

## **Global House Price Fluctuations: Synchronization and Determinants**

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**Marco E. Terrones** (IMF)

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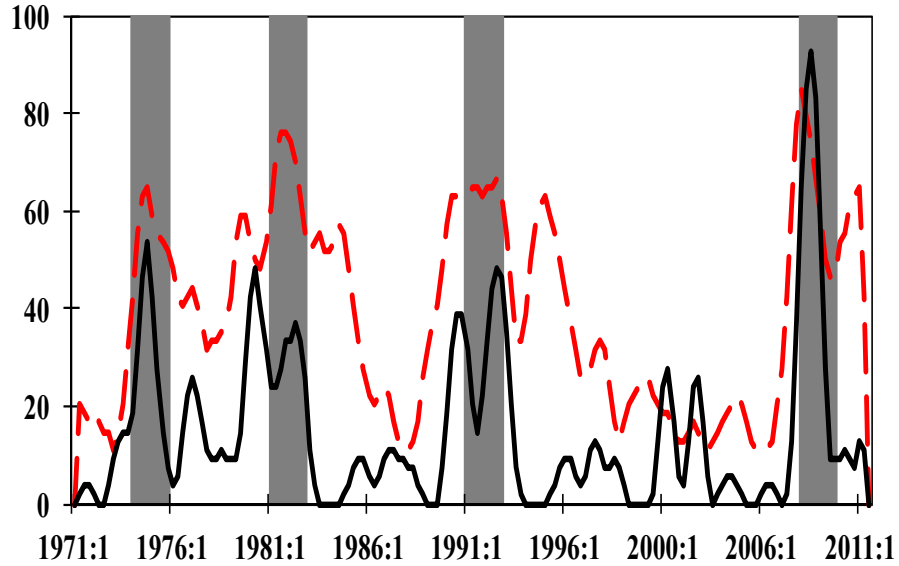
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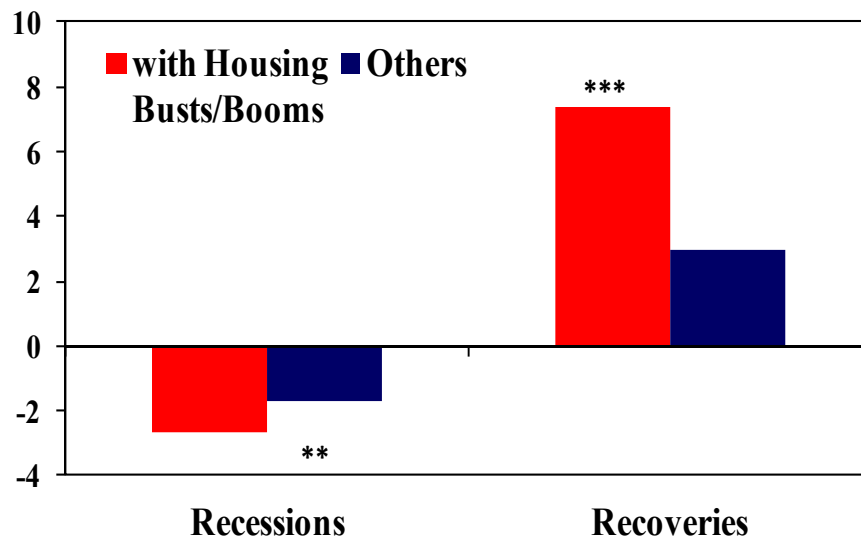
## Coincidence of Housing Downturns and Recessions

*(fraction of countries in recession or housing downturns, in percent)*



## Amplitude of Cycles with Housing Booms/Busts

*(percent decline/increase in GDP during recessions/recoveries)*



## Motivation

- **Synchronized movements in housing markets** appeared to play an important role during the global financial crisis
  - Highly **synchronized housing booms** coincided with strong economic growth prior to the global financial crisis... **Synchronized housing busts** were accompanied by deep recessions and financial disruptions since 2007
- Leading to questions about the extent and determinants of **synchronization in housing markets...**

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## Objective: Two Questions

- How synchronized are housing cycles across countries?
- What are the main shocks driving movements in global house prices?

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## **A Vast Literature...**

- A number of empirical papers on the sources of house price movements at the country level
- Using a number of methodologies, including VAR, FAVAR, GVAR, and Dynamic Factor models
- Employing various identification schemes to evaluate the importance of a wide range of shocks
- And reporting numerous results...

## **Limited Knowledge... Three Major Challenges**

- Treating interest rate shocks as “monetary policy shocks” in VARs with recursive identification... Big discussion on the role of monetary policy in driving the housing boom (Assenmacher-Wesche and Gerlach, 2010; Calza and others, 2009; Goodhart and Hoffmann, 2008; Cardarelli and others, 2008; Gupta and others, 2012)
- Considering shocks with no “structural interpretation” in GVARs (Ambrogio Cesa-Bianchi (2011); Hiebert and Vansteenkiste (2009); Vansteenkiste (2007))
- Often excluding global considerations despite the synchronized nature of house prices

## How to approach the two questions?

- Focus on the role of “global” shocks in driving “global” house prices
- Employ different types of identification schemes to understand the sources of house price movements using FAVAR models  
*(interest rate shocks vs. monetary policy shocks)*
- Examine the degree of synchronization of house prices and its determinants over a long period of time in a large number of countries

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## Findings

- How synchronized are housing cycles across countries?
  - *House prices exhibit less synchronization than most other variables but they do tend to move together*
  - *They have become more synchronized over time*

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## Findings

- What are the main shocks driving movements in global house prices?
  - *Global interest rate shocks tend to have a significant role*
  - *Almost 50 percent of house price fluctuations due to interest, credit, equity and income shocks*
  - *Not structural shocks, but they are suggestive...*
  
  - *Global monetary policy shocks per se do not play a major role; and neither productivity nor credit supply shocks do*
  - *Uncertainty shocks do play an important role (30 percent)*

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## Outline

- Dataset and Methodology
- How synchronized are housing cycles across countries?
- What are the main shocks driving global house prices? (*Recursive identification*)
- What are the main shocks driving global house prices? (*Identification with sign restrictions*)
- Conclusion
- ***EXTRA: House Prices and Current Account Movements***

## Outline

- Dataset and Methodology

## Dataset

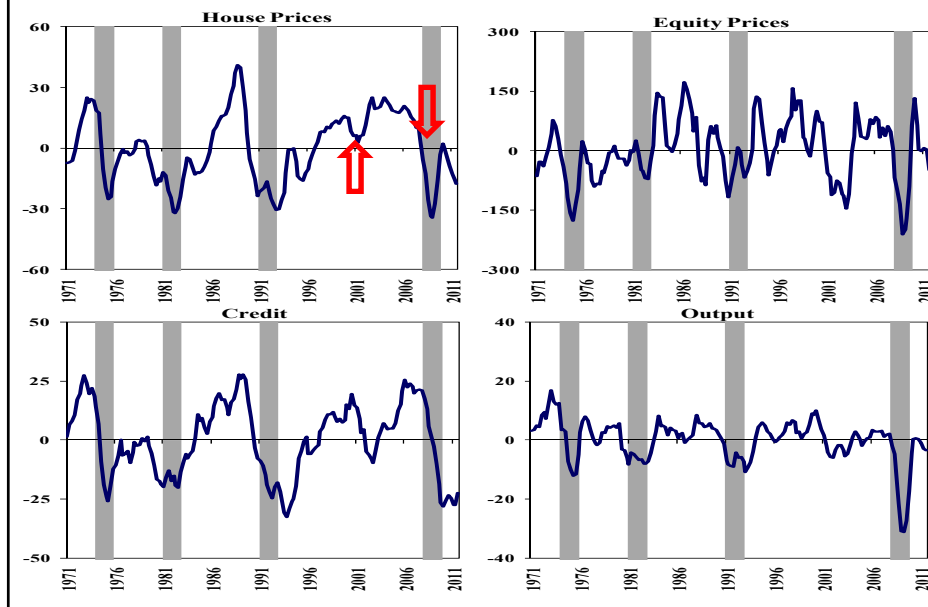
- **Quarterly series over the period 1971:1-2011:3**
  - Output, house prices, equity prices, credit, and the short- and long-term interest rates
  - Data to identify various shocks: Reserves, Credit Spreads, Default Rates, Uncertainty
  - Real, seasonally adjusted, 4-quarter growth rates
- **18 advanced OECD countries**
  - Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, the United Kingdom, the United States
- **The full sample and two subsamples**
  - Pre-Globalization: 1971:1-1984:4
  - Globalization: 1985:1-2011:3
  - Kose, Otrok, Prasad (IER, 2012)
- **Sources: OECD; IMF; GDS; and various other databases**

## Methodology

- Estimate the common component (global factor) in each variable
  - The first principal component across countries of each data series
  - Variance explained by the global factor is significant (housing=30; equity=60)
- Analyze the degree and evolution of synchronization of house prices over time using various metrics
  - Correlations; Concordance; Variance decompositions
- Analyze the sources of synchronization using FAVARs under different identification schemes

## Global Factors

*(growth rates, in percent, gray bars denote global recessions)*





## Outline

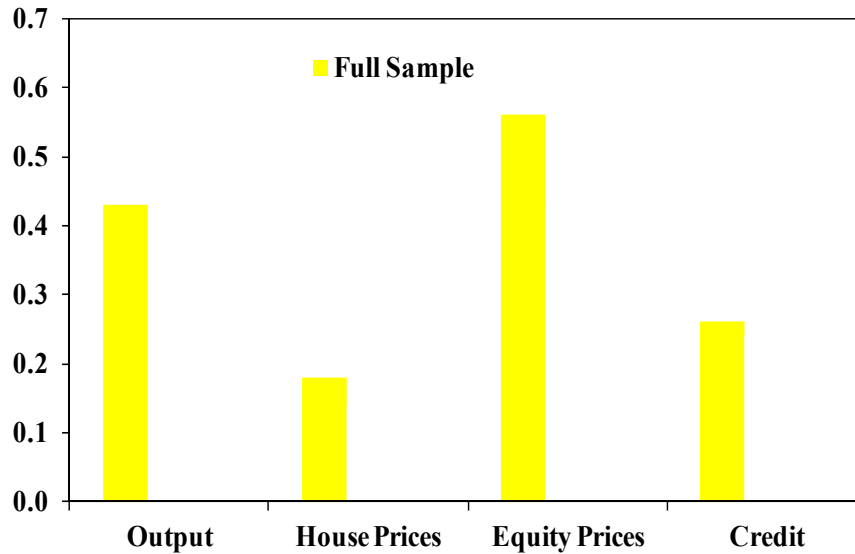
- Dataset and Methodology
- How synchronized are housing cycles across countries?

## Synchronization of House Prices Over Time

- Analyze the degree and evolution of synchronization of house prices over time using various metrics
  - Cross-country correlations
  - Distribution of cross-country correlations
  - Concordance of cycles
  - Variance decompositions of prices due to global factors
- The full sample and two subsamples
  - Full Sample: 1971:1-2011:3
  - Pre-Globalization: 1971:1-1984:4
  - Globalization: 1985:1-2011:3

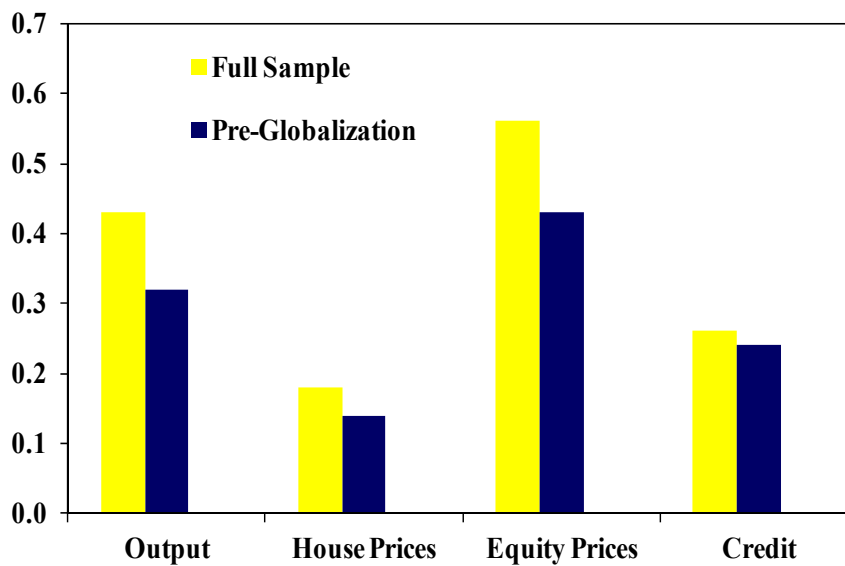
## Cross-Country Correlations – 1

*(average correlation across countries)*



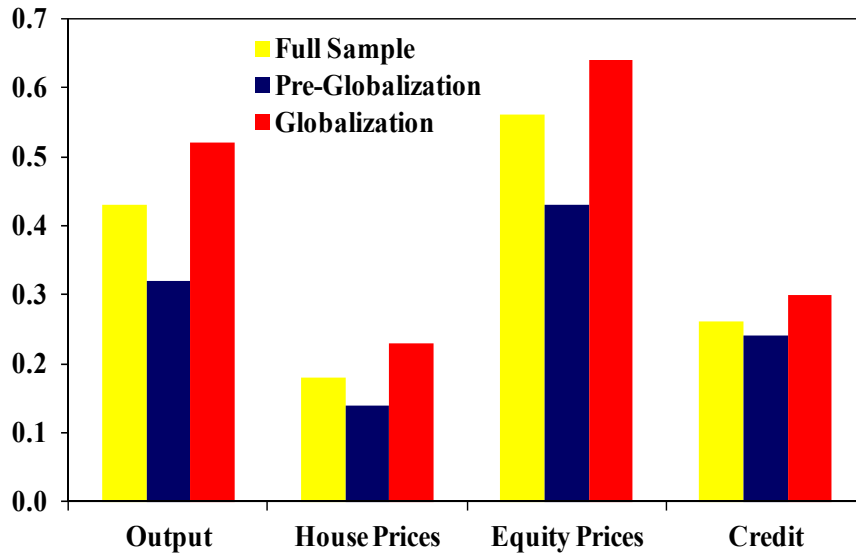
## Cross-Country Correlations – 2

*(average correlation across countries)*



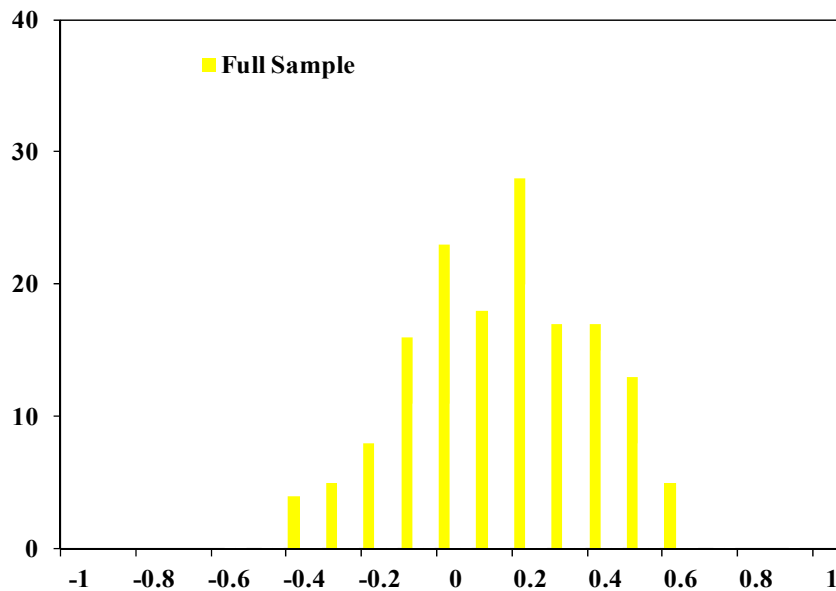
### Cross-Country Correlations – 3

*(average correlation across countries)*



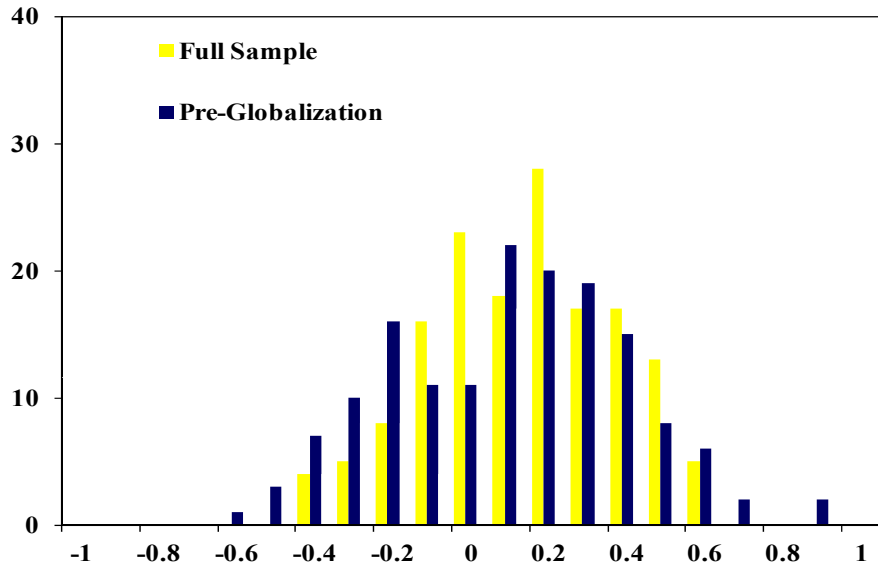
### Distribution of Correlations: House Prices - 1

*(correlations across countries)*



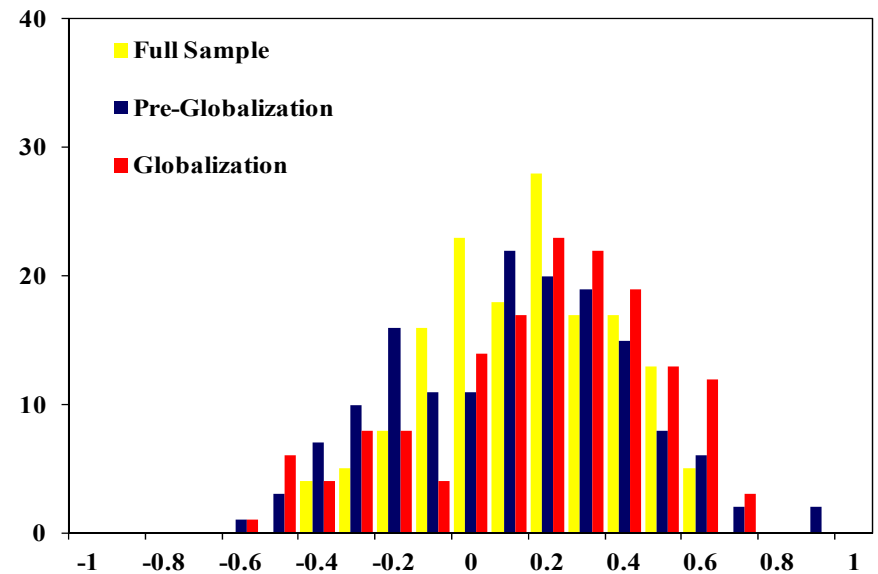
## Distribution of Correlations: House Prices - 2

*(correlations across countries)*



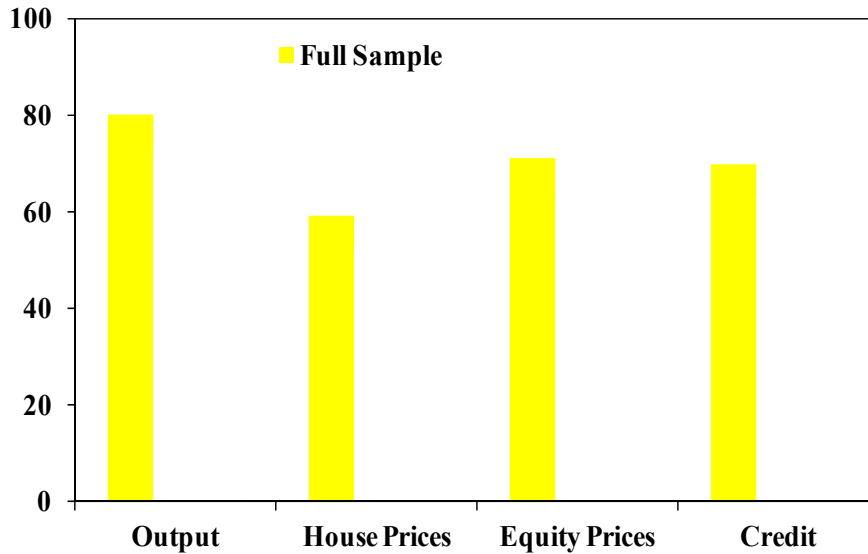
## Distribution of Correlations: House Prices - 3

*(correlations across countries)*



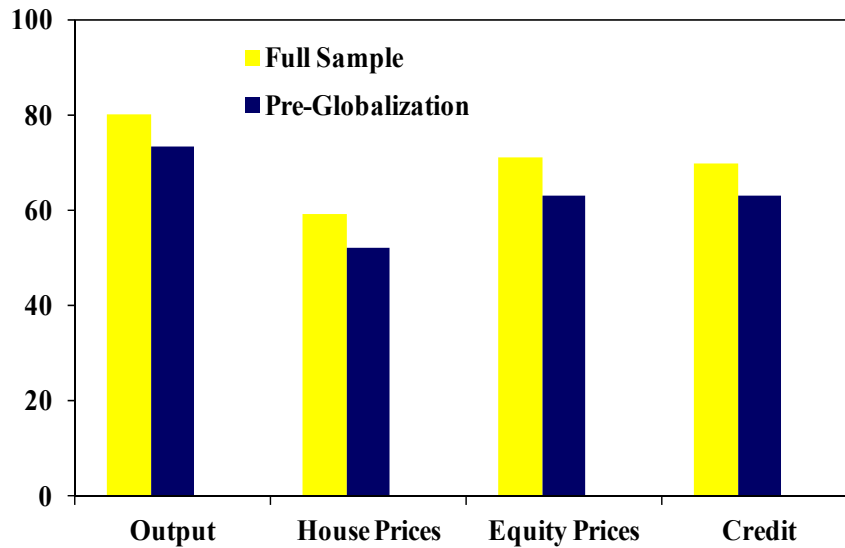
## Concordance of Cycles Across Countries - 1

*(fraction of time cycles across countries in the same phase, median, in percent)*



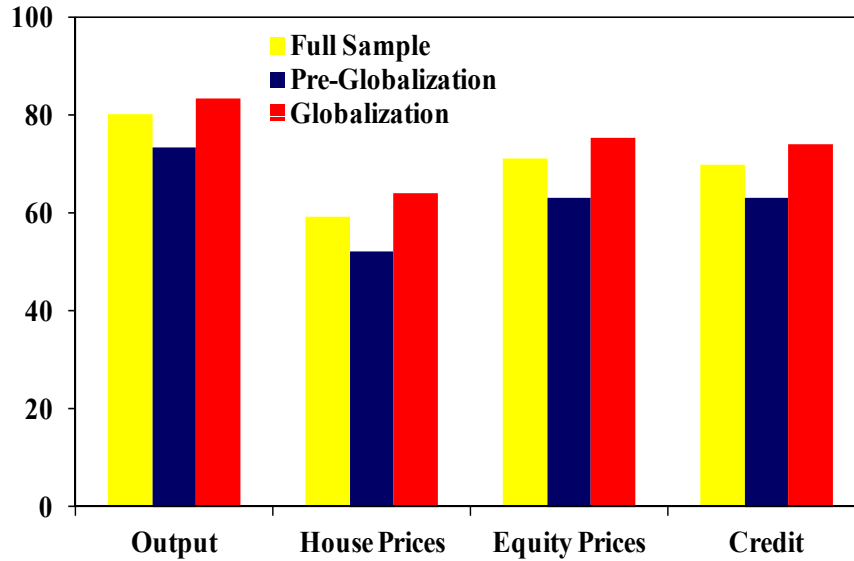
## Concordance of Cycles Across Countries - 2

*(fraction of time cycles across countries in the same phase, median, in percent)*



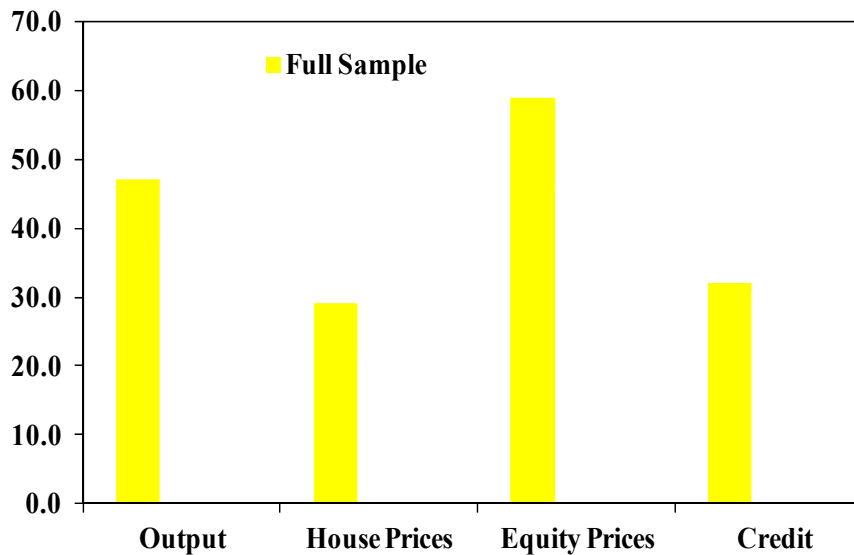
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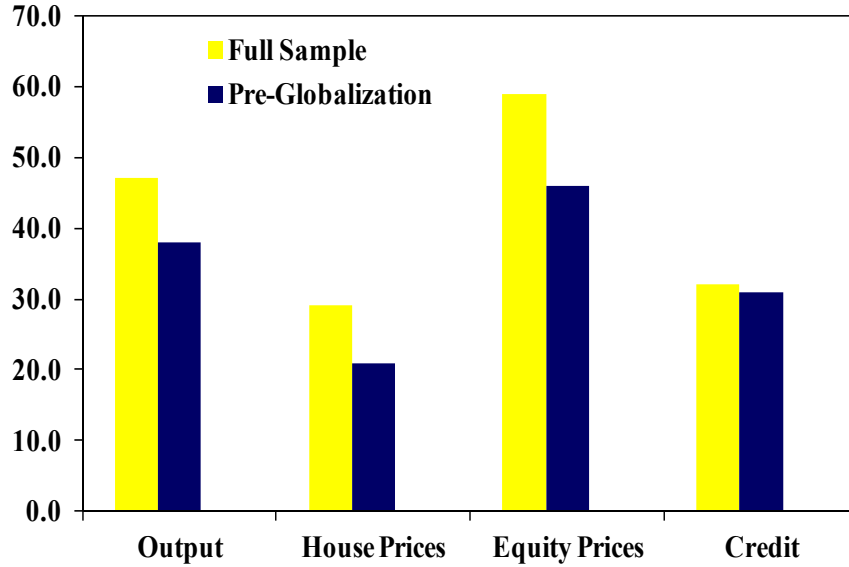
### Variance Explained by the Global Factors - 1

*(fraction of variance due to the global factor, average, in percent)*



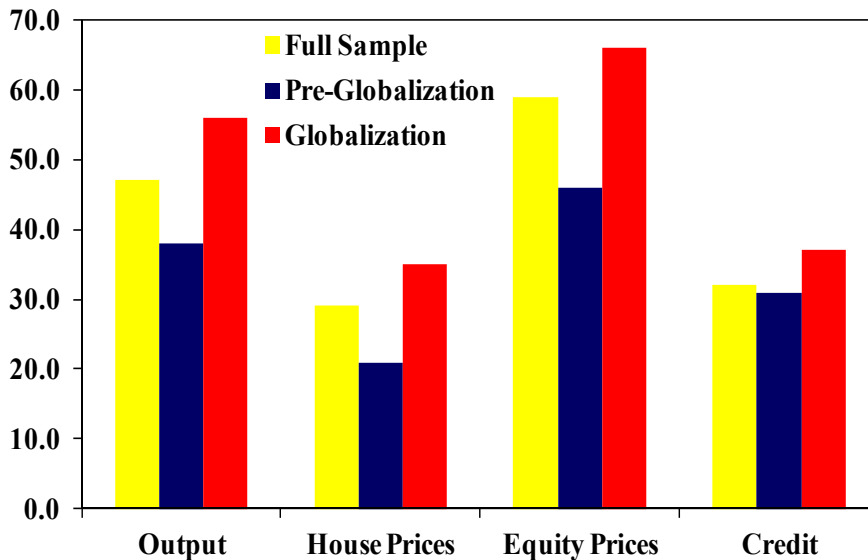
## Variance Explained by the Global Factors - 2

*(fraction of variance due to the global factor, average, in percent)*



## Variance Explained by the Global Factors - 3

*(fraction of variance due to the global factor, average, in percent)*



## Synchronization of House Prices Over Time

- **How synchronized are housing cycles across countries?**
  - *House prices exhibit less synchronization than most other variables but they do tend to move together*  
Correlation=0.2; Concordance = 60 %; Factor Variance= 30 %
- **Have they become more synchronized over time?**
  - *Yes, they have. Increase in synchronization is statistically significant*  
Correlation=0.14 to 0.23; Concordance = 52 to 64 %; Factor Variance= 21 to 35 %
- **Results robust to changes in the definition of sub-samples**
  - The Great Moderation period (1985:1-2007:4) instead of the Globalization Period (1985:1-2011:3)

## Outline

- Dataset and Methodology
- How synchronized are housing cycles across countries?
- What are the main shocks driving global house prices?  
(*Recursive identification*)



## Methodology

- Estimate FAVAR models to analyze the importance of various shocks that could explain fluctuations in house prices

$$y_t = a_{(0)} + A_{(1)}y_{(t-1)} + A_{(2)}y_{t-2} + \dots + A_{(l)}y_{t-l} + u_t$$
$$t = 1, \dots, T, \text{ and } l=1, \dots, L$$

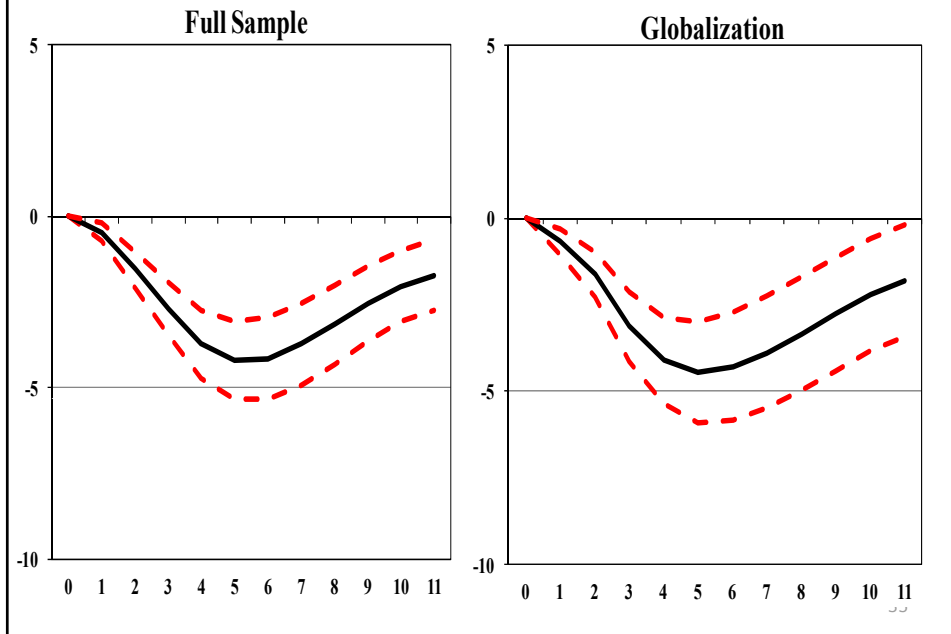
where  $y_t$  is an  $m \times 1$  vector of variables at date  $t$ ,  $A_l$  is an  $m \times m$  coefficient matrix for each lag of the variable vector with  $a_{(0)}$  being the constant term, and  $m$  is the number of variables in the model.  $u_t$  is the vector of one-step ahead prediction error. With the lag length,  $l$  kept at four

- Two types of FAVAR models
  1. contains only the estimated global factors.
  2. Mostly includes a mix of the estimated global factors and some country specific variables, such as default rate, and spreads.

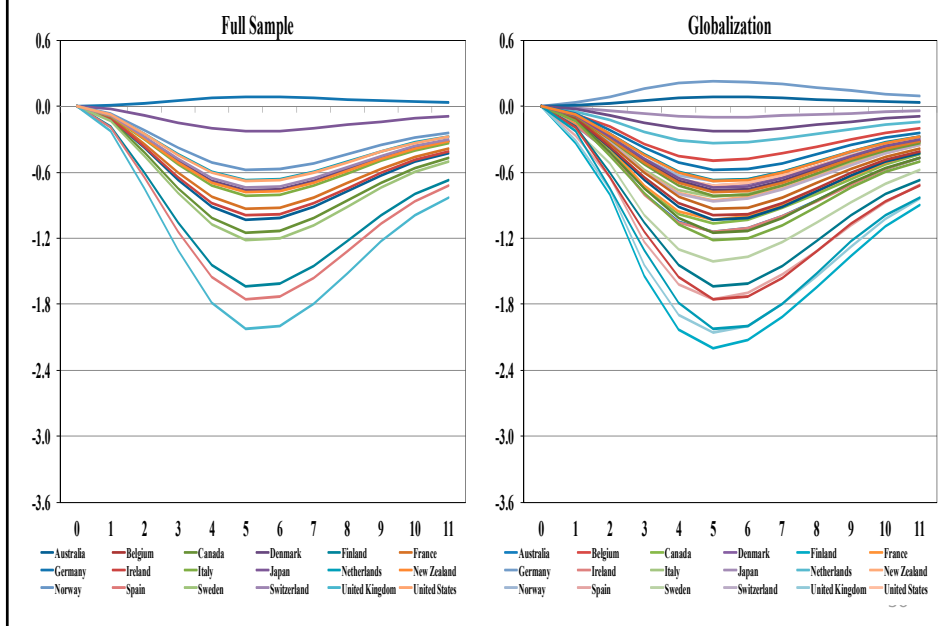
## Identification of Shocks - Recursive

- Standard recursive (*Cholesky*) decomposition
  - Interpret as a preliminary investigation of potential sources for synchronization
  - Not structural interpretation
  - Allow us to interpret the common results in the literature
  - Motivate the more structural approach
- The order of variables: output, house prices, interest rates, credit, and equity prices
  - motivated by the fact that real variables are likely to adjust slower than do financial market variables, so the order is from most slowest temporal adjustment to the fastest

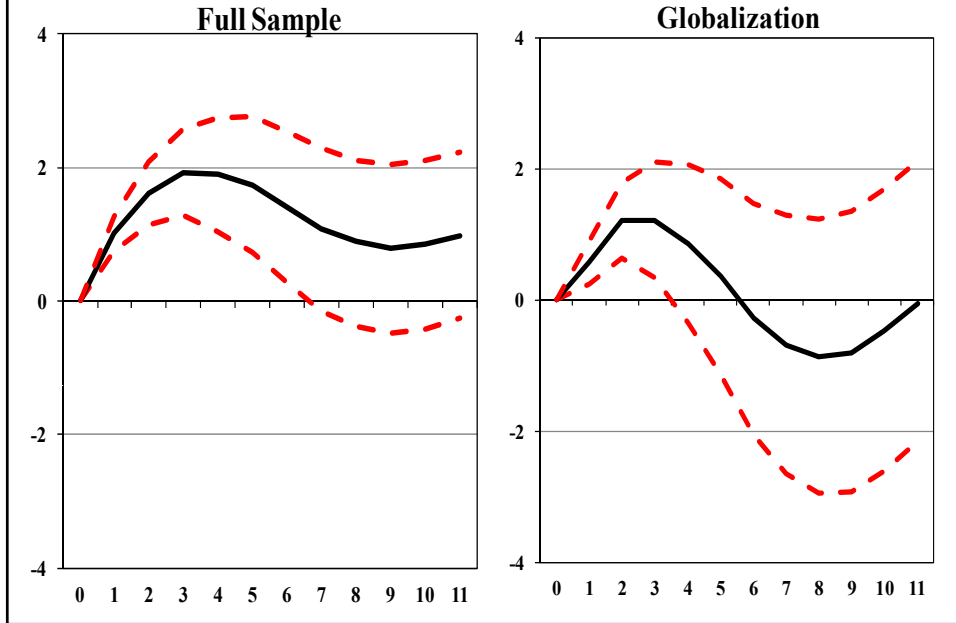
## Responses of House Prices to Interest Rate Shocks - G



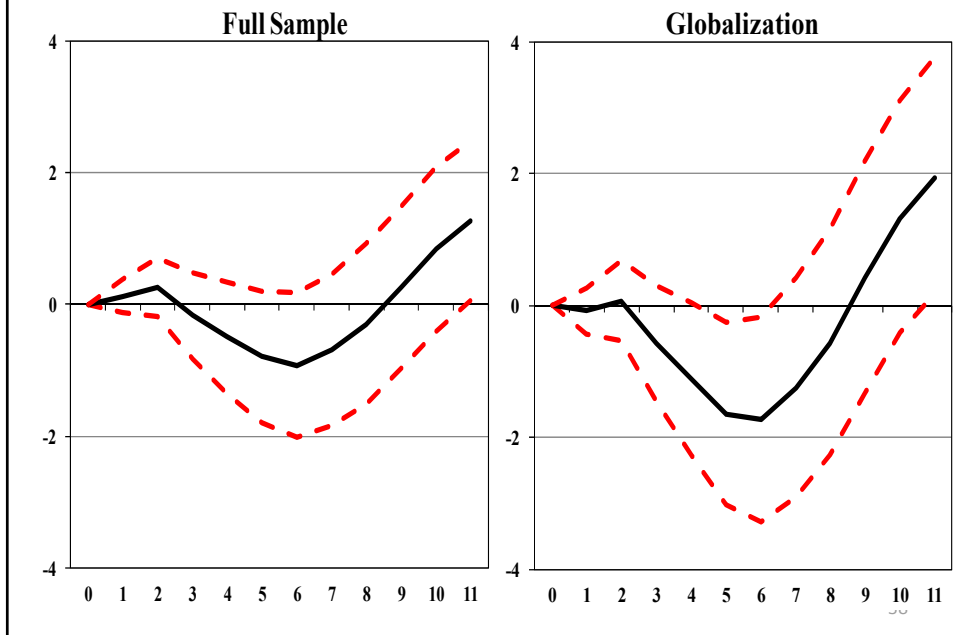
## Responses of National House Prices to Interest Rate Shocks



## Responses of House Prices to Credit Shocks - G



## Responses of House Prices to Equity Price Shocks



## Variance Decomposition of House Prices

(fraction of variance due to each shock, full sample, in percent)

Forecast Horizon (in quarters)	House Prices	Output	Short-term Interest Rates	Credit	Equity Prices
1	91.77	3.71	0.91	3.36	0.25
4	74.69	2.59	14.66	7.03	1.02
8	57.44	3.87	27.85	7.87	2.97
12	52.53	5.22	28.76	8.86	4.62

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## Sensitivity

- Estimating models for the Great Moderation (1985:1-2007:4) period... **No change!**
- Changing the order of financial variables... **No change!**
- Estimating models for the G-7 (instead of 18 countries)... **No change!**
- Analyzing the transmission of national shocks to global house prices... **No change in the headline results!**  
 [At least in the case of large countries, such as the United States, the nation specific shocks can generate impulse responses similar to those associated with their global equivalents.]

## Findings w/ Recursive Identification

- Global interest rate shocks have a significant but delayed impact on global house prices (surprise shocks to interest rates-which may be driven by markets or by monetary policy-affect the cost of borrowing; the impact varies across countries as mortgage-to-GDP ratio differs)
- Global credit shocks do matter as well but global income shocks whether earned or through portfolio (equity) have a muted impact on global house prices
- All four shocks (interest rate, credit, output, and equity) account for roughly half of the variation in house prices
- **CAVEAT:** All reduced form results... A shock here is a combination of many shocks... Useful to see as the literature focuses on these... But a more robust identification approach is needed

## Outline

- Dataset and Methodology
- How synchronized are housing cycles across countries?
- What are the main shocks driving global house prices?  
(*Recursive identification*)
- What are the main shocks driving global house prices?  
(*Identification with sign restrictions*)

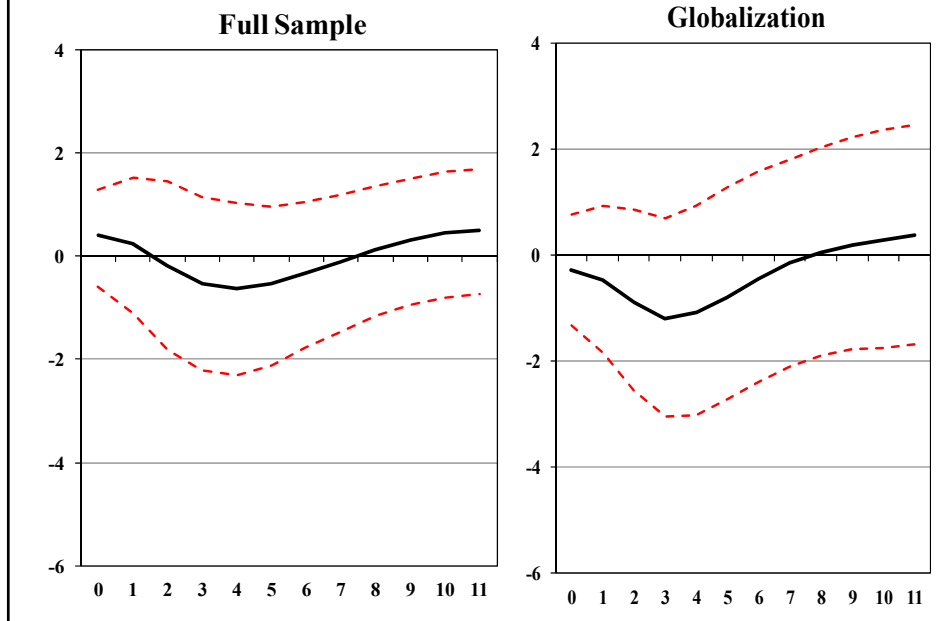
## Identification of Shocks – Sign Restrictions

- Identifying structural shocks with sign restrictions
  - Uhlig (2005)
  - Allow us to produce impulse responses that are qualitatively consistent with standard theoretical predictions (restrictions are derived from structural models)
    - To impose sign restrictions, we draw random impulse vectors and retain only those that meet the restrictions on the sign of the response for some of the variables in the model (Bayesian Methods; 4 quarters; 5000 accepted impulse responses]
  - FAVARs use the global factors-
  - Some use additional data to identify certain shocks
- For global monetary, productivity, credit market shocks, and uncertainty shocks: Identification, Results, Interpretation...

## Global Monetary Policy Shocks: Identification

- Use the sign restrictions following Uhlig (2005); a contractionary monetary policy shock
  - Interest rates rise; Reserves fall; Inflation falls; for the first 3 periods
- The order of variables: reserves, inflation, short-term interest rates, output, house prices, credit, long-term interest rates

## Responses of House Prices to Monetary Policy Shocks



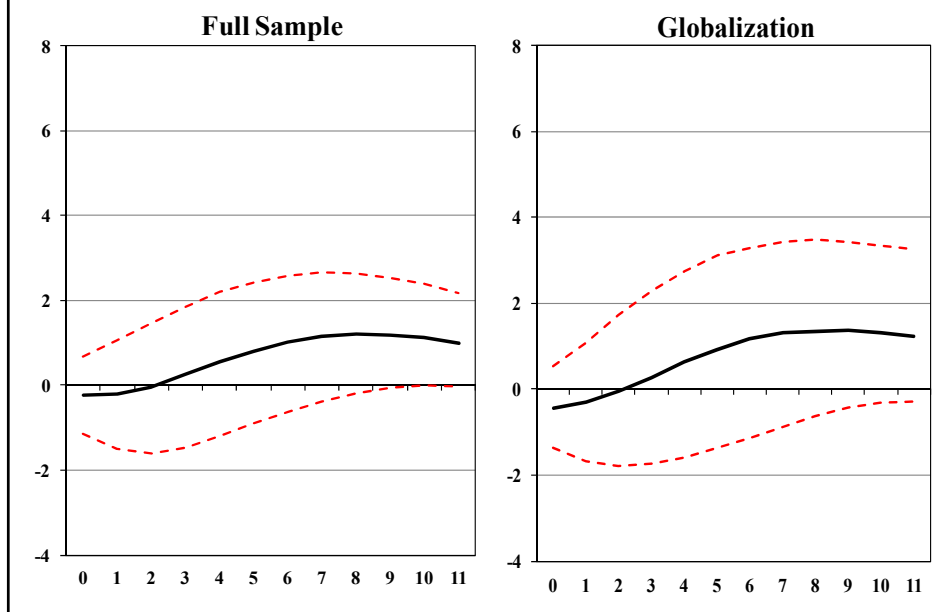
## Global Monetary Policy Shocks: Interpretation

- Global monetary policy shocks do not appear to have a significant impact on global house prices, in contrast to the result about global interest rate shocks
- Not all interest rate movements related to monetary policy... Interest rates can move unexpectedly due to changes in tax policies, policies with respect to debt accumulation, spillovers associated with international financial flows/crises
- The monetary policy part of the reduced form innovation to interest rates is not significant, but shocks stemming from the “non-monetary policy” part appear to be important
- More frequent and larger shocks to monetary policy at the national level than there are at the global level

## Global Productivity Shocks: Identification

- Use the sign restrictions following Peersman and Straub (2009); a positive productivity shock
  - Productivity increases; Output rises; Inflation falls
- The order of variables: reserves, inflation, short-term interest rates, output, house prices, credit, long-term interest rates

## Responses of House Prices to Productivity Shocks





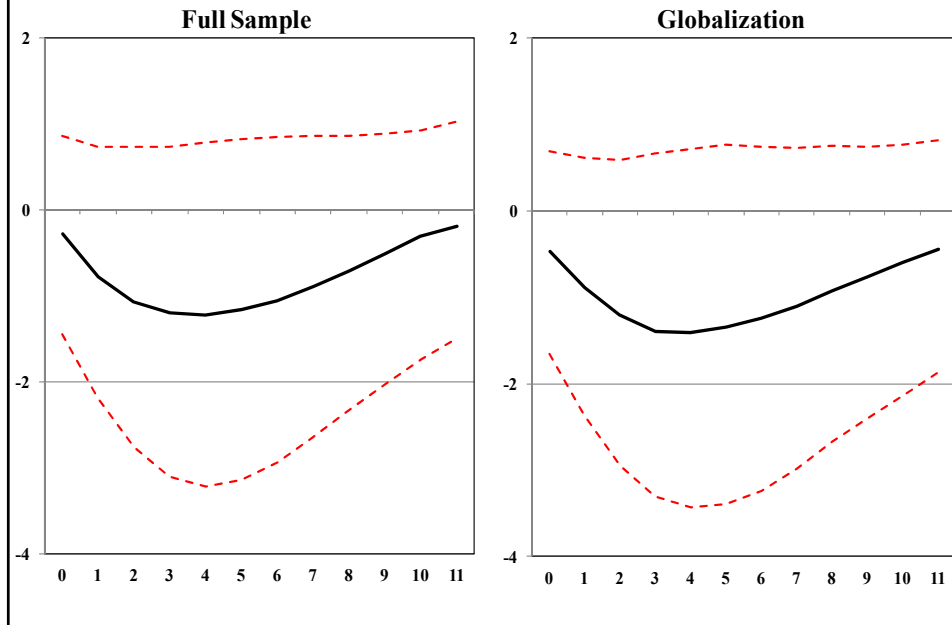
## Global Productivity Shocks: Interpretation

- Shocks to global productivity tend to have a positive but insignificant effect on global house prices
- They tend to drive up global output, but their impact is quite small.
- Given that the impact of shocks to output growth on house prices is modest (from the earlier exercise), the insignificant impact of productivity shocks on house prices is not surprising either

## Global Credit Market Shocks: Identification

- Use the sign restrictions following Meeks (2012); a decline in credit supply
  - Credit falls; Credit Spreads rise; Default rates do not rise (credit supply shock; not an endogenous decline in credit due to lenders reducing credit in response to expectations of an increase in future default rates; derived using a costly state verification model)
- The order of variables: credit spread, inflation, short-term interest rates, output, house prices, credit, default rate
- **Credit spreads** (Corporate bond spreads difference between Moody's seasoned Aaa and Baa corporate bonds for the U.S.); **Default rates** (rates for Moody's rated U.S. speculative-grade corporate bonds)

## Responses of House Prices to Credit Market Shocks



### Global Credit Market Shocks: Interpretation

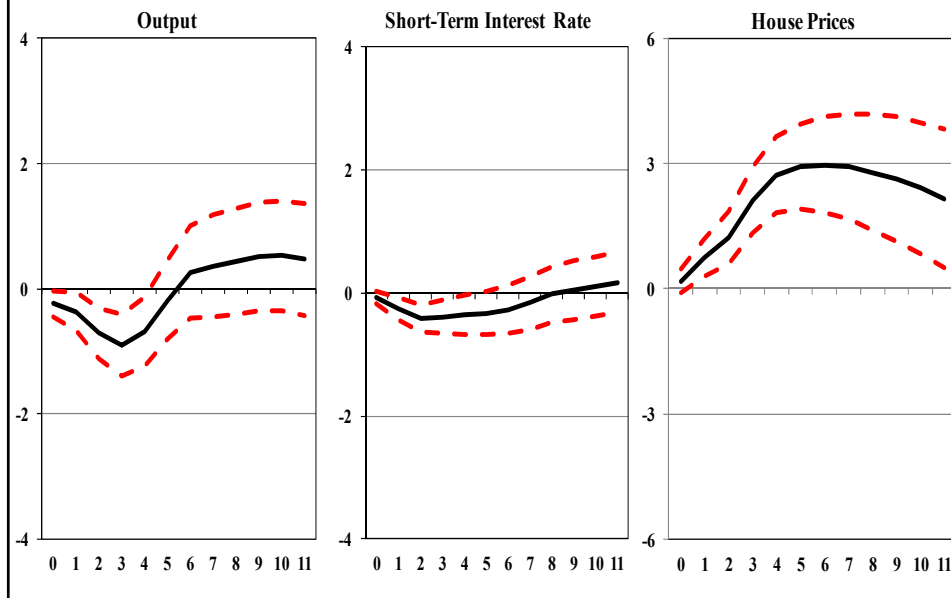
- Exogenous supply side movements in global credit do not appear to be a significant driver of global house prices, in contrast to the result about global credit shocks
- Reduced form credit shock is a combination of many shocks... Supply of credit, demand for credit... Credit and house prices often move together... So, it is not appropriate to assign a structural interpretation...
- Global credit markets usually function well and shocks in these markets are often relatively small... Credit shocks do play an important role during periods of disruptions in financial markets (Helbling et al, 2011)... But those types of episodes are rare
- More frequent and larger shocks to credit supply and demand at the national level than the global level... Credit demand shocks play a role in driving house prices (Eickmeier, Gambacorta, Hofmann, 2012)

## Global Uncertainty Shocks: Identification

- Use the approach in Bloom (2009)
  - Macroeconomic uncertainty can have an impact on output through demand and supply channels.
  - Financial market imperfections can amplify the negative impact of uncertainty
  - Uncertainty is assumed to be exogenous (similar to productivity in some applications) and proxied by stock market volatility of the G-7 countries
- The order of variables: equity prices, uncertainty, the short- and long-term interest rates, house prices, inflation and output

## Responses to Global Uncertainty Shocks

*(Globalization Period and G-7 Sample)*



## Variance Decompositions of House Prices

*(fraction of variance due to each shock, globalization sample, in percent)*

Forecast Horizon (in quarters)	Productivity Shocks	Monetary Policy Shocks	Credit Shocks	Uncertainty Shocks
1	7.66	9.20	8.85	5.56
4	9.52	13.86	11.32	20.74
8	12.42	14.21	13.60	29.07
12	12.96	14.27	13.83	29.1

First three shocks from the estimations with the 18 country sample  
Uncertainty shocks for the G-7 sample

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## Global Uncertainty Shocks: Interpretation

- Reduce output and interest rates for the full sample period and globalization period: Consistent with Bloom (2009) and Leduc and Liu (2012)
- The impact of uncertainty shocks on global house prices is positive and significant during the globalization period for the G-7 countries
- When there is heightened uncertainty in a risky asset (equities), people substitute into an asset (housing) that is perceived to be relatively safer ... house prices are generally less volatile (or safer) than equity prices during the globalization period
- Positive uncertainty shocks are associated with a decline in interest rates... Declines in interest rates tend to increase in house prices

## Findings w/ Sign Restrictions Identification

- Global monetary policy shocks per se do not play a major role; and neither productivity nor credit shocks. Clear distinction between monetary policy and interest rate shocks; credit and credit supply shocks.... Different results than those at the country level; Intensity and magnitude of shocks tend to be smaller at the global level
- Three of them together account for 40 percent of the variation
- Uncertainty shocks do play an important role (roughly 30 percent during the globalization period). Positive impact due to substitution of safe asset (housing); decline in interest rates in response to uncertainty shocks
- Robust findings... robust to changes in the time period (Great Moderation), country sample (18 country vs. G-7), ordering of financial variables

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## Outline

- Dataset and Methodology
- How synchronized are housing cycles across countries?
- What are the main shocks driving global house prices?  
(*Recursive identification*)
- What are the main shocks driving global house prices?  
(*Identification with sign restrictions*)
- Conclusion

## Findings

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  - *House prices exhibit less synchronization than most other variables but they do tend to move together*
  - *They have become more synchronized over time*
- What are the main shocks driving movements in global house prices?
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  - *Not structural findings, but they are suggestive...*
  - *Global monetary policy shocks per se do not play a major role; and neither productivity nor credit shocks*
  - *Uncertainty shocks do play an important role (30 percent)*

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## Future Empirical Research: Three Areas

- Consider the roles played by a wider range of shocks in explaining house prices
  - Shocks to fiscal and financial policies; capital flows
- Analyze differential effects of shocks and structural features of countries
  - Linkages through the banking system
  - Sources of changes in the degree of synchronization of house prices
- Study shocks affecting house prices during periods of financial disruptions and booms
  - Time-series models with heterogeneity and nonlinearities; Counterfactuals