House Prices, Interest Rates and Macroeconomic Fluctuations: International Evidence

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Disclaimer: The view of these paper are of the authors, and do not reflect the views of the IMF.
• House prices and financial and macroeconomic aggregates are strongly interlinked.
  – Large house price movements, by affecting households’ net wealth and capacity to borrow and spend, influence aggregate demand and output.
  – Likewise, changes in macroeconomic (i.e. changes in disposable income) and financial conditions (i.e. credit and interest rates) affect house prices.
House Prices and Economic Activity
Growth, Percent

Sources: BIS and OECD
House Prices and Macro Aggregates Correlation

Note: Dotted lines are two standard error bands
House Prices and Financial Variables Comovement

Note: Dotted lines are two standard error bands
• Economies are also interlinked – business cycles across the world are synchronized.

– Output is synchronized across industrial countries. [The extent of this synchronization seems to have increased with globalization].

– Interest rates and stock prices also are synchronized across industrial countries -- return arbitrage and portfolio diversification.
International comovement of Output, Stock Prices, and Interest Rates

Note: Dotted lines are two standard error bands
Are house prices synchronized across industrial countries?

- Little is known.
- Common mantra -- Housing is an asset that cannot be traded internationally, thus housing markets are “local” markets.
- Helbling and Terrones (2003) found that house prices busts tended to be synchronized.
- Many countries industrial countries have been experiencing a house price boom.
• What do we hope to learn?
  – Can the movement in the price of a nontraded asset (housing) be synchronized across countries?
  – If so, what is the source of that synchronization?
  – Will a U.S. or global house price ‘correction’ affect real growth?
  – What are the effects of global interest shocks on global housing prices?
International comovement of House Prices

Note: Dotted lines are two standard error bands
Outline

• What are the sources of HP synchronization?
  – Dynamic Factor Model.

• What are the implications?
  – Housing market shocks to one country could potentially have global implications
    Use VARs that combine country-specific variables with global factors obtained from the DFM.
Dynamic Factor Model

- Unobservable Index Model
  - Index of Common Economic Activity
  - A few ‘factors’ drive many time series (Sargent and Sims 1977)

- Dynamic factor models exploit covariation in large datasets that may be useful in measuring the extent and nature of comovement or forecasting while avoiding overparameterization
Single Factor Model

- n observable variables, denoted $y_i$, $i = 1,...,n$,
- a single common factor, $f$, accounts for all comovement among the $n$ variables.

$$y_{it} = a_i + b_i f_t + \varepsilon_{it}$$

$E \varepsilon_{it} \varepsilon_{jt-s} = 0$ for $i \neq j$.

- The idiosyncratic errors $\varepsilon_{it}$, are modeled as $p_i$-order autoregressions:

$$\varepsilon_{i,t} = \phi_{i,1} \varepsilon_{i,t-1} + \phi_{i,2} \varepsilon_{i,t-2} + \ldots + \phi_{i,p_i} \varepsilon_{i,t-p_i} + u_{i,t}$$

$E u_{it} u_{jt-s} = \sigma_i^2$ for $i = j$, $s=0$, 0 otherwise.

$u_{it} \sim N(0, \sigma_i^2)$. 
• The evolution of the factor is likewise governed by an autoregression, of order q:

\[ f_t = \varphi(L)f_t + \mu_t \]

\( \varphi(L) \) is a lag polynomial of order q

\( \mu_t \) is iid \( N(0,1) \)

• Identification Issues:
  – Sign of factor loadings and factor not separately identified (fix one factor loading to be positive)
  – Scale of factor loadings and factor not separately identified (fix the innovation variance of the factor)
Estimating Dynamic Factor Models on Large Data Sets

• Approximate Dynamic Factor Models
  – Forni, Hallin, Lippi, Reichlin (2001)

• Bayesian Dynamic Factor Models
A DFM of AP, IR, and Macro Aggregates.

• The model decomposes each observable variable into 4 components
  – A “World” factor common to all variables in all countries
  – An “Aggregate” factor that is common to each type of macro aggregate. For example, we have an “Aggregate” house factor that is common to HP in all countries.
  – A “Country” factor that measures comovement across all variables in a particular country
  – An idiosyncratic component
• The model includes the following 7 observables
  – per capita consumption growth
  – per capita GDP growth
  – per capita residential investment growth
  – the growth rate of residential house prices
  – stock prices growth (S&P 500 or equivalent)
  – changes in short term interest rates
  – changes in long term interest rates
• For 13 countries
  U.S, U.K., Denmark, Italy, Netherlands, Norway, Sweden, Switzerland, Canada, Japan, Ireland, Australia, New Zealand.

Data is quarterly -- 1980:1-2003:4
The DF Model

\[
\text{House}_{US,t} = a_{\text{HouseUS}} + b_{\text{HouseUSi}} f_t \text{world} + b_{\text{CountryHouseU.S.}} f_t \text{U.S.} + b_{\text{WorldHouseHouseU.S.}} f_t \text{WorldHouse} + \epsilon_{\text{HouseUS,t}}
\]

\[
\text{GDP}_{US,t} = a_{\text{GDPUS}} + b_{\text{GDPUSi}} f_t \text{world} + b_{\text{CountryGDPU.S.}} f_t \text{U.S.} + b_{\text{WorldGDPGDPU.S.}} f_t \text{WorldGDP} + \epsilon_{\text{GDPUS,t}}
\]

\[
\vdots
\]

\[
\text{Stock}_{US,t} = a_{\text{StockUS}} + b_{\text{StockUSi}} f_t \text{world} + b_{\text{CountryStockU.S.}} f_t \text{U.S.} + b_{\text{WorldStockStockU.S.}} f_t \text{WorldStock} + \epsilon_{\text{StockUS,t}}
\]

\[
\text{House}_{UK,t} = a_{\text{HouseUK}} + b_{\text{HouseUKi}} f_t \text{world} + b_{\text{CountryHouseU.K.}} f_t \text{U.K.} + b_{\text{WorldHouseHouseU.K.}} f_t \text{WorldHouse} + \epsilon_{\text{HouseUK,t}}
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\text{GDP}_{UK,t} = a_{\text{GDPUK}} + b_{\text{GDPUKi}} f_t \text{world} + b_{\text{CountryGDPU.K.}} f_t \text{U.K.} + b_{\text{WorldGDPGDPU.K.}} f_t \text{WorldGDP} + \epsilon_{\text{GDPUK,t}}
\]

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\vdots
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\[
\text{Stock}_{UK,t} = a_{\text{StockUK}} + b_{\text{StockUKi}} f_t \text{world} + b_{\text{CountryStockU.K.}} f_t \text{U.K.} + b_{\text{WorldStockStockU.K.}} f_t \text{WorldStock} + \epsilon_{\text{StockUK,t}}
\]

The b’s are the factor loadings
• The degree to which the DFM is a good fit for the data can be judged by the amount of the variation in the observable variable that is explained by the factors:

\[
\frac{(b^i_{j,i})^2 \text{var}(f^i_t)}{\text{var}(Y^j_t^i)}
\]

• The factors explain on average 50% of the movements in real GDP and interest rates, nearly 60% of the movements in stock prices and 40% of the movements in house prices.
• What is the world factor?

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• Some combination of real activity and interest rates
- Global components are an important determinant of world housing prices, with some exceptions

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Global components are an important determinants of stock prices.

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Global components are also an important determinants of interest rates (short term).

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• Global components are an important determinants of interest rates (long term).

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- Exposure to Global Cycles
  - Housing exposure to external factors reflects the economy exposure to these factors.
• Exposure to Global Cycles
• Importance of Factors Varies over Time

![Graph showing US House Price and Scaled Factors (Demeaned)]
• Importance of Factors Varies over Time

IRL House Price and Scaled Factors (Demeaned)
International Linkages in AP, IR, and Real Activity

• Use of VARs to study global linkages and spillovers.
  – VARS combine a small number of country-specific variables and global factors.
  – Related to FAVAR.
  – Here we use global factors to trace the response of shocks originating in one country into other countries.
• The reduced form VAR is given by:

\[ Y_t = A(L)Y_{t-1} + u_t \quad \text{E}(u_t'u_t') = \Sigma \]

\(Y_t\) is a \((m \times 1)\) vector of observable data and latent factors
\(A(L)\) is a matrix lag polynomial
Exercise 1: Identifying the housing shock using a recursive structure

- U.S. House prices, interest rates and GDP, global interest rate factor and global housing factor
- U.S. housing prices ordered first, interest rates last
• Will a shock to US house Prices affect U.S. real GDP?

Impulse Response Function: U.S.

- Response is prolonged
• What will a shock to US house Prices do to global house prices?

**Impulse Response to House U.S. Shock**

Response is delayed
Exercise 2: Global interest rates and global housing prices:

- Recursive VAR structure

- Global factor for interest rates (long term), GDP, housing prices and stock returns

- housing prices ordered first, interest rates last
• What will a global interest rate shock do to world house prices?
Conclusion

- House prices are highly synchronized across industrial countries – reflecting global developments, particularly in int. rates.
- The global cycles in real variable, housing prices and stock returns have distinctly different periodicities.
- Much of the comovement in HP and SP are specific to those variables.
- Shocks to US house prices have global repercussions, but with significant delay.