The Housing Sector over Business Cycles: Empirical Analysis and DSGE Modelling

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Goals of the paper

We analyse the dynamics of the housing sector over business cycles:

1. Empirical analysis of cyclicality of the housing market data
   1.1 on a sample of advanced economies,
   1.2 for the Czech economy.

2. We develop a cascade of DSGE models:
   - Are standard supply and demand mechanisms sufficient to mimic cyclical properties of housing market data?
   - YES, they can!
Motivation

DSGE models with housing are dominated by the Iacoviello-Neri (2010) framework with collateral-constrained households:

- empirical supports for the collateral effect is weak in microeconometric studies (at least in European studies that distinguish households with various type of house ownership):
  - this was confirmed for the Czech case by a study by Brůha, Hlaváček & Komárek (2013).

- We find macro support weak as well!

- Policy implications are crucially dependent on whether:
  - exogenous house price changes cause macroeconomic fluctuations, or
  - whether movements in house prices are mere symptoms of business cycles.
Stylised facts

First, we attempted at establishing stylised facts on the cross-section of market-based economies:

- We collected several data sources on property prices (Eurostat, BIS dataset, Dallas FED datasets)
- Data on National Accounts (Eurostat, IMF)
- Sectoral data – construction sector (output, labour inputs): Eurostat

and then seeks for stable patterns.
Cyclicality of house prices (band-pass filter)
Cyclicality of output of the construction sector (band-pass filter)

\[ \rho(\text{Real GDP}_t, \text{Buildings (volume)}_{t+k}) \]

\[ \rho(\text{Real GDP}_t, \text{Dwelling permits (number)}_{t+k}) \]

\[ \rho(\text{Real GDP}_t, \text{Dwelling permits (m}^2\text{)}_{t+k}) \]

\[ \rho(\text{Real GDP}_t, \text{Office permits (m}^2\text{)}_{t+k}) \]
Cyclicality of labour input to the construction sector (band-pass filter)

\[ \rho(\text{Real GDP}_t, \text{Labour (persons)}_{t+k}) \]

\[ \rho(\text{Real GDP}_t, \text{Labour (hours)}_{t+k}) \]

\[ \rho(\text{Real GDP}_t, \text{Hours (NACE: construction)}_{t+k}) \]

\[ \rho(\text{Real GDP}_t, \text{Hours (all NACE)}_{t+k}) \]
Sensitivity analysis

We did sensitivity analysis:

1. filtration method (HP filter, growth rates)
2. other methods (DFM)
3. and more ... (ongoing research)

Property prices and output of / inputs to the construction sector are cyclical:

- true for the Czech Republic after 2005

We then ask what ingredients are needed to replicate these findings in a structural DSGE model
Cascade of DSGE models

We present four DSGE models with the housing sector of increasing complexity:

1. Houses are exogenous (falling from the sky): \( f_S \).
2. Houses are produced from the intermediate sector: \( f_Y \).
3. Houses are produced with sector-specific inputs (labour, capital): \( f_{LK} \).
4. Houses are produced with sector-specific inputs and land: \( f_{LKP} \).

Moreover, we consider various values of the elasticity of substitution between consumption and housing.
Model: houses fall from the sky.

The diagram illustrates the domestic economy and its interactions with the rest of the world. It highlights the flow of goods, services, and financial transactions. Here are the key components:

- **Domestic economy**
  - Households
  - Domestic intermediate producers
  - Intermediate importers
    - Production flows
  - Consumption
  - Government
  - Investment
  - Exports
  - House stock
  - Dividends
  - Wages
  - Rent
  - Purchases and sales
  - Rent

- **Rest of the World**
  - Foreign debt
  - Imports
  - Exports

- **Financial Flows**
  - Red lines represent financial flows.
  - Green lines represent housing sector flows.
  - Black lines represent real flows.

Key equations:

- $Y = M + C + G + I + X$
- $P = C + I + G$
- $H = C + I + G$
- $S = Y - C - I - G$

**Terms**:

- **Y**: Gross Domestic Product
- **M**: Imports
- **C**: Consumption
- **G**: Government Expenditure
- **I**: Investment
- **X**: Exports
- **H**: House Stock
- **S**: Savings
- **P**: Capital Stock

The diagram uses different colored lines to distinguish between real and financial flows, as well as the housing sector.
Model: houses fall from the sky.

Utility function:

\[
\mathbb{E}_0 \sum_{t=0}^{\infty} \left( \prod_{\tau=0}^{t} \beta_{\tau} \right) \left[ \frac{\log(C_t - \chi \bar{C}^F_{t-1})}{(1 - \chi)^{-1}} + \frac{\phi_H \exp(\varepsilon^H_t) H_t^{1-\eta}}{1 - \eta} + \phi_L a_t^L (1 - L_t) \right],
\]

where \(C_t\) is consumption, \(\bar{C}^F\) is external habit, \(L_t\) is labour, \(H_t\) is the stock of houses, \(\varepsilon^H_t\) is a housing preference shock, \(\eta\) is the utility curvature with respect to the stock of houses.

The process for the amount of houses is an exogenous AR(1) defined as follows:

\[
\log H_t = \rho_H \log H_{t-1} + (1 - \rho_H) \log H + \varepsilon^H_t,
\]

where \(\rho_H\) is an autoregressive parameter and \(\varepsilon^H_t\) is the exogenous shock.
Model: houses are produced from the intermediate good.

Black lines – real flows, red lines – financial flows, green lines – housing sector
Model: houses are produced from sector-specific inputs.

Black lines – real flows, red lines – financial flows, green lines – housing sector.
Model: houses are produced also from land.

Black lines – real flows, red lines – financial flows, green lines – housing sector
Impulse responses: technology shock

- Consumption (q/q, p.a.)
- Investment (q/q, p.a.)
- Exports (q/q, p.a.)
- Imports (q/q, p.a.)
- Interest rate (p.a.)
- Nominal exchange rate (q/q, p.a.)
- Nominal wages (q/q, p.a.)
- Py inflation (q/q, p.a.)
- Pc inflation (q/q, p.a.)
- Py inflation (q/q, p.a.)
- Pm inflation (q/q, p.a.)
- New houses (q/q, p.a.)
- House prices (q/q, p.a.)
- Prices of new houses (q/q, p.a.)

Baseline, f_S, f_Y, f_LK, f_LKP, f_Yns (ρ ns = 1)
Impulse responses: housing preference shock

eps-H

- Consumption (q/q, p.a.)
- Investment (q/q, p.a.)
- Exports (q/q, p.a.)
- Imports (q/q, p.a.)
- Interest rate (p.a.)
- Nominal exchange rate (q/q, p.a.)
- Nominal wages (q/q, p.a.)
- Py inflation (q/q, p.a.)
- Pc inflation (q/q, p.a.)
- Pi inflation (q/q, p.a.)
- Px inflation (q/q, p.a.)
- Pm inflation (q/q, p.a.)
- New houses (q/q, p.a.)
- House prices (q/q, p.a.)
- Prices of new houses (q/q, p.a.)

Baseline
fS
fY
fLK
fLKP
fYns (ρns = 1)
Impulse responses: shock to house technology
Impulse responses: technology shock under different parameterization of $\eta$ (Model fY)
Impulse responses: housing preference shock under different parameterization of $\eta$ (Model fY)
Moments: Correlation of House Prices with Selected Variables
Moments: Correlation of New Houses with Selected Variables

![Graphs showing correlation of new houses with selected variables.](attachment:image.png)
Moments: Correlation of New Houses with Selected Variables (Various Values of $\eta$)
Summary

In this research, we asked whether DSGE models without exotic features can replicate basic cyclical facts about the housing market:

- we believe that the answer is YES.
- Hence, no need to bother with the collateral effects etc. that:
  - are probably empirical not relevant (at least for European countries),
  - have counter-factual macroeconomic implications (counter-cyclicality of investments).

- Our research supports the view that house price fluctuations are merely symptoms of business cycles, not their cause.
  - although it may be that in some episodes, the cycle was amplified through the housing market (e.g. via balance sheets of financial institutions).
Thank you for your attention!

Comments and discussion welcome
Back-up slides
Countercyclical investments under housing preferences as the source of business cycles?

Housing preference shock (Iacoviello & Neri, 2010)

- If the house price bust caused the Great Recession, investments should boom in 2008.
- How many booms with falling investments can you remember?
Related Micro Studies

Collateral channel – rejected:

Campbell and Cocco (2007) find on UK data a link between the financial market and house prices but not through the collateral effect of house prices on consumption.

Attanasio et al. (2009) identify expectations as the likely cause as the estimated effect is roughly the same for homeowners and renters.

McCarthy and McQuinn (2013) find on Irish data significant responses of consumption to house price shocks, but not through credit constraint.

Collateral channel – accepted:

Cooper (2013) reports a significant collateral channel without controlling for home ownership