Choice of currency basket weights and its implications on trade balance

Hsiang-Ling Han*

Economics Division, Babson College, Wellesley, MA 02457-0310, USA

Received 14 August 1998; revised 10 June 1999; accepted 23 August 1999

Abstract

This paper seeks to find an optimal choice of currency basket weights for emerging economies that peg their currencies to a currency basket, and to examine the long-run relationship between the real exchange rates of a group of trading partners. A general equilibrium model is set up to establish an optimal set of currency basket weights, coupled with the choice of fiscal policy, to simultaneously stabilize trade balance and aggregate price level of an economy. This optimal set of weights is a weighted average of two sets of weights; each targets at one policy goal (stabilizing either balance of trade or aggregate price level) at a time. Empirical studies including vector autoregression (VAR) analysis and cointegration analysis on the long-run relationship between the Thai baht and the real exchange rates of its major trading partners are presented. © 2000 Elsevier Science Inc. All rights reserved.

JEL classification: F31; C32

Keywords: Currency basket; Vector autoregression; Cointegration

1. Introduction

The Dow Jones Industrial Average lost more than 7 percent of its value on October 28, 1997. It was preceded by a 5.8 percent plunge in the Hong Kong Stock Market following months of speculation and devaluation of Southeast Asian currencies. Many people believe that the downward spiral originated in the Thai government's insistence on pegging the Thai baht to the U.S. dollar. The domino effect eventually reached South Korea and Japan. South Korea's currency, the won, lost the maximum daily trading limit, 10 percent of its value, on November 20, 1997. The demise of a powerful Japanese broker, Yamaichi Securities Co., on November 24, 1997, propelled the Asian currency and financial crises to another climax.

* Corresponding author. Tel.: 781-239-5851; fax: 781-239-5239.
E-mail address: han@babson.edu (H.-L. Han)

1059-0560/00/$ – see front matter © 2000 Elsevier Science Inc. All rights reserved.
PII: S1059-0560(00)00060-5
The debate on the optimal exchange rate policy that prevents this type of financial crisis from happening has been going on for decades. The focus of this paper, however, is on the choice of currency basket weights and its implications on trade balance for emerging economies. It is known that most of the Southeast Asian countries that encounter currency crises peg their currency to a basket dominated by the U.S. dollar. The paper, using Thailand as an example, investigates whether the choice of currency basket weights is optimal and the relation of the currency basket weights with its balance of trade.

A general equilibrium model is set up to establish an optimal choice of currency basket weights, coupled with an optimal fiscal policy, to simultaneously stabilize overall balance of trade and price level of an economy. The model takes multilateral trade flows as well as macroeconomic policy targets into consideration. Long-run relationships between the Thai baht and the real exchange rates of its major trading partners are then explored. Thailand is used to conduct the empirical work of the paper because it is believed that this wave of currency crisis was originated there. It is interesting to analyze and to examine how the currency basket weights chosen by the Thai government affect the value of the Thai baht, their trade balance, and their current account balance, even though those weights are not officially publicized.

Two approaches are used to analyze the long-run relationships between the Thai baht and the real exchange rates of its major trading partners. Vector autoregression (VAR) analysis is used to estimate a system of interrelated real exchange rates and to analyze the dynamic impact of random disturbances on the system of variables. The impulse-response function is presented to trace the effect of a shock to a real exchange rate on current and future values of another real exchange rate. The second approach, focusing on the long-run cointegrating relationship between these real exchange rates, includes canonical cointegrating regression (CCR) and Johansen’s LR test.

Most tests for cointegration [e.g., Engle & Granger (1987) and Phillips & Ouliaris (1988)] took the null hypothesis of no cointegration. Failures to reject the null hypothesis of no cointegration are often interpreted as evidence against economic models that hypothesize cointegration. This type of methodology is known to have relatively low power. The two methodologies used in this paper, however, are relatively powerful and have good small sample properties. CCR proposed by Park (1992) tests the null hypothesis of cointegration. Han (1996) investigated the small sample properties of the CCR tests and concluded the tests perform well with reasonable size and power even when the samples are small. The Johansen’s LR test is now commonly used, and numerous researches have proven it to be a reasonable testing method for cointegration.

This paper is organized as follows. Section 2 reviews the literature on the choice of exchange rate regimes. Section 3 presents a general equilibrium model that establishes an optimal set of weights for a currency basket, coupled with an optimal fiscal policy, to reach two economic policy goals at the same time. Prior to conducting the empirical analysis for the Thai baht, section 4 discusses the evolution of the exchange rate system in Thailand that provides the background understanding of the Thai crisis. Section 5 presents two sets of empirical results for real exchange rates (all against the U.S. dollar) of Thailand, Japan, Germany, the Netherlands, and Singapore. The
first set of results includes a vector autoregression (VAR), variance decomposition, and impulse-response function analysis. The second set of results includes the test for cointegration and the estimation of cointegrating vector for the group of currencies. Section 6 is the concluding remarks.

2. Literature review

Most of the literature relating to the choice of exchange rate arrangements is cast in terms of a dichotomy between fixed and flexible exchange rates. In practice, however, systems of rigidly fixed or perfectly flexible rates are hardly ever observed. Different types of exchange rates arrangements may be appropriate for different countries, depending on their structural characteristics, external environments, and macroeconomic and political circumstances. Moreover, as structural characteristics, external environments, or macroeconomic and political circumstances change over time, market pressures on exchange rates may sometimes become so overwhelming that they essentially force changes in the exchange rate arrangements (like what happened in Thailand).

Discussions of optimal currency arrangements have changed considerably over the past half-century. The debate over fixed versus flexible exchange rates around 1960 centered on the issue of whether international capital flows would be stabilized under flexible rates (Friedman, 1953). A new school of thought emerged in 1960s, analyzing the types of structural characteristics that made it optimal for a country to choose one type of arrangement over the other (Mundell, 1969; McKinnon, 1963; Kenen, 1969). These studies focused on a number of relevant structural characteristics of economies, including size and openness, diversity of production activities and occupational skills, geographic factor mobility, fiscal redistribution mechanisms, policy preferences, wage and price flexibility, exposure to shocks, and level of financial development. Mundell also led the analysis of optimal currency areas. He defined an optimal currency area as “a domain within which exchange rates are fixed,” rather than an area with a single currency.

The conventional wisdom in the 1970s was that the currencies of developed countries should float but the currencies of less-developed countries (LDCs) should not. With the advent of generalized floating, both Malaysia and Singapore allowed their currencies to float until both countries decided in 1975 to peg their currencies to baskets of currencies of their trading partners. Korea and Thailand initially pegged their currencies to the U.S. dollar, but later switched to pegging their currencies to basket composites after a major devaluation of the nominal exchange rates. Korea switched from the dollar peg to the composite peg in 1980 following a 20-percent devaluation, while Thailand adopted the basket pegging arrangement after a devaluation in 1985. The Philippines officially adopted the U.S. dollar peg system, while making several adjustments to the nominal parity through a series of devaluations (Gan, 1994).

Analysis of optimal exchange rate arrangements in the 1980s and 1990s was extended largely in association with deliberations over the move toward monetary integration in Europe. It has emphasized issues such as the adverse effects of exchange rate uncertainty, the credibility of monetary policy, the option value of an inflation tax,
the scope for international policy cooperation, and the endogeneity of factor mobility or other structural characteristics (Edison & Melvin, 1990). By the mid-1980s, the policy-making community actively discussed proposals for replacing the system of flexible exchange rates among major currencies with a system of target zones (Krugman, 1991). A “target zone” is an arrangement with wide margins around an adjustable set of exchange rates. In early 1990s, the theory of optimal currency areas was to consider various practical issues associated with the move toward monetary integration in Europe (Bayoumi, 1994).

More recently, the study on exchange rate regimes is linked with financial fragility and macroeconomic policies. Chang and Velasco (1997) found that a currency board cannot implement a socially optimal allocation. In addition, bank runs are possible under a currency board. They also found that a fixed exchange rate system may implement a social optimum but is more prone to bank runs and exchange rate crises than a currency board. However, they found that a flexible exchange rate system implements the social optimum and eliminates runs, provided the exchange rate and central bank lending policies are appropriately designed.

The focus of this paper is to search for explanations for the 1997 Asian foreign exchange market crises. Therefore, only the currency basket arrangement that has been adopted by most of the Southeast Asian countries is studied here. One explanation is that the choices of weights to determine basket composites of these countries may not be adequate to deter speculators from attacking these Southeast Asian currencies. For example, the top priority of the central bank of Thailand for the period of 1985 to 1997 has been to hold the baht stable against a basket of currencies dominated by the U.S. dollar. The policy helped to cut inflationary expectations in Thailand and made it one of the world’s fastest-growing economies, but also created a huge current account deficit. The inter-relationship between currency basket weights, overall trade balances, and price level will be analyzed in our model.

3. The basic model

The model is set up to show that a combination of optimal fiscal policy and currency basket weights can reach two policy goals at the same time (e.g., keep the overall balance of trade as well as price level unchanged). The analysis is based on Branson and Katseli (1981), and can be extended to include other economic policies such as monetary policy and trade (tariff) policy.

Assume that the home country produces two goods: exports goods and nontraded goods. Exports are not consumed by the home country residents and nontraded goods are consumed only by the home country residents. The real exchange rate stabilization is also assumed in the model as in Branson and Katseli (1981). Notation and definition of the symbols used in the model are summarized in Table 1.

3.1. The export market

The home country export supply depends on the relative home-currency price of exports to nontraded goods \( \left( \frac{p_x}{p_0} \right) \), as well as on the price elasticity of export supply.
Table 1
Notation and definition of symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_i$</td>
<td>units of home currency per unit of $i$ currency, $i=0,..., N$; $N =$ numeraire country.</td>
</tr>
<tr>
<td>$J_i$</td>
<td>units of numeraire ($$) per unit of $i$ currency.</td>
</tr>
<tr>
<td>$r$</td>
<td>units of home currency per unit of numeraire.</td>
</tr>
<tr>
<td>$q_i$</td>
<td>foreign country’s price of non-traded goods.</td>
</tr>
<tr>
<td>$q_{si}(q_{mi})$</td>
<td>foreign country’s price of exports (imports).</td>
</tr>
<tr>
<td>$p_0$</td>
<td>home country’s price of non-traded goods.</td>
</tr>
<tr>
<td>$Z$</td>
<td>$dZ/Z$, for any variable $Z$.</td>
</tr>
<tr>
<td>$p_{sx}(p_{sm})$</td>
<td>home country prices of exports (imports).</td>
</tr>
<tr>
<td>$X(M)$</td>
<td>export (imports) quantities of home country.</td>
</tr>
<tr>
<td>$O$</td>
<td>quantities of non-traded goods.</td>
</tr>
<tr>
<td>$\alpha_i(\beta_i)$</td>
<td>home country export (import) shares to (from) country $i$.</td>
</tr>
<tr>
<td>$d_s(s_s)$</td>
<td>price-elasticities of export demand (supply) in home country.</td>
</tr>
<tr>
<td>$d_m(s_m)$</td>
<td>price-elasticities of import demand (supply) in home country.</td>
</tr>
<tr>
<td>$\delta_0(\delta_m)$</td>
<td>semi-elasticity of import (non-traded goods) demand with respect to interest rate in home country.</td>
</tr>
<tr>
<td>$\phi$</td>
<td>semi-elasticity of money demand with respect to interest rate in home country.</td>
</tr>
<tr>
<td>$\varepsilon_{sx}$</td>
<td>income-elasticity of imports in home country.</td>
</tr>
<tr>
<td>$\varepsilon_{0x}$</td>
<td>income-elasticity of non-traded goods in home country.</td>
</tr>
<tr>
<td>$\theta$</td>
<td>share of non-traded goods spending to total spending in home country.</td>
</tr>
<tr>
<td>$BT$</td>
<td>balance of trade on goods and services in home country’s currency.</td>
</tr>
<tr>
<td>$MY$</td>
<td>quantity of money.</td>
</tr>
<tr>
<td>$R$</td>
<td>domestic nominal interest rate.</td>
</tr>
<tr>
<td>$y_0$</td>
<td>real income of home country.</td>
</tr>
</tbody>
</table>

The export supply function can be written as shown in Eq. (1),

$$\ln X = s_s (\ln p_x - \ln p_0),$$

which implies that the higher relative price of exports to nontraded goods, the more exports will be supplied.

Demand for the home country exports by country $i$, given country $i$’s currency price of the home country exports and country $i$’s currency price of its own nontraded goods, is specified as shown in Eq. (2):

$$\ln X_i = -d_s (\ln q_{si} - \ln q_i).$$

That is, the home country export demand by country $i$ is a function of the relative price of the home country exports (country $i$’s imports) to country $i$’s nontraded goods ($q_{si}/q_i$), both measured in country $i$’s currency. The price elasticity of export demand in all countries is assumed equal $d_s$ to for simplicity. Goods arbitrage ensures the equality of the home country currency price of exports ($p_x$) and country $i$’s currency price of exports ($T_i q_{si}$), as shown in Eq. (3),

$$p_x = T_i q_{si},$$

where $T_i = Jr$.

The equilibrium condition for the export market is when the export supply from the home country equals the aggregate demand for exports from the rest of the world.
Total differentiation of the condition shows that percentage change in export price \( (\hat{\rho}_x) \) is a function of percentage change in the price of domestic nontraded goods \( (\hat{\rho}_0) \), percentage change in the home country’s real exchange rate against the numeraire, \((r + \hat{q}_N - \hat{q}_N)\) as well as percentage change in the numeraire’s real exchange rates against third countries, \((\hat{J}_i + \hat{q}_i - \hat{q}_N)\), as shown in Eq. (4),

\[
\hat{\rho}_x = \hat{\rho}_0 + k(r + \hat{q}_N - \hat{q}_0) + k \sum \alpha_i(\hat{J}_i + \hat{q}_i - \hat{q}_N), \tag{4}
\]

where \( k \equiv d_i/(d_i + s_i) \).

As mentioned in Branson and Katseli (1981), \( k \) represents market power on the export (the home country) side. A small country assumption means \( k = 1 \). By substituting condition (4) into the export market (1), Eq. (5) can be shown:

\[
\hat{X} = s_m(\hat{\rho}_0 + \sum \alpha_i(\hat{J}_i + \hat{q}_i - \hat{q}_N)). \tag{5}
\]

Percentage change in exports is a function of percentage change in the home country’s real exchange rate, percentage change in foreign real exchange rates, and the parameters of \( k \) and \( s_m \).

### 3.2. The import market

In the import market, assume that the home country government spends \( aG \) on imports, where \( G \) indicates the government spending and \( a \) indicates the portion of government spending on imports. The supply of imports by country \( i \) is a function of the relative \( i \)-currency price of imports (i.e., country \( i \)'s exports) to country \( i \)'s nontraded goods. It is similar to Eq. (1) and it can be expressed as shown in Eq. (6):

\[
\ln M_i = s_m(\ln q_{mi} - \ln q_i). \tag{6}
\]

The aggregate demand for imports by the home country is dependent on the relative home currency price of imports to nontraded goods, the real income level, the nominal interest rate, and the government spending in the home country, as shown in Eq. (7),

\[
\ln M = -d_m(\ln p_m - \ln p_0) + \epsilon_m \ln y - \delta_m R + \gamma_m \ln G, \tag{7}
\]

where \( \gamma_m = aG/M \) indicates the government spending share of imports market. Equating the demand and supply of imports, it is shown that the corresponding change in the import price is a function of percentage change in the price of domestic nontraded goods, percentage change in the home country’s real exchange rate, percentage change in foreign real exchange rates, percentage change in the real income, change in the nominal interest rate, government spending, and other elasticity parameters. Eq. (8) is given as follows:

\[
\hat{p}_m = \hat{p}_0 + k'(r + \hat{q}_N - \hat{q}_0) + k' \sum \beta_i(\hat{J}_i + \hat{q}_i - \hat{q}_N) + \epsilon_m \hat{y} - \delta_m dR + \gamma_m \hat{G}, \tag{8}
\]

where \( k' \equiv s_m/(d_m + s_m) \), \( \delta'_m \equiv \delta_m/(d_m + s_m) \), \( \epsilon'_m \equiv \epsilon_m/(d_m + s_m) \), and \( \gamma'_m \equiv \gamma_m/(d_m + s_m) \). Substituting condition [Eq. (8)] into the import market [Eq. (6)], it can be shown that percentage change in imports \( (\hat{M}) \) is a function of percentage change in domestic and foreign real exchange rate and other elasticity parameters.
3.3. The nontraded goods market

Demand and supply of nontraded goods for the home country are specified in an analogous way. Percentage change in the price of nontraded goods can be expressed as shown in Eq. (9),

\[ \hat{p}_0 = k_0 \hat{p}_x + (1 - k_0)\hat{p}_m + \varepsilon_0\hat{y} - \delta_0' dR + \gamma_0' \hat{G} , \]

where \( k_0 = s_0/(s_0 + d_0) \), \( \varepsilon_0' = \varepsilon_0/(s_0 + d_0) \), \( \delta_0' = \delta_0/(s_0 + d_0) \), and \( \gamma_0 = (1 - a)G/O \) is the government spending share of nontraded goods. Eq. (9) means that percentage change in the price of nontraded goods is dependent on percentage change in the price of exports and imports, percentage change in the real income, change in the nominal interest rate, and percentage change in the government spending. It can also be shown that percentage change in nontraded goods \( \hat{O} \) depends on the same factors that affect percentage change in the price of nontraded goods.

3.4. The money market

Demand for real money balances is a function of the real income and the nominal interest rate, as shown in Eq. (10),

\[ \ln M_Y - \ln p_t = \ln y - \phi R, \]

where \( p_t \) is the consumer price index (CPI) and is defined as \( CPI = p_t = p_0^m p_m^{1-\theta} \). It is assumed that the interest rate \( (R) \) can be chosen by the central bank to certain extent. For example, the Bank of Thailand (BOT) successfully adjusted the interest rate ceiling and monitored credits extended to the private sectors in early 1980s. From 1985 to 1985, the BOT also played a leading role in bringing down domestic interest rates by reducing interest rate ceilings on several occasions. Let us focus on the impacts of fiscal policy, and assume that there is no tariff and no monetary policy \( (M = 0) \). The real income of the home country is defined as the nominal income divided by the aggregate price level, as given by Eq. (11):

\[ y = \frac{p_0 O + p_0 X}{p_0^m}, \]

Differentiating both sides of Eq. (11) gives Eq. (12):

\[ \hat{y} = a(\hat{p}_0 + \hat{O}) + b(\hat{p}_x + \hat{X}) - \theta \hat{p}_0 - (1 - \theta)\hat{p}_m, \]

where \( a = p_0 O/(p_0 O + p_0 X) \), \( b = p_0 X/(p_0 O + p_0 X) \), and \( a + b = 1 \). Substituting all percentage changes of nontraded goods, price of nontraded goods, exports, price of exports, and price of imports \( (\hat{p}_0, \hat{O}, \hat{p}_x, \hat{X}, \hat{p}_m) \) into Eq. (12), it can be shown that, according to Eq. (13):

\[ \hat{y} = (a(1 + s_o) - bs_o)\hat{p}_0 + (b(1 + s_x) - as_o)\hat{p}_x - \theta \hat{p}_0 - (1 - \theta)\hat{p}_m \]

\[ = A \hat{p}_0 + B\hat{p}_x - \theta \hat{p}_0 - (1 - \theta)\hat{p}_m, \]

where \( A = a(1 + s_o) - bs_o \), \( B = b(1 + s_x) - as_o \), \( A + B = 1 \) and \( A > 0, B > 0 \). Eq. (13) implies that percentage change in the real income is a function of percentage
changes in all prices, including nontraded goods, exports, and imports. Then, substituting percentage change in the real income \((\dot{y})\) into Eq. (10) and letting \(MY = 0\), it shows that change in the nominal interest rate is as shown in Eq. (14):

\[
dR = \frac{1}{\phi}(A\dot{\rho}_0 + B\dot{\rho}_x) .
\] (14)

When the prices of nontraded goods and exports increase, the nominal interest rate increases.

Next is to solve the simultaneous equations of (4), (8) and (9) for \(\dot{p}_x, \dot{p}_m, \dot{X}\) and then for \(\dot{X}, \dot{M}, \dot{O}\). These results will further be utilized to determine the optimal weights for different policy goals. Details are shown in mathematical appendix.

3.5. Policy goals

3.5.1. Stabilizing the balance of trade

The balance of trade on goods and services in the home country currency is defined as \(BT = p_xX - p_mM\). Differentiating \(BT\) and choosing \(p_x = p_m = 1\) initially result in Eq. (15):

\[
dBT = (\dot{p}_x + \dot{X})X - (\dot{p}_m + \dot{M})M .
\] (15)

Substituting the results from previous section on \(\dot{p}_x, \dot{p}_m, \dot{X}, \dot{M}\) and assuming that \(X = M\) at the beginning leads to Eq. (16),

\[
dBT = \Gamma_1\dot{\rho}_0 + \Gamma_2\dot{\rho}_x + \Gamma_3\dot{\rho}_m - \gamma_m\dot{G},
\] (16)

where \(\Gamma_1 = -(s_x + d_m) - (\varepsilon_m - \delta_m/\phi)A + \varepsilon_m\theta, \Gamma_2 = (1 + s_x) - (\varepsilon_m - \delta_m/\phi)B,\) and \(\Gamma_3 = -(1 - d_m) + \varepsilon_m(1 - \theta)\). Substituting \(\dot{\rho}_0, \dot{\rho}_x, \dot{\rho}_m\) (see the appendix) into Eq. (16), we get Eq. (17),

\[
dBT = H_1(\dot{r} + \dot{q}_N - \dot{\rho}_0) + \sum H_2(\dot{J}_i + \dot{q}_i - \dot{q}_N) + H_3\dot{G},
\] (17)

where \(H_1 = \Gamma_1E_1 + \Gamma_2\Pi_1 + \Gamma_3\Lambda_1, H_2 = \Gamma_1E_2 + \Gamma_2\Pi_2 + \Gamma_3\Lambda_2, H_3 = \Gamma_1E_3 + \Gamma_2\Pi_3 + \Gamma_3\Lambda_3 - \gamma_m\). The detailed definition of \(E_1, E_2, E_3, \Pi_1, \Pi_2, \Pi_3, \Lambda_1, \Lambda_2, \Lambda_3\) can be found in the mathematical appendix.

If

\[
\frac{(s_x + d_m) + (\varepsilon_m - \delta_m/\phi)A}{\varepsilon_m} < \theta < \frac{\varepsilon_m - (1 - d_m)}{\varepsilon_m}
\]

it can be shown that \(H_1, H_2, H_3\) are positive, therefore \(H_1\) and \(H_3\) are positive. But the sign for \(H_2\) is uncertain and depends on the government spending share of imports \((\gamma_m)\). To stabilize the trade balance and let \(dBT = 0\), the home country’s real exchange rate against the numeraire must equal, as shown in Eq. (18):

\[
(\dot{r} + \dot{q}_N - \dot{\rho}_0) = -\sum w_i(\dot{J}_i + \dot{q}_i - \dot{q}_N) - Z_1\dot{G},
\] (18)

where the weight is defined as \(H_1^{-1}H_3\) and is the weight in a currency basket if the balance of trade is kept unchanged, and \(Z_1, defined as H_1^{-1}H_3,\) is the reaction of the home country currency toward the change in government purchases. A decrease in
(\(\hat{J}_i + \hat{q}_i - \hat{q}_N\)) (i.e., the depreciation of \(i\)th currency), will deteriorate the trade balance by \(H_{2i}\). In order to keep the balance of trade unchanged and to offset the impact from the depreciation of \(i\)th currency, the home country currency against numeraire (\(\hat{r} + \hat{q}_N - \hat{p}_0\)) should increase (depreciate) according to \(w_i\). Also, when government spends more on imports, the trade balance will deteriorate and the home currency should depreciate according to \(Z_1\).

Branson and Katseli (1981) show that the weights to be chosen in a currency basket in order to stabilize real exchange rate, without including any policy variable to reach any policy goal, is \((\hat{r} + \hat{q}_N - \hat{p}_0) = -\sum w_i^p (\hat{J}_i + \hat{q}_i - \hat{q}_N)\) Stabilization of real exchange rate is also assumed in our model. However, in contrast to Branson and Katseli’s (1981) model, we include the policy variable (G) in Eqs. (7), (8), (9), and consider a nontraded market affected by government purchases (G). Eq. (18) is derived following these assumptions. Eq. (18) indicates that government purchases could change and the home country currency against numeraire \((\hat{r} + \hat{q}_N - \hat{p}_0)\) should react to the change according to \(Z_1\), even though the real value of \(i\)th currency does not change. The term \(w_i\) in Eq. (18) is the weight in a currency basket if we want to keep the trade balance unchanged. Both are derived under the assumptions stated in the model.

3.5.2. Stabilizing the consumer price index

The consumer price index is defined in the previous section as \(CPI = p_I = p_i p_m^{l_0}\). Therefore, the change in the CPI is \(\hat{p}_I = \theta \hat{p}_0 + (1 - \theta) \hat{p}_m\). Letting \(\hat{p}_I = 0\), Eq. (19) can be shown,

\[(\hat{p} + \hat{q}_N - \hat{p}_0) = -\sum w'_i (\hat{J}_i + \hat{q}_i - \hat{q}_N) - Z_2 \hat{G},\]

(19)

where \(w'_i = (\theta E_1 + (1 - \theta) \Lambda_1)^{-1}(\theta E_2 + (1 - \theta) \Lambda_2)\) and \(Z_2 = (\theta E_1 + (1 - \theta) \Lambda_1)^{-1}(\theta E_3 + (1 - \theta) \Lambda_3)\). Both can be shown to be positive. In order to keep the CPI unchanged, when \(i\)th currency appreciates \([\hat{J}_i + \hat{q}_i - \hat{q}_N]\) increases, the home country currency against numeraire, \((\hat{r} + \hat{q}_N - \hat{p}_0)\), should appreciate (decrease) according to \(w'_i\). When the government purchases increase by one percent, the home country currency should appreciate according to \(Z_2\), even though the real value of \(i\)th currency does not change.

Eqs. (18) and (19) give us the weights in a currency basket if we are aiming at either stabilizing balance of trade or consumer price index. As clearly shown in these equations, it is possible for the government to optimally implement both fiscal policy and currency basket policy to stabilize balance of trade and consumer price index simultaneously.

3.5.3. Stabilizing both the balance of trade and the consumer price index

To show the case that changes in the balance of trade and the consumer price index are zero simultaneously, one need to combine Eqs. (18) and (19) into Eq. (20),

\[(\hat{r} + \hat{q}_N - \hat{p}_0) = -\sum w_i (\hat{J}_i + \hat{q}_i - \hat{q}_N) - Z_2 \hat{G} = -\sum w'_i (\hat{J}_i + \hat{q}_i - \hat{q}_N) - Z_2 \hat{G},\]

(20)

to solve the optimal fiscal policy as shown in Eq. (21):
In order to stabilize both the overall trade balance and the consumer price index, government purchase \( (G) \) is no longer an exogenous variable and should follow the process as specified in \((21)\). \( G \) has to respond to a change in the real value of \( i^{th} \) currency. We then substitute Eq. \((21)\) into Eq. \((17)\) to get Eq. \((22)\),

\[
(\hat{r} + \hat{q}_N - \hat{q}_0) = -\sum [rw'_i + (1 - r)w_i](\hat{J}_i + \hat{\dot{q}}_i - \hat{\dot{q}}_N) = -\sum w^*_i(\hat{J}_i + \hat{\dot{q}}_i - \hat{\dot{q}}_N),
\]

where \( r = \frac{Z_1}{Z_1 - Z_2} \).

From Eqs. \((21)\) and \((22)\), it is shown that both \( G \) and the home country currency \((\hat{r} + \hat{q}_N - \hat{p}_0)\) have to respond to the changes in the real value of \( i^{th} \) currency at \((\hat{J}_i + \hat{\dot{q}}_i - \hat{\dot{q}}_N)\) the same time to stabilize overall balance of trade and consumer price index. The optimal weight in a currency basket \((w^*)\) that reaches these two policy goals simultaneously is a weighted average of two separate sets of weights \((w_i, w'_i)\), each targeted at one policy goal. The weight \( r \) is a function of the structural parameters. The results show that by combining an optimal fiscal policy that follows Eq. \((21)\) with a currency basket peg that uses an optimal set of weights \([w^* \text{ in Eq. } (22)]\), one economy can insulate its overall balance of trade and aggregate price level from a change in a third-country’s real exchange rate.

4. The currency basket system in Thailand

To understand the evolution of the exchange rate policy in Thailand, one has to analyze the macroeconomic performance during the period of 1980 to 1997. From 1980 to 1984, Thailand experienced a number of economic problems as the result of an unfavorable world economic environment and, to a certain extent, of domestic overspending. The major problem encountered during this period was the threat of external instability. The problem of external imbalance became most serious in 1983 when the current account deficit reached 7 percent of GDP, international reserves dwindled to only three months imports, and the external debt level increased rapidly. With this in mind, demand-management policy during this period was aimed at reducing external imbalance towards a sustainable level. As a consequence of these stabilization policies coupled with a weak world economic environment, real economic growth slowed down to an annual average of 5 percent by the mid-1980s.

However, the external stability was restored by the mid-1980s. The current account deficit was lowered to 4 percent of GDP in 1985, and the current account even recorded a small surplus in 1986. International reserves rose to 4.8 months of imports by 1986. The debt-service ratio, defined as the ratio of short and long-term debts to income originating from exports, peaked at 22 percent in 1985 and started to level off thereafter. During 1985–86, the domestic inflation rate was maintained at an annual rate of 2 percent. While economic stability seemed to be under control, both internally and
externally, economic growth was weak. Real GDP had a growth rate of slightly more than 3 percent in the 1985–86 period.

The policy focus during the 1985–1986 period was therefore shifted towards stimulating a recovery of the economy. By 1987, the economic growth had been revived. Particularly, Thailand experienced an economic boom during the period 1987–1990, characterized by an average rate of economic growth of over 10 percent a year. This record of economic growth is regarded as being exceptionally high both in absolute terms and in comparison with other dynamic countries in the entire Asia-Pacific region [see e.g., Robinson, et al. (1991), p. 10, and Asian Development Bank (1992)]. The double-digit growth rates were accompanied by modest, though increasing, domestic inflation rates (2.5–6.0 percent annually). In addition, current account deficits were kept at an average of around 4 percent of GDP, while international reserves and the external debt position became healthier than during the earlier period.

The monetary and exchange rate policies from 1980 to 1997 are closely related to the above-mentioned macroeconomic performance. Discretionary, restrictive fiscal and monetary policies as well as exchange rate management were implemented and monitored with great caution to restore economic stability. Regarding fiscal policy, the government put much effort into curbing the growth of its expenditure and into increasing its efficiency in revenue collection. On the monetary policy front, a high interest rate policy was adopted with the aim of achieving three objectives. One was to induce more domestic savings, another was to slow down credit expansion, and the last one was to align domestic with foreign interest rates in order to prevent capital outflow.

In this connection, the Bank of Thailand (BOT) successively adjusted interest rate ceilings and monitored credits extended to the private sector, particularly those for import purposes. These measures, combined with other anti-inflationary measures launched by several government agencies, were, to a large extent, successful in reviving internal stability by bringing down the inflation rate from 19.9 percent in 1980 to 3.8 percent in 1983. In contrast, external instability was still left unresolved. Eventually, in January 1984, a tighter measure of monetary policy, direct credit control, was imposed on domestic commercial banks to reduce the rapid expansion of credit. The use of this measure was regarded as a new experience for Thailand’s monetary management at the time. This measure was, however, abolished eight months later as it was claimed in some circles as being too restrictive in bringing down the credit expansion [Akrasanee, et al. (1991)].

As for the arrangement for the Thai baht, it can be divided into five distinct phases: (1) the pre-par value system (until 1963); (2) the par value system (1963–1978); (3) the daily fixed system (1978–1981); (4) the de facto fixed system (1981–1984); and (5) the basket of currency system (1984–present). The focus of this paper is more on the last two periods.

In the first half of the 1980s, the strengthening of the U.S. dollar led to a subsequent devaluation of the Thai baht vs. the U.S. dollar, creating a great opportunity for Thailand’s monetary authorities to contemplate changes in the exchange rate system at that time. In 1981, the Thai baht was devalued twice against the U.S. dollar, first
by 1.1 percent in May and the second time by 8.7 percent in July. At the same time, the daily fixing system between the Thai baht and the U.S. dollar was replaced by a fixed exchange rate system. Although the devaluation of the baht had to a certain extent helped improve Thailand’s external balances, its beneficial effects were short-lived due to the prolonged strength of the U.S. dollar.

The Thai baht was devalued once again by 14.8 percent in November 1984, shortly after the credit control scheme was revamped, and since then the value of the Thai baht has been pegged to a basket of currencies. The move to this new exchange rate system was viewed as an important step toward the use of a more flexible exchange rate regime. At the very beginning of adopting this system, the Thai baht was pegged to a basket of the currencies of Thailand’s major trading partners. The weighting scheme at that time was based on the relative importance of the currencies of Thailand’s trading partners. Detailed information of this weighting was not publicized, and that provided the monetary authorities some discretion in the implementation of exchange rate policy.

This kind of weighting scheme was used for about one year. After the G-7 meeting in September 1985 and the currency realignment, the U.S. dollar depreciated rapidly. This led the Thai authorities to adjust the weighting scheme by giving a higher weight to the U.S. dollar, from approximately 50–55 percent to 80–85 percent [Akrasenee, et al. (1991), p. 239]. The actual weights of currency basket, however, continue to be not publicized. In this regard, exchange rate policy has been claimed to be an important instrument in correcting external disequilibrium problems in Thailand over the period 1980–1991. As documented in Wibulswasdi (1987 and 1988), the main focus of the exchange rate policy in Thailand has been to support the competitiveness of exports while maintaining the confidence of participants in the exchange market. Subsequent developments in the financial and economic conditions of the country proved that the implementation of the new exchange rate policy achieved the intended objectives up to 1996.

Under the new exchange rate regime, the baht-U.S. dollar rate is the exchange rate that has been used by the monetary authorities as a basis for setting an appropriate level for the baht’s external value against other major trading partners [e.g., Japan, the U.K., Germany, Hong Kong, Malaysia, and Singapore; see Hataiseree (1995)]. More precisely, such a nominal exchange rate is set by the Exchange Equalization Funds (EEF) Committee. This committee was created by a special law in 1955 with a mandate to stabilize and maintain the external value of the Thai baht at a level deemed appropriate for domestic overall economic and financial conditions. Although the EEF is legally set up as a separate entity from the BOT, its top executive personnel have always come from present high-ranking officials at the BOT to ensure a close collaboration between the two institutions.¹

The daily nominal exchange rate between the Thai baht and the U.S. dollar appears to have been adjusted in response to the three proximate factors: (1) movements of the exchange rates of major currencies in the international foreign exchange market; (2) patterns of selling and buying of foreign currencies in the domestic market; and (3) prevailing conditions in, and likely outlook for, Thailand’s economy [Wibulswasdi
Since the adjustments based on (1) and (2) have generally been regarded as short-run in nature, their effects on the rate setting seem to be minimal. Nevertheless, adjustments in the exchange rate following developments in these two factors have to be pursued constantly in order to shield the domestic economy from the adverse effects of fluctuations in the exchange rates of major currencies in the international foreign exchange market.

Adjustments of the exchange rate based on (3) have been viewed as being the most important, since they constitute a policy intention of the BOT. Intervention actions under this last category are primarily aimed at addressing a broader issue of Thailand’s economy over a longer period, such as a deterioration in competitiveness, external debt, or the balance of payments.

However, all three of these types of adjustments started to show their lack of control over the Thai economy in late 1996. Under the currency basket since 1985, the Thai baht has been determined overwhelmingly by the U.S. dollar. However, at the same time, Thailand had and continues to have substantial trade relationships with Japan. As the Japanese yen depreciated against the U.S. dollar from April 1995 to the summer of 1997, the real effective exchange rate of Thai baht appreciated against the Japanese yen. Due to the appreciation, export competitiveness was lost. Export from Thailand declined and current account deficits increased in the 1996–1997 period. This currency basket system therefore became the prime force that triggered the Asian currency crisis.

5. The long-run relationship between real exchange rates

The long-run relationship between real exchange rates of a group of trading partners, when the balance of trade is kept unchanged, is implied in Eq. (18). It shows that, in order to stabilize the trade balance of the home country, when the currency against the numeraire depreciates by 1 percent, the home currency against the numeraire should also depreciate by $v_i\%$ to maintain the relative competitiveness. The total impact from all currencies in the basket on the value of the home currency should add up to one. The results can be used to test the overall competitiveness of the home country and to analyze the effect of exchange rate movement of the home country on its trade balance. Because the actual weights employed by the BOT are not known to the public, it is not appropriate to directly compare the optimal weights derived from the model and the actual weights used in the Thai currency basket. However, there are other methods to analyze how far apart the used weights were from the optimal weights and their implications on trade balances.

The nonstructural approach of vector autoregression (VAR) is first applied to estimate the response of the home country currency when the values of its trading partners’ currencies depreciate or appreciate. The VAR results are further examined to assess the cause of trade balance surplus or deficit in the home country. The impulse response analysis and variance decomposition are also performed.

The long-run relationship between real exchange rates of trade-related countries is also investigated using the concept of cointegration. If a country pegs its currency...
to a basket, there should be a long-run relationship between the log levels of the real exchange rates (all measured against the numeraire) of countries involved. It means that the percentage change in the real exchange rates among trading partners should be cointegrated. Analyzing the cointegrating vector will also shed new light on whether or not the used weights are optimal.

The augmented Dickey-Fuller test is applied to test the nonstationarity of the log levels of real exchange rates prior to perform cointegration tests. Johansen’s LR test and the canonical cointegrating regression proposed by Park (1992) are then used to test for cointegration and to estimate the cointegrating vector.

After normalizing the cointegrating vector \((1, -\beta_1, -\beta_2, \ldots, -\beta_i)\)', it is implied in the model that, if the trade balance of the home country is stabilized, the summation of the elements in the cointegrating vector ought to be zero. That is, the summation of the impact of all the currencies in the basket is negative one. If the summation of the elements in the cointegrating vector is negative, the percentage change in the home country's real exchange rate is less than the uniform percentage change in its trading partners' real exchange rates. It indicates that the home country currency is relatively inflexible, comparing to the currencies chosen in its currency basket. The inflexibility will affect the home country’s competitiveness in the exports market. It may also cause international speculative attacks on the home currency.

5.1. Vector autoregression (VAR)

Assume all the real exchange rates in a currency basket are endogenous variables, and every endogenous variable in the system is a function of the lagged values of all the endogenous variables in the system. The VAR is expressed as shown in Eq. (23),

\[
y_t = A_1 y_{t-1} + A_2 y_{t-1} + \ldots + A_p y_{t-p} + B x_t + \epsilon_t,
\]

where \(y_t\) is a \(k \times 1\) vector of endogenous variables, \(x_t\) is a \(d \times 1\) vector of exogenous variables, \(A_1, \ldots, A_p\) and \(B\) are matrices of coefficients to be estimated, and \(\epsilon_t\) is a vector of innovations that may be contemporaneously correlated with each other but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand-side variables.

Following the estimation of an unrestricted VAR are the impulse response analysis and variance decomposition. An impulse response function traces the effect of a one standard deviation shock to one of the innovations on current and future values of the endogenous variables. By contrast, variance decomposition decomposes variation in an endogenous variable into the component shocks to the endogenous variables in the VAR. The variance decomposition gives information about the relative importance of each random innovation to the variables in the VAR.

According to the Bank of Thailand’s Quarterly Bulletin, the five largest trading partners of Thailand in the 1980s and 1990s are Japan, the United States, Singapore, the Netherlands, and Germany. Therefore, a VAR of log levels of the real exchange rates (all against the U.S. dollar) of the Thai baht, the Japanese yen, the Singapore dollar, the Dutch Guilder, and the Deutsche Mark is first estimated and analyzed.
5.1.1. Data
The data are all quarterly, covering from 1981 Q1 to 1998 Q1 period. Bilateral real exchange rates are calculated using nominal exchange rates and consumer price indices (CPIs). The data are taken from the IMF’s International Financial Statistics; Board of Governors, Federal Reserves System; Bureau of Labor Statistics, Department of Labor; Statistics Bureau and Statistics Center, Management and Coordination Agency, Government of Japan; and Datastream International, Inc.

5.1.2. Empirical results on the VAR
Table 2 presents the VAR results. The AIC criterion is used to determine the lag periods. It is found that the log level of the Thai baht mainly depended on its own past values, which indicate the relative inflexibility of the Thai baht responding to changes in the currency values of its trading partners. The results also show that the log levels of the five real exchange rates are close to I(1) process. (Formal tests will be performed later.) It is also found that when the real exchange for the Japanese yen against the U.S. dollar increased (i.e., the Japanese yen depreciated), the real exchange rate for the Thai baht against the U.S. dollar decreased (i.e., the Thai baht appreciated). This would make Thai products be relatively uncompetitive, would lead to a trade deficit with Japan, and would cause an increase in the deficit of its current account. The same scenario would happen when the value of the Dutch Guilder changed. Yet the coefficient for the Dutch Guilder is not significant.

It is more interesting to examine the impulse response function and variance decomposition to see the actual response of the log level of Thai baht to the changes in the log levels of other currencies. The impulse response functions and variance decomposition are calculated using the ordering: log DM, log Guilder, log yen, log Singapore dollar, and log baht. Four impulse response functions are plotted in Fig. 1, representing the effects of the first four innovations (to the log levels of DM, Guilder, yen, and Singapore dollar) on the log level of Thai baht.

It is observed that an increase in (a positive shock to) the log levels of Deutsche Mark and Singapore dollar was associated with an increase in the log level of Thai baht for the first two to three quarters, but this increase was reverse afterwards. Within about 12 quarters, the shock had almost disappeared. When the Deutsche Mark and the Singapore dollar depreciated, the Thai baht followed at first, but only lasted for about three quarters. If no other policy was implemented, Thai products would lose their relative competitiveness against German and Singaporean products by the end of third year.

However, when there was a positive shock to the log levels of Japanese yen, there was a contemporaneous decrease in the log level of Thai baht. This effect reached zero within about three quarters, but reappeared again at the fourth quarter and persisted over the next eight quarters. It indicates that when yen depreciated, because of the choice for currency basket weights, the Thai baht appreciated first. Thai products lost their relative competitiveness with Japanese products immediately after yen depreciated, even though these two countries were competing in different exports markets. The trade disadvantage gradually diminished in about a year when the Thai baht started to follow yen’s depreciation.
### Table 2

#### VAR results for real exchange rates

<table>
<thead>
<tr>
<th></th>
<th>LNRTH</th>
<th>LNRDM</th>
<th>LNRNH</th>
<th>LNRJP</th>
<th>LNRSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNRTH(–1)</td>
<td>1.045469 (0.15194)</td>
<td>0.013519 (0.15341)</td>
<td>0.021640 (0.15632)</td>
<td>0.132609 (0.16982)</td>
<td>0.155962 (0.05890)</td>
</tr>
<tr>
<td>LNRTH(–2)</td>
<td>–0.226498 (0.18752)</td>
<td>–0.09533 (0.18934)</td>
<td>–0.087936 (0.19293)</td>
<td>–0.068529 (0.19135)</td>
<td>–0.037279 (0.20959)</td>
</tr>
<tr>
<td>LNRDM(–1)</td>
<td>0.438811 (0.98636)</td>
<td>0.051967 (0.89494)</td>
<td>0.038529 (0.91935)</td>
<td>0.017515 (0.99906)</td>
<td>0.022114 (0.33457)</td>
</tr>
<tr>
<td>LNRDM(–2)</td>
<td>–0.76059 (0.89325)</td>
<td>1.256588 (0.90390)</td>
<td>0.99377 (0.91902)</td>
<td>0.981662 (0.93986)</td>
<td>0.946215 (0.36426)</td>
</tr>
<tr>
<td>LNRDM(–3)</td>
<td>0.226498 (0.18752)</td>
<td>0.221411 (0.34357)</td>
<td>1.256588 (0.90390)</td>
<td>0.99377 (0.91902)</td>
<td>0.946215 (0.36426)</td>
</tr>
<tr>
<td>LNRDM(–4)</td>
<td>0.501686 (0.4466)</td>
<td>1.256588 (0.90390)</td>
<td>0.99377 (0.91902)</td>
<td>0.981662 (0.93986)</td>
<td>0.946215 (0.36426)</td>
</tr>
<tr>
<td>LNRDM(–5)</td>
<td>0.226498 (0.18752)</td>
<td>0.013519 (0.15341)</td>
<td>0.021640 (0.15632)</td>
<td>0.132609 (0.16982)</td>
<td>0.155962 (0.05890)</td>
</tr>
<tr>
<td>LNRDM(–6)</td>
<td>0.438811 (0.98636)</td>
<td>0.051967 (0.89494)</td>
<td>0.038529 (0.91935)</td>
<td>0.017515 (0.99906)</td>
<td>0.022114 (0.33457)</td>
</tr>
<tr>
<td>LNRDM(–7)</td>
<td>–0.76059 (0.89325)</td>
<td>1.256588 (0.90390)</td>
<td>0.99377 (0.91902)</td>
<td>0.981662 (0.93986)</td>
<td>0.946215 (0.36426)</td>
</tr>
<tr>
<td>C</td>
<td>0.501686 (0.4466)</td>
<td>0.126567 (0.65287)</td>
<td>0.082234 (0.66526)</td>
<td>1.57286 (0.72271)</td>
<td>0.167315 (0.25064)</td>
</tr>
</tbody>
</table>

Note: LNRTH is the log level of Thai baht, LNRDM is the log level of Deutsche Mark, LNRNH is the log level of Dutch Guilder, LNRJP is the log level of Japanese yen, and LNRSP is the log level of Singapore dollar.

Sample (adjusted): 1981:3 1998:1

Included observations: 67 after adjusting endpoints

Standard errors & t-statistics in parentheses
When there was a positive shock to the log level of Dutch Guilder, there was no immediate effect on the Thai baht for about two quarters, and then a positive effect on the Thai baht re-emerged at the third quarter and persisted for the next nine quarters. It means that the Thai baht has about six months lag to catch up with the Guilder's depreciation. The relatively unusual behavior of the Thai baht compared to its trading partners may explain partially why the trade deficits of Thailand persisted, and eventually led to the 1997 currency crisis.

Table 3 provides the information on variance decomposition of the log level of Thai baht. Considering one period (quarter) horizon, 72.5 percent of the variation in the Thai baht came from its past fluctuation, followed by the changes in the Singapore dollar, the Deutsche Mark, the Japanese yen, and the Dutch Guilder. Among the
Table 3
Variance decomposition of LNRTH

<table>
<thead>
<tr>
<th>Period</th>
<th>S.E.</th>
<th>LNRTH</th>
<th>LNRDM</th>
<th>LNRNH</th>
<th>LNRJP</th>
<th>LNRSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.049072</td>
<td>72.55696</td>
<td>5.849413</td>
<td>0.015556</td>
<td>8.017193</td>
<td>13.56088</td>
</tr>
<tr>
<td>2</td>
<td>0.072966</td>
<td>68.68763</td>
<td>7.795586</td>
<td>0.035529</td>
<td>4.185243</td>
<td>19.29601</td>
</tr>
<tr>
<td>3</td>
<td>0.088642</td>
<td>64.72563</td>
<td>11.13566</td>
<td>0.178516</td>
<td>2.836175</td>
<td>21.12402</td>
</tr>
<tr>
<td>4</td>
<td>0.100324</td>
<td>62.76674</td>
<td>13.63750</td>
<td>0.409468</td>
<td>2.215928</td>
<td>20.97037</td>
</tr>
<tr>
<td>5</td>
<td>0.109604</td>
<td>62.22923</td>
<td>14.91825</td>
<td>0.591636</td>
<td>1.887996</td>
<td>20.37289</td>
</tr>
<tr>
<td>6</td>
<td>0.117044</td>
<td>62.27442</td>
<td>15.48842</td>
<td>0.735768</td>
<td>1.801865</td>
<td>19.69953</td>
</tr>
<tr>
<td>7</td>
<td>0.122802</td>
<td>62.27442</td>
<td>15.48842</td>
<td>0.735768</td>
<td>1.801865</td>
<td>19.69953</td>
</tr>
<tr>
<td>8</td>
<td>0.127002</td>
<td>62.50190</td>
<td>15.86802</td>
<td>1.067648</td>
<td>2.087091</td>
<td>18.45734</td>
</tr>
<tr>
<td>9</td>
<td>0.129869</td>
<td>62.46867</td>
<td>15.96381</td>
<td>1.289950</td>
<td>2.331089</td>
<td>17.94828</td>
</tr>
<tr>
<td>10</td>
<td>0.131696</td>
<td>62.31972</td>
<td>15.99237</td>
<td>1.550755</td>
<td>2.592909</td>
<td>17.54424</td>
</tr>
<tr>
<td>11</td>
<td>0.132793</td>
<td>62.07503</td>
<td>15.97372</td>
<td>1.841025</td>
<td>2.848660</td>
<td>17.26156</td>
</tr>
<tr>
<td>12</td>
<td>0.133449</td>
<td>61.75392</td>
<td>15.91387</td>
<td>2.147436</td>
<td>3.078235</td>
<td>17.10654</td>
</tr>
</tbody>
</table>

Ordering: LNRDM LNRNH LNRJP LNRSP LNRTH

Notes: (1) The column S.E. is the forecast error of the variable for each forecast horizon. (2) LNRTH is the log level of Thai baht, LNRDM is the log level of Deutsche Mark, LNRNH is the log level of Dutch Guilder, LNRJP is the log level of Japanese yen, and LNRSP is the log level of Singapore dollar.

major trading partners, the Thai baht was most sensitive to the change in the Singapore dollar (except the fluctuation in the Thai baht itself). It may be because of the geographical location and similar export products of these two countries. Even when the forecast horizon was extended through 12 quarters, among Thai’s trading partners, the Singapore dollar still explained largest portion of the variance in the Thai baht. However, when the forecast horizon was increased, the Thai baht was more and more sensitive to the change in the Deutsche Mark. It shows the gradually increased linkage between the European market and the Asian market. These results also explain why the Asian currency crisis had a domino effect on worldwide financial and currency markets.

5.2. Cointegration

5.2.1. Implications of cointegration

Let $X(t)$ be a two-dimensional difference stationary process [i.e., I(1) process]. $X(t) - X(t - 1) = \mu + v(t)$ for $t \geq 1$ where $\mu$, the drift term, is a two-dimensional vector of nonzero real numbers; and $v(t)$, the error term, is stationary with mean zero; and each component of has a positive long-run variance. This assumption rules out deterministic trends of orders higher than or equal to quadratic. The initial value of $X_i(0), i = 1, 2$, is an arbitrary random variable. Then, as shown in Eq. (24),

$$X_i(t) = \mu_i t + X_i^0(t),$$ (24)

where $X_i^0(t) = X(0) + \sum_{\tau=1}^t v_i(\tau)$. Since $X_i^0(t) - X_i^0(t - 1) = v_i(t)$, $X_i^0(t)$ is an I(1) process without a drift. Relation (24) decomposes a difference stationary process with a drift term into a deterministic trend arising from the drift term and a difference stationary process without a drift term.
Table 4
ADF test for the log level of the Thai baht

<table>
<thead>
<tr>
<th>ADF Test Statistic</th>
<th>1% Critical Value*</th>
<th>5% Critical Value</th>
<th>10% Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.530030</td>
<td>-4.1013</td>
<td>-3.4779</td>
<td>-3.1663</td>
</tr>
</tbody>
</table>

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRTH)
Method: Least Squares
Included observations: 66 after adjusting endpoints

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNRTH(-1)</td>
<td>-0.142682</td>
<td>0.093255</td>
<td>-1.530030</td>
<td>0.1312</td>
</tr>
<tr>
<td>D(LNRTH(-1))</td>
<td>0.239562</td>
<td>0.135663</td>
<td>1.765858</td>
<td>0.0824</td>
</tr>
<tr>
<td>D(LNRTH(-2))</td>
<td>0.127480</td>
<td>0.138504</td>
<td>0.920403</td>
<td>0.3610</td>
</tr>
<tr>
<td>C</td>
<td>0.447331</td>
<td>0.297183</td>
<td>1.505239</td>
<td>0.1374</td>
</tr>
<tr>
<td>@TREND(1981:1)</td>
<td>0.000413</td>
<td>0.000343</td>
<td>1.203749</td>
<td>0.2333</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.082624</td>
<td></td>
<td></td>
<td>0.007873</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.022469</td>
<td></td>
<td></td>
<td>0.053378</td>
</tr>
<tr>
<td>S.E. of regression</td>
<td>0.052775</td>
<td></td>
<td></td>
<td>-2.972811</td>
</tr>
<tr>
<td>Sum squared resid</td>
<td>0.169900</td>
<td></td>
<td></td>
<td>-2.806928</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>103.1028</td>
<td></td>
<td></td>
<td>1.373507</td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
<td>1.983141</td>
<td></td>
<td></td>
<td>0.253651</td>
</tr>
</tbody>
</table>

* MacKinnon critical values for rejection of hypothesis of a unit root.

Suppose that $X_1(t)$ and $X_2(t)$ are cointegrated with a cointegrating vector $(1,-\beta)'$, the linear combination of $X_1(t) - \beta X_2(t)$ should be stationary. Eq. (24) implies Eq. (25):

$$X_1(t) - \beta X_2(t) = (\mu_1 - \beta \mu_2) t + [X_0^1(t) - \beta X_0^2(t)].$$

(25)

Therefore, the stationarity of $X_1(t) - \beta X_2(t)$ requires not only that is stationary, but also $\mu_1 - \beta \mu_2 = 0$. The first requirement is called stochastic cointegration and requires only the stochastic components of both series to be cointegrated. It is possible that $X_1(t)$ and $X_2(t)$ are stochastically cointegrated while $\mu_1 - \beta \mu_2$ is not zero, therefore $X_1(t) - \beta X_2(t)$ is not stationary. The second requirement is called the deterministic cointegration restriction, which implies that $(1, -\beta)'$ not only eliminates the stochastic trend but also the deterministic trend. The deterministic cointegration restriction has not been tested in most of applied economics papers using the concept of cointegration.

5.2.2. Canonical cointegrating regression (CCR)

Park (1992) directly applied the concept of cointegration to test for both stochastic and deterministic cointegration restrictions. The CCR procedure involves a data transformation which uses only the stationary components of a cointegrating model. A cointegrating relationship supported by the cointegrating model would remain unchanged after such a data transformation. The CCR transformation makes the error term in a cointegrating system uncorrelated at the zero frequency with regressors. Therefore, the CCR procedure yields asymptotically efficient estimators and provides
### Table 5

ADF test for the log level of DM

<table>
<thead>
<tr>
<th>ADF Test Statistic</th>
<th>1% Critical Value*</th>
<th>5% Critical Value</th>
<th>10% Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.593317</td>
<td>-4.1013</td>
<td>-3.4779</td>
<td>-3.1663</td>
</tr>
</tbody>
</table>

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LNRDM)

Method: Least Squares


Included observations: 66 after adjusting endpoints

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNRDM(-1)</td>
<td>-0.101417</td>
<td>0.063652</td>
<td>-1.593317</td>
<td>0.1163</td>
</tr>
<tr>
<td>D(LNRDM(-1))</td>
<td>0.178431</td>
<td>0.127318</td>
<td>1.401459</td>
<td>0.1661</td>
</tr>
<tr>
<td>D(LNRDM(-2))</td>
<td>-0.019206</td>
<td>0.125548</td>
<td>0.152977</td>
<td>0.8789</td>
</tr>
<tr>
<td>C</td>
<td>0.074362</td>
<td>0.054550</td>
<td>1.363199</td>
<td>0.1778</td>
</tr>
<tr>
<td>@TREND(1981:1)</td>
<td>-0.000490</td>
<td>0.000571</td>
<td>0.858370</td>
<td>0.3940</td>
</tr>
</tbody>
</table>

R-squared 0.065562  Mean dependent var 0.001858

Adjusted R-squared 0.004287  S.D. dependent var 0.055435

S.E. of regression 0.055316  Akaike info criterion 2.878787

Sum squared resid 0.186649  Schwarz criterion 2.712904

Log likelihood 99.99997  F-statistic 1.069969

Durbin-Watson stat 1.887497  Prob(F-statistic) 0.379193

* MacKinnon critical values for rejection of hypothesis of a unit root.

Asymptotic chi-square tests for the null hypothesis of cointegration which are free from nuisance parameters.

Suppose that $X_i(t)$ are cointegrated with a cointegrating vector $(1, -\beta)'$ and the error term in the cointegrated system is $\varepsilon(t)$. Assume that $\varepsilon(t)$ is stationary and ergodic with zero mean. Let $\Psi(i) = E[\varepsilon(t)\varepsilon(t-i)']$ be the covariance function of $\varepsilon(t)$. The long-run variance of $\varepsilon(t)$, $\Omega$, is then equal to $\Sigma_{-\infty}^{\infty} \Psi(i)$. Decompose $\Omega$ as $\Omega = \Sigma + \Lambda + \Lambda'$, where $\Sigma = \Psi(0)$ and $\Lambda = \Sigma_{-\infty}^{\infty} \Psi(i)$. Define $\Gamma = \Sigma + \Lambda$, and denote each element of $\Omega$ and $\Gamma$ by corresponding lower case with subscript e.g., $\Omega = [\omega_{11}, \omega_{12}, \omega_{21}, \omega_{22}]$. Then define $\Gamma_3 = [\gamma_{12}, \gamma_{22}]'$ and let $\hat{\Sigma}, \hat{\Gamma}_2, \hat{\beta}, \hat{\omega}_{12}, \hat{\omega}_{22}$ denote consistent estimators of $\Sigma$, $\Gamma_2$, $\beta$, $\omega_{12}$, $\omega_{22}$. The data transformation process in the CCR is as shown in Eq. (26):

$$X^*_1(t) = X_1(t) - \left[ \sum_{i=1}^{\infty} \hat{\Gamma}_2(i) + (0, \hat{\omega}_{12}; \hat{\omega}_{22}') \right] \varepsilon(t),$$

$$X^*_2(t) = X_2(t) - \left[ \sum_{i=1}^{\infty} \hat{\Gamma}_2(i) \right] \varepsilon(t).$$

(26)

The CCR estimator is obtained by the ordinary least squares regression of $X^*_1(t)$ on $X^*_2(t)$ along with appropriate deterministic terms, as shown in Eq. (27):

$$X^*_1(t) = \theta + \sum_{i=1}^{\infty} \gamma_i t^i + \beta X^*_2(t) + \varepsilon^*(t).$$

(27)

The CCR is implemented with an estimated $\varepsilon(t)$ and estimated long-run covariance.
Table 6
ADF test for the log level of Dutch Guilder

<table>
<thead>
<tr>
<th>ADF Test Statistic</th>
<th>1% Critical Value*</th>
<th>5% Critical Value</th>
<th>10% Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.679896</td>
<td>-4.1013</td>
<td>-3.4779</td>
<td>-3.1663</td>
</tr>
</tbody>
</table>

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRNH)
Method: Least Squares
Included observations: 66 after adjusting endpoints

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LN(RNH(-1))</td>
<td>-0.107610</td>
<td>0.064057</td>
<td>-1.679896</td>
<td>0.0981</td>
</tr>
<tr>
<td>D(LNRNH(-1))</td>
<td>0.191445</td>
<td>0.126856</td>
<td>1.509156</td>
<td>0.1364</td>
</tr>
<tr>
<td>D(LNRNH(-2))</td>
<td>-0.032809</td>
<td>0.125038</td>
<td>-0.262395</td>
<td>0.7939</td>
</tr>
<tr>
<td>C</td>
<td>0.087776</td>
<td>0.059021</td>
<td>1.487196</td>
<td>0.1421</td>
</tr>
<tr>
<td>@TASTREND(1981:1)</td>
<td>-0.000383</td>
<td>0.000505</td>
<td>-0.757954</td>
<td>0.4514</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.074125</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.013411</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.E. of regression</td>
<td>0.05733</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum squared resid</td>
<td>0.189477</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td>99.50374</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
<td>1.859970</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* MacKinnon critical values for rejection of hypothesis of a unit root.

parameters that are required for the data transformation [Eq. (26)]. Let $H(p,q)$ denote the standard Wald statistic to test the hypothesis $\gamma_{p+1} = \gamma_{p+2} = \ldots = \gamma_q = 0$, with the estimate of variance of $\epsilon(t)$ replaced by the long-run variance of the CCR. The $H(p,q)$ test is chi-square distributed and is free from nuisance parameters. $H(0,q)$ tests the deterministic cointegration restriction, and $H(1,q)$ tests the stochastic cointegration restriction. Han (1996) used Monte Carlo simulations to examine the small sample properties of the CCR test. It is found that the CCR tests performed reasonably well in terms of size and power when sample size was small.

5.2.3 Johansen VAR-based Cointegration Test

Given a group of nonstationary variables, the methodology developed by Johansen (1991, 1995) is to test the stochastic and deterministic restrictions imposed by cointegration jointly. Rewriting the VAR of order $p$ (equation (23)) as Eq. (28),

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + Bx_t + \epsilon_t,$$

(28)

where $\Pi = \sum_{i=1}^{p} A_i - I$, $\Gamma_i = -\sum_{j=i+1}^{p} A_j$. Granger's representation theorem asserts that if the coefficient matrix $\Pi$ has reduced rank $r < k$, then there exist $k \times r$ matrices $\alpha$ and $\beta$ each with rank $r$ such that $\Pi = \alpha \beta'$ and $\beta' y_t$ is stationary. $r$ is the number of cointegrating relations (the cointegrating rank) and each column of $\beta$ is the cointegrat-
ing vector. The elements of $\alpha$ are known as the adjustment parameters in the vector error correction model. Johansen’s method is to estimate the $P$ matrix in an unrestricted form, then test whether one can reject the restriction implied by the reduced rank of $P$. As it is mentioned above, the Johansen’s test is a joint test for the deterministic and stochastic cointegration restrictions. Therefore, one cannot separately test each of these restrictions. When there is no cointegrating relation accepted, it may be because of either the deterministic or the stochastic restriction is violated.

5.2.4. Empirical results on tests for cointegration

The augmented Dickey-Fuller (ADF) test is applied to perform a unit root test for the log levels of all five real exchange rates. Results are tabulated in Tables 4–8. It is found that all five series are nonstationary and I(1) process. The results provide the basis for testing cointegration. Table 9 summarizes Johansen’s LR test for cointegration between the log levels of these five real exchange rates. The LR test indicates that there is one cointegrating vector. These five real exchange rates do have a long-run relationship as a currency basket peg implies.

However, the elements of the normalized cointegrating vector do not add up to zero. It is found that summation of the elements of the normalized cointegrating vector is negative. The percentage change in the value of the Thai baht against the U.S. dollar is less than the combined percentage change in its trading partners’ real
Table 8
ADF test for the log level of Singapore dollar

<table>
<thead>
<tr>
<th>ADF Test Statistic</th>
<th>1% Critical Value*</th>
<th>5% Critical Value</th>
<th>10% Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.593692</td>
<td>-4.1013</td>
<td>-3.4779</td>
<td>-3.1663</td>
</tr>
</tbody>
</table>

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRSP)
Method: Least Squares
Included observations: 66 after adjusting endpoints

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNRSP(−1)</td>
<td>-0.062623</td>
<td>0.039294</td>
<td>-1.593692</td>
<td>0.1162</td>
</tr>
<tr>
<td>D(LNRSP(−1))</td>
<td>0.309653</td>
<td>0.125591</td>
<td>2.465572</td>
<td>0.0165</td>
</tr>
<tr>
<td>D(LNRSP(−2))</td>
<td>-0.084275</td>
<td>0.135542</td>
<td>-0.621768</td>
<td>0.5364</td>
</tr>
<tr>
<td>C</td>
<td>0.042511</td>
<td>0.027081</td>
<td>1.569738</td>
<td>0.1216</td>
</tr>
<tr>
<td>@TREND(1981:1)</td>
<td>-0.000231</td>
<td>0.000203</td>
<td>-1.135057</td>
<td>0.2608</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.16739</td>
<td>Mean dependent var</td>
<td>0.000131</td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.058820</td>
<td>S.D. dependent var</td>
<td>0.023400</td>
<td></td>
</tr>
<tr>
<td>S.E. of regression</td>
<td>0.022701</td>
<td>Akaike info criterion</td>
<td>-4.660081</td>
<td></td>
</tr>
<tr>
<td>Sum squared resid</td>
<td>0.031435</td>
<td>Schwarz criterion</td>
<td>-4.494198</td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td>158.7827</td>
<td>F-statistic</td>
<td>2.015563</td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
<td>1.915636</td>
<td>Prob(F-statistic)</td>
<td>0.103451</td>
<td></td>
</tr>
</tbody>
</table>

* MacKinnon critical values for rejection of hypothesis of a unit root.

exchange rates. When there is a 1 percent change against the U.S. dollar in the Deutsche Mark, the Japanese yen, the Dutch Guilder, and the Singapore dollar, the percentage change of the Thai baht against the U.S. dollar is less than 1 percent. The Thai baht was relatively inflexible, or it pegged too much to the U.S. dollar, compared to other currencies chosen in its currency basket. It also implies that the currency basket weights chosen by the Thai government may not be adequate to maintain the competitiveness of the Thai products.

Table 10 summarizes the CCR test results. Andrews and Monahan’s (1992) VAR prewhitening method together with the Andrews’ (1991) automatic bandwidth are used to estimate the cointegrating vector. The p-value of $H(0, I)$ statistic that tests for the deterministic cointegration restriction is 0.09. The deterministic cointegration restriction cannot be rejected at 5 percent significance level. The p-values of $H(1, q)$ statistics that test for stochastic cointegration restriction range between 0.208 and 0.313. The stochastic cointegration restriction cannot be rejected either. Overall, the CCR results also indicate that the log levels of these five real exchange rates are cointegrated. The CCR results also show that summation of the elements of the normalized cointegrating vector is negative. Because the CCR uses different scaling factor, the estimated normalized cointegrating vector is different from Johansen’s VAR results. However, both methods show consistent signs for each element of the cointegrating vector. Results from both methods also reach the same conclusion that
Table 9
Johansen cointegration test results

Sample: 1981:1 1998:1
Included observations: 66
Test assumption: Linear deterministic trend in the data
Series: LNRTH LNRDM LNRNH LNRJP LNRSP
Lags interval: 1 to 2

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Likelihood Ratio</th>
<th>5 Percent Critical Value</th>
<th>1 Percent Critical Value</th>
<th>Hypothesized no. of CE(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.411181</td>
<td>89.59234</td>
<td>87.31</td>
<td>96.58</td>
<td>None*</td>
</tr>
<tr>
<td>0.312001</td>
<td>54.63630</td>
<td>62.99</td>
<td>70.05</td>
<td>At most 1</td>
</tr>
<tr>
<td>0.215675</td>
<td>29.95446</td>
<td>42.44</td>
<td>48.45</td>
<td>At most 2</td>
</tr>
<tr>
<td>0.116085</td>
<td>13.92093</td>
<td>25.32</td>
<td>30.45</td>
<td>At most 3</td>
</tr>
<tr>
<td>0.083808</td>
<td>5.776920</td>
<td>12.25</td>
<td>16.26</td>
<td>At most 4</td>
</tr>
</tbody>
</table>

Unnormalized Cointegrating Coefficients:

<table>
<thead>
<tr>
<th>LNRTH</th>
<th>LNRDM</th>
<th>LNRNH</th>
<th>LNRJP</th>
<th>LNRSP</th>
<th>@TREND(81:2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5.325281</td>
<td>-3.078102</td>
<td>2.941115</td>
<td>-0.123515</td>
<td>4.205830</td>
<td>0.012573</td>
</tr>
<tr>
<td>0.970892</td>
<td>-14.64932</td>
<td>13.63602</td>
<td>0.107845</td>
<td>0.641780</td>
<td>-0.023955</td>
</tr>
<tr>
<td>-1.033552</td>
<td>-3.069582</td>
<td>2.216782</td>
<td>1.394651</td>
<td>2.647082</td>
<td>0.014957</td>
</tr>
<tr>
<td>0.825143</td>
<td>-1.698328</td>
<td>0.046429</td>
<td>1.062682</td>
<td>-1.038261</td>
<td>-0.007093</td>
</tr>
<tr>
<td>-0.433470</td>
<td>-10.92547</td>
<td>11.20770</td>
<td>0.332703</td>
<td>0.033636</td>
<td>-0.010117</td>
</tr>
</tbody>
</table>

Normalized Cointegrating Coefficients: 1 Cointegrating Equation(s)

<table>
<thead>
<tr>
<th>LNRTH</th>
<th>LNRDM</th>
<th>LNRNH</th>
<th>LNRJP</th>
<th>LNRSP</th>
<th>@TREND(81:2)</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.000000</td>
<td>0.578017</td>
<td>-0.552293</td>
<td>0.023194</td>
<td>-0.789786</td>
<td>-0.002361</td>
<td>-2.750862</td>
</tr>
<tr>
<td>(0.52273)</td>
<td>(0.49799)</td>
<td>(0.05091)</td>
<td>(0.06558)</td>
<td>(0.00078)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Log likelihood 766.4269

* (***) denotes rejection of the hypothesis at 5%(1%) significance level.
L.R. test indicates 1 cointegrating equation(s) at 5% significance level.

the currency basket weights for the Thai baht were not optimal and would result in the relative inflexibility of the Thai baht compared to the currencies chosen in its currency basket.

6. Conclusions

This paper first proposes a general equilibrium model to seek an optimal choice of currency basket weights for countries pegging their currencies to a currency basket. It is found that an economy can either stabilize its overall trade balance or consumer price index, depending on which set of weights is chosen. Furthermore, it is also shown in the paper that both stabilizing overall trade balance and consumer price index can be reached simultaneously by choosing an optimal set of weights for a currency basket and implementing an optimal fiscal policy at the same time.
Table 10
CCR test results

<table>
<thead>
<tr>
<th>Regressand</th>
<th>Estimated Coefficients(^a)</th>
<th>H(0,1)(^b)</th>
<th>H(1,2)(^c)</th>
<th>H(1,4)(^c)</th>
<th>H(1,5)(^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Thai baht</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log DM</td>
<td>2.098 (0.419)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log Guilder</td>
<td>−2.127 (0.385)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log yen</td>
<td>0.046 (0.065)</td>
<td>0.09</td>
<td>0.215</td>
<td>0.208</td>
<td>0.313</td>
</tr>
<tr>
<td>Log Singapore dollar</td>
<td>−0.864 (0.088)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Andrews and Monahan’s (1992) VAR prewhitening method together with the Andrews’ (1991) automatic bandwidth estimator are used.
\(a\) Standard errors are shown in parentheses.
\(b\) p-values are shown in parentheses. This statistic tests the deterministic cointegration restriction.
\(c\) p-values are shown in parentheses. This statistic tests the stochastic cointegration restriction.

This paper further investigates the long-run relationship between the real exchange rates in a currency basket. Using the data of Thailand and its major trading partners, the VAR results show that, between the period of 1981 Q1 and 1998 Q1, the Thai baht against the U.S. dollar depreciated following the depreciation of the Deutsche Mark and the Singapore dollar. But the comparable depreciation disappeared in about two to three quarters. By contrast, the Thai baht against the U.S. dollar first appreciated when the Japanese yen against the U.S. dollar depreciated, and then the Thai baht started to depreciate after four quarters. This unusual behavior of the Thai baht hurt the relative competitiveness of Thai products in the export market at crucial moments and led to its trade deficit. The combination of exchange rate behavior and huge current account deficits may draw the international speculators’ attention and their attacks on the Thai baht.

Based upon results from the canonical cointegrating regression and the Johansen’s LR test, the real exchange rate of the Thai baht against the U.S. dollar and its five largest trading partners are cointegrated in the long run. The estimated cointegrating vector reveals that the value of the Thai baht against the U.S. dollar was relatively stable compared to the currency values of its trading partners in the 1980–1998 period. The overall inflexibility of the Thai baht led to its overvaluation when other currencies depreciated in the past two decades. It initially cut inflationary expectation in Thailand and helped the Thai economy to grow rapidly, but it eventually resulted in a huge trade deficit, current account deficit, and the 1997 currency crisis.

Acknowledgments

The author would like to thank Dr. Pongsak Hoontrakul, the editor, and an anonymous referee for their helpful discussion and suggestions. The financial support from the Board of Research of Babson College is also gratefully acknowledged. The author is responsible for any remaining errors.
Mathematical appendix

Solutions for simultaneous equations (4), (8) and (9) for \( \hat{\rho}_0, \hat{\rho}_i, \hat{\rho}_m \) are

\[
\hat{\rho}_0 = E_1(f + q_N - \hat{\rho}_0 + \sum \Gamma_1(J_i + \hat{q}_i - \bar{q}_x) + \Gamma_2 \hat{G}_i)
\]

\[
\hat{\rho}_i = \Pi_1(f + q_N - \hat{\rho}_0 + \sum \Pi_2(J_i + \hat{q}_i - \bar{q}_x) + \Pi_3 \hat{G}_i)
\]

\[
\hat{\rho}_m = \Lambda_1(f + q_N - \hat{\rho}_0 + \sum \Lambda_2(J_i + \hat{q}_i - \bar{q}_x) + \Lambda_3 \hat{G}_i)
\]

Define \( \Omega_1 = \varepsilon_\omega - \delta_\omega^\prime / \phi \) and \( \Omega_2 = \varepsilon_\phi - \delta_\phi^\prime / \phi \). Let \( D_1 = 1 - k_0 - \varepsilon_\omega (1 - \theta) \), and \( D_2 = 1 - \varepsilon_\phi (1 - \theta) \), and \( D_3 = 1 - k' + \Omega_2 A - \varepsilon_\omega \theta \).

\[
E_1 = \frac{D_1(k\Omega_2 B + k') + D_2(k_0 k + k\Omega_2 B)}{-D_1(\Omega_1 + 1 - \varepsilon_\omega^\prime \theta) + D_2(1 - k_0 + \varepsilon_\theta^\prime \theta - \Omega_2)}
\]

\[
E_2 = \frac{D_1(\Omega_1 B k\alpha_i + k\beta_i) + D_2(\Omega_1 B k\alpha_i)}{-D_1(\Omega_1 + 1 - \varepsilon_\omega^\prime \theta) + D_2(1 - k_0 + \varepsilon_\theta^\prime \theta - \Omega_2)}
\]

\[
E_3 = \frac{\gamma_\omega D_1 + \gamma_\phi D_2}{-D_1(\Omega_1 + 1 - \varepsilon_\omega^\prime \theta) + D_2(1 - k_0 + \varepsilon_\theta^\prime \theta - \Omega_2)}
\]

\[
\Pi_1 = \frac{D_1(k' - k - k\Omega_1 A + k\varepsilon_\omega^\prime \theta) + D_2(k(1 - \Omega_2 A + \varepsilon_\theta^\prime \theta)}{-D_1[(1 - k)(\varepsilon_\omega^\prime \theta - \Omega_1) - 1] + D_2[(1 + (\varepsilon_\theta^\prime \theta - \Omega_2)(1 - k) - k(1 - k_0))}
\]

\[
\Pi_2 = \frac{D_1(k' \beta_i - k k' \beta_i - (1 - k' + \Omega A - \varepsilon_\omega^\prime \theta)k\alpha_i) + D_2(1 - \Omega_2 A + \varepsilon_\theta^\prime \theta)k\alpha_i}{-D_1[(1 - k)(\varepsilon_\omega^\prime \theta - \Omega_1) - 1] + D_2[(1 + (\varepsilon_\theta^\prime \theta - \Omega_2)(1 - k) - k(1 - k_0))}
\]

\[
\Pi_3 = \frac{(1 - k)(\gamma_\omega D_1 + \gamma_\phi D_2)}{-D_1[(1 - k)(\varepsilon_\omega^\prime \theta - \Omega_1) - 1] + D_2[(1 + (\varepsilon_\theta^\prime \theta - \Omega_2)(1 - k) - k(1 - k_0))}
\]

\[
\Lambda_1 = \frac{(k_0 + \Omega_2 B)[kD_3 - k'(1 - k)] + (1 - \Omega_2 A + \varepsilon_\theta^\prime \theta)(k' + k\Omega_2 B)}{-D_1(\Omega_1 + k\Omega_1 B - 1 + k' + \varepsilon_\omega^\prime \theta)(k_0 + \Omega_2 B)[(1 - k)D_2 - kD_3 + k'(1 - k)]}
\]

\[
+ (1 - \Omega_2 A + \varepsilon_\theta^\prime \theta)(D_2 - k\Omega_1 B - k')
\]

\[
\Lambda_2 = \frac{(k_0 + \Omega_2 B)[D_3 k' \alpha_i - (1 - k)k' \beta_i] + (1 - \Omega_2 A + \varepsilon_\theta^\prime \theta)(k' \beta_i - \Omega_1 B k\alpha_i)}{-D_1(\Omega_1 + k\Omega_1 B - 1 + k' + \varepsilon_\omega^\prime \theta)(k_0 + \Omega_2 B)[(1 - k)D_2 - kD_3 + k'(1 - k)]}
\]

\[
+ (1 - \Omega_2 A + \varepsilon_\theta^\prime \theta)(D_2 - k\Omega_1 B - k')
\]

\[
\Lambda_3 = \frac{[\Omega_2 B(1 - k) + D_3] \gamma_\theta + [1 - \Omega_2 A + \varepsilon_\theta^\prime \theta - (1 - k)(k_0 + \Omega_2 B)] \gamma_\phi}{-D_1(\Omega_1 + k\Omega_1 B - 1 + k' + \varepsilon_\omega^\prime \theta)(k_0 + \Omega_2 B)[(1 - k)D_2 - kD_3 + k'(1 - k)]}
\]

\[
+ (1 - \Omega_2 A + \varepsilon_\theta^\prime \theta)(D_2 - k\Omega_1 B - k')
\]

Note

1. The Bank of Thailand specifies before 9 a.m. every day the rate setting between the Thai baht and U.S. dollar. This intervention rate is liable to change the following day for various reasons. During a day, from 9.00 a.m., the BOT commits itself to buy from or sell to commercial banks any amount of the intervention
currency (the U.S. dollar) at an existing official intervention rate, thus implicitly supporting commercial banks’ transactions by assuming the role of market maker. These intervention rates are liable to change in the following day for the following reasons: (1) fluctuations in the market quotations of the currencies included in the index; and (2) conditions in the domestic foreign exchange market (especially strong imbalances between supply and demand).

References


