EXCHANGE RATE REGIMES

Emi Nakamura    Jón Steinsson

Columbia

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**Key Questions**

- Theoretical arguments for floating versus pegging
- What do countries do? 
  (Ilzetzki-Reinhart-Rogoff 17, Reinhart-Rogoff 04)
- Does it matter? What can be learned from it? 
  (Baxter-Stockman 89, Broda 04, Krugman 89, Mussa 86)
Exchange Rate Regimes
A Very Short History
EXCHANGE RATES IN THE 18TH AND 19TH CENTURIES

The dominant monetary arrangement in the 18th and 19th centuries was a spicie standard (e.g. gold or silver standard)

A specie standard is essentially a fixed exchange rate regime
  - Exchange rate pegged to specie rather than some other currency
  - Also typically involves lower legal limit on reserves

Gold standard therefore vulnerable to speculative attacks
  - Credibility of commitment to gold standard important
  - Countries would suspend convertability during major wars
**Downfall of International Gold Standard**

- All countries (except US) went off gold in WWI
- International gold standard resurrected in 1920’s
  - But much weaker than before
  - Rise of left wing politics had eroded political support
    and international cooperation was lacking (Eichengreen 92)
- Inter-war gold standard collapsed in the Great Depression
  - Great Depression may have been caused by France hoarding gold
    i.e., not playing by the “rules of the game”
  - Countries that left gold standard earlier suffered less in
    depression (Eichengreen and Sachs 85)
**Bretton Woods**

- After WWII new system of fixed exchange rates
  - US Dollar pegged to gold
  - Other currencies pegged to US dollar
- Not really a gold standard
  - Severe restrictions on gold trade by citizens
- Why the emphasis on fixed exchange rates?
  - See Nurkse 44, 45 for thinking of the time
- Friedman 53: famous case for flexible exchange rates
**Modern Era**

- Bretton Woods system collapses in early 1970s
- Since then free float among major currencies (e.g., USD, GBP, DEM/EUR, JPY, SWF)
- Smaller countries have frequently pegged to bigger countries
  - European Exchange Rate Mechanism
  - Asian countries pegged to US dollar
- Currency crises have been common
The Theoretical Cases for Floating and Fixing
Suppose economy is hit by increase in money demand
Classic Case for Fixed Exchange Rates
Mundell (1968), Poole (1970)

- Suppose economy is hit by increase in money demand
- Flexible rates:
  - Shock leads to appreciation which reduces output
- Fixed rate:
  - Central bank must sell money for FX to prevent appreciation
  - This insulates economy from shock
Classic Case for Fixed Exchange Rates

Mundell (1968), Poole (1970)

- Suppose economy is hit by increase in money demand
  - Flexible rates:
    - Shock leads to appreciation which reduces output
  - Fixed rate:
    - Central bank must sell money for FX to prevent appreciation
    - This insulates economy from shock
- Presumes floating monetary policy fixes money supply
- Interest rate rule takes care of this
Real country specific shocks call for relative price changes

How to achieve these?

- All prices in the economy can change
- The exchange rate can adjust

With sticky prices, exchange rate adjustment is much easier
At least in the modern world, internal prices are highly inflexible ... an incipient deficit that is countered by a policy of permitting or forcing prices to decline is likely to produce unemployment ... unemployment produces steady downward pressure on prices and wages, and the adjustment will not have been completed until the deflation has run its sorry course.
The argument for a flexible exchange rate is...very nearly identical with the argument for daylight savings time. Isn’t it absurd to change the clock in summer when exactly the same result could be achieved by having each individual change his habits? All that is required is that everyone decide to come to his office an hour earlier, have lunch an hour earlier, etc. But obviously it is much simpler to change the clock....The situation is exactly the same in the exchange market.
Friedman’s argument relies on exchange rate changes affecting relative prices across countries.

But empirically exchange rate pass-through is limited.
(Campa-Goldberg 05, Gopinath-Itskhoki-Rigobon 10, Nakamura-Steinsson 12)
Friedman’s argument relies on exchange rate changes affecting relative prices across countries.

But empirically exchange rate pass-through is limited (Campa-Goldberg 05, Gopinath-Itskhoki-Rigobon 10, Nakamura-Steinsson 12).

Limits expenditure switching benefits of exchange rate flexibility.

In this case exchange rate flexibility leads to inefficient deviations from law or one price.

See: Devereux-Engel 03, Corsetti-Dedola-Leduc 11.
EXCHANGE RATE INSTABILITY:

- Keynes, Nurkse argued in 1940s that flexible exchange rates would yield instability.
- Friedman argued that speculators would stabilize exchange rates.
  - Profitable to buy low and sell high.
**Exchange Rate Instability:**

- Keynes, Nurkse argued in 1940s that flexible exchange rates would yield instability
- Friedman argued that speculators would stabilize exchange rates
  - Profitable to buy low and sell high
- Exchange rate instability of post-Bretton Woods era, arguably, vindicated Keynes and Nurkse on this point
A credible fixed exchange rate can replace bad domestic monetary policy with good foreign monetary policy.

But fixed exchange rates are typically imperfectly credible:
- Subject to runs and crises
- These crises are costly
Exchange Rate Arrangements
What Do Countries Do?
Goal of the Paper:

- Document exchange rate arrangements for 194 countries over period 1946-2016
- Follow up on Reinhart and Rogoff (2004):
  - Improves on choice of anchor country
  - Adds more countries and longer sample period
- Document capital account restrictions
 HISTORY OF FX REGIME CLASSIFICATION

IMF used to classify exchange rate regimes according to official government statements (de jure classification)
- Many supposedly fixed rates often adjusted
- Some supposedly flexible rates heavily managed

De facto classifications:
- Shambaugh (2004): Based on exchange rate variability
- Levy Yeyati and Sturzenegger (2005): Based on exchange rate variability and behavior of reserves
- Reinhart and Rogoff (2004): Based on exchange rate variability incorporating parallel FX markets and country chronologies

IMF has since moved to de facto classification
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IMF has since moved to de facto classification
Table 1: Coherence of Methodologies to Code Exchange Rate Regimes

<table>
<thead>
<tr>
<th></th>
<th>IMF</th>
<th>Levy-Yeyati &amp; Sturzenegger</th>
<th>Reinhart &amp; Rogoff</th>
<th>Shambaugh</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMF</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levy-Yeyati and Sturzenegger</td>
<td>59%</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinhart and Rogoff</td>
<td>59%</td>
<td>55%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Shambaugh</td>
<td>68%</td>
<td>65%</td>
<td>65%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Notes: Taken from table 3.3 of Klein and Shambaugh (2010). Entries are percentages of observations where different methodologies agree. All classifications are collapsed to three categories: pegged, intermediate, and floating.

Source: Rose (2011)
IMPORTANCE OF PARALLEL FX MARKETS

The IMF classification has been simplified into what it was back in the days of Bretton Woods —namely, Pegs and Other. The dark portions of the bars represent cases with unified exchange rates, and the lightly shaded portion of each bar represents cases with dual or multiple exchange rates. In the early 1970s, accounting for over 90 percent of all exchange rate arrangements, over half of these “pegs” masked parallel markets that, as we shall show, often exhibited quite different behavior.

Source: Reinhart and Rogoff (2004)
Importance of Parallel FX Markets

- Parallel FX markets the norm in Europe in the 40’s and 50’s
- Restoration of convertibility occurred in Europe in 1958
- Parallel FX market common in less developed countries
**Importance of Parallel FX Markets**

- Parallel FX markets the norm in Europe in the 40’s and 50’s
- Restoration of convertibility occurred in Europe in 1958
- Parallel FX market common in less developed countries

- Parallel FX market better barometer of monetary policy
  - When monetary policy is too loose to maintain peg, parallel rate will start depreciating
FIGURE II

Official Exchange Rates Typically Validate the Changes in the Market Rates

Sources: PickandSédillot [1971]; International Currency Analysis, WorldCurrency Yearbook, various issues.

Source: Reinhart and Rogoff (2004)
II.C. How Important Are Parallel Markets?

There are cases where the parallel (or secondary) exchange rate applies only to a few limited transactions. An example is the “switch pound” in the United Kingdom during September 1950 through April 1967.

However, it is not unusual for dual or parallel markets (legal or otherwise) to account for the lion’s share of... Second, we develop a quantitative measure of the potential size of the leakages into dual or parallel exchange markets.

9. For example, while the United Kingdom of officially had dual rates through April 1967, the secondary rate was so...

Source: Reinhart and Rogoff (2004)

### TABLE II

**Inflation, Official and Market-Determined Exchange Rates: Country-by-Country Pairwise Correlations**

<table>
<thead>
<tr>
<th>Percent of countries for which the correlations of:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The market-determined exchange rate and inflation are higher than the correlations of the official rate and inflation</td>
<td>73.7</td>
</tr>
<tr>
<td>The market-determined exchange rate and inflation are lower than the correlations of the official rate and inflation</td>
<td>26.3</td>
</tr>
</tbody>
</table>

*Sources: International Monetary Fund, International Financial Statistics, Pick’s Currency Yearbook, World Currency Report, Pick’s Black Market Yearbook, and the authors’ calculations. The correlations reported are those of the twelve-month percent change in the consumer price index with the twelve-month percent change in the relevant bilateral exchange rate lagged six months.*
Even with this refinement, there remain 11 episodes whose anchor remains unclassified based on exchange rate behavior alone. Table 1 lists these cases and how, using supplementary information we were able to allocate these to a currency bloc. We use four separate criteria to assign a reference currency to these countries. First, in which currency is the majority of foreign trade invoiced? Second, in which currency is the largest share of external (public and publically guaranteed) debt denominated? Third, which currency comprises the largest share of central bank foreign reserves? And finally, which was the most recent anchor currency? Conveniently, all four indicators point to the same reference currency in all countries in the table. As Table 1 highlights, nearly all these cases are a recent phenomenon, beginning in the early 2000s and accelerating during the global financial crisis. The last column summarizes the Freely Floating? No Anchor, Managed Float? Anchor Determined by ER Variability, and Other Criteria: Anchor Classified.

Source: Ilzetzki, Reinhart, and Rogoff (2017)
Table 1: Classifying the Unclassified Anchors with Supplementary Indicators

<table>
<thead>
<tr>
<th>Country (anchor)</th>
<th>Years</th>
<th>Fine ERA Classification</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil (USD)</td>
<td>2001-</td>
<td>12</td>
<td>94% of exports and 84% of imports in USD. 90% of PPG debt in USD. Anchored to USD before the 2000s.</td>
</tr>
<tr>
<td>Canada (USD)</td>
<td>2001-</td>
<td>12</td>
<td>70% of exports and 75% of imports in USD. Debt in domestic currency. Most recently anchored to USD.</td>
</tr>
<tr>
<td>Chile (USD)</td>
<td>2008-</td>
<td>12</td>
<td>No data available on invoicing, but given the large share of copper in exports and the denomination of international copper prices in USD, the lion share of exports are likely denominated in USD. Algorithm anchors the CLP to the USD as recently as 2008.</td>
</tr>
<tr>
<td>Colombia (USD)</td>
<td>2008-</td>
<td>12</td>
<td>Close to 100% of invoicing in USD and close to 100% of public debt in USD. Algorithm classifies a dollar anchor as recently as 2008.</td>
</tr>
<tr>
<td>Iceland (USD)</td>
<td>2001-</td>
<td>10</td>
<td>Very diversified invoicing between USD, GBP and EUR, but with USD the largest share. Central bank FX reserves diversified with USD the largest close to 50%.</td>
</tr>
<tr>
<td>India (USD)</td>
<td>2012-</td>
<td>10</td>
<td>86% of exports and 80% of imports in USD. 80% PPG debt in USD.</td>
</tr>
<tr>
<td>Israel (USD)</td>
<td>2005-</td>
<td>10</td>
<td>Approximately 70% of exports and imports denominated in USD. Over 60% of Bank of Israel reserves in USD. Most recently anchored to the USD.</td>
</tr>
<tr>
<td>Korea (USD)</td>
<td>1999-</td>
<td>12</td>
<td>Anchored to the USD in the 1990s. Other data unavailable.</td>
</tr>
<tr>
<td>Latvia (EUR)</td>
<td>1998-2001</td>
<td>10</td>
<td>Diversified invoicing, with EUR the majority at approximately 50% of imports and exports. The country was in transition to joining the Eurozone.</td>
</tr>
<tr>
<td>Turkey (USD)</td>
<td>1998-2000 and 12 (from 2003)</td>
<td>10</td>
<td>Diversified invoicing with the majority in USD. Foreign currency public debt is 60% in USD and 40% in EUR.</td>
</tr>
<tr>
<td>Uruguay (USD)</td>
<td>2009-</td>
<td>10</td>
<td>Anchored to the USD until the late 2000s. Other data unavailable.</td>
</tr>
</tbody>
</table>

Source: Ilzetzki, Reinhart, and Rogoff (2017)
Anchor Currency Classification

- Classification of anchor and exchange rate regime somewhat intertwined
- Freely floating: No anchor
- Relatively fixed: Based on FX volatility
- Managed float:
  - Calculate one-year moving average of monthly absolute change in exchange rate with respect to all candidate anchors (USD, EUR, JPY, GBP, AUD, CNY)
  - Smallest movements with respect to single anchor more than 50% of time linked to that anchor
  - If not, treated separately
Figure 3. The Geography of Anchor Currencies, 1950 and 2015

1950

Source: Ilzetzki, Reinhart, and Rogoff (2017)
2015

Source: Ilzetzki, Reinhart, and Rogoff (2017)
E VOLUTION O F A NCHOR CURRENCIES

- Large shift towards USD as anchor
- Emergence of DEM/EUR as anchor

Several waves:
- Dismantling of the GBP zone
- Breakdown of Bretton Woods leads to emergence of DEM/EUR
- Collapse of the Soviet Union
Figure 4 Post-World War II Major Anchor Currencies
Share of countries, 1946-2015, excludes freely falling cases

Number of countries weighted by their share in world GDP, 1950-2015, excludes freely falling cases

Note: The Country Chronologies that supplement this paper show the evolution of the anchor currency on a country-by-country basis.

Source: Ilzetzki, Reinhart, and Rogoff (2017)
Exchange Rate Classification

Two classifications:
- Fine: 15 categories
- Course: 6 categories
The fine classification codes are:

1. No separate legal tender or currency union
2. Pre announced peg or currency board arrangement
3. Pre announced horizontal band that is narrower than or equal to +/-2%
4. De facto peg
5. Pre announced crawling peg; de facto moving band narrower than or equal to +/-1%
6. 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%
7. De facto crawling peg
8. De facto crawling band that is narrower than or equal to +/-2%
9. Pre announced crawling band that is wider than or equal to +/-2%
10. De facto crawling band that is narrower than or equal to +/-5%
11. Moving band that is narrower than or equal to +/-2% (i.e., allows for both appreciation and depreciation over time)
12. De facto moving band +/-5%/ Managed floating
13. Freely floating
14. Freely falling
15. Dual market in which parallel market data is missing.

Source: Ilzetzki, Reinhart, and Rogoff (2017)
<table>
<thead>
<tr>
<th>Code</th>
<th>Fine Classification</th>
<th>Coarse Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No separate legal tender</td>
<td>1. No separate legal tender</td>
</tr>
<tr>
<td>2</td>
<td>Pre announced peg or currency board arrangement</td>
<td>1. Pre announced peg or currency board arrangement</td>
</tr>
<tr>
<td>3</td>
<td>Pre announced horizontal band that is narrower than or equal to +/-2%</td>
<td>1. Pre announced horizontal band that is narrower than or equal to +/-2%</td>
</tr>
<tr>
<td>4</td>
<td>De facto peg</td>
<td>1. De facto peg</td>
</tr>
<tr>
<td>5</td>
<td>Pre announced crawling peg</td>
<td>2. Pre announced crawling peg</td>
</tr>
<tr>
<td>6</td>
<td>Pre announced crawling band that is narrower than or equal to +/-2%</td>
<td>2. Pre announced crawling band that is narrower than or equal to +/-2%</td>
</tr>
<tr>
<td>7</td>
<td>De facto crawling peg</td>
<td>2. De facto crawling peg</td>
</tr>
<tr>
<td>8</td>
<td>De facto crawling band that is narrower than or equal to +/-2%</td>
<td>2. De facto crawling band that is narrower than or equal to +/-2%</td>
</tr>
<tr>
<td>9</td>
<td>Pre announced crawling band that is wider than or equal to +/-2%</td>
<td>3. Pre announced crawling band that is wider than or equal to +/-2%</td>
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<td>Moving band that is narrower than or equal to +/-2% (i.e., allows for both appreciation and depreciation over time)</td>
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<tr>
<td>12</td>
<td>Managed floating</td>
<td>3. Managed floating</td>
</tr>
<tr>
<td>13</td>
<td>Freely floating</td>
<td>4. Freely floating</td>
</tr>
<tr>
<td>14</td>
<td>Freely falling</td>
<td>5. Freely falling</td>
</tr>
<tr>
<td>15</td>
<td>Dual market in which parallel market data is missing.</td>
<td>6. Dual market in which parallel market data is missing.</td>
</tr>
</tbody>
</table>

Source: Ilzetzki, Reinhart, and Rogoff (2017)
Exchange rate behavior examined to verify official announcements.
Figure 2. Exchange Rate Arrangement Classification Algorithm

Sequence and general scheme

Statistical tests

\[ \varepsilon_{t,n} = |\Delta s_{t,n}| \text{ in monthly frequency} \]

\[ \varepsilon_{t,n} = 0 \text{ for } 4 \text{ consecutive months?} \]

Yes \quad \text{Peg}

No

\[ P(\varepsilon_{t,n} < 2\%) > 80\% \text{ w/in 5 year rolling window} \]

Yes \quad \text{Narrow band}

No

Freely floating index:

\[ E\{\varepsilon_{t,n}\}/P(\varepsilon_{t,n} < 1\%) \text{ w/in 5 year rolling window.} \]

Within 99\% CI of bilateral index of reserve currencies?

No \quad \text{Managed Float}

Yes \quad \text{Freely Float}

Source: Ilzetzki, Reinhart, and Rogoff (2017)
Among country-year pairs that are not pegs, bands, or freely falling, IRR want to distinguish between free float and managed float.
Among country-year pairs that are not pegs, bands, or freely falling, IRR want to distinguish between **free float** and **managed float**

Create index: $E[\epsilon_{n,t}] / P(\epsilon_{n,t} < 0.01)$ where $\epsilon_{n,t} = |\Delta s_{n,t}|$

Calculate distribution of index for anchor countries (i.e., for most obviously freely floating exchange rates)
Among country-year pairs that are not pegs, bands, or freely falling, IRR want to distinguish between **free float** and **managed float**

Create index: \( E[\epsilon_{n,t}] / P(\epsilon_{n,t} < 0.01) \)

where \( \epsilon_{n,t} = |\Delta s_{n,t}| \)

Calculate distribution of index for anchor countries (i.e., for most obviously freely floating exchange rates)

If index is within 99% CI, then freely floating

Otherwise managed floating

Much fuller description in Reinhart-Rogoff 04
Euro Zone and Other Currency Unions

- Euro floats. But Euro Zone not single sovereign entity
- IMF categorizes Euro Zone countries as freely floating
Euro Zone and Other Currency Unions

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- IRR place currency unions at the bottom of flexibility spectrum
  - Define exchange rate arrangements at country not currency level
  - Even large countries have small vote share
  - Introduction of Euro should reduce FX flexibility not increase it
**Euro Zone and Other Currency Unions**

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- IMF categorizes Euro Zone countries as freely floating
- IRR place currency unions at the bottom of flexibility spectrum
  - Define exchange rate arrangements at country not currency level
  - Even large countries have small vote share
  - Introduction of Euro should reduce FX flexibility not increase it
- Other currency unions simpler since they usually peg to EUR or USD
Figure 5. The Geography of Exchange Rate Arrangements, 1950 and 2015

1950

Source: Ilzetzki, Reinhart, and Rogoff (2017)
Figure 5. The Geography of Exchange Rate Arrangements, 1950 and 2015


Source: Ilzetzki, Reinhart, and Rogoff (2017)
Figure 7. De Facto Exchange Rate Arrangements, Coarse Classification, 1946-2016: Arrangement Categories as Shares of World GDP

Groups 1 and 2: Less flexibility, primarily nominal exchange rate anchors

Group 1: De jure pegs become rarer but de facto less so.

Group 2: De facto Crawling Bands in developing and emerging markets

Source: Ilzetzki, Reinhart, and Rogoff (2017)
Groups 3 and 4: Flexibility, primarily interest rate, money and most (not all) inflation targeters

Group 4: Freely floating, few but high income

Group 3: Wide bands and managed floating, in some cases in parallel markets

Source: Ilzetzki, Reinhart, and Rogoff (2017)
Groups 5 and 6: Flexibly unstable: Anchorless

Group 6: Lack of convertibility is common

Group 5: Chronic inflation and currency crashes are a significant share

Source: Ilzetzki, Reinhart, and Rogoff (2017)
Theoretical arguments for floating versus pegging

What do countries do?
(Ilzetzki-Reinhart-Rogoff 17, Reinhart-Rogoff 04)

Does it matter? What can be learned from it?
(Baxter-Stockman 89, Broda 04, Krugman 89, Mussa 86)
Exchange Rate Arrangements
Does It Matter?
Does It Matter?

- Conventional wisdom: No it doesn’t!
- Typical citation: Baxter-Stockman 89
Goal of the Paper:

- Are business cycles different under fixed vs. flexible exchange rate regimes?
- Compare pre-1973 to 1973-1986 for set of countries
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- Compare pre-1973 to 1973-1986 for set of countries

Stated conclusion:

*Aside from greater variability of real exchange rates under flexible than pegged nominal exchange-rate systems, we find little evidence of systematic differences in the behavior of macroeconomic aggregates or international trade flows under alternative exchange-rate systems.*
Fig. 1. Standard deviation of industrial production (%); linear trend filter.

Source: Baxter and Stockman (1989)
M. Baxter and A.C. Stockman, Business cycles and the exchange rate regime.

Fig. 1. Standard deviation of industrial production (%); linear trend filter.

Fig. 2. Standard deviation of industrial production (%); first difference filter.

Source: Baxter and Stockman (1989)
Fig. 3. Correlation of industrial production with U.S.; linear trend filter.

Source: Baxter and Stockman (1989)
Fig. 4. Correlation of industrial production with U.S.; first difference filter.

Source: Baxter and Stockman (1989)
Fig. 5. Average growth rate of industrial production (%).

Source: Baxter and Stockman (1989)
RESULTS FOR INDUSTRIAL PRODUCTION

- Volatility higher for most countries in flex period
- Correlation of growth with US much lower in flex period
- Average growth much lower in flex period

Nakamura-Steinsson (Columbia)
RESULTS FOR INDUSTRIAL PRODUCTION

- Volatility higher for most countries in flex period
- Correlation of growth with US much lower in flex period
- Average growth much lower in flex period

- Hard to square with stated conclusion!
- But of course this proves nothing about causal effect of money since other things are going on.
Goal of the Paper:

- Do countries with flexible exchange rates react differently to terms of trade shocks from countries with fixed exchange rate.
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- Do countries with flexible exchange rates react differently to terms of trade shocks from countries with fixed exchange rate?

- Traditional theory suggests that flexible exchange rates help countries react to terms of trade shock:
  - Devalue in response to adverse terms of trade shock
  - This increases demand and makes up for adverse consequences of terms of trade shock
Goal of the Paper:

- Do countries with flexible exchange rates react differently to terms of trade shocks from countries with fixed exchange rate?
- Traditional theory suggests that flexible exchange rates help countries react to terms of trade shock:
  - Devalue in response to adverse terms of trade shock.
  - This increases demand and makes up for adverse consequences of terms of trade shock.
- Definition of terms of trade: $tt_{it} = P_{it}^{ex} / P_{it}^{im}$ (in home currency)
Research Design

- Divides countries into fixed, flexible, intermediate regimes ($R_{it}$)
- Runs panel VAR with coefficient different for each regime

\[ A_0 Y_{it} = A(L) Y_{it} + B(L) X_{it} + u_{it} \]

\[ Y_{it} = [\Delta \log tt_{it}, \Delta \log y_{it}, \Delta \log rer_{it}, \Delta \log p_{it}] \]
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- Runs panel VAR with coefficient different for each regime

\[
A_0 Y_{it} = A(L) Y_{it} + B(L) X_{it} + u_{it}
\]

\[
Y_{it} = [\Delta \log tt_{it}, \Delta \log y_{it}, \Delta \log rer_{it}, \Delta \log p_{it}]
\]

- Assumes that terms of trade is exogenous (ordered first in Cholesky decomposition)
- Controls: openness, financial development, change in current account, change in real gov expenditures as share of GDP.
Research Design

- Annual data, four lags, sample period 1973-1996
- 75 developing countries
- Requires $R_{it} = R_{it-1} = R_{it-2}$.
  I.e., drops regime switch years and few years after
- Estimated using seemingly unrelated regressions
Exchange Rate Classification

- de jure IMF classification doesn’t reflect reality
- Why not base a classification purely on volatility of the exchange rate?
  - Stability may mean fix or may mean absence of shocks
**Exchange Rate Classification**

- de jure IMF classification doesn’t reflect reality
- Why not base a classification purely on volatility of the exchange rate?
  - Stability may mean fix or may mean absence of shocks
- Makes use of Ghosh-Gulde-Ostry-Wolf 97 classification
  - Starts with de jure
  - Divides fixers into frequent and infrequent adjusters
  - Distinguish heavily managed floats from other floats
  - Three way classification with intermediate regimes being: pegged frequent adjusters, cooperative arrangements, floats in pre-determined range, heavily managed floaters
or, in the case of basket pegs, in their weights. All other pegs are classified as infrequent adjusters. They also distinguish between heavily managed floats and other types of floats. Also following Ghosh et al. (1997), I adopt a three-way classification of pegged, intermediate and floating regimes. Pegged regimes include countries with single currency pegs, SDR pegs, other official basket pegs and secret basket pegs excluding those classified as frequent adjusters in these categories. The pegged frequent adjusters are included in the intermediate category along with all cooperative arrangements, floats within a pre-determined range and heavily managed floats. The floating category includes other types of managed floats and the independent floats.

Fig. 1 shows the evolution of exchange rate regimes for the 75 developing countries in the sample during the period 1973–1996.

2.1.2. Descriptive statistics


Source: Broda (2004)

Notes: The Exchange Rate Regime Classification is based on Ghosh et al (1997).
Exogeneity of Terms of Trade

- Idea: small countries are price takers in international markets
Idea: small countries are price takers in international markets

Three worries:

- Countries may be large in a particular export (e.g., Chile for copper, Brazil for coffee, Malaysia for rubber, etc.)
- May have pricing power over highly differentiated products
- Home demand shocks would affect terms of trade (through prices or exchange rates)
Some specific exceptions remain, notably, Brazil's iron ore exports and Cote d'Ivoire's cocoa exports. For these cases, it then becomes important to assess the effect of the endogeneity bias in the regression analysis. First, since the paper focuses on the different responses across exchange rate regimes, the bias has to be different across regimes for it to influence the results. The countries in Table 2 cover a broad range of regimes, from fully flexible regimes (Sri Lanka) to fixed regimes (Cote d'Ivoire). Second, if the endogeneity comes from the effects of real GDP on terms of trade, finding positive terms of trade coefficients may become more difficult. Take the case of Brazil's iron exports. A negative supply shock to the production of iron would increase Brazil's terms of trade at the same time that real GDP is falling, inducing a negative correlation between terms of trade and real GDP. As will be shown in Section 4, the data suggests the opposite and, therefore, if anything, the bias makes finding positive and significant coefficients more difficult. Third, if the real exchange rate affects the terms of trade, the direction of the bias would be unclear and would depend on whether a country has monopoly power over the goods they buy or sell.

The above exceptions notwithstanding, Table 3 shows that exports, imports, and the real exchange rate fail to Granger cause the terms of trade in the developing countries.

### Table 2

<table>
<thead>
<tr>
<th>SITC</th>
<th>Good</th>
<th>Country</th>
<th>Good’s X-share in country’s total X</th>
<th>Good’s X-share in world’s total X</th>
</tr>
</thead>
<tbody>
<tr>
<td>71</td>
<td>Coffee and Substitutes</td>
<td>Brazil</td>
<td>5.6</td>
<td>17.71</td>
</tr>
<tr>
<td>281</td>
<td>Iron ore concentrates</td>
<td>Brazil</td>
<td>5.38</td>
<td>29.28</td>
</tr>
<tr>
<td>652</td>
<td>Cotton fabrics, woven</td>
<td>China</td>
<td>2.29</td>
<td>16.41</td>
</tr>
<tr>
<td>658</td>
<td>Textile articles nes</td>
<td>China</td>
<td>1.76</td>
<td>20.51</td>
</tr>
<tr>
<td>831</td>
<td>Travel goods, handbags</td>
<td>China</td>
<td>1.94</td>
<td>27.13</td>
</tr>
<tr>
<td>842</td>
<td>Mens outerwear nonknit</td>
<td>China</td>
<td>3.94</td>
<td>20.3</td>
</tr>
<tr>
<td>843</td>
<td>Womens outerwear nonknit</td>
<td>China</td>
<td>4.79</td>
<td>17.65</td>
</tr>
<tr>
<td>844</td>
<td>Undergarments nonknit</td>
<td>China</td>
<td>1.66</td>
<td>18.34</td>
</tr>
<tr>
<td>848</td>
<td>Headgear, nontxtl clothing</td>
<td>China</td>
<td>1.96</td>
<td>23.52</td>
</tr>
<tr>
<td>851</td>
<td>Footwear</td>
<td>China</td>
<td>4.44</td>
<td>18.41</td>
</tr>
<tr>
<td>894</td>
<td>Toys, sporting goods, etc</td>
<td>China</td>
<td>4.06</td>
<td>19.15</td>
</tr>
<tr>
<td>899</td>
<td>Other manufactured goods</td>
<td>China</td>
<td>1.91</td>
<td>16.38</td>
</tr>
<tr>
<td>72</td>
<td>Cocoa</td>
<td>Cote d’Ivoire</td>
<td>39.92</td>
<td>24.27</td>
</tr>
<tr>
<td>653</td>
<td>Woven man-made fib fabric</td>
<td>Korea</td>
<td>5.58</td>
<td>20.12</td>
</tr>
<tr>
<td>233</td>
<td>Natural rubber, gums</td>
<td>Malaysia</td>
<td>2.06</td>
<td>21.73</td>
</tr>
<tr>
<td>424</td>
<td>Fixed veg oil nonsoft</td>
<td>Malaysia</td>
<td>5.23</td>
<td>47.54</td>
</tr>
<tr>
<td>762</td>
<td>Radio broadcast receivers</td>
<td>Malaysia</td>
<td>4.77</td>
<td>18.74</td>
</tr>
<tr>
<td>271</td>
<td>Fertilizers, crude</td>
<td>Morocco</td>
<td>6.47</td>
<td>22.01</td>
</tr>
<tr>
<td>752</td>
<td>Automatic data proc equip</td>
<td>Singapore</td>
<td>15.9</td>
<td>15.12</td>
</tr>
<tr>
<td>74</td>
<td>Tea and Mate</td>
<td>Sri Lanka</td>
<td>13.06</td>
<td>18.67</td>
</tr>
<tr>
<td>36</td>
<td>Rice</td>
<td>Thailand</td>
<td>3.46</td>
<td>26.54</td>
</tr>
<tr>
<td>37</td>
<td>Fish etc prepd, prsvd nes</td>
<td>Thailand</td>
<td>3.03</td>
<td>18.43</td>
</tr>
<tr>
<td>232</td>
<td>Natural rubber, gums</td>
<td>Thailand</td>
<td>4.06</td>
<td>32.77</td>
</tr>
<tr>
<td>Total</td>
<td>22 Goods</td>
<td>9 Countries</td>
<td>6.23</td>
<td>22.21</td>
</tr>
</tbody>
</table>

Notes: By changing the cutoff line to 5 and 10%, 50 and 39 goods were selected. Source: Handbook of International Trade and Development Statistics (1996–1997), United Nations.

Source: Broda (2004)
of Friedman's predictions, long-run differences across regimes are not significant. Moreover, domestic price responses do not differ significantly and therefore broadly concur with Friedman's predictions.

3.2.2. How important are terms-of-trade shocks?

The main objective of this sub-section is to determine the contribution of terms-of-trade shocks to the actual variance of real GDP, real exchange rates, and prices in developing countries. The contribution of terms of trade is computed by using Fig. 3. Responses to a 10% (PV) permanent fall in TT.

Source: Broda (2004)
**Main Results**

- Output losses larger for fixers
- RER response larger for floaters
- Fixers see deflation, while floaters see inflation
Asymmetry

Are these results different for positive relative to negative shocks?

- Allows for asymmetric responses to positive and negative shocks
- Does this separately for floaters and fixers

Results:

- No asymmetry for fixers
- Asymmetry for floaters
Responses to a 10% (PV) Permanent Positive (dotted line) and Negative (solid line) change in TT under Fixed Regimes

Figure 9: Real GDP Response

Figure 10: RER Response

Source: Broda (2004)
different signs within exchange rate regimes. The additional restrictions imposed on the model result in coefficients that are less robust to specification changes relative to the main empirical model.

The response to positive and negative shocks may be asymmetric within regimes. Under pegs, for example, the stickiness of prices might be larger when prices are required to fall compared with when they have to rise. This would imply that the adjustment to positive shocks should be smoother in terms of output since the change in relative prices are easier to bring about.

Figs. 9 and 10 depict the responses of real GDP and the real exchange rate to a negative (solid line) and positive (dotted line) 10% terms-of-trade change in countries with a fixed exchange rate regime. In pegs, the short-run real GDP response is symmetric across shocks and the real exchange rate response is not significantly different from zero following a positive or negative shock. A Wald test for the null hypothesis that coefficients of the terms-of-trade variable in the real GDP (\(\text{rer}\)) regression are larger (smaller) after negative shocks than after positive shocks is rejected at the 1% level (not reported). These responses suggest that nominal rigidities may not be larger for downward relative to upward movements of the terms of trade.

In countries with flexible regimes, the response to shocks of opposite sign is less symmetric. Fig. 12 shows that the real exchange rate sharply depreciates immediately following a negative shock but barely appreciates after a positive shock. This difference is only significant for the period contemporaneous to the shock. Two years after a positive shock, the real exchange rate has appreciated by 3.9%, which is not significantly different from the 5.7% real depreciation 2 years after a negative shock. The real GDP responses suggest that, after a positive shock, the impact effect on real GDP is larger than after a negative shock (see Fig. 11). The different short-run responses of real GDP and real exchange rate suggests that countries follow a counter-cyclical exchange rate policy when shocks are negative but less so when shocks are positive. The long run responses are not significantly different. For an examination of the significance of these responses, see Table 5.

Source: Broda (2004)
Alternative Research Design

- Hard to interpret results due to possible endogeneity of terms of trade
- Possible instruments:
  - Bartik instrument or sensitivity instrument
  - E.g., Global oil prices times country sensitivity of terms of trade
- Time fixed effects
  - Inclusion would eliminate time series variation
  - Broda focuses on difference, which is similar
Examine Rates and Price Rigidity

Can we infer anything about price rigidity from the behavior of exchange rates?
Can we infer anything about price rigidity from the behavior of exchange rates?

Well, nominal and real exchange rates are highly correlated.
Nominal vs. Real Exchange Rate

Figure 1.3
Nominal versus real exchange rate. □: exchange rate; +: relative price.

Source: Krugman (1989)
This seems straightforward enough. I would leave the subject here and go on to policy issues, except that the state of debate in contemporary economics doesn’t let me. To me, the prima facie case that prices are sticky is overwhelming...For many of my colleagues, however, continuous market clearing and the absence of any money illusion are fundamental tenets, and this obliges them to explain away the appearance of price inflexibility as some kind of optical illusion....

Source: Krugman (1989)
In particular, one now often hears the argument that the kind of evidence I have presented ... has got the causation backwards–that what really happens is that real exchange rates are moving around for real reasons, and the attempt of monetary authorities to stabilize domestic price levels creates the correlation between real and nominal rates.

Source: Krugman (1989)
Mussa Fact

- Do movements in nominal exchange rates (or lack thereof) "cause" movements in the real exchange rate?
- Or vice versa?
- Mussa: Look at discontinuity in the volatility of the real exchange rate at the time of changes in the exchange rate regime
Floating exchange rates extremely volatile

Exchange rate movements seem disconnected from movements of other macro variables
  But evidence on this point is poorly developed
Floating exchange rates extremely volatile

Exchange rate movements seem disconnected from movements of other macro variables
  * But evidence on this point is poorly developed

Krugman: Exchange rates can move so much precisely because they seem to matter so little!
Exchange Rate Disconnect

- Floating exchange rates extremely volatile
- Exchange rate movements seem disconnected from movements of other macro variables
  - But evidence on this point is poorly developed
- Krugman: Exchange rates can move so much precisely because they seem to matter so little!
- We don’t have a good theoretical or empirical handle on this issue!!

Interesting recent paper: Itskhoki and Mukhin (2017)