Financial Constraints and Exchange Rate Flexibility in Emerging Market Economies*

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Abstract

Empirical evidence from the Asian financial crisis of 1997-1998 suggests that exchange rate depreciation may have had a contractionary effect on the traded good sector of the worst-hit economies. Many writers have suggested that this was caused by exchange rate sensitive credit constraints affecting the production sector. This paper documents some of this evidence, and uses it to develop a structural model that features an important role for credit constraints in the financing of traded goods production. We show that this model can explain why emerging market governments would be more concerned with variations in exchange rates than would be implied by standard 'optimal currency area' criteria. Moreover, the model implies that monetary policy may be a very ineffective tool in emerging market economies.

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1. Introduction

Since the financial crises of the late 1990s, there has been an active debate about the appropriate exchange rate policies for emerging market economies.[1] While there is some degree of consensus that intermediate exchange rate regimes such as soft pegs or target zones are no longer feasible, being too vulnerable to speculative pressures, there is far less agreement on whether emerging market economies should move towards freely floating exchange rates (for instance, within a monetary regime governed by an inflation targeting objective), or adopt a hard peg, currency board, or fully dollarize.

This paper makes a contribution to this debate by first providing some evidence on the response of the East Asian economies to the crisis of 1997-99, and then by developing a model that is consistent with this evidence. The model can be used to evaluate the appropriate monetary policy stance for emerging market economies that are vulnerable to rapid movements in flows of capital. The essential message of the paper is that the standard optimal currency area (OCA) analysis of exchange rate regimes, used heavily in the debate on the costs and benefits of the European single currency, for instance, is not a fully appropriate framework for evaluating exchange rate regimes in emerging markets. In order to adequately understand the costs and benefits of exchange rate movements for emerging markets, we have to acknowledge the importance of financial market constraints. In particular, in the presence of distortions or constraints in financial markets, (discussed, for instance, by Krugman 1999, Aghion, Bacchetta, and Banerjee 2001), exchange rate adjustment will no longer necessarily play a stabilizing role in the economy, as in OCA analysis, but may in fact generate endogenous supply shocks by tightening constraints in financial markets. When we develop this feature in an analytical framework we find that it is always desirable to penalize exchange rate volatility more heavily than would be the case if we based our judgement purely on OCA type considerations, and in fact, a hard exchange rate peg might dominate a policy of pure floating exchange rates.

There is an extensive literature based on the notion that exchange rate movements have different effects in emerging markets than in more developed economies (see Agenor and Montiel 1998, for references). Recent analyses of the Asian crisis have added to this literature by emphasizing credit constraints and financial market distortions in emerging markets that may depend on the exchange rate (Krugman 1999, Chang and Velasco 2000, Aghion, Bacchetta, and Banerjee 2001). Our model can be seen as a simple application of this literature to the discussion over the appropriate exchange rate policy for emerging markets.

1 Among many other papers, see Chang and Velasco (2000), Calvo and Reinhart (2000), Fischer (2001), Frankel (1999), Schmitt and Uribe (2000), Mendoza (2000).

A key macroeconomic feature of recent emerging market experience has been the instability of capital flows. Sachs (1998), Calvo (1999), and McKinnon and Pill (1998) provide a macroeconomic interpretation of capital market reversals in small open economies. They emphasize the joint 'transfer-problem' aspect of capital market reversals; a sudden reversal of capital flows requires a shift of resources from the domestic economy to the rest of the world, representing an external transfer, and also a shift of resources from the sheltered non-tradables sector, to the tradables or export sector, representing an internal transfer. In combination with a sharp real exchange rate depreciation, we would anticipate that a capital market reversal would cause a slump in the non-tradables sector and a boom in the tradables sector. But the evidence shown in Section 2 below reveals that for most East Asian economies, the crisis was associated with a very sharp decline in output of *both* tradable and non-tradable goods. To the extent the response of tradable goods production in the crisis moved the 'wrong way', at least for a considerable time, this gives prima facie evidence of the role of financial market constraints in production that are sensitive to exchange rate movements.

We then develop a model of nominal and real exchange rate determination which emphasizes the importance of financial market constraints. The key constraint that we identify is in the purchase of imported intermediate inputs. Much anecdotal evidence at the time of the crisis suggested that export firms could not take advantage of the improved competitiveness associated with exchange rate depreciation because of difficulties in obtaining credit for imported raw materials purchases. In our model, importing intermediate firms are subject to a credit constraint, which limits the purchases of intermediate imports to be no greater than their initial nominal assets. This is a variant of the collateral constraints introduced by Aghion, Bacchetta, and Banerjee (2001). We show that a capital market reversal may lead to a nominal exchange rate depreciation of such a magnitude that this constraint becomes binding. In that case, the fall in the availability of intermediate imports may generate a negative 'supply shock' in the traded goods sector. This can account for a fall in traded goods output following a capital market crisis.

We go on to show that this financial constraint alters the balance of the argument between 'fixed and floating' exchange rates toward greater exchange rate stability. While the effect of financial constraints might not offer a case for fully fixed exchange rates, it will always have the effect of reducing the desired volatility of the exchange rate that a policy maker would choose. Moreover, in light of the difficulty of achieving 'intermediate regimes', it may tilt the argument in favour of full dollarization for some emerging market economies. Moreover, it provides a rationale for the empirical observation, made by Levy Yeyati and Sturzenegger (1999), and Calvo and Reinhart (2000), that many emerging market economies display a 'fear of floating'.

The paper is organized as follows. The next section gives some empirical evidence from Asian countries. Section 3 develops a model of real and nominal exchange rate determination. Section 4 illustrates the results of the model. Section 5 concludes.

2. Evidence from the Asian Crisis

The standard model of a capital market shock, as discussed in the last section, implies that a sudden reversal of capital inflows to an emerging market economy should be followed by a combination of both an external and internal transfer (see Krugman 1999, and McKinnon and Pill 2000). The external transfer occurs because the sudden reversal of capital inflows must involve a net transfer of funds from the economy to the rest of the world. This requires the economy to generate a current account surplus, either by reducing absorption, increasing GDP, or both. The internal transfer is necessary because in almost all episodes of capital inflows, much investment goes into the non-tradable sector (e.g. construction). But on net, this investment must be repaid through trade surpluses. As a result, a capital market reversal requires a shift of resources out of the non-tradable goods sector towards the tradable goods sector, which occurs simultaneously with a real exchange rate depreciation. These predictions follow almost directly from the macroeconomic accounting of open economies subject to capital market shocks. They are not sensitive to the particular theory of crises that is used for analysis (see e.g. Tornell and Schneider 2001, Aghion, Bacchetta, and Banerjee 2001).

Figures 1-3 document the experience of aggregate GDP, the real exchange rate, and the current account for the eight major East Asian economies. In terms of the response to the 1997-1998 crisis, the pattern is essentially the same for all countries. There was a substantial real depreciation, large increase in the current account balance, and a fall in GDP. In particular, the real depreciation and current account turnaround is seen in all economies. In terms of GDP, the worst hit economies were Indonesia, Korea, Thailand, and Malaysia. After this, Hong Kong experienced a sharp fall in output, whereas Singapore, Taiwan and the Philippines had only a relatively mild slowdown in GDP (especially in Taiwan), but also experienced a substantial real depreciation and current account increase.

One prediction of the basic model of capital market shocks (e.g. Tornell and Schneider 2000), is that there should be a sharp increase in the size of the tradable goods (or export) sector. In face of a large real exchange rate depreciation, domestic export goods will become more competitive, either through a fall in the domestic real wage, a fall in the world relative price, or a combination of the two.

But the evidence from the Asian crisis does not support this pattern of response in the traded goods sector. Figure 4 documents the breakdown of sectoral output dynamics for each country into tradable and non-tradable sectors (Hong Kong figures were not available).[2]

For Thailand, Malaysia, the Philippines, Indonesia, and Korea, there is evidence that the non-tradable goods sector grew faster than the tradable goods sector in the early 1990s, as capital inflows were taking place. This is what would be expected, as capital inflows are used for investment in infrastructure, etc. However, as regards the components of GDP, the impact of the crisis differs from the standard model. Following the capital market reversal for the same five countries, we see not a decline in non-tradables and a rise in tradables, but a decline in both sectors. Thus, while the external transfer took

2 In each case, Traded goods are defined as Agriculture, Mining and Manufacturing. Non-traded goods, are Construction, Communications and Transport, and other Services industries.

place very quickly, there is little immediate evidence of the internal transfer. The figures provide no evidence at all that factors of production were transferred from the non-tradable sector towards the tradable sector. Rather, production fell dramatically in both sectors, in all countries. At the same time, the figures also show that the fall in traded goods production was more temporary than that in the non-tradable sector. In Malaysia, Korea, Thailand, and Indonesia, tradable production begins to increase in 1999 and generally grows much faster than non-tradable production.

One objection to the argument made above is that the real exchange rate depreciation was a common phenomenon across the region. There is substantial inter-regional trade in all East Asian economies. This means that the fall in the real exchange rates against Europe or North America did not necessarily improve effective competitiveness for a substantial component of regional exports. Figure 5 avoids this problem by focusing only on exports to the US, from Malaysia, Thailand, and Korea. Given the large increase in competitiveness vis a vis the US economy, one would anticipate a substantial burst of exports following the crisis. For all three economies, the figures seem to indicate a substantial lag in US export growth. Korean exports were essentially flat until 1999. Thailand and Malaysia had relatively small US export growth during 1998, followed by substantial growth in 1999.

The sharp fall in production of tradable goods in face of a rise in competitiveness, followed by a substantial growth after about a delay of one year, suggests that tradable good sectors in these economies were subject to production constraints generated by the dynamics of the crisis itself. Much anecdotal discussion at the time pointed to the difficulty of obtaining trade credit financing for exporters in the crisis-hit countries. The key aspect of production in many emerging markets is that a large component of gross output (in the traded goods sector) is accounted for by imports of intermediate goods, or partly finished goods, which are then combined with local factors of production to be exported. Given that intermediate imports are purchased from the non-crisis countries, a sharp real depreciation raises the domestic cost of purchasing these goods.

Since local labour costs are unlikely to be indexed (at least fully) to the exchange rate, the depreciation still improves the effective competitiveness of the export sector. But with weak domestic financial institutions, the higher cost of intermediate imports may increase the difficulty of obtaining trade credit. In particular, trade credit may be restricted by the domestic balance sheet position. A real exchange rate depreciation is likely to make trade credit harder to get in these circumstances. In the model below, we develop this idea in a simple manner.

3. The Structural Model

We outline a model of a small economy which has two sectors: tradable and non-tradable. It is small in the sense that it takes both world interest rates and its domestic terms of trade as given. In the non-tradable sector, there are nominal rigidities; prices of non-tradable goods are set in advance. Household utility depends upon composite good that combines tradable and non-tradable goods.

3.1 Household Preferences and Constraints

The representative agent gets utility from consumption C_t, and disutility from time spent working in the tradables and non-tradables, H_t^T and H_t^{NT}. Work in each sector is perfectly substitutable, so that total work time is $H_t = H_t^{NT} + H_t^T$. We may write the inter-temporal utility function as:

$$E_0 \sum_{t=0} \beta^t (U(C_t) - V(H_t))$$

where U is increasing and concave, and V is increasing and convex. Aggregate consumption is a linear homogenous function of consumption of tradable and non-tradable goods:

$$C_t = \left[a^{-\frac{1}{\phi}} \left(C_t^{NT} \right)^{1-\frac{1}{\phi}} + (1-a)^{-\frac{1}{\phi}} \left(C_t^T \right)^{1-\frac{1}{\phi}} \right]^{\frac{1}{1-\frac{1}{\phi}}}$$

where ϕ is the elasticity of substitution between tradable and non-tradable goods in preferences. The non-tradable good is in turn defined over the consumption of a continuum of differentiated goods, so that $C_t^{NT} = \left[\int_0^1 x_t^{1-\frac{1}{\rho}}(i) di \right]^{\frac{1}{1-\frac{1}{\rho}}}$, with $\rho > 1$.

It therefore follows that the consumer price index and the price index for non-tradable goods are written respectively as:

$$P_t = \left[a \left(P_t^{NT} \right)^{1-\phi} + (1-a) \left(P_t^T \right)^{1-\phi} \right]^{\frac{1}{1-\phi}} \qquad P_t^{NT} = \left[\int_0^1 P_t^{NT}(i)^{1-\rho} di \right]^{\frac{1}{1-\rho}}$$

where P_t^T is the common price for all tradable goods, and $P_t^{NT}(i)$ is the price of type i non-tradable good. Each household faces the choice of purchasing current consumption goods, either tradable or non-tradable, working, accumulating domestic or foreign nominal bonds and allocating financing to intermediate importing firms.

The household earns income from wages, profits from the non-tradable goods firms, dividend payments from the intermediate imported firm (see below), and returns on domestic and foreign bond holdings. The household’s budget constraint is therefore written as:

$$P_t C_t + B_t + S_t B_t^* = W_t H_t + \Pi_t + (1+i_t) B_t + (1+i_t^*) S_t B_{t-1}^* + P_t^T d_t^I - T_t \quad , \tag{1}$$

where B_t (B_t^*) represents the holding of domestic (foreign) bonds, i_t (i_t^*) is the nominal interest rate on domestic (foreign) bonds, W_t is the nominal wage, Π_t is profit income, S_t is the nominal exchange rate, d_t^I is dividend income received from intermediate importing firms, and T_t is a nominal government tax.

3.2 Household Optimal Choices

The household's optimal choice of bond holdings and labour supply results in the following first order conditions:

$$U'(C_t) = E_t \beta \left(1+i^*_{t+1}\right) \frac{S_{t+1}}{S_t} \left(\frac{P_t}{P_{t+1}} \right) U'(C_{t+1}) \tag{2}$$

$$U'(C_t) = E_t \beta \left(1+i_{t+1}\right) \left(\frac{P_t}{P_{t+1}} \right) U'(C_{t+1}) \tag{3}$$

$$U'(C_t) \frac{W_t}{P_t} = V'(H_t)\ . \tag{4}$$

Finally, the individual demands for non-tradable and tradable goods are given as:

$$C_t^T = (1-a) \left(\frac{P_t^T}{P_t} \right)^{-\phi} C_t , \quad C_t^{NT}(i) = a \left(\frac{P_t^{NT}(i)}{P_t} \right)^{-\phi} C_t\ . \tag{5}$$

3.3 Firms

Tradable Goods Firms

A perfectly competitive industry produces tradable goods using the production function:

$$Y_t^T = Min[\frac{V_t}{\omega}, \frac{I_t}{1-\omega}] , \tag{6}$$

where ω is the share of value added (V_t) in production, and $1-\omega$ is the share of imported intermediates (I_t). The assumption that value added and intermediate imports are combined in fixed proportions seems a reasonable one, especially in the short term, where technological structure is fixed. Value added is defined by the production function:

$$V_t = F^T(H_t^T)$$

where $F^T(.)$ is increasing and concave. Profits for the non-traded goods firm are given by $\Pi_t = P_t Y_t^T - W_t H_t^T - Q_t I_t$, where Q_t is the price of the intermediate import.

The traded good firm will choose employment and intermediate inputs to maximize profits. The following conditions follow from profit maximization:

$$(P_t^T - (1-\omega) Q_t) \frac{F'(H_t^T)}{\omega} = W_t \tag{7}$$

$$I_t = \frac{(1-\omega)}{\omega} V_t \ . \tag{8}$$

Intermediate Importers

Competitive firms purchase intermediate imports from abroad, and sell them to domestic traded goods firms. These intermediate importers are owned by domestic households. The flow budget constraint of a typical importer is

$$B_{t+1}^I + P_t^T d_t^I = \Pi_t^I + (1+i_t)B_t^I \ ,$$

where $\Pi_t^I = Q_t I_t - S_t P_{It}^* I_t$ represents the profit earned by the intermediate importer, and B_t^I represents bond holdings of the importer. We assume that purchases of intermediate imported goods are subject to the credit constraint given by:

$$S_t P_{It}^* I_t \leq B_t^I \tag{9}$$

Thus, intermediate imports must not be greater than the initial bond holdings of the importing firms. This constraint is not derived endogenously, but simply assumed as part of the operating environment of the intermediate importer. But it captures the notion that movements in exchange rates may impose rationing on the purchases of intermediate goods. If the constraint is not binding, then importers simply sell intermediates to traded goods producers at cost and thus we have $Q_t = S_t P_{It}^*$. If the constraint is binding, then $I_t = \frac{B_t^I}{S_t P_{It}^*}$, and the domestic price of intermediate imports paid by traded good firms may be higher.

The problem of the importer is to choose intermediate imports to maximize its profits, ensuring that the constraint (9) is satisfied. Our analysis below looks at the case where there is an unanticipated shock in the first period, which leads the constraint to bind in that period. After this the constraint will no longer bind.[3]

Non-traded Goods Firms

The non-tradable firm i has the increasing and concave production function given by:

$$Y_t^{NT}(i) = F^N(H_t^N(i)) \ .$$

In the non-tradable sector, each production firm has market power, and sets the price as a markup over marginal cost. If non-tradable goods prices were perfectly flexible, then the profit maximizing decision for firm i would imply:

$$P_t^{NT}(i) F^{N\prime}(H_t^{NT}(i)) = \frac{\rho}{\rho - 1} W_t \ , \tag{10}$$

3 This follows because in a perfect foresight equilibrium households will lend to the intermediate importer so that (9) will never bind. In a more general stochastic model it is possible that credit constraints would be occasionally binding over time.

where $\frac{\rho}{\rho-1}$ represents the monopoly markup. We will also look at the impact of foreign interest rate and monetary policy shocks under the assumption that the non-tradable goods price cannot adjust in the period of the shock. For this experiment, we make the assumption that the non-tradable price is set at the value pertaining to the initial steady state.

3.4 Monetary and Fiscal Policy

We follow the recent literature (Woodford 2001, Clarida, Gali, and Gertler 1999) in abstracting from the details of the monetary mechanism, and simply assume that the monetary authority follows a domestic interest rate targeting rule. We may define the domestic nominal interest rate implicitly by the condition $(1+i_{t+1})^{-1} = \beta \frac{U'(C_{t+1})}{U'(C_t)} \frac{P_t}{P_{t+1}}$. Then the monetary authority is assumed to follow the rule:

$$(1+i_{t+1}) = \frac{1}{\beta}\left(\frac{S_t}{S_0}\right)^{\omega} \exp(-v_t), \quad \omega > 0 . \tag{11}$$

The parameter ω represents the coefficient of exchange rate intervention. So long as $\omega>0$, there is a determinate equilibrium value for the nominal exchange rate. The higher is ω, the closer the monetary rule approximates a pegged exchange rate, where the target for the exchange rate peg is S_0. The variable v_t represents an independent monetary policy shock that could be thought of as a discretionary money expansion.

One aspect of this structural model is that there is monopoly power in the non-tradable good sector. This means that there is a welfare loss due to monopoly pricing of non-tradable goods — in a steady state output and employment of non-tradable goods will be too small. We assume that the fiscal authority offers an employment subsidy to eliminate this inefficiency. This subsidy is financed with lump-sum taxes. In addition, because we are not concerned with government deficits, we assume that the stock of government bonds outstanding is maintained constant, with interest payments on these bonds being also financed by lump-sum taxes.

3.5 Equilibrium

Given the equations of household optimality, profit maximization, satisfaction of the monetary authority's budget constraint, and market clearing conditions, we may construct an equilibrium of this economy. Since non-tradable goods must be both produced and consumed only in the domestic economy, the market clearing condition in the non-tradable sector is written as:

$$Y_t^{NT} = C_t^{NT} , \tag{12}$$

(since all non-tradable firms are alike, we drop the firm-specific subscript hereafter). From the combination of (1) and (11), this implies that the economy's external balance of payments relationship is

$$B_{t+1}^{*} = (1+i_t^{*})B_t^{*} + \frac{P_t^T}{S_t}(C_t^T - Y_t^T) \,. \tag{13}$$

Finally, we assume that the tradable goods price obeys the 'law of one price' condition

$$P_t^T = S_t \,, \tag{14}$$

where the foreign currency price of the tradable good is normalized to unity.

4. Solution and Calibration of the Model

4.1 Steady State Equilibrium

We focus on a perfect foresight equilibrium where agents have full knowledge of the path of the money supply and foreign interest rates from date zero. In addition, assume that the foreign interest rate is constant, and equal to the domestic rate of time preference, so that $\beta(1+i^{*})=1$. Then if the economy starts out with a zero net foreign asset position, it is easy to establish that a steady state equilibrium is attained at date zero, where the current account is zero, and consumption and output are constant over time. This equilibrium may be described by the following conditions, which give the four equilibrium values of $\bar{H}^{NT}, \bar{H}^{T}, \bar{p}^{N}, \bar{C}$:

$$F^{NT}(\bar{H}^{NT}) = a\left(\frac{p^N}{\Gamma(p^N)}\right)^{-\phi}\bar{C} \tag{15}$$

$$(1-(1-\omega)\bar{q})\frac{F^T(\bar{H}^T)}{\omega} = (1-a)\left(\frac{1}{\Gamma(p^N)}\right)\bar{C} \tag{16}$$

$$\bar{I} = \frac{(1-\omega)}{\omega}F^T(\bar{H}^T) \tag{17}$$

$$\frac{\rho}{\rho-1}\frac{F^{T}{}'(\bar{H}^T)}{\omega}(1-(1-\omega)q) = p^N F^{N}{}'(\bar{H}^{NT}) \tag{18}$$

$$U'(\bar{C})\frac{F^{T'}(\bar{H}^T)}{\Gamma(p^N)} = V'(\bar{H}^{NT}+\bar{H}^T) \tag{19}$$

where $\Gamma(p^N) = \left[ap^{N(1-\phi)} + (1-a)\right]^{\frac{1}{1-\phi}}$, $p^N = {P^{NT}}/{S}$, and $q_t = \frac{Q_t}{P_t^T}$. From the solutions given by this system, we may recover all other variables.

4.2 Monetary Policy

The equilibrium depends on the stance of monetary policy. If all prices are perfectly flexible, then monetary policy determines only the level of domestic prices and the domestic nominal interest rate. If, however, the non-traded goods prices are pre-set, then the monetary policy rule is important for the path of real variables in the economy, following an unanticipated shock. We look at two aspects of monetary policy. First, when the economy is subject to an interest rate or capital market shock (as described below), the degree to which monetary policy responds to the exchange rate is a critical factor in the impacts of this shock. This feature of monetary policy is governed by the *intervention* parameter ω. But we also allow for the possibility of an independent, discretionary monetary policy shock, captured by the parameter v_t .

4.3. Interest Rate Shocks

We wish to compare the effects of different exchange rate rules on the response of the economy to external shocks. In particular we want to compare the trade-off between the need for exchange rate flexibility to deal with the macro effect of external shocks against the cost of exchange rate variation coming from the 'balance sheet' impact on the intermediate importers. To illustrate the trade-off we focus on the economy's response to foreign interest rate shocks. The foreign interest rate determines the cost of borrowing for a small economy, and simultaneously determines the scale of capital inflows or outflows. A capital market shock of the type seen in recent emerging market crises may be thought of as a sudden and unanticipated rise in the interest rate. We can think of this shock as being an exogenous rise in the rest of world risk premium for the foreign country (McKinnon 1998), or more structurally, it can be thought of as the result of a collapse in confidence in an emerging market that precipitates a self-fulfilling 'bank-run' type outflow of capital. In either case, the proximate effect is for the economy to face a sudden rise in the cost of borrowing.

To model this as simply as possible, we conduct the following experiment. Assume that the initial foreign interest rate is such that the current account is in balance if the level of net foreign assets is zero; i.e. $\beta(1+i^*)=1$. But in the first period, there may be a positive or negative shock to the foreign interest rate; $\beta(1+i_1^*)>1$ ($\beta(1+i_1^*)<1$) . Following this, however, the foreign interest rate returns back to the domestic rate of time preference, so that $\beta(1+i_t^*)=1$ for all $t>1$. Assuming that the economy starts out in the steady state position described in the previous paragraph, then this perturbation in the foreign interest rate will generate a period zero current account surplus (deficit) if the foreign interest rate rises above (falls below) the domestic rate of time preference. Following this, however, in period 1 and for all future periods, the current account will be zero, and consumption, labour supply, and the relative price of non-tradable goods will be constant.[4]

4 Although this is quite a simple approach to modeling a capital market shock, it has some degree of generality. A self-fulfilling panic of the type described by Chang and Velasco (2000) can be thought of as equivalent to a temporary rise in the external real interest rate (Cook and Devereux 2001).

4.4 Calibration

It is not possible to obtain an analytical solution for this model, due to the nature of the importing firm's credit constraint, and to the presence of current account dynamics. Instead, we calibrate the model, and obtain the solution numerically. We make the following assumptions with respect to functional forms. Let the utility function be:

$$\frac{C^{(1-\sigma)}}{1-\sigma}-\frac{\eta}{1+\psi}H^{1+\psi} .$$

The parameter σ represents the inter-temporal elasticity of substitution, and ψ represents the inverse of the elasticity of labour supply. In addition, the production functions for traded and non-traded goods respectively are:

$$F^{T}=A^{T}(H^{NT})^{\gamma},\quad F^{NT}=A^{NT}(H^{NT})^{\alpha}\quad \alpha<1,\gamma<1 .$$

Table 1 reports the baseline calibration assumptions. We follow the open economy macro literature in picking parameter values. The inter-temporal elasticity of substitution is set at 2, following Backus, Kydland, and Kehoe (1994). The rate of time preference is set at 0.05, so the subjective discount factor is 0.952. Initially, the foreign interest rate is then set at 0.05 also. The value of η is unimportant, just determining scale, so we set it arbitrarily to unity. The share of non-traded goods in the consumer price index is set at 0.5, following the evidence cited in Schmitt and Uribe (2000) for Mexico and Cook and Devereux (2001) for Malaysia and Thailand. The elasticity of labour supply is set to 0.5, so that $\psi = 2$. This is roughly in the middle of the various estimates of labour supply in the literature, based on micro evidence and aggregate macro data. The elasticity of substitution between non-traded and traded goods is set at 1.5. This accords with the assumptions made in Backus, Kydland, and Kehoe (1994) over the elasticity of substitution between home and foreign goods. The elasticity of substitution between varieties of non-traded goods is ρ , and this governs the equilibrium markup of price over cost in the non-traded good sector. We assume that this markup is 20 per cent. This is slightly higher than the common value of 10 per cent (Basu and Fernald 1999) used for macro studies of the industrial economies, but it is likely that markups are higher in emerging markets. We assume that non-traded goods production is relatively labour intensive, with $\alpha = 0.7$, and traded goods is relatively non-labour intensive, with $\gamma = 0.3$. Evidence of this from East Asian data is presented in Cook and Devereux (2001).

We also need to choose the initial stock of assets held by intermediate importers. We will first describe the results when this constraint never binds. Then, relatively arbitrarily, we will assume that initial assets are two per cent higher than the steady state intermediate import requirement. This means, for instance, that any shock which generates a greater than two per cent nominal exchange rate depreciation will, ceteris paribus, lead the credit constraint (9) to bind.

Finally, we vary the interest rate adjustment parameter ω , between 0.01, which represents a case where the monetary authority is content to allow significant adjustment in the nominal exchange rate, and 9000, representing a case where the monetary authority essentially keeps the exchange rate pegged. In addition, in the analysis below we examine an optimal monetary rule that lies between these two values.

Table 1: Baseline Calibration

Variable	Value	Variable	Value
σ	2	ϕ	1.5
β	0.952	ρ	6
η	1	α	0.7
α	0.5	γ	0.3
ψ	2	ω	0.01, 9000
D^I	$1.02\bar{S}P_I^*\bar{I}$		

4.5 Capital Market Shocks

We now examine the impact of changes in the rest of the world interest rate (as defined in Section 3.2 above) on the current account, the real exchange rate, output and welfare in the domestic economy. As noted above, the starting point is assumed to be the economy in initial steady state with zero net debt, defined by the system (15)-(19). Given the calibration set out in Table 1, a value of the world interest rate of 0.05 produces this steady state.

We define the first period current account as B_1^*, the real exchange rate as $\frac{P_1^{NT}}{P_1}$ (the relative price of non-traded goods in terms of the domestic CPI), and output is defined as the CPI deflated sum of production in the non-traded and traded goods sector:

$$\frac{p_1^N F^{NT}(H_1^{NT}) + F^T(H_1^T)}{\Gamma(p_1^N)}.$$

We examine the impact of the world interest rate shock in two cases; first in the case where the credit constraints are non-binding, and then the case where the credit constraints do bind for positive shocks to the interest rate. In each case, we compare the impact of the shock under flexible and fixed exchange rates.

4.6 Interest Rate Shocks without Financing Constraints

Figure 6 illustrates the impact of variations in the interest rate on the period 1 levels of GDP, traded sector output, the real exchange rate, and overall lifetime welfare. This figure compares the case $\omega = 0.5$ (flexible exchange rates) with ω =9000 so the exchange rate is held fixed. The solid lines represent the flexible exchange case, while the dotted lines represent the fixed exchange rate case.

Figure 1a shows that beginning at current account balance, a temporary interest rate increase will raise GDP in both the fixed and flexible exchange rate economy. The rise in the interest rate will cause a fall in current consumption and a rise in future consumption, causing a rise in current labour supply and a rise in output. Output will rise by more under the flexible exchange rate case however, because under flexible exchange rates the interest rate shock can generate a temporary real exchange rate depreciation. Under a flexible exchange rate the real depreciation is facilitated by a nominal depreciation, while under a fixed exchange rate, the real exchange rate is unaffected by the interest rate shock, in the initial time period. Depreciation under flexible exchange rates simultaneously increases demand in the non-traded goods sector, as well as cushioning the overall fall in current consumption, since the effective real interest rate rises by less than the rise in the foreign interest rate. Traded good output actually rises by more under fixed exchange rates, because the greater fall in current consumption generates a higher shift up in labour supply, and a greater fall in the real wage.

Figure 6d illustrates the welfare impact of the interest rate shock. Welfare will rise under either exchange rate regime, whether the interest rate rises or falls, simply because of the gains from international borrowing or lending, relative to autarky. This result is sensitive to the assumption of zero initial net foreign assets. If the economy was in an initial net debtor position, then a rise in the foreign interest rate would have tended to reduce welfare directly through negative wealth effects. But despite this, it would still be the case that welfare under flexible exchange rates is higher than under fixed exchange rates, even if overall welfare falls in each case. Flexible exchange rates strictly welfare dominate. Welfare is higher everywhere with flexible exchange rates except in the special case where there is no borrowing or lending. Essentially, this illustrates the standard OCA benefits of a flexible exchange rate in the presence of asymmetric shocks, since a movement in world interest rates may be thought of as reflecting the presence of asymmetric macro shocks. In face of external shocks that require real exchange rate adjustment, it is better to allow the nominal exchange rate to facilitate this adjustment.

4.7 Interest Rate Shocks with Financing Constraints Sometimes Binding

Now let us look at the case where financing constraints sometimes bind, and this depends on the movement of the exchange rate. Specifically, we take a case where the finance constraint binds under flexible exchange rates if the interest rate shock is positive and high enough, but the constraint never binds under fixed exchange rates. Granted, this is a special case, and it is easy to calibrate so the constraint never binds (for the range of interest rate shocks we look at in the figures) in either case, or where the constraint sometimes binds in both fixed and flexible exchange rate regimes. But what is true is that the finance constraint will always be *more binding* under flexible exchange rates, due to the impact of nominal depreciation on the constraint.

In Figure 7, the finance constraint binds under flexible exchange rates when the foreign interest rate is higher than six per cent. The figure illustrates that the finance constraint has a dramatic impact on the effects of positive interest rate shocks under flexible exchange rates (negative interest rate shocks work in the same way as before, since they do not make the finance constraint more binding). A positive interest rate shock will lead to nominal exchange rate depreciation. Without finance constraints, this would lead to a strong rise in GDP, more than that seen under fixed exchange rates. But when the finance constraint binds, an interest rate shock that is high enough can generate a fall in GDP, as the nominal depreciation leads to a rationing of intermediate imports, and a fall in traded goods output. In effect, the nominal exchange rate depreciation arising from the interest rate increase has a contractionary effect on the economy. Now we find that GDP would be greater even under fixed exchange rates, when the finance constraint is not binding, than under the flexible exchange rate. (The behaviour of the real exchange rate is identical whether the finance constraint is binding or not, and is omitted from Figure 7).

The presence of finance constraints also has a direct effect on the welfare comparison of fixed and flexible exchange rates. Figure 7 shows that lifetime utility is a function of the period 1 interest rate. We see that when the finance constraint does not bind, utility is everywhere higher under the flexible exchange rate case. But as the interest rate reaches the threshold where the finance constraint binds, welfare is higher under a fixed exchange rate.

How would we compare overall welfare between fixed and flexible exchange rates? A simple approach is to assume that the distribution of foreign interest rates is such that each interest rate between 0.01 and 0.09 is equally likely. In this case we may compute expected utility by integrating across the welfare loci in Figures 6 and 7, weighting by probabilities. A computation for the calibration under study reveals the following. As is clear, in the unconstrained environment, a flexible exchange rate monetary rule will dominate a fixed exchange rate rule. But with the finance constraint binding in the manner described in Figure 7, we find that a fixed exchange rate dominates. In this sense, we may conclude that the presence of financial market distortions may generate a preference for greater nominal exchange rate stability.

While we have only described the trade-off between a fixed exchange rate rule and a rule in which the monetary authority puts almost no weight on the exchange rate, we could also study intermediate rules. It will be the case that a rule which puts more weight on the exchange rate does better than either a fixed exchange rate or a flexible exchange rate rule as described above. But the essential message is unchanged. The presence of exchange rate-sensitive financing constraints in trade increases the desirability of exchange rate stability.

4.8 Perverse Effects of Monetary Policy Shocks

The presence of credit constraints in the traded goods sector alters the calculation of the net benefits of exchange rate flexibility. The exchange rate no longer necessarily acts as a mechanism for stabilizing GDP, but may be de-stabilizing, when financing constraints are sensitive to exchange rate movements. There is an immediate corollary of this conclusion that pertains to the effectiveness of monetary policy in an emerging market economy operating under this type of credit constraint. Monetary policy works in this economy only by influencing the nominal and real exchange rate. For instance, in Chang and Velasco (2000), monetary expansion can reduce real interest rates by generating a current real exchange rate depreciation, stimulating aggregate demand and output. But when an exchange rate depreciation pushes the economy towards a binding credit constraint, monetary policy expansion may have indirect negative effects on the output of traded goods. In fact, monetary policy may be contractionary for the overall economy.

Figure 8 illustrates the impact of an unanticipated monetary policy expansion (a rise in v_t) in the model, both with and without binding finance constraints. In the absence of the finance constraint, monetary policy works in a familiar way. The monetary expansion generates a nominal depreciation, and a rise in current consumption. Demand and output rise in the non-tradable sector, and overall GDP expands in the first period.

When the exchange rate effects of monetary policy expansion lead the credit constraints to bind, however, Figure 7 shows that the net negative effect on the production of tradable goods may be large enough to offset the increased demand in the non-tradable sector. Overall, GDP may fall.

This example provides an illustration of the viewpoint of Calvo and Reinhart (2000), who emphasize the limitations on the use of monetary policy for macroeconomic purposes in emerging market economies. It should be emphasized that this perverse effect of monetary policy is not related to the standard criticisms of independent monetary policy in emerging markets. We have purposely abstracted from the conventional problems related to political constraints or the credibility of monetary policy. In this economy, the usefulness of monetary policy is constrained purely by financial market distortions.

5. Conclusions

This paper uses empirical evidence from the response of some Asian economies to the financial crisis of 1997-1998 to support a theoretical model that features an important role for exchange rate sensitive financial market distortions. We show that this model can explain why emerging market countries would be more concerned with variations in exchange rates than would be implied by standard OCA criteria. Moreover, the model implies that monetary policy may be a very ineffective tool in emerging market economies.

All this suggests that a currency board or an explicit dollarization of the monetary system may be less costly for emerging markets than suggested by conventional analysis. Nevertheless, the issue is more complicated than that. As emphasized by Eichengreen and Hausmann (1999) and Krugman (1998), emerging markets and 'mature developed' economies are treated quite differently by international capital markets. Mature developed economies do not face constraints on issuing debt in their own currencies, and are not forced to follow pro-cyclical policies in response to international crises. From the perspective of the policy-maker, it would clearly be more desirable to gain status as a 'mature developed' economy, than to face the constraints imposed on emerging markets, whatever the form of the exchange rate system used in the latter. If an emerging market economy could cross this 'threshold' in status, it might wish then to allow more exchange rate flexibility.

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Figure 1: GDP

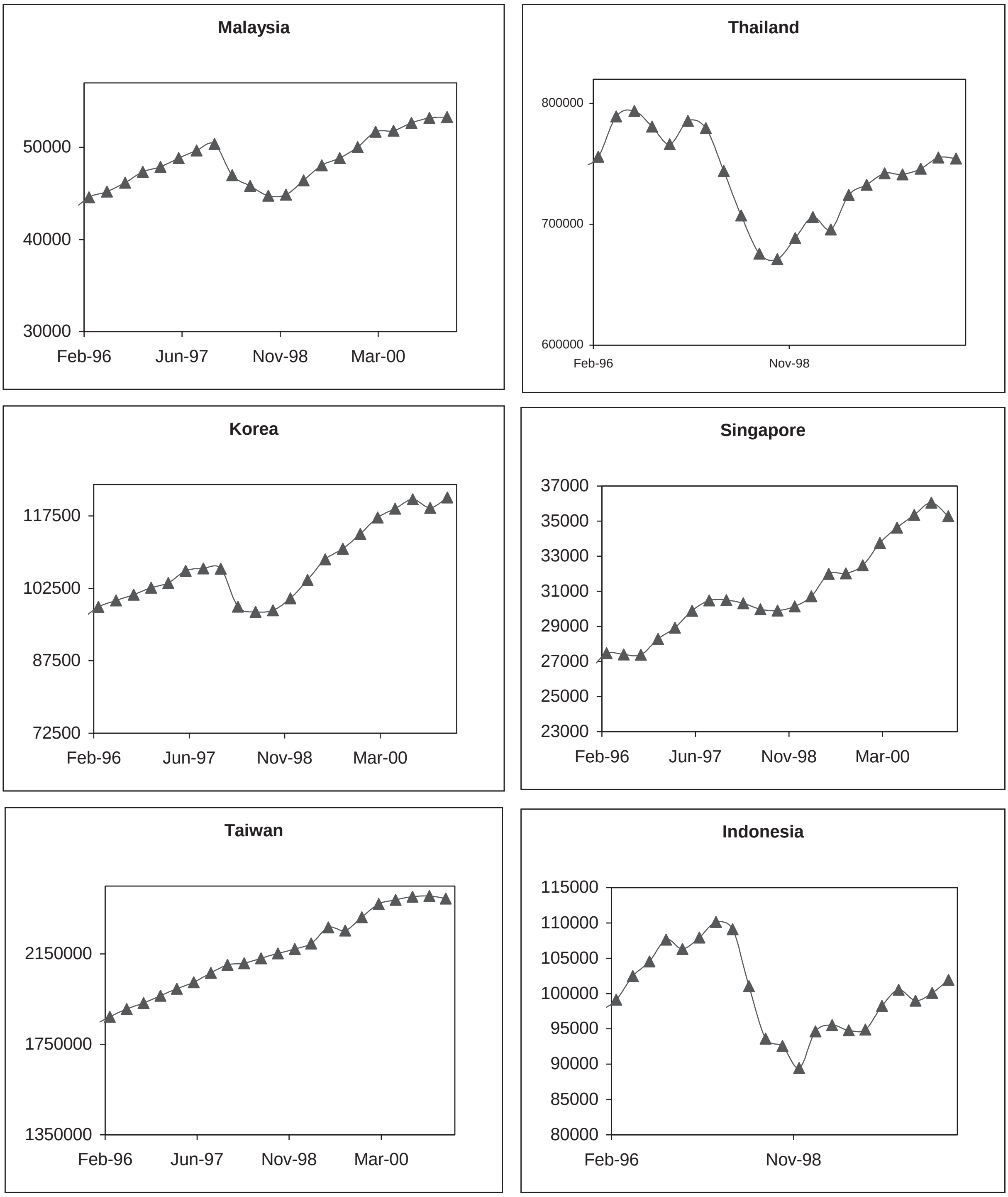
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Figure 1: GDP (Continued)

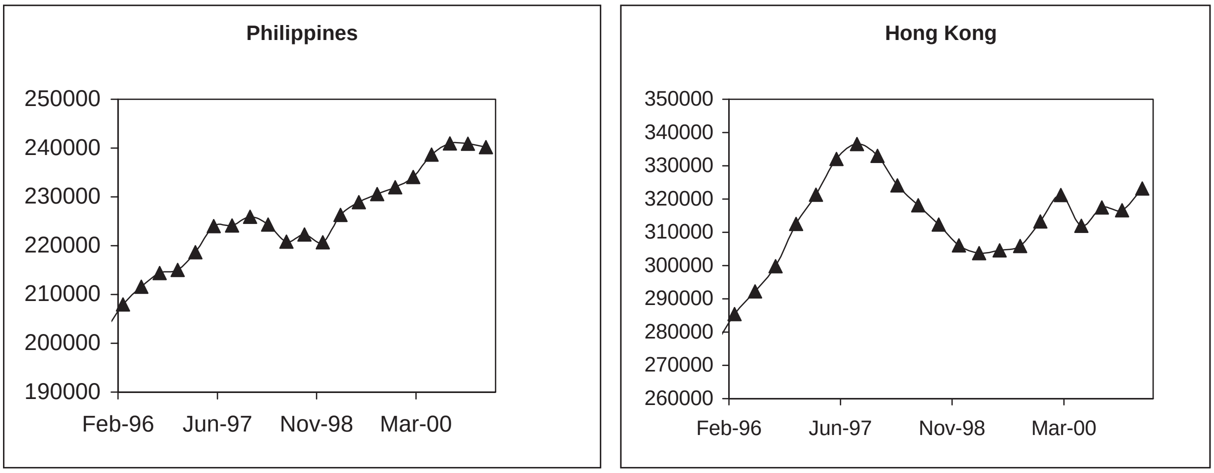


Figure 2: Real Effective Exchange Rates

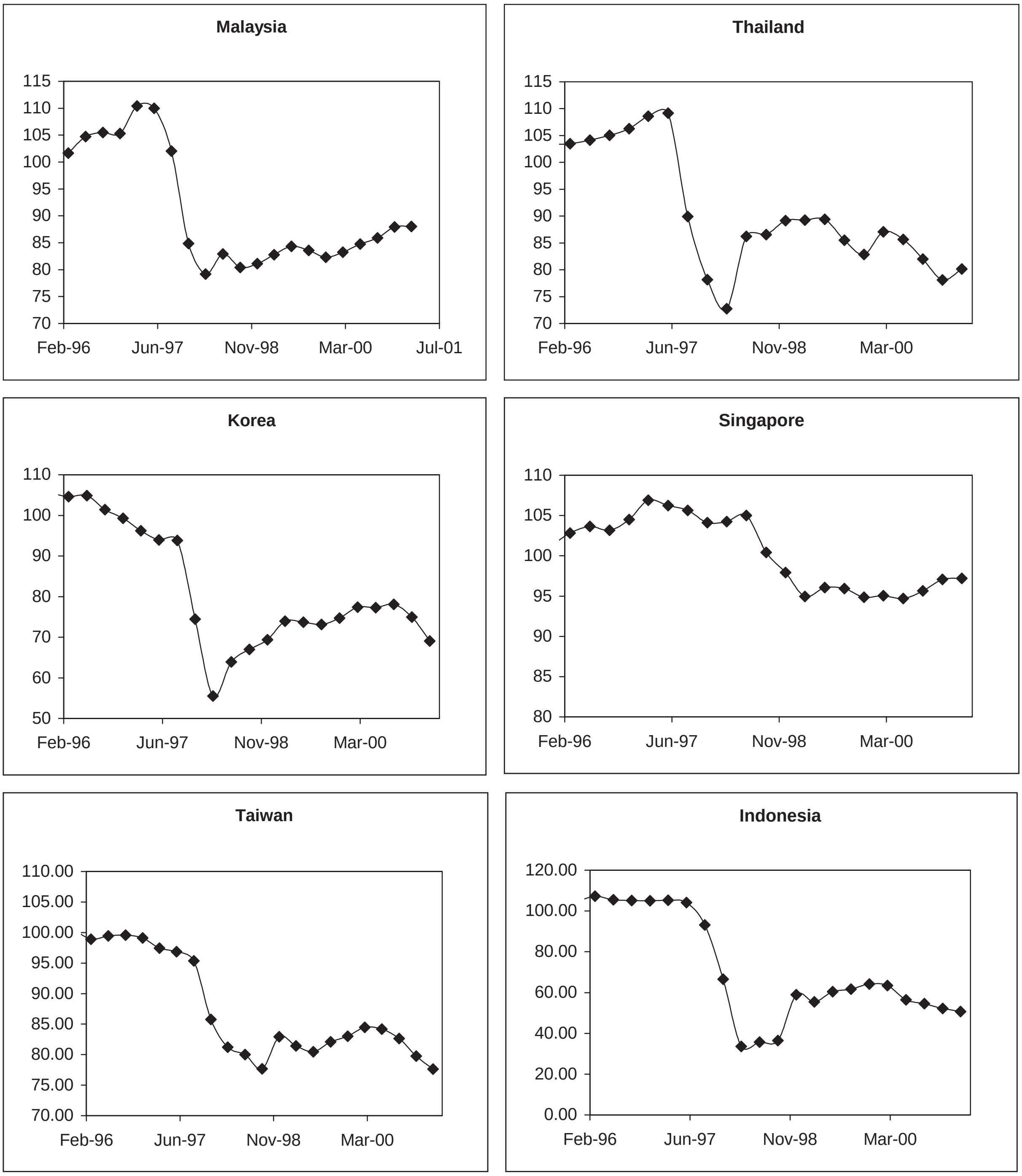


Figure 2: Real Effective Exchange Rates (Continued)

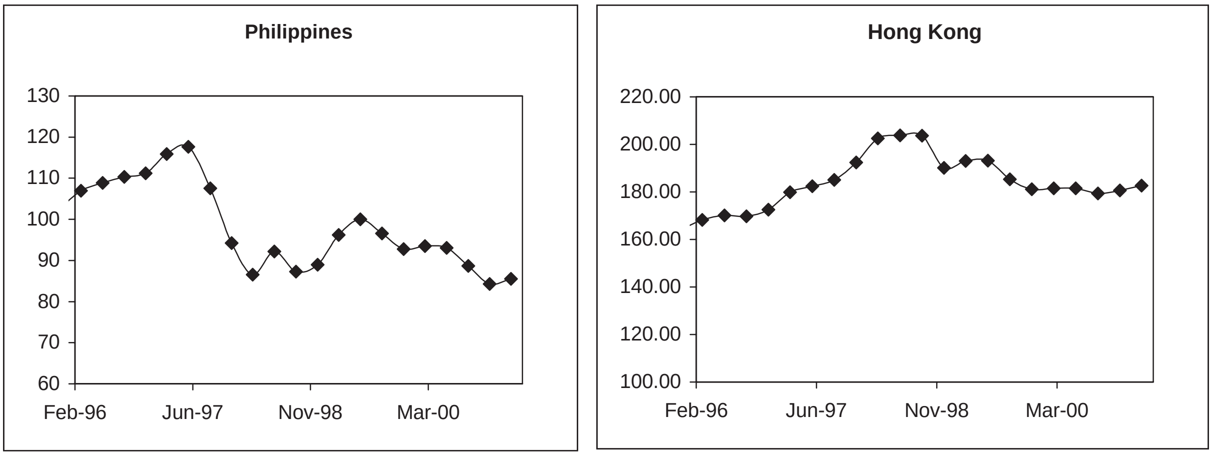


Figure 3: Current Account to GDP Ratio

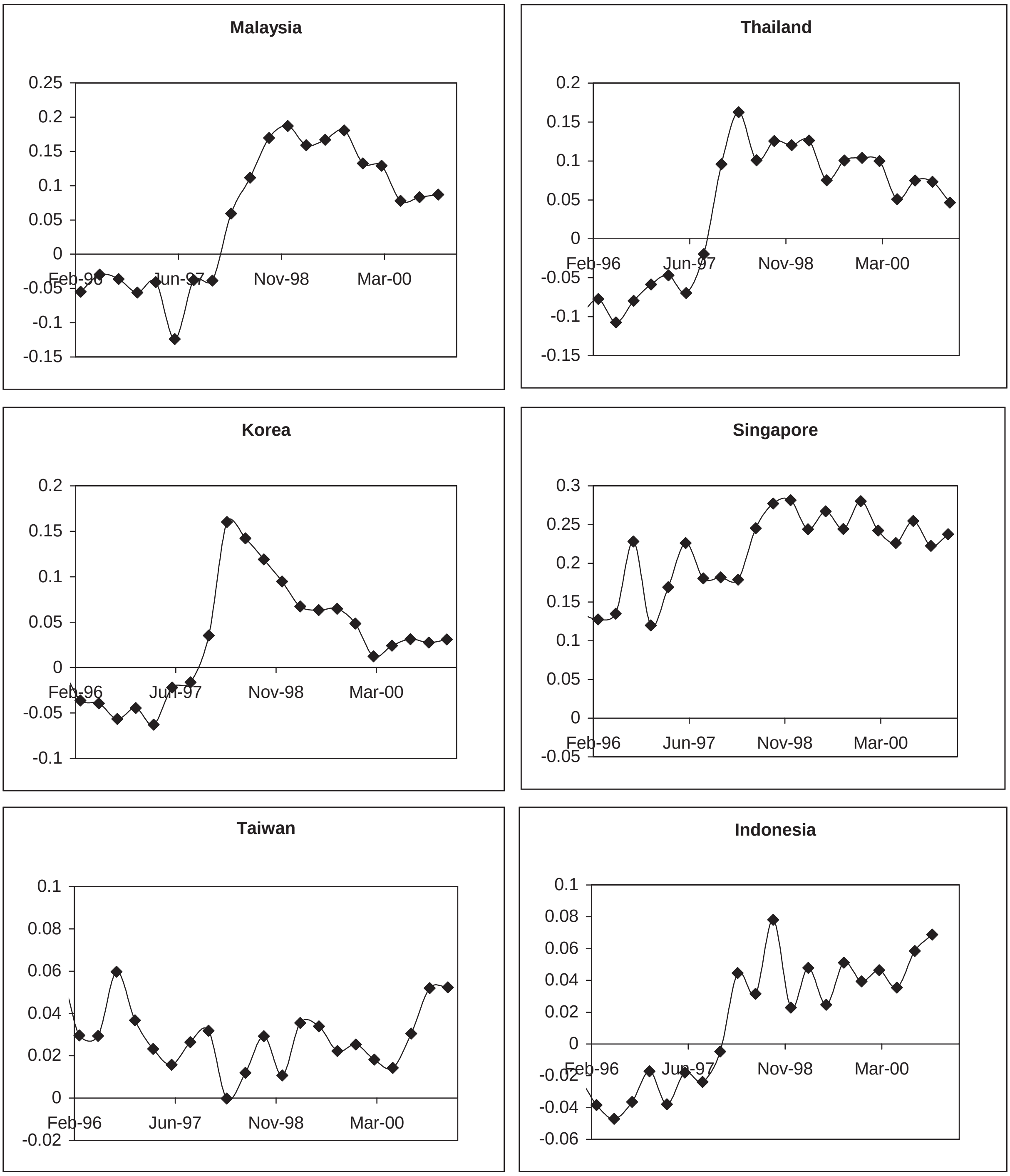


Figure 3: Current Account to GDP Ratio (Continued)

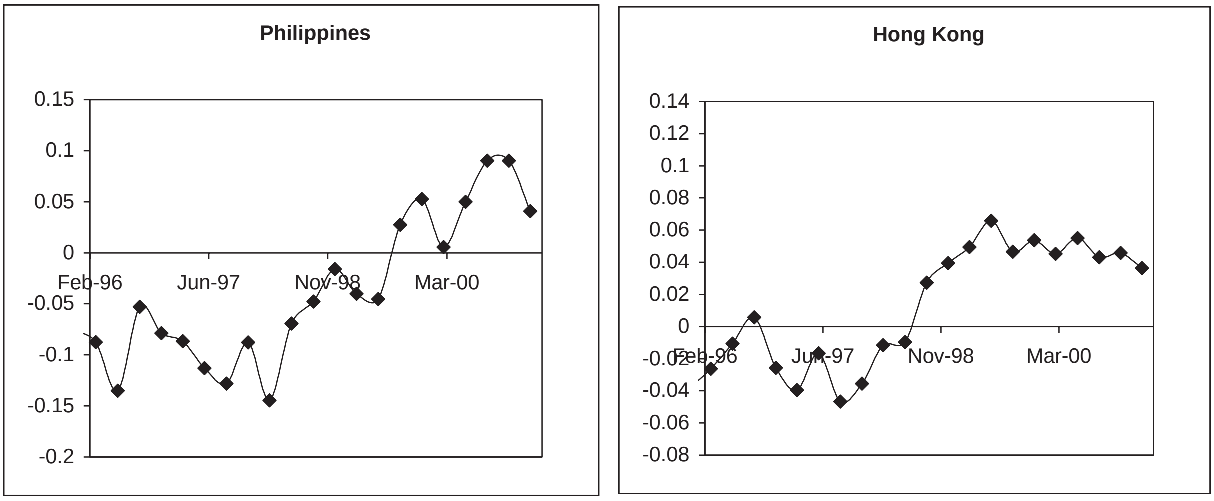


Figure 4: Tradable and Non-Tradable Sector Output

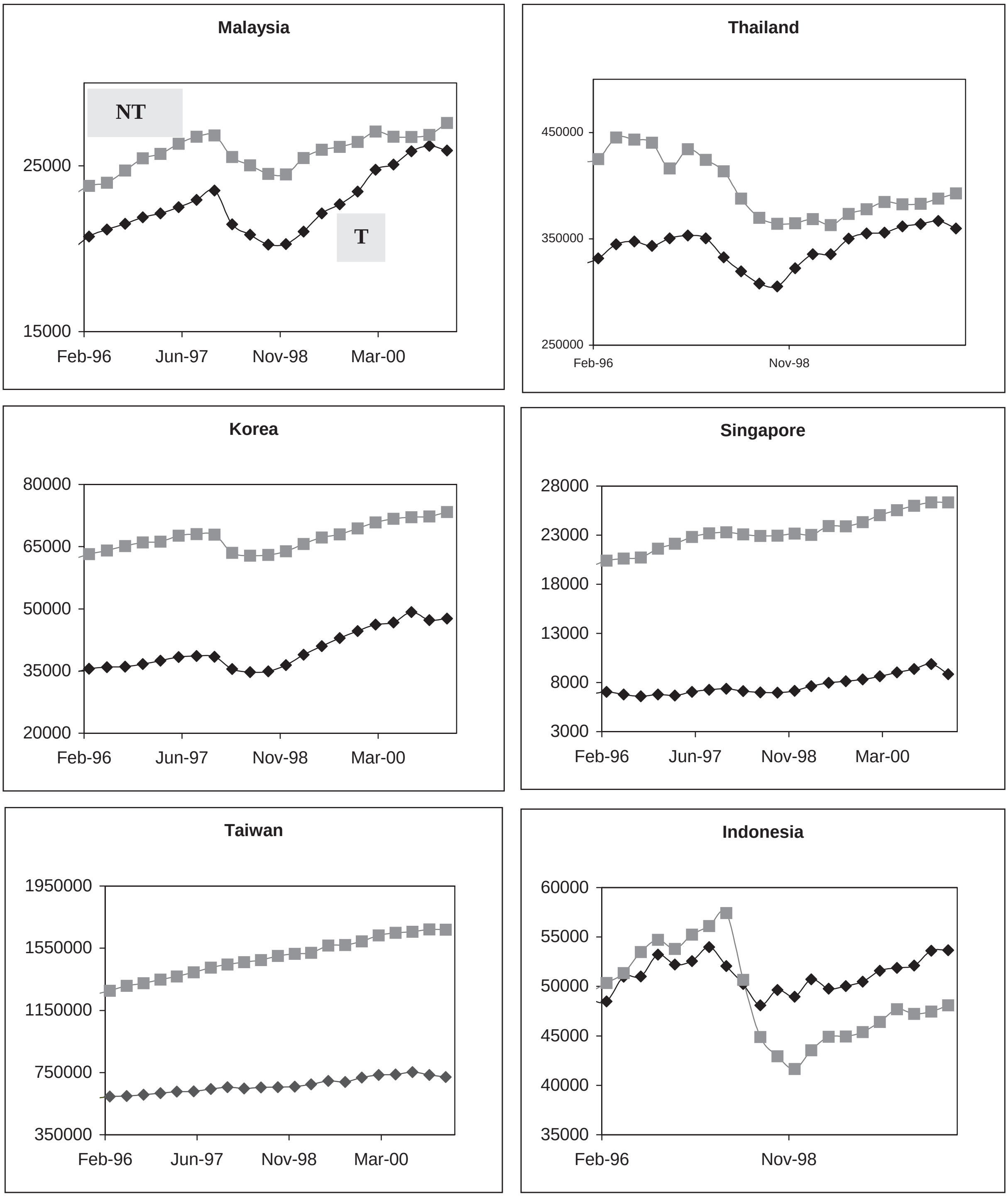


Figure 4: Tradable and Non-Tradable Sector Output (Continued)

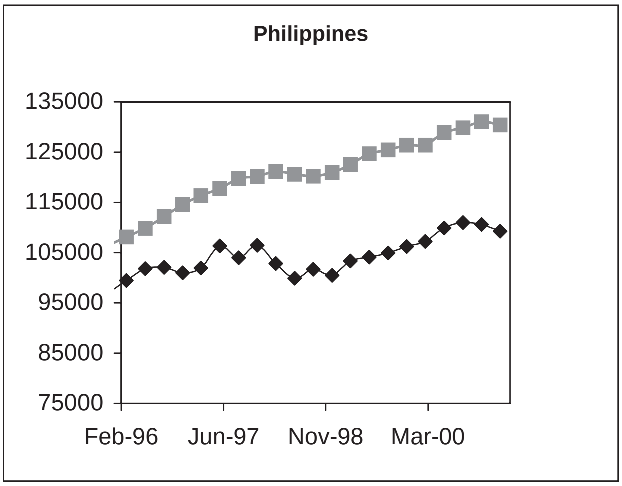
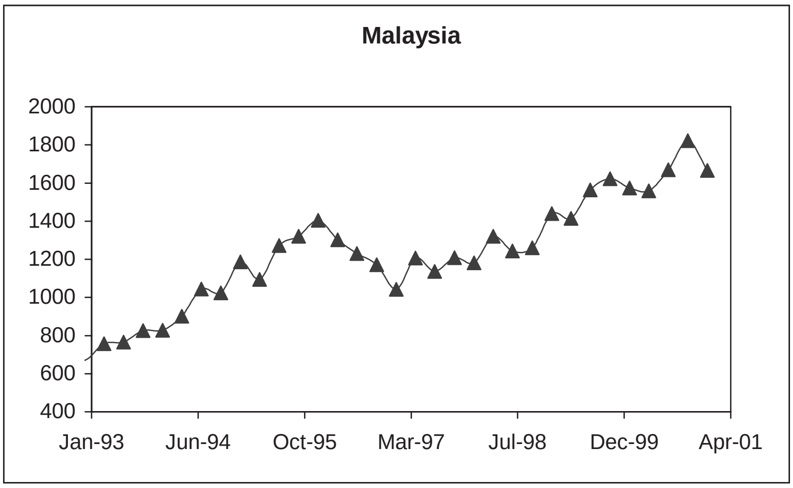
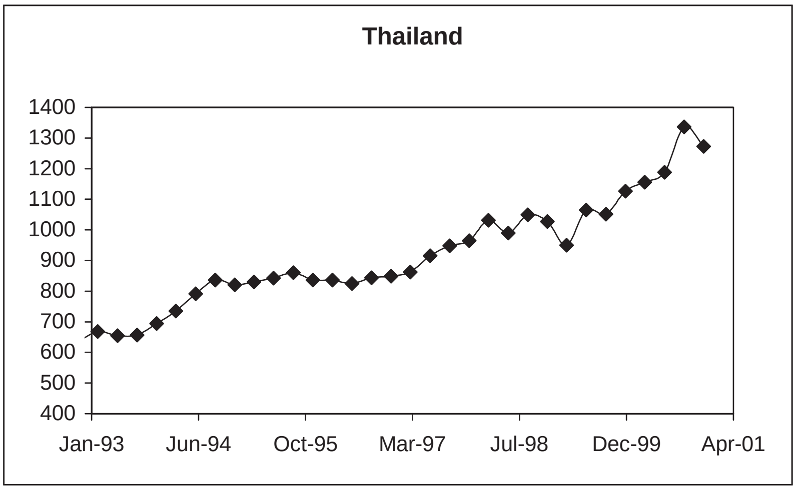


Figure 5: Exports to US





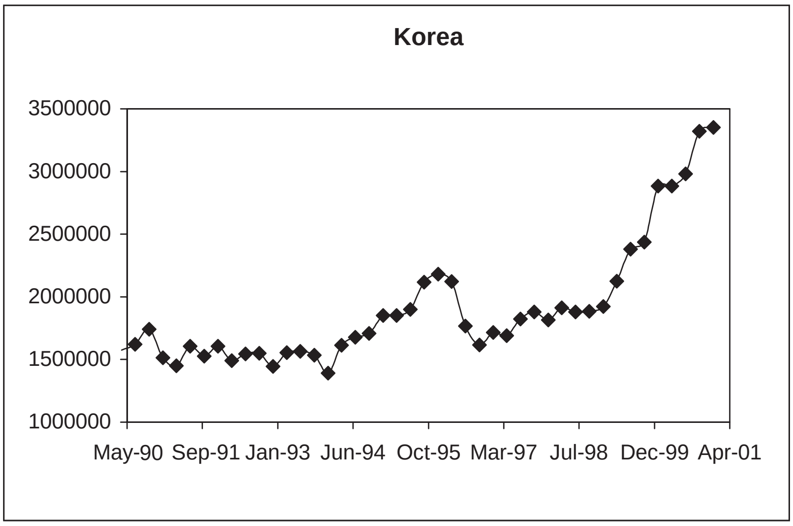


Figure 6: Capital Market Shocks without Finance Constraints

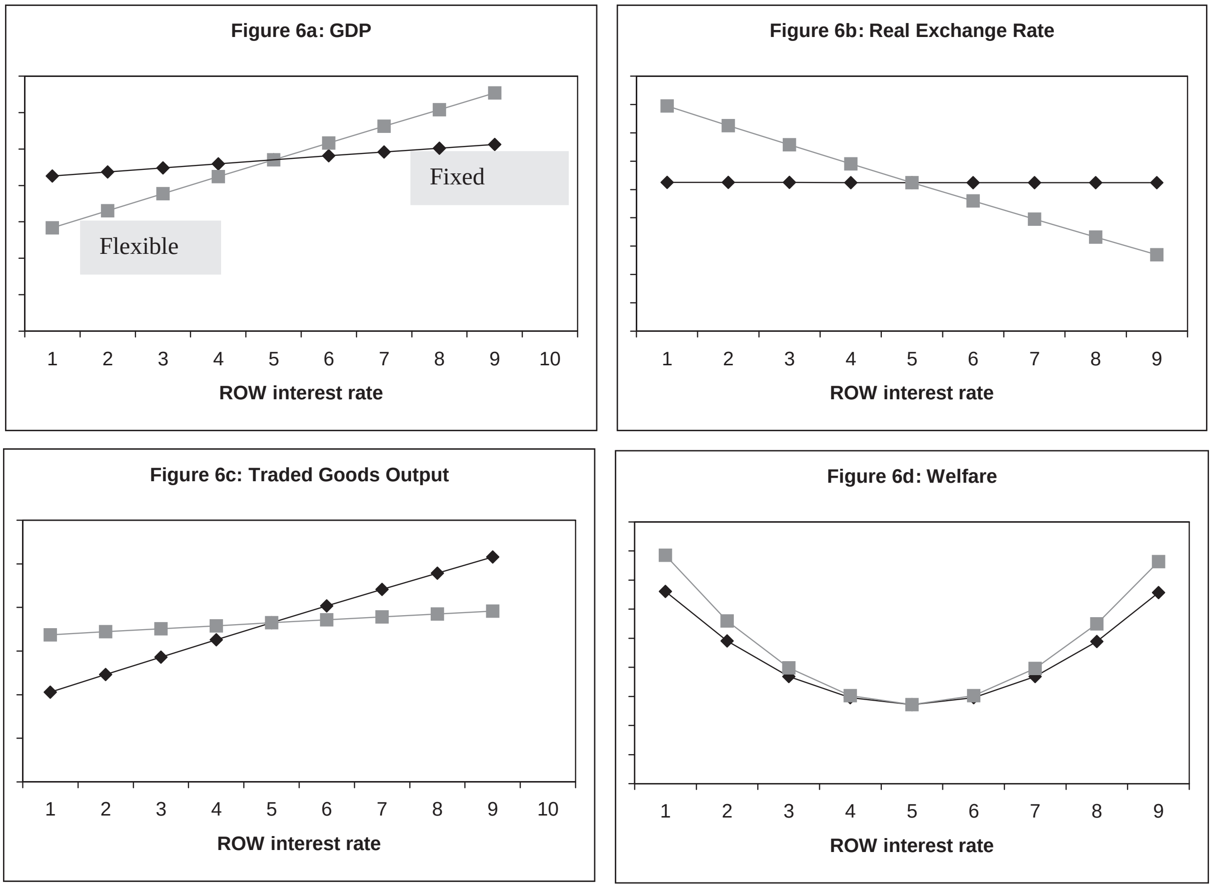


Figure 7: Capital Market Shocks with Finance Constraints

Figure 7a: GDP

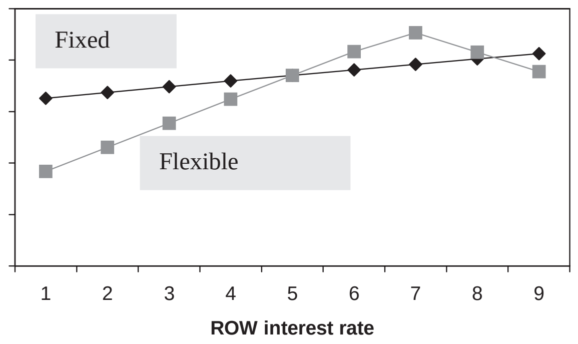


Figure 7b: Traded Goods Output

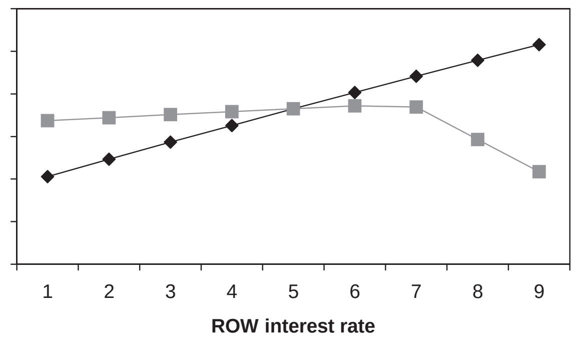


Figure 7c: Welfare

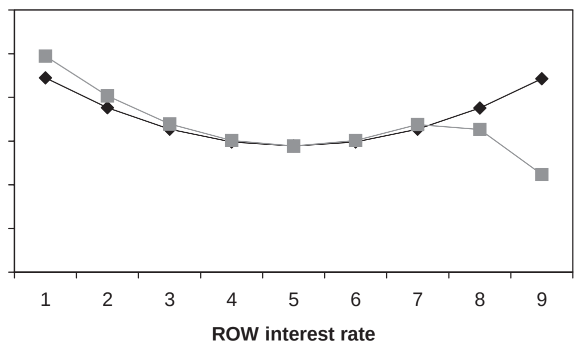


Figure 8: GDP, Expansionary Monetary Shock