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.

This work shows 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 that frictions are important to capture fluctuations in both the real exchange and trade balance.
REAL EXCHANGE RATE

\[ RER = NER \times \frac{P_{ger}}{P_{esp}} \]

units: \( \frac{\text{pesetass}}{\text{deutsche marks}} \times \frac{\text{deutsche marks/German basket}}{\text{pesetass/Spanish basket}} = \frac{\text{Spanish baskets}}{\text{German basket}} \)
Suppose $P_{esp}^T = NER \times P_{ger}^T$ (law of one price)

$$RER^N = \frac{P_{esp}}{P_{ger}^T} \times \frac{P_{ger}}{P_{esp}} = \frac{(P_{ger}/P_{ger}^T)}{(P_{esp}/P_{esp}^T)}$$

$RER^N$ is the part of the real exchange rate explained by the relative price of nontraded goods.

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

$$RER^T = \frac{NER \times P_{ger}^T}{P_{esp}^T}$$

Notice that

$$RER = RER^T \times RER^N$$

**TRADED:** Agriculture and Industry

**NONTRADED:** Construction and Services
Peseta-Duetsche Mark Real Exchange Rate

Year:

Real Exchange Rate:
RERN
RER
MODELING CAPITAL FLOWS INTO SPAIN

\[ Y_j = AN_j^{1-\alpha} K_j^\alpha \]
\[ y_j = A k_j^\alpha \]
\[ r_j = \alpha A k_j^{\alpha-1} - \delta \]
\[ y_{esp} = 21,875 \quad \text{(1986)} \]
\[ y_{ger} = 27,879 \]
\[ k_{esp} = 45,528 \]
\[ k_{ger} = 73,618 \]
\[ \frac{y_{esp}}{y_{ger}} = \left( \frac{k_{esp}}{k_{ger}} \right)^\alpha \]
Let $\alpha = 0.3020$

$$\frac{y_{\text{esp}}}{y_{\text{ger}}} = 0.8649$$

in data

$$\frac{y_{\text{esp}}}{y_{\text{ger}}} = 0.7847$$

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

\[ A_{esp} = y_{esp}/k_{esp}^\alpha = 857.3298 \]

\[ A_{ger} = y_{ger}/k_{ger}^\alpha = 945.0353 \]

Equate marginal products

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

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

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

\( (r_{ger} = 0.057 \implies r_{esp} = 0.088) \)
THE MODEL

Consumers

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

subject to

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

\[ a_t \geq -A \]

where

\[ a_t = q_{t-1} k_t + b_t. \]
COST MINIMIZATION + ZERO PROFITS

\[ w_t = A_T(1 - \alpha_T)(k_{Tt}/\ell_{Tt})^{\alpha_T} \]
\[ = p_{Nt}A_N(1 - \alpha_N)(k_{Nt}/\ell_{Nt})^{\alpha_N} \]

\[ 1 + r = (A_T\alpha_T(\ell_{Tt}/k_{Tt})^{1-\alpha_T} + (1 - \delta)q_t)/q_{t-1} \]
\[ = (p_{Nt}A_N\alpha_N(\ell_{Nt}/k_{Nt})^{1-\alpha_N} + (1 - \delta)q_t)q_{t-1} \]

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

\[ c_{Nt} + z_{Nt} = A_N k_{Nt}^{\alpha_N} \ell_{Nt}^{1-\alpha_N} \]
\[ k_{Tt} + k_{Nt} = k_t \]
\[ \ell_{Tt} + \ell_{Nt} = \bar{\ell} \]
\[ k_{t+1} - (1 - \delta)k_t = G Z_{Nt}^\gamma z_{Tt}^{1-\gamma} \]
\[ c_{Tt} + z_{Tt} + b_{t+1} = A_T k_{Tt}^{\alpha_T} \ell_{Tt}^{1-\alpha_T} + (1 + r_t)b_t \]
CALIBRATION

\[ y_N = 1.0481 k_N^{0.2869} \ell_N^{0.7131} \]

\[ y_T = 1.0214 k_T^{0.3109} \ell_T^{0.6891} \]

\[ x = 1.9434 z_T^{0.3802} z_N^{0.6198} \]

\[ \delta = (\delta k/y)/(k/y) = 0.0576 \]

\[ \epsilon = \frac{(c_N/c_T)^{1-\rho}}{1 + (c_N/c_T)^{1-\rho}} = \frac{0.5830^{1-\rho}}{1 + 0.5830^{1-\rho}} \]

\[ \beta = 1/(1 + r^*) = 0.9463 \]

\[ r = \alpha A_{ger} k_{ger}^{\alpha-1} - \delta \]
Basic model - traded output

![Graph showing traded GDP (% total GDP) over years from 1985 to 1996. The graph compares model predictions with data.](image-url)
Basic model - trade balance

trade balance (%GDP)

years


data

model
Basic model - real exchange rate

![Graph showing real exchange rate over years from 1985 to 1996. The model line is steady at 1.00, while the data line shows a downward trend from 1.00 to around 0.94.]
Production possibilities frontier

- Traded
- Non traded
LABOR ADJUSTMENT FRICTIONS

\[ \ell_{Nt+1} \leq \lambda \ell_{Nt} \]
\[ \ell_{Tt+1} \leq \lambda \ell_{Tt} \]

\[ \lambda > 1 \]

(In the numerical experiments \( \lambda = 1.01 \).)
CAPITAL ADJUSTMENT FRICTIONS

\[ x_{Nt+1} + x_{Tt+1} \leq Gz_N^\gamma z_T^{1-\gamma} \]

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

\[ k_{Tt+1} \leq \phi(x_{Tt+1}/k_{Tt})k_{Tt} + (1 - \delta)k_{Tt} \]

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

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

(In the numerical experiments \( \eta = 0.9 \).)
Model with capital and labor adjustment frictions
- traded output

![Graph showing traded GDP (% total GDP) over years from 1985 to 1996. The graph compares the model predictions with the actual data. The model line is shown in blue, and the data line is shown in red. The trend shows a decrease in traded GDP as a percentage of total GDP from 1985 to 1992, followed by a slight increase towards 1996.]
Model with capital and labor adjustment frictions

- trade balance


Trade balance (%GDP)

Data

Model
Model with capital and labor adjustment frictions
- real exchange rate

![Graph showing model and data for real exchange rate from 1985 to 1996. The model line is shown as a solid blue line, and the data line is shown as a dashed red line. The real exchange rate values range from approximately 0.86 to 1.06.](image-url)
Model with capital and labor adjustment frictions
- labor in traded sector

![Graph showing the trend of traded labor percentage from 1985 to 1996, with lines labeled 'model' and 'data'.]