Equilibrium Exchange Rates of Eight East Asian Currencies: A Fundamental Equilibrium Exchange Rate (FEER) Approach

Se-Eun Jeong and Jacques Mazier
University of Paris-Nord (CEPN)
99 avenue Jean-Baptiste Clément F 93430 Villetaneuse, France
E-mail : j_seeun@yahoo.co.kr, mazier@seg.univ-paris13.fr

Se-Eun JEONG and Jacques MAZIER---Equilibrium exchange rates of eight East Asian Currencies: a Fundamental Equilibrium Exchange Rate approach

The theoretical framework of FEER of Williamson (1994) serves as a reference to appreciate the exchange rate misalignments of eight East Asian currencies during the period 1982-2000. For Japan, China and South Korea misalignments are estimated with the help of a multinational model while for the other South East Asian countries a simplified model is used for each of them. Before the crisis of 1997 only the Korean won and the Thaï bath were actually overvalued and the Chinese yuan was undervalued. Since the drastic devaluations in 1997-1998 the Asian currencies have been undervalued, except for the Japanese yen and the New Taiwan dollar. Finally some implications for regional monetary cooperation in East Asia are drawn.

JEL Classification : F31, F32, F33, F42.
Key words: Fundamental equilibrium exchange rates, East Asian monetary cooperation, Macroeconomic balance approach.
1. INTRODUCTION

In understanding the crisis of 1997-1998 and the following recovery of the Asian countries, the exchange rate misalignment of their currencies is considered as a central question. Were the devaluation of Chinese yuan in 1994 and the overvaluation of other Asian currencies important factors of the crisis in 1997? Were the considerable devaluations following the crisis of a justifiable magnitude? Does current configuration of Asian currencies’ parities seem appropriate at the beginning of the 2000s, in particular, with respect to Japan locked in stagnation and China forced to rapid growth? What kind of exchange rate regimes can be regarded as well-founded at the regional level?

In this paper, exchange rate misalignments are defined as the gap, in percentage, between observed exchange rates and equilibrium ones. They will be estimated for the eight East Asian currencies for the period 1982-2000 following the “Fundamental Equilibrium Exchange Rates” approach (FEER in the sense of Williamson 1985, 1994). The FEERs are defined as the exchange rates prevailing when the economy reaches simultaneously the external equilibrium (corresponding to sustainable current account) and the internal equilibrium (corresponding to the full utilisation of productive potential). The FEER approach is based on a structural model that describes mainly the foreign trade relations and relates explicitly the movements of exchange rates to internal and external imbalances. In addition, multinational model allows the estimation of equilibrium exchange rates of the main commercial partners in a coherent manner.

Other methodologies exist like the BEER approach (Behavioural Equilibrium Exchange Rates, Clark and Macdonald, 1999) or the NATREX model (Stein and alii, 1995). These approaches rest on a reduced equation for estimating the equilibrium exchange rates. They seem less suitable than the FEER for various reasons. The fundamentals and the specification of the reduced equation often lack of accuracy. They do not take clearly the internal equilibrium into account. Lastly, the compatibility of the equilibrium exchange rates of the different commercial partners is not ensured.

Calculations for the three main Asian currencies (Japan, China and South Korea) will be conducted with the help of a multinational model describing the external trade of these three countries with their principal partners (United States, Euro Zone and the rest of the world). For the other five South East Asian currencies (Taiwan, Indonesia, Malaysia, Philippines and Thailand), a simplified model will be used for each of them and the results will be articulated with those of the multinational model. Exchange rate results will be given both in real effective terms and in nominal bilateral terms against the dollar. A global vision of the values of East Asian currencies will be obtained for the 1982-2000 period and some conclusions will be drawn regarding the future of the
exchange rate regime at the regional level in order to overtake the limits of a simple dollar peg policy.

Without resorting to simulations of heavy multinational models like those realised in earlier works with the FEER, our methodology is inspired by those adopted by Couhaerde & Mazier (2000) and Borowski & Couhaerde (2000). A simple multinational model of foreign trade is specified in logarithmic differential with regard to the equilibrium and the degree of misalignment of exchange rates can be obtained directly. Relative to these previous works, several methodological improvements can be underlined.

- Equilibrium current account balances are determined by estimating the structural determinants of the current account (demographic features, stages of development, foreign direct investment, public deficit, net foreign assets, etc.) with panel data sets, following the studies of Faruqee and Debelle (1998) and Chinn and Prasad (2000).

- The foreign trade model is constructed with a complete account of the interdependence between the major countries. The rest of the world is modelled explicitly, which guarantees the coherence of the results at the world level and resolves the problem of the n-1 parities. Lastly, the effects of the external debt service on the current account are incorporated in the model.

- Sensitivity tests are conducted in order to assess the sensitivity of the results to the estimated equilibriums (current account, internal equilibrium) and to the values of parameters (price-elasticity).

- Calculations have confirmed that for the small countries the use of a multinational model was not necessary to estimate equilibrium exchange rates. For these countries, however, the results in terms of real effective exchange rates can be completed by calculations of the bilateral nominal exchange rates using the results obtained with the multinational model.

The article is organised as follows. A second section presents the model used. A third one examines the determinants of the internal and external equilibrium of East Asian countries. A fourth section gives the results of the estimated equilibrium exchange rates for the East Asian currencies as well as the results of sensitivity tests. The main implications of methodological and empirical results are given in conclusion. Some implications for regional monetary cooperation in East Asia are drawn.

2. THE THEORETICAL MODEL

2.1. The Multinational model for the three main countries in East Asia

The model describes the trade structure of the three main Asian countries (Japan, South
Korea and China), as well as of the United States and the Euro Zone (equations of trade volumes (1) (2) and trade prices (5) (6)). As for the rest of the world, their export and import in volume are determined as the residual of the equations of the world trade equilibrium in volume (3) and in value (4) while their export and import prices are determined in the same way as the other countries. We can notice that this multinational specification gives a fully account of the interdependence effects in volumes and prices of the exports and imports of the whole countries.

We incorporate a consumption price equation (7) in order to take into account the feedback effect between the consumption and import prices. The real effective exchange rates are defined as relative consumption prices with the five countries of our model as trade partners (8). With usual notations, the model is written as:

Trade volume equations
\[ X_i = X_0 DM_i^{nXi} COMPX_i^{exi} \]  
\[ DM_i = \Pi_j M_j^{a_{ij}} \]  
\[ COMPX_i = PMX_i / PX_i \]  
\[ M_i = M_0 DI_i^{rmi} (PD_i/P_Mi)^{ami} \]  
for   \( i = \{1=Japan, 2=South Korea, 3=China, 4=United States, 5=Euro zone\} \)

World trade equilibrium in value and in volume
\[ \sum PX_i X_i = \sum PM_i M_i \]  
\[ \sum X_i = \sum M_i \]  

Price equations
\[ PM_i = PMM_i^{omi} PD_i^{1-ami} \]  
\[ PMM_i = \Pi_j (E_j PX_j/E_j)^{uij} \]  
\[ PX_i = PMX_i^{axi} P_i^{1-axi} \]  
\[ PMX_i = \Pi_j (E_j PX_j/E_j)^{bij} \]  
\[ PD_i = PM_i^{1-ai} P_i^{ai} \]  
\[ R_i = \Pi_j (PD_j/E_j)^{vij} / (PD_i/E_i) \]  
for \( i = \{1 \text{ to } 6= \text{rest of the world}\} \)

Where \( X=\text{exports in volume} ; DM = \text{world demand in volume} ; COMPX= \text{export price competitiveness} ; PX = \text{export prices} ; PMX = \text{competitor export prices} ; M = \text{imports in volume} ; PM = \text{import prices} ; PMM = \text{world import prices} ; PD = \text{consumption prices} ; P = \text{producer prices} ; E = \text{nominal bilateral exchange rates vis-à-vis the dollar} ; R = \text{real effective exchange rates}. \)
We notice that in the model the dollar plays the role of reference ($E_4 = 1$) and the bilateral exchange rates of the other currencies against the dollar are written as $1S = E_1$ yen, $E_2$ won, $E_3$ yuan, $E_5$ euro, $E_6$ monetary unities of the rest of the world.

In this framework, the fundamental equilibrium exchange rates (FEER) are defined as the real effective exchange rates that are compatible with the simultaneous realization of the internal and external macroeconomic equilibrium at medium term of each country. Internal equilibrium means the trajectory of the potential production and the external equilibrium means the sustainable current account at medium term.

As we mentioned, the estimations are conducted in logarithmic differentials. Variables in smaller letters means logarithmic differential of the variables, as $e = dE/E = (E - E^e)/E^e$ for the bilateral exchange rates and $x = dX/X = (X - X^e)/X^e$ for the other variables. In logarithmic differentials, the previous model is transformed into:

\[ x_i = \eta_i \Sigma \alpha_{ij} m_j + e_i (px_i - px) \]  
\[ pm_i = \Sigma \lambda_{ij} (px_j - e_j) + e_i \]  
\[ m_i = \eta_m di_i + \alpha_m e_{mi} (pd_i - pmm_i) \]  
\[ pmm_i = \Sigma \mu_{ij} (px_j - e_j) + e_i \]  
\[ \Sigma wx_i x_i = \Sigma wm_i m_i \]  
\[ \Sigma vx_i x_i = \Sigma vm_i m_i \]  
\[ px_i = \alpha_{si} pmx_i + (1 - \alpha_{si}) p_i \]  
\[ pm_i = \alpha_{mi} pmm_i + (1 - \alpha_{mi}) pd_i \]  
\[ pd_i = a_i pm_i + (1 - a_i) p_i \]  
\[ r_i = e_i - pd_i + \Sigma \nu_{ij} (pd_j - e_j) \]  

Where $wx_i$, $wm_i$, $vx_i$ and $vm_i$ represent the shares of country $i$ in the world exports in volume, the world imports in volume, the world exports in value and the world imports in value respectively.

The degree of deviation of internal demand from its equilibrium level of country $i$ is accounted for by the internal equilibrium imbalances $d_i = (DI_i - DI_i^e)/DI_i^e$ with $DI_i^e$ = equilibrium internal demand. This equilibrium internal demand is determined by the potential production.

The gap between actual current accounts and equilibrium ones as a percentage of GDP, central in determining exchange rate misalignments, constitutes the last equation for a
country $i$:

$$b_i = B_i/P_Y - B_i^i/P_iY_i^e = d (B_i/P_iY_i) = \mu_i d (B_i/PM_iM_i)$$

$$= \mu_i d ((PX_iX_i - PM_iM_i - i_iE_iF_i)/PM_iM_i) = \mu_i dT_i - \mu_i d (i_iE_iF_i/PM_iM_i)$$

$$= \mu_i dT_i - \mu_i d (i_iE_iF_i/PM_iM_i) (e_i - pm_i - m_i)$$

$$= \mu_i dT_i (px_i + x_i - pm_i - m_i) - \mu_i \sigma_{xi} (e_i - pm_i - m_i)$$

(9)

with $i = \{1 = Japan, 2 = South Korea, 3 = China, 4 = United States, 5 = Euro zone\}$

Where $T_i = PX_iX_i / PM_iM_i = \text{ratio of exportation to importation}$; $\mu_i = PM_iM_i/P_iY_i = \text{openness ratio}$; $F_i = \text{net external position in dollars}$; $i_i = \text{interest rates}$; $\sigma_{xi} = i_iE_iF_i/PX_iX_i = \text{ratio of external debt services to exports}$.

In the estimation of the equilibrium exchange rates, the observed current account $B/P_Y$ should be corrected by the effects of exchange rate variations in past some years because some parts of current account disequilibrium are just due to delayed adjustment to exchange rate variations.

Compared to earlier studies of the same kind, the following methodological differences must be emphasised:

- The foreign debt service is explicitly considered in the equation of the current account target.
- The foreign trade of the rest of the world, although it is are not modelled with its own export and import equations, is calculated in an endogenous way by the equilibrium of the world trade in volume and in value, which assures macroeconomic coherence at the international level.
- Summing up the current account targets of the five countries enables us to find out the target for the rest of the world ($B^e/P^eY^e_{RW}$). But this target cannot be used for the estimation of the equilibrium exchange rate of the rest of the world in the same way as for the other countries, that is, this constraint cannot be imposed to all the countries. The model, however, allows us to calculate an “equilibrium exchange rate” of the rest of the world ($e_{RW}$) without this one being compatible with its current account target $B^e/P^eY^e_{RW}$. The equilibrium exchange rate of the rest of the world is determined to be coherent with the equilibrium exchange rates of the five other countries under the constraint of the world trade balance.

On the whole, the multinational model is comprised of 35 endogenous variables ($x_i$, $m_i$, $px_i$, $pm_i$, $pd_i$ for the six countries or areas and the five bilateral exchange rates $e_i$) for 35
equations \((x_i, m_i, b_i)\) for the five countries other than the rest of the world, \(p_x, p_m, p_d\) for the six countries and the two world trade equilibrium equations). The real effective exchange rates \(r_i\) are afterwards calculated with the help of the bilateral exchange rates and of the consumption prices. The producer prices \(p_i\) are supposed unchanged at the present level of calculation, which means that we don’t include the price-wages circle in our model. The exogenous variables are the internal equilibrium gap and the external equilibrium gap \((d_i \text{ and } b_i)\).

### 2.2. The simplified model for the other five South East Asian countries

Apart from the three main Asian countries, we don’t use a complete multinational model to calculate equilibrium exchange rates. As far as small countries are concerned, it is acceptable to suppose that they don’t have much effect in trade volumes and prices of the other bigger countries and, on the contrary, their trades are influenced by bigger countries’ trades. Based on this hypothesis, we use a simple national model which describes the country’s external trade in the same way as in the previous multinational model, but in which world demand and world trade prices are exogenous. Besides, the use of the complete multinational model confirms that, when a country is of small size, the estimated equilibrium exchange rate is extremely similar, whether we utilize the complete multinational model with full trade interdependence or a simple model limited to a one country. The following equations specify the trade volume and price equations for a country facing world economy. The last equation (14) describes the formation of current account as a percentage of GDP.

\[
\begin{align*}
X_i &= X_{0i} D_i^{\eta_{xi}} (E_{Fi} P^*/P_{Xi})^{\alpha_{xi}} = X_{0i} D_i^{\eta_{xi}} R_i (1-\alpha_{xi})^{\alpha_{xi}} \\
M_i &= M_{0i} D_i^{\eta_{mi}} (P_i/P_{Mi})^{\alpha_{mi}} = M_{0i} D_i^{\eta_{mi}} R_i^{\alpha_{mi}} \\
PX_i &= (E_{Fi} P^*)^{\alpha_{xi}} P_i^{1-\alpha_{xi}} = R_i^{\alpha_{xi}} P_i \\
PM_i &= (E_{Fi} P^*)^{\alpha_{mi}} P_i^{1-\alpha_{mi}} = R_i^{\alpha_{mi}} P_i \\
d((B_i/P_i Y_i)) &= b_i = d((B_i/P_i M_i)(P_i M_i/P_i Y_i)) = \mu d(B_i/P_i M_i) \\
&= \mu d((P_i X_i - P_i M_i - i F_i E_{Fi})/P_i M_i) \\
\end{align*}
\]

Where \(P^*\) = world prices; \(D^*\) = world demand in volume; \(E_{Fi}\) = nominal effective exchange rates of country \(i\); \(R_i = E_{Fi} P^*/P_i\) = real effective exchange rates of country \(i\); \(\mu_i = P_i M_i/P_i Y_i\) = openness ratio.

Using logarithmic derivatives with \(x_i=(X_i-X_i^e)/X_i^e\) and the same notations as previously:
\[
x_i = \eta_{xi} d_i^* + (1-\alpha_{xi}) \varepsilon_{xi} r_i \quad (10')
\]
\[
m_i = \eta_{mi} d_i - \alpha_{mi} \varepsilon_{mi} r_i \quad (11')
\]
\[
p_{xi} = \alpha_{xi} r_i + p_i \quad (12')
\]
\[
p_{mi} = \alpha_{mi} r_i + p_i \quad (13')
\]
\[
b_i = \mu_i T_i (p_{xi} + x_i - p_{mi} - m_i) - \mu_i T_i \sigma_{xi} ((1 - \alpha_{mi}) r_i - p^* - m_i) \quad (14')
\]

with \( r_i = \text{ef}_{fi} + p^* - p_i \)

The real effective exchange rate, with respect to the equilibrium one in logarithmic differential (\( r_i = R_i - R_i^e / R_i^e \)), can be estimated in a simpler way than in the case of multinational model (eq.15):

\[
r_i = \left( \frac{(b_i / \mu_i T_i) - \eta_{xi} d_i^* + (1-\sigma_{xi}) \eta_{mi} d_i - \sigma_{xi} p^*)}{S_i} \right) / S_i \quad (15)
\]

with \( S_i = (1-\alpha_{xi}) \varepsilon_{xi} + \alpha_{xi} + \alpha_{mi} \varepsilon_{mi} - \alpha_{mi} - \sigma_{xi} (1+\alpha_{mi} \varepsilon_{mi} - \alpha_{mi}) \)

For a small country facing the rest of the world, this formula is simplified with assumption (\( p^* = d^* = 0 \)) as:

\[
r_i = \left( \frac{(b_i / \mu_i T_i) + (1-\sigma_{xi}) \eta_{mi} d_i}{S_i} \right) / S_i \quad (16)
\]

**Calculation of the nominal bilateral exchange rates against dollar**

Fundamental equilibrium exchange rate problems are focused on real effective exchange rates. However, nominal bilateral parities are more intelligible when we are concerned with monetary policy perspectives. The complete multinational model allows, for the main currencies, the calculation of the nominal bilateral exchange rates against dollar. The bilateral exchange rates of the other Asian currencies (\( e_i \)) can be calculated from the previously determined real effective exchange rates (\( r_i \)) and the bilateral exchange rates of the principal currencies estimated with multinational model by reversing the formula defining the real effective exchange rates (17).

\[
r_i = e_i - p_{di} + \Sigma v_{ij} (pd_{dj} - e_j) \quad (17)
\]

with \( j = \{1=Japan, 2=South Korea, 3=China, 4=United States, 5=\text{Euro Zone}, 6=\text{Rest of the world}\} \) and \( i = \{\text{Taiwan, Thailand, Malaysia, Indonesia, Philippines}\} \)

For the sake of simplification, we take Japan, South Korea, China, United States, Euro Zone, and the rest of the world as the partner countries for country \( i \) and we use the values of \( pd_{dj} \) and \( e_j \) estimated previously with the multinational model. It can be noticed
that the country i was supposed to be included in the rest of the world in the case of the multinational model. We take the approximation that pd\textsubscript{j} and e\textsubscript{j} of the rest of the world including the country i in the multinational model equal pd\textsubscript{j} and e\textsubscript{j} of the rest of the world excluding the country i in the simplified model. To estimate the bilateral exchange rates, we still need the consumption prices of country i (18). Import prices are determined by the world import prices (pmm\textsubscript{i}) of country i (19 and 20).

\begin{align*}
\text{pd}_i &= a_i\text{pm}_i + (1-a_i)p_i \quad (18) \\
\text{pm}_i &= \alpha_m\text{pmm}_i + (1-\alpha_m)\text{pd}_i \quad (19) \\
\text{pmm}_i &= \sum \mu_{ij}(px_j-e_j) + e_i \quad (20) \\
\text{pd}_i &= a_i\alpha_m/(1-a_i(1-\alpha_m))\text{pmm}_i \quad (21)
\end{align*}

Under the hypotheses \(\alpha_m=1\) and \(p_i=0\), as before, and with the equation (17):

\begin{align*}
\text{pd}_i &= a_i\text{pmm}_i =a_i e_i + a_i \sum \mu_{ij}(px_j-e_j) \quad (22) \\
r_i &= e_i - a_i e_i - a_i \sum \mu_{ij}(px_j-e_j) + \sum \nu_{ij}(\text{pd}_j-e_j) \quad (23)
\end{align*}

which gives the nominal bilateral exchange rates against the dollar e\textsubscript{i}

\[e_i=1/(1-a_i)[r_i + a_i \sum \mu_{ij}(px_j-e_j) - \sum a_i(\text{pd}_j-e_j)] \quad (24)\]

### 2.3. Elasticities of trade equations

Without doing original econometric work, the trade equations are taken from existing estimations realised with specifications close to the standard model presented before. We use especially long-term elasticities. Considering the uncertainties of estimation, sensibility tests to elasticity modifications will be made later in the research. The following table 1 compares trade bloc elasticities for the five countries provided by different available estimations.

On the whole, the elasticities for a given country are relatively close one another, except for few cases. Considering, for a synthetic comparison, the total effect of the real exchange rates on the trade balance \(S=\alpha(1-\alpha)+\beta\alpha m-\alpha m+\alpha x\), the different estimations produce rather similar results. Only the NIGEM model and the Kim model for Korea give lower values. The elasticities of the MIMOSA model for Japan and the United States (close to those of Wren-Lewis), those of Barell for Korea, those of Déés for China and those of Hervé for the Euro Zone\(^1\) are taken for our simulation. The price

\(^1\) The ECB model of the Euro zone has been estimated using the whole intra and extra-european trade which is not suited while the Hervé model is restricted to the extra-european trade.
Table 1: Elasticities of trade equations for the multinational model

<table>
<thead>
<tr>
<th>Country</th>
<th>Demand elasticity</th>
<th>Price elasticity</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \eta_x )</td>
<td>( \eta_m )</td>
<td>( \alpha_x )</td>
<td>( \alpha_m )</td>
<td>( S )</td>
<td>( \varepsilon_x )</td>
<td>( \varepsilon_m )</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>1.01</td>
<td>1.50</td>
<td>0.19</td>
<td>0.56</td>
<td>1.47</td>
<td>1.26</td>
<td>1.47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1.69</td>
<td>0.61</td>
<td>0.24</td>
<td>0.75</td>
<td>1.19</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.16</td>
<td>1.43</td>
<td>0.16</td>
<td>0.78</td>
<td>1.43</td>
<td>1.36</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>Korea</td>
<td>2.0</td>
<td>1.2</td>
<td>1</td>
<td>1.20</td>
<td>0.10</td>
<td>2.2</td>
<td>0.102</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.29</td>
<td>1.593</td>
<td>1.01</td>
<td>1</td>
<td>1.16</td>
<td>1.11</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>0.75</td>
<td>1.04</td>
<td>0.56</td>
<td>0.66</td>
<td>0.89</td>
<td>0.71</td>
<td>0.462</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0.979</td>
<td>0.66</td>
<td>0.60</td>
<td>0.64</td>
<td>0.66</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>1.04</td>
<td>1.56</td>
<td>0.09</td>
<td>0.50</td>
<td>1.14</td>
<td>0.91</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2.52</td>
<td>0</td>
<td>1</td>
<td>0.11</td>
<td>0.52</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.12</td>
<td>2</td>
<td>0.19</td>
<td>0.55</td>
<td>1.16</td>
<td>0.96</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>Euro Zone</td>
<td>1.05</td>
<td>1.06</td>
<td>0.30</td>
<td>0.35</td>
<td>0.63</td>
<td>0.82</td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>0.3</td>
<td>0.35</td>
<td>0.64</td>
<td>1.39</td>
<td>0.75</td>
<td></td>
</tr>
</tbody>
</table>

* Import prices aren't estimated econometrically in the NIGEM model

elasticities are rather in accordance with the generally admitted hierarchical position of the countries in the world trade. The relatively weak value for China could be surprising but might be explained by the particular nature of the Chinese trade. The trade model of China was estimated for the period 1985-1998 and for the first half of the 1980s the role of exchange rates in exports and imports is considered as little significant. By the way, Japanese and American exporters turn out to be largely price maker.

Table 2 shows the trade equation elasticities for the five South East Asian countries. The different empirical studies give results that are rather close concerning the demand elasticity for one given country. These elasticities are in general statistically significant and, for the majority of cases, above 1, which seems plausible for rapidly growing countries. On the other hand, price elasticities are often small, especially in the case of elasticity of exports, and very different according to studies. The results of Senhadji are generally higher than those of the IMF concerning price elasticity of imports. If we adopt the hypothesis of « price taker » for exporters on the world market (\( \alpha_x = 1 \)) and of « price maker » for importers (\( \alpha_m = 1 \)), the only important price elasticity is that of imports.
Table 2: Elasticities of trade equations of the South East Asian countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Source</th>
<th>( \varepsilon_x )</th>
<th>( \varepsilon_m )</th>
<th>( \eta_x )</th>
<th>( \eta_m )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>IMF</td>
<td>0.32</td>
<td>0.68**</td>
<td>1.27</td>
<td>1.66**</td>
</tr>
<tr>
<td></td>
<td>Senhadji</td>
<td>1.55(2.56)</td>
<td></td>
<td></td>
<td>0.9(2.21)</td>
</tr>
<tr>
<td>Malaysia</td>
<td>IMF</td>
<td>0.53</td>
<td>0.01</td>
<td>1.86**</td>
<td>1.47**</td>
</tr>
<tr>
<td>Philippines</td>
<td>IMF</td>
<td>-0.1</td>
<td>-0.75</td>
<td>1.34**</td>
<td>1.65**</td>
</tr>
<tr>
<td></td>
<td>Senhadji</td>
<td>1.71(2.22)</td>
<td></td>
<td></td>
<td>2.09(2.27)</td>
</tr>
<tr>
<td>Thailand</td>
<td>IMF</td>
<td>0.99</td>
<td>0.75</td>
<td>2.73**</td>
<td>1.03**</td>
</tr>
<tr>
<td></td>
<td>Barrell</td>
<td>0.45(1.86)</td>
<td>0.93(2.77)</td>
<td>2.59(2.544)</td>
<td>1.59(4.52)</td>
</tr>
<tr>
<td></td>
<td>Senhadji</td>
<td>1.64(2.66)</td>
<td></td>
<td></td>
<td>1.77(2.69)</td>
</tr>
<tr>
<td>Taiwan</td>
<td>Barrell</td>
<td>0.89(2.64)</td>
<td>1.74(2.39)</td>
<td>2.18(31.52)</td>
<td>1.17(2.53)</td>
</tr>
</tbody>
</table>

( ) = T statistics ; ** = significant at 1%

In the case of Malaysia, the price elasticity of imports is too low and, in the case of Philippines, it is wrongly signed in the results of the IMF. These results seem to come from the problem of deficient data and the existence of controls on imports, not from truly weak price elasticity of imports of these two countries. Senhadji’s results show that the price elasticities of imports are not weak, nor wrongly signed for these countries. But they seem too high in comparison with common empirical results for developing countries. We retain 0.88 as a price elasticity of imports, an average of 48 developing countries in the empirical work of Senhadji (1997) for Malaysia and Philippines. For other countries, the results marked in bold in table 2 seem to be reasonable as elasticity values of the external bloc.

3. EXTERNAL AND INTERNAL EQUILIBRIUM AT MEDIUM TERM

3.1. Estimation of equilibrium current account

As the current account equals the difference between domestic saving and investment (i.e. the saving-investment balance), current account developments are examined from the perspective of the fundamental medium to long-run determinants of the saving and investment behaviours (Faruque & Debelle, 1998 ; Chinn & Prasad, 2000). The principal determinants of the current account at medium term are: the dependency ratios of young and old populations relative to the working age population, which exert a negative influence, with a higher dependency ratio leading to more spending; the net
foreign assets, which have a positive effect due to the capital income resulting from it; the foreign direct investments, which permit for a deterioration of the current account in so far as an improvement of the productive potential can be expected; the relative real GDP per capita, which exerts a non-linear influence according to the stages of development; the openness ratio, which plays negatively, a higher openness meaning a greater possibility of assuring the debt service in the future; the government budget balance, with a public deficit having a negative effect on the current account. Finally, the output gap is included as a short-term variable, because an excessive utilisation of the production capacity contributes to the deterioration of the current account. But this last variable will be eliminated in the simulation of the equilibrium current account.²

The equations of the determinants of the current account are estimated on panel data for 1981-2000 for two groups of countries. One group is composed of 20 industrial countries and will be used for determining the current account targets of Japan, South Korea, Taiwan, the Euro zone and the United States. The other group, composed of 18 emerging economies, will be used for determining the current account targets of China, Indonesia, Malaysia, Philippines and Thailand.

The inclusion of a temporal effect can be justified as long as it represents temporary shocks, occurring in a given year, which have an important impact on the current account balance and on their financing pattern. This effect can be, however, redundant with the output gap that represents also the effects of short-term factors. The including of fixed effects is more questionable. Numerous studies based on panel data incorporate fixed effects for each country in order to capture specific country effects that are not represented by the common explanatory variables.

\[
\text{CUR}_t = \alpha_1 \text{GOV}_t + \alpha_2 \text{DEP}_t + \alpha_3 Y_t + \alpha_4 \text{FDI}_t + \alpha_5 \text{NFA}_t + \alpha_6 \text{OPEN}_t + \alpha_7 \text{GAP}_t + b_i + c_t + u_t \tag{25}
\]

Where CUR= current account balance (as a percentage of GDP), GOV= government budget balance (as a percentage of GDP), DEP= dependency ratios, population under the age of 19 years as a percentage of population between 20-64 years old and population over the age of 65 years as a percentage of population between 20-64 years old, Y= real GDP per capita, in PPP dollars (as a percentage of that of the United States, base year =1990), FDI= foreign direct investments (as a percentage of GDP), NFA= net

² We tested stationarity using panel data unit root tests. We apply the « standardized t-bar statistic » proposed by Im, Sesaran and Shin (2002) that can be used to the more general case where the errors may be serially correlated. Test results allow concluding that most of variables are stationary for industrial country group and emerging country group, except for OPEN for emerging country group.
foreign assets (as a percentage of GDP), OPEN= degree of openness (imports+exports as a percentage of GDP), GAP= output gap (actual real GDP as a percentage of potential GDP), bi=specific country effect, ci= temporal effect.

For the industrial countries, the coefficients are on the whole significant with the predicted signs (Table 3). The government budget balance plays positively with coefficients statistically significant in the different specifications. The dependency ratios of the young and old dependent populations have negative effects on the current account. As predicted, the net inflow of foreign direct investments allows more current account deficit while net foreign assets exert a positive influence through the capital income that they create. On the contrary, GDP per capita produces rarely significant results.

The results obtained with the different specifications are quite similar. The inclusion of temporal effect does not improve the results substantially. The fixed effects raise the determination ratio, but diminish the role of net external assets whose evolutions are sensibly contrasting across countries. Besides, the specification with fixed effects can be a source of bias. Finally, it’s the specification without fixed effects nor temporal effect that is adopted for the estimation of equilibrium current account in the medium run.

**Table 3 Estimation of the determinants of current accounts for the industrial countries**

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>Fixed Effects</th>
<th>Temporal Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOV</td>
<td>0.23 (5.07)</td>
<td>0.25 (4.35)</td>
<td>0.21 (4.17)</td>
</tr>
<tr>
<td>DEP young</td>
<td>-0.06 (-2.01)</td>
<td>-0.20 (-5.30)</td>
<td>-0.01 (-0.42)</td>
</tr>
<tr>
<td>DEP old</td>
<td>-0.11 (-2.39)</td>
<td>-0.34 (-2.76)</td>
<td>-0.08 (-1.61)</td>
</tr>
<tr>
<td>FDI</td>
<td>-0.31 (-2.50)</td>
<td>-0.15 (-1.15)</td>
<td>-0.33 (-2.62)</td>
</tr>
<tr>
<td>Y</td>
<td>0.00 (-0.24)</td>
<td>-0.17 (-4.31)</td>
<td>0.00 (0.27)</td>
</tr>
<tr>
<td>NFA</td>
<td>0.09 (12.35)</td>
<td>0.05 (3.08)</td>
<td>0.09 (12.47)</td>
</tr>
<tr>
<td>GAP</td>
<td>-0.48 (-7.46)</td>
<td>-0.50 (-7.58)</td>
<td>-0.51 (-7.13)</td>
</tr>
<tr>
<td>Constant</td>
<td>5.95 (2.51)</td>
<td>0.88 (2.8)</td>
<td>0.88 (2.8)</td>
</tr>
<tr>
<td>adjusted R²</td>
<td>0.43</td>
<td>0.60</td>
<td>0.43</td>
</tr>
</tbody>
</table>

( ) : T statistics

Results of panel data unit root tests

<table>
<thead>
<tr>
<th></th>
<th>CUR</th>
<th>GOV</th>
<th>DEP young</th>
<th>DEP- Old</th>
<th>FDI</th>
<th>Y</th>
<th>NFA</th>
<th>GAP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-7.4</td>
<td>-11.5</td>
<td>-6.9</td>
<td>-1.96</td>
<td>-9.8</td>
<td>-5.3</td>
<td>-4.8</td>
<td>-12.1</td>
</tr>
</tbody>
</table>

Note: critical values are -1.96 (at 5%) and -1.65 (at 10%).
Results for the emerging countries are relatively significant, although slightly worse than those for the industrial countries (Table 4). The principal variables play in the same way as for industrial countries, but some variables play differently. The real GDP per capita, representative of the stage of development, plays positively, which can not be explained simply if we referred only to the traditional theory of debt cycle, but which can be interpreted as the result of a more complicated non-linear relationships. The net foreign assets exert a positive influence while net flows of FDI allow a worsening of the current account deficit. The degree of openness plays negatively. For the developing countries, more openness means the capacity to pay back their debt in the future due to expected higher exportations, which attracts capitals.

Table 4 Estimation of the determinants of current accounts for developing countries

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>Fixed Effects</th>
<th>Temporal Effect</th>
<th>4 country effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOV</td>
<td>0.11</td>
<td>0.15</td>
<td>0.09</td>
<td>0.17</td>
</tr>
<tr>
<td>DEP young</td>
<td>-0.03</td>
<td>-0.02</td>
<td>-0.01</td>
<td>-0.05</td>
</tr>
<tr>
<td>DEP old</td>
<td>-0.36</td>
<td>0.75</td>
<td>-0.30</td>
<td>-0.38</td>
</tr>
<tr>
<td>FDI</td>
<td>-0.27</td>
<td>-0.38</td>
<td>-0.35</td>
<td>-0.38</td>
</tr>
<tr>
<td>Y</td>
<td>0.07</td>
<td>0.10</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>NFA</td>
<td>0.04</td>
<td>-0.04</td>
<td>0.05</td>
<td>0.03</td>
</tr>
<tr>
<td>GAP</td>
<td>-0.41</td>
<td>-0.30</td>
<td>-0.40</td>
<td>-0.38</td>
</tr>
<tr>
<td>OPEN</td>
<td>-0.01</td>
<td>0.00</td>
<td>-0.01</td>
<td>-0.01</td>
</tr>
<tr>
<td>dummy Chili</td>
<td></td>
<td></td>
<td></td>
<td>-3.61</td>
</tr>
<tr>
<td>dummy Egypte</td>
<td></td>
<td></td>
<td></td>
<td>2.24</td>
</tr>
<tr>
<td>dummy Thaïlande</td>
<td></td>
<td></td>
<td></td>
<td>-3.03</td>
</tr>
<tr>
<td>dummy Venezuela</td>
<td></td>
<td></td>
<td></td>
<td>2.31</td>
</tr>
<tr>
<td>Constant</td>
<td>5.06</td>
<td>3.13</td>
<td>7.00</td>
<td></td>
</tr>
<tr>
<td>adjusted R²</td>
<td>0.23</td>
<td>0.37</td>
<td>0.26</td>
<td>0.30</td>
</tr>
</tbody>
</table>

Results of panel data unit root tests

<table>
<thead>
<tr>
<th>CUR</th>
<th>GOV young</th>
<th>DEP</th>
<th>DEP</th>
<th>Y</th>
<th>NFA</th>
<th>FDI</th>
<th>GAP</th>
<th>OPEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10.0</td>
<td>-12.9</td>
<td>-4.4</td>
<td>-2.3</td>
<td>-5.6</td>
<td>-9.9</td>
<td>-14.2</td>
<td>-16.8</td>
<td>-0.9</td>
</tr>
</tbody>
</table>

Note: critical values are -1.96 (at 5%) and -1.65 (at 10%).
Regarding the possible biases produced by the country effects and the redundancy with output gap of the temporal effects, a specification without fixed effects, nor temporal ones, seems to be the most suitable as in the case of the industrial countries. But its determination ratio is rather low. One possible way to resolve this problem is to include several country effects, statistically the most significant in our estimation. Actually, all the country effects are not substantially significant. The estimation with country specific effects limited to only four countries seems to produce the most satisfying results.\(^3\)

3.2. The simulated equilibrium current balances

The following figures give the current account balances with observed and equilibrium values. The equilibrium current account of Japan improves from -0.7% to more than 2% of GDP in average during the 1990s because of the improvement of net external position, despite the negative effects of the public balance worsening at the end of the period. The effect of increasing dependency ratio of old dependent population is more than compensated by that of decreasing dependency ratio of young dependent population.

Similarly equilibrium current account of South Korea experiences a vigorous improvement from -5% of GDP to a situation close to equilibrium during the 1990s. The principal explanation is given by the decreasing dependency ratio of young dependent population and the improvement of the net external position that brought about a positive contribution at the beginning of the 1990s.

In the case of China, equilibrium value is close to -0.7% of GDP until the first years of 1990s, which seems coherent with the policy adopted by Chinese authorities that wanted to avoid resorting to considerable external debt. The downward shift of equilibrium value to reach –1% to -1.5% of GDP from 1992-1994 can be well explained by the start of the increasing wave of FDI, but also by the increasing degree of openness. The amelioration of net external position plays in the opposite direction while the opposed evolutions of the two dependency ratios are compensating each other.

Taiwan experiences an increasing trend of the equilibrium current account since the start of the 1980s because of the diminishing dependency ratio of young dependent population and the accumulation of net external assets. Unlike South Korea, its net external assets do not diminish during the 1990s, due to continuing current account surplus. Its external net assets remain around 50% of GDP since the start of that decade.

---

\(^3\) We estimated the equation in incorporating specific country dummies one by one. Country dummies of Chile, Egypt, Thailand and Venezuela turned out to be the most significant and produced higher determination ratios than the other country dummies.
Apart from Philippines, the three Asian countries - Indonesia, Malaysia and Thailand - have shown a weak increase in their equilibrium current balances before the crisis of 1997-98. Indonesia experienced an increase of its equilibrium current accounts from -2.5% to -0.8% of GDP, Malaysia from -5% to -1% and Thailand from -5.5% to -2%. The factors of this increasing trend are of the same nature in these countries, but of different magnitude.

The dependency ratios of young population have diminished strongly and the stages of development represented by the per capita income have progressed also substantially in these three countries, which has contributed to the improvement of the equilibrium current balances. In addition, the reduction of the government deficit has favoured the
increase of equilibrium current account, in particular in the case of Malaysia. On the other hand, net external assets and inflows of foreign direct investments played so as to lower the equilibrium current balance. The net external assets have decreased during the first half of 1980s, increased during the second half and stagnated from the start of the 1990s until the crisis. In Philippines, the factors of change were more limited over the period, whether net external assets, inflows of FDI or government deficit were concerned. The diminution of the dependency ratio of young population had a positive effect, but was compensated by the deterioration of the per capita income.

In 1997, the increase of government deficit and the decrease of net external assets and of income per capita following the crisis contributed to that of equilibrium current
balance for the ASEAN countries, especially for Thailand. Since 1998, these variables have improved in the four countries, but to different degrees according to countries and depending especially of the FDI configuration.

The United States had an equilibrium current balance that declined from -0.5% to -1.5% of GDP due to the reduction of their net foreign assets, before they registered a weak upturn at the end of the 1990s because of the decrease of the government deficit. Finally, the equilibrium current balance of the Euro zone improved from -1.3% to 1.5% of GDP at the end of the period because of the increase of the net foreign assets, the decrease of the dependency ratio of young population and the improvement of the public finance.

A last correction should be specified. In the theoretical framework of fundamental equilibrium exchange rates, the whole difference between the observed current balance and the equilibrium one must not be interpreted entirely as an external disequilibrium. A part of this difference is due to the delayed effects of variations of exchange rates that have not yet occurred entirely, but should be accounted for in estimation. This correction is done by using the dynamic structures of the external trade equations from which we obtained elasticities. South Korea and Indonesia adjust the most rapidly their trades to variations of exchange rates while China and Euro zone know the largest delayed effects, especially because of slow reaction of imports. Precedent figures show observed and corrected current accounts with equilibrium ones.

**Figure 3** Observed, corrected and equilibrium current accounts, the United States, Euro zone

![Graph showing observed, corrected, and equilibrium current accounts for the United States and Euro zone](image-url)
3.3. **The estimation of internal equilibrium**

The internal equilibrium is defined as the full utilisation of productive resources of one country without provoking inflation pressures. For the sake of simplification, a restrictive approach, limited to the measure of the potential output, is adopted. Potential output provides, however, a useful indicator of the general supply capacity. Different methods can be employed in calculating potential production or trend production and the corresponding output gap. For the United States, Japan, the Euro zone and Korea, we take the values estimated with production function by the OECD (2001) and the Bank of Korea (2000). This approach consists in estimating the potential production with estimated production function and available production factors in the country. It demands more information and more hypotheses regarding economic mechanisms than other simpler approaches but is less mechanical and more relevant theoretically.

For China, Taiwan and the four ASEAN countries, we calculate output gap by using the Hodrick-Prescott filter on real GDP (industrial production in the case of China) over the period 1970-2000. The data was withdrawn from the database of CHELEM or OECD. It should be noted that in the external bloc of Japan, the United States and Euro Zone, the import volume equations were estimated with the internal demand rather than with GDP. A simple regression can be established between internal demand and GDP. From this relation, the gaps between actual internal demand and its equilibrium can be calculated for these three countries.

The three main countries, the United States, Euro zone and Japan experienced evolutions of the internal equilibrium close one another during the 1980s. Through the first half of the 1980s marked by a substantial recession, observed productions were inferior to potential one, strongly in the United States and to a lesser degree in Japan. Output gaps were reduced with the recovery in the second half of the 1980s. The countries’ internal equilibrium evolutions were more contrasting during the 1990s. Recession in the United States during 1991 was short and followed by a long period of expansion. Japanese and European economies contracted together, then Japan showed a lasting period of under-utilisation of his productive potential while Euro zone knew a gradual amelioration from 1997.

South Korean economy experienced a quite fluctuating evolution of its output gap with a remarkable slowdown at the start of the 1980s, followed by a strong recovery briefly interrupted at the start of the 1990s. The expansionist phase of the 1990s came to an end with the crisis of 1998, followed soon by a vigorous recovery. China registered also a quite unstable evolution of its output gap largely disconnected with those of other
countries. After alternating recession periods, notably at the end of the 1980s, and lasting booming periods, China escaped the Asian crisis in 1997-1998. Taiwan is characterized, in contrary, by an output gap of limited magnitude compared to other countries, apart from under-utilisation of production capacities during the first half of the 1980s. Since then, its production has remained remarkably close to its potential one.

The four ASEAN countries showed cyclical evolutions of large magnitude and relatively similar one another over 1980-2000. The boom of the beginning of the 1980s was followed by a slowdown that reached its lowest between 1985 and 1987. Afterwards, with strategy of openness to outward and inflows of FDI, these economies continued to grow until the crises of 1997-1998. Thailand was the first country affected from the year 1996, but the most profoundly affected was Indonesia. Philippines remained less performing during booming periods in the 1990s, but underwent the negative effects of the crisis to a lesser degree.
4. THE ESTIMATION OF THE EQUILIBRIUM EXCHANGE RATES

Estimated equilibrium exchange rates will be given successively for three big Asian currencies (Japanese yen, Chinese yuan and South Korean won), as well as for the American dollar, euro and a fictive monetary unity of the rest of the world, and then for the five other South East Asian currencies. Sensitivity tests allow for assessing the effects of uncertainties that might mark the estimation results. Finally the structure of bilateral exchange rates of East Asian currencies will be examined in bilateral terms against the Japanese yen.

4.1. The three main currencies in East Asian region

With internal and external equilibrium previously estimated, the solving of multinational model for the six countries produces the misalignment of exchange rates in terms of real effective exchange rate \( r_i = (R_i - R_i^e)/R_i^e \) and nominal exchange rate against dollar \( e_i = (E_i - E_i^e)/E_i^e \), which allows to determine under-valuation \( (e_i > 0 \text{ et } r_i > 0) \) or overvaluation \( (e_i < 0 \text{ et } r_i < 0) \) (table 5).

The Japanese yen appeared undervalued compared to the US dollar during the 1980s (around 16% in the middle of the 1980s in real effective terms). This situation, which reflects the massive current account surplus in a context of sustained growth, came to an end in 1990, following the revaluation of the yen and the reduction of the Japanese current surplus. At that time, the yen was close to its equilibrium value. This situation continued despite the appreciation of the yen compared to the dollar and in 1995 the yen was always estimated only slightly overvalued. During the second half of the 1990s, the yen remained close to equilibrium value in real effective terms despite weak economic growth. In nominal terms against the dollar, the evolution of the yen is slightly different, especially during the 1990s. The strong under-valuation of yen compared to dollar in the middle of the 1980s diminished so as to disappear in 1990, before the yen became slightly overvalued in 1995. In contrary, since 1997, the yen became undervalued again of 10 to 15% against dollar.

In a context of recovery from crisis and of current deficit, the Korean won seemed to be close to its equilibrium value at the beginning of the 1980s. Then, with the economic boom and the increasing current surplus, the won became undervalued (of 20% or so in real terms and of more than 50% in nominal terms against dollar) since the middle of the 1980s. Following the appreciation of the won, this situation came to an end in 1990 with the disappearance of the current surplus and the deterioration of the economic situation. The Korean won became overvalued (of 14% in real terms and of 25% in
Table 5: Under-valuation ($r_i > 0$ et $e_i > 0$) or overvaluation ($r_i < 0$ et $e_i < 0$) for the six main countries in the multinational model

<table>
<thead>
<tr>
<th>Year</th>
<th>Real effective exchange rates</th>
<th>Nominal rates against dollar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Japan</td>
<td>Korea</td>
</tr>
<tr>
<td>1982</td>
<td>0.11</td>
<td>0.00</td>
</tr>
<tr>
<td>1983</td>
<td>0.12</td>
<td>0.06</td>
</tr>
<tr>
<td>1984</td>
<td>0.13</td>
<td>0.03</td>
</tr>
<tr>
<td>1985</td>
<td>0.16</td>
<td>0.04</td>
</tr>
<tr>
<td>1986</td>
<td>0.13</td>
<td>0.19</td>
</tr>
<tr>
<td>1987</td>
<td>0.13</td>
<td>0.19</td>
</tr>
<tr>
<td>1988</td>
<td>0.05</td>
<td>0.17</td>
</tr>
<tr>
<td>1989</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>1990</td>
<td>0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>1991</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>1992</td>
<td>0.06</td>
<td>0.03</td>
</tr>
<tr>
<td>1993</td>
<td>0.00</td>
<td>0.01</td>
</tr>
<tr>
<td>1994</td>
<td>0.00</td>
<td>-0.02</td>
</tr>
<tr>
<td>1995</td>
<td>-0.04</td>
<td>-0.04</td>
</tr>
<tr>
<td>1996</td>
<td>-0.04</td>
<td>-0.14</td>
</tr>
<tr>
<td>1997</td>
<td>0.00</td>
<td>-0.04</td>
</tr>
<tr>
<td>1998</td>
<td>0.04</td>
<td>0.28</td>
</tr>
<tr>
<td>1999</td>
<td>-0.01</td>
<td>0.20</td>
</tr>
<tr>
<td>2000</td>
<td>-0.01</td>
<td>0.09</td>
</tr>
</tbody>
</table>

nominal terms against dollar) on the eve of the 1997 Asian crisis. The devaluation of the won in 1998 went beyond justifiable magnitude and ended in a remarkable undervaluation compared to the dollar in spite of the slight correction in 1999, more in real effective terms than in nominal terms against dollar.

In China the beginning of the 1980s is difficult to interpret due to the mode of regulation of the external trade that prevailed at that time and that was controlled strongly by government. However, the yuan seemed to be strikingly overvalued in the middle of the 1980s (of 27% in real terms) with the massive current account deficit. The introduction of an exchange rate determined by the swap centers led to a de facto devaluation that permitted to reverse this situation until the stabilisation of 1990 when the yuan was close to its equilibrium parity, with a significant current surplus contrasting with the slowing down of the economic activity.
Renewed devaluations and the increasing usage of the swap exchange rate allowed the actual exchange rate to follow the depreciation of the equilibrium exchange rate in a context of degradation of the current account and of considerable inflation, so that in 1994, the year of the unification of the exchange rate system, the yuan was always close to its equilibrium parity in nominal and real terms. The second half of the 1990s marked a turning point. The economic boom and the return of current surplus, while the FDI inflows permitted more deficits in the current account target, led to a revaluation of the equilibrium level of the yuan. The maintenance of the exchange rate of the yuan means then an increasing under-valuation until the year 1997, and a persistent under-evaluation afterwards in nominal and real terms. This diagnostic could help to find an explanation of the resistance of the yuan facing the Asian crisis. In 2000, under-valuation of yuan is of 32% in real effective terms and of 62% in nominal terms against dollar.

Figure 5 Observed and equilibrium exchange rates of three main East Asian countries
4.2. The five South East Asian currencies

The solution of the second type of model (model of one country facing the world) yields the misalignments of real effective exchange rates for Taiwan and the four ASEAN countries that are reported in table 6. Misalignments of nominal exchange rates against the US dollar can also be calculated by mobilizing results of the precedent simulation.

Taiwan is a country comparable with South Korea in numerous respects. Regarding the exchange rate policy, the two countries showed relatively close evolutions until the eve of 1997 Asian crisis. The 1980s are, at first, marked by an increasing under-valuation of New Taiwan dollar in real and nominal terms. Then, under the pressure of current account surplus, the New Taiwan dollar was appreciated and became close to its equilibrium rates by the year 1990. With decline of surplus of current account and growth close to its potential, the Taiwanese dollar had tendency to become weakly overvalued during the first half of the 1990s, but this overvaluation was very limited on the eve of Asian crisis (-2% in 1996 and -5% in 1997), which appears as a first difference with the case of South Korea. Crisis management was also very different with very modest devaluation of the Taiwanese dollar and a persistence of weak overvaluation in real terms, that contrasts with under-valuation of the other currencies in the region and which constitutes a handicap for Taiwanese economy. On the other hand, the under-valuation is more noticeable in nominal terms against dollar (about 13% en 2000).

Malaysia, Philippines and Thailand present similarity with respect to exchange rate policy during the 1980s. The first years are marked by the ending of economic boom
along with current account deficits, which can be interpreted by an overvaluation of their currencies. In the middle of the 1980s, nominal and real depreciation of these currencies result to substantial amelioration of their current account balances in a context of under-utilisation of their production capacity, leading to an under-valuation of these currencies between 1985 and 1989, in particular to a relatively important extent in the case of Philippines. A reversal took place from the start of the 1990s in Malaysia and in Thailand, where economic recovery was related to the reappearance of important disequilibrium in current account balances, highlighting the overvaluation, in nominal terms against dollar and also in real effective terms, of Malaysian ringgit and Thai baht. This phenomenon is less present in the case of Philippines, where the growth is more modest and the current account deficit more contained. This overvaluation persists, but in a more attenuated way, until the middle of the 1990s.

Table 6 : Under-valuation (rᵢ >0 et eᵢ>0) or overvaluation (rᵢ <0 et eᵢ<0) for the five South East Asian countries

<table>
<thead>
<tr>
<th>Year</th>
<th>Real effective exchange rates</th>
<th>Nominal rates against dollar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Taiwan</td>
<td>Indonesia</td>
</tr>
<tr>
<td>1982</td>
<td>0.06</td>
<td>-0.30</td>
</tr>
<tr>
<td>1983</td>
<td>0.07</td>
<td>-0.34</td>
</tr>
<tr>
<td>1984</td>
<td>0.08</td>
<td>-0.01</td>
</tr>
<tr>
<td>1985</td>
<td>0.10</td>
<td>-0.07</td>
</tr>
<tr>
<td>1986</td>
<td>0.25</td>
<td>-0.29</td>
</tr>
<tr>
<td>1987</td>
<td>0.14</td>
<td>-0.14</td>
</tr>
<tr>
<td>1988</td>
<td>0.04</td>
<td>-0.07</td>
</tr>
<tr>
<td>1989</td>
<td>0.02</td>
<td>-0.04</td>
</tr>
<tr>
<td>1990</td>
<td>0.03</td>
<td>-0.16</td>
</tr>
<tr>
<td>1991</td>
<td>0.05</td>
<td>-0.17</td>
</tr>
<tr>
<td>1992</td>
<td>0.03</td>
<td>-0.04</td>
</tr>
<tr>
<td>1993</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1994</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>1995</td>
<td>-0.03</td>
<td>-0.01</td>
</tr>
<tr>
<td>1996</td>
<td>-0.02</td>
<td>0.08</td>
</tr>
<tr>
<td>1997</td>
<td>-0.05</td>
<td>0.25</td>
</tr>
<tr>
<td>1998</td>
<td>-0.02</td>
<td>0.21</td>
</tr>
<tr>
<td>1999</td>
<td>0.02</td>
<td>0.05</td>
</tr>
<tr>
<td>2000</td>
<td>-0.01</td>
<td>0.10</td>
</tr>
</tbody>
</table>
In 1996, at the eve of the Asian crisis with newly increasing current account deficit in Thailand, the baht is overvalued (-16% in real terms) and in Philippines the overvaluation is more limited (-10% in real terms). On the other hand Malaysia escapes to the phenomenon of overvaluation in 1996. Except for Thailand where overvaluation appears significant, although more modest than that of the start of the 1990s, overvaluation does not seem to be the main cause of the crisis in these Asian countries. The significant devaluations following the crisis contribute to the reconstitution of very large current account surplus and result in an important under-valuation of these three currencies in real and nominal terms, more marked in the case of Thailand and

Figure 6 Observed and equilibrium exchange rates of the five South East Asian countries
Philippines than in Malaysia (about 30% in real terms in 2000 in Thailand and Philippines).

Indonesia is an oil-exporting country whose current balance shows different profile from those of other countries in East Asian region, especially in the 1980s. The counter-oil shock in 1986 strongly degrades its current account deficits, leading to overvaluation of its currency, which continued until 1992. From then, a sustained GDP growth and a current account deficit under control are coherent with the tendency of weak under-valuation in real (8% in 1996) and nominal terms. In Indonesia too, the crisis does not seem to be related to overvaluation of its currency like in Malaysia. The currency the most afflicted by the crisis was, however, the Indonesian rupee, which might be explained more by political reasons than by strictly economic ones. The devaluation of the Indonesian rupee, of the most important amplitude among the East Asian countries, in nominal and real terms, resulted only in a limited amelioration of its current account, considering the stagnation of GDP growth, and in a modest under-valuation (10% in real terms). This result reflects without doubt the destructive effects of the crisis on the Indonesian production system and the deterioration of its non-price competitiveness.

4.3. The results of sensitivity tests

Considering the existing uncertainties in the estimation of external and internal equilibrium and in the measure of trade elasticities, three kinds of sensibility tests have been realised:

- an increase of the target current balance of 1% of GDP;
- an increase of the potential production of 1%;
- an increase of the export price elasticity of 20%.

Several information can be withdrawn from these results (table 7):

- The sensitivity to the potential production is limited. A higher potential production and, consequently, an increased under-utilisation of production capacities lead to a more significant real overvaluation of the currency. The elasticity is close to -1 on average, meaning that an additional under-utilisation of 1% results in an increased overvaluation of -1%.

- The sensitivity to the current account target is moderate, except for the United States. Without surprise, an increase in the current account target, that is, a reduction of the gap b, leads to an overvaluation of the concerned currency. The effect is all the more weak as the share of exports in GDP and the elasticity of the current account to the real exchange rate are higher, which explains the relatively small effect for the Asian countries and, to a lesser extent, for Europe.
### Table 7 Results of sensitivity tests for the multinational model (average of changes from the base simulation, absolute average in the case of price elasticity)

<table>
<thead>
<tr>
<th></th>
<th>Real effective exchange rates</th>
<th>Nominal rates against dollar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Japan</td>
<td>Korea</td>
</tr>
<tr>
<td>bc jp</td>
<td>-0.056</td>
<td>0.001</td>
</tr>
<tr>
<td>bc kr</td>
<td>0.000</td>
<td>-0.027</td>
</tr>
<tr>
<td>bc ch</td>
<td>0.004</td>
<td>0.002</td>
</tr>
<tr>
<td>bc us</td>
<td>0.022</td>
<td>0.013</td>
</tr>
<tr>
<td>bc euro</td>
<td>0.034</td>
<td>0.021</td>
</tr>
<tr>
<td>y jp</td>
<td>-0.011</td>
<td>0.000</td>
</tr>
<tr>
<td>y kr</td>
<td>0.001</td>
<td>-0.010</td>
</tr>
<tr>
<td>y ch</td>
<td>0.001</td>
<td>0.000</td>
</tr>
<tr>
<td>y us</td>
<td>0.002</td>
<td>0.001</td>
</tr>
<tr>
<td>y euro</td>
<td>0.005</td>
<td>0.003</td>
</tr>
<tr>
<td>εx jp</td>
<td>0.008</td>
<td>0.001</td>
</tr>
<tr>
<td>εx kr</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>εx ch</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>εx us</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>εx euro</td>
<td>0.004</td>
<td>0.002</td>
</tr>
</tbody>
</table>

- **bc**: increase of 1% in \( B^e / P^e \) \( \Delta (bc-bc^e) = -0.01 \)
- **y**: increase of 1% in potential production \( \Delta (Y-Y^e/Y^e) = -0.01 \)
- **ε**: increase of 20% in the price elasticity of exports.

The sensitivity to the export price elasticities also turns out to be small. On the whole, higher export price elasticity leads to smaller changes in exchange rates to absorb the same amount of current account imbalances. Absolute average of results means the degree of lesser misalignments of exchange rates under higher price elasticity. This result is reassuring considering the existing uncertainties in the estimation of these parameters.

We have conducted the same kind of sensitivity tests for Taiwan, Indonesia, Malaysia, Philippines and Thailand (Table 8). Unlike multinational model, changes in internal and external equilibrium targets do not affect the equilibrium exchange rates of the other countries in this simplified model. It’s reassuring to see that the sensitivity of results to changes in several parameters is not important like in the multinational model.

These sensitivity tests assure that the approach of Fundamental Equilibrium Exchange Rate provides rather robust results, in spite of the uncertainties in estimating the internal and external equilibrium and the parameters of trade equations.
Table 8  Results of sensitivity tests for five South East Asian countries (average of changes from base simulation, absolute average in the case of price elasticity)

<table>
<thead>
<tr>
<th></th>
<th>Indonesia</th>
<th>Malaysia</th>
<th>Philippines</th>
<th>Thailand</th>
<th>Taiwan</th>
</tr>
</thead>
<tbody>
<tr>
<td>$bc_i$</td>
<td>-0.073</td>
<td>-0.020</td>
<td>-0.064</td>
<td>-0.054</td>
<td>-0.011</td>
</tr>
<tr>
<td>$y_i$</td>
<td>-0.024</td>
<td>-0.017</td>
<td>-0.019</td>
<td>-0.014</td>
<td>-0.007</td>
</tr>
<tr>
<td>$\varepsilon_{mi}$</td>
<td>0.023</td>
<td>0.013</td>
<td>0.030</td>
<td>0.026</td>
<td>0.007</td>
</tr>
</tbody>
</table>

$bc$ : increase of 1% in $B^e/P^e$  $\Delta(bc-bc^e) = -0.01$

$y$ : increase of 1% in potential production  $\Delta (Y^e/Y^e) = -0.01$

$\varepsilon_{mi}$ : increase of 20% in the price elasticity of imports

4.4. Exchange rate misalignments of East Asian currencies against one another

The knowledge of equilibrium exchange rates in bilateral terms against the dollar enables us to calculate bilateral exchange rates of Asian currencies against one another. The figure 7 illustrates the under-valuation or overvaluation of East Asian currencies in nominal terms against the Japanese yen. We take the yen as reference currency, not only because Japan is the most important country in the region, in spite of recent difficulties, but also because the yen is, with the New Taiwan dollar, the currency the least misaligned against dollar.

An interesting result is that the currencies of South Korea, Taiwan and Malaysia maintained relatively balanced position against the yen all along the period until the financial crisis of 1997-1998. The other currencies experienced quite marked misalignments against the yen during the 1980s, but approached their equilibrium levels.

Figure 7 Under-valuation or overvaluation of the East Asian currencies against yen
during the 1990s before the crisis, except for the Chinese yuan. This diagnostic attests
the existence of a kind of exchange rate stability among the East Asian countries, based
on dollar peg policies during the 1990s, despite the potential risks of these policies.
After the crisis, the situation of relative equilibrium exchange rates among them was
broken and the whole Asian currencies, except the New Taiwan dollar, seem to be
under-valued compared to the Japanese yen. In 2000, the currencies the most
undervalued against the Japanese yen are those of Philippines, Thailand and China
while those of South Korea, Malaysia and Indonesia are less strongly under-valued. As
far as exchange rates are concerned, Japan finds itself in an unfavourable position vis-à-
vis its East Asian partners, while the yen appears, in contrary, to be under-valued as
compared to the dollar. At the opposite, China has a currency substantially under-valued
as compared to the yen, but also as compared to the New Taiwan dollar and, to a lesser
degree, the Malaysian ringgit, the Indonesian rupee and, more recently, the Korean won,
which contributes to increasing current account surplus.

5. CONCLUSION

Two types of lessons regarding the estimation methodology and the results can be
withdrawn.
Regarding the methodology, several improvements have been incorporated, as
compared to previous empirical studies of the same kind: inclusion of external debt
service; modelling of the external trade interdependencies, including those of the rest of
the world; solution of the n-1 independent equilibrium exchange rates for n currencies
and estimation of current account targets with econometric method using panel data.
Sensitivity tests were also conducted in order to assess the degree of dependency of the
results to the adopted targets and to the values of parameters. The results appeared rather robust, which is reassuring, considering the existing uncertainties in the estimation of these parameters. Finally, the utilisation of a model with one country in the case of a small country has been justified in a rigorous way.

Regarding the results, the estimation of equilibrium exchange rates enables us to answer to the questions mentioned in the introduction concerning the configuration of the East Asian currencies before and after the Asian crisis of 1997-1998.

It does not seem that the Asian currencies were altogether overvalued at the time of the crisis. Among the ASEAN currencies, Thailand’s baht alone experienced a substantial overvaluation in 1996 while the other currencies were not at all overvalued (Malaysia and Indonesia) or were overvalued to a lesser degree (Philippines). The Korean won was overvalued in 1996, but not the New Taiwan dollar. These estimations suggest that contagion effects were an important factor of the generalised crisis in the Asian region in 1997-1998. The fears of the international investors related to the financial vulnerability of these countries facilitated the spread of these contagion effects.

At the beginning of the 1990s, the overvaluation of several Asian currencies was of a magnitude comparable to or higher than that of 1997-1998, but the consequences were not as destabilising as in the last case. One difference between the two periods can be found at the level of the financial liberalization which has intensified itself through the last decade and has increased the degree of instability. We might also think that the lasting overvaluation of several ASEAN currencies during the first half of the 1990s had already increased the financial vulnerability of these countries, but that this financial vulnerability has manifested itself only later with the rise of new tensions on the currencies.

The Chinese yuan was, as for it, definitely under-valued at the time of the crisis, which explains the good resistance of China facing the crisis, but which does not prove that the under-valuation of the Chinese yuan was the major cause of the neighbouring countries’ crisis.

The devaluations of Asian currencies following the crisis seem to have been excessive. Overreaction phenomenon of markets must have played in the course of these devaluations, which was unavoidable considering the gravity of the crisis. In addition, Thailand and South Korea have reduced the degree of under-valuation of their currencies since 1998. The case of Indonesia is more specific with its currency close to equilibrium all along the 1990s and which experienced the most serious devaluation in 1998, without registering an improvement of current balance as compared to the magnitude of exchange rate adjustment. The under-valuation remained relatively limited.
and the political crisis has contributed to the weakening of the Indonesian production system and to the deterioration of its non-price competitiveness.

Lastly, the configuration of parities of the East Asian currencies does not seem satisfying at the beginning of the 2000s. Before the crisis, during the 1990s, the parities of the East Asian currencies against the yen remained relatively close to equilibrium, but this equilibrium was broken with the crisis. Especially the Japanese yen and the New Taiwan dollar, which was not devaluated like the other currencies, suffer from overvaluation. The other currencies benefit from under-valuation more or less marked according to the countries, which favours current account performances. One of the currencies the most under-valued is the Chinese yuan. After the Asian crisis, China did not devaluate its currency, but inflows of FDI, export stimulation strategy and modernisation of its production devices seem to have improved its non-price competitiveness and allows for a strengthening of its current account surplus. A too large under-valuation of the Chinese currency makes problem at medium and long run because it can curb restructuring efforts of Chinese industries and aggravate external disequilibrium within East Asian countries, in particular in relation to countries like Japan and Taiwan.

Some implications for regional monetary cooperation can be drawn. The Asian crisis has made clear that volatile international capital can provoke generalised financial regional crisis although the misalignment did not seem serious for all the currencies. This means that Asian countries should cooperate more closely to face the speculative attacks of international capitals. Bilateral swap arrangements and repurchasing facilities like those adopted in the Chiang Mai Initiative (2000) constitute efforts in that direction. Such arrangements are useful but have to be completed by more formal procedures. Facing increasing imbalances, they are insufficient, both to organise the necessary adjustments and to fight the financial instability.

Since 1998, short-term responses have been reduced, in most of the East Asian countries, to a de facto dollar peg policy in a more or less rigid way. If the dollar peg policy permits to avoid competitive depreciation strategies that are counterproductive for countries highly integrated and close competitors in world markets, it is not sufficient to prevent the risks of monetary misalignments. Stabilised bilateral exchange rates between Asian developing countries do not mean an equilibrated exchange rate regime and new imbalances might appear. Estimated results of exchange rate misalignments for the years following the crisis imply the necessity of cooperation efforts in order to adjust misaligned exchange rates like it is the case at the beginning of the 2000s. Especially, the substantial misalignments of Japanese yen and Chinese yuan are worrisome. To restore regional monetary stability, these estimated results should be
taken into account.
To protect themselves, it would be in the interest of the Asian countries to take into account the yen’s movement. Different institutional arrangements have been considered in that direction (the common basket peg policy proposed by Williamson (1998), the yen bloc strategy of Kwan (2001), the creation of an Asian Currency Unit). They could be adapted to each country according to the extent of economic integration and the similarity in economic structures. Whatever type of peg might be chosen, the estimated equilibrium exchange rates could be used to give the reference parities at the launching of the system. Later on, enough flexibility should be preserved by adopting, for example, “monitoring bands”. In addition, periodic adjustments should be conducted in order to recognize that equilibrium exchange rates are changing at medium term in accordance with shocks and the evolution of structural parameters. These adjustments should allow participating currencies to remain around the equilibrium exchange rates.

REFERENCES

Brillet, J.L.(2000), A workbook for the use of the Chinese annual model, INSEE.
their impact on trade and investment in the APEC region”, *IMF Occasional Paper*, n°145, December.


STATISTICAL SOURCES

CEPII, Database of CHELEM
IMF, International Financial Statistics,
IMF, World Economic Outlook,
United Nations, World Population Prospects,
United Nations, World Investment Table,
World Bank, World Tables,
OECD, Economic Outlook