The Macroeconomic Consequences of Exchange Rate Depreciations

Masao Fukui¹  Emi Nakamura²  Jón Steinsson²

¹Boston University

²UC Berkeley

April 2023
How does an exchange rate depreciation affect the economy?

Surprisingly: It is not so clear!

- Simple textbook logic suggests expansionary effect
  (Dornbusch 80, Obstfeld-Rogoff 96)
- Long literature on contractionary depreciations
  (Diaz Alejandro 63, Cooper 69, Krugman-Taylor 78, Auclert et al. 21; Krugman 99, Aghion-Bacchetta-Banerjee 01)
- Long literature on exchange rate disconnect
  (Meese-Rogoff 83, Baxter-Stockman 89, Flood-Rose 95, Obstfeld-Rogoff 00, Devereux-Engel 02, Itskhoki-Mukhin 21)

Precious little consensus
The Challenge

- Exchange rates are endogenous

- For example: Bad domestic shock
  - Currency depreciates and economy does badly
  - Not evidence of contractionary effect of depreciation
  - Direct effect of the shock is a confound

- Hard to measure causal effect of exchange rate movements

- Is it even possible?
Our Approach

- Compare USD pegs versus floats when USD exchange rate changes

Example:
- Egypt pegs to USD, South Africa floats versus USD
- When USD depreciates, EGP depreciates versus ZAR
- How does this event affect other macro outcomes in Egypt versus South Africa?

“Regime-induced” exchange rate fluctuations
- Not all the variation in EGP and ZAR
- Component of exchange rate fluctuations that is caused by earlier choice of exchange rate regime
Assumption: Pegs and floats are not differentially exposed to other shocks that are correlated with the USD

Time fixed effects absorb direct effect of shocks driving USD (and indirect effects through other channels than exchange rate)

Exclude exchange rate fluctuations coming from domestic shocks
  - We consider USD vs. 24 “advanced economies” excluded from analysis

What is left? “Regime-induce” effect of foreign exchange rate change

Most obvious concern goes against our findings
Main Empirical Results

- Depreciation strongly expansionary:
  - 10% depreciation $\rightarrow$ 5.5% increase in GDP (over 5 years)

- Net exports fall
  - Rules out export-led boom from expenditure switching

- Nominal interest rates rise
  - Rules out monetary policy induced boom

- Inconsistent with a large class of models
Show that a financially driven exchange rate model (FDX) can match our empirical results

- UIP shocks make currency “cheap”
- Household/firms borrow from abroad $\rightarrow$ boom

Also consistent with unconditional exchange rate disconnect, Backus-Smith fact, Mussa fact

- Need two financial shocks to exchange rate
  - UIP shocks generate $\text{Cor}(E_t, Y_t) > 0$
  - Capital flight shocks generate $\text{Cor}(E_t, Y_t) < 0$
- Pegging eliminates UIP shocks but effects of capital flight shocks worse
Empirical Setup
Annual data for period 1973-2019

BIS Trade-weighted USD exchange rate relative to 24 countries:
  - Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, United Kingdom

We exclude these countries from our pegger and floater samples
High values are a more depreciated USD
FX classification based on Ilzetzki-Reinhart-Rogoff 19

- Pegs: Fine classification codes 1-8 with USD anchor
- Floats: Fine classification code 13 or with anchor other than USD

This choice is based on comovement with USD:

\[
\Delta e_{i,t} = \alpha_{r(i),t} + \sum_k \gamma_k \Pi_{i,t}(k) \times \Delta e_{USD,t} + \Gamma' hX_{i,t-1} + \epsilon_{i,t},
\]

Many “floats” are countries that peg to euro
EXCHANGE RATE REGIMES

Pegs by Region

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Consequences of Exchange Rate Depreciations

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**How Do Pegs Differ from Floats?**

<table>
<thead>
<tr>
<th>Variable</th>
<th>No control</th>
<th>Time FE</th>
<th>Region x Time FE</th>
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<td>-0.02</td>
<td>-0.09</td>
<td>0.74*</td>
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<tr>
<td></td>
<td>(0.31)</td>
<td>(0.31)</td>
<td>(0.39)</td>
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<td>Log Real GDP Per Capita</td>
<td>0.36</td>
<td>0.32</td>
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<tr>
<td></td>
<td>(0.22)</td>
<td>(0.22)</td>
<td>(0.23)</td>
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<tr>
<td>Export to GDP</td>
<td>-0.01</td>
<td>-0.01</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
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<tr>
<td>Import to GDP</td>
<td>-0.03</td>
<td>-0.03</td>
<td>-0.03</td>
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<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>Export Share to the US</td>
<td>0.04***</td>
<td>0.04***</td>
<td>-0.00</td>
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<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
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<td>Import Share to the US</td>
<td>0.05***</td>
<td>0.05***</td>
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<td></td>
<td>(0.01)</td>
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<td></td>
<td>(0.18)</td>
<td>(0.19)</td>
<td>(0.26)</td>
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<td>Inflation Rate (p.p.)</td>
<td>-0.89</td>
<td>-0.65</td>
<td>2.21***</td>
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<td>(1.51)</td>
<td>(1.41)</td>
<td>(0.69)</td>
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<td>TBill Rate (p.p.)</td>
<td>1.01</td>
<td>0.89</td>
<td>2.86***</td>
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<td>(0.84)</td>
<td>(0.90)</td>
<td>(0.96)</td>
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<td>Commodity Exports to GDP</td>
<td>0.05*</td>
<td>0.06**</td>
<td>0.04</td>
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<td>(0.03)</td>
<td>(0.03)</td>
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<td>Commodity Imports to GDP</td>
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<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
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Empirical Specification

\[ y_{i,t+h} - y_{i,t-1} = \alpha_{i,h} + \alpha_{r(i),t,h} + \beta_{h}Peg_{i,t} \times \Delta e_{USD,t} + \Gamma'_{h}X_{i,t-1} + \gamma_{h}Peg_{i,t} + \epsilon_{i,t,h} \]

- Benchmark controls:
  - Lagged growth of \( y_{i,t} \), real GDP, and treatment variable
- Standard errors are two-way clustered by country and time
- We drop top and bottom 0.5% of each outcome variable
- Drop year of and year after country switches exchange rate regime
- Regions: Europe, Americas, Africa, Asia-Oceania
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<td>GDP</td>
<td>WDI</td>
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<td>Consumption</td>
<td>WDI</td>
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<td>Export</td>
<td>WDI</td>
<td>3319</td>
<td>142</td>
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<tr>
<td>Import</td>
<td>WDI</td>
<td>3319</td>
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<tr>
<td>Net Exports</td>
<td>Constructed</td>
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<td>Nominal Interest Rate</td>
<td>IFS</td>
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<td>IFS</td>
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<td>Terms of Trade</td>
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<tr>
<td>Manufacturing GDP</td>
<td>WDI</td>
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<td>Service GDP</td>
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<td>Agriculture GDP</td>
<td>WDI</td>
<td>4184</td>
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<td>Mining, Construction, Energy GDP</td>
<td>WDI</td>
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Empirical Results
Dynamic Response to Depreciation: Benchmark

Nominal Effective Exchange Rate

Real Effective Exchange Rate

GDP

Consumption

No Controls  Two lags  X rate with USD

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Dynamic Response by Sector

Manufacturing GDP

Service GDP

Agriculture GDP

Mining, Construction, Energy GDP

Het. by CA Opennes
Plaza Accord

- January 1985: James Baker becomes Treasury Secretary
- September 22, 1985: G5 jointly agreement to depreciate USD

![Graph showing log Real Exchange Rate to USD and log Real GDP over years from 1982 to 1990. The graphs illustrate the impact of the Plaza Accord on exchange rates and GDP.]
ROBUSTNESS

- Time FE rather than region x time FE
- No controls (except FE)
- Drop more outliers
- Classify 9-12 as Floats
- Classify 9-12 as Pegs
- GDP-weighted USD exchange rate
- Control for interaction between peg and:
  - US GDP, inflation, and T-Bill rate
  - Commodity price index
- Balanced panel
- Include 24 “advanced” economies
A Financially Driven Exchange Rate Model
How does an exchange rate depreciation stimulate the economy?

Expenditure switching:
- Home goods cheaper / foreign goods more expensive
- Net exports should rise
- In our results: net exports fall

Monetary expansion:
- Looser monetary policy decreciates the exchange rate and boosts output
- Nominal interest rate should fall
- In our results: nominal interest does not fall

So, what is going on?
We propose a financially driven exchange rate (FDX) model to match our empirical results.

Builds on Itskhoki and Muhkin (2021)

Two important additions:

- Households and firms can borrow abroad subject to financial frictions

- Two types of financial shocks
  1. UIP shocks
  2. Capital flight (and flight to safety) shocks

Having two shocks is important to match exchange rate disconnect, Backus-Smith fact, and Mussa fact.
Three-region New Keynesian model
- Regions: US, Pegs, Floats

Households with habit formation preferences

Unions set sticky wages as in Erceg-Henderson-Levin 00

Firms with investment adjustment costs and Calvo-type sticky prices. Set prices in local currency (LCP)

US and Float monetary policy is an interest rate rule
No deep-pocketed investors that fully eliminate return differentials across countries

Noise traders cause exogenous fluctuations in demand for currency $j$

International bond traders, households, and firms have limited capacity to arbitrage return differentials

Noise traders cause UIP deviations (UIP shock)

Later we will introduce a second financial shock (capital flight shock)
Households invest in domestic equity/bonds and foreign bonds

Firms issue domestic equity/bonds and foreign bonds

Real return on domestic equity/bonds is $r_{it+1}$

Real return on foreign bonds is $r_{ijt+1}$

\[
(1 + r_{ijt+1}) = (1 + r_{jt+1}) \frac{Q_{jit+1}}{Q_{jit}}
\]

Importantly, in our model:

\[
\mathbb{E}_t (1 + r_{it+1}) \neq \mathbb{E}_t (1 + r_{ijt+1})
\]

due to financial frictions.
Households seek to maximize the return on their portfolio net of adjustment costs:

$$\max_{\{s_{ijt}^h\}} \mathbb{E}_t \left[ \left( 1 - \int_0^1 s_{ijt}^h \, dj \right) (1 + r_{it+1}) + \int_0^1 \left( s_{ijt}^h (1 + r_{ijt+1}) - \Phi_{ij}^h(s_{ijt}^h) \right) \, dj \right]$$

- $s_{ijt}^h$ is portfolio share in country $j$ bonds
- Adjustment cost:
  $$\Phi_{ij}^h(s_{ijt}) = \frac{\Gamma^h}{2\bar{s}_{ij}} (s_{ijt}^h - \bar{s}_{ij})^2$$
  - $\bar{s}_{ij}$ is steady state portfolio share
- Indeterminate to first order. We treat as free parameter and calibrate.
Solution of portfolio problem yields

\[ E_t(1 + r_{ijt+1}) - E_t(1 + r_{it+1}) = \frac{\Gamma^h}{\bar{s}_{ij}} (s^h_{ijt} - \bar{s}_{ij}) \]

Households increase \( s^h_{ijt} \) when returns are high

This trading is limited by adjustment costs

Severity of adjustment costs governed by \( \Gamma^h \)

Return differential remains in equilibrium
Firms seek to minimize their funding costs net of adjustment costs:

\[
\min_{\{s_{ijt}\}} \mathbb{E}_t \left[ \left( 1 - \int_0^1 s_{ijt} \,dj \right) (1 + r_{it+1}) + \int_0^1 \left( s_{ijt}(1 + r_{ijt+1}) - \Phi_{ij}^f(s_{ijt}) \right) \,dj \right]
\]

- \( s_{ijt} \) is funding share in country \( j \) bonds
- Adjustment cost:
  \[
  \Phi_{ij}^f(s_{ijt}) = \frac{\Gamma^f}{2\bar{s}_{ij}} (s_{ijt} - \bar{s}_{ij})^2
  \]
- \( \bar{s}_{ij} \) is steady state funding share
- We assume country net foreign position is zero in steady state
  (firm liabilities equal household assets in steady state)
Solution of funding problem yields

\[ \mathbb{E}_t(1 + r_{ijt+1}) - \mathbb{E}_t(1 + r_{it+1}) = -\frac{\Gamma^f}{\bar{s}_{ij}} (s_{ijt}^f - \bar{s}_{ij}) \]

- Firms increase \( s_{ijt}^f \) when returns are low (cheap foreign financing)
- This trading is limited by adjustment costs
- Severity of adjustment costs governed by \( \Gamma^f \)
- Return differential remains in equilibrium
Noise traders sell US bonds and buy country $j$ bonds

- Position in country $j$ bonds is $n^\psi \psi_{jt}$

$$
\psi_{jt} = \rho^\psi \psi_{jt-1} + \epsilon^\psi_{jt}
$$

- $\epsilon^\psi_{jt}$ is the country $j$ “UIP shock”
International bond arbitrageurs engage in carry trade

Maximize CARA utility over real returns:

$$\max_{B_{Ujt}} -\mathbb{E}_t \frac{1}{\gamma} \exp \left( -\gamma \left[ \tilde{R}_{Ujt+1} \frac{P_{Ut+1}}{P_{Ut}} B_{Ujt} \right] \right)$$

- $B_{Ujt}$ is quantity invested (long currency $j$, short USD)
- Per dollar nominal return:

$$\tilde{R}_{Ujt+1} \equiv (1 + i_{jt}) \frac{\mathcal{E}_{jUt+1}}{\mathcal{E}_{jUt}} - (1 + i_{Ut})$$
Solution to international bond arbitrageurs’ problem:

\[ B_{Ujt}^I = \frac{1}{\Gamma^B} \left[ \ln(1 + i_{jt}) - \ln(1 + i_{Ut}) + E_t \Delta \ln E_{jU_{t+1}} \right] \]

where \( \Gamma^B \equiv \gamma \text{var}(\Delta \ln E_{jU}) \)

- Carry trade position proportional to expected return
- Carry trade position limited by risk aversion and risk (\( \Gamma^B \))
Noise trader asset demand creates UIP deviations

Households, firms, and international bond arbitrageurs trade against the noise traders

Limited arbitrage capacity implies UIP deviations not eliminated
Adding up demand for currency $j \in F$ bonds yields (to 1st order)

$$(1 + i_{j,t}) = \mathbb{E}_t(1 + i_{U,t}) \frac{\mathcal{E}_{jU,t+1}}{\mathcal{E}_{jU,t}} \exp(\Omega(\{NFA_{kt}\}_k, \psi_{jt}))$$

where the UIP deviation is

$$\Omega(\{NFA_{kt}\}_k, \psi_{jt}) \equiv -\Gamma \left[ \left( 1 - \int \bar{s}_{ji} \, di \right) NFA_{jt} + \int \bar{s}_{ij} NFA_{it} \, di + n^\psi \psi_{jt} \right]$$

and

$$\Gamma \equiv 1 / \left( \frac{1}{\Gamma^B} + \left[ \frac{1}{\Gamma^h} + \frac{1}{\Gamma^f} \right] \frac{\bar{a}}{\beta} \int_{i \in \{P,U\}} (\bar{s}_{ji} + \bar{s}_{ij}) \, di \right)$$
In contrast to floaters, UIP holds for peggers

\[(1 + i_{jt}) = \mathbb{E}_t (1 + i_{Ut}) \frac{\mathcal{E}_{Ut+1}}{\mathcal{E}_{Ut}} \quad \text{for } j \in P\]

- There is no exchange rate risk
- International bond arbitrageur willing to take large positions to offset noise traders
- Central bank also willing to take large positions
  (Peg assumed to be perfectly credible)
Calibration

- Most parameters externally calibrated to standard values

- Regions sizes: $|U| = 0.3, |F| = 0.5, |P| = 0.2$

- Trade elasticity: $\eta = 1.5$

- Gross foreign asset positions: $\bar{s} = 0.52$ (Benetrix, Lane, Shambough 15)

- Choose $n^\psi, \Gamma, \text{var}(\epsilon^\psi_{jt})$ so that effect of NFA on UIP deviations is small

- Choose slopes of price and wage Phillips curves ($\kappa_p$ and $\kappa_w$) and habit parameter ($h$) to best fit our empirical responses
Regime-Driven Depreciations: Model vs. Data
Response to a US Dollar UIP Shock

- Nominal Exchange Rate
- Real Exchange Rate
- GDP
- Consumption
- Net Exports
- Nominal Interest Rate

Other Variables

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COMPARISON TO ITSKHOKI-MUHKIN 21 ($\bar{s} = 0$)

Real Exchange Rate

Household and Firm Rate of Return

GDP

Net Exports
**Table: Alternative Shocks Driving US Dollar**

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<thead>
<tr>
<th></th>
<th>Impact Response</th>
<th>5Y Average Response</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>$e$</td>
<td>$i$</td>
</tr>
<tr>
<td>Data</td>
<td>0.74</td>
<td>0.07</td>
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<tr>
<td>Model</td>
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<tr>
<td>US UIP Shock</td>
<td>0.74</td>
<td>0.04</td>
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<tr>
<td>US Monetary Shock</td>
<td>0.74</td>
<td>-0.41</td>
</tr>
<tr>
<td>US Technology Shock</td>
<td>0.74</td>
<td>-0.23</td>
</tr>
</tbody>
</table>
Large nominal rigidity necessary for fitting IRF

Other pricing regimes (PCP and DCP) cannot fit NX and ToT

Extension of the model to tradable and non-tradable sector
  ⇒ bulk of GDP response from non-tradable (consistent with data)

Results robust to introducing hand-to-mouth households
Exchange Rate Disconnect and Mussa Facts
Our model matches large conditional responses we estimate:

- 10% regime-induced depreciation $\rightarrow$ 5.5% increase in GDP

Does this mean it is inconsistent with disconnect / Mussa facts?

- Exchange rates are super volatile and barely correlated with other real variables (Exchange rate disconnect)
- Breakdown of Bretton Woods saw large increase in RER volatility, but scant effects on other real variables
Not necessarily:

- Multiple shocks drive exchange rate
- Regime-induced depreciations only a subset of shocks

Second shock: “capital flight” shock

- UIP shock: Noise traders spooked about currency
  (UIP shock $\Rightarrow$ depreciation $\Rightarrow$ boom)
- Capital flight shock: Everyone spooked about currency
  (Capital flight shock $\Rightarrow$ depreciation & recession)
Households and firms trade foreign bonds through banks.

Banks face stochastic borrowing constraints (Bianchi-Lorenzoni 21).

Banks solve

$$\max_{b_{ijt}} \left( (1 + r_{ijt+1}) b_{ijt} - (1 + r_{jt+1}) \frac{Q_{jit+1}}{Q_{jit}} b_{ijt} \right)$$

subject to $b_{ijt} \leq \bar{b}_{it}$

Here:

- $r_{ijt+1}$ is rate bank lends at domestically in currency $j$
- $(1 + r_{jt+1})Q_{jit+1} / Q_{jit}$ is rate it finances itself at
- $b_{ijt}$ is net issuance of foreign currency bonds $j$ in country $i$
Solution to bank’s problem:

\[(1 + r_{jit+1}) = (1 + r_{jt}) \frac{Q_{jit+1}}{Q_{jit}} (1 + \zeta_{it})\]

where \(\zeta_{it}\) is the Lagrange multiplier on the bank’s borrowing constraint

\(\zeta_{it}\) acts as an intermediation wedge

We assume that:

\[\zeta_{it} = \rho \zeta \zeta_{it-1} + \epsilon_{it}^{\zeta}\]

and call \(\{\epsilon_{it}^{\zeta}\}\) a capital flight shock
Adding up demand for currency \( j \in F \) bonds yields (to 1st order)

\[
(1 + i_{j,t}) = \mathbb{E}_t (1 + i_{U,t}) \frac{\mathcal{E}_{jU,t+1}^{U,t}}{\mathcal{E}_{jU,t}^{U,t}} \exp(\Omega(\{NFA_{kt}\}_k, \psi_{jt}, \{\zeta_{kt}\}_k))
\]

where the UIP deviation is

\[
\Omega(\{NFA_{kt}\}_k, \psi_{jt}, \{\zeta_{kt}\}_k) \equiv -\Gamma \left[ (1 - \int \bar{s}_{ji} di) NFA_{jt} + \int \bar{s}_{ij} NFA_{it} di 
+ n^\psi \psi_{jt} + n^\zeta (-\int \bar{s}_{ji} di \zeta_{jt} + \int \bar{s}_{ij} \zeta_{it} di) \right]
\]

But capital flight shock also affects funding costs of households and firms directly (last slide)
Response to UIP Shock

Nominal Exchange Rate

Response to Capital Flight Shock

Nominal Exchange Rate

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Consider case with both UIP and capital flight shocks

Calibrate volatility of shocks to hit volatility of NER and GDP

Calibrate $n\zeta$ so as to match $\text{corr}(\Delta RER, \Delta GDP)$

- $n\zeta$ governs degree to which capital flight shocks affects UIP condition
- Capital flight shock also affects funding rates of households and firms directly
### Exchange Rate Disconnect

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<td>0.114</td>
<td>0.169</td>
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<td>std($\Delta RER$)</td>
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<td>std($\Delta GDP$)</td>
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<td>0.039</td>
<td>0.022</td>
<td>0.029</td>
<td>0.042</td>
<td>0.014</td>
<td>0.017</td>
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<tr>
<td>std($\Delta NX$)</td>
<td>0.032</td>
<td>0.021</td>
<td>0.019</td>
<td>0.014</td>
<td>0.024</td>
<td>0.022</td>
<td>0.006</td>
</tr>
<tr>
<td><strong>B. Correlation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>corr($\Delta RER$, $\Delta NER$)</td>
<td>0.712</td>
<td>0.992</td>
<td>0.987</td>
<td>0.989</td>
<td>0.996</td>
<td>0.868</td>
<td>1.000</td>
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<tr>
<td>corr($\Delta RER$, $\Delta GDP$)</td>
<td>-0.068</td>
<td>-0.068</td>
<td>0.490</td>
<td>0.603</td>
<td>-0.603</td>
<td>0.882</td>
<td>0.689</td>
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<tr>
<td>corr($\Delta RER$, $\Delta C$)</td>
<td>-0.137</td>
<td>-0.134</td>
<td>0.535</td>
<td>0.567</td>
<td>-0.544</td>
<td>0.597</td>
<td>0.676</td>
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<tr>
<td>corr($\Delta RER$, $\Delta NX$)</td>
<td>0.213</td>
<td>0.126</td>
<td>-0.165</td>
<td>-0.589</td>
<td>0.481</td>
<td>0.955</td>
<td>-0.670</td>
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**Mussa Facts**

<table>
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<tr>
<th></th>
<th>$(\psi, \zeta)$</th>
<th>$\psi$ only</th>
<th>$\zeta$ only</th>
<th>$(\psi, A)$</th>
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<td>Float  Peg</td>
<td>Float  Peg</td>
<td>Float  Peg</td>
<td>Float  Peg</td>
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<td>std($\Delta NER$)</td>
<td>0.114 0.000</td>
<td>0.090 0.000</td>
<td>0.070 0.000</td>
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<td>std($\Delta RER$)</td>
<td>0.111 0.005</td>
<td>0.087 0.000</td>
<td>0.069 0.005</td>
<td>0.110 0.005</td>
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<tr>
<td>std($\Delta GDP$)</td>
<td>0.037 0.053</td>
<td>0.020 0.000</td>
<td>0.031 0.053</td>
<td>0.037 0.020</td>
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<tr>
<td>std($\Delta C$)</td>
<td>0.039 0.045</td>
<td>0.015 0.000</td>
<td>0.035 0.045</td>
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<td>0.007 0.000</td>
<td>0.020 0.026</td>
<td>0.019 0.018</td>
</tr>
</tbody>
</table>

Pegging does two things:

- Eliminates UIP shocks $\rightarrow$ less volatility
- No MP stabilization after capital flight shocks $\rightarrow$ more volatility
Use “regime-induced” exchange rate variation to identify the causal effect of an exchange rate depreciation

10% depreciation $\rightarrow$ 5.5% increase in GDP (over 5 years)
- Net exports fall (not export led boom)
- Interest rates rise (not MP led boom)

Financially driven exchange rate (FDX) model can explain findings

Also consistent with exchange rate disconnect / Mussa facts
Appendix
<table>
<thead>
<tr>
<th>Fine Code</th>
<th>Coarse Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>No separate legal tender or currency union</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Pre announced peg or currency board</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Pre announced horizontal band that is narrower than or equal to ±2%</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>De facto Peg</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>Pre announced crawling peg; de facto moving band narrower than or equal to ±1%</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>Pre announced crawling band that is narrower than or equal to ±2% or de facto horizontal band that is narrower than or equal to ±2%</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>De facto crawling peg</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>De facto crawling band that is narrower than or equal to ±2%</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>Pre announced crawling band that is wider than or equal to ±2%</td>
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<tr>
<td>10</td>
<td>3</td>
<td>De facto crawling band that is narrower than or equal to ±5%</td>
</tr>
<tr>
<td>11</td>
<td>3</td>
<td>Moving band that is narrower than or equal to ±2%</td>
</tr>
<tr>
<td>12</td>
<td>3</td>
<td>De facto moving band ±5% / Managed floating</td>
</tr>
<tr>
<td>13</td>
<td>4</td>
<td>Freely floating</td>
</tr>
<tr>
<td>13.1</td>
<td></td>
<td>Other anchor and course classification 1 to that anchor</td>
</tr>
<tr>
<td>13.2</td>
<td></td>
<td>Other anchor and course classification 2 to that anchor</td>
</tr>
<tr>
<td>13.3</td>
<td></td>
<td>Other anchor and course classification 3 to that anchor</td>
</tr>
</tbody>
</table>
Coarse classification: 6 categories

1) Peg  
2) Narrow band  
3) Broad band / managed float  
4) Freely floating  
5) Freely falling  
6) Dual market / missing data

(We drop freely falling and dual market / missing data)

Assign anchor currency. Mostly USD. But also EUR/GEM/FFR etc.
EXCHANGE RATE REGIMES BY REGION

Africa

Americas

Asia/Oceania

Europe

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Consequences of Exchange Rate Depreciations

April 2023
Dynamic Response to Depreciation: No Controls
Dynamic Response to Devaluation: Two Lags

Noimnal Effective Exchange Rate

Real Effective Exchange Rate

Real GDP

Consumption

Baseline
Two Lags
Dynamic Response of the Exchange Rate

Nominal Effective Exchange Rate

Real Effective Exchange Rate

Nominal Exchange Rate to USD
INVESTMENT AND NET EXPORTS

![Graphs showing the trends in Investment, Net Exports, Exports, and Imports over time.](image-url)
**Dynamic Response to Depreciation**

- **Nominal Interest Rate**
- **CPI**
- **Real Interest Rate**
- **Terms of Trade**

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Consequences of Exchange Rate Depreciations

April 2023
ROBUSTNESS: NO CONTROLS (EXCEPT FOR FE)
Robustness: Two lags

Change from Baseline: Two lags of controls, instead of one.
**Robustness: Drop Top and Bottom 1%**

Change from Baseline: Drop top and bottom 1% of outcome.
CLASSIFY 9-12 AS FLOATS

Change from Baseline: Classify 3 as Floats.
Classify 9-12 as Pegs

Change from Baseline: Classify 3 as Pegs.
GDP-weighted USD Exchange Rate

Change from Baseline: GDP weighted U.S. Dollar Exchange Rate

Nominal Effective Exchange Rate

Real Effective Exchange Rate

GDP

Consumption

Investment

Net Exports

Nominal Interest Rate

CPI

Terms of Trade

Change from Baseline: GDP weighted U.S. Dollar Exchange Rate
Change from Baseline: Control Peg X Commodity Price Change

Nominal Effective Exchange Rate

Real Effective Exchange Rate

GDP

Consumption

Investment

Net Exports

Nominal Interest Rate

CPI

Terms of Trade

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Consequences of Exchange Rate Depreciations
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NON-MISSING OBS. FOR ALL VARIABLES

Change from Baseline: Non-missing for all variables

Nominal Effective Exchange Rate

Real Effective Exchange Rate

GDP

Consumption

Investment

Net Exports

Nominal Interest Rate

CPI

Terms of Trade

Back
Include 24 “Advanced” Economies
Households maximize

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t [u(C_{it} - hC_{it-1}) - \chi(n_{it})]$$

where

$$u(C_{it} - hC_{it-1}) = \frac{(C_{it} - hC_{it-1})^{1-\sigma}}{1-\sigma}$$

$$\chi(n_{it}) = \frac{n_{it}^{1+\nu}}{1+\nu}$$

and

$$C_{it} = \left( (1-\alpha)^{1/\eta} (c_{iit})^{\eta-1/\eta} + \alpha^{1/\eta} \int_0^1 (c_{jit})^{\eta-1/\eta} dj \right)^{\eta/(\eta-1)},$$

and $c_{jit}$ is a CES basket with elasticity of substitution $\epsilon_\rho > 1$.
**Labor Unions and Sticky Wages**

- Households supply labor through a continuum of unions which differentiate $n_{it}$ into specialized types $N_{it}(\ell)$.
- These enter firm production function through CES basket

$$N_{it} = \left( \int_0^1 \left( N_{it}(\ell) \right)^{\frac{1}{\epsilon_w}} d\ell \right)^{\frac{\epsilon_w}{\epsilon_w - 1}}$$

- Firm cost minimization yields

$$N_{it}(\ell) = \left( \frac{W_{it}(\ell)}{W_{it}} \right)^{-\epsilon_w} N_{it}, \quad \text{where} \quad W_{it} = \left( \int_0^1 W_{it}(\ell)^{1-\epsilon_w} d\ell \right)^{1/(1-\epsilon_w)}$$

- Labor unions choose wage $W_{it}(\ell)$ to maximize household utility. Can reoptimize wage with probability $1 - \delta_w$. 
Two types of firms: production and price-setting

Production firms produce country-specific good and sell it in a competitive country-specific wholesale market at price $p_{it}^{mc}$

Production function:

$$Y_{it} = A_{it}(K_{it}^{\kappa} N_{it}^{1-\kappa})^{1-\omega} X_{it}^\omega,$$

Productivity:

$$\ln A_{it} = \rho^A \ln A_{it-1} + \epsilon^A_{it}$$

Capital:

$$K_{it+1} = K_{it}(1 - \delta_k) + I_{it}$$

$I_{it}$ and $X_{it}$ are same basket as $C_{it}$
Production firms own a diversified portfolio of price-setting firms and face investment adjustment costs:

\[ S\left(\frac{I_{it}}{I_{it-1}}\right) = \frac{\phi_I}{2} \left(\frac{I_{it}}{I_{it-1}} - 1\right)^2 \]

They maximize the value of their real earnings:

\[ D_{it} = \frac{1}{P_{it}} \left[ p_{it}^{mc} Y_{it} - P_{it} I_{it} \left(1 + S\left(\frac{I_{it}}{I_{it-1}}\right)\right) - W_{it} N_{it} - P_{it} X_{it} + \Pi^p_{it}\right] \]
Price-setting firms purchase local goods at price $p_{it}^{mc}(1 - \tau^p_i)$

They differentiate them and sell their brand/variety as a monopolist.

They sell both domestically and abroad.

They price in local currency (LCP).

They reoptimize prices with probability $1 - \delta_p$. 
Central banks in US and F follow an interest rate rule:

\[ \ln(1 + i_{jt}) = \ln R + \rho^m \ln(1 + i_{jt-1}) + (1 - \rho^m) \phi \pi \pi_{jt} + \epsilon_{jt}^m \]

for \( j \in \{F, U\} \)

Central bank in P fix nominal exchange rate to US dollar:

\[ E_{jUt} = \bar{E}_{jU} \]

for \( j \in P \)
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
<th>Notes &amp; Targets</th>
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</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>Discount factor</td>
<td>0.96</td>
<td>Annual interest rate 4%</td>
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<tr>
<td>$1/\sigma$</td>
<td>EIS</td>
<td>1</td>
<td>Standard</td>
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<tr>
<td>$1/\nu$</td>
<td>Frisch elasticity</td>
<td>0.5</td>
<td>Standard</td>
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<tr>
<td>$\omega$</td>
<td>Intermediate inputs share</td>
<td>0.5</td>
<td>Itskhoki-Mukhin (2021)</td>
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<tr>
<td>$\alpha$</td>
<td>Openness</td>
<td>0.2</td>
<td>Imports-to-GDP ratio 40%</td>
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<tr>
<td>$\kappa$</td>
<td>Capital share in value-added</td>
<td>0.43</td>
<td>Investment-to-GDP ratio 22%</td>
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<tr>
<td>$\delta$</td>
<td>Capital depreciation rate</td>
<td>0.04</td>
<td>Penn World Table 10.0</td>
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<td>$\phi_I$</td>
<td>Investment adjustment cost</td>
<td>2.5</td>
<td>Christiano et al. (2005)</td>
</tr>
<tr>
<td>$\phi_\pi$</td>
<td>Taylor coefficient</td>
<td>1.5</td>
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<tr>
<td>$\rho_m$</td>
<td>Monetary policy inertia</td>
<td>0.43</td>
<td>Smets-Wouters (2007)</td>
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<tr>
<td>$\eta$</td>
<td>Trade elasticity</td>
<td>1.5</td>
<td>Standard</td>
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<td>$\bar{s}$</td>
<td>Foreign currency assets &amp; liabilities</td>
<td>0.52</td>
<td>Benetrix et al. (2015)</td>
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<tr>
<td>$\rho$</td>
<td>Shock persistence</td>
<td>0.89</td>
<td>Itskhoki-Mukhin (2021)</td>
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<td>${\theta_{ij}^k}$</td>
<td>Pricing regime</td>
<td>LCP</td>
<td>Itskhoki-Mukhin (2021)</td>
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<tr>
<td>$\Gamma$</td>
<td>Bond demand inverse elasticity</td>
<td>0.001</td>
<td>Itskhoki-Mukhin (2021)</td>
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**Estimated Parameters**

<table>
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<th>Parameter</th>
<th>Description</th>
<th>Value</th>
<th>Standard error</th>
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<tr>
<td>$\kappa_p$</td>
<td>Price Phillips curve slope</td>
<td>0.024</td>
<td>(0.006)</td>
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<tr>
<td>$\kappa_w$</td>
<td>Wage Phillips curve slope</td>
<td>0.010</td>
<td>(0.003)</td>
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<td>$h$</td>
<td>Habit</td>
<td>0.819</td>
<td>(0.039)</td>
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RESPONSE TO US DOLLAR UIP SHOCK

Investment

Exports

Imports

Terms of Trade

Inflation

Real Interest Rate

% of s.s. GDP

% of s.s. GDP

% of s.s. GDP

% deviation from s.s.

% deviation from s.s.

p.p. deviation from s.s.

p.p. deviation from s.s.

Years

Years

Years

Years

Years

Years

Years

Years

Years

Years

Years

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Consequences of Exchange Rate Depreciations

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**Half Nominal Rigidity**

![Graphs of various economic indicators](image)

- **Nominal Exchange Rate**: Shows the percentage deviation from steady state over years, distinguishing between baseline and half wage/price stickiness scenarios.
- **Real Exchange Rate**: Similar to the nominal exchange rate but with a focus on real values.
- **GDP**: Represents the percentage of steady-state GDP over years.
- **Inflation**: Displays p.p. deviation from steady state over years.
- **Nominal Interest Rate**: Includes the percentage deviation from steady state over years.
- **Real Interest Rate**: Also shows p.p. deviation from steady state over years.

These graphs illustrate the effects of exchange rate depreciations on various economic indicators, highlighting the differences between baseline and half wage/price stickiness scenarios.
DCP AND PCP

Net Exports

Terms of Trade

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April 2023
Tradable and Non-tradable Sectors

- **Nominal Exchange Rate**
- **Real Exchange Rate**
- **GDP**
- **Net Exports**
- ** Tradable GDP**
- **Non-tradable GDP**

Yearly data showing % deviation from s.s. and % of s.s. GDP.
Hand-to-Mouth Agents

Nominal Exchange Rate

Real Exchange Rate

GDP

Years
% deviation from s.s.
Nominal Exchange Rate
Hand to Mouth
Baseline

Years
% deviation from s.s.
Real Exchange Rate

Years
% of s.s. GDP
GDP

Years
% of s.s. GDP
Consumption

Years
% of s.s. GDP
Investment

Years
% of s.s. GDP
Net Exports
CORRELATION OF RER AND NET EXPORTS

Country Size and Corr(ΔRER, ΔNX)

Mean Log Real GDP

Corr(ΔRER, ΔNX)

-0.2
0
0.2
0.4
0.6
20 22 24 26 28
RER and Exports/Imports

USA

JPN

GBR

CAN

FRA

DEU

ITA

RUS

Back

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