Financial liberalization and economy crisis: macromodelling the Thai economy

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# APPENDIX 3.1

## Chronology of the Thai Currency Crisis

Developments from January 1997 to June 1998

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>February 5</td>
<td>Somprasong Land become the first Thai Company to default on interest payments on a Euro CD.</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>Finance One, Thailand's largest finance company, signed a memorandum of Understanding to merge with Thai Danu Bank on account of the liquidity problem.</td>
</tr>
<tr>
<td></td>
<td>March 10</td>
<td>The Thai government says it will buy $3.9bn in bad property debt from Financial Institutions but reneges on this promise. IMF Managing Director Michel Camdessus says: &quot;I don't see any reason for this crisis to develop further&quot;.</td>
</tr>
<tr>
<td></td>
<td>May 14-15</td>
<td>Thailand's baht currency comes under attack by speculators who decided Thailand's slowing economy and political instability meant it was time to Sell. Thailand and Singapore jointly intervene to defend the baht, but Thailand refuses to devalue it.</td>
</tr>
<tr>
<td></td>
<td>May 23</td>
<td>Thai Danu Bank's board of directors decided to refrain from merging with Finance One.</td>
</tr>
<tr>
<td></td>
<td>June 19</td>
<td>Thai Finance Minister Amnuay Viravan, an opponent of devaluation, resigns after a Cabinet row over his plans to balance the fiscal budget by introducing a raft of new excise taxes.</td>
</tr>
<tr>
<td></td>
<td>June 27</td>
<td>The Thai central bank suspended operations of 16 cash-strapped finance companies for a period of 30 days in order for them to submit plans and Improve their position for merging with other stronger finance companies.</td>
</tr>
<tr>
<td></td>
<td>June 30</td>
<td>Thai Prime Minister Chavalit Yonchaiyudh assures the nation in a televised address there will be no devaluation of the baht.</td>
</tr>
<tr>
<td></td>
<td>July 2</td>
<td>Thailand announced the change in its foreign exchange system to managed floatation, causing the baht to weaken from Baht 25.79 per US dollar on June 30, 1997 to Baht 28.9 per US dollar on the announcement day. This is a trigger for the East Asian crisis.</td>
</tr>
<tr>
<td></td>
<td>July 28</td>
<td>Thailand calls in the IMF.</td>
</tr>
<tr>
<td></td>
<td>August 5</td>
<td>Thailand announces austerity measures as part of IMF suggested policies for a rescue package. Central bank suspends another 42 finance firms, bringing the total number of suspended finance companies to 58 out of the original 91.</td>
</tr>
<tr>
<td></td>
<td>August 11</td>
<td>The IMF unveils in Tokyo a rescue package for Thailand including loans totaling $16 billion from the IMF and Asian nations.</td>
</tr>
<tr>
<td></td>
<td>August 16</td>
<td>Raise the value-added tax (VAT) from 7% to 10%.</td>
</tr>
<tr>
<td></td>
<td>August 20</td>
<td>IMF approves a US$3.9 billion stand-by credit for Thailand, and releases a disbursement of US$ 1.6 billion (Press Release No.97/37). The package now</td>
</tr>
</tbody>
</table>
totals $16.7 billion. Brunei later adds $500 million to the bailout package, bringing it to a total of $17.2 billion.

October 14 - Thai new Finance Minister Thanong Bidaya announces details of a comprehensive financial stabilization plan.

October 27 - Global stock prices fall sharply following a dramatic decline in East Asian Equity markets.

November 4 - Thai Prime Minister (Chavalit Yongchhiriyddh) resigns over financial crisis.

November 6 - The IMF is gloomier on the outlook for Thailand, confident the IMF's $17.2 billion assistance will work, but only once the country's political instability is over. Thursday, confusion reigned as two former premiers race to gather enough Parliament seats to form the country's next government: Chatichai Choonhavan of the Chart Pattanna Party and Chuan Leekpai of the Democrat Party. After a few days of messy squabbling, Chuan emerged victorious.

November 9 - Chuan Leekpai was named as Prime minister. The business community reacted positively to Chuan's appointment.

November 25 - Thailand issues Letter of Intent on additional measures.

December 8 - The Financial Restructuring Authority announced that only two of the 58 suspended finance companies since mid-year had passed screening and would be allowed to reopen, namely, Bangkok Investment and Kiatnakin Finance and Securities. The financial system thus underwent a severe liquidity crunch.

- The Executive Board completes the first review of the stand-by arrangement and disburses US$810 million (New Brief No.97/29).

December 2 - Moody's Investors Service downgraded foreign currency credit ratings for four countries, Indonesia, Malaysia, South Korea and Thailand. It downgraded Thailand's foreign currency ceiling for bonds and notes to a junk-bond status, but still confirmed the ceilings for bank deposits.

December 25 - Thai Finance Minister Tarrin Nimmanahaeminda said that the government would not close any more financial institutions, but would focus on strengthening them as part of overall efforts to revive the economy. His statement came amid market speculation the Bank of Thailand may take over the management of Bangkok Metropolitan Bank, which has seen a steady run on deposits and is having trouble finding a partner.

1998

January 6 - Thailand announced that it would ask the International Monetary Fund to ease the terms of its $17.2 billion bailout package and as its currency, the baht, fell to a new low of 52 to the dollar, downing from about 25 to the dollar when the government was forced to let it float last July. Prime Minister Chuan Leekpai said Thailand would seek to soften an IMF requirement that it produce a budget surplus this year. "We have cut spending substantially but shortfalls in revenue will be as high as 100 billion baht, which makes it important to adjust the plan," he said. The IMF package, agreed to in August, was based on the projection that the baht would stabilize at about 32 to the dollar.
<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
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<tbody>
<tr>
<td>January 30</td>
<td>The BOT abolished the two-tier currency market imposed on May 15, 1997, to deter currency speculation.</td>
</tr>
<tr>
<td>February 12</td>
<td>The IMF agreed to relax a key condition of its US$17.2 billion bailout package to Thailand requiring the Government to post a budget surplus of 1% of GDP in fiscal 1998. Instead, Thailand will be allowed to have a budget deficit of 1-2% of GDP in the fiscal year ending on September 30, IMF Asia-Pacific director Hubert Neiss said. In addition, the IMF will also allow Thailand to ease its high domestic interest rates but after the currency market stabilizes. The IMF’s decision to ease the fiscal program comes after a review of Thai macroeconomic conditions which have shown a positive development. Moreover, the Thai economy has slowed down so much, following the introduction of the IMF program, that a continued stringent austerity regime might prompt a new economic crisis.</td>
</tr>
<tr>
<td>February 24</td>
<td>Thailand issues Letter of Intent on additional measures.</td>
</tr>
<tr>
<td>March 4</td>
<td>The Executive Board completes the second review of the stand-by arrangement and disburses US$270 million (New Brief No. 98/5).</td>
</tr>
<tr>
<td>March 23</td>
<td>The Thai baht recovers from a low of 52 to the dollar to 39.8 to the dollar Resulting from positive developments, including tough decisions to clean up the banking sector; the Thai public’s growing confidence in their banks; the improvement in the balance of payments and the current account; foreign investors’ confidence in Thailand; and the commitment of the Government to follow through with the reform program.</td>
</tr>
<tr>
<td>May 26</td>
<td>Thailand issues Letter of Intent on additional measures.</td>
</tr>
<tr>
<td>June 10</td>
<td>The Executive Board completes the third review of the stand-by arrangement, disbursing US$135 million (New Brief No. 98/19), and concludes the 1998 Article IV consultation. (Press Information Notice (PIN) No.98/44)</td>
</tr>
</tbody>
</table>

Note: This Chronology of the crisis is based on information from several news sources (Reuters, Wall Street Journal, New York Times, CNNfn, Financial Times, Bloomberg, etc)
APPENDIX 3.2

Bangkok International Banking Facilities (BIBF)¹

Bangkok International Banking Facilities or BIBF was established in March 1993 as a facility to allow international financial businesses to be conducted in Thailand. The establishment of BIBF was a major step in Thailand's financial liberalization which aimed to serve the increasingly sophisticated needs of international trade and investment and enhance the capability of Thai financial institutions in international lending and other international banking businesses, and thus reduce the costs of foreign borrowing by Thai entrepreneurs. Meanwhile, BIBF is intended to capitalize on Thailand's geographical advantage as a gateway to former centrally planned economies in Southeast Asia in serving the financial needs and requirements of both the regional economy and the Thai market. The Bank of Thailand gives licences to both domestic and foreign banks to operate offshore banking facilities including both raising funds overseas and lending them domestically (out-in lending) or raising funds overseas for lending outside Thailand (out-out lending)².

The major benefit of BIBF is the tax incentives as spelled out in the Royal Decree on Exemption and Reduction of Tax Rates for BIBF activities. The most important is a reduction in the corporate income tax rate from 30% to 10%. In addition there is an exemption from specific business tax and municipal tax which is currently at 3.3% of total turnover, an exemption from stamp duties and an exemption...

¹ The information about the nature of BIBF operations above mainly comes from two sources.

² Out-in financing transactions involve taking foreign-currency deposits or loans from foreign countries and lending the funds in Thailand. Out-out financing operations are of two types.
   a. Foreign currency: Taking foreign currency deposits or loans from foreign countries and lending the funds thus derived in foreign countries.
   b. Thai currency: Taking Thai currency deposits or loans from foreign countries and lending the funds in foreign countries.
from taxation on the permanent establishment of foreign financial institutions where they have not had permanent establishment in Thailand. With regard to withholding tax on interest payments on deposits or borrowings, this is exempted for out-out transactions with non-residents. As for the out-in transactions, they are subject to such tax of 10%, i.e., a reduction from 15% for countries without double-taxation agreement with Thailand. Moreover, cross-border borrowing within the same juristic entity of a Thai commercial bank is also exempted from such tax since corporate income taxes on Thai commercial banks are calculated on a consolidated basis.

The Thai financial crisis that erupted in mid 1997 partly resulted from the operation of the BIBF, and also attributable to the moral hazard from an implicit guarantee of a fixed exchange rate system which provided predictability to domestic borrowers who saw no need to hedge against exchange risk. The introduction of BIBF has led to substantial changes in the structure of balance of payments financing. There was a rapid growth of out-in lending which grew three-fold during the first few years of operation from 456.6 billion baht in 1994, to 1.4 trillion baht in 1997. Second, there was a shift in foreign direct investment to BIBF lendings as intra-company loans (a component of FDI) were replaced by BIBF loans. This indicates a significant “rebooking” of FDI through BIBF in order to gain the benefits from the tax exemptions. Third, sourcing of funds by BIBF operations has led to a significant shortening of Thailand’s external debt maturity. For example, Thai residents borrow long-term from BIBF, but BIBF fund these loans through a revolving facility of shorter term credit from abroad. Therefore with rapid growth in BIBF lendings the short-term liabilities of the banking system have increased substantially mainly reflecting the short-term fundings, albeit with a significant amount under a revolving facility by BIBF. As a result Thailand’s external debt rose from US$18.9 billion in 1992 to US$41.1 billion in 1995. Of this, about US$23.7 billion or 58% were the short-term liabilities of BIBF.

In addition, under BIBF operations rules and regulations on offshore activities were kept at a minimum to lessen the burden on the operating institutions. As the
BIBFs were permitted to lend in virtually unlimited amounts to residents, their lending exposures grew substantially. This was the case especially with the new BIBFs that tried to increase their business volume so that it would qualify them for an upgrade to full-branch status in line with the selection criteria of performance laid down by the Bank of Thailand.
APPENDIX 4.1

The Mundell-Fleming Model

Mathematical Solution of the MF Model under a Flexible Exchange Rate

The LM schedule or equilibrium in the money market is given by:

\[ \frac{M}{P} - L = L(r, Y) \]  
\[ (A4.1.1) \]

where \( M \) is the nominal money supply, \( P \) is the aggregate price level, \( L \) is the real demand for money which is assumed to depend positively upon domestic income and inversely on the domestic rate of interest. Setting \( \frac{dL}{dY} = L_Y > 0; \frac{dL}{dr} = L_r < 0 \)

The slope of the LM curve: \( \frac{dr}{dY} = -\frac{L_Y}{L_r} \)  
\[ (A4.1.2) \]

The IS schedule or equilibrium in the goods market, is represented by:

\[ Y = D = A(Y, r) + T(e, Y) + G \]  
\[ (A4.1.3) \]

where \( A \) stands for absorption, \( r \) for the nominal interest rate, \( T \) denotes the surplus on the current account, \( G \) the autonomous government spending. \( \frac{dA}{dY} = 0 < A_Y < 1; \frac{dA}{dr} = A_r < 0; \frac{dT}{dY} = T_Y < 0; \frac{dT}{de} = T_e > 0 \)

The slope of the IS curve: \( \frac{dr}{dY} = \frac{(1-A_Y-T_Y)}{A_r} < 0 \)  
\[ (A4.1.4) \]

The BP schedule which is the equilibrium in the foreign exchange market, is given by the current and capital accounts of the balance of payments.

\[ B = T(e, Y) + K(r) = 0 \]  
\[ (A4.1.5) \]

The slope of the BP curve: \( \frac{dr}{dY} = \frac{-T_Y}{K_r} > 0 \)  
\[ (A4.1.6) \]

Where \( K \) represents capital inflows, \( K_r > 0 \) implying that if the domestic interest rate \( (r) \) exceeds the world rate \( (r^*) \) then there are positive capital inflows and vice versa. With perfect capital mobility, however, \( K_r \rightarrow \infty \) indicating instantaneous inflows or outflow of capital in response to interest rate differentials.

Totally differentiating equation (A4.1.1), (A4.1.3), and (A4.1.5), the following, in matrix form, can be obtained:

\[
\begin{bmatrix}
L_Y & L_r & 0 \\
(1-A_Y-T_Y) & -A_r & -T_e \\
T_y & K_r & T_e
\end{bmatrix}
\begin{bmatrix}
dY \\
dr \\
de
\end{bmatrix}
= 
\begin{bmatrix}
1 & 0 \\
0 & 1 \\
0 & 0
\end{bmatrix}
\begin{bmatrix}
dM \\
dG
\end{bmatrix}
\]
The determinant is given by:
\[ \Delta = T_e [L_y (k_r - A_r) - L_r (1 - A_y)] > 0 \]  
(A4.1.7)

Turning to the monetary and fiscal policy multipliers:

**First monetary policy (a rise in \( M \))**:

\[ \frac{dY}{dm} = \frac{T_e (k_r - A_r)}{\Delta} > 0 \] (A4.1.8); if \( k_r \to \infty \) hence \( \frac{dY}{dM} = \frac{1}{L_y} \) (A4.1.9)

\[ \frac{dr}{dM} = \frac{-T_e (1 - A_y)}{\Delta} < 0 \] (A4.1.10); if \( k_r \to \infty \) hence \( \frac{dr}{dM} = 0 \) (A4.1.11)

\[ \frac{de}{dM} = \frac{K_r (1 - A_y - T_y) + A_r T_y}{\Delta} > 0 \] (A4.1.12)

If \( k_r \to \infty \), in equilibrium \( r = r^* \) and if \( r^* \) is fixed, then \( dr = dr^* = 0 \); and \( A_r = 0 \).

\( L_r = 0 \). The determinant given by (A4.5) reduces to:

\[ \Delta = T_e L_y K_r; \text{ then } \frac{de}{dM} = \frac{(1 - A_y - T_y)}{T_e L_y} > 0 \] (A4.1.13)

**Next fiscal policy (a rise in \( G \))**

\[ \frac{dY}{dG} = \frac{-L_r}{L_y (k_r - A_r) - L_r (1 - A_y)} > 0 \] (A4.1.14); if \( k_r \to \infty \) then \( \frac{dY}{dG} = 0 \) (A4.1.15)

\[ \frac{dr}{dG} = \frac{L_y}{L_y (k_r - A_r) - L_r (1 - A_y)} > 0 \] (A4.1.16); if \( k_r \to \infty \) then \( \frac{dr}{dG} = 0 \) (A4.1.17)

\[ \frac{de}{dG} = \frac{L_r T_y - L_y K_r}{\Delta} < 0 \] (A4.1.18); if \( k_r \to \infty \) then \( \frac{de}{dG} = -\frac{1}{T_e} < 0 \) (A4.1.19)

**Mathematical Solution of the MF Model under a Fixed Exchange Rate**

In the case of a fixed exchange rate regime, money supply \( (M) \) is an endogenous variable which consists of two components;

\[ M = C + F \] (A4.1.20)

Where \( C \) is the domestic component of the money supply, \( F \) is foreign exchange reserves which change with the balance of payments and hence \( dF = dB \). Now the model equations can be represented as follows:
\[ dy + Lrdr - dF = dC \]  
(A4.1.21)

\[(1-Ay-Ty)dy - Ardr = Tede + dG \]  
(A4.1.22)

\[ Tydy + Krdr - dB = Tede \]  
(A4.1.23)

where \( d\epsilon = 0 \) because the exchange rate is fixed by the authorities. These three equations can be rearranged in Matrix form:

\[
\begin{bmatrix}
L_y & L_r & -1 \\
(1 - Ay - Ty) & -Ar & 0 \\
Ty & Kr & -1
\end{bmatrix}
\begin{bmatrix}
dY \\ dr \\ dB
\end{bmatrix}
=
\begin{bmatrix}
1 & 0 & dC \\
0 & 1 & dG \\
0 & 0 & dF
\end{bmatrix}
\]  
(A4.1.24)

The determinant is given by:

\[
\Delta = Ar(L_y - Ty) - (1 - Ay - Ty)(Kr - Lr) < 0
\]  
(A4.1.25)

**Monetary policy effects:**

\[
\frac{dY}{dc} = \frac{Ar}{\Delta} > 0; \quad \text{if } Kr \rightarrow \infty \text{ then } \frac{dY}{dc} = 0
\]  
(A4.1.26)

\[
\frac{dr}{dc} = \frac{Ar(L_y - Ty) - KrTy}{\Delta} < 0; \quad \text{if } Kr \rightarrow \infty \text{ then } \frac{dr}{dc} = 0
\]  
(A4.1.27)

Next, Fiscal policy:

\[
\frac{dY}{dG} = \frac{-Kr + Lr}{\Delta} > 0; \quad \text{if } Kr \rightarrow \infty \text{ then } \frac{dY}{dG} = \frac{1}{1 - Ay - Ty} > 0
\]  
(A4.1.32)

\[
\frac{dr}{dG} = \frac{-Ly + Ty}{\Delta} > 0; \quad \text{if } Kr \rightarrow \infty \text{ then } \frac{dr}{dG} = 0
\]  
(A4.1.33)

\[
\frac{dB}{dG} = \frac{Ly}{\Delta} > 0; \quad \text{if } Kr \rightarrow \infty \text{ then } \frac{dB}{dG} = \frac{Ly}{1 - Ay - Ty}
\]  
(A4.1.34)
APPENDIX 4.2

The Dornbusch Model

Full solution of the DB Model

Equations of the model are as follows:

\[ E(e) = r - r^* \]  \hspace{1cm} \text{(A4.2.1)}  \\
\[ E(e) = \theta(e - e) \]  \hspace{1cm} \text{Regressive Expectations (A4.2.2)}  \\
\[ m - p = -\lambda r + \phi y \]  \hspace{1cm} \text{Money market equilibrium (A4.2.3)}  \\
\[ p = \pi(d - y) \]  \hspace{1cm} \text{Phillips curve (A4.2.4)}  \\
\[ d = \delta(e - p) - \sigma r + \gamma y \]  \hspace{1cm} \text{Aggregate demand (A4.2.5)}

\textbf{Notation:} Lower-case variables are in natural logarithms, an exception being the interest rate. A dot indicates the change of the respective variable over time. Greek letter denote positive parameters. \( E(.) \) is the expectations operator. The following list of variables will be used both in Appendix 4.2 and 4.3.

- \( p \): domestic inflation rate
- \( r, r^* \): domestic and foreign rates of interest
- \( d \): aggregate demand for domestic goods
- \( m \): domestic money
- \( y \): aggregate supply of domestic goods
- \( e \): rate of depreciation
- \( e^* \): equilibrium exchange rate
- \( p \): domestic price level

Substituting (A4.2.1) in (A4.2.2) and then (A4.2.2) in (A4.2.3) and rearranging, we obtain

\[ p = m - \phi y + \lambda r^* + \lambda \theta (e - e) \]  \hspace{1cm} \text{(A4.2.6)}

In long run steady state the actual and equilibrium exchange rate will be equal, hence the long run price level will have the form

\[ \bar{p} = m + \lambda r^* - \phi y \]  \hspace{1cm} \text{(A4.2.7)}

Substituting (A4.2.7) in (A4.2.6) for \( m \) we obtain the asset market equilibrium expressed in terms of deviations from long run equilibrium

\[ e - \bar{e} = (-1/\lambda \theta)(p - \bar{p}) \]  \hspace{1cm} \text{(A4.2.8)}

with a negative slope: \( \partial e / \partial p = -1/\lambda \theta \).

Goods market equilibrium is found by substituting (A4.2.5) in (A4.2.4), and we then obtain

\[ p = \pi[\delta(e - p) - \sigma r + (\gamma - 1)y] \]  \hspace{1cm} \text{(A4.2.9)}
Substituting for $r$ from (A4.2.3) in (A4.2.9), setting $p = 0$ in (A4.2.9) and rearranging we obtain the goods market equilibrium

$$p = \frac{\lambda \delta}{\lambda \delta + \sigma} e + \frac{\sigma}{\lambda \delta + \sigma} m - \frac{\lambda (1 - \gamma) + \sigma \phi}{\lambda \delta + \sigma} y$$

(A4.2.10)

where $0 < \partial p / \partial e < 1$

In the long run equilibrium, $p = 0$, $E(e) = 0$; and hence $r = r^*$, substituting (A4.2.5) in (A4.2.4), we obtain the $p = 0$ schedule (the PPP line) where its slope is unity

$$p = e - \frac{(1 - \gamma) y}{\sigma} + \frac{\sigma \phi}{\delta}$$

(A4.2.11)

By equating (A4.2.10) and (A4.2.11) we obtain the long run equilibrium exchange rate at which both the $p = 0$ schedule (PPP line) and the goods market schedule intersect:

$$e = m - \phi y + \frac{1 - \gamma}{\delta} y + (\lambda + \frac{\sigma}{\delta}) r^*$$

(A4.2.12)

from (A4.2.11) and (A4.2.8), the long run neutrality of money, that is, $\partial e / \partial m = \partial e / \partial p = 1$ and PPP holds in the long run.

However in the short run, the asset market equation (A4.2.8) holds continuously, and substituting for $e$ from (A4.2.12) and $p$ from (A4.2.7) yields

$$e = (\frac{1}{\lambda \theta} + 1)m - \frac{1}{\lambda \theta} p + (\lambda + \frac{\sigma}{\theta} + \frac{1}{\lambda \theta}) r^* - (\phi + (\frac{\gamma - 1}{\delta} + \frac{\phi}{\lambda \theta}) y$$

if $p$ and $y$ remain constant in the short run, and hence

$$\partial e = [\frac{1}{\lambda \theta} + 1] \partial m > 1$$

(A4.2.13)

in the short run the exchange rate overshoots its long run equilibrium.

**Dornbusch Model with Perfect Foresight Expectations**

Perfect foresight expectations imply that the expected change in the exchange rate next period based on information available in this period is exactly the change which occurs. That is:
\[ E(e) = e \]

so that the UIP condition is:
\[ r = r^* + e \]  \hspace{1cm} (A4.2.14)

Equation (A4.2.14), in contrast to equation (A4.2.1), the actual change in the exchange rate appears instead of the expected change. This reflects a deterministic framework in which economic agent possesses rational expectation and is equivalent to the case of perfect foresight.

Now, from the money market equation (A4.2.3), solving for \( r \)
\[ r = \frac{p - m}{\lambda} + \frac{\phi}{\lambda} y \]  \hspace{1cm} (A4.2.15)

This is the interest rate that, given real income, clears the money market. Further, solving for \( r^* \) in the long run price level (\( \bar{p} \)) in (A4.2.7):
\[ r^* = \frac{\bar{p} - m}{\lambda} + \frac{\phi}{\lambda} y \]  \hspace{1cm} (A4.2.16)

Subtracting (A4.2.16) from (A4.2.15) obtains the change in the exchange rate as a deviation from its equilibrium value is
\[ (r - r^*) = \dot{e} = \frac{p - \bar{p}}{\lambda} \]  \hspace{1cm} (A4.2.17)

Next substituting (A4.2.3), (A4.2.7) and (A4.2.12) into (A4.2.9) we obtain the change in price level as a deviation from its equilibrium value:
\[ \dot{p} = \pi \delta (e - \bar{e}) - \pi (\delta + \frac{\sigma}{\lambda})(p - \bar{p}) \]  \hspace{1cm} (A4.2.18)

Equation (A4.2.17) and (A4.2.18) form a simultaneous first-order dynamic system that yields adjustment paths for \( p \) and \( e \), and can be represented by the homogeneous matrix equation:
\[ \begin{bmatrix} \dot{p} \\ \dot{e} \end{bmatrix} = \begin{bmatrix} -\pi (\delta + \frac{\sigma}{\lambda}) & \pi \delta \\ 1/\lambda & 0 \end{bmatrix} \begin{bmatrix} p - \bar{p} \\ e - \bar{e} \end{bmatrix} = A \begin{bmatrix} p - \bar{p} \\ e - \bar{e} \end{bmatrix} \]  \hspace{1cm} (A4.2.19)

the eigenvalues of \( A \) are obtained from \( |A - \theta I| = 0 \) where \( I \) is the identity matrix, that is
\[ \begin{bmatrix} -\pi (\delta + \frac{\sigma}{\lambda}) - s & \pi \delta \\ 1/\lambda & -s \end{bmatrix} = 0 \]

hence the characteristic equation is
This will have two solutions, which are the roots of the system

\[ s_1, s_2 = -\frac{1}{2} \pi (\delta + \sigma / \lambda) \pm \frac{1}{2} \left[ \pi^2 (\delta + \sigma / \lambda)^2 + 4\pi \delta / \lambda \right]^{\frac{1}{2}} \]  \hspace{1cm} (A4.2.20)

the two roots (eigenvalues) have opposite signs. The unique saddle path is given by the negative root, say, \( (s_1) \). Hence the unique stable saddle-path rational expectation solution is then given by:

\[
\begin{align*}
\dot{p} &= s_1 (p - \bar{p}) \hspace{1cm} (A4.2.21) \\
\dot{e} &= s_1 (e - \bar{e}) \hspace{1cm} (A4.2.22)
\end{align*}
\]

Equation (A4.2.21) can be used to show what circumstances the simple regressive expectations scheme used in the simple DB model may be rational.

With regressive expectation \( E(e) = \theta (e - \bar{e}) \)

With perfect foresight \( E(e) = \bar{e} \)

From (A4.2.22) \( \theta \) must equal \(-s_1\) for there to be no expectational errors. With perfect foresight \( \theta \) depends upon the model's structural parameters. Using (A4.2.20), the degree of overshooting is larger, when the competitiveness \((\delta)\) and interest elasticities \((\sigma)\) of aggregate demand are smaller and when the interest elasticity of money demand \((\lambda)\) is smaller. If \((\lambda)\) becomes smaller a large change in interest rates to equilibrate the money market after a change in the money supply is required. To preserve the UIP then requires a large actual change in spot rate. If \((\sigma)\) and \((\delta)\) are small there is a little change in prices via the Phillips curve. Hence less of the disequilibrium in the money market is taken up by the price level but more by the interest rate. The latter then leads to the exchange rate overshooting as described above.
APPENDIX 4.3

The Portfolio Balance Model

Exchange Rate Dynamic

Equations of the model are as follows:

\[ W = M + B + eF \]

wealth constraint \hspace{1cm} (A4.3.1)

\[ M = m(r, r^*+E(e))W \]

money market equilibrium \hspace{1cm} m_1 < 0, m_2 < 0 \hspace{1cm} (A4.3.2)

\[ B = b(r, r^*+E(e))W \]

domestic bond market equilibrium \hspace{1cm} b_1 > 0, b_2 < 0 \hspace{1cm} (A4.3.3)

\[ eF = f(r, r^*+E(e))W \]

foreign bonds market equilibrium \hspace{1cm} f_1 < 0, f_2 > 0 \hspace{1cm} (A4.3.4)

\[ \dot{F} = \frac{dF}{dt} = CA = T(e/p,W,i) + r^*F \] \hspace{1cm} T_1 > 0, T_2,T_3 < 0 \hspace{1cm} (A4.3.5)

Linearizing (A4.3.5), with \( r^* \) assumed constant, yields:

\[ d\dot{F} = \dot{F} = (T_1 + T_2F)de + (eT_2 + r^*)de = 0 \]

Thus the \( \dot{F} = 0 \) schedule has a negative slope given by:

\[ \frac{de}{dF^*} = -(eT_2+r^*)/(T_1+T_2F^*) \geq 0 \hspace{1cm} (A4.3.6) \]

Linearizing equation (A4.3.2) and (A4.3.4) give solution for \( r \) and \( e \), with \( r^* \) assumed constant:

\[ \begin{bmatrix} \dot{e} \\ \dot{r} \end{bmatrix} = \begin{bmatrix} f_1 & f_2 \\ m_1 & m_2 \end{bmatrix} \begin{bmatrix} r \\ e \end{bmatrix} \]

which implies that

\[ \begin{bmatrix} \dot{e} \\ \dot{r} \end{bmatrix} = \left[ f_1 m_2 - m_1 f_2 \right]^{-1} \begin{bmatrix} m_2 & -f_2 \\ -m_1 & f_1 \end{bmatrix} \begin{bmatrix} \dot{E} F^*/W \\ \dot{M}/W \end{bmatrix} \]

so that \( e = 0 \) is given by

\[ e = \phi [ (E F^*/W), (M/W) ] = 0 \hspace{1cm} \text{where } \phi_1 > 0, \phi_2 < 0 \hspace{1cm} (A4.3.8) \]

---

Linearizing equation (A4.3.5) and (A4.3.8) give the following second-order dynamic system:

\[
\begin{bmatrix}
\dot{E} \\
\dot{F}
\end{bmatrix} = \begin{bmatrix}
\phi_1(F/W) & \phi_1(E/W) \\
(T_1 + T_2 F) & (E + r^*)
\end{bmatrix} \begin{bmatrix}
E \\
F
\end{bmatrix} + \begin{bmatrix}
\phi_1(M/W) \\
T_2(M + B) + T_3 i
\end{bmatrix}
\]  

(A4.3.9)

The necessary and sufficient condition for stability is that the determinant of the 2*2 matrix be negative to give a saddle path equilibrium. Since the determinant is given by:

\[
\frac{\phi_1}{W} (r^* F^* - ET_1)
\]  

(A4.1.10)

thus a saddle path equilibrium exists if \( r^* F^* < ET_1 \).

That is if the wealth effect on the trade balance exceeds the foreign interest rate effect. The reasoning behind this necessary stability condition is that when there is a current account surplus there will be an appreciation of the exchange rate which generates a fall in net exports. However, the current account surplus also implies an accumulation of foreign assets and with it increased interest receipts which improve the surplus. Thus, for the appreciation of the exchange rate to reduce the surplus it is necessary that the fall in net exports exceed the increased interest receipts.

Figure A4.1 represents the plausible slopes of the \( F^* = 0 \) schedule with their respective directions of movements given by arrows.
# APPENDIX 6.1

## Definitions and Sources of Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sources</th>
<th>Definition of variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aggregate demand for real output ($y^d$)</td>
<td>NESDB</td>
<td>GDP at constant 1972 prices</td>
</tr>
<tr>
<td>2. Private consumption ($c^P$)</td>
<td>NESDB</td>
<td>Private consumption expenditure at constant 1972 prices</td>
</tr>
<tr>
<td>3. Total private investment ($i^{Pp}$)</td>
<td>NESDB</td>
<td>Defined as gross fixed capital formation for private sector plus change in inventories at 1972 prices</td>
</tr>
<tr>
<td>4. Non productive investment ($i^{np}$)</td>
<td>NESDB</td>
<td>Proxied by household investment which is defined as private construction on residential and new land at 1972 prices.</td>
</tr>
<tr>
<td>5. Productive investment ($i^{pp}$)</td>
<td>NESDB</td>
<td>Defined as total private investment minus non-productive investment</td>
</tr>
<tr>
<td>6. Trade balance ($t$)</td>
<td>NESDB, IMF</td>
<td>Trade balances (fob) deflated by consumer price index at 1972 prices</td>
</tr>
<tr>
<td>7. Aggregate supply of output ($y^s$)</td>
<td>NESDB</td>
<td>Measured by GDP at current factor cost</td>
</tr>
<tr>
<td>8. Real private sector wealth ($w^p$)</td>
<td>NESDB</td>
<td>Private sector real wealth is not available. Hence to obtain the domestic real wealth, it is derived from private capital stock plus National Income.</td>
</tr>
<tr>
<td>9. Government consumption ($c^G$)</td>
<td>NESDB</td>
<td>General government consumption expenditure at 1972 prices</td>
</tr>
<tr>
<td>10. Public Investment ($i^G$)</td>
<td>NESDB</td>
<td>Defined as gross domestic capital formation for the public sector at 1972 prices</td>
</tr>
<tr>
<td>11. Public capital stock ($k^G$)</td>
<td>NESDB</td>
<td>Calculated from gross domestic capital formation for the public sector.</td>
</tr>
<tr>
<td>Variables</td>
<td>Sources</td>
<td>Definition of variables</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>------------------------</td>
</tr>
<tr>
<td><strong>Endogenous variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Private capital stock ($k^p$)</td>
<td>NESDB</td>
<td>Calculated from productive investment.</td>
</tr>
<tr>
<td>14. Net long-term flows ($lt^f$)</td>
<td>IMF (Balance of Payments Statistics (yearbook) and International Financial Statistics (IFS))</td>
<td>Defined as direct investment plus portfolio investment plus other long-term capital in Balance of Payments account</td>
</tr>
<tr>
<td>15. Tobin’s q ($q$)</td>
<td></td>
<td>Proxied by SET (Stock Exchange of Thailand) price index.</td>
</tr>
<tr>
<td>16. Real profit ($R$)</td>
<td></td>
<td>The data is available, but is not appropriate to the definition underlying the model. Hence the parameter is derived from existing studies.</td>
</tr>
<tr>
<td>17. Domestic nominal wage ($w$)</td>
<td>NESDB</td>
<td>Proxied by compensation of employees in National Income account at current market price.</td>
</tr>
<tr>
<td><strong>Exogenous variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. World nominal interest rate ($r^*$)</td>
<td>IMF (IFS)</td>
<td>Proxied by USA’s deposit interest rate.</td>
</tr>
<tr>
<td>19. Nominal exchange rate ($e$)</td>
<td>IMF (IFS)</td>
<td>Bilateral nominal spot exchange rate of the Thai baht against the US dollar. An increase in the exchange rate depicts a nominal depreciation of the Thai baht.</td>
</tr>
<tr>
<td>20. Nominal money supply ($m$)</td>
<td>IMF (IFS)</td>
<td>Defined as currency in circulation plus demand deposits (M1)</td>
</tr>
<tr>
<td>21. Current account ($f$)</td>
<td>IMF (IFS)</td>
<td>Current account in Balance of Payments</td>
</tr>
<tr>
<td>Variables</td>
<td>Sources</td>
<td>Definition of variables</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>------------------------</td>
</tr>
<tr>
<td><strong>Endogenous variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net foreign asset stock ((f))</td>
<td>IMF (IFS)</td>
<td>Derived from the Current Account</td>
</tr>
<tr>
<td>Foreign exchange reserves ((res))</td>
<td>IMF (IFS)</td>
<td></td>
</tr>
<tr>
<td>Domestic price level ((p))</td>
<td>IMF (IFS)</td>
<td>Measured by CPI (consumer price index)</td>
</tr>
<tr>
<td>Domestic nominal interest rate ((r))</td>
<td>IMF (IFS)</td>
<td>Proxied by demand deposit interest rate</td>
</tr>
<tr>
<td>World real income ((y^*))</td>
<td>IMF (IFS)</td>
<td>Proxied by USA's National Income</td>
</tr>
<tr>
<td><strong>Exogenous variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>World price level ((p^*))</td>
<td>IMF (IFS)</td>
<td>Measured by USA's CPI</td>
</tr>
</tbody>
</table>

Note: NESDB The National Economic and Social Development Board  
IMF International Monetary Fund