



# Housing in DSGE Modelling

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The views expressed in this presentation are those of the author  
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# Introduction

Macroeconomic Models with housing and credit constrained households help us understand the stylised macroeconomic implications of booms (which are often housing booms) and household deleveraging. Models also help in analysing the macroeconomic effects of policies (e. g. property taxes).

Even Krugman, who otherwise is an outspoken sceptic of DSGE models has used such a model for analysing the macro implications of deleveraging (see Krugman, Eggertson 2010).

The purpose of this presentation is to show how housing investment is modelled in standard DSGE models.

We focus both on housing booms and busts/deleveraging.

# Structure of presentation

## 1. How is housing investment modelled in DSGE models?

Determinants of housing investment

Modelling housing: fundamentals, credit , bubbles.

How well can these factors be distinguished empirically?

## 2. Effects of deleveraging and bursting housing bubble

A quantitative assessment of deleveraging and bursting of house price bubble in the EA periphery

# Household decision problem:

Household maximises (intertemporal) Utility function over consumption and housing services (proportional to housing stock) (see, e. g. Iacoviello 2015)

$$U(C_t, H_t)$$

s. t. Budget constraint

$$D_t = (1 + r_{t-1})D_{t-1} + P_t^C C_t + P_t^H I_t^H + Y_t$$

Collateral constraint

$$D_t = (1 - \chi)H_t P_t^H$$

$\psi_t$  :Lagrange Multiplier of the collateral constraint

$$\psi_t = \begin{cases} 0 & \text{Collateral constraint does not bind} \\ > 0 & \text{Collateral constraint is binding} \end{cases}$$

# Housing investment decision

2 ways to look at it:

1. Residential investment equation

$$H_t = \frac{\omega C_t}{(r_t + \pi_{t+1}^C - \pi_{t+1}^H + \delta^H + \psi_t \chi) P_t^{H,C}}$$

Housing stock is proportional to consumption, for constant relative prices, constant real interest rate and constant lending conditions.

Housing stock responds negative to relative house prices.

Housing stock responds positively to expected house price inflation.

## 2. Housing Stock is an asset => House Price equation

The above housing demand equation can be rewritten as an asset price equation

$$P_t^{H,C} = \omega \frac{C_t}{H_t} + \frac{(1 - \delta^H)}{(1 + r_t + \psi_t \chi)} P_{t+1}^{H,Y} = \frac{U_{H,t}}{U_{C,t}} + \frac{(1 - \delta^H)}{(1 + r_t + \psi_t \chi)} P_{t+1}^{H,Y}$$

House prices increase if the ratio of marginal utility of housing to consumption increases.

But it also responds positively to the expected increase in house prices and improvement in lending conditions.

BUT:

If house prices are like asset prices, then they can also be subject to bubbles

$$B_t = \frac{(1 - \delta^H)}{(1 + r_t + \psi_t \chi)} B_{t+1}$$

Note: B is growing at rate  $(r_t + \psi_t \chi + \delta^H) > 0$

And the market price for housing:  $P_t^{H,Y} + B_t$

is indistinguishable from the fundamental price  $P_t^{H,Y}$

$$(P_t^{H,C} + B_t) = \frac{U_{H,t}}{U_{C,t}} + \frac{(1 - \delta^H)}{(1 + r_t + \psi_t \chi)} (P_{t+1}^{H,Y} + B_{t+1})$$

## Identifying Fundamentals, bubbles and credit constraints

$$H_t = \frac{\omega C_t}{(r_t + B_t + \pi_{t+1}^C - (\pi_{t+1}^H + \Delta B_{t+1}) + \delta^H + \psi_t \chi)(P_t^H)}$$

$$C_t = \frac{1 + \rho}{1 + i_t - \pi_t^C + \psi_t} E_t C_{t+1}$$

Housing stock reacts to

Fundamentals:  $\omega$  demographics, pop in 'house building age'

Bubbles: optimistic house price expectations



Distinguishing between Bubbles and Fundamental shocks to housing investment is difficult:

- Both shift housing investment in the same direction.

Distinguishing between bubbles/fundamentals and credit constraints is easier:

- Bubbles/fundamentals shift housing investment up and lower (or keep constant) private investment.
- Credit loosening shifts housing investment and private consumption up.

# What has been the main driver of the financial cycle (e. g. in Spain)?

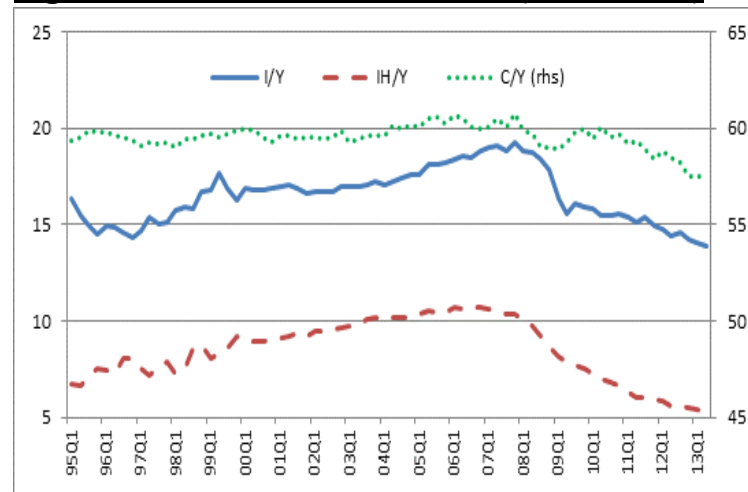
Stylised facts for Spain (Boom):

Consumption to GDP ratio roughly constant

BUT:

100% increase in housing investment

Fig. 1.b Real demand shares (% of GDP)



I [IH]: non-residential [housing] investment; C: consumption

The above analysis suggests that macro models attribute more importance to the bubble for explaining the housing boom and less to credit loosening.

# This conjecture is confirmed by shock decompositions:

Figure 1: Spain - Savings Rate

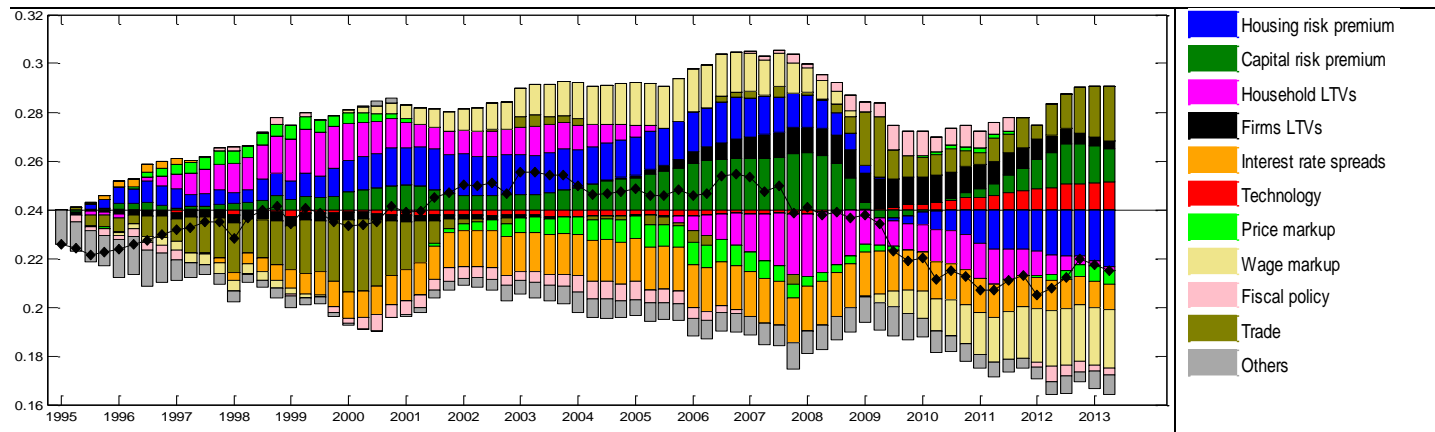
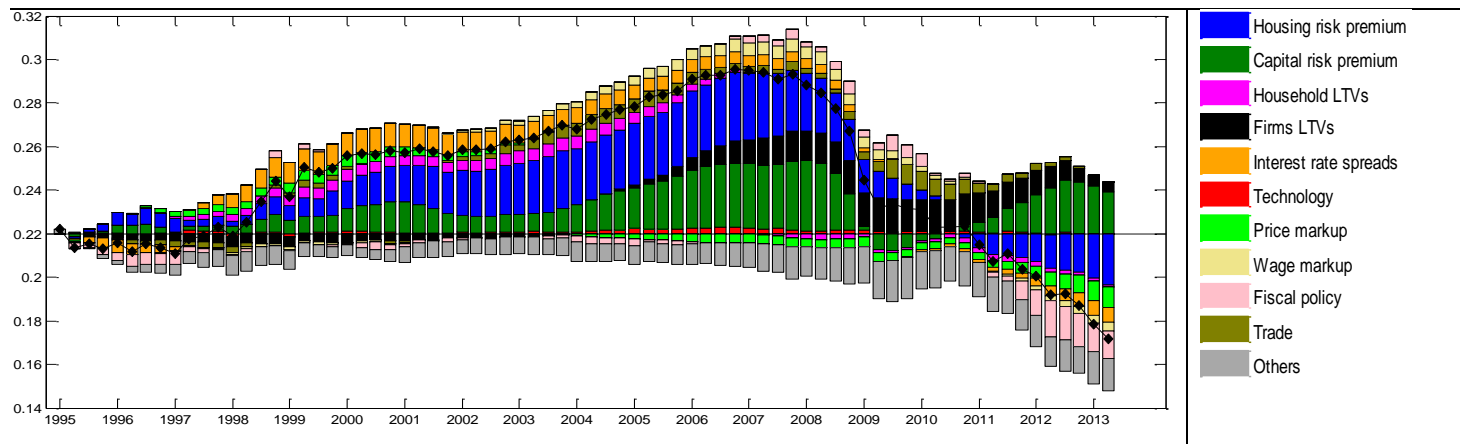


Figure 2: Spain - Investment Rate



Investment boom is mostly explained by:

Housing bubble (blue)

Corporate investment bubble (green)

Credit loosening played a smaller role for the investment boom (but had an effect on lowering savings rate)

## **It is difficult to distinguish between fundamentals and bubbles in real time**

This can be illustrated by looking at analysis provided for member states before 2009.

The EU Economy 2006 Review dealt with adjustment dynamics in the Euro Area and also contained a chapter on Spain.

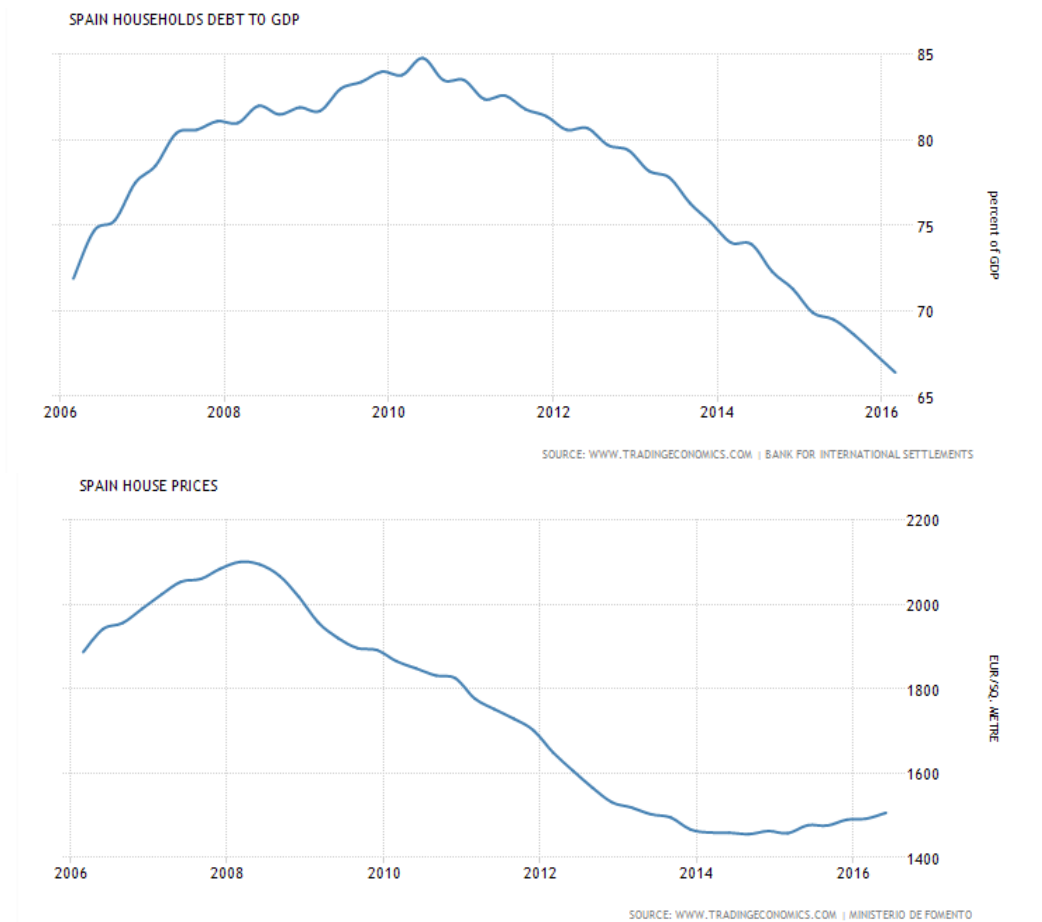
Mainly fundamental factors were identified:

*'In the early years of monetary union, several factors triggered a strong boom in residential construction: these included the lagged impact of declining interest rates, an easing of credit constraints on households, major migration flows, and the impact of tourism and of demographics.'*

Source: The EU Economy Review 2006

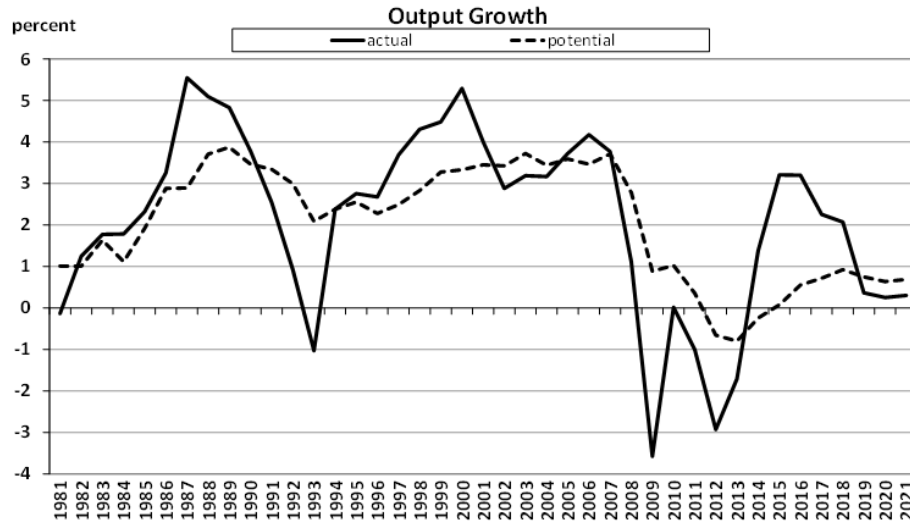
# Household Deleveraging and falling house Prices (the case of Spain)

What is the macroeconomic impact?



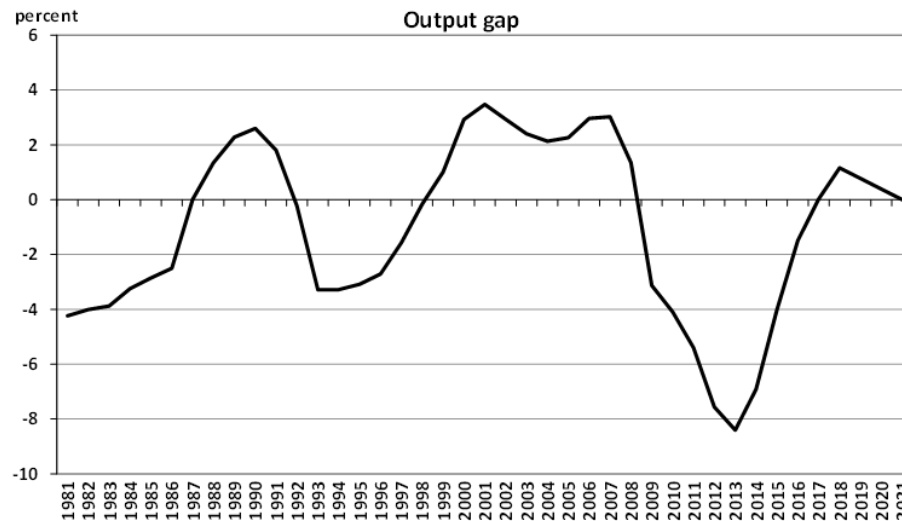
Can deleveraging and the decline of house prices contribute towards explaining some of the stylised facts of the recent financial crisis?

# Decline of Potential growth:

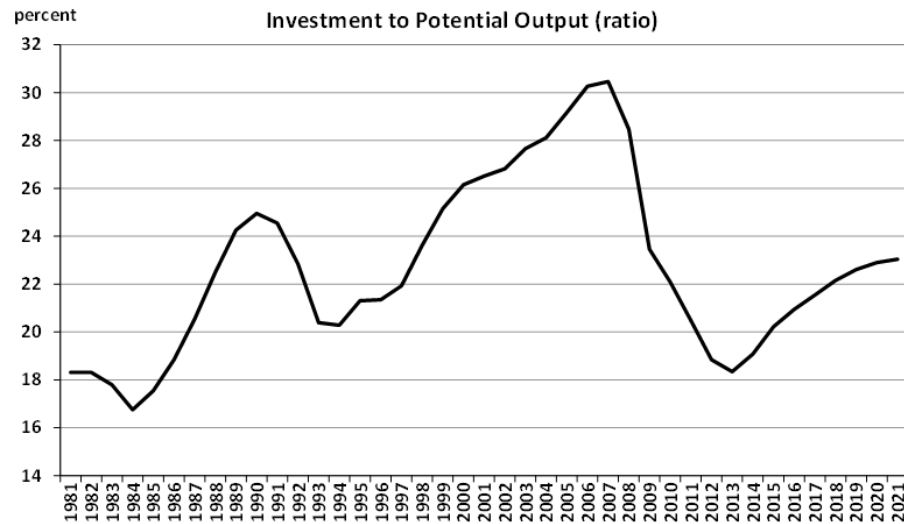


# Long lasting recession

GDP Loss:  
>10%



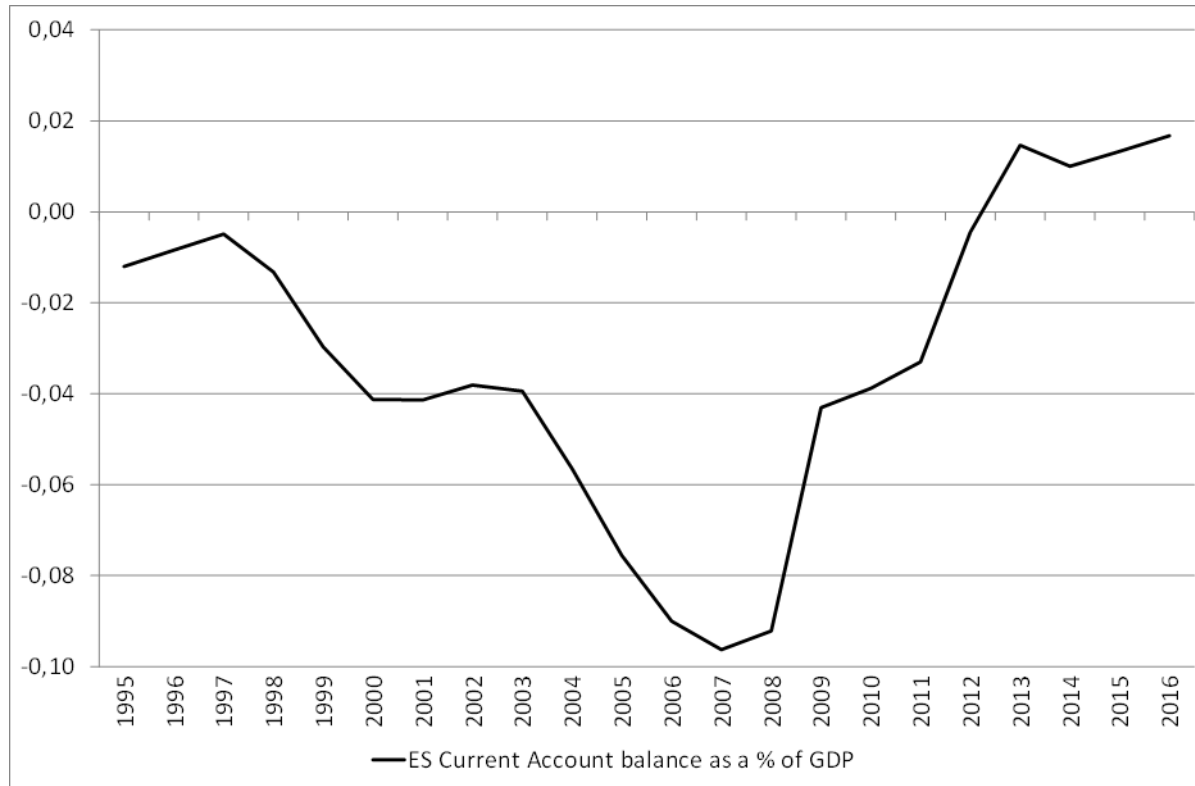
# Boom and Bust of Investment



# Persistent increase in unemployment and NAWRU



# Medium Term Cycle of the Current Account





As will be shown in the following simulation exercise, a model with credit constrained households and residential investment can account for some of the stylised facts of the current recession.

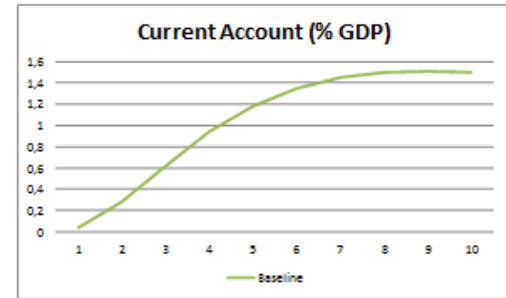
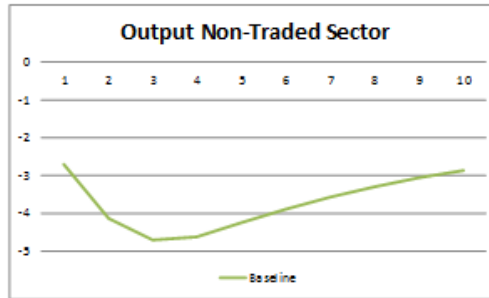
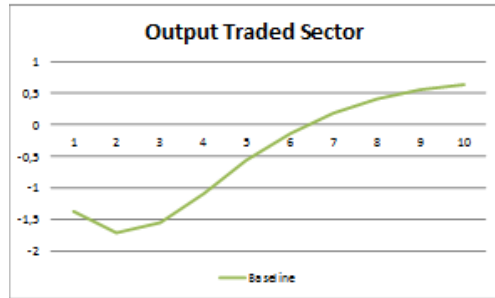
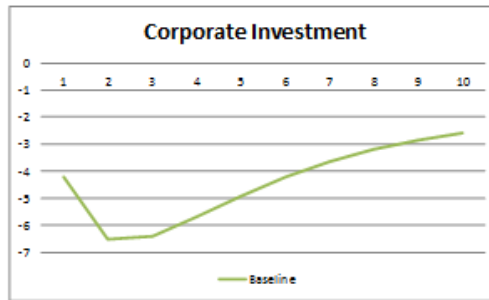
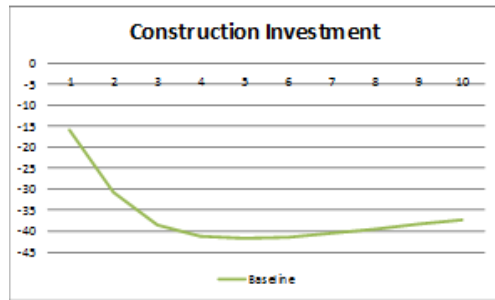
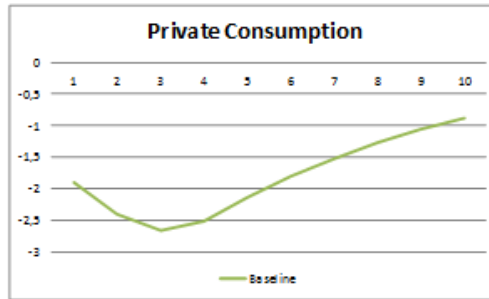
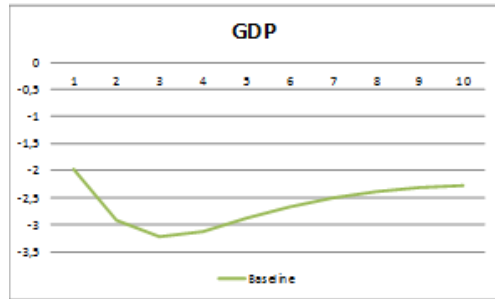
In particular it can replicate:

- Persistent decline of GDP
- Fall of inflation
- Strong decline in housing investment
- Increase in unemployment
- Improvement in the current account

Simulation experiment:

- HH Debt declines by 20%
- House prices decline by 25%

# EA Periphery: Deleveraging and falling House Prices



Persistent decline of GDP, driven by housing and corporate investment.

Because of wage and price adjustments, the traded sector recovers more quickly.

The competitiveness gain and persistent domestic demand contraction increase the current account.

However:

The standard DSGE model is unable to explain the drop of GDP in Spain (relative to a pre-crisis projection) of more than 10%.

The pure deleveraging and house price shock only accounts for about 20% of the decline in economic activity in Spain.

This was also noticed in a paper by Justiniano et al. (2015) for the US.

Important amplifying mechanisms via the banking sector are missing:

e. g.

Mortgage loan losses => recapitalisation needs for banks => reduced loans to NFCs.

For an attempt to incorporate these effects, see Breuss et al. (2015)

[http://ec.europa.eu/economy\\_finance/publications/economic\\_paper/2015/pdf/ecp550\\_en.pdf](http://ec.europa.eu/economy_finance/publications/economic_paper/2015/pdf/ecp550_en.pdf)

# Conclusions

Though housing investment constitutes a relatively small part of economic activity, it can have profound macro effects, both in the boom and the bust phase.

DSGE models can be used to analyse the effects of fundamental shocks (income, relative price, interest rate effects and loan supply) and of bubbles.

Identifying bubbles in real time requires additional information and economic judgment.

The stylised facts of the bust can in principle be matched with the bursting of the housing bubble and credit tightening.

However, in quantitative terms, the pure housing related shock only accounts for a small fraction of the decline in economic activity in Spain/periphery (ca. 10-20%).

Additional amplifying mechanisms via the banking system must be considered as well.