Floating Exchange Rates as Employment Protection

by

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1. Introduction

More than half a century ago, Milton Friedman (1953) argued that flexible exchange rates help insulate the economy against shocks.

Subsequent experience has shown that floating exchange rates can be quite volatile.

Does the exchange rate volatility shelter the real economy?

Do floating exchange rates help deal with the current crisis?
2. Outline

- Employment and investment

- Current crisis.

- Model of exchange rate volatility, employment and investment.
  — Textbook model,
  — Effect of exchange rate volatility.

- Conclusions.
3. Employment and investment

Employment and investment are closely related both across countries as well as for each country over time. ("Modigliani puzzle.")

Labor as a “quasi-fixed factor of production”.

- Mortensen and Pissarides: Investment in new vacancies.

- Phelps (1994): Investment in;
  - The training of new workers,
  - The expansion of market share through lower markups of price over marginal costs
  - Labor-intensive capital goods.

Relationship between investment and employment is quite robust. See Smith and Zoega (2006, 2007).
4. **Current crisis**

In the current crisis firms are not investing in the hiring of new workers or in new investment goods sufficiently to maintain high employment.

- Insufficient global demand.
- Balance sheet problems.
- Uncertain outlook.

Countries with floating exchange rates have not fared much better than the fixed exchange rate countries: UK, US, Hungary, ....

- Lower exchange rates improve competitiveness, but
- exchange rate volatility may impede investment in both capital equipment as well new hiring.
Unemployment and real exchange rates
Observation: More exchange rate volatility does not necessarily go together with less output volatility.
Literature

Alogoskoufis and Smith (1991): floating exchange rates lead to greater inflation and unemployment persistence.

Caporale (1994): greater persistence of real exchange rates, real interest rates, unemployment rates and industrial production in 18 OECD countries after the collapse of Bretton Woods.

Effects resemble those of labour market rigidities:

Bertola (1990), Bentolila and Bertola (1990) and Lazear (1990): firing costs increase unemployment persistence.
5. **Textbook model**

**IS curve**

The demand for output $Z$ as a function of real interest rates for a given level of real exchange rates;

$$Z = v - z_1(i - \pi) + z_2E$$

(1)

where $\pi$ is the rate of inflation, $z$ measures the slope of the IS curve, $E$ is the nominal exchange rate, $v$ is a stochastic variable that captures changes in demand and $i$ is the nominal rate of interest.

**Taylor rule**

Interest rates are set according to a Taylor rule

$$i = \bar{i} + \phi \pi$$

(2)

where $\phi > 0$ measures the response by the central bank to inflation developments.

**Uncovered interest parity**

Exchange rates determination is described by;

$$\frac{\dot{E}}{E} = i - i^* - p$$

(3)

where $i^*$ is the foreign interest rate, and $p$ denotes a risk premium.
Phillips curve
Inflation is described by a Phillips curve;
\[ \pi = \lambda \left( Q - Q^p \right), \quad \lambda > 0 \]  \hspace{1cm} (4)
where \( Q^p \) measures potential output which grows at the same rate as demand \( Z \) and \( \lambda \) measures the steepness of the Phillips curve.

Stochastic demand
The volume of demand follows a geometric Brownian motion that captures the business cycle;
\[ dv = \eta_y v dt + \sigma_y v dB \]  \hspace{1cm} (5)
where \( B \) is a standard Wiener process; \( dB = \varepsilon \sqrt{dt} \) since \( \varepsilon \) is a normally independent distributed random variable with mean zero and a standard deviation of unity; \( \eta_y \) is the drift parameter and \( \sigma \) the variance parameter.

Economic growth
Potential output grows deterministically at rate \( \eta_y \);
\[ dQ^p = \eta_y Q dt. \]  \hspace{1cm} (6)
Implications

- When demand surges at home and output and employment rise, inflation rises which leads to interest rate increases and an immediate appreciation of the currency.

- A fall in demand will similarly lead to a fall in interest rates and an immediate depreciation of the currency.

- Flexible exchange rates manage to offset some of the effects of the volatility of demand.

- However, model ignores the volatility effects of exchange rate fluctuations on investment.
6. Exchange rate volatility

Flexible exchange rates have supply side effects in the labor market.

Assumptions

— Firm owned by domestic citizens and produces its (tradable) output at home for exports.

— The representative firm’s supply of output and the level of (foreign) demand determine the (foreign) price of output, while the domestic price also depends on the (nominal) exchange rate $E$.

— There are government regulations that stipulate redundancy payments $Ex$ in the event of layoffs.

— There is also a direct cost of setting up operations that takes the form of a cost of hiring and training new workers $I$.

— Replace output demand volatility $\sigma_v$ with exchange rate volatility $\sigma$. 
— Let foreign demand grow at rate $\eta_Z$ and domestic productivity at rate $\eta_v$.

— Replace equations (2-4) with an equation capturing exchange rate volatility. The process of the exchange rate is described by the geometric Brownian motion,

$$dE = \frac{x}{\bar{p}} i - \bar{i} - \frac{p^u}{p^d} Edt + \sigma EdB$$

where $\bar{p}$ represents the expected exchange rate risk premium.

**Hiring and firing**

Assume that the production function is linear $Q = gN$ where $g$ denotes labour productivity, $N$ is employment in a factory and $Q$ is output.

Output demanded is a negative function of the (foreign) price $P^*$,

$$Q = Z^x P^* - 1/(1-\gamma) ,$$

where $0 < \gamma < 1$.

Revenues in terms of foreign currency $R^f$,

$$R^f = Z^{1-\gamma} (gN)^\gamma , \quad 0 < \gamma < 1. \quad (8)$$
For simplicity, it is assumed that $N$ is fixed, $g$ grows at rate $\eta_v$ and $Z$ grows at a rate of $\eta Z$.

Revenues per factory in terms of domestic currency $R$, written as

$$R = EZ^{1-\gamma} (gN)^\gamma, \quad 0<\gamma<1$$

are stochastic due to the fluctuations of exchange rates.

By Ito’s lemma, the stochastic differential equation for revenue, expressed in domestic currency, is represented by

$$dR = \alpha R dt + \sigma R dB,$$}

where $\alpha = i^* - \bar{p} + (1-\gamma)\eta + \gamma \eta g$ is the trend growth rate.

Current profits in domestic currency can then be written as

$$\text{Current Profits} = R - C$$

where $C$ denotes the fixed daily operative costs of the factory. It is assumed that the firm faces a constant rate of death $\lambda$, which measures the probability that the firm goes out of business at each moment in time.

Firms maximise the intertemporal shareholder value, which is equal to the expected discounted value of profits $V$.

$$V = E^{\tilde{H}}_{T} \left| R - C \right| e^{-\frac{x}{2} \mu + \int_{0}^{t} \mu \ dt} dt^{\frac{1}{2}}$$

where $\mu$ and $\lambda$.
where $\mu$ represents the appropriate risk-adjusted discount and $E[\cdot]$ is the expectation operator. The Bellman equation considering no-arbitrage conditions follows:

$$(r + \lambda) V = R - C + (r - \delta) RV_R + \frac{1}{2} \sigma^2 R^2 V_{RR},$$  \hspace{1cm} (13)

where $r$ is the risk-free rate of interest and $\delta = \mu - \alpha$.

With no adjustment costs of entry (hiring), $I$, and/or exit (firing), $Ex$, each factory’s expected, present-discounted value of future profits, $V^p$ in real terms is represented by:

$$V^P = \frac{R}{\delta + \lambda} - \frac{C}{r + \lambda},$$  \hspace{1cm} (14)

Note that $V^P$ is also a particular solution to the Bellman equation (13).

The option values (the value of the option to hire a worker and the value of the option to fire a worker) comes from the homogenous part of the Bellman equation (13):

$$(r + \lambda) V = (r - \delta) RV_R + \frac{1}{2} \sigma^2 R^2 V_{RR},$$  \hspace{1cm} (15)

The general (homogenous) solutions, $V^H$, to this differential equation are

$$V^H = A_1 R^{\beta_1} + A_2 R^{\beta_2},$$  \hspace{1cm} (16)

where $\beta_1$ and $\beta_2$ are the roots for characteristic equations and
When $R$ approaches zero, the value of the option to enter – set up a new factor – $V_I^H$, should go to zero since no one would enter when there are no revenues at all. Thus,

$$V_I^H = A_1 R^\beta 1.$$  \(19\)

Similarly, when $R$ approaches infinity, the value of the option to exit – dismantle factory – $V_E^H$, should go to zero. Thus

$$V_E^H = A_2 R^\beta 2,$$  \(20\)

which implies that no firm would fire workers in a boom of that magnitude.

- When the representative firm decides to set up a new factory it gains $V^p$ and the option to discontinue its operations in the future, $V_E^H$, pays the training – or entry – costs $I$ and sacrifices an option to enter later $V_I^H$. 

\[ \beta_1 = \frac{1}{2} \frac{r-\delta}{\sigma^2} + \sqrt{\frac{3}{2} \frac{r-\delta}{\sigma^2} - \frac{1}{2} \frac{\psi}{\sigma^2} + \frac{2(r+\lambda)}{\sigma^2}} > 1, \]  \(17\)

\[ \beta_2 = \frac{1}{2} \frac{r-\delta}{\sigma^2} - \sqrt{\frac{3}{2} \frac{r-\delta}{\sigma^2} - \frac{1}{2} \frac{\psi}{\sigma^2} + \frac{2(r+\lambda)}{\sigma^2}} < 0. \]  \(18\)
When, during an economic downturn, the firm then decides to fire incumbent workers, it gains \(-V^p\) (since \(V^p\) is then a negative number) and an option to re-enter \(V^H_I\), pays the redundancy payments or exit costs \(Ex\), and sacrifices an option to go out of business later, \(V^H_E\).

The value-matching conditions look as follows;

\[
\frac{RI}{\delta + \lambda} - \frac{C}{r + \lambda} + A_2 R^\beta I^2 = I + A_1 R^\beta I^1 
\]  
(21)

\[
-\frac{RE}{3 \delta + \lambda} - \frac{C}{r + \lambda} + A_1 R^\beta E^1 = Ex + A_2 R^\beta E^2 
\]  
(22)

The smooth-pasting conditions follow:

\[
\frac{1}{\delta + \lambda} + A_2 R^\beta I^2 = A_1 R^\beta I^1 
\]  
(23)

\[
-\frac{1}{\delta + \lambda} + A_1 R^\beta E^1 = A_2 R^\beta E^2 
\]  
(24)

Equations (21), (22), (23) and (24) form a non-linear system of equations with four unknown parameters, \(R_I\), \(R_E\), \(A_1\) and \(A_2\), and can be solved for numerically.
Exchange rate volatility as a labor market rigidity

We can now calculate the entry and exit thresholds for different values of the redundancy payments as well as the degree of exchange-rate uncertainty $\sigma$.

**Table 1. Benchmark values**

<table>
<thead>
<tr>
<th>$\gamma$</th>
<th>0.7</th>
<th>$\mu$</th>
<th>0.08</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\eta_v$</td>
<td>0.0</td>
<td>$r$</td>
<td>0.05</td>
</tr>
<tr>
<td>$i = i^*$</td>
<td>0.03</td>
<td>$\bar{p}$</td>
<td>0.00</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.12</td>
<td>$I$</td>
<td>150</td>
</tr>
<tr>
<td>$\eta_z$</td>
<td>0.03</td>
<td>$Ex$</td>
<td>100</td>
</tr>
<tr>
<td>$C$</td>
<td>75</td>
<td>$\lambda$</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Figure 1. The effect of exit costs on the entry thresholds with different values of $\sigma$. Other parameters: $\gamma = 0.7$, $\eta_\gamma = 0.02$, $\eta_\sigma = 0.0$, $\mu = 0.08$, $r = 0.05$, $I = 150$, $C = 75$, $\lambda = 0.05$.

Figure 2. The effect of exit (firing) costs on the exit thresholds with different values of sigma, $\sigma$. Other parameters: $\gamma = 0.7$, $\eta_\gamma = 0.03$, $\eta_\sigma = 0.0$, $\mu = 0.08$, $r = 0.05$, $I = 150$, $C = 75$, $\lambda = 0.05$. 
Figure 3. Iso-protection curves for the entry decision. Other parameters: \( \gamma = 0.7 \), \( \eta_e=0.03 \), \( \eta_i=0.0 \), \( \mu = 0.08 \), \( r = 0.05 \), \( I = 150 \), \( C = 75 \), \( \lambda = 0.05 \).

Figure 4. Iso-protection curves for the exit decision. Other parameters: \( \gamma = 0.7 \), \( \eta_e=0.03 \), \( \eta_i=0.0 \), \( \mu = 0.08 \), \( r = 0.05 \), \( I = 150 \), \( C = 75 \), \( \lambda = 0.05 \).
Effect of growing and declining industries

Figure 5. The effect of exit costs on the entry/exit thresholds with different values of demand growth rate $\eta$. Other parameters: $\gamma=0.7$, $\sigma=0.18$, $\eta_E=0.0$, $\mu=0.08$, $r=0.05$, $E=150$, $C=60$, $\lambda=0.05$.

Figure 6. The effect of sigma $\sigma$ on the entry/exit thresholds with different values of demand growth rate $\eta$. Other parameters: $\gamma=0.7$, $\sigma=0.18$, $\eta_E=0.0$, $\mu=0.08$, $r=0.05$, $E=100$, $I=150$, $C=75$, $\lambda=0.05$.

- The effect of exchange-rate volatility is thus to deter the entry high-growth industries and to slow down the dismantling of declining ones.
7. **Conclusions**

- Exchange-rate volatility raises both the costs of hiring and firing in a way similar to explicit firing costs.

- In comparison to firing costs, exchange-rate volatility is more damaging to entry. In particular, exchange-rate volatility is particularly bad for the entry of promising new industries.

- The labor market inertia created by volatile exchange rates offsets the benefits of having an independent monetary policy.

- An exchange rate depreciation may not boost output and employment if it coincided with greater exchange rate volatility.