Shocks vs Structure: Explaining Differences in Exchange Rate Pass-Through Across Countries and Time

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Motivation

• Exchange rate pass-through (ERPT): critical for inflation

• Challenge: Estimating ERPT
  – Well known: varies substantially across countries
  – Less appreciated: can vary substantially over time within a country
  – Can be critically important for forecasting and setting monetary policy
    • Examples: UK & euro
Examples

Key question: how will a given exchange rate movement “pass through” into inflation?


Source: Speech by Benoit Coeuré, 11/09/17
Two Empirical Approaches

• **“Structure”: Dominant approach**
  - Highlights role of relatively stable country characteristics
    - inflation rate & variability, openness, frequency of price adjustments, nominal rigidities, foreign currency invoicing, central bank credibility, monopoly power
  - Yields “rules of thumb” for ERPT for a country given its characteristics
  - Focus: cross-section dimension (or long time-series)
    - Campa & Goldberg (2005, 2010), Devereux *et al.* (2015), Gopinath (2015), many others....

• **“Shocks”: Less common, increasing interest**
  - Highlights role of different shocks behind ER movement
    - monetary policy vs. demand vs supply vs risk shocks
  - Yields estimates of ERPT that change over short periods of time
  - Focus: time-series dimension (often limited countries)
Our Paper

• Assess relative importance of “shocks” vs. “structural” approaches to ERPT
  – Explaining cross-section variation
  – Explaining time-series variation

• Conclusion: Both “shocks” and “structure” important
  – Structural approach most important in cross-section
  – Shocks equally important—and sometimes more important—in explaining time-series variation

• Estimates of pass-through for forecasts (and monetary policy) should incorporate both the structural and shocks approaches
Today

• Standard, reduced-form estimates of ERPT
• Shock-based methodology & estimates of ERPT
• Estimates of role of “structural” versus “shock” variables:
  – Explaining cross-section dimension
  – Explaining time-series dimension
  – Relative magnitudes
• Conclusions
Today

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Sample

• 3 criteria
  – Flexible exchange rates
    • IMF AREARs, “floating” or “free floating”, ≥10 years
  – Small open economies
    • No significant effect on world export prices (i.e., not US & EA)
  – Data on key variables required for analysis
    • Quarterly data (short-term interest rates, real GDP, etc)

• Final sample: 26 countries
  – 11 “advanced” and 15 “emerging”
  – Maximum time period: 1990-2015
Reduced-Form ERPT

• Standard approach
  • Campa & Goldberg (2005), Burstein & Gopinath (2014), Gopinath (2015)
  • Distributed lag regression (for full sample period & shorter windows):
    \[ p_t = \alpha + \sum_{n=0}^{4} \beta_{t-n} s_{t-n} + \sum_{n=0}^{4} \gamma_{t-n} wxp_{t-n} + \delta \Delta gdp_t + \varepsilon_t \]

  \( p_t \): quarterly log change in domestic CPI
  \( s_t \): quarterly log change in domestic effective exchange rate index
  \( wxp_t \): quarterly log change in trade-weighted index of foreign export prices
  \( \Delta gdp_t \): quarterly log change in domestic GDP

• ERPT: sum of the coefficients on all lags of the exchange rate (\( \sum_{n=0}^{4} \beta_{t-n} \))
  • Usually: time-invariant parameter (historical average)
  • Base case: lags for 4 quarters, OLS with Newey-West standard errors robust to autocorrelation of lags up to 8 quarters
  • 28 variants (controls, lag structures, etc.)
Estimates: Reduced-Form ERPT (Long Sample ERPT)
Estimates: Reduced-Form ERPT
Fixed 6-year windows

ADVANCED ECONOMIES
Estimates: Reduced-Form ERPT
Rolling 6-year windows

SELECTED ADVANCED ECONOMIES

Questions standard rule-of-thumb approach to ERPT!
Today

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SVAR Identification

• Adapt SVAR framework developed in Forbes et al. (2015) for UK
• Same sample of 26 small-open economies, 1990-2015
• Identify 5 domestic and global shocks:
  – domestic supply, domestic demand and domestic monetary policy shocks;
  – global persistent and transitory shocks.
• Identification through a combination of short- and long-run zero restrictions as well as sign restrictions
  – Algorithm based on Rubio-Ramirez et al. (2010) and Binning (2013)
• Bayesian estimation with standard Minnesota priors
Estimates: Shock-Based ERPT
Average & Range Across Countries

8 quarters after ER shock
Shock-Based ERPT

• Estimate role of different shocks in ERPT across countries
  – Monetary policy & demand shocks the greatest weight on average
  – But substantial differences across countries
    • Examples: Iceland and Australia

• Estimate role of different shocks in ERPT across time within countries
  – Changing weights for some countries
    • Examples: Korea & Chile
Role of Different Shocks

Average share of exchange rate forecast error variance (across countries) explained by SVAR shocks
Today

• Standard, reduced-form estimates of ERPT
• Shock-based methodology & estimates of ERPT
• Estimates of role of “structural” versus “shock” variables:
  – Explaining cross-section dimension
  – Explaining time-series dimension
  – Relative magnitudes
• Conclusions
Estimates: Shocks vs. Structure

• Assess role of “structural” variables and “shock” variables in explaining differences in average rates of ERPT across countries
  – 2-stage regression approach with wtd-least squares following Campa & Goldberg (2005)

• “Structural” variables
  – % imports invoiced in foreign currency, ER volatility, π volatility, π rate, EM dummy
  – Trade openness, % differentiated goods, regulation

• “Shock” variables
  – Monetary, demand, supply, global permanent, global transitory
  – Relative weight of demand to monetary shocks

• Results
### Cross-Section: Bivariate Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Significance</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign currency %</td>
<td>0.50*</td>
<td>expected sign &amp; significant (5% level)</td>
<td></td>
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<tr>
<td>ER volatility</td>
<td>4.12*</td>
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<td>π (average)</td>
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<td>π volatility</td>
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<tr>
<td>Less differentiated</td>
<td>0.12</td>
<td>expected sign &amp; not significant</td>
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<tr>
<td>Regulation</td>
<td>0.08*</td>
<td>unexpected sign &amp; significant (5% level)</td>
<td></td>
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<tr>
<td>% demand shock</td>
<td>-0.26</td>
<td>unexpected sign &amp; not significant</td>
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<tr>
<td>% monetary policy</td>
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<td>unexpected sign &amp; not significant</td>
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<tr>
<td>% demand/monetary</td>
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<td>unexpected sign &amp; not significant</td>
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<tr>
<td>% supply shock</td>
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<td>% permanent</td>
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<td>% temporary</td>
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<tr>
<td><strong># observations</strong></td>
<td><strong>18 26 26 26 26 26 26 19 26 26 26 26 26 26</strong></td>
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<tr>
<td><strong>Adjusted-R^2</strong></td>
<td><strong>0.28 0.3 0.44 0.62 0.12 0.05 -0.04 0.23 0.06 -0.03 0.05 -0.02 -0.02 -0.04</strong></td>
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## Cross-Section: Multivariate Results

<table>
<thead>
<tr>
<th>Structure</th>
<th>Foreign currency %</th>
<th>0.06 (0.17)</th>
<th>ER volatility</th>
<th>0.18 (1.18)</th>
<th>π (average)</th>
<th>3.82 (6.82)</th>
<th>π volatility</th>
<th>17.17** (7.70)</th>
<th>23.61*** (3.21)</th>
<th>17.50*** (2.69)</th>
<th>16.74*** (2.77)</th>
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<tr>
<td></td>
<td>Emerging market dummy</td>
<td>(0.08) (0.05)</td>
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<td>Less differentiated goods/imports</td>
<td>0.38* (0.21)</td>
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<td>0.21 (0.21)</td>
<td>0.17 (0.24)</td>
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<td></td>
<td>Regulation</td>
<td>(0.02) (0.02)</td>
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<tr>
<td>Shocks</td>
<td>% monetary policy shock</td>
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<tr>
<td># observations</td>
<td>18 19 26 26</td>
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<td>Adjusted-$R^2$</td>
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## Time Series: Bivariate Results (Fixed 6-year windows)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign currency %</td>
<td>0.95</td>
<td>expected sign &amp; significant (5% level)</td>
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<tr>
<td>ER volatility</td>
<td>1.29*</td>
<td>expected sign &amp; not significant</td>
</tr>
<tr>
<td>π (average)</td>
<td>6.10**</td>
<td>unexpected sign &amp; not significant</td>
</tr>
<tr>
<td>π volatility</td>
<td>12.40**</td>
<td>unexpected sign &amp; significant (5% level)</td>
</tr>
<tr>
<td>Trade openness</td>
<td>0.63*</td>
<td></td>
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<tr>
<td>Less differentiated</td>
<td>0.77*</td>
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<tr>
<td>Regulation</td>
<td>0.00</td>
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<tr>
<td>% demand shock</td>
<td>-0.22*</td>
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<tr>
<td>% monetary policy</td>
<td>0.32**</td>
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<tr>
<td>% demand/monetary</td>
<td>-0.03**</td>
<td></td>
</tr>
<tr>
<td># observations</td>
<td>39 74 74 74 74 76 59 74 74 74</td>
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<td>Adjusted-$R^2$</td>
<td>0.47 0.52 0.53 0.63 0.52 0.52 0.49 0.52 0.55 0.53</td>
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</table>
## Time Series: Multivariate Results

<table>
<thead>
<tr>
<th>Structure</th>
<th>Non-overlapping 6-year windows</th>
<th>Rolling 6-year windows</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>π volatility</strong></td>
<td><strong>Trade openness</strong></td>
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<tr>
<td></td>
<td><strong>Adj. R^2</strong></td>
<td><strong>Adj. R^2</strong></td>
</tr>
<tr>
<td><strong>π volatility</strong></td>
<td>16.65*** (2.69)</td>
<td>16.25*** (2.54)</td>
</tr>
<tr>
<td><strong>Trade openness</strong></td>
<td>1.21*** (0.25)</td>
<td>0.92*** (0.33)</td>
</tr>
<tr>
<td><strong>% demand shock</strong></td>
<td>-0.02 (0.09)</td>
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</tr>
<tr>
<td><strong>% monetary policy</strong></td>
<td>0.15 (0.12)</td>
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</tr>
<tr>
<td><strong>% demand/monetary</strong></td>
<td>-0.02** (0.01)</td>
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<td><strong># observations</strong></td>
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<td>1304 1304 1304</td>
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<tr>
<td><strong>Adjusted-R^2</strong></td>
<td>0.75 0.76 0.77</td>
<td>0.06 0.05 0.03</td>
</tr>
</tbody>
</table>
Shocks vs. Structure: Summary

• Cross-section:
  – Structure variables: generally have expected sign, many significant & magnitudes can be large
  – Shock variables: generally have expected sign, but rarely significant & magnitudes smaller
  – Structural variables explain much of cross-section variation in ERPT, shock variables little

• Time-series:
  – Structure variables: generally have expected sign, but only some significant (\( \pi \) volatility), magnitudes can be large
  – Shock variables: generally have expected signs & usually significant (demand/monetary shocks), magnitudes can be large
  – Shock and structural variables each explain similar share of time-series variation in ERPT
# Shocks vs. Structure: Summary

<table>
<thead>
<tr>
<th></th>
<th>Non-overlapping 6-year windows</th>
<th>Rolling 6-year windows</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>π volatility</strong> (Structure)</td>
<td>12.40*** (2.85)</td>
<td>13.68*** (2.49)</td>
</tr>
<tr>
<td><strong>% monetary policy</strong> (Shock)</td>
<td>0.32*** (0.12)</td>
<td>0.38*** (0.09)</td>
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<tr>
<td><strong>Constant</strong></td>
<td>-0.04 (0.03)</td>
<td>-0.03 (0.04)</td>
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<td><strong># observations</strong></td>
<td>74</td>
<td>74</td>
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<tr>
<td><strong>Degrees of freedom</strong></td>
<td>47</td>
<td>47</td>
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<tr>
<td><strong>Adjusted-R²</strong></td>
<td>0.63</td>
<td>0.55</td>
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Final Thoughts

• Pass-through can vary significantly across time as well as across countries

• To understand ERPT:
  – Structural variables most important to understand cross-country differences in averages over long periods
  – The shock behind the exchange rate movement can be just as important at specific times

• Incorporating both “shocks” and “structure” will improve ability to forecast inflation and set monetary policy
Backup
# SVAR identification

<table>
<thead>
<tr>
<th></th>
<th>Domestic supply shock</th>
<th>Domestic demand shock</th>
<th>Domestic monetary policy shock</th>
<th>Global persistent shock</th>
<th>Global transitory shock</th>
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<tr>
<td><strong>Short-run restrictions</strong></td>
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<tr>
<td>UK GDP</td>
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<td>+</td>
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<tr>
<td>UK CPI</td>
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<td>+</td>
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<td>UK interest rate</td>
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<td>+</td>
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<td>UK nominal ERI</td>
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<td>+</td>
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<td>Foreign export prices</td>
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<td><strong>Long-run restrictions</strong></td>
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<td>UK GDP</td>
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<td>0</td>
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</tbody>
</table>
Different Roles of Different Shocks

Australia

- Global temporary
- Monetary policy
- Supply
- Base level and trend
- Effective exchange rate

Iceland

- Global temporary
- Monetary policy
- Supply
- Base level and trend
- Effective exchange rate
Different Roles of Different Shocks

Forecast error variance decomposition of exchange rate changes, 1990-2015
Changing Weights of Different Shocks

Blue: contribution of demand shock  
Red: contribution of monetary policy shock
Estimates: Shock-Based ERPT
(Long Sample ERPT)