After financial openings, like that in Spain and Mexico in the late 1980s, large capital inflows have been accompanied by substantial appreciations in the real exchange rate. Previous work has shown that, to capture the timing of capital inflows and the changes in the relative prices of nontraded goods, frictions in factor markets are important.

The model here stresses the role of the imperfect substitutability between domestic and foreign traded goods in determining the terms of trade, whose movements are major components of real exchange rate fluctuations.
This is preliminary work based on


"Tradability of Goods and Real Exchange Rate Fluctuations" with Caroline M. Betts
\[ RER = NER \times \frac{P_{ger}}{P_{esp}} \]

units: \( \frac{\text{pesetas}}{\text{deutsche marks}} \times \frac{\text{deutsche marks/German basket}}{\text{pesetas/Spanish basket}} \)

\[ = \frac{\text{Spanish basket}}{\text{German basket}} \]

Suppose \( P_{esp}^T = NER \times P_{ger}^T \) (law of one price)

\[ \hat{RER} = \frac{P_{esp}^T}{P_{ger}^T} \times \frac{P_{ger}}{P_{esp}} = \frac{(P_{ger}/P_{ger}^T)}{(P_{esp}/P_{esp}^T)} \]

\( \hat{RER} \) is the part of the real exchange rate explained by the relative price of nontraded goods.
REAL EXCHANGE RATE - DATA

YEAR


RER

RERp

log(RER)
What is left over in $RER$ is the part explained by the terms of trade.

$$TOT = \frac{NER \times P^T_{ger}}{P^T_{esp}}$$

Notice that

$$RER = TOT \times \hat{RER}$$

**TRADED**
Agriculture and Industry

**NONTRADED**
Construction and Services
MODELING CAPITAL FLOWS INTO SPAIN

\[ Y_j = AN_j^{1-\alpha} K_j^\alpha \]
\[ y_j = A k_j^\alpha \]
\[ (r_j = \alpha A k_j^{\alpha-1} - \delta) \]

\[ y_{esp} = 21,875 \quad (1986) \]
\[ y_{ger} = 27,879 \]
\[ k_{esp} = 45,528 \]
\[ k_{ger} = 73,618 \]

\[ \frac{y_{esp}}{y_{ger}} = \left( \frac{k_{esp}}{k_{ger}} \right)^\alpha \]

Let \( \alpha = 0.3020 \)

\[ \frac{y_{esp}}{y_{ger}} = 0.8649 \]

in data

\[ \frac{y_{esp}}{y_{ger}} = 0.7847 \]

Differences in capital per worker explain 63 percent of differences in output per worker between Spain and Germany.
**HOW LARGE SHOULD CAPITAL FLOWS BE?**

Calibrate

\[ A_{esp} = \frac{y_{esp}}{k_{esp}} = 857.3298 \]

\[ A_{ger} = \frac{y_{ger}}{k_{ger}} = 945.0353 \]

Equate marginal products

\[ \alpha A_{esp} k_{esp}^{a-1} = \alpha A_{ger} k_{ger}^{a-1} \]

\[ k_{ger} = 73,618 \quad \text{implies} \quad k_{esp} = 64,030 \]

Spanish capital stock would have to increase by 18,502, which is 85 percent of Spanish GDP, 41 percent of Spanish capital stock.

\[ (r_{ger} = 0.057 \quad \text{implies} \quad r_{esp} = 0.088) \]
**MODEL**

**Consumers**

\[
\max \sum_{t=0}^{\infty} \beta^t (\epsilon c_T^\rho + (1 - \epsilon) c_N^\rho - 1) / \rho
\]

subject to

\[
p_T t c_T + p_N t c_N + a_{t+1} = w_t \bar{\ell} + (1 + r_t) a_t + T_t
\]

\[
a_t \geq -A
\]

where

\[
a_t = q_{t-1} k_t + b_t
\]
Feasibility-Equilibrium Conditions

Domestically produced traded good
\[ x_{Dt} + x_{Ft} = A_D k_{Dt}^{1-a_D} \]

Armington aggregator
\[ c_{Tt} + z_{Tt} = M(\mu x_{Dt}^{\zeta} + (1 - \mu)m_t^{\zeta})^{1/\zeta} \]

Nontraded good
\[ c_{Nt} + z_{Nt} = A_N k_{Nt}^{1-a_N} \]

Balance of payments
\[ m_t + b_{t+1} = p_{Dt}x_{Ft} + (1 + r_t)b_t \]

Investment
\[ k_{t+1} - (1 - \delta)k_t = Gz_T^\gamma z_{Nt}^{1-\gamma} \]

Foreign demand
\[ x_{Ft} = D((1 + \tau_{Ft})p_{Dt})^{1-1/\zeta} \]

Factor markets
\[ k_{Dt} + k_{Nt} = k_t, \quad \ell_{Dt} + \ell_{Nt} = \ell \]

Transfer of tariff revenue
\[ T_t = \tau_{Dt}m_t \]
**Profit maximization**

\[
w_t = p_{Dt}A_D(1 - \alpha_D)(k_{Dt}/\ell_{Dt})^{\alpha_D} \\
= p_{Nt}A_N(1 - \alpha_N)(k_{Nt}/\ell_{Nt})^{\alpha_N}
\]

\[
1 + r_t = (p_{Dt}A_D\alpha_D(\ell_{Dt}/k_{Dt})^{1-\alpha_D} + (1 - \delta)q_t)/q_{t-1} \\
= (p_{Nt}A_N\alpha_N(\ell_{Nt}/k_{Nt})^{1-\alpha_N} + (1 - \delta)q_t)q_{t-1}
\]

\[
p_{Tt} = q_t\gamma G(z_{Nt}/z_{Tt})^{1-\gamma} \\
p_{Nt} = q_t(1 - \gamma)G(z_{Tt}/z_{Nt})^{\gamma}
\]

\[
x_{Dt} = \mu \left( \frac{1}{1-\xi} M^{\frac{\xi}{1-\xi}} (p_{Tt}/p_{Dt}) \right)^{\frac{1}{1-\xi}} (c_{Tt} + z_{Tt}) \\
m_t = (1 - \mu) \left( \frac{1}{1-\xi} M^{\frac{\xi}{1-\xi}} \right)^{\frac{1}{1-\xi}} (c_{Tt} + z_{Tt})
\]

where

\[
p_{Tt} = (1/M)[\mu \left( \frac{1}{1-\xi} p_{Dt} \right)^{\frac{-\xi}{1-\xi}} + (1 - \mu) \left( 1 + \tau_{Dt} \right)^{\frac{-\xi}{1-\xi}}]^{\frac{-(1-\xi)}{\xi}}
\]
LABOR ADJUSTMENT FRICTIONS

\[
\begin{align*}
\ell_{Dt+1} & \leq \lambda \ell_{Dt} \\
\ell_{Nt+1} & \leq \lambda \ell_{Nt} \\
\lambda & > 1
\end{align*}
\]

If constraint binds, labor in traded goods sector receives a different wage, \( w_{Dt} \), than the wage of labor in the nontraded goods sector, \( w_{Nt} \).

(In simulations, \( \lambda = 1.01 \).)
CAPITAL ADJUSTMENT FRICTIONS

\[ i_{Dt+1} + i_{Nt+1} \leq Gz_{Tt}z_{Nt}^{1-\gamma} \]

\[ k_{Dt+1} \leq \phi(i_{Dt+1}/k_{Dt})k_{Dt} + (1 - \delta)k_{Dt} \]

\[ k_{Nt+1} \leq \phi(i_{Nt+1}/k_{Nt})k_{Nt} + (1 - \delta)k_{Nt} \]

\[ \phi'(i/k) > 0, \quad \phi''(i/k) < 0, \quad \phi(\delta) = \delta, \quad \phi'(\delta) = 1 \]

\[ (\phi(i/k) = (\delta^{1-\eta}(i/k)^\eta - (1 - \eta)\delta)/\eta, \quad 0 < \eta \leq 1) \]

Adjusting the sector specific capital stock rapidly is costly. (In simulations \( \eta = 0.9 \).)
REAL EXCHANGE RATE - MODEL

![Graph showing the real exchange rate model over years 1986 to 1996. The graph illustrates the changes in the real exchange rate (RER) and its price (RERp) over time.]