International Financial Integration
The Effects of Liquidity and Capital Controls

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World Bank

(joint with Eduardo Levy Yeyati and Neeltje Van Horen)

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Outline

1. What we do in the paper
2. Cross-market premium
3. Liquidity
4. Capital controls
5. Conclusion
Outline

- What we do in the paper
- Cross-market premium
- Liquidity
- Capital controls
- Conclusion
1. What we do

- Take advantage of migration of stocks abroad
  - Two identical assets with many advantages
- Price divergence from LOOP as new measure of IFI
- Under full integration, LOOP should hold

- Extent of integration
- Effects of liquidity
  - Trading frequency and trading activity
- Effects of capital controls
  - Controls on outflows
  - Controls on inflows
1. What we do

Structure of the paper

1. Introduction
2. Data
3. Methodology
4. The Cross-Market Premium and Financial Integration
   - AR and TAR Estimates
   - Integration and Liquidity
5. Time-Varying Financial Integration: Capital Controls
   - Capital Controls and the Cross-Market Premium
   - Capital Controls: What and When?
   - Summary Statistics
   - Case Study: Argentina 2000-2007
6. Conclusions
Outline

- What we do in the paper
- Cross-market premium
- Liquidity
- Capital controls
- Conclusion
2. Cross-market premium: Definition

*Cross-market premium*

- Measure of international financial integration
- Law of One Price needs to hold when markets are integrated
- % price difference between their (underlying) shares at home and DRs in NY
- Underlying stock can be transformed into DR and vice versa, so arbitrage pressure when prices diverge
2. Cross-market premium: Definition

**Cross-market premium** Difference between the home market price of the stock and its NY price:

\[ \pi_t = \frac{S_t r P_{t}^{\text{und}} - P_{t}^{\text{dr}}}{P_{t}^{\text{dr}}} \]

- \( \pi_t \) = premium at time \( t \)
- \( S_t \) = spot exchange rate
- \( r \) = number of underlying stocks per DR
- \( P_{t}^{\text{und}} \) = price of underlying stock in local currency
- \( P_{t}^{\text{dr}} \) = price of the DR in NY in U. S. dollars
2. Cross-market premium: Some advantages

- Two truly identical assets, avoiding index composition
- Free from the idiosyncratic risk related to default risk
  - Same issuer, same legal rights
- Market-based measure, no empirical model imposed
- Continuous measure, between complete segmentation and complete integration
- Amenable to the use of TAR models; linear models understate convergence speed
- Avoids potential aggregation bias
2. Cross-market premium: Data

- Analysis
  - 98 stocks
  
2. Argentina
3. Brazil
4. Chile
5. Indonesia
6. Mexico
7. Russia
8. South Africa
9. South Korea
10. Venezuela
2. Cross-market premium: Methodology

1. Summary statistics
   - Mean
   - Median
   - Standard deviation

2. AR estimates
   - Convergence speed

3. TAR estimates
   - No-arbitrage bands
   - Convergence speed
2. Cross-market premium: Methodology

- TAR estimates

\[
\Delta x_t \quad I_{in} \beta_{in} x_{t-1} \quad I_{out} \beta_{out} \Phi x_{t-1}, c \quad \varphi_j \Delta x_{t-j} \quad \varepsilon_t, \\
\sigma_t \quad \alpha_0 \quad \alpha_j \varepsilon_t^2 \quad \lambda_j \sigma_t^2, \\
\Phi x_{t-1}, c_{up} \quad x_{t-1} \quad c_{up} \quad \text{if } x_{t-1} \quad c_{up}, \\
\Phi x_{t-1}, c_{low} \quad x_{t-1} \quad c_{low} \quad \text{if } x_{t-1} \quad c_{low}, \\
c_{up} \quad 0 \quad \text{and } c_{low} \quad 0, \\
I_{out} \quad 1 \quad \text{if } x_{t-1} \quad c_{up} \quad \text{or } x_{t-1} \quad c_{low} ; \quad \text{zero otherwise,} \\
I_{in} \quad 1 \quad \text{if } c_{low} \quad x_{t-1} \quad c_{up} ; \quad \text{zero otherwise.}
\]
2. Cross-market premium

Argentina – No controls
Outline

- What we do in the paper
- Cross-market premium
- Liquidity
- Capital controls
- Conclusion
3. Liquidity
3. Liquidity
3. Liquidity

**Summary statistics**

<table>
<thead>
<tr>
<th>Country</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev.</th>
<th>5th Pctile</th>
<th>95th Pctile</th>
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3. Liquidity

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<th>95th Pctile</th>
<th>Obs.</th>
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<td>0.12</td>
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<td>-0.74</td>
<td>0.96</td>
<td>2,618</td>
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### 3. Liquidity

#### AR estimates

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<th>Country</th>
<th>AR Half-Life</th>
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<td>All Days</td>
<td>Contemporaneous Trading Days</td>
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<td>0.73</td>
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<tr>
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<td>0.77</td>
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<td>1.64</td>
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<tr>
<td>All Stocks</td>
<td>1.54</td>
<td>1.05</td>
<td></td>
</tr>
</tbody>
</table>
3. Liquidity: Liquidity proxies

**All days – AR estimates**

\[ y = -0.27x \]

(-4.74)
3. Liquidity: Liquidity proxies

Contemporaneous trading days – AR estimates

\[ y = -0.11x \]

\[ e(\text{Trading Value}|X) \]

\[ e(\text{Half-Life}|X) \]

\(-3.29\)
3. Liquidity: Liquidity proxies

All days – AR estimates

\[ y = -2.55x \]

\[ e(\text{Trading Frequency}|X) \]

\[ e(\text{Half-Life}|X) \]

\(-5.13\)
3. Liquidity: Liquidity proxies

Contemporaneous trading days – AR estimates

\[ y = -0.53x \]

\[ e(\text{Trading Frequency}|X) \]

\[ e(\text{Half-Life}|X) \]

(-2.19)
## 3. Liquidity: AR vs. TAR

### AR and TAR – Contemporaneous trading

<table>
<thead>
<tr>
<th>Country</th>
<th>AR Half-Life</th>
<th>TAR Thres</th>
<th>TAR Half-Life</th>
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</thead>
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<tr>
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<td>0.73</td>
<td>0.25</td>
<td>0.50</td>
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<tr>
<td>Brazil</td>
<td>0.77</td>
<td>0.24</td>
<td>0.59</td>
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<tr>
<td>Chile</td>
<td>1.07</td>
<td>0.35</td>
<td>0.64</td>
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<tr>
<td>Indonesia</td>
<td>1.64</td>
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<tr>
<td>Korea</td>
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<td>0.22</td>
<td>1.65</td>
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<tr>
<td>Mexico</td>
<td>1.43</td>
<td>0.20</td>
<td>0.63</td>
</tr>
<tr>
<td>Russia</td>
<td>0.89</td>
<td>0.11</td>
<td>0.60</td>
</tr>
<tr>
<td>South Africa</td>
<td>1.06</td>
<td>0.22</td>
<td>0.93</td>
</tr>
<tr>
<td>Venezuela</td>
<td>1.05</td>
<td>0.68</td>
<td>0.91</td>
</tr>
<tr>
<td>All Stocks</td>
<td>1.05</td>
<td>0.26</td>
<td>0.69</td>
</tr>
</tbody>
</table>
3. Liquidity: AR vs. TAR

Non-linearities in the premium

Correlation: 0.36

[0.00]
2. Liquidity: AR vs. TAR

Non-linearities in the premium

Correlation: 0.26

[0.02]
3. Liquidity: Liquidity proxies

\[ y = -0.09x \]

\[ e(\text{Trading Value} | X) \]

\[ e(\text{Threshold} | X) \]

\[ (-3.27) \]
3. Liquidity: Liquidity proxies

Contemporaneous trading days – TAR estimates – Half-life

\[ y = -0.05x \]

\[ e(\text{Trading Value}|X) \]

\[ e(\text{Half-Life}|X) \]

\((-1.82\)
3. Liquidity: Liquidity proxies

All days – TAR estimates – Threshold

\[ y = -2.02x \]

\[ (-2.36) \]
3. Liquidity: Liquidity proxies

Contemporaneous trading days – TAR estimates – Half-life

\[ y = -1.06x \]

\[ (-1.20) \]
Outline

- What we do in the paper
- Cross-market premium
- Liquidity
- Capital controls
- Conclusion
4. Capital controls

- Capital controls increase transaction costs

- Controls on outflows: positive premium
  - Arbitrage not possible when local price > NY price
  - Arbitrage possible when NY price > local price

- Controls on inflows: negative premium
  - Arbitrage not possible when NY price > local price
  - Arbitrage possible when local price > NY price

- Cross-market premium measures effective intensity of controls
  - More capital flows, larger premium
4. Capital controls

Control on outflows

Venezuela
4. Capital controls

Control on outflows
South Africa
4. Capital controls

Control on inflows
Chile
4. Capital controls

Controls on inflows

Korea (South) - Restricted Stocks

Medium

Low
4. Capital controls

Controls on inflows
South Korea – Unrestricted stocks
4. Capital controls

Controls on outflows

Argentina
4. Capital controls

Controls on foreign ownership

Indonesia
4. Capital controls

No controls
Brazil
4. Capital controls

![No controls](chart)

**Mexico**
4. Capital controls

No controls
Russia
4. Capital controls

- AR estimates

\[
\begin{align*}
    x_t &= \alpha_0 + \alpha_1 D_{cont} + \beta x_{t-1} + \beta_{cont} x_{t-1} D_{cont} + \sum_{k=1}^{k} \varphi_{j} \Delta x_{t-j} + \varphi_{cont,j} \Delta x_{t-j} D_{cont} + \varepsilon_t, \\
    \sigma_t^2 &= \alpha_0 \exp \lambda D_{cont} + \sum_{j=1}^{p} \alpha_{j} \varepsilon_t^2 + \sum_{j=1}^{q} \lambda_{j} \sigma_t^2.
\end{align*}
\]
The table compares the summary statistics of the cross-market premium over no control and control periods for the subsample of countries that experienced a period of capital controls. The cross-market premium is defined as the percentage difference between the dollar price of the stock in the domestic market and the price of the corresponding DR in New York. The countries' summary statistics are based on the simple average of the cross-market premium of the stocks in each country's portfolio. The pooled data contain these country averages. In the case of Korea, the summary statistics for the tranquil period are derived from the average cross-market premium of the unrestricted stocks and the ones for the different control periods are derived from the average cross-market premium of the restricted stocks. For Korea, three control periods are distinguished: the first period of high restrictions lasts until January 1999, the second period of intermediate restrictions extends from January 1999 to November 2000, and the third period of low restrictions covers November 2001 onwards (see main text and Appendix Table 3). ***, **, and * indicate whether the mean is statistically different from the mean in the tranquil period at one, five, or ten percent significance level, respectively.

<table>
<thead>
<tr>
<th>Period</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev.</th>
<th>5th Pctile</th>
<th>95th Pctile</th>
<th>Obs.</th>
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<td>13.95</td>
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<td>20.97</td>
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<td>1,963</td>
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</table>
## 4. Capital controls

### Summary statistics By Country

<table>
<thead>
<tr>
<th>Country</th>
<th>Period</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev.</th>
<th>5th Pctile</th>
<th>95th Pctile</th>
<th>Obs.</th>
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<tbody>
<tr>
<td>Argentina</td>
<td>No Control</td>
<td>0.06</td>
<td>0.00</td>
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<td>-0.97</td>
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## 4. Capital controls

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4. Capital controls

Controls on outflows and inflows
Argentina
4. Capital controls

Controls on outflows and inflows
Argentina – Sovereign government bond market
## 4. Capital controls

### Argentina

#### Summary Statistics

<table>
<thead>
<tr>
<th>Country</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev.</th>
<th>5th Pctile</th>
<th>95th Pctile</th>
<th>Obs.</th>
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4. Capital controls

### Argentina

#### AR and TAR Results

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<th>Period</th>
<th>AR Average Half-Life</th>
<th>TAR Average Thres-Up</th>
<th>TAR Average Thres-Low</th>
<th>TAR Average Half-Life</th>
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Outline

- What we do in the paper
- Cross-market premium
- Liquidity
- Capital controls
- Conclusion
5. Conclusion: Summary of results

- Strong financial integration: cross-market premium close to 0, with rapid convergence and narrow bands

- Non-linear models capture well the premium, consistent a no-arbitrage band due to transaction costs
  - Convergence speeds slower under ARs, and the difference in speed proportional to the band-width

- Convergence speed more rapid and no-arbitrage bands narrower, the more liquid a stock is
  - Large companies (liquid stocks) well financially integrated
5. Conclusion: Summary of results

- Capital controls effectively segment stock markets, weakening arbitrage across markets
  - Controls lead to wider bands and more persistent deviations
- In sum, arbitrage works well for liquid companies, fully integrated with the international financial system …
- … but integration disrupted as stocks become less liquid or governments introduce capital controls
5. Conclusion: Policy implications

- Cross-market premium useful measure of IFI
- Capital controls directly reflected in the premium
- The more binding the constraint, the larger the premium
  - Stricter controls
  - More capital flows (given controls)
- Premium shows actual effectiveness of controls
- Controls that don’t segment markets are not reflected
  - Foreign/domestic resident partition immaterial
- No evasion, but tax paid to financial market participants
- No welfare analysis
Thank you!