The Stabilization of an Open Economy with Capital Controls: An Analysis Using Malaysian Data*

Abstract
The purpose of this paper is to analyze the effectiveness of capital controls and fixed exchange rates in improving economic welfare. We apply Malaysian data to our theoretical model and derive the following results for the period of our estimation. High exchange rate volatility negatively affects Malaysian net exports and real GDP. By stabilizing the exchange rate and recovering monetary policy autonomy, capital controls and fixed exchange rates can lead to lower values of loss functions. This beneficial effect is stronger, the more open the Malaysian economy.

1. Introduction
Since the Asian financial crisis, capital controls have received much attention with regard to their use as a way to help stabilize an economy suffering from the negative effects of foreign-exchange-market turbulence. Malaysia adopted exchange controls in September 1998, and judging from its economic performance since then, the controls

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seem to have aided the country’s economic recovery after the Asian financial crisis. This does not mean, however, that the benefits of capital controls outweigh their costs for every country under all circumstances.

To begin analyzing the macroeconomic benefit of capital controls, we need only recall the theory of the “incompatibility triangle” (also popularly known as the “impossible trinity”), implied by Robert Mundell’s famous policy analysis. This theory states that, in general, a country cannot simultaneously maintain free capital movement, an independent monetary policy, and a fixed-exchange-rate regime. Viewed from this perspective, Malaysia sacrificed the free movement of capital in order to gain the benefits of a fixed exchange-rate and monetary policy autonomy.

This paper focuses on these two benefits and analyzes how they aided Malaysia in recovering from the Asian financial crisis. In terms of exchange rate systems and capital controls, there are three main policy choices available to an open economy: regimes in which (A) capital movement is free, and the currency is freely floated; (B) capital movement is free, and the exchange rate is fixed; or (C) capital controls are in place, and the exchange rate is fixed. According to the incompatibility triangle theory, if a country adopts policy regime B, it will lose its monetary policy autonomy, in the sense that the money supply is no longer an autonomous policy instrument, but an endogenous variable. We compare policy regimes A and C, to emphasize capital controls as a means to recover independence in monetary policy.

To analyze the benefits of exchange rate stability, we employ the partial derivative representing the sensitivity of GDP to exchange rate volatility ($\alpha$) as a measure of the openness of the real sector of the economy. An increase in $\alpha$ can reflect increased openness from two sources: an increase in the trade/GDP ratio and an increase in the response of GDP to exchange rate volatility. By assigning different values to this partial derivative, we can observe the changes in the values of losses under the optimal policy (i.e., the policy that minimizes the loss function when a shock occurs). Our goal is to show that the more open a country’s economy is (and, therefore, the more sensitive it is to exchange rate volatility), the more beneficial are capital controls if that country wishes to retain its monetary policy autonomy.

Our paper is organized as follows. Section 2 reviews the actual policy measures taken in Malaysia from late 1997 to 2001 and how they have been evaluated by

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2 Trade is the sum of exports and imports.
economists. Section 3 lays out the model and the reduced-form equations, defines the loss functions, and solves for the levels of money supply that minimize the welfare losses incurred for two policy regimes (viz., [A] when capital movement is free, and the currency is freely floated and [C] when capital controls are in place, and the exchange rate is fixed), when three types of shock hit the economy. The shock can be a demand shock, a supply shock, or a capital account shock. Section 4 reports the estimation results of our model using Malaysian data. In section 5 these estimated parameters are used to derive the actual values of losses. This enables us to determine the relative superiority of the two regimes and to observe the effect of increased sensitivity to exchange rate volatility. Section 6 summarizes our conclusions. An important result of our analysis is that exchange rate volatility increases the effects of negative disturbances on a small country’s economy as the degree of that country’s economic openness increases, which implies that if a country is very open, a sensible policy in response to a shock would be to introduce capital controls and a fixed exchange rate.

2. Malaysia’s policy responses to the Asian crisis

Table 1 shows Malaysia’s main economic indicators for 1995–2001. After experiencing a recession in 1980, Malaysia’s economy grew rapidly from 1988 until the Asian financial crisis in 1998. Malaysia’s financial system was healthier than that of Thailand or South Korea and was also less dependent on foreign short-term capital than that of those two countries (as measured by its smaller share of short-term overseas liabilities).3 International capital flows through Malaysia’s banking sector were controlled. Nevertheless, Malaysia was buffeted by the instability in Thailand’s financial system beginning in May 1997 and by the subsequent devaluation of the baht in July 1997, which led to capital flight and, eventually, declines in the Malaysian stock market and the ringgit/US$ exchange rate. The devaluation pressure came from the offshore market.4 As devaluation became widely predicted by investment analysts, offshore investors began to take short positions on the ringgit, which pushed the interest rate in the offshore market higher than the domestic interest rate. This interest rate gap led to a large-scale outflow of capital, thereby making devaluation inevitable and worsening the economic and financial situation. To combat these alarming trends, Malaysia undertook orthodox adjustment policies: one tactic was to tighten the money supply.

4 Until capital and exchange rate controls were instituted in September 1998, the offshore market was centered in Singapore, because Singapore placed few restrictions on nonresident transactions of the ringgit. Thus, hedging operations between the ringgit and other currencies were transacted mainly in Singapore.
From September 1998, however, because of the slowdown in bank lending due partly to monetary tightening and partly to declining demand for funds by corporations, the Malaysian authorities shifted to a new policy regime. The main strategies of Malaysia’s new policy were (1) to place restrictions on capital movements, (2) to adopt a combination of looser monetary and fiscal policies, and (3) to fix the exchange rate at 3.8 ringgit/US$. The capital controls reduced the internationalization of the ringgit mainly by requiring foreign investors to keep their short-term capital in the country for a minimum of 12 months. Policymakers believed that, as a side benefit, overseas ringgit-denominated assets would flow back into the country and help ease the lack of liquidity in the domestic markets and stabilize the stock market. On 9 February 1999, an “exit levy system” replaced the short-term capital restrictions: investors who wished to pull their money out of Malaysia could do so after paying a tax of 10–30 percent. The effects of this tax were to spread out the timing of capital outflows, reduce volatile short-term capital flows, and attract new funds. Details of the capital control regime and its evolution over time are listed in table 2.

The capital controls made it possible to implement the second strategy, a relaxed monetary policy. The gradual move toward an expansionary monetary policy can be seen in figure 1, which shows the decline in Malaysia’s real interest rate (money market rate minus consumer-price-index inflation rate) from mid-1998. The expansionary monetary policy was implemented alongside an expansionary fiscal policy. Public investment was targeted to those projects that were unlikely to cause imports to increase and were characterized by a short time lag between planning and execution (see Ministry of Finance, Malaysia 1998). Perkins and Woo (2000) point out that Malaysia’s capital controls and reflation policy were successful.
A number of selective exchange control measures were introduced, aimed specifically at eliminating the offshore ringgit market and restricting the supply of ringgit to speculators.

A requirement was introduced to repatriate all ringgit held offshore, including ringgit deposits in overseas banks, by 1 October 1998; such deposits required Bank Negara Malaysia approval thereafter. An approval requirement was imposed on the transfer of funds between external accounts and for the use of funds for other than permitted purposes (i.e., the purchase of ringgit assets). Licensed offshore banks were prohibited from trading in ringgit assets, which had previously been allowed up to permitted limits.

A limit was introduced on exports and imports of ringgit by resident and nonresident travelers, effective 1 September 1998. No such limits existed previously.

Residents were prohibited from granting ringgit credit facilities to nonresident correspondent banks and stockbroking companies. Such credit had previously been permitted, subject to a limit.

Residents were prohibited from obtaining ringgit credit facilities from nonresidents. This had previously been permitted, subject to limits.

Payments for all imports and exports were required to be settled in foreign currency.

Ringgit financial assets could be purchased and sold only through authorized depository institutions. Trading in Malaysian shares on Singapore’s Central Limit Order Book over-the-counter market was prohibited de facto as a result of strict enforcement of the existing law requiring Malaysian shares to be registered on the Kuala Lumpur stock exchange prior to trade.

1 September 1998. Portfolio and other forms of investment
A number of additional measures were introduced, aimed at preventing heavy capital outflows originating from residents and nonresidents.

Official approval was required for nonresidents to convert ringgit held in external accounts into foreign currency, except for purchases of ringgit assets, conversion of profits, dividends, interest, and other permitted purposes. No such restriction existed previously. There were, however, no restrictions on conversions of ringgit funds in the external accounts of nonresidents with work permits, or in the accounts of embassies, high commissions, central banks, international organizations, and missions of foreign countries in Malaysia.

A 12-month waiting period was required for nonresidents to convert ringgit proceeds from the sale of Malaysian securities held in external accounts. This excluded foreign-direct-investment flows, repatriation of interest, dividends, fees, commissions, and rental income from portfolio investment. No such restriction existed previously.

A prior approval requirement was imposed for all residents investing abroad, beyond a certain limit, in any form. This requirement was previously applied only to corporate residents with domestic borrowing.

A specific limit was placed on exports of foreign currency by residents up to the amounts brought into Malaysia for nonresidents. Previously there was no restriction on the export of foreign currency notes and traveler’s checks on the person or in the baggage of a traveler. Exports by other means required approval, regardless of the amount.

12 December 1998. Lending in ringgit
Commercial banks and financial companies were allowed to extend loans to nonresidents for the purpose of purchasing office space or residential, commercial, or industrial property in Malaysia between 12 December 1998 and 12 January 1999, subject to certain conditions.

13 January 1999. Portfolio investment
Capital flows for the purpose of trading in derivatives on the commodity and monetary exchange of Malaysia, and the Kuala Lumpur options and financial futures exchange, were permitted for nonresidents, without being subject to rules governing external accounts, provided these transactions were conducted through “designated external accounts” that could be created with tier-1 commercial banks in Malaysia.

15 February 1999. Portfolio investment
The 12-month holding-period rule for repatriation of portfolio capital was replaced with two measures:

1. A graduated system of exit levies was applied to the repatriation of the principal of capital investments (and shares, bonds, and other financial instruments, except property investments) made prior to 15 February 1999. The levy decreased over the duration of the investment and thus penalized earlier repatriations: the levy was 30 percent if the principal of the investment was repatriated less than 7 months after entry, 20 percent if repatriated in 7 to 9 months, and 10 percent if repatriated in 9 to 12 months. No levy was imposed on the principal if it was repatriated after 12 months.

2. A graduated exit levy was applied to the repatriation of profits from investments made after 15 February 1999 in shares, bonds, and other financial instruments, except property investments. The levy decreased over the duration of the investment: the levy was 30 percent if the profits were repatriated less than 7 months after entry, 20 percent if repatriated in 7 to 9 months, and 10 percent if repatriated after 12 months. No exit levy was imposed on the repatriation of capital.

The aim was to preempt the potential exodus of funds in September, when the holding period was set to expire, and to encourage fresh inflows to facilitate an economic recovery.
because the country’s economic downturn was a result of depressed demand as opposed to a supply-side shortfall.

The pegging of the exchange rate at 3.8 ringgit/US$ was the third measure taken by the Malaysian authorities in the third quarter of 1998. This change in the exchange rate regime had two main effects on the economy. First, the fixed exchange rate of 3.8 ringgit/US$ meant that the ringgit was undervalued when compared with the currencies of other countries in the region, and, as a result, Malaysian exports increased by approximately US$10 million between 1998 and 1999 (Perkins and Woo 2000). In this way, the fixed exchange rate helped the process of economic recovery. The second effect was that the fixed exchange rate regime stabilized Malaysia’s economy by reducing volatility in the foreign-exchange markets.5 Because the

5 Jomo (2001, 205) writes, “clearly, the ringgit peg brought a welcome respite to businessmen after over a year of currency volatility.”
Malaysian economy is unusually dependent on foreign trade, exchange rate volatility affected the Malaysian economy more than it would have affected an economy that is much less dependent on international trade. In 1998, the ratio of foreign trade to GDP \( \frac{\text{exports} + \text{imports}}{\text{GDP}} \) was 207 percent for Malaysia, 110 percent for the Philippines, 101 percent for Thailand, 98 percent for Indonesia, and 85 percent for South Korea.

Initial reactions to Malaysia’s capital controls were mostly negative. For instance, the IMF expressed its belief that “any restriction imposed on the movement of capital is not conductive to building investor confidence” (Asian Wall Street Journal 1998, 2). The general sentiment of investors and analysts during the early days of the capital controls is summed up by Meesook et al. (2001, 3): “initially there was concern that these controls might be used to avoid needed policy adjustment, and investors and market analysts reacted negatively.”

The assessment of Malaysia’s policies grew more positive, however, as the country’s economy recovered. The IMF’s gradual acceptance of these policies can be seen in successive publications of its *World Economic Outlook* (IMF 1998, 1999a, 1999b). Meesook et al. (2001, 3) note that the “market assessment turned more positive . . . as it became clear that Malaysia’s macroeconomic policies were not out of line, [and] that the undervalued pegged exchange rate was contributing to the rapid recovery of exports and output.” On the capital control measures, Edwards (1999, 70) writes, “although it is too early to assess fully the effects of this policy [Malaysian capital controls] on that country’s economic performance, preliminary evidence suggests that, contrary to the fears of orthodox analysts, the temporary controls did not produce much harm.”

Although the evaluations of Malaysia’s policies have generally become more positive, some analysts reserve judgment about the degree to which these policies have contributed to the country’s recovery (Jomo 2001). South Korea and Thailand were also able to recover rapidly from the financial crisis, but they adopted more orthodox, IMF-endorsed policies and received loans from the IMF. Kaplan and Rodrik (2001) show quantitatively that Malaysia recovered faster than South Korea and Indonesia, two of the countries that implemented IMF-endorsed policies. Kaplan and Rodrik’s analysis takes into account the difference in the timing of the recovery policies, which would have affected the timing of the countries’ recoveries. Using estimations from a structural vector autoregression (VAR) model that is calibrated on Malaysian data,6 Cook and Devereux (2002) conclude that controls or taxes on capi-

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6 Cook and Devereux’s (2002) estimated coefficients are not reported in the paper, but if the structural VAR method was used also to estimate these coefficients, the mechanism within the macroeconomy for transmission of the effects of capital controls is not made clear.
tal flows can successfully restrain capital outflows in a small open economy hit by financial panic. Cook and Devereux also show that the macroeconomic effects of a financial panic can be countered most successfully when exchange rates are fixed.

3. Theoretical analysis

3.1 The model
In our model below, the home country is assumed to be a small country. All variables other than the interest rate are expressed in natural logarithms, and all variables are expressed as deviations from the long-run trend. An asterisk after a variable denotes a foreign variable, and all parameters expressed by Greek letters are positive.

Demand is composed of consumption, investment, and net exports. The equilibrium for the aggregate demand in the domestic-goods market is expressed as

\[ y_t = \alpha_1 y_t - \alpha_2 r_t + \alpha_3 (e_t + p_t^* - p_t) + \alpha_4 (y_t^* - y_t) + \gamma_1 - \alpha_5 \sigma_t + \nu_t, \]

where \( y_t \) is GDP, \( r_t \) is the real interest rate, \( e_t \) is the nominal exchange rate, \( p_t \) is the price level, and \( g_t \) is government expenditure for period \( t \). \( \sigma_t \) denotes the exchange rate risk, which is positive, and \( \nu_t \) is an aggregate-demand disturbance variable.

The equilibrium in the domestic money market is expressed as

\[ m_t - p_t = -\beta_i l + \beta_y y_t + u_t, \]

where \( m_t \) is the money supply, money demand is a function of the nominal interest rate and GDP, \( i_t \) is the domestic nominal interest rate, and \( u_t \) is a monetary disturbance variable.

The aggregate supply is a function of changes in the price level, the nominal exchange rate, and supply shocks:

\[ y_t = \gamma_1 (p_t - p_{t-1}) - \gamma_2 (e_t + p_t^* - p_t) + w_t, \]

condition, calibrated stationary-state coefficient values are subject to change according to the choice of initial values, a familiar criticism that applies to Cook and Devereux's analysis as well.

7 Our model is an extension of the model in Yoshino, Kaji, and Suzuki (2002, forthcoming).
8 Our theoretical model is in log form, whereas our empirical model is in level form. The reason we used the level form in our empirical analysis is that it provides better estimated results.
where $e_i$ is the nominal exchange rate and $w_i$ is the disturbance variable for the aggregate supply. The first term on the right-hand side of equation (3) is based on the assumption of lagged nominal wage adjustment, hence enabling the aggregate supply to increase (decrease) when the price level in the current period is higher (lower) than the price level in the previous period, and vice versa. The second term in equation (3) expresses the relationship between the exchange rate and supply: production increases when the exchange rate of the ringgit appreciates, because the intermediate goods that Malaysia must import become cheaper.

In addition, when capital movements are unrestricted, the interest rate parity condition,

$$i_i = i_i^* + E_i e_{i+1} - e_i + z_i,$$

will hold, where $z_i$ is the disturbance variable for the interest rate parity equation (the capital inflow disturbance) and $E_i e_{i+1}$ is the expected exchange rate in the next period that is forecast in the present period. We assume that the expected exchange rate will equal its long-run equilibrium trend value. As stated earlier, all variables are expressed as deviations from their long-run trends. This means that the deviation of the long-run equilibrium exchange rate is 0, that is,

$$E_i e_{i+1} = e = 0.$$

Then the interest rate parity condition becomes

$$i_i = i_i^* - e_i + z_i.$$  \text{ (4)}

3.2 Capital controls and the exchange rate regime

Below we discuss three policy regimes that differ from one another according to whether capital controls are in place and by the type of exchange rate regime that is implemented.

\textbf{Policy regime A. Floating exchange rate, free capital movement}  In the case of policy regime A, because capital movements are unrestricted, the interest rate parity condition holds. In equations (1) through (4), the endogenous variables are GDP in period $t$, the exchange rate, the nominal domestic interest rate, and the price level. The exogenous variables are the money supply, foreign GDP, the foreign price level, the foreign interest rate, and the price level in the period $t - 1$. Deriving the reduced forms for GDP, the exchange rate, and the price level, we arrive at the following equations. GDP becomes
Policy regime B. Fixed exchange rate, free capital movement

In the case of policy regime B, the exchange rate is fixed, hence the exchange rate risk in equation (1) disappears. The endogenous variables are GDP, the domestic nominal interest rate, the money supply, and the price level. The exogenous variables are the exchange rate, the foreign GDP, the foreign price level, the foreign interest rate, and the price level in the period \( t - 1 \).

The reduced forms for GDP, the price level, and the money supply, respectively, are

\[
y_t = \frac{1}{\Delta_b} \left\{ (-\alpha_1', -\alpha_2, p'_{t-1} + \alpha_3 y'_{t-1} + \alpha_4, y_{t-1} + \alpha_5, \sigma_{n} + g_{t} + v_{t} + \gamma_{z_{t}})(\beta_1, \gamma_1 + \beta_2, \gamma_2) \right\}
\]

where

\[
\Delta_b = (1 - \alpha_1 + \alpha_4)(\beta_1, \gamma_1 + \beta_2, \gamma_2) + (\alpha_2 + \alpha_3)(\beta_2, \gamma_2 + \beta_1)\]

and the exchange rate and the price level become, respectively,

\[
e_t = \frac{1}{\Delta_b} \left\{ (1 - \alpha_1 + \alpha_4)(-m_{t} - \beta_1, y'_{t-1} + u_{t} - \beta_1, y_{t-1}) - \gamma_1 - \gamma_2) + (-\gamma_2, p'_{t-1} + w_{t}) \right\}
\]

and

\[
p_t = \frac{1}{\Delta_b} \left\{ (1 - \alpha_1 + \alpha_4)(-\beta_1, y'_{t-1} - \gamma_2, p'_{t-1} + w_{t}) - \gamma_1 - \gamma_2) + (-m_{t} - \beta_1, y'_{t-1} + u_{t} - \beta_1, y_{t-1}) \right\}.
\]

\[
\begin{align*}
\Delta_b &= (1 - \alpha_1 + \alpha_4)(\beta_1, \gamma_1 + \beta_2, \gamma_2) + (\alpha_2 + \alpha_3)(\beta_2, \gamma_2 + \beta_1); \\

\Delta_b &= (1 - \alpha_1 + \alpha_4)(\beta_1, \gamma_1 + \beta_2, \gamma_2) + (\alpha_2 + \alpha_3)(\beta_2, \gamma_2 + \beta_1);
\end{align*}
\]

and

\[
\begin{align*}
e_t &= \frac{1}{\Delta_b} \left\{ (1 - \alpha_1 + \alpha_4)(-m_{t} - \beta_1, y'_{t-1} + u_{t} - \beta_1, y_{t-1}) - \gamma_1 - \gamma_2) + (-\gamma_2, p'_{t-1} + w_{t}) \right\} \\
p_t &= \frac{1}{\Delta_b} \left\{ (1 - \alpha_1 + \alpha_4)(-\beta_1, y'_{t-1} - \gamma_2, p'_{t-1} + w_{t}) - \gamma_1 - \gamma_2) + (-m_{t} - \beta_1, y'_{t-1} + u_{t} - \beta_1, y_{t-1}) \right\}.
\end{align*}
\]
Policy regime C. Fixed exchange rate, capital controls in place

The introduction of capital controls into the model means that the interest rate parity condition (equation (4)) no longer holds; therefore, only equations (1) through (3) are used in the analysis. Because the exchange rate is fixed, the exchange rate risk variable disappears from equation (1). In the case of policy regime C, the endogenous variables are GDP, the domestic interest rate, and the price level. The exogenous variables are the exchange rate, the money supply, the nominal interest rate, foreign GDP, the foreign interest rate, and the price level in the period \( t - 1 \).

The reduced forms for GDP and the price level, respectively, are

\[
y_p = \frac{1}{\Delta_c} \left[ (1 - \alpha_1 + \alpha_4)(-\beta_1 y_{t-1} + \alpha_{p'} + \alpha_4 y_{t}' + \gamma_{t}' + v_t) (-\gamma_1 - \gamma_2) \right.
\]

\[
- (-\alpha_2 + \alpha_3) (-\gamma_2 y_{t-1} + \alpha_2 y_{t}' + \gamma_2 y_{t}' + v_t) (-\gamma_3 - \gamma_4) \left. \right] \]

\[
p_p = \frac{1}{\Delta_c} \left[ (1 - \alpha_1 + \alpha_4) \beta_3 (-\gamma_1 y_{t-1} + \gamma_2 y_{t}' + \gamma_3 y_{t}' + v_t) \right.
\]

\[
+ \alpha_3 [\beta_2 (-\gamma_1 y_{t-1} + \gamma_2 y_{t}' + \gamma_3 y_{t}' + v_t) (-m_t + u_t)] \left. \right] \]

\[
+ (-\alpha_2 + \alpha_3) (-\gamma_2 y_{t-1} + \alpha_2 y_{t}' + \gamma_2 y_{t}' + v_t) (-\gamma_3 - \gamma_4) \left. \right] \]

where

\[
\Delta_c = \beta_3 (1 - \alpha_1 + \alpha_4) (-\gamma_1 - \gamma_2) + \alpha_3 \beta_2 (-\gamma_1 - \gamma_2) - \alpha_2 - \beta_1 (-\alpha_2 + \alpha_3). \]

3.3 Setting the policy target function

We now investigate the relationship between the government’s policy targets and the optimal monetary policy to achieve these targets. Given our focus on monetary policy, our investigation is limited to policy regimes A and C, because the money supply is endogenous in policy regime B. We assume that the government’s objective is either the stabilization of GDP and the exchange rate, or the stabilization of GDP and the price level. An optimal monetary policy can be defined as the monetary policy that will minimize the loss function \( L \) when a shock occurs. The shocks are (1) a demand shock, (2) a supply shock, or (3) a sudden change in capital inflow.
If the policy objective is the stabilization of GDP and the exchange rate, then the policy target function becomes

\[ L = \omega_1 y^2 + \omega_2 e^2. \] (5)

Note that because each variable is expressed as the deviation from the long-run equilibrium, the target GDP and the exchange rate are the same as the long-run equilibrium. Similarly, if the policy objective is the stabilization of GDP and the price level, then the policy target function becomes

\[ L = \omega_1 y^2 + \omega_2 p^2. \] (6)

Assuming that the different shocks are not correlated and taking the variance of the reduced form for the exchange rate in policy regime A, we have

\[ \sigma_v = \eta_1 \nu_1^2 + \eta_2 \nu_2^2 + \eta_3 \nu_3^2. \] (7)

Exchange rate volatility will negatively affect exports and imports in the same period in which the shock occurs, and it will reduce aggregate demand.

Table 3 lists the solutions for the optimal money supply and the loss function, when the money supply takes optimal values. All exogenous values are set to zero except for the shock under consideration. For the situations in which the policy regime is choice C (fixed exchange rate, capital controls) and the policy objective is the stabilization of GDP and the exchange rate, then the government can make the loss function equal to zero. In these situations, the exchange rate has zero fluctuations by assumption, yielding the situation of target \( y \) and one policy \( m \).

In all situations with policy regime C, we assume that the capital controls are strict enough to rule out shocks resulting from capital inflows. This means that the loss function with policy regime C is always zero when the capital account shock is the only shock, that is, there is no need for offsetting monetary policy.

4. Empirical analysis

In this section, we estimate a macroeconometric model for Malaysia that is inspired by (and thus not identical to) the theoretical model discussed in section 3. Our data are from the IMF’s International Financial Statistics, and the sample period is the fourth quarter of 1992 to the fourth quarter of 2001. For the home country variables, we use the average ringgit/dollar (RM/US$) exchange rate \( e \), the money market rate \( i \), the consumer price index \( p \), and M2 \( m \). For the foreign variables, we use
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Table 3. Loss function values \(L\) of the macroeconomic model and the optimal values for the money supply \(m\)

1. Case of an aggregate demand shock

IA. Policy target: Stabilization of GDP and exchange rate

Policy regime A. Floating exchange rate, free capital movement

\[
m_{A,t} = -\frac{\omega_1 (\beta_1 \gamma_1 + \beta_2 \gamma_2 + \gamma_2) \frac{dy}{dm} + \omega_2 (\beta_1 - \beta_2 \gamma_2) \frac{dp}{dm} + \frac{de}{dm}}{\omega_1 \left( \frac{dy}{dm} \right)^2 + \omega_2 \left( \frac{dp}{dm} \right)^2}
\]

\[
L = \omega_1 \left[ \left( \beta_1 \gamma_1 + \beta_2 \gamma_2 + \gamma_2 \right) \frac{dy}{dm} + \frac{de}{dm} \right]^2 + \omega_2 \left[ \left( \beta_1 - \beta_2 \gamma_2 \right) \frac{dy}{dm} + \frac{de}{dm} \right]^2
\]

Policy regime C. Fixed exchange rate, capital controls

\[
m_{C,t} = \frac{\beta_1}{\alpha_2} v_t
\]

\[
L = 0
\]

IB. Policy target: Stabilization of GDP and price level

Policy regime A. Floating exchange rate, free capital movement

\[
m_{A,t} = -\frac{\omega_1 (\beta_1 \gamma_1 + \beta_2 \gamma_2 + \gamma_2) \frac{dy}{dm} + \omega_2 (\beta_1 - \beta_2 \gamma_2) \frac{dp}{dm} + \frac{de}{dm}}{\omega_1 \left( \frac{dy}{dm} \right)^2 + \omega_2 \left( \frac{dp}{dm} \right)^2}
\]

\[
L = \omega_1 \left[ \left( \beta_1 \gamma_1 + \beta_2 \gamma_2 + \gamma_2 \right) \frac{dy}{dm} + \frac{de}{dm} \right]^2 + \omega_2 \left[ \left( \beta_1 - \beta_2 \gamma_2 \right) \frac{dy}{dm} + \frac{de}{dm} \right]^2
\]

Policy regime C. Fixed exchange rate, capital controls

\[
m_{C,t} = -\frac{\omega_1 \beta_1 (1 - \gamma_1) \frac{dy}{dm} + \omega_2 \beta_1 \frac{dp}{dm}}{\omega_1 \left( \frac{dy}{dm} \right) \Delta_c + \omega_2 \left( \frac{dp}{dm} \right) \Delta_c}
\]

\[
L = \omega_1 \left[ \beta_1 (1 - \gamma_1) \frac{dy}{dm} + \frac{de}{dm} \Delta_c m_{C,t} \right]^2 + \omega_2 \left( \beta_1 \frac{dp}{dm} + \Delta_c m_{C,t} \right)^2
\]
Table 3. (Continued)

II. Case of an aggregate supply shock
IA. Policy target: Stabilization of GDP and exchange rate
Policy regime A. Floating exchange rate, free capital movement

\[ m_A = \omega \left[ (\beta_1 \gamma_1 + \beta_2 \gamma_2 + \gamma_3) \left( -\alpha_2 \eta_2 \right) + (\alpha_1 + \alpha_2) \beta_1 \right] \frac{dy}{dm} + \omega \left( \frac{de}{dm} \right)^2 \Delta_A \]

\[ + \omega \left( \frac{dp}{dm} \right)^2 \Delta \]

\[ L = \omega \left[ (\beta_1 \gamma_1 + \beta_2 \gamma_2 + \gamma_3) \left( -\alpha_2 \eta_2 \right) + (\alpha_1 + \alpha_2) \beta_1 \right] \frac{dy}{dm} + \omega \left( \frac{de}{dm} \right)^2 \Delta_A m_A \]

Policy regime C. Fixed exchange rate, capital controls

\[ m_C = \omega \left[ (\beta_1 \gamma_1 + \beta_2 \gamma_2 + \gamma_3) \left( -\alpha_2 \eta_2 \right) + (\alpha_1 + \alpha_2) \beta_1 \right] \frac{dy}{dm} + \omega \left( \frac{de}{dm} \right)^2 \Delta_A m_A \]

L = 0

IB. Policy target: Stabilization of GDP and price level
Policy regime A. Floating exchange rate, free capital movement

\[ m_{A,y} = \omega \left[ (\beta_1 \gamma_1 + \beta_2 \gamma_2 + \gamma_3) \left( -\alpha_2 \eta_2 \right) + (\alpha_1 + \alpha_2) \beta_1 \right] \frac{dy}{dm} + \omega \left( \frac{dp}{dm} \right)^2 \Delta_A \]

\[ + \omega \left( \frac{dy}{dm} \right)^2 \Delta \]

\[ L = \omega \left[ (\beta_1 \gamma_1 + \beta_2 \gamma_2 + \gamma_3) \left( -\alpha_2 \eta_2 \right) + (\alpha_1 + \alpha_2) \beta_1 \right] \frac{dy}{dm} + \omega \left( \frac{dp}{dm} \right)^2 \Delta_A m_{A,y} \]

Policy regime C. Fixed exchange rate, capital controls

\[ m_{C,y} = \omega \left[ (\beta_1 \gamma_1 + \beta_2 \gamma_2 + \gamma_3) \left( -\alpha_2 \eta_2 \right) + (\alpha_1 + \alpha_2) \beta_1 \right] \frac{dy}{dm} + \omega \left( \frac{dp}{dm} \right)^2 \Delta_A \]

\[ L = \omega \left[ (\beta_1 \gamma_1 + \beta_2 \gamma_2 + \gamma_3) \left( -\alpha_2 \eta_2 \right) + (\alpha_1 + \alpha_2) \beta_1 \right] \frac{dy}{dm} + \omega \left( \frac{dp}{dm} \right)^2 \Delta_A m_{C,y} \]

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III. Case of a capital account shock

IIIA. Policy target: Stabilization of GDP and exchange rate

Policy regime A. Floating exchange rate, free capital movement

\[ m_{\Delta,Y} = - \frac{\omega_1 \left\{ \left( -\beta_1 \gamma_1 + \beta_1 \gamma_2 + \gamma_2 \right) \alpha_2 + \left( \beta_1 \gamma_1 + \beta_1 \gamma_2 + \gamma_2 \right) \left( -\alpha_2 \eta_2 \right) \right\} [ dy \over dm ] + \omega_2 \left\{ \left[ \left( -\alpha_2 + \alpha_1 \right) \left( -\alpha_2 + \alpha_1 \right) \right] \left( -\gamma_1 - \gamma_2 \right) \beta_1 + \alpha_2 \beta_2 \left( \gamma_1 + \gamma_2 \right) + 1 \right\} [ de \over dm ]}{\omega_1 \left( [ dy \over dm ] \Delta_\lambda + [ de \over dm ] \Delta_\lambda \right)} \]

\[ L = \omega_1 \left\{ \left( -\beta_1 \gamma_1 - \beta_1 \gamma_2 - \gamma_2 \right) \alpha_2 + \left( \beta_1 \gamma_1 + \beta_1 \gamma_2 + \gamma_2 \right) \left( -\alpha_2 \eta_2 \right) \right\} \left( 1 - \alpha_2 + \alpha_1 \right) \left( -\alpha_2 + \alpha_1 \right) \beta_2 \left( \gamma_1 + \gamma_2 \right) + 1 \]

Policy regime B. Fixed exchange rate, capital controls

IIIIB. Policy target: Stabilization of GDP and price level

Policy regime A. Floating exchange rate, free capital movement

\[ m_{\Delta,Y} = - \frac{\omega_1 \left\{ \left( -\beta_1 \gamma_1 + \beta_1 \gamma_2 + \gamma_2 \right) \alpha_2 + \left( \beta_1 \gamma_1 + \beta_1 \gamma_2 + \gamma_2 \right) \left( -\alpha_2 \eta_2 \right) \right\} [ dy \over dm ] + \omega_2 \left\{ \left( 1 - \alpha_2 + \alpha_1 \right) \gamma_1 \beta_1 + \alpha_2 \beta_2 \left( \gamma_1 + \gamma_2 \right) \right\} \left( 1 - \alpha_2 + \alpha_1 \right) \left( -\alpha_2 + \alpha_1 \right) \beta_2 \left( \gamma_1 + \gamma_2 \right) + 1 \right\} [ dy \over dm ]}{\omega_1 \left( [ dy \over dm ] \Delta_\lambda + [ dp \over dm ] \Delta_\lambda \right)} \]

\[ L = \omega_1 \left\{ \left( -\beta_1 \gamma_1 - \beta_1 \gamma_2 - \gamma_2 \right) \alpha_2 + \left( \beta_1 \gamma_1 + \beta_1 \gamma_2 + \gamma_2 \right) \left( -\alpha_2 \eta_2 \right) \right\} \left( -\alpha_2 + \alpha_1 \right) \left( -\alpha_2 + \alpha_1 \right) \left( -\gamma_1 - \gamma_2 \right) \beta_2 \left( \gamma_1 + \gamma_2 \right) + 1 \]

Policy regime C. Fixed exchange rate, capital controls

No need for offsetting monetary policy.

\[ L = 0. \]

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U.S. GDP and the U.S. federal funds interest rate. Our estimation method is two-stage least-squares regression.

The results of our estimation are as follows:

**Consumption function**

\[
RCONS = 80.33 + 0.32RGDP
\]

\[
(4.67) \quad (11.27)
\]

\[DW = 1.3075 \text{ (DW is the Durbin-Watson statistic.)}\]

**Investment function**

\[
RINV = -103.53 + 0.57RGDP + (3.32 - 14.67DUMMY)RI - 95.86CDUMMY
\]

\[
(-2.28) \quad (8.73) \quad (1.08) \quad (-2.60) \quad (-5.95)
\]

\[DW = 2.0535\]

**Money market equation**

\[
RMS = -1,003.19 + 5.60RGDP - 44.37RI
\]

\[
(-4.70) \quad (19.93) \quad (-3.08)
\]

\[DW = 0.7588\]

**Net export function**

\[
RNEX = -973.27 + 17.69RISAGDP - 0.59RGDP - 94.69EXV
\]

\[
(-10.78) \quad (8.34) \quad (-4.00) \quad (-1.59)
\]

\[DW = 0.9194\]

**Aggregate supply equation**

\[
CPI = 3.52 + 0.96CPI(-1) + 0.0076YGAP(-1) + 0.61REXR
\]

\[
(3.03) \quad (55.59) \quad (2.58) \quad (2.14)
\]

\[DW = 1.7064\]

**Interest rate linkage**

\[
I = (1.38 - 1.63DUMMY)USA + 0.76DE + 4.47DUMMY
\]

\[
(16.82) \quad (-3.45) \quad (0.39) \quad (1.86)
\]

\[DW = 0.2689\]

In these equations,

\[
RCONS = \text{real consumption (consumption/CPI)}
\]

\[
RGDP = \text{real GDP}
\]

\[
RINV = \text{real investment}
\]
RI = the real interest rate, calculated as \( i_t - p_t + p_{t-1} \) by assuming that the expected future increase in the price level will be the same in the current period.

\( DUMMY = \) capital controls dummy (set to 1 from the fourth quarter of 1998 up to the fourth quarter of 2001)

\( CDUMMY = \) financial crisis dummy (set to 1 from the fourth quarter of 1997 up to the fourth quarter of 2001)

\( RMS = \) the money supply in real terms

\( RNEX = \) net real exports (real exports − real imports)

\( RUSAGDP = \) U.S. GDP in real terms

\( EXV = \) exchange rate volatility proxied by the variation in the exchange rate for 12 months, beginning with the first month of the period (Var[EX])

\( CPI = \) the consumer price index

\( YGAP = \) the deviation of GDP from the long-run trend (\( \hat{y}_t = \alpha_0 + \alpha_1 t + \alpha_2 t^2 \) is the long-run equilibrium value of \( y \), where \( t \) is a time trend)

\( REXR = \) the real exchange rate

\( USAI = \) the U.S. interest rate

\( DE = \) the expected rate of depreciation of the exchange rate, proxied by the actual subsequent exchange rate movements (\( EX [+1] - EX \), where \( EX \) is the log of the exchange rate).

Consumption is expressed as a function of GDP, and the marginal propensity to consume is 0.31. Investment is expressed as a function of real GDP, the real interest rate of the previous period, and the dummy variables for the capital controls and for the financial crisis. The money market equation is expressed as a function of real GDP and the real interest rate.

Exports are expressed as a function of U.S. GDP and exchange rate volatility. The exchange rate coefficient was found to be not statistically significant and is therefore excluded. Imports are expressed as a function of only domestic GDP and exchange rate volatility because the exchange rate was found to be not significant. The exchange rate volatility variable has a statistically significant effect on both exports and imports.

Aggregate supply is expressed as a function of the deviation of the price level from the previous period, the deviation of GDP from the long-run equilibrium, and the exchange rate in real terms. Lastly, the interest rate linkage equation shows Malaysia’s nominal interest rate as a function of the U.S. interest rate, a dummy variable expressing the capital controls, and the expected rate of depreciation of the exchange rate. While the introduction of capital controls reduces the influence of the U.S. interest rate, it raises the Malaysian risk premium by 4.47 percentage points.
5. Calculating the welfare consequences

Table 4 shows the values of the loss function resulting from the execution of the optimal policy, with the coefficients estimated in section 4 substituted into the equations derived in section 3. In policy regime A (floating exchange rate, free capital movement), the value of $\alpha_5$ has been multiplied by 0, 0.5, 1, and 2 to show how increased integration into the world economy (e.g., a rising ratio of international trade to GDP) changes the welfare cost of a given amount of exchange rate volatility. Because exchange rate volatility does not exist in policy regime C, only one loss value is given.

Some of the results are in accordance with intuition. The intuitively clearest case is when the shock originates in the capital account of the balance of payments. Here, the capital controls in policy regime C make it superior to policy regime A, regardless of which of the two sets of policy objectives is chosen (see panel III of table 4).

A quite straightforward analysis is also available when exchange rate stability is desired for its own sake (i.e., when exchange rate deviation is an element in the loss function). With such a preference, the fixed exchange rate feature in policy regime C will ensure the inferiority of policy regime A, regardless of the nature of the shock, and regardless of whether $\alpha_5$ is zero or a positive value (see left-hand side of table 4).

The interesting finding when the policy objective is the stabilization of both output and the exchange rate, and when policy regime A is in force, is that the same-sized shock will inflict the greatest cost when it is a capital account shock and the lowest cost when it is a supply-side shock.

Prior reasoning provides much less assistance in choosing between policy regime A and policy regime C when the policy objective is to minimize output fluctuations and price fluctuations, and when the shock is not from capital flows. When $\alpha_5$ is zero, policy regime A shows a loss of $6.25 \times 10^{-4}$ in response to a demand-side shock, and policy regime C shows a bigger loss, of $2.48 \times 10^{-3}$. Policy regime C is better only when $\alpha_5$ or trade integration is large. The general conclusion from the three cases in the right-hand side of table 4 underscores the well-tested proposition that the best policy regime cannot be defined independently of the origin of the shock and independently of the structure of the economy. And, of course, the “taste” of the policymaker can unilaterally define what is always the best policy regime, as evidenced by the left-hand side of table 4.
### Table 4. Loss function values

#### I. Aggregate demand shock

<table>
<thead>
<tr>
<th>Policy regime</th>
<th>$0_{x1}$</th>
<th>$0.5, \sigma_1$</th>
<th>$\alpha_1$</th>
<th>$2\alpha_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Floating exchange rate, free capital movement</td>
<td>-1.0757</td>
<td>24.3884</td>
<td>-49.8526</td>
<td>-100.7809</td>
</tr>
<tr>
<td>L</td>
<td>0.0003</td>
<td>0.0161</td>
<td>0.00558</td>
<td>2.7403</td>
</tr>
<tr>
<td>C. Fixed exchange rate, capital controls</td>
<td>3.9113</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In regimes A and C, $0_{x1}$ is calculated with values set at $v = 1$, $w = 1$, and $z = 1$; $\omega_1 = 0.5$, and $\eta = 0.5$.

#### II. Aggregate supply shock

<table>
<thead>
<tr>
<th>Policy regime</th>
<th>$0_{x1}$</th>
<th>$0.5, \sigma_1$</th>
<th>$\alpha_1$</th>
<th>$2\alpha_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Floating exchange rate, free capital movement</td>
<td>-0.9982</td>
<td>-22.6199</td>
<td>46.2580</td>
<td>93.5142</td>
</tr>
<tr>
<td>L</td>
<td>0.0006</td>
<td>0.3211</td>
<td>1.3415</td>
<td>12.9065</td>
</tr>
<tr>
<td>C. Fixed exchange rate, capital controls</td>
<td>-3.9113</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In regimes A and C, $0_{x1}$ is calculated with values set at $v = 1$, $w = 1$, and $z = 1$; $\omega_1 = 0.5$, and $\eta = 0.5$.

#### III. Capital-inflow shock

<table>
<thead>
<tr>
<th>Policy regime</th>
<th>$0_{x1}$</th>
<th>$0.5, \sigma_1$</th>
<th>$\alpha_1$</th>
<th>$2\alpha_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Floating exchange rate, free capital movement</td>
<td>-0.4137</td>
<td>25.2144</td>
<td>46.8425</td>
<td>94.0987</td>
</tr>
<tr>
<td>L</td>
<td>7.85 E-5</td>
<td>0.3531</td>
<td>1.4062</td>
<td>5.6124</td>
</tr>
<tr>
<td>C. Fixed exchange rate, capital controls</td>
<td>-0.0026</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In regimes A and C, $0_{x1}$ is calculated with values set at $v = 1$, $w = 1$, and $z = 1$; $\omega_1 = 0.5$, and $\eta = 0.5$.

Note: $0_{x1}$ is calculated with values set at $v = 1$, $w = 1$, and $z = 1$; $\omega_1 = 0.5$, and $\eta = 0.5$. |
6. Conclusion

We concentrated on openness and the use of capital controls as means to recover monetary policy autonomy when the exchange rate is fixed after an economic shock. By comparing different exchange rate regimes, we analyzed the potential benefits of introducing capital controls and a fixed exchange rate. After calculating the theoretical loss using a theoretical model, we estimated the coefficients using actual Malaysian data. We found that exchange rate volatility has a negative effect on Malaysia’s exports and imports. After substituting the estimated coefficients into the loss function, we were able to conclude that Malaysia’s gains from capital controls and fixed exchange rates increase with its openness.

When the policy targets are the stabilization of both GDP and the exchange rate, the simultaneous use of capital controls and a fixed exchange rate automatically achieves one of the policy targets, and thus the policy instrument can be focused on the remaining target. In this way the loss can be brought down to zero. More importantly, our model predicts that exchange rate volatility will cause larger disturbances in a small economy as the degree of its economic openness increases. The loss resulting from exchange rate volatility can increase with openness, even when an optimal policy is put in place. In such a situation, it is clearly better to introduce capital controls and a fixed exchange rate. The absence of capital inflow shocks is another benefit of capital controls and a fixed exchange rate.

In closing, we want to caution the reader against the possibility of false precision. First, some of the behavioral assumptions in the macroeconomic model reported in section 4 are not in accordance with the underpinnings of the theoretical model discussed in section 3. Second, both the empirical model and the theoretical model have several unsatisfactory features, for example, in the modeling of expectations and in the neglect of fiscal policy as a macroeconomic policy instrument. The calculations in table 4 should therefore be viewed as a heuristic rather than an exactly rigorous exercise. It is hoped that these calculations are illustrative of the relative welfare costs of policy regime A and policy regime C for different sets of policy objectives when different shocks hit the economy. Given the limited nature of our simulations, we have no pretensions that our calculations are precise estimates of the absolute welfare gains. The results in table 4 should be correctly recognized as preliminary findings from an ongoing research program on the macroeconomic stabilization of small open economies.

References

Stabilization of an Open Economy with Capital Controls


