis representing the nominal exchange rate (instead of the usual interest rate) and the horizontal axis showing the output level. The usage of the exchange rate on the vertical axis leads to an upward sloping *IS* curve because a depreciation – an increase in *e* – improves the trade balance and increases the demand for domestic output. The downward sloping *LM* curve results as a depreciation increases the price of imports and reduces nominal money balances, therefore requiring a correspondingly lower real income.

Figure 1 Modified *IS-LM* framework illustrating insulation properties



Source: Genberg (1989), p. 448

With the model above, when a real shock occurs (a shift in the *IS* curve), a flexible exchange rate would fluctuate between e_{1-} and e_{1+}, and output variation would vary between y_{1-} and y_{1+}. A fixed rate in this case would lead to higher output variability, between y_{2-} and y_{2+}. When a monetary shock occurs (a shift in the *LM* curve), a flexible rate would cause output variability but there is no output variation with a fixed rate, since authorities will intervene in the money market to maintain the fixed rate. The conclusion is obvious. Some degree of managed floating is superior to either a fixed or purely floating rates, at least for minimising output variability.

The analysis can be extended to differentiate between domestic and foreign monetary shocks (Aizenman & Frankel 1985; Flood & Marion 1982). *Ceteris paribus*, flexible exchange rates can insulate against the effects of monetary shocks emanating from abroad, while fixed exchange rates can neutralise domestic shocks. Black (1976) has also made a distinction between shocks in non-tradeable goods (fixed regime preferred) and tradeable goods (flexible regime preferred).

An alternative slant to the problem has been to evaluate performance utilising different criteria. These include minimisation of real consumption variations (Fischer 1977; Frankel & Aizenman 1982), price fluctuations (Flood 1979), unemployment (Aizenman & Frankel 1985), as well as some combination of various macroeconomic objectives (Argy 1985; Turnovsky 1983). Within the context of Australia, Pitchford (1993) studied the effects of trade price shocks and inflation insulation properties. Once again, the performance of alternative regimes would depend on the nature and source of the shocks.

Later theoretical analyses have attempted to identify the optimal degree of exchange rate management using models of the macroeconomy. Such studies utilise structural models incorporating aggregate demand, aggregate supply, money demand, money supply and interest parity functions, among others. These are then expressed in reduced form, and a value for an optimal intervention parameter that minimises the variance of output is calculated. Studies of this nature derive an optimal intervention policy where the choice between fixing or floating is dependent in a complicated fashion on the structural parameters of the economy and the interaction of the covariance matrix of the shocks (Argy 1990; Pikoulakis 1995; Roper & Turnovsky 1980)

Empirical work bearing on insulation has been undertaken at two levels. First, evaluations have been performed on how economies react to different disturbances under alternative exchange rate regimes. Simulation models have been applied to study the effects of structure on the performance of different exchange rate rules. This has been performed with two-country models (Aurikko 1988; Carlozzi 1982; Murphy 1986), three country models (Argy, McKibbin & Siegloff 1988) and global models (McKibbin & Sachs 1986). The main conclusions have supported those made with the simpler models. In general, for the choice in terms of short-run stabilisation policy, there is a need to know the size and relationships between unobserved shocks to the economy, as well as infer the nature of these shocks from exchange rate movements. This task is extremely difficult due to the possibility of exchange rates not always responding to fundamentals.

Table 2 Empirical literature on insulation properties

Methodology	***Finding***	***Literature***
2-Country Simulation Modelling	Fixed rates more stabilising for domestic monetary shocks, flexible rates for stabilising for foreign monetary shocks	Aurikko (1988); Carlozzi (1982); Murphy (1986)
3-Country Simulation Modelling	Fixed rates more stabilising for domestic monetary shocks, flexible rates for stabilising for real shocks	Argy, McKibbin & Siegloff (1988)
Global Simulation Modelling	Flexible rates more stabilising for real shocks, fixed rates perform well foreign monetary shocks	McKibbin & Sachs (1988)
Historical Appraisal	No influence of regime on insulation	Hutchison & Walsh (1992); Mills & Wood (1993)

Second, evaluations have been made on how countries have historically reacted under alternative exchange rate arrangements. Such studies take a broad range of macroeconomic indicators and determine their variability under different regimes. Hutchison & Walsh (1992) and Mills & Wood (1993) perform analyses of the UK and Japanese economy, respectively, and find that the exchange rate regime has little influence on the variability of macroeconomic variables. The various strands of literature are summarised in table 2.

2.3 Policy discipline

The literature on policy discipline developed mainly from the concept of 'time-inconsistency' first introduced by Kydland & Prescott (1977). This strand of literature emphasises the role of credibility and political factors in the choice of an exchange rate regime. The optimal choice of regime would therefore rest upon a balance between credibility and flexibility – between restraining expectations of inflation and the freedom to implement alternative policies.

The call for *monetary* discipline argues that a pegged exchange rate will provide an unambiguous 'anchor' for economic policy – which helps to establish the credibility of a program tailored to reduce inflation, since it 'ties' the government's hands (Barro & Gordon 1983a, b; Canzoneri 1985; Calvo & Guidotti 1993). A simplified discussion of this argument is developed as follows. Suppose that the output for an economy is determined by a supply function of the following form

$$y = y_n + \alpha(\Delta p - \Delta p^e) \tag{1}$$

where y and y_n are the actual and natural levels of output and Δp and Δp^e are the actual and expected rates of inflation, respectively. Suppose further that the government tries to minimise a social loss function that depends on both output and inflation variability such that

$$L = \beta[(y - (y_n + k)]^2 + (\Delta p - \Delta p_n)^2 \tag{2}$$

where the function $(y_n + k)$ expresses the targeted level of output, with k being a constant target. If the above equation were to be minimised period by period, a parameter of the optimal inflation rate Δp^* may be obtained

$$\Delta p^* = [\beta\alpha^2 / (1 + \beta\alpha^2)]\ \Delta p^e + [1 / (1 + \beta\alpha^2)]\ (\Delta p_n + k\beta\alpha) \tag{3}$$

which can be thought of as a reaction function of the central bank. This is denoted R_g in figure 2. Assuming that the private sector makes systematic forecast errors of the inflation rate (owing to asymmetric information), we can write its reaction function as

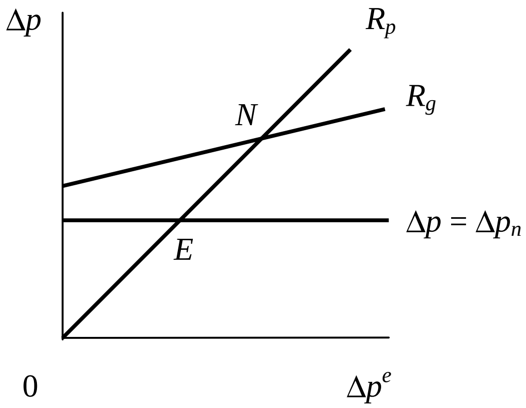
$$\Delta p^e = \Delta p \tag{4}$$

This is denoted R_p in figure 2. This can then be expressed as a simple, one-shot game with two players, the government and the private sector. The non-cooperative Nash equilibrium is given by point N where

$$y = y_n \text{ and } \Delta p = \Delta p_n + k\beta\alpha \tag{5}$$

$\Delta p = \Delta p_n$ in figure 2 shows a fixed rule to which the central bank commits.

Figure 2 Game with 2 players illustrating policy discipline



Source: Genberg (1989), p. 461

Here the case for a fixed rule is clear. The cooperative equilibrium with a fixed rule of $\Delta p = \Delta p_n$ at E minimises the social welfare loss[3]. This has led several authors to argue that an open economy with relatively poor monetary credibility could reduce its inflation rate by fixing its exchange rate *vis-à-vis* the currency of a country with relatively high anti-inflation credibility (Giavazzi & Pagano 1988; De Grauwe 1992). Fixed exchange rates were thus a commitment technology which national authorities could employ in order to ‘import’ credibility. Coles & Philippopoulos (1997) have carried this line of research even further by arguing for the superiority of target zones in minimising this welfare loss.

The issue of *fiscal* discipline is similar to that of monetary discipline. Authorities are encouraged to pursue anti-inflationary fiscal policies in line with a fixed exchange rate in order to establish credibility (Caramazza & Aziz 1997). Recent research, however, has increasingly challenged this view. There have been arguments that a flexible exchange rate may be just as effective in disciplining policies as it allows the excess burden of taxation to be spread over both taxes and seigniorage (De Kock & Grilli 1993). Moreover, Bredemkamp & Deppler (1990) and Tornell & Velasco (1995) have arrived at the conclusion that fixed regimes do not necessarily imply greater fiscal discipline.

It is possible to combine the argument for credibility presented in this section together with the argument advanced in the previous section for some degree of flexibility. This derives directly from the analysis of Rogoff (1985), where he presented the optimal degree of commitment to a fixed exchange rate. This degree of commitment measures the level to which a central bank may be granted considerable autonomy when it has a reputation for financial conservatism; it is given by minimising the loss function such that

---

[3] However, if the game was treated as a repeated game, then there is a possibility of a cooperative equilibrium at *E*, based on the reputation already established and the threat of punishment due to time inconsistent behaviour.

$$L = (\beta - \gamma)[(y - (y_n + k)]^2 + (\Delta p - \Delta p_n)^2 \tag{6}$$

where $(\beta - \gamma)$ indicates a relatively higher weight placed on output variability. Extending this approach to a small open economy we can obtain a loss function that incorporates output stability, price stability and exchange rate stability in the function

$$L = (\beta - \gamma)[(y - (y_n + k)]^2 + (\Delta p - \Delta p_n)^2 + \delta\,(s - s_n)^2 \tag{7}$$

where s and s_n are the actual and natural nominal exchange rates, respectively.

Empirical studies on policy credibility have generally agreed on the importance of finding the middle ground. Isard (1995, p. 198) studied European data and concludes "…national authorities have lost credibility by tying their hands too tightly." Helpman, Leiderman & Bufman (1994) assert that gliding peg arrangements are superior to fixed regimes in establishing credibility. The research on the optimal degree of commitment to a fixed exchange rate has yielded the general conclusion that while these levels differ across countries, the more independent the central bank, the more credible its policies (Alesina & Summers 1993; Cuikerman 1992; Eijffinger & Schaling 1993, 1998). Table 3 summarises the research in this area.

Table 3 Empirical literature on policy discipline

Methodology	***Finding***	***Literature***
European Countries	Extreme fixity damages credibility	Isard (1995)
Chile, Israel & Mexico	Gliding peg superior to fixed rate in establishing credibility	Helpman, Leiderman & Bufman (1994)
Multiple Countries	Optimal degree of commitment for a central bank differs across countries, but the more independent the central bank, the more credible its policies	Alesina & Summers (1993); Cuikerman (1992); Eijffinger & Schaling (1993, 1998)

2.4 Policy efficiency

This aspect focuses on how efficient policies will be in correcting disequilibria under alternative regimes. Evaluation is based on three key criteria. The first criterion draws upon the Tinbergen (1952) principle that the greater the number of independent instruments available in a regime, the more the targets that might be achieved[4]. The second criterion looks at the 'mean' size of the multiplier – the larger the multiplier, the less the change in the instrument required to achieve a given change in the target variable – and applies this to alternative regimes (Mundell 1963). The final criterion explores the degree of uncertainty attached to a policy multiplier under each regime (Frankel 1988).

In sum, the choice of exchange rate regimes based on this strand of literature is dependent on the number of policy instruments available, the relative impact of these instruments on target variables and the degree of certainty attached to the effects of each instrument. The potential instruments available under each regime are shown in table 4.

It would be useful to briefly summarise the findings with respect to the three criteria. It is clear from the table that the managed float is superior to the other regimes when considering the number of policy instruments available. This is followed by, in order of policy efficiency, the free float, the adjustable peg and

[4] The principle actually advances that if governments aimed at n independent targets of policy then they should also have n effective and unbounded instruments of policy if these targets are all to be met.

the fixed exchange rate regimes (Argy 1989). For the second criterion, fiscal policy is "…almost certainly stronger under fixed rates than under flexible rates; on the other hand monetary policy is almost certainly stronger under flexible than under fixed rates" (Argy 1989, p. 78). Finally, under the third criterion, there is much greater certainty about the effects of monetary and fiscal policy under fixed rather than flexible rates in the short term, while studies have yet to ascertain the certainty effects of policies under alternative regimes in the medium to long term (Argy 1989).

Table 4[5] Potential instruments available under alternative regimes

Regime	***Wages Policy***	***Monetary Policy***	***Fiscal Policy***	***Ex. Rate Policy***
Fixed	✓	×	✓	×
Adjustable Peg	✓	×	✓	✓ (limited)
Target Zones	✓	×	✓	×
Managed Floating	✓	✓ (limited)	✓	✓ (limited)
Freely Floating	✓	✓	✓	×

Adapted from: Argy (1989), p. 42

2.5 Optimal basket peg

The optimal basket literature is an offshoot of the credibility literature that concerns itself with the choice of currencies to peg to in a basket. It aims to derive the optimal currency basket with respect to some target variables for a small open economy faced with random shocks. Examples of optimality criteria include stabilisation of domestic output, stabilisation of domestic money stock levels and stabilisation of domestic competitiveness. Different approaches have been used, including numerical models (Bhandari 1985), empirical macroeconomic studies (Edison & Vårdal 1987; Pikkarainen, 1986), game theoretic approaches (Sauramo 1989) and microeconomic studies (Pikkarainen 1991a, b).

These studies generally indicate that, under present circumstances, there is no reason to believe that basket pegging can provide what single currency pegging failed to do: increase the stability of the exchange rate and in effect, the economic fundamentals it influences. The best that a country can do is hope that fluctuations in the currencies of major trading partners can be somewhat neutralised by a plausible system of relevant weights, and unfortunately, the 'perfect' weights remain unknown. However, there is a case for countries that are financially strong enough to peg to do so on a small basket of currencies, without a sophisticated system of weights, with the US dollar and Japanese yen included in the basket (Polak 1989) or on the SDR (Crockett & Nsouli 1977; Williamson 1982).

2.6 Political choice

The studies on political choice of exchange rate regime attempt to provide the optimal exchange rate regime in a political setting, by taking into account political processes in the decision-making process. Ruland & Viaene (1993), for example, develop a model that consists of three players – importers, exporters and speculators – who are involved in the foreign exchange market. They then study the effects of coalition

[5] For a detailed elaboration of this table, see Argy (1989). Argy's table does not include a target zone regime, which has been added into this one.

formation and political competition on the degree of policy intervention, and hence the type of regime chosen. Edwards (1996) considers the choice using Probit analysis, including the variable political instability into the regression, while Milesi-Ferretti (1993) studies electoral considerations in the context of the choice of an exchange rate regime.

There is little consensus among policymakers or economists about the appropriate exchange rate regime. This is in no small part due to the fact that conclusions about the optimal exchange rate mechanism are model-specific. Much work remains to be done to reach a unified theoretical framework that encompasses all of these considerations in recommendations towards an optimal regime choice.

Ever since the breakdown of the Bretton Woods system, countries have pursued largely independent exchange rate regimes. The general consensus is that a middle-of-the-road choice of a managed float or a target zone appears to offer the best of both worlds. The optimal choice literature has not fully answered all questions, and this appears to be a most fertile area for future research. There is a dearth of empirical studies concerning the insulation properties of exchange rate regimes; the choice of rules for ensuring policy discipline remains unanswered; there are few suggestions on ensuring policy efficiency through choice of regime; and there is a need for research concerned with integrating economic recommendations with political processes.

It is with the area of the insulation properties of exchange rate regimes that this present work is concerned. Specifically, it aims to address the gap in the literature for empirical research on the optimal regime choice, with relation to insulation of output from various shocks, and to draw conclusions based on the results obtained. As economies continue their integration and open-economy macroeconomics gains even greater prominence, the economics of exchange rate regime choice looks set to be an undeniable component of modern macroeconomic policymaking.

3. Theoretical framework

This section presents the theoretical framework for the present study. This will proceed first with the presentation of a small, open-economy structural macro model that specifically incorporates the exchange rate, followed by the solution of the model both in terms of the exchange rate and random disturbances, yielding modified *IS* and *LM* functions.

The equation for the optimal intervention parameter, which represents the optimal degree of exchange rate management, is then shown in the final section, along with a short discussion of some of the other works made in the same vein. Various propositions will be established within the sections to highlight the theoretical implications of the model.

3.1 Small, open-economy model

The model presented in this section is a slightly modified version[6] of that of Genberg (1989), but is fairly representative of the type of model used in the literature for analysis of insulation properties in open-economy macroeconomics. Besides the representative properties, the model was chosen because of its parsimony and the minimal data requirements; all data for variables were easily available and obtainable from reliable sources.

The key assumptions are that the small economy produces a single good that in general is an imperfect substitute for the good produced by the rest of the world. The economy absorbs some of its own production and exports the balance. Likewise, it takes imports from the rest of the world at a foreign price that it cannot influence.

The notation used is standard and explained in table 5. The eight stochastic shocks, u^j included in the model are assumed to be mutually and serially uncorrelated and have a mean of zero. Let their variances be denoted

[6] Specifically, Genberg's (1989) model incorporates a shock to the interest parity condition while the model presented here does not.

σ_j. In order to facilitate mathematical analysis, the values of all parameters, except for interest rate variables, are written in log-linear form. Table 6 lists the ten basic equations of the model.

Table 5 Notation used in structural model

Notation	***Definition***
y	Output of domestic good (log)
r	Domestic real rate of interest
s	Nominal exchange rate (log)
s^e	Expected nominal exchange rate (log)
p	Price of domestic output (log)
p^e	Expected price of domestic output (log)
p^*	Price of foreign output (log)
w	Nominal wage rate (log)
w^c	Contract wage rate (log)
i	Domestic nominal interest rate
i^*	Foreign nominal interest rate
m	Domestic money supply (log)
u^j	Stochastic shocks (log)

Table 6 Equations of the structural model

Definition	***Equation***	***Number***
Aggregate Demand	$y_t = -\alpha\, r_t + \beta\,(s_t + p_t^* - p_t) + u_t^{yd}$	(8)
Aggregate Supply	$y_t = -\theta\,(w_t - p_t) + u_t^{ys}$	(9)
Contract Wage	$w_t = w_t^c + u_t^w$	(10)
Wage Indexation Formula	$w_t^c = \varepsilon\, s_t + u_t^{wc}$	(11)
Interest Parity Condition	$i_t = i_t^* + (s^e - s_t)$	(12)
Money Demand Function	$i_t = -\lambda\,(m_t - p_t) + \gamma\, y_t + u_t^{md}$	(13)
Money Supply Rule	$m_t = \delta\, s_t + u_t^{ms}$	(14)
Definition of Real Interest Rate	$r_t = i_t - (p^e - p_t)$	(15)
Normalisation	$i_t^* = u_t^{i^*}$, $p_t^* = u_t^{p^*}$	(16a), (16b)

Equation (8) represents the aggregate demand side of the economy and asserts that the real demand for goods is a negative function of the real interest rate and a positive function of the real exchange rate, which is expressed as the relative price of the foreign good. The disturbance term u_t^{yd} is a shock on expenditure.

Equation (9) represents the aggregate supply side of the economy. The supply of output is a negative function of the real wage rate, which is the nominal wage rate deflated by the price of domestic output. This specification uses the contracting approach to introduce some degree of nominal rigidity into the model. It does not, however, take into account other influences on the aggregate supply such as capital stock and technical progress[7]. u_t^{ys} represents a supply shock.

Equation (10) is the contract wage formula which itself is determined by an indexation formula (11). The indexation formula is not the usual type showing the relation between inflation and nominal wages. Rather, it hypothesises a link between the nominal exchange rate and nominal wages, and is represented as a contemporaneous feedback from the nominal spot exchange rate. The contract wage is set such that output is equal to capacity output in the absence of any shocks. Given the structure of the model and the assumed stochastic properties of the shocks u_t^w and u_t^{wc}, this is equivalent to setting the contract wage so that the *expected* equilibrium output level equals the *expected* capacity output level.

Equation (12) is the interest parity condition, where the term (s^e – s_t) stands for the expected rate of depreciation of the domestic currency (since s^e represents the expected level of *s* in the period *t* + 1, or alternatively, the equilibrium level of *s* in the absence of any shock). The interest parity condition is assumed to be not subject to any random disturbance, or alternatively, to be without a risk premium[8].

Equation (13) is the money demand function that gives the nominal interest rate as a negative function of real money balances – which is the nominal money supply divided by the price index (represented as the difference between the change in the the money supply and the price level) – and a positive function of output. u_t^{md} is therefore a disturbance to money demand.

Equation (14) is the money supply rule that assumes that domestic monetary policy is subject to a feedback rule on the exchange rate, and is directed towards stabilising the nominal exchange rate. Monetary policy may therefore take the form of open market operations or unsterilised foreign exchange intervention. Since money supply control is assumed to be imperfect, allowance is made for such errors with the stochastic shock u_t^{ms}.

This equation (14) also accommodates a variety of potential exchange rate regimes. If δ = 0 then money supply is exogenous and the regime is a freely floating one. If δ = – ∞ then there is a fixed exchange rate regime with monetary management. If δ is between 0 and – ∞ then the regime is a managed float, and δ represents the degree to which authorities ‘lean against the wind’. It might also be possible that authorities ‘lean with the wind’, leading to a value of δ that is more than 0. The range of δ is therefore (– ∞, ∞).

The degree of intervention in the foreign exchange market as represented by δ is therefore intervention based on changes in the money supply. While foreign exchange intervention through purchase and sale of foreign exchange in the market exists, it is recognised that the primary form of foreign exchange intervention involves monetary policy[9]. The official intervention issue is taken up again in section 5.

Equation (15) defines the real interest rate, which is the difference between the nominal interest rate and the expected rate of inflation, given by (p^e – p_t). The explanation for this term is analogous to that used for the exchange rate in equation (12).

---

[7] Solow (1957) argues convincingly for the inclusion of technical change and capital stock into the aggregate production function. It should be noted, however, that his findings relate primarily to a long-run macroeconomic model and these may be safely omitted in the present macroeconomic model, which is more interested in output variability in the short-run.

[8] While the addition of this premium increases the realism of the model, the model is unnecessarily complicated by its inclusion, and the model will also run into problems of under-identification, as will be evident later on.

[9] Indeed, Svensson (1989, p. 473) goes as far as to say that “exchange rate policy is monetary policy”.

The normalisation equations (16a) and (16b) for i^* and p^* are chosen so that the equilibrium of the model in the absence of shocks can be given by

$$y = p = s = w = w^c = i = m = 0 \tag{17}$$

This also represents the *expected* equilibrium values which justifies setting $s^e = p^e = 0$, in the absence of shocks.

3.2 Solution for output in terms of exchange rate

By straightforward substitutions, the model can be reduced to two equations in terms of s_t, y_t and shocks, u_t. This is obtained through equating the aggregate demand and aggregate supply functions to obtain the *IS* curve (for the goods market) and the money demand and money supply functions to obtain the *LM* curve (for the money market). The *IS* function is given in equation (18) and the *LM* in equation (19).

$$y_t = [(1 - \varepsilon) / (1/(\alpha + \beta) + 1/\theta)]\ s_t - [1 / (1/(\alpha + \beta) + 1/\theta)]\ u_t^l + [1/(1 + (\alpha + \beta)/\theta)]\ u_t^y - [\alpha / (1 + (\alpha + \beta)/\theta)]\ u_t^i \tag{18}$$

$$y_t = -[(1 + \lambda\, \varepsilon - \lambda\, \delta) / (\gamma + \lambda/\theta)]\ s_t + [1/(\gamma + \lambda/\theta)][u_t^i + u_t^m - \lambda\, u_t^l] \tag{19}$$

where

$u_t^l = u_t^{wc} + u_t^w - (1/\theta)\ u_t^{ys}$

$u_t^y = u_t^{yd} + \beta\ u_t^{p*}$

$u_t^i = u_t^{i*}$

$u_t^m = \lambda\ u_t^{ms} - u_t^{md}$

This semi-reduced form is consistent with the illustrative model (figure 1) presented earlier. The conclusions already drawn are expected to hold in the present model, provided that the real and nominal shocks are interpreted in terms of the structural shocks introduced here.

3.3 Propositions

Three propositions can be established from the abovementioned analysis.

Proposition 1: Fixed exchange rates are superior (inferior) to floating if the variance of the aggregate composite shock in the *LM* function (19) is sufficiently large (small) relative to the variance of the aggregate composite shock in the *IS* function (18). In particular, if the domestic money demand function is very unstable or if domestic monetary control is very imprecise (leading to a high value for var(u_t^m) in either case), then a fixed exchange rate regime will stabilise output and is therefore preferable. Alternatively, if the demand function for domestic goods is highly unstable (where a high value for var(u_t^y) results), then a floating rate regime will stabilise output and is preferred[10].

Proposition 2: If the interest elasticity of spending, α, is small (< 1), then a highly variable foreign interest rate (which leads to a value for var(u_t^i) that is high) increases the desirability of exchange rate fixity. This is because a value of less than one for α leads to a small value for the composite coefficient $[\alpha/(1 + (\alpha + \beta)/\theta)]$; this in turn leads to a smaller variance for the aggregate composite shock in the *IS* function. As established by proposition 1, fixed exchange rates are preferred in this case where the variance of the real shock is relatively less than that of the monetary shock.

[10] The unstable demand function for domestic goods may be a result of either random fluctuations in the trade balance or random fluctuations in domestic 'autonomous' spending.

Proposition 3: Except in limiting cases, some degree of exchange rate management is better than either free floating ($\delta = 0$) or complete fixity ($\delta = -\infty$). This arises because so long as an economy experiences both types of shocks, neither of the polar cases will minimise output volatility.

3.4 Solution for output in terms of random disturbances

By further manipulation, the solution for output in terms of shocks may be obtained. This occurs via removal of the s_t term and solving for y_t in terms of u_t. This is given by equation (20).

$$\Psi\, y_t = -(x + \lambda)\, u_t^l + [1/(\alpha + \beta)][x]\, u_t^y + [1 - \alpha/(\alpha + \beta)\, x]\, u_t^i + u_t^m \tag{20}$$

where

$$\Psi = \gamma + \lambda/\theta + [(1 + (\alpha + \beta)/\theta)/(\alpha + \beta)]\, x$$

$$x = (1 + \lambda\, \varepsilon - \lambda\, \delta)/(1 - \varepsilon)$$

Equation (20) can then be used to derive further results, such as the optimal degree of exchange rate management, which is discussed in the following section. It should be noted that the present framework caters to only domestic real and nominal random shocks. Additional conclusions may be reached by extending the analysis to cater for disturbances that originate from either the home economy or from abroad, or for larger, multi-country models[11].

3.5 Optimal intervention parameter

By assuming that shocks are mutually uncorrelated, it is possible to obtain the variance of output y_t such that

$$\mathrm{Var}(y) = 1/\Psi^2\, [(x + \lambda)^2\, \sigma_l + [1/(\alpha + \beta)^2][x^2]\, \sigma_y + [1 - \alpha/(\alpha + \beta)\, x]^2\, \sigma_i + \sigma_m] \tag{21}$$

This output variance may then be minimised with respect to δ. To obtain a value for δ which would be the optimal intervention parameter, the differentiated equation would be equated to zero and solved for δ (which is a long and tedious process).

Alternatively, the problem could be solved by a method that utilises the definition of x. This procedure would first involve differentiation of var(y) with respect to x (since the parameter δ only appears in the composite coefficient x). Differentiation of equation (21) yields[12]

$$dy/dx = (\alpha\theta + \alpha^2 + \beta^2 + 2\alpha\beta + \beta\theta)\, \sigma_m / (\gamma\theta - \lambda)\, \sigma_y + (-\alpha\beta - \alpha^2 - \gamma\alpha^2\theta - \alpha\theta - \lambda\alpha^2)\, \sigma_i + (\lambda\alpha\theta + \lambda\beta\theta - 2\gamma\alpha\beta\theta - \gamma\beta^2\theta - \gamma\alpha^2\theta)\, \sigma_l - [(\alpha\theta + \lambda\alpha\beta + \beta^2 + \gamma\alpha\beta\theta + \lambda\alpha^2 + \alpha^2 + \gamma\alpha^2\theta + 2\alpha\beta + \beta\theta)\, \sigma_i + (\lambda^2\alpha\theta - \gamma\lambda\alpha^2\theta - 2\gamma\lambda\alpha\beta\theta - \gamma\lambda\beta^2\theta + \lambda^2\beta\theta)\, \sigma_l] / [(-\gamma\theta - \lambda)\, \sigma_y + (-\alpha\beta - \alpha^2 - \gamma\alpha^2\theta - \alpha\theta - \lambda\alpha^2)\, \sigma_i + (\lambda\alpha\theta + \lambda\beta\theta - 2\gamma\alpha\beta\theta - \gamma\beta^2\theta - \gamma\alpha^2\theta)\, \sigma_l] \tag{22}$$

which is effectively the optimal value of x, which shall be denoted x^*. Then, by using the definition of x given in equation (21), the optimal intervention parameter can be shown to be

$$\delta^* = 1/\lambda\, (1 - x^*) + \varepsilon\, (x^*/\lambda + 1) \tag{23}$$

This clearly shows that the optimal degree of intervention in the foreign exchange market depends largely on the degree of wage indexation (as given by ε) in the economy.

---

[11] The interested reader should consult the excellent works by Argy (1989), Genberg (1989) or Kotilainen (1995) for further discussion of issues that proceed along this tangent.

[12] The differential equation (22) was far too complex to have been solved manually. *Maple*® V, release 4 (1996) was used for the solution presented.

3.6 Additional propositions

Additional propositions may be established from the results presented.

Proposition 4: Optimal wage indexation is a perfect substitute for an optimal exchange rate intervention policy provided that the objectives of wage indexation and monetary policy are the same and that both are based on the same information. When wage indexation is optimal in the economy (such that ε is chosen so as to minimise the variance of y around its expected value), then ε is chosen so as to make $x = x^*$. Perfect wage indexation, however, does not imply optimal wage indexation.

Proposition 5: Assuming that wage indexation is chosen as a substitute for exchange rate intervention policy, a greater degree of floating is preferable to a fixed peg. When the exchange rate is allowed to move freely, such movements provide some, albeit imperfect, information about shocks affecting the economy and so indexing wages to the exchange rate allows for better reduction of output variability. When the exchange rate is fixed, this source of information is lost and with it, the stabilising effects of optimal wage indexation.

3.7 Previous empirical research

The general results presented in this section and the preceding one were also derived in the works of Argy (1990), Blundell-Wignall & Gregory (1990), Pikoulakis (1995) and Roper & Turnovsky (1980) for an open economy and Barro (1977) and Canzoneri, Henderson & Rogoff (1983) for a closed economy. The discussion here shall restrict itself to the studies performed in the context of the open economy.

Argy (1989) utilised a model of a small open economy and studies the effects of shocks that originate both from the domestic as well as foreign country. He derives an optimal level of foreign exchange intervention in terms of both domestic and foreign shocks. Blundell-Wignall & Gregory (1990) applied a small-country commodity-exporting model and solves for the optimal intervention parameter by consideration of both terms of trade shocks and money market shocks.

Roper & Turnovsky (1980) examined the optimal market intervention in the foreign exchange regime within the context of a macro model that emphasises the trade-off between changes in a country's balance of payments and changes in its exchange rate. They derived an optimal intervention parameter that was not dissimilar to that of Blundell-Wignall & Gregory (1990). Pikoulakis (1995) worked with a much more sophisticated symmetric, two-country model, solving for an optimal intervention level with respect to shocks in the goods, wages and money market.

Although these papers differ in the models used and the source and nature of shocks to the economy, the conclusions of the preceding analysis have been similar to those based on the works of these authors. The glaring omission from these works has been that all have stopped at the theoretical level and none have proceeded on towards estimating the optimal choice of an exchange rate regime econometrically, using the tools mentioned above.

It is essential to note at this point that the outcomes of all the models used are based on theoretical conjectures. They incorporate a host of simplifying assumptions and possess limited complexity. However, the basis of economic theory has not been compromised in any case, so these models can be expected to provide reliable, although not necessarily always applicable, results.

Clearly, the theoretical framework presented in this section is far from perfect. It has attempted to present a methodology for obtaining the optimal intervention parameter for an economy, within the constraints of a parsimonious structural macro model and various simplifying assumptions. Modifications to improve the model's realism include introducing more variables to the structural equations, better modelling expectations and incorporating a risk premium into the interest parity condition.

Nonetheless, the framework offers a solid foundation for deriving conclusions concerning the optimal choice of an exchange rate regime. By applying the current framework to the Australian economy, the calculated coefficients for the structural parameters, when applied to the different propositions raised, can be used to derive results concerning the optimal regime. The results obtained would then be of both academic as well as practical interest. Its theoretical contribution lies in the added understanding of the economy that the result would provide. Its potential use in policymaking is also important. Since the current exchange rate regime, based on the degree of exchange rate intervention, is available, it is possible to draw conclusions that might be used to assist the government in directing policy towards choosing the optimal exchange rate regime.

4. Econometric framework

4.1 Econometric Model

The econometric model developed here is based on the structural model of the macroeconomy presented in the previous section. The model to be estimated is a ten-equation system with nine variables. Of the ten equations, five are behavioural and the rest are definitions and identities. Identities with no unknown parameters and disturbance terms are substituted into the equations to be estimated. This reduces the system into the five-equation system presented in table 7.

Table 7 Equations of the econometric model

Theoretical equations	***Econometric equations***	***Number***
$\underline{y_t} = -\alpha\,[i_t - (p_n - p_t)] + \beta\,(s_t + p_t{}^* - p_t) + u_t^{yd}$	$Y_t = -\alpha\, R_t + \beta\, REALS_t + \mu_t$	(23)
$y_t = -\theta\,(w_t - p_t) + u_t^{ys}$	$Y_t = -\theta\, REALW_t + \mu_t'$	(24)
$w_t = \varepsilon\, s_t + u_t^{w} + u_t^{wc}$	$W_t = \varepsilon\, S_t + \mu_t''$	(25)
$[i_t{}^* + (s_n - s_t)] = -\lambda\,(m_t - p_t) + \gamma\, y_t + u_t^{md}$	$I_t = -\lambda\, REALM_t + \gamma\, Y_t + \mu_t'''$	(26)
$m_t = \delta\, s_t + u_t^{ms}$	$M_t = \delta\, S_t + \mu_t''''$	(27)

The aggregate demand equation (23) was derived from a substitution of the definition of the real interest rate given by equation (15) into the variable r_t in equation (8). The wage equation (25) was obtained from a substitution of the wage indexation formula (11) into the variable w_t^c in the contract wage equation (10). Substitution of the interest parity condition in equation (12) into i_t in the money demand equation (13) gave equation (26). Equations (24) and (27) were taken directly from equations (9) and (14), respectively.

Table 8 Composite variables in econometric model

Composite variable	***Calculation***	***Number***
R_t	$I_t - (P_t - P_{t-1})$	(28)
$REALS_t$	$S_t + P_t{}^* - P_t$	(29)
$REALW_t$	$W_t - P_t$	(30)
I_t	$I_t{}^* + (S_t - S_{t-1})$	(31)
$REALM_t$	$M_t - P_t$	(32)

There are five composite variables. R_t represents the real interest rate effect, $REALS_t$ represents the real exchange rate effect, $REALW_t$ represents the real wage rate effect, I_t represents the nominal interest rate and $REALM_t$ represents real money balances. Each variable was calculated using its corresponding theoretical equation. For equations that required the difference between expected and actual levels of a particular variable, the difference between the actual and lagged variables was used instead. This is based on an assumption of rational expectations that is backward instead of forward looking. The calculations for each of these variables are shown in table 8.

The other variables are single variables, where S_t represents the spot exchange rate of local currency to foreign currency; M_t represents the money supply measured by seasonally adjusted M3; P_t represents the price level measured by the Consumer Price Index (CPI) on all items; W_t represents the nominal wage rate for full time employment and Y_t represents the output level measured by the seasonally adjusted real Gross Domestic Product (GDP) on all items. P_t* and I_t* represent the foreign equivalents of the price level and interest rate, respectively. All variables were transformed with natural logarithms, with the exception of the interest rate variable I_t.

The simultaneous equation system of table 8 has two exogenous variables, P_t* and I_t*, and two lagged endogenous variables, S_{t-1} and P_{t-1}. This gives a total of four predetermined variables. It was ascertained that none of the equations were under-identified.

4.2 Data Sources & Methodology

Data used for the regressions were gathered from a mix of databases. Y_t, P_t, W_t, P_t* and I_t* were drawn as quarterly data from the Main Economic Indicators of the Organisation for Economic Co-operation and Development (OECD) for Australia and the United States[13]. S_t was drawn as monthly data from the Australian Bureau of Statistics (ABS) and a three-month simple average was used to obtain quarterly data. The values of S_t were obtained in terms of Australian dollars to US dollars. M_t was drawn from the Reserve Bank of Australia (RBA) as monthly data, and a three-month simple average was similarly applied to obtain quarterly data. All databases were accessed using EconData dx Data Express, version 2.1. Data used were taken for the time period 1976: Q1 to 1996: Q1, giving a total of 81 observations. After adjustments for first differences and lags, the first three observations for each data set were dropped. This brought the starting observation to 1976:Q4, coinciding neatly with the managed float of the Australian dollar.

In order to avoid simultaneous equation bias, the method of Two Stage Least Squares (2SLS) was employed. The first regression was run on each of the dependent variables against the four predetermined variables P_t*, I_t*, S_{t-1} and P_{t-1}, and the second on each of the dependent variables against the estimated values of the endogenous dependent variables.

It was recognised that the money demand equation (26) is contrary to convention, which usually places $REALM_t$ as the dependent variable and I_t as the independent variable, instead of the other way around. The Granger (1969) test of causality was applied to equation (26) and the hypothesis that $REALM_t$ Granger-causes I_t could not be rejected at the 10% level, thereby justifying its somewhat unusual representation.

As the interest rate variable was calculated according to equation (31), a correlation matrix was run between the calculated values of I_t and actual interest rate variables. The observations for the actual interest rate were obtained as a three-month simple average of the monthly 90-day commercial bill rate from OECD Main Economic Indicators. The correlation coefficient was significant at the 1% level, but its value showed only a moderate correlation. After dropping outlier values (that corresponded to the oil shocks of the 1970s), the strength of the correlation increased considerably, providing a strong correlation.

In order to correct for autocorrelation, first differences were calculated for all equations. Augmented Dickey-Fuller tests employed after first differences were taken indicated that the data had achieved stationarity, implying that the data were first order integrated I(1) processes. The constant term was dropped from the regressions, because the first differenced model should be estimated without an intercept term (Gujarati 1995). Regressions run possessed two insignificant coefficients, and R_t remained incorrectly signed. The Durbin-Watson *d* statistic is not applicable to a regression-through-the-origin model, and this renders the statistic unusable. Runs tests (Geary 1970) applied to the regressions showed that autocorrelation had indeed been removed.

---

[13] The United States was used as the representative foreign country due to its size and its strong influence on world economic conditions. The relatively unrestricted American economy is also more reflective of foreign country influences than Japan, which, despite being Australia's largest trade partner, is prone to strong government intervention that distorts macroeconomic variables.

4.3 Estimated parameters

The final regression results, as well as the relevant significance tests, are presented in table 9, corrected to four significant figures.

Table 9[14] Estimated parameters

Variable / Expected Sign	***Coefficient Symbol***	***Estimated Coefficient/ Standard Error***	***P-value***
R_t (–)	α	0.003822 (0.002581)	0.143
$REALS_t$ (+)	β	0.5710 (0.3798)	0.137
$REALW_t$ (–)	θ	–1.584 (0.8721)	0.073*
S_t (+)	ε	0.9313 (0.4605)	0.047**
$REALM_t$ (–)	λ	–58.41 (35.12)	0.10*
Y_t (+)	γ	122.6 (46.05)	0.01***
S_t (+)	δ	1.665 (0.8102)	0.043**

Two variables, R_t and $REALS_t$, are insignificant at the 10% level. This result could have possibly been improved with a larger number of observations. Unfortunately, no additional observations for the variable W_t were available from the databases. The insignificance of the variable R_t could also be responsible for its incorrect sign.

The calculation of the optimal intervention parameter involved an interaction of the different coefficients, and omission of any coefficient or assuming its value to be equal to zero would very likely influence the final result. The two coefficients for R_t and $REALS_t$ were therefore included in the calculations. While accepting that this may compromise the reliability of the results, it should be remembered that the p-values were also not very large and could be accepted at the 15% level.

4.4 Diagnostic tests

The diagnostic tests performed for each equation are presented in table 10. Because of the nature of the 2SLS methodology, hypothesis testing in 2SLS is complicated by unknown distributions, rendering the normal *t*- and F-tests invalid. These are therefore interpreted as asymptotically normal and chi-square (White 1993). As a result, no F-test statistics for the overall regression are given.

R^2 values in all these cases were negative, and therefore unusable[15]. Instead, the R^2 values calculated between observed and predicted values were used. While these remained low, the critical factor remains the

---

[14] The asterisks behind the p-values indicate the significance, where * indicates 10% significance level, ** indicates 5% significance level and *** indicates 1% significance level.

[15] R^2 values obtained using 2SLS are not well defined and may be negative. The lower bound of R^2 values using 2SLS is in fact minus infinity (White 1993).

underlying theoretical expectations about the model. In any case, the presence of low R^2 values in determining the suitability of a model has been frequently downplayed (Achen 1982; Cameron 1993; Goldberger 1991; Granger & Newbold 1976). However, there is recognition of the fact that the model is possibly misspecified, which simply reiterates the point made earlier that the model is a theoretical, as opposed to empirical, one.

Table 10 Diagnostic tests

Equation	***Diagnostic Test***	***Value***
(28)	R^2 between observed & predicted	0.0026
	Runs test normal statistic	–0.581
(29)	R^2 between observed & predicted	0.012
	Runs test normal statistic	0.390
(30)	R^2 between observed & predicted	0.0080
	Runs test normal statistic	–0.428
(31)	R^2 between observed & predicted	0.037
	Runs test normal statistic	1.47
(32)	R^2 between observed & predicted	0.0022
	Runs test normal statistic	–0.581

As noted earlier, the Durbin-Watson *d* statistic is not applicable to a regression-through-the-origin model and was therefore not utilised. Tests for the presence of autocorrelation in the residuals were carried out using Runs tests (Geary 1970). The calculated normal statistic for these tests falls within the 95% confidence interval for not rejecting the null hypothesis that the sequence of residuals is random, and therefore the conclusion that there is no significant autocorrelation holds.

4.4 Diagnostic tests

As the theoretical and empirical signs for the coefficients of the structural parameters differ, the calculated functions employed the signs and values that were estimated empirically. As a consequence, the functions shown below may differ from those presented earlier. Intermediate steps for the calculations are available upon request.

The calculated *IS* and *LM* functions of output in terms of exchange rate and stochastic shocks are

$$y_t = (2.87 \times 10^{-2})\, s_t - 0.418\, u_t^l + 0.736\, u_t^y - (2.81 \times 10^{-3})\, u_t^i$$

$$y_t = 0.2624\, s_t + (6.271 \times 10^{-3})\, u_t^i + (6.271 \times 10^{-3})\, u_t^m - 0.3663\, u_t^l$$

where

$$u_t^l = u_t^{wc} + u_t^w - 0.6313\, u_t^{ys}$$

$$u_t^y = u_t^{yd} + 0.5710\, u_t^{p*}$$

$$u_t^i = u_t^{i*}$$

$$u_t^m = 58.41\, u_t^{ms} - u_t^{md}$$

The calculated output function in terms of stochastic shocks is

$y_t = -0.4240\, u_t^l + 0.8268\, u_t^y - (7.647 \times 10^{-4})\, u_t^i - (7.698 \times 10^{-4})\, u_t^m$

The calculated optimal intervention parameter is

$\delta^* = 0.9484 - 0.03306\, x^*$

where

$x^* = (8.984 \times 10^{-3})\, \sigma_m / \sigma_y - (4.530 \times 10^{-3})\, \sigma_i - 9.999\, \sigma_l - [0.6725\, \sigma_i - 583.3\, \sigma_l] / [-252.6\, \sigma_y + (4.531 \times 10^{-3})\, \sigma_i - 9.999\, \sigma_l]$

The values for the variances of the different stochastic shocks were then obtained from the regression residual variances. For two shocks, u_t^{i*} and u_t^{p*}, the variances were taken from the variances of the actual variables, as defined by the normalisation equations (16a) and (16b). The variances are set out in table 11.

Table 11 Variances of stochastic shocks

Stochastic shock	***Value***	***Nature***
$\mathrm{var}(u_t^{yd})$	7.546×10^{-4}	Real
$\mathrm{var}(u_t^{ys})$	5.672×10^{-3}	Real
$\mathrm{var}(u_t^w + u_t^{wc})$	1.607×10^{-3}	Real
$\mathrm{var}(u_t^{md})$	3.366	Monetary
$\mathrm{var}(u_t^{ms})$	4.973×10^{-3}	Monetary
$\mathrm{var}(u_t^l) = \mathrm{var}(u_t^w + u_t^{wc}) + 0.6313^2\, \mathrm{var}(u_t^{ys})$	3.868×10^{-3}	Real
$\mathrm{var}(u_t^y) = \mathrm{var}(u_t^{yd}) + 0.5710^2\, \mathrm{var}(p_t^*)$	1.595×10^{-2}	Real
$\mathrm{var}(u_t^i) = \mathrm{var}(i_t^*)$	11.51	Monetary
$\mathrm{var}(u_t^m) = 58.41^2\, \mathrm{var}(u_t^{ms}) + \mathrm{var}(u_t^{md})$	20.33	Monetary

The optimal intervention parameter can be calculated from assumptions made concerning the variances above. Assuming a pure monetary shock, the variances of the real shock variables would be equated to zero and the optimal intervention parameter calculated exclusively from the variances of the monetary shocks. Conversely, a pure real shock alone would be calculated from the variances of the real shocks alone. This would then yield values of δ* under real, monetary and combined real and monetary shocks, and these are given in table 12. These values all lie within the expected range of $(-\infty, \infty)$.

Table 12 Calculated optimal intervention parameter

Nature of shock	***Symbol***	***Calculated value***
Real shock	δ_r^*	0.9074
Monetary shock	δ_m^*	$-\infty$
Combined shock	δ_c^*	0.4330

Whilst the econometric model estimated in this section is not as robust as more sophisticated models of the macroeconomy, it served its primary purpose of providing estimates of the structural parameters in the economy. In particular, the aggregate demand equation (23) probably does not fully capture the influences on aggregate demand. One is led to suspect that either consumption, the largest component of Australia's output expenditure (Maddock & McLean 1987; Boehm 1993), or government expenditure is not adequately captured. However, as noted earlier, the acceptance of the two coefficients means only a slight increase in the possibility of committing a Type I error.

This does not entirely render the calculated results irrelevant. It must be remembered that the primary aim of the thesis remains the discovery of the optimal choice of an exchange rate regime. As a consequence, the exact magnitude of the measured optimal intervention parameter, although useful, is not of primary importance. This is because such a choice is governed by the general magnitude (either a very large, negative number for a fixed regime or a number insignificantly different from zero for a free float) and direction (whether 'leaning with' or 'leaning against' the wind) of the value of δ.

These, fortunately, remain unaffected by the lower confidence that has to be attached to the value of δ^* due to the acceptance of the two insignificant coefficients. Furthermore, although the value of δ^* is of primary importance, the other significant estimated parameters are also utilised – through the propositions raised – to assist in this optimal choice.

5. Evaluation & Implications

5.1 Theoretical implications

The hypothesis that freely floating exchange rates is the optimal exchange rate regime for Australia can been rejected. The optimal intervention parameter for a free float would be zero; all calculated δ^* values were nonzero and, for monetary shocks, the value tended towards the upper limit of $-\infty$. It is clear that the alternative hypothesis – that the optimal exchange rate regime for Australia, with regard to reducing output volatility, is *not* a freely floating exchange rate regime, regardless of the nature of the shocks considered – has to be accepted.

The second hypothesis that the optimal degree of intervention in the foreign exchange market with the aim of reducing output variability lies between a rigidly fixed and freely floating regime cannot be rejected. The calculated δ^* and estimated α, ε and σ_j values show that a managed float, with a bias towards intervention through 'leaning against the wind', is the optimal exchange rate regime when the objective is to reduce output volatility. This is discussed further in the next section.

5.2 Evaluation of propositions

The aggregate composite real shock on the *IS* function is given by

$$-\,[1 / (1/(\alpha + \beta) + 1/\theta)]\; u_t^l + [1/(1 + (\alpha + \beta)/\theta)]\; u_t^y - [\alpha / (1 + (\alpha + \beta)/\theta)]\; u_t \qquad (33)$$

Taking variances and substituting the calculated parameter values would give the variance of a pure real shock

$$\sigma_{IS} = 0.1744\, \sigma_l + 0.5422\, \sigma_y + (7.920 \times 10^{-6})\, \sigma_i \qquad (34)$$

The variances already obtained can then be substituted and it can be shown that the variance of a real shock, σ_{IS}, is 9.414×10^{-3}. The same treatment may be applied to obtain the variance of a nominal shock, and the value of σ_{LM} obtained in this case is 1.771×10^{-3}.

The literature on exchange rate determination suggests that the observed movements of nominal exchange rates are due to the combination of movements in international capital and speculative shifts in asset preferences among countries (Taylor 1995; Pentecost 1993). This would mean that monetary shocks are the principal type of shock experienced by modern economies. The calculated values of σ_{IS} and σ_{LM}, however, would reject this theory in the context of Australia. This is not entirely unexpected. The Australian dollar has traditionally been strongly influenced by commodity prices (Freebairn 1989; Macfarlane & Tease 1989; McKenzie 1986), indicating the possibility that real shocks may be primary type of shock experienced by Australia. Therefore, proposition 1 would submit that a flexible exchange rate regime would be preferable for any unanticipated pure shock, in relation to the Australian economy.

It should be noted, however, that to accurately identify the nature of shocks responsible for macroeconomic instability is arduous, and in most cases it is virtually impossible (Aghevli, Khan & Montiel 1991). The theoretical model may miss out on a plethora of other disturbances an economy may encounter, and consequently, the above statement should be understood with that limitation in mind.

The interest elasticity of spending, α, at 0.003822 is less than one and very small, and can be interpreted as highly inelastic. At the same time, the variance of the foreign interest rate σ_i*, with relation to the variances of other shocks, is fairly large at 11.51. Proposition 2 would thus suggest that, for the Australian economy, there is an increased desirability for exchange rate fixity, and so a choice of either a fixed peg or a managed float with a bias towards fixity is better for minimising output volatility.

The calculated values of the optimal intervention parameter for either purely real or monetary shocks lie within their expected ranges and are entirely consistent with theoretical analyses, with respect to the direction of the optimal intervention parameter. The magnitude of δ^*, however, is a purely empirical matter that cannot be ascertained by comparison using theoretical conclusions.

For a monetary disturbance, authorities should engage in ‘perfect leaning against the wind’. This is equivalent to maintaining a fixed exchange rate regime, which is the theoretically optimal solution for reducing output variability (Argy 1989). The value of δ^* in response to a monetary shock is expected to tend towards $-\infty$, and this is exactly what was obtained for the calculated value of δ_m^*.

For a real disturbance, output increases and the currency appreciates. In order to stabilise output, money needs to be tightened further, and so authorities would need to ‘lean with the wind’ or to effectively destabilise the exchange rate in order to stabilise output (Argy 1989). This means the operation of a managed float regime. The value of δ^* in response to a real shock is expected to be positive, and this was also obtained for the calculated value of δ_r^*.

For combined shocks, the value of δ_c^* was positive, which indicates that authorities should engage in a ‘lean with the wind’ policy similar to that just mentioned above and, in effect, maintain a managed float regime. In sum, the conjecture of proposition 3 that a managed float is better than free floating or complete fixity holds.

The degree of wage indexation in the economy, ε, is 0.9313. This value is very high, implying close to perfect wage indexation. This high level of wage indexation means that output effects on the wage rate are stronger, or that an exchange rate appreciation (depreciation) would force wages down (up) further. The stronger the output effects, the more restrictive monetary policy must be, and this means stronger ‘leaning with the wind’ (Argy 1989). This high value of ε could also be the reason for the positive δ_c^* value. Whether this value of ε is the optimal wage indexation is a question that is beyond the scope of this dissertation, and hence propositions 4 and 5 are not addressed any further here.

It is sufficient to recognise that since the degree of wage indexation in the economy is imperfect ($\varepsilon \neq 1$), authorities can expect changes in the money supply, or monetary policy, to have effects on the real sector of the economy, that are transmitted through the exchange rate. This allows for an optimal wage indexation policy to be chosen as a substitute for an exchange rate intervention policy, as proposition 5 suggests. A managed or free float is therefore preferred in this case, since it allows the transmission of information about shocks that is otherwise lost with a fixed regime.

It is expedient to recapitulate at this point the fact that the interpretations made above have been done so based on the objective of minimising output volatility. Alternative economic objectives, such as minimising price or unemployment variability would possibly lead to different implications, even with the same parameters.

5.3 Practical implications

Official intervention in the foreign exchange market occurs when the government or monetary authority actively attempts to influence the exchange rate. Intervention is of two kinds: sterilised intervention, where authorities take action in order to offset (or 'sterilise') the effects of the resulting change in official foreign asset holdings on the domestic monetary base; and non-sterilised intervention, where the money base is allowed to change as a result of the intervention (Corden 1994).

There are three main channels of influence on exchange rates: first, through a direct portfolio balance effect from sterilised intervention; second, through a direct money stock effect from an unsterilised intervention and third, through a signalling (or expectations) effect of policy intentions (Argy 1994). There are other methods of influencing exchange rates, but these are less important and are not discussed here[16].

The portfolio balance effect works through a change in the relative supplies of assets. For example, if the authorities sell (buy) foreign exchange and carry out an open market purchase (sale) of domestic bonds, then the effect of the rise in official reserves on the money supply is sterilised and there is no net movement of the exchange rate (assuming perfect asset substitutability). If asset substitution were imperfect, then the swap operation would lead to an appreciation of the currency and a fall in the interest rate.

The direct money stock effect is straightforward. Suppose that there is upward (downward) pressure on the exchange rate; monetary authorities can counteract this pressure by applying expansionary (contractionary) monetary policy. This influence on interest rates and its subsequent inducement of capital movements would lead to exchange rate movements that change the exchange rate.

The signalling effect allows a change in expectations about the future exchange rate to reinforce stabilising effects by providing the market with relevant information that was previously unknown and hence not incorporated into the prevailing exchange rate (Mussa 1981). This effect works on the assumption that the authorities possess superior information as compared to other market participants and that they are willing to reveal this information through their actions.

The literature on the portfolio balance effect from sterilised intervention mostly concludes that its effects are short-term and very small (Frankel 1982b; Lewis 1988; Obstfeld 1983, 1990; Rogoff 1984). Studies of the signalling effect have produced mixed results (Dominguez 1986; Humpage 1989), with earlier studies finding this channel of influence impotent (Marston 1987), but later studies giving more support to its efficacy (Catte, Galli & Rebecchini 1992; Dominguez & Frankel 1993a, 1993b). The empirical evidence summarised in Almekinders & Eijffinger (1991) and confirmed by Ghosh (1992) concludes that while the portfolio balance effect from sterilised intervention has a limited ability to influence the exchange rate, this is reinforced by the signalling effect such that the two in concert exert a significant, though weak, influence.

It is therefore the direct money stock effect that exerts the strongest influence on the exchange rate. This has been recognised in the literature (Argy 1982; Kenen 1988; Svensson 1989), and is the approach adopted in the present study. All practical policy recommendations that arise here therefore assume that the channel of influence used to implement exchange rate management is based on the direct money stock effect, carried out through monetary policy. This assumption is also reinforced by the fact that the principal mode of intervention used by the Reserve Bank in foreign exchange management is that of monetary policy (Allan, Elstone, Lock & Valentine 1990).

5.4 Evaluation of parameters

The officially reported exchange rate regime for Australia is a free float (International Monetary Fund 1997). However, the estimated coefficient value of 1.665 for δ suggests that there is a certain degree of intervention in the foreign exchange market, and this is inclined towards a policy of 'leaning with the wind', since it has a positive value. Kearney (1997) and Allan *et al* (1990) report that the RBA's activities in the foreign

[16] These methods include the use of fiscal policy, of administrative controls over imports and exports, of special inducements to foreign banks to hold reserves of a particular currency and of various devices used to alter the levels of official reserves without intervention or borrowing (Argy 1982).

exchange market include 'smoothing' and 'testing' operations, as well as a certain amount of exchange rate intervention. This accounts for the non-zero value obtained for the estimated δ value.

The optimal degree of intervention of course depends on the nature of the shocks in question. It would not be presumptuous, though, to take the optimal degree of intervention as the one for combined shocks, if for no reason other than the fact that it caters for the more realistic situation of either type of shock arising. The value of δ^*, then, would be $\delta_c^* = 0.4330$. This result also supports a 'leaning with the wind' policy stance.

Compared to the actual intervention parameter, the RBA is obviously engaging in a 'leaning with the wind' policy that is close to optimal[17]. While this discrepancy might suggest the possibility of over-correction, two points should be kept in mind. First, the calculated values are the long-term values, and give no indication concerning the RBA's actions in individual circumstances. Second, the value calculated involves the interaction of two coefficients that are only significant at the 15% level, and so it is wise to exercise extreme caution in interpreting the results in this way.

The conclusion that surfaces time and again is that a managed regime is the optimal choice of a regime, within the context of the present study. This can be more formally established through the incorporation of an elementary scoring system[18], based on the evaluation of the propositions made earlier. This is provided in table 13 below.

For simplicity, only three regimes are considered: a fixed peg, a managed float and a free float. Equal weights were assigned for the various criteria. Scores were assigned such that the preferred regime was scored a one and the others received no score. A half-point was assigned to a regime that could technically offer the promise of the preferred regime, but would depend on the policy stance adopted. For example, for the first criterion, since a freely floating exchange rate regime is preferable for any unanticipated pure shock, it was assigned a point, and a managed float was assigned a half-point.

Table 13 Analysis of regime choice

Criterion	***Fixed Peg***	***Managed Float***	***Free Float***
Variance of Shocks	0	0.5	1
Interest Elasticity of Spending	1	0.5	0
Nature of Shocks			
– Real Shock	0	1	0
– Monetary Shock	1	0	0
– Combined Shock	0	1	0
Degree of Wage Indexation	0	0.5	1
Total Score	2	3.5	2

From the results of the preceding analysis, should Australia therefore move away from a freely floating exchange rate regime and adopt a managed float? From the estimated value of δ, it is clear that it has already done just that. Despite the officially reported free float, a managed float regime of active intervention has been consistently applied since 1986 (Kearney 1997). Australia's current regime is a relatively 'clean' float by world standards (Kearney 1997), and that somewhat justifies its official representation as a freely floating exchange rate regime. What is important is the recognition by policymakers that should the need arise, the

[17] Recall that the range of δ lies between $(-\infty, \infty)$.

[18] Scoring analyses such as these used to evaluate alternative foreign exchange policy options are common in the works of Argy (1982, 1985). The aforementioned works have inspired the approach adopted here.

monetary authority should be ready to intervene in the foreign exchange market to minimise output variability.

The research is unable to provide a clear, unambiguous answer as to whether a policy of 'leaning with' or 'leaning against the wind' is superior, simply because such a policy recommendation would depend on the type of shock experienced. Economic forecasting has also been largely unsuccessful in the forecasting of shocks experienced by the economy (Genberg 1989). The same approach can however be used to obtain a general idea of which policy approach is more likely to be applied. This is shown in table 14.

Table 14 Analysis of policy choice

Criterion	***'Leaning With the Wind'***	***'Leaning Against the Wind'***
Variance of Shocks	1	0
Interest Elasticity of Spending	0	1
Nature of Shocks		
– Real Shock	1	0
– Monetary Shock	0	1
– Combined Shock	1	0
Degree of Wage Indexation	1	0
Total Score	4	2

It would seem that a policy of 'leaning with the wind' is more likely to be applied when all the different influences on the insulation properties of a regime are considered.

Needless to say, a proper regime choice and policy stance recommendation based on the objective of reducing output variability would involve rigorous benefit-cost analysis which would both include weightings attached to the different criteria as well as take into account social benefits and costs. The choice of weightings and social factors, then, is a decision that is solely at the discretion of the individual policymaker.

The overriding purpose of this section has been to bring the theoretical conclusions reached in the first section into the realm of practical, applicable policy suggestions and initiatives. Yet the optimal choice remains a complicated one, and is likely to vary from case to case, in accordance to the different preferences of policymakers, the choice of variables and the size, nature and source of shocks experienced by the economy. The recommendations have also been made according to model-specific results, and its wider generalisability will have to be established with further research.

Whilst the research points towards a 'leaning with the wind' policy stance for exchange rate management (and hence monetary policy), the Reserve Bank may choose to keep monetary policy steady instead of subjecting it to management of the exchange rate, in order to fulfil other macroeconomic objectives. There is evidence that this has been the case before (Wood 1998).

It is also useful to recall the alternative types of exchange rate regimes first mentioned in section 2. The target zone model has not been directly addressed here; neither have options such as a dual exchange rate regime. These might very well provide superior insulation properties compared to the managed float that has been given support by the research here.

6. Conclusion

The study shows that a freely floating exchange rates is the optimal exchange rate with respect to minimising output variability, and that this has been pursued in practice.

The principal limitation of the study has already been alluded to. The theoretical model is extremely simple, and the lack of robustness renders estimates obtained somewhat questionable. A model that is parsimonious yet adequately captures the nuances of the macroeconomy is needed. That in itself would introduce its own set of problems, such as an excessively complicated model.

Specific limitations can be summarily touched upon. The interest rate parity condition, equation (12), can be extended to incorporate a random shock, u_t^r, which can be thought of as a risk premium. This would remove the assumption of perfect asset substitution and increase the model's capability to provide responses to uncertainty in the world financial market. Second, the aggregate demand function, equation (8), can be modified to include additional explanatory variables, such as the foreign output level, y_t*. Likewise, the aggregate supply function can incorporate more dependent variables, such as imported inputs, as well. Alternative explanatory variables may also be used, such as a more widely-trade weighted average exchange rate variable. Third, more recent advances in macroeconomic modelling can be applied, such as more realistic expectations mechanisms and partial adjustment mechanisms. For example, the value of the expected inflation rate can be obtained either from published industry surveys or calculated from Reserve Bank formulas; and the forward rate in the foreign exchange can be used as a value for the expected exchange rate.

The stochastic shocks experienced by the economy have been domestic shocks. In reality, both domestic and foreign shocks are present; also, the covariances of shocks, which may be important in the real world, have been dismissed. An explicit consideration of these shocks can be incorporated. Fifth, there might have been an appreciable structural change in the exchange rate from a free to a managed float within the time period of the study. Whilst this could have been modelled with dummy variables, the exact time of the shift is not known. Proper modelling of the shift would require an understanding of the RBA's operations during this time, which was outside the scope of the present study. Finally, the model is a single-country model with foreign influences. A two- or three-country model would allow a richer menu of regimes and disturbances, besides making the model more applicable to the structure of the world economy today.

Any future research on this topic can begin with adopting a more robust theoretical framework, using the limitations highlighted above as suggestions for building a better model. Research that takes individual cases of shocks experienced by the economy and compares the actual and optimal degrees of intervention by the central bank, is another useful area, and has been carried out for the Canadian economy (Weymark 1995). No such research has been made using Australian data.

A unified approach to the choice of optimal regime is also needed. This can work along two main lines: one that harmonises various optimal degrees of intervention using a mix of different macroeconomic objectives; and a second that combines the optimal choice with regard to insulation properties with other approaches such as policy discipline and political choice influences.

Another area that also calls for additional work is the application of the insulation properties approach to an optimal choice of regime using data from Asian countries. This is particularly interesting in the light of the recent Asian financial crisis, where the exchange rate arrangements of many Southeast Asian nations played a crucial role in the transmission of imported foreign shocks and led to the contagion experienced by the entire region.

References

Achen, C.H. 1982, 'Interpreting and Using Regression', *Sage Publications*, Beverly Hills, California, pp. 58-67

Aizenman, J. & Frenkel, J.A. 1985, 'Optimal Wage Indexation, Foreign Exchange Intervention, and Monetary Policy', *American Economic Review*, vol. 75, no. 3, pp. 402-23

Alesina, A. & Summers, L. 1993, 'Central Bank Independence and Macroeconomic Performance: Some Comparative Evidence', *Journal of Money, Credit and Banking*, vol. 25, pp. 151-62

Allan, R., Elstone, R., Lock, G. & Valentine, T. 1990, *Foreign Exchange Management*, Allen & Unwin, Sydney, Australia

Almekinders, G.J. & Eijffinger, S.C.W. 1991, 'Empirical Evidence on Foreign Exchange Market Intervention: Where Do We Stand?', *Weltwirtschaftliches Archiv*, vol. 127, no. 5, pp. 645-77

Argy, V. 1982, 'Exchange Rate Management in Theory and Practice', *Princeton Studies in International Finance*, no. 50, Princeton University Press, Princeton, New Jersey

Argy, V. 1985, 'Flexible Exchange Rates – Twelve Years After – Are There Alternatives?', *Australian Economic Review*, no. 10, pp. 27-36

Argy, V. 1989, 'Choice of Exchange Rate Regime for a Smaller Economy: A Survey of Some Key Issues', *Macquarie University Research Paper*, no. 333

Argy, V. 1990, 'The Transmission of Foreign Disturbances under Different Exchange Rate Regimes', *Journal of Banking and Finance*, vol. 14, no. 5, pp. 929-46

Argy, V. 1994, *International Macroeconomics: Theory and Policy*, Routledge, London

Argy, V., McKibbin, W. & Siegloff, E. 1989, 'Exchange Rate Regimes for a Small Country in a Multi-Country World', *Princeton Studies in International Finance*, no. 67, Princeton University Press, Princeton, New Jersey

Aurikko, E. 1988, 'Rational Exchange Rate and Price Expectations Under Different Exchange Rate Regimes in Finland', *Bank of Finland Discussion Papers*, no. 12/88

Barro, R. 1977, 'Long-term Contracts, Sticky Prices, and Monetary Policy', *Journal of Monetary Economics*, vol. 3, no. 3, pp. 305-16

Barro, R. & Gordon, D. 1983a, 'A Positive Theory of Monetary Policy in a Natural Rate Model', *Journal of Political Economy*, vol. 91, no. 3, pp. 589-610

Barro, R. & Gordon, D. 1983b, 'Rules, Discretion and Reputation in a Model of Monetary Policy', *Journal of Monetary Economics*, vol. 12, no. 1, pp. 101-21

Bhandari, J.S. 1985, 'Experiments with the Optimal Currency Composite', *Southern Economic Journal*, vol. 51, no. 3

Black, S.W. 1976, 'Exchange Policies for Less Developed Countries in a World of Floating Rates', in Kenen, P.B. (ed.) 1993, *The International Monetary System: Highlights from Fifty Years of Princeton's Essays in International Finance Series*, Westview Press, Boulder, Colorado, pp. 213-55

Blundell-Wignall, A. & Gregory, R.G. 1990, 'Exchange Rate Policy in Advanced Commodity Exporting Countries: Australia and New Zealand', in Argy, V. & De Grauwe, P. (eds.), *Choosing an Exchange Rate Regime: The Challenge for Smaller Industrial Countries*, International Monetary Fund, Washington, D.C., pp. 224-71

Boehm, E.A. 1993, *Twentieth Century Economic Development in Australia, 3rd edition*, Longman Cheshire, Melbourne, Australia

Boyer, R. 1978, 'Optimal Foreign Exchange Market Intervention', *Journal of Political Economy*, vol. 86, no. 6, pp. 1045-56

Calvo, G.A. & Guidotti, P.E. 1993, 'On the Flexibility of Monetary Policy: The Case of the Optimal Inflation Tax', *Review of Economic Studies*, vol. 60, no. 3, pp. 667-87

Cameron, S. 1993, 'Why is R^2 Adjusted Reported?', *Journal of Quantitative Economics*, vol. 9, no. 2, pp. 183-86

Canzoneri, M.B. 1985, 'Monetary Policy Games and the Role of Private Information', *American Economic Review*, vol. 75, no. 5, pp. 1056-70

Canzoneri, M.B., Henderson, D.W. & Rogoff, K. 1983, 'The Information Content of the Interest Rate and Optimal Monetary Policy', *Quarterly Journal of Economics*, vol. 98, no. 4, pp. 545-66

Caramazza, F. & Aziz, J. 1997, 'Exchange Rate Arrangements and Economic Performance in Developing Countries', *World Economic Outlook Fall 1997*, no. 297

Carlozzi, N. 1982, 'Economic Disturbances and Exchange Regime Choice', *Federal Reserve Bank of Philadelphia Working Paper*, no. 82-8

Catte, P., Galli, G. & Rebecchini, S. 1992, 'Concerted Interventions and the Dollar: An Analysis of Daily Data', *Paper Presented at the Rinaldo Ossola Memorial Conference*, July, Banca d'Italia

Coles, M. & Philippopoulos, A. 1997, 'Are Exchange Rate Bands Better Than Fixed Exchange Rates? The Imported Credibility Approach', *Journal of International Economics*, vol. 43, pp. 133-153

Corden, W.M. 1994, *Economic Policy, Exchange Rates, and the International Economy*, Oxford University Press, Oxford

Crockett, A.D. & Nsouli, S.M. 1977, 'Exchange Rate Policies for Developing Countries', *Journal of Development Studies*, vol. 13, pp. 125-43

Cuikerman, A. 1992, *Central Bank Strategy, Credibility and Independence*, MIT Press, Cambridge, Massachusetts

De Grauwe, P. 1992, *The Economics of European Monetary Integration*, Oxford University Press, Oxford, England

De Kock, G. & Grilli, V. 1993, 'Fiscal Policies and the Choice of Exchange Rate Regime', *Economic Journal*, vol. 103, no. 417, pp. 347-58

Dominguez, K.M. 1986, 'Does Sterilised Intervention Influence Exchange Rates? A Test of the Signalling Hypothesis', mimeograph, Harvard University

Dominguez, K.M. & Frankel, J.A. 1993a, 'Does Foreign Exchange Intervention Matter? The Portfolio Effect', *American Economic Review*, vol. 83, no. 4, pp. 1356-69

Dominguez, K.M. & Frankel, J.A. 1993b, 'Foreign Exchange Intervention: An Empirical Assessment', in Frankel, J.A. (ed.), *On Exchange Rates*, MIT Press, Cambridge, Massachusetts, pp. 327-45

Edison, H.J. & Vårdal, E. 1987, 'Optimal Currency Basket in a World of Generalised Floating: An Application to Nordic Countries', *International Journal of Forecasting*, vol. 3, no. 1, pp. 81-96

Edwards, S. 1996, 'Exchange Rates and the Political Economy of Macroeconomic Discipline', *American Economic Review*, vol. 86, no. 2, pp. 159-63

Eijffinger, S. & Schaling, E. 1993, 'Central Bank Independence: Theory and Evidence', *Centre for Economic Research Working Paper*, no. 9325

Eijffinger, S. & Schaling, E. 1998, 'Optimal Commitment in an Open Economy: Credibility versus Flexibility', unpublished working paper, Centre for Economic Research, Tillberg University, The Netherlands

Fischer, S.F. 1977, 'Stability and Exchange Rate Systems in a Monetary Model of the Balance of Payments', in Aliber, R.Z. (ed.), *The Political Economy of Monetary Reform*, Allanheld, Osmun & Company, New York, New York, pp. 59-73

Fleming, J.M. 1962, 'Domestic Financial Policies Under Fixed and Under Floating Exchange Rates', *International Monetary Fund Staff Papers*, vol. 9, no. 3, pp. 369-80

Flood, R.P. 1979, 'Capital Mobility and the Choice of Exchange Rate Systems', *International Economic Review*, vol. 2, no. 2, pp. 405-16

Flood, R.P. & Marion, N.P. 1982, 'The Transmission of Disturbances Under Alternative Exchange Rate Regimes with Optimal Indexing', *Quarterly Journal of Economics*, vol. 97, no. 1, pp. 43-66

Frankel, J.A. 1982, 'In Search of the Exchange Risk Premium: A Six-Currency Test Assuming Mean-Variance Optimisation', *Journal of International Money and Finance*, vol. 1, no. 3, pp. 255-74

Frankel, J.A. 1988, 'Obstacles to International Macroeconomic Policy Co-ordination', *Princeton Studies in International Finance*, no. 64, Princeton University Press, Princeton, New Jersey

Freebairn, L. 1989, 'Is the $A a Commodity Currency?', in Clements, K. & Freebairn, J. (eds.), *Exchange Rates and Australian Commodity Exports*, Centre of Policy Studies, Monash University, Clayton & Economic Research Centre, University of Western Australia, Perth

Frankel, J.A. & Aizenman, J. 1982, 'Aspects of the Optimal Management of Exchange Rates', *Journal of International Economics*, vol. 13, no. 3/4, pp. 231-56

Friedman, M. 1953, 'The Case for Flexible Exchange Rates', in *Essays in Positive Economics*, University of Chicago Press, Chicago, Illinois

Geary, R.C. 1970, 'Relative Efficiency of Count of Sign Changes for Assessing Residual Autocorrelation in Least Squares Regression', *Biometrika*, vol. 57, pp. 123-27

Genberg, H. 1989, 'Exchange Rate Management and Macroeconomic Policy: A National Perspective', *Scandinavian Journal of Economics*, vol. 91, no. 2, pp. 439-69

Ghosh, A.R. 1992, 'Is It Signalling? Exchange Intervention and the Dollar-Deutschemark Rate', *Journal of International Economics*, vol. 32, no. 2, pp. 201-20

Giavazzi, F. & Pagano, M. 1988, 'The Advantage of Tying One's Hands – EMS Discipline and Central Bank Credibility', *European Economic Review*, vol. 32, pp. 1055-1171

Goldberger, A.S. 1991, *A Course in Econometrics*, Harvard University Press, Cambridge, Massachusetts

Granger, C.W.J. 1969, 'Investigating Causal Relations by Econometric Models and Cross-Spectral Methods', *Econometrica*, vol. 37, no. 3, pp. 424-38

Granger, C.W.J. & Newbold, P. 1976, 'R^2 and the Transformation of Regression Variables', *Journal of Econometrics*, vol. 4, pp. 205-10

Gujarati, D.N., *Basic Econometrics, 3rd edition*, McGraw Hill, Singapore

Harberler, G. 1970, 'The International Monetary System: Some Recent Developments and Discussion', in Halm, G.N. (ed.), *Approaches to Greater Flexibility of Exchange Rates: The Bürgenstock Papers*, Princeton University Press, Princeton, New Jersey

Heller, H.R. 1978, 'Determinants of Exchange Rate Practices', *Journal of Money, Credit and Banking*, vol. 10, no. 3, pp. 308-21

Helpman, E., Leiderman, L. & Bufman, G. 1994, 'A New Breed of Exchange Rate Bands: Chile, Israel and Mexico', *Economic Policy*, vol. 19, pp. 259-306

Holden, P., Holden, M. & Suss, E.C. 1979, 'The Determinants of Exchange Rate Flexibility: An Empirical Investigation', *Review of Economics and Statistics*, vol. 61, no. 3, pp. 327-33

Honkapohja, S. & Pikkarainen, P. 1992, 'Country Characteristics and the Choice of the Exchange Rate Regime: Are Mini-Skirts Followed by Maxis?', *Centre for Economic Policy Research Discussion Paper*, no. 744

Humpage, O.F. 1989, ‘On the Effectiveness of Exchange Market Intervention’, mimeograph, Federal Reserve Bank of Cleveland

Hutchison, M. & Walsh, C.E. 1992, ‘Empirical Evidence on the Insulation Properties of Fixed and Flexible Exchange Rates’, *Journal of International Economics*, vol. 32, no.3/4, pp. 241-63

International Monetary Fund 1997, *International Financial Statistics*, IMF Publications, Washington, D.C.

Isard, P. 1995, *Exchange Rate Economics*, Cambridge University Press, Cambridge, England

Kearney, C. 1997, ‘International Finance and Exchange Rate Policy’, in Kriesler, P. (ed.), *The Australian Economy 2*, Allen & Unwin, St. Leonards, Australia

Kenen, P.B. 1969, ‘The Theory of Optimum Currency Areas: An Eclectic View’, in Mundell, R.A. & Swoboda, A. (eds.), *Monetary Problems of the International Economy*, University of Chicago Press, Chicago, Illinois

Kenen, P.B. 1988, *Managing Exchange Rates*, Routledge, London

Kenen, P.B. (ed.) 1993, *The International Monetary System: Highlights from Fifty Years of Princeton’s Essays in International Finance Series*, Westview Press, Boulder, Colorado

Kindleberger, C.P. 1969, ‘The Case for Fixed Exchange Rates, 1969’, *The International Adjustment Mechanism Conference Series*, no. 2, Federal Reserve Bank of Boston, Boston, Massachusetts, pp. 93-108

Kotilainen, M. 1995, *Exchange Rate Unions: A Comparison with Currency Basket and Floating Rate Regimes*, ELTA The Research Institute of the Finnish Economy, Helsinki, Finland

Kydland, F. & Prescott, E. 1977, ‘Rules Rather than Discretion: The Inconsistency of Optimal Plans’, *Journal of Political Economy*, vol. 85, no. 3, pp. 473-91

Lewis, K.K. 1988, ‘Testing the Portfolio Balance Model: A Multilateral Approach’, *Journal of International Economics*, vol. 24, no. 1, pp. 109-27

Macfarlane, I.J. & Tease, W.J. 1989, ‘Capital Flows and Exchange Rate Determination’, *Research Discussion Paper*, no. 8909, Reserve Bank of Australia, Sydney

Maddock, R. & McLean, I.W. 1987, *The Australian Economy in the Long Run*, Cambridge University Press, Cambridge, England

Marston, R.C. 1982, ‘Wages, Relative Prices and the Choice Between Fixed and Flexible Exchange Rates’, *Canadian Journal of Economics*, vol. 15, no. 1, pp. 87-103

Marston, R.C. 1987, ‘Exchange Rate Policy Reconsidered’, *National Bureau of Economic Research Working Paper*, no. 2310

Mathieson, D. & Rojas-Suarez, L. 1990, ‘Financial Market Integration and Exchange Rate Policy’, *International Monetary Fund Working Paper*, no. WP/90/2

McKenzie, I.M. 1986, ‘Australia’s Real Exchange Rate During the Twentieth Century’, *Economic Record*, vol. 62, supplement, pp. 69-78

McKibbin, W. & Sachs, J. 1988, ‘Comparing the Global Performance of Alternative Exchange Arrangements’, *Journal of International Money & Finance*, vol. 7, no. 4, pp. 387-410

McKinnon, R.I. 1963, ‘Optimal Currency Areas’, *American Economic Review*, vol. 52, no. 4, pp. 717-25

Milesi-Ferretti, G.M. 1993, ‘The Disadvantage of Tying Their Hands: On the Political Economy of Policy Commitments’, *Centre for Economic Performance Discussion Papers*, no. 125

Mills, T.C. & Wood, G.E. 1992, ‘Does the Exchange Rate Regime Affect the Economy?’, *Federal Reserve Bank of St. Louis Review*, vol. 75, no. 4, pp. 3-20

Mundell, R.A. 1961, ‘A Theory of Optimum Currency Areas’, *American Economic Review*, vol. 51, no. 4, pp. 657-65

Mundell, R.A. 1963, ‘Capital Mobility and Stabilisation Policy Under Fixed and Flexible Exchange Rates’, *Canadian Journal of Economics and Political Science*, vol. 27, no. 6, pp. 475-85

Mundell, R.A. 1982, ‘The Appropriate Use of Monetary and Fiscal Policy for Internal and External Balance’, *International Monetary Fund Staff Papers*, vol. 9, no.1, pp. 70-9

Murphy, C.W. 1986, ‘Exchange Rate Policy and the AMPS Model’, in Nguyen, D.T. & Gregory, R.D. (eds.), *Proceedings of Conference at the Australian National University*, Canberra, Australia, July, pp. 41-54

Obstfeld, M. 1983, ‘Exchange Rates, Inflation, and the Sterilisation Problem: Germany 1975-1981’, *European Economic Review*, vol. 21, no. 1, pp. 161-89

Obstfeld, M. 1990, ‘The Effectiveness of Foreign Exchange Intervention: Recent Experience, 1985-1988’, in Branson, W.H., Frenkel, J.A. & Goldstein, M. (eds.), *International Policy Co-ordination and Exchange Rate Fluctuations*, University of Chicago Press, Chicago, pp. 146-52

Pentecost, E.J. 1993, *Exchange Rate Dynamics: A Modern Analysis of Exchange Rate Theory and Evidence*, Edward Elgar, Cheltenham, Gloucestershire

Pikkarainen, P. 1986, ‘The Choice of the Optimal Currency Basket for a Central Bank’, *Bank of Finland*, d. 62

Pikkarainen, P. 1991a, ‘Behaviour of the Open Economy Firm: The Basket Peg Regime’, *University of Helsinki Discussion Papers*, no. 307, University of Helsinki, Helsinki

Pikkarainen, P. 1991b, ‘International Portfolio Diversification: The Basket Peg Regime’, *University of Helsinki Discussion Papers*, no. 306, University of Helsinki, Helsinki

Pikoulakis, E. 1995, *International Macroeconomics*, St. Martin’s Press, New York, New York

Pitchford, J. 1993, ‘Trade Price Shocks and Insulation: Australia’s Experience with Floating Rates’, *Centre for Economic Policy Research Discussion Papers*, no. 283, Canberra, Australia

Polak, J.J. 1989, 'The Choice of an Exchange Rate Regime', in Sutalaksana, D.M. (ed.), *Development Issues in the Current International Monetary System: Essays in Honour of Byanti Kharmawan 1906-1982*, IMF Publications, Washington, D.C., pp. 132-148

Poole, W. 1970, 'Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model', *Quarterly Journal of Economics*, vol. 84, no. 1, pp. 197-216

Quirk, P.J. 1994, 'Fixed or Floating Exchange Regimes: Does It Matter for Inflation?', *International Monetary Fund Working Paper*, WP/94/134

Rogoff, K. 1984, 'On the Effects of Sterilised Intervention: An Analysis of Weekly Data', *Journal of Monetary Economics*, vol. 14, no. 2, pp. 133-50

Rogoff, K. 1985, 'The Optimal Degree of Commitment to an Intermediate Target', *Quarterly Journal of Economics*, vol. 100, no. 4, pp. 1169-89

Roper, D.E. & Turnovsky, S.J. 1980, 'Optimal Exchange Market Intervention in a Simple Stochastic Macro Model', *Canadian Journal of Economics*, vol. 13, no. 3, pp. 296-309

Ruland, L.J. & Viane, J.M. 1993, 'The Political Choice of the Exchange Rate Regime', *Economics and Politics*, vol. 5, no. 3, pp. 271-84

Sachs, J.D. 1996, 'Economic Transition and the Exchange Rate Regime', *American Economic Review*, vol. 86, no. 2, pp. 147-52

Sauramo, P. 1989, 'Interactions of Exchange Rate Policies: A Case of Two Small Interdependent Countries', *LIER Research Report*, no. 20, Labour Institute for Economic Research

Savvides, A. 1990, 'Real Exchange Rate Variability and the Choice of Exchange Rate Regime in Developing Countries', *Journal of International Money & Finance*, vol. 9, no. 4, pp. 440-54

Solow, R.M. 1957, 'Technical Change and the Aggregate Production Function', *Review of Economics and Statistics*, vol. 39, pp. 312-20

Svensson, L.E.O. 1989, 'Comments on H. Genberg, "Exchange Rate Management and Macroeconomic Policy: A National Perspective"', *Scandinavian Journal of Economics*, vol. 91, no. 2, pp. 473-76

Taylor, M.P. 1995, 'The Economics of Exchange Rates', *Journal of Economic Literature*, vol. 33, no. 1, pp. 13-47

Tinbergen, J. 1952, *On the Theory of Economic Policy*, North-Holland, Amsterdam, Netherlands

Tornell, A. & Velasco, A. 1995, 'Fixed Discipline and the Choice of Exchange Rate Regime', *European Economic Review*, vol. 39, no. 3/4, pp. 759-70

Turnovsky, S.J. 1983, 'Exchange Market Intervention Policies in a Small Open Economy', in Bhandari, J. & Putnam, L.B. (eds.), *Economic Interdependence and Flexible Exchange Rates*, pp. 286-311

Weymark, D.N. 1995, 'Estimating Exchange Market Pressure and the Degree of Exchange Market Intervention for Canada', *Journal of International Economics*, vol. 39, no. 2, pp. 273-95

White, K.J. 1993, *SHAZAM User's Reference Manual Version 7.0*, McGraw Hill, New York, New York

Williamson, J.H. 1982, 'A Survey of the Literature on the Optimal Peg', *Journal of Development Economics*, vol. 18, pp. 39-61

Wood, A. 1998, 'Slow, Steady Approach to Rates is in the Nation's Best Interests', *The Australian*, 10th November 1998

Data sources

Australian Bureau of Statistics, *Australian Bureau of Statistics Time Series Statistics Plus*, from EconData Pty Ltd, *dx version 2.1 Time Series Data Express*

Australian Bureau of Statistics, *Treasury Model of the Australian Economy*, cat. no. ABS 1364.0, Belconnen, Australian Capital Territory, Australia

Australian Bureau of Statistics, *ABS NIF-10S Model Database*, cat. no. ABS 1340.0, Belconnen, Australian Capital Territory, Australia

EconData Pty Ltd, *dx version 2.1 Time Series Data Express*, Site License 2085A

International Monetary Fund, *International Financial Statistics*, IMF Publications, Washington, D.C.

Organisation for Economic Co-operation and Development, *OECD Main Economic Indicators*, OECD Publications, Paris, France

Summers, R., Heston, A., Nuxoll, D.A. & Aten, B., *Penn World Table Database, Mark 5.6*, from EconData Pty Ltd, *dx version 2.1 Time Series Data Express*

Reserve Bank of Australia, *Statistical Directory of the Reserve Bank of Australia Bulletin*, Sydney, New South Wales, Australia