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# Housing Demand, Savings Gluts and Current Account Dynamics*

Pedro Gete
Georgetown University and IE Business School

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**Abstract**

This paper studies the role of housing markets in explaining recent current account dynamics. I document a strong negative correlation, both across and within countries, between housing and current account dynamics. Then, in a quantitative two-country model without exchange rate driven expenditure switching, I analyze savings glut shocks and three drivers of housing demand (population, loan-to-value and housing price expectations) for which I input their dynamics observed in the OECD economies since the mid 1990s. Housing drivers alone imply counterfactual interest rate dynamics. Savings glut shocks alone cannot account for the housing dynamics. The combination of both types of shocks allows to match the emergence and narrowing of the Global Imbalances and the housing booms and busts. Counterfactuals using the model suggest that, as long as loan-to-values are regulated and housing expectations are not very optimistic, the large global imbalances of the mid-2000s are unlikely to return.

**JEL codes**: F32, G28, R21

* Pedro Gete, Georgetown University, Department of Economics, ICC 580, 37th and O Sts., NW, Washington, DC 20057. 202-687-5582. pg252@georgetown.edu. I am very grateful to Anil Kashyap, Sam Kortum and Monika Piazzesi for their advice and support. I thank Fernando Alvarez, Chuqiao Bi, Tim Bian, Steven Davis, Maris Goldmanis, Veronica Guerrieri, Dirk Krueger, Robert Lucas, John Leahy, Priscilla Man, Hector Perez, Martin Schneider, Hyun Song Shin, Nancy Stokey, Harald Uhlig, anonymous referees and workshop participants at several instittions for helpful comments. Financial support from Banco de España, La Caixa and the University of Chicago is gratefully acknowledged. I also thank the Bank of Spain and the Board of Governors of the Federal Reserve for hospitality while part of this research was undertaken. Christophe Andre and Anthony Murphy were very kind to provide some data. The views in this paper are those of the author and do not necessarily reflect the views of the Federal Reserve Bank of Dallas or the Federal Reserve System.

# 1 Introduction

Before the 2007 financial crisis, large current account deficits in the U.S. and other OECD economies attracted considerable attention from academia and policy-makers. The topic was referred to as "the Global Imbalances" and the main concerns were threefold: 1) the imbalances may be reflecting intentional distortions, such as unfair trade practices or exchange rate manipulations (see for example IMF 2007); 2) The imbalances were due to domestic distortions, such as large public deficits or excessive private savings ("savings gluts") which were in individual economies' self-interest to correct (Bernanke 2005); 3) The adjustment of the imbalances would require large exchange rate adjustments (a dramatic dollar depreciation) to induce expenditure switching from foreign to domestic goods and services (Krugman 2007, Obstfeld and Rogoff 2005). A decade later, the imbalances have narrowed markedly, exchange rate adjustments have played a limited role, and the open question is if the narrowing is temporary or permanent (IMF 2014).

In this paper I show that both the expansion and shrinking of the Global Imbalances since the mid 1990s is intimately connected with the dynamics of housing markets. First, I document that, during the last two decades, there has been considerable heterogeneity in the dynamics of housing markets and the current account in OECD economies. These dynamics have a strong negative correlation, both within and across countries. For example, countries like Spain or the U.S., among others, had large housing booms and current account deficits. Current account reversals coincided with a decline in housing markets. Meanwhile, in countries like Canada, Germany or Switzerland, residential investment and housing prices decreased in the midst of large current account surpluses. Reductions in these surpluses coincided with an improvement in housing dynamics.[1]

Second, I study a quantitative two-country model with housing. The model has no role for exchange rate adjustments to induce expenditure switching as there is only one tradable good. The dynamics of the current account are driven by expenditure expansion or reduction. Increases in the demand for housing lead to a current account deficit for three reasons: 1) Higher housing prices soften collateral constraints and allow an increase in consumption and imports that generates a current account deficit; 2) Building houses requires imports of tradable goods for construction, appliances, furniture, utilities and related sectors; 3) Residential investment promotes reallocation of labor and capital from industries producing tradable goods towards nontradable industries as construction. Trade deficits decouple consumption from production,

[1]For data availability reasons I focus on OECD economies. China conforms to the group of countries whose current account surplus shrank after 2007 while its housing markets boomed.

and countries import tradable goods to replace the goods that used to be produced by the inputs reallocated to building houses.

I analyze the three drivers of housing markets most popular in the real estate literature: 1) Population dynamics. Between 1994 and 2006 immigration to countries like Spain and the U.S. led to nearly a 20% increase in population. A large body of literature has documented that immigration pushes up housing values, see for example Otterstrom (2015) or Saiz (2007). 2) Changes in collateral requirements (loan-to-value, LTV). Several authors like Corbae and Quintin (2015), Favilukis et al. (2010) or Kermani (2012) argue that looser credit standards helped feed the housing boom, and then their reversal led to the subsequent bust. 3) Changes in housing price expectations. Cheng et al. (2013), Foote et al. (2012), Garriga et al. (2012), Gelain et al. (2015), Ling et al. (2013), Soo (2013), and Van der Cruijsen (2014), among others, provide evidence that homebuyers' beliefs played a key role in recent housing dynamics.

If we input dynamics for population, LTVs and housing price expectations similar to those observed in OECD economies since the mid 1990s, then the model generates dynamics for housing quantities and prices (including both prices and price-to-rent ratios), and for the current account that are similar to the data, both in size and in timing. However, housing demand drivers alone cannot explain the whole story. The model driven by the three housing drivers generates counterfactual increases in interest rates because housind demand encourages higher credit demand. When I add a credit supply shock to the simulations (a foreign savings glut), then the model can account for housing, current account and interest rate dynamics. Savings glut shocks alone are not enough to match the observed housing dynamics and would lead to counterfactual housing price-to-rent ratios.

The previous exercise suggests that housing demand may have been a key driver of current account dynamics, both during the period of the Global Imbalances, and during the sharp reversal of the deficits that took place after the housing collapse. Savings glut shocks reinforced the housing drivers. Exchange rate-induced expenditure switching does not seem very important to understand recent current account dynamics, as a model abstracting from it is consistent with the data.

Finally, I use the model to perform counterfactuals in which I simulate current account dynamics when LTVs are regulated and expectations of housing prices are moderate. These two assumptions seem to be the new normal for housing markets in most OECD economies. The exercise suggests that we will not see the reappearance of the Global Imbalances even in the presence of savings gluts.

This paper complements alternative theories for the Global Imbalances. For example, Backus et al. (2014) consider the role of demographic trends in an OLG model in which saving decisions are tied to life expectancy. Barattieri (2014) proposes an explanation based on the U.S. comparative advantage in services and the asymmetric trade liberalization process in goods trade versus service trade. Broer (2014) studies models in which higher income risk can explain the observed fall in the U.S. asset position. Caballero et al. (2008) model the savings glut hypothesis proposed by Bernanke (2005). Eugeni (2015) theorizes the savings glut in a two-country OLG model with pay-as-you-go pension systems. Fogli and Perri (2006) show that reductions in aggregate volatility caused by the "Great Moderation" could have reduced precautionary savings in the U.S. more than in other countries and caused a current account deficit. Jacob and Peersman (2013) estimate that shocks to the marginal efficiency of investment are the main driver of cyclical fluctuations in the U.S. trade balance. Mendoza et al. (2009) attribute the current account imbalances to financial globalization among countries with idiosyncratic risks and heterogeneous domestic financial markets. Housing demand is an interesting complementary explanation because it can account for the heterogeneity in the current account positions of countries with similar levels of financial development. Models focused on U.S.-specific factors have trouble explaining why the dynamics of the U.S. current account have been so similar to other developed economies.

There are a few papers that address the link between housing markets and the Global Imbalances. Aizenman and Jinjarak (2013) and this paper are the first papers to document and study the strong correlation between housing and current account dynamics both during the housing boom and bust periods. Aizenman and Jinjarak (2013) is a panel regression study that shows that the most significant variable in accounting for real estate valuation changes is the lagged real estate valuation appreciation, followed by lagged declines of the current account to GDP ratio. Other papers have focused on the correlation between housing and the current account during the housing boom. Gete (2009) documents the correlation during the booms, and theorizes that input reallocation between tradable and non-tradable sectors may help in explaining why housing demand can generate trade deficits. Matsuyama (1990) theoretically studies the current account consequences of income effects on residential investment. Laibson and Mollerstrom (2010) relate housing and current account dynamics assuming a behavioral bubble and aggregate wealth effects. Adam et al. (2011) study a small open economy model with a collateral constraint in which Bayesian learning about housing prices amplifies the effects of interest rate cuts. Punzi (2013) studies business cycle simulations of a two-country version of the Iacoviello (2005) model of housing collateral effects. Also, using a two-country version of Iacoviello (2005), Ferrero (2013) focuses on impulse responses to monetary policy and LTV shocks. To maximize the collateral channel, he assumes that all agents in the domestic economy are constrained. Basco (2014), Justiniano et al. (2014) and Favilukis et al. (2012) study the effects of the Global Imbalances on housing markets. Basco (2014) shows that globalization makes housing rational bubbles more likely to appear in developed countries and documents that an increase in the current account deficit raised U.S. housing prices. Favilukis et al. (2012) argue that changes in international capital flows played at most a small role in driving housing price movements in the recent years, and that the key causal factor was a financial market liberalization and its subsequent reversal. Justiniano et al. (2014) claim that foreign capital flows account for between one fourth and one third of the increase in U.S. housing prices.

The paper proceeds as follows. Section 2 documents three facts about housing and current account dynamics. Section 3 describes the model and Section 4 the calibration. Section 5 analyzes the main mechanisms that connect housing and current account dynamics. Section 6 discusses the main quantitative exercise and Section 7 the counterfactual experiment. Section 8 concludes.

# 2 Some Facts about Housing and Current Account Dynamics

In this Section I document three facts that motivate the remainder of the paper. First, as Figure 1 illustrates, several OECD economies have had large and persistent current account deficits since the mid 1990s. Most current account deficits have decreased significantly since 2006. The U.S. is not a special case; its current account dynamics have been similar to those of several other countries.

Second, there has been substantial heterogeneity in both the current account and housing dynamics of developed economies. For example, countries like Spain or the U.S. have had large increases in residential investment, housing prices and employment in construction since the mid 1990s to around 2006. Meanwhile, real housing prices and residential investment decreased in countries like Germany or Switzerland, among others. The dynamics reversed after 2006, when housing markets collapsed in countries like Spain or the U.S. and started to rise in the countries that did not experience a boom in the previous decade. The x-axis in Figure 2 shows the wide heterogeneity in housing dynamics among OECD countries. The y-axis shows the heterogeneity in the dynamics of the current account to GDP ratio.[2]

[2] The Figure contains all OECD countries for which I found available data in the OECD database. For housing prices these countries are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, South Korea, Luxembourg, Netherlands, New Zealand, Portugal, Spain, Sweden, Switzerland, UK and US. For residential investment and employment in construction some countries were not available. I excluded Norway because of the weight of oil prices in its current account dynamics.

Third, changes in housing dynamics have a strong negative correlation with changes in current account dynamics, both within and across countries. The strong correlation holds both during the period of housing booms (mid-1990s to around 2006), and during the period of housing busts (2007-2012). Figure 2 shows the cross-country correlations. Figure 3 focuses on the within-country correlations. The left column of Figure 2 contains scatterplots of changes in housing variables and changes in the current account ratios between 1996 and 2006, while the right column redoes the scatterplots for the period from 2007 through 2012. Housing variables and the current account had monotonic behavior between these dates. Countries that experienced housing booms also had larger current account deficits. Moreover, the current account reversals coincided with the decline in housing markets.[3] The heterogeneity within Europe is especially interesting, because the European Union as a whole had a nearly balanced current account.

# 3 Model

There is a domestic and a foreign country. In both countries, there is a housing sector, which is non-tradable, and a sector producing tradable goods. All trade between countries is intertemporal since there is only one tradable good.

## 3.1 Domestic Households

At period $t$ there is a mass $N_{d,t}$ of infinitely-lived domestic households who can be patient or impatient. These two types differ in three dimensions: 1) The discount factor for the patient households is larger than for the impatient households ($\beta_p > \beta_i$).[4] 2) The impatient households face a collateral constraint that limits their borrowings to a fraction of the discounted expected value of the houses they hold. 3) Patient domestic households have access to two types of one-period bonds: an international bond, $\hat{B}$, with real interest rate $\hat{R}$, to borrow or save with the foreign households; and domestic bonds, $B$, with real interest rate $R$, to lend to the domestic impatient households. A non-arbitrage condition governs the relation between the two types of bonds. The impatient domestic households can only borrow from the domestic patient households. This is a simplifying assumption without loss of generality. In fact, the impatient domestic households can borrow from the foreign households through the domestic

[3] Anecdotal evidence suggests that emerging markets also followed the patterns reported in Figure 3.

[4] This is a standard mechanism to allow for credit relations in which the impatient household borrow from the patient household (Iacoviello 2005).

patient households, who in that regard behave as financial intermediaries.

Households supply labor inelastically in their home country. Every period in the domestic country, there are $(1-\phi) N_{d,t}$ patient households, and $\phi N_{d,t}$ impatient households. The parameter $\phi$ controls both the share of impatient households over the total domestic population, and their share in the income of the domestic country. The total population of the domestic country, $N_{d,t}$, can change over time to analyze how population dynamics affect housing markets.

### 3.1.1 Domestic Patient Households

There is a representative domestic patient household that maximizes the expected utility of its members

$$E_0 \sum_{t=0}^{\infty} \beta_p^t (1-\phi) N_{d,t} u\left(c_{d,t}^p, h_{d,t}^p\right), \tag{1}$$

where $c_{d,t}^p$ and $h_{d,t}^p$ are the per capita consumption of tradable goods and housing. The flow of housing consumption is equal to the per capita stock of housing. Preferences are constant relative risk aversion over a constant elasticity of substitution aggregator of housing services and tradable goods consumption

$$u\left(c_{d,t}^p, h_{d,t}^p\right) = \frac{\left[\left[(1-\theta)\left(c_{d,t}^p\right)^{\frac{\varepsilon-1}{\varepsilon}} + \theta\left(h_{d,t}^p\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}\right]^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}, \tag{2}$$

where $\sigma$ is the elasticity of intertemporal substitution as well as the inverse of the coefficient of relative risk aversion. $\varepsilon$ is the static, or intratemporal, elasticity of substitution between housing and tradable goods consumption. $\theta \in (0,1)$ is a parameter that affects the share of consumption of housing services in total expenditure.

The aggregate variables for the domestic patient households are: $C_{d,t}^p = (1-\phi) N_{d,t} c_{d,t}^p$, $H_{d,t}^p = (1-\phi) N_{d,t} h_{d,t}^p$, $B_{d,t}^p = (1-\phi) N_{d,t} b_{d,t}^p$, and $\hat{B}_{d,t} = (1-\phi) N_{d,t} \hat{b}_{d,t}$. $\hat{b}_{d,t}$ are the patient households' per capita holdings of the international bond, and $b_{d,t}^p$ are the per capita holdings of domestic bonds.

The budget constraint for the representative domestic patient household is

$$\begin{aligned} &C_{d,t}^p + B_{d,t}^p + \hat{B}_{d,t} + q_{d,t}\left(H_{d,t}^p - (1-\delta) H_{d,t-1}^p\right) + (1-\phi) N_{d,t} \frac{\psi_B}{2} \hat{b}_{d,t}^2 = \\ &= R_{t-1} B_{d,t-1}^p + \hat{R}_{t-1} \hat{B}_{d,t-1} + (1-\phi) I_{d,t}, \end{aligned} \tag{3}$$

where $q_{d,t}$ is the price of a domestic house in terms of tradable goods, $\delta$ is the house depreciation rate, $R_t$ is the domestic gross real interest rate, $\hat{R}_t$ is the international gross real interest rate, $I_{d,t}$ is the households' income (to be defined below), $\psi_B$ is the parameter that controls the adjustment costs in the holdings of international bonds. The adjustment costs ensure that there is a unique steady state (Schmitt-Grohe and Uribe 2003).

The first order conditions of the domestic patient households give the non-arbitrage restriction between the return of the two bonds:

$$R_t \left[1 + \psi_B \hat{b}_{d,t}\right] = \hat{R}_t. \tag{4}$$

Both bonds give the same return when the adjustment cost goes to zero, as well as in the steady state.

### 3.1.2 Domestic Impatient Households

The representative domestic impatient household maximizes the expected utility of its members

$$E_0 \sum_{t=0}^{\infty} \beta_i^t \phi N_{d,t} u(c_{d,t}^i, h_{d,t}^i), \tag{5}$$

$$u\left(c_{d,t}^i, h_{d,t}^i\right) = \frac{\left[\left[(1-\theta)\left(c_{d,t}^i\right)^{\frac{\varepsilon-1}{\varepsilon}} + \theta\left(h_{d,t}^i\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}\right]^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}, \tag{6}$$

where all variables are as defined for the patient household, but now they have the superscript of the impatient household. I assume that $\beta_i < \beta_p$. The aggregate variables for the impatient households are $C_{d,t}^i = \phi N_{d,t} c_{d,t}^i$, $H_{d,t}^i = \phi N_{d,t} h_{d,t}^i$ and $B_{d,t}^i = \phi N_{d,t} b_{d,t}^i$.

The representative domestic impatient household chooses per capita housing, tradable consumption, and domestic bond holdings $\left(b_{d,t}^i\right)$ to maximize (5) – (6) subject to her aggregate budget constraint:

$$C_{dt}^i + B_{dt}^i + q_{dt}\left(H_{dt}^i - (1-\delta) H_{dt-1}^i\right) = R_{t-1} B_{d,t-1}^i + \phi I_{d,t}. \tag{7}$$

Impatient households' per capita borrowings cannot be larger than a fraction $m_t$ of the discounted future value of their current houses. That is,

$$b^i_{dt} = \frac{-m_t E_t \left(q_{d,t+1} h^i_{dt}\right)}{R_t}. \tag{8}$$

## 3.2 Domestic Firms

Firms produce tradable goods ($Y_T$) using labor ($N_T$). Tradable goods can be used for consumption by households in both countries, or as housing appliances ($Y_a$). New houses ($Y_h$) are produced using non-tradable housing structures ($Y_s$), and tradable goods to which I refer as the housing appliances. The housing structures are built using labor ($N_s$) and land ($L$). The production functions are:

$$Y_{Td,t} = N^{\alpha}_{Td,t}, \tag{9}$$

$$Y_{sd,t} = \left[N^{\alpha}_{sd,t}\right]^{\gamma} L_d^{1-\gamma}, \tag{10}$$

$$Y_{hd,t} = \min\left(Y_{sd,t}, \tau Y_{ad,t}\right), \tag{11}$$

where $\alpha$, $\gamma$, $\tau$ are parameters. Every period there is an exogenous flow of land $L$. The subscript $d$ denotes domestic variables. The Leontief assumption in (11) captures the complementarities between tradable and non-tradable goods in producing houses. It implies that, in equilibrium,

$$Y_{sd,t} = \tau Y_{ad,t}.$$

There is a quadratic adjustment cost ($\psi_n$) to moving labor across sectors. The cost is paid in units of tradable goods. Since the domestic households own the firm and the land, households' income is the firms' revenue from selling new houses and new tradable goods net of the appliances used to produce houses and the adjustment costs:

$$I_{d,t} = q_{d,t} Y_{hd,t} + Y_{Td,t} - Y_{ad,t} - \frac{\psi_n}{2}\left(N_{sd,t} - N_{sd,t-1}\right)^2. \tag{12}$$

## 3.3 Foreign Country

To simplify, I assume there are only patient unconstrained households in the foreign country. The representative foreign household chooses per capita consumption of tradable goods, non-tradable foreign housing, and international bonds $\left(\hat{b}_{f,t}\right)$ to maximize

$$E_0 \sum_{t=0}^{\infty} \beta_p^t N_{f,t} u(c_{f,t}, h_{f,t}), \tag{13}$$

$$u(c_{f,t}, h_{f,t}) = \frac{\left[\left[(1-\theta) c_{f,t}^{\frac{\varepsilon-1}{\varepsilon}} + \theta h_{f,t}^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}\right]^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}. \tag{14}$$

subject to her aggregate budget constraint:

$$C_{f,t} + \hat{B}_{f,t} + q_{f,t}\left(H_{f,t} - (1-\delta) H_{f,t-1}\right) + N_{f,t} \frac{\psi_B}{2} \hat{b}_{f,t}^2 = \hat{R}_{t-1} \hat{B}_{f,t-1} + I_{f,t}. \tag{15}$$

The aggregate variables for the foreign households are $C_{f,t} = N_{f,t} c_{f,t}$, $H_{f,t} = N_{f,t} h_{f,t}$ and $\hat{B}_{f,t} = N_{f,t} \hat{b}_{f,t}$.

Foreign firms have the same technology as domestic firms:

$$Y_{Tf,t} = N_{Tf,t}^{\alpha}, \tag{16}$$

$$Y_{sf,t} = \left[N_{sf,t}^{\alpha}\right]^{\gamma} L_f^{1-\gamma}, \tag{17}$$

$$Y_{hf,t} = \min\left(Y_{sf,t}, \tau Y_{af,t}\right), \tag{18}$$

where $N_{Tf,t}$ and $N_{sf,t}$ are the amounts of labor allocated to tradable goods and the housing sector in the foreign country. The income of foreign households is the total revenue of the foreign firms:

$$I_{f,t} = q_{f,t} Y_{hf,t} + Y_{Tf,t} - Y_{af,t} - \frac{\psi_n}{2}\left(N_{sf,t} - N_{sf,t-1}\right)^2. \tag{19}$$

## 3.4 Market Clearing

In each country, the labor used to produce in the two sectors must equal the total labor supply:

$$N_{Td,t} + N_{sd,t} = N_{d,t}, \tag{20}$$

$$N_{Tf,t} + N_{sf,t} = N_{f,t}. \tag{21}$$

The increase in the housing stock is the new houses produced minus the depreciation:

$$H^i_{d,t} + H^p_{d,t} - (1-\delta)\left(H^i_{d,t-1} + H^p_{d,t-1}\right) = Y_{hd,t}, \tag{22}$$

$$H_{f,t} - (1-\delta) H_{f,t-1} = Y_{hf,t}. \tag{23}$$

Tradable goods are used for consumption, as housing appliances, and to pay for the portfolio and labor movement adjustment costs:

$$C_{ft} + C^p_{d,t} + C^i_{d,t} + Y_{ad,t} + Y_{af,t} + (1-\phi) N_{d,t}\frac{\psi_B}{2}\hat{b}^2_{d,t} + N_{ft}\frac{\psi_B}{2}\hat{b}^2_{f,t}$$
$$= Y_{Td,t} + Y_{Tf,t} - \frac{\psi_N}{2}(N_{sd,t} - N_{sd,t-1})^2 - \frac{\psi_N}{2}(N_{sf,t} - N_{sf,t-1})^2$$

The net supply of domestic bonds between the patient and impatient households equals zero:

$$B^p_{d,t} + B^i_{d,t} = 0. \tag{24}$$

The net supply of international bonds between the two countries equals zero:

$$\hat{B}_{d,t} + \hat{B}_{f,t} = 0. \tag{25}$$

The trade balance is the difference between the tradable goods produced and those consumed:

$$TB_{d,t} = Y_{Td,t} - Y_{ad,t} - C^p_{d,t} - C^i_{d,t} - (1-\phi) N_{d,t}\frac{\psi_B}{2}\left(\hat{b}_{d,t}\right)^2 - \frac{\psi_n}{2}(N_{sd,t} - N_{sd,t-1})^2.$$

While the current account is the change in the net foreign asset position:

$$CA_{d,t} = \hat{B}_{d,t} - \hat{B}_{d,t-1}. \tag{26}$$

# 4 Calibration

I calibrate the model using aggregate and micro data from OECD countries, although for some series only U.S. data were available. Some parameters are exogenously selected based on values that are common in the literature, or on micro-evidence. The other parameters are selected for the steady state of the model to match some key statistics. In the steady state there is no international debt $\left(\hat{B}_d = 0\right)$. I assume that one period in the model is one year.

1. *Exogenously selected parameters.* For the intertemporal elasticity of substitution $(\sigma)$, I follow the real business cycle literature that usually assumes $\sigma = \frac{1}{2}$, which under CRRA preferences implies a value for risk aversion of 2. Concerning the elasticity of substitution between consumption of goods and housing services, several papers have argued for elasticities below 1, implying complementarity between tradable goods and housing services. For example, Davidoff and Yoshida (2008) obtain estimates for this elasticity ranging from 0.4 to 0.9. Kahn (2008) provides evidence based on both aggregate and microeconomic data that is less than one. Lustig and Van Nieuwerburgh (2006) use 0.05 to match the volatility of U.S. rental prices in an asset pricing model with housing collateral. Flavin and Nakagawa (2002) estimate 0.13 between housing and nondurable consumption (proxied by food consumption at home and eaten out). Since a key element of housing in my model is its nontradability, I work with $\varepsilon = 0.4$, a value close to the estimate in Tesar (1993) that the elasticity between traded and nontraded goods is 0.44.

I assume the same labor share across sectors and set it to the standard $\alpha = 0.67$. For the depreciation of the stock of houses, I use 2% annual depreciation, $\delta = 0.02$, which is consistent with the report from the Bureau of Economic Analysis (2004) that annual depreciation rates for one-to-four-unit residential structures are between 1.1% and 3.6%.

2. *Endogenously selected parameters.* I set the discount factor of the patient households to $\beta^p = 0.97$ to target a 3% annual real interest rate in the steady state. As discussed in Iacoviello and Neri (2010), the impatient households' discount factor $(\beta^i)$ needs to be small enough to guarantee that the borrowing constraint (8) is always binding. For an annual model, I choose $\beta^i = 0.85$, which is within the range of values used in the literature. For example, in quarterly models, Iacoviello (2005) chooses $\beta^i = 0.95$ while Punzi (2013) uses $\beta^i = 0.98$. Ferrero (2014) argues that the choice of $\beta^i$ depends on the change in the LTV ratio. In a quarterly model, he chooses $\beta^i = 0.96$ when the LTV changes from 0.75 to 0.99, and a smaller $\beta^i = 0.89$, when the LTV changes from 0.85 to 0.95.

There is no consensus in the literature regarding the share of households whose borrowing is constrained. This is an important parameter for the reaction of the domestic economy to LTV shocks. In the standard life-cycle model with one risk-free asset, the fraction of constrained households is very small (usually below 10%) under parameterizations where the model's distribution of net worth is in line with the data (Heathcote et al. 2009). On the other extreme, Ferrero (2014) assumes that 100% of households face borrowing constraints. Iacoviello (2005) estimates that 64% of the wage income goes to the patient households. I assume that 40% of the domestic households are impatient $(\phi = 0.4)$. This number is consistent with recent papers which measure the share of constrained households using data on liquidity constrained households. For example, Justiniano et al. (2014), using different U.S. Surveys of Consumer Finances (SCF), estimate that these households represent 61% of the population and 46% of the labor income. Kaplan and Violante (2014) find that between 25% and 66% of households hold sizeable amounts of illiquid wealth, yet consume all of their disposable income during a pay-period. Lusardi et al. (2011) show that 25% of U.S. households are certainly unable to "come up with $2,000 within a month", and 49% probably could not come up with the $2,000 at all.

I choose the steady state value of the LTV parameter, $m = 0.92$, to match the 1994 median LTV for first-time home buyers (the most important marginal group of home buyers), as computed by Duca et al. (2011). I normalize population to be one in the steady state. The remaining six parameters ($\tau$, $\theta$, $\gamma$, $\psi_n$, $\psi_B$, $\frac{L_d}{N_d}$) control the size of the housing sector, appliances and the elasticity of the housing supply. I calibrate them to match the following six targets in a world with symmetric country sizes in the steady state:[5] 1) A ratio of residential investment to output of 5%. This is the U.S. long-term average. 2) A ratio of spending on housing services relative to consumption of durables and services of 17% (Davis and Van Nieuwerburgh 2014). The level of housing costs in household budgets varies from 16% to 27% in the OECD countries (OECD 2011). 3) The average homebuyer spends around 5% of the value of their house on appliances, furnishings, and remodeling activities (Siniavskaia 2008). 4) The share of employment in the construction sector is 5% (Boldrin et al. 2013). 5) The aggregate housing price-to-rent ratio is 22 (Davis et al. 2008). 6) An average price-elasticity of housing supply equal to 1.15 over the first two years. This value is consistent with the evidence for OECD economies of Caldera and Johansson (2013). The parameters of the calibrated model are summarized in Table 1.

# 5 Impulse Responses

To illustrate how the model connects housing and current account dynamics, this Section analyzes impulse responses for different values of the parameters. First, Figure 4 reports the responses to an increase in the expectations of domestic housing prices for high and low housing supply elasticity. When the land share in structures is high ($\gamma$ is low) housing supply is inelastic since most of the structures are land, which is exogenously fixed. All panels of Figure 4 assume that the share of impatient households is zero ($\phi = 0$) to shut down the collateral consumption channel which is analyzed in Figure 5. Figure 4 shows that the current account reacts more when housing supply is elastic. This is because construction needs tradable goods (housing ap-

[5] That is, $N_d = N_f$, $L_d = L_f$.

pliances), and because the reallocation of labor towards nontradables (construction) encourages imports of consumption goods to smooth the opportunity cost of building new houses, which is the foregone production of tradable goods. By importing consumer tradables the economy can build non-tradables while still consuming tradables.[6]

Figure 5 reports the responses to the same shock than in Figure 4 but alters the share of impatient households ($\phi$). The current account reacts much more when the share of impatient households is large. Higher expected housing prices leads to higher current prices, more collateral value of housing and larger borrowing by the constrained households. These households, given their low discount factor, allocate most of their new borrowing into consumption of the non-durable good, which is tradable (Figure 5c). This accounts for the larger current account deficit of Figure 5d. However, as Figure 5b plots, if the share of impatient households is large enough the collateral mechanism leads to a counterfactual observation: the housing price-to-rent ratio decreases.[7] Housing prices (the value of the housing asset) increase less than housing rents (the value of the housing flow) because the collateral channel encourages the consumption by the impatient households, who value less the durable good.

# 6 Simulations

This Section simulates the model for three sets of exogenous shocks. One set has only the housing demand drivers: population, LTV and housing price expectations. In the figures I refer to this set of shocks as "Model, housing drivers". The second set only has a shock to the foreign discount factor ("Model, savings glut" in the figures). The third set of shocks is the combination of the housing and savings glut shocks (I refer to this set as "Model, housing drivers + savings glut"). Section 6.1 discusses how I use data to discipline the exogenous shocks. Then I input the exogenous shocks into the model and report the reactions of its endogenous variables comparing them with OECD data.[8] This is the same methodology that Garriga et al. (2012) and Justiniano et al. (2014) use to analyze U.S. housing markets, and how Meza and Urrutia (2011) study exchange rates and net exports dynamics. The goal is to evaluate

[6] Gete (2009) analyzes theoretically this mechanism.

[7] The relation between the rental and house price is

$$q_t = p_{l,t} + \beta(1-\delta)E_t\left[q_{t+1}\frac{u_{c,t+1}}{u_{c,t}}\right],$$

where $p_{l,t}$ is the rental rate and $u_{c,t}$ the marginal utility of consumption.

[8] The model is solved using a nonlinear Newton-type algorithm (Adjemian et al. 2011) for a perfect foresight version.

the ability of the model and its driving forces to account for both housing and current account dynamics.

## 6.1 Driving Forces

As driving forces I use savings glut shocks and three drivers of housing markets:

1) Housing price expectations that I measure from survey data collected by Case et al. (2012). They surveyed around 5000 recent homebuyers in four U.S. counties regarding the nominal housing prices they expected to see next year.[9] To construct series of expectations of real prices I merge the Case et al. (2012) data with the inflation expectations from the Michigan Survey of Consumers. The top panel of Figure 6 compares the expectations of real housing prices (dashed lines) for each county with the realized housing prices (solid lines).[10] The bottom panel of Figure 6 redoes the top panel but for the expectations of housing price growth. Figure 6 shows that households underestimated housing price growth until 2005. When I give shocks to housing price expectations I impose them to generate expectations close to those reported in Figure 6.[11] This can be seen in Figure 7c, which contains the exact expectations that the model uses and also the data from Figure 6. In the case with only the savings glut shock the housing expectations are fully rational and totally endogenous (model line denoted as "Model, savings glut").

2) The model line in Figure 7a plots the dynamics of population used for the model simulations. It is close to the experiences of Spain and the U.S. In these countries immigration led to nearly a 20% increase in population between 1994 and 2006.

3) Figure 7b plots the median LTV series for first time home buyers estimated by Duca et al. (2011) and the series I feed into the model (variable $m_t$). The U.S. data estimated by Duca et al. (2011) clearly show an increase in loan-to-values from the mid-1990s until 2006, at which point a reversal occurred. I could not find an equivalent series for more countries, but anecdotal

[9] To my knowledge, Case et al. (2012) is the longest survey with quantitative data on expected housing price growth. The data start in 2003. Table 41 in the Michigan Survey, which has been available since 1978, offers qualitative answers to the question of when is a good time to buy a house. To interpolate the series of expectations back to 1994, I used the average growth of real expected house prices computed with the Case et al. (2012) data for 2003-2006. The series are consistent with the qualitative answers from Table 41 of the Michigan Survey.

[10] I computed the realized prices using housing prices from Freddie Mac and inflation from the Bureau of Labor Statistics.

[11] Technically, when I input price expectations in the Euler equations I replace $q_{d,t+1}$ by an expected price $q^e_{d,t+1} = q_{d,t+1} + e_t$. Then, I input a series of $e_t$ shocks such that $q^e_{d,t+1}$ matches the data from Case et al. (2012). In steady state there are no expectation shocks and expectations match realized house prices. Garriga et al. (2012) use a similar methodology to give shocks to expectations.

evidence suggests LTV ratios were relaxed in many other countries. For example, Akin et al. (2014) document how the manipulation on appraisal values permitted Spanish banks to lend at higher LTV ratios than what banking regulations allowed. I assume that the LTV returns to the steady state in about 30 years. The results that I obtain for the housing boom are very similar to Justiniano et al. (2014), who also matched Duca's LTV series up to 2006 but then assumed that the agents take the 2006 LTV levels as permanent.

4) Figure 7d shows that the housing drivers alone generate counterfactual dynamics for interest rates. Higher housing demand increases credit demand and interest rates rise to achieve equilibrium. The foreign savings glut is a credit supply shock which can generate the right path for interest rates. Higher demand for savings from the foreigners leads to lower rates. To discipline the foreign discount factor shocks I impose that the model generates real interest rates with a downward trend as in Figure 7d.

## 6.2 Endogenous Dynamics

Figure 8 contains the endogenous reaction of the model when I input the driving forces discussed above. Panels a, b, c and d contain the reaction of the housing variables in the domestic economy (housing prices, price-to-rent ratios, employment in construction and residential investment). The model driven by the three housing drivers generates housing dynamics quite similar, both in terms of the size of the changes; and in the turning points, to the data from the countries. The dynamics of the current account are also consistent with the data. However, the three housing drivers fail to generate decreases in real interest rates (Figure 7d).

The model driven only by savings glut shocks replicates the dynamics of real interest rates but fails to generate the right comovement between housing prices and price-to-rent ratios. Impatient households are the most sensitive to interest rate changes and they value more the flow of housing (rental rate) than the stock (housing prices). Garriga et al. (2012) pointed out a similar problem: when their perfect foresight model generates decreasing interest rates it cannot explain both the dynamics of the price-to-rent ratio and of housing prices.[12] Here the model can better match the data because the expected increases in housing prices from the Case et al. (2012) survey lead to an increase in the asset value of housing.

Combining housing drivers and savings glut shocks allow to account for both housing and interest rate dynamics. Higher expected prices encourage demand for homeownership, not for

[12] Shocks to the preferences for housing, which drive housing dynamics in most of the macro-housing literature, would also generate counterfactual price-to-rent ratios and interest rates because they increase the preference for the housing flow.

rental. Foreign demand for savings lowers interest rates.

Panels e and f of Figure 8 report the domestic and foreign current account dynamics. Like in the data, the countries with an increase in housing prices and residential investment run a current account deficit. Increases in housing prices soften collateral constraints, the constrained households borrow more and allocate most of their borrowings to consumption of tradable goods, thus pushing the current account towards a deficit. Moreover, the construction sector imports tradable goods as housing appliances or furniture. The foreign economy runs a current account surplus while lending to the housing booming country.

The reversal of the current account in the domestic economy is driven by the collapse of the housing boom. Lower housing prices tighten collateral constraints and reverse the imports for consumption. Moreover, activity in the construction sector slows with the collapse of employment in construction after 2007 (Panels c and d in Figure 8). Once the housing boom is gone in the domestic economy, the foreign economy starts to run a current account deficit, and housing prices and residential investment increase. These dynamics are very similar to those of countries like Canada.

# 7 Counterfactuals

Following the recent financial crisis, many countries have imposed regulations capping LTV around 80% (Claessens et al. 2014). Moreover, it does not seem likely that in the short-run households' expectations of housing prices display the optimism of the housing boom period. Figure 9 analyzes the implications of this new environment for current account dynamics. It compares the combination of the housing and savings glut shocks that provided the best match to the data in Figure 8 ("Model, housing drivers + savings glut"), with two counterfactuals. In both counterfactuals LTV is fixed at 80% (Figure 9a) and the savings glut and population dynamics are as in Figure 8. However, in one case housing prices are expected to increase by 2% annually, while in the other case housing prices are expected to decrease 5% in the short run and then later on increase by 1% annually.

Figure 9 shows that, even if the savings glut persists, lower housing demand translates into lower interest rates, lower housing dynamics and a smaller current account deficit. Thus, the counterfactuals suggest that it is unlikely to have a comeback of the Global Imbalances as long as housing markets do not repeat the dynamics of the decade before the financial crisis.

# 8 Conclusions

This paper documented a strong correlation, both across and within countries, between housing and current account dynamics over the decade before the 2007 financial crisis and also in the years after it. Then, using a quantitative two-country model, I showed that the combination of housing demand drivers and savings glut shocks can generate housing booms and busts together with the emergence and contraction of large current account deficits. The dynamics are similar to the OECD data, also for the interest rate. The model does not use exchange rate driven expenditure switching to account for the data. Counterfactuals using the model suggest that the large Global Imbalances of the mid-2000s are a past phenomenon unlikely to return as long as LTVs are regulated and housing expectations are not very optimistic.

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# Tables

**Table 1: Parameters**

| *Description* | *Parameter* | *Value* |
|---|---|---|
| Patient households' discount factor | $\beta^p$ | 0.97 |
| Impatient households' discount factor | $\beta^i$ | 0.85 |
| Share of impatient households | $\phi$ | 0.4 |
| Intertemporal elasticity of substitution | $\sigma$ | 0.5 |
| Intratemporal elasticity of substitution | $\varepsilon$ | 0.4 |
| Housing depreciation rate | $\delta$ | 0.02 |
| Ratio of housing appliances over structures | $\frac{1}{\tau}$ | 0.2 |
| LTV parameter | $m$ | 0.92 |
| Share of housing services in utility | $\theta$ | 0.18 |
| Labor share in production | $\alpha$ | 0.67 |
| Land share in housing production | $1-\gamma$ | 0.2 |
| Steady state population | $N_d = N_f$ | 1 |
| Land supply per capita | $\frac{L_d}{N_d} = \frac{L_f}{N_f}$ | $10^{-5}$ |
| Labor adjustment cost | $\psi_n$ | 7 |
| Adjustment cost on international bond | $\psi_B$ | 0.045 |

# Figures

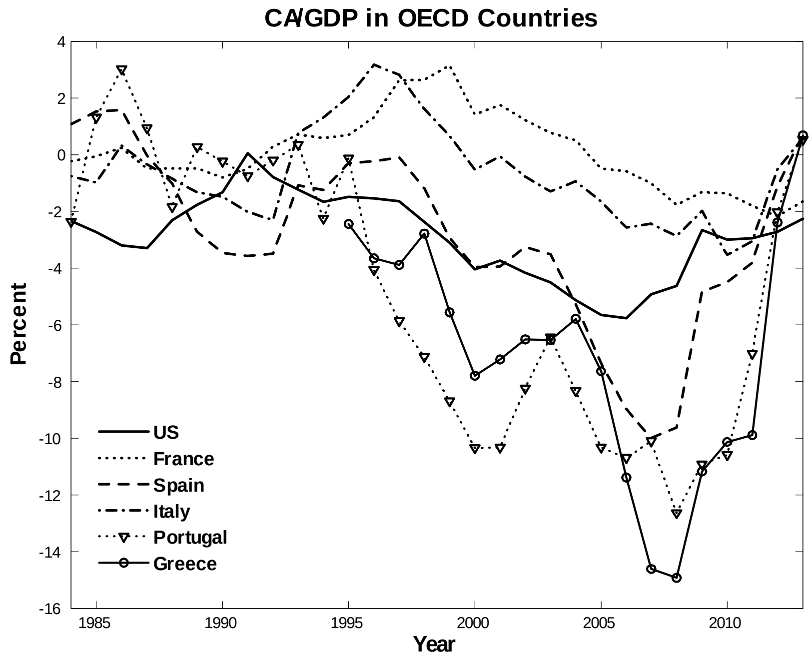


**Figure 1. Ratio of the Current Account to GDP for some OECD Countries.**

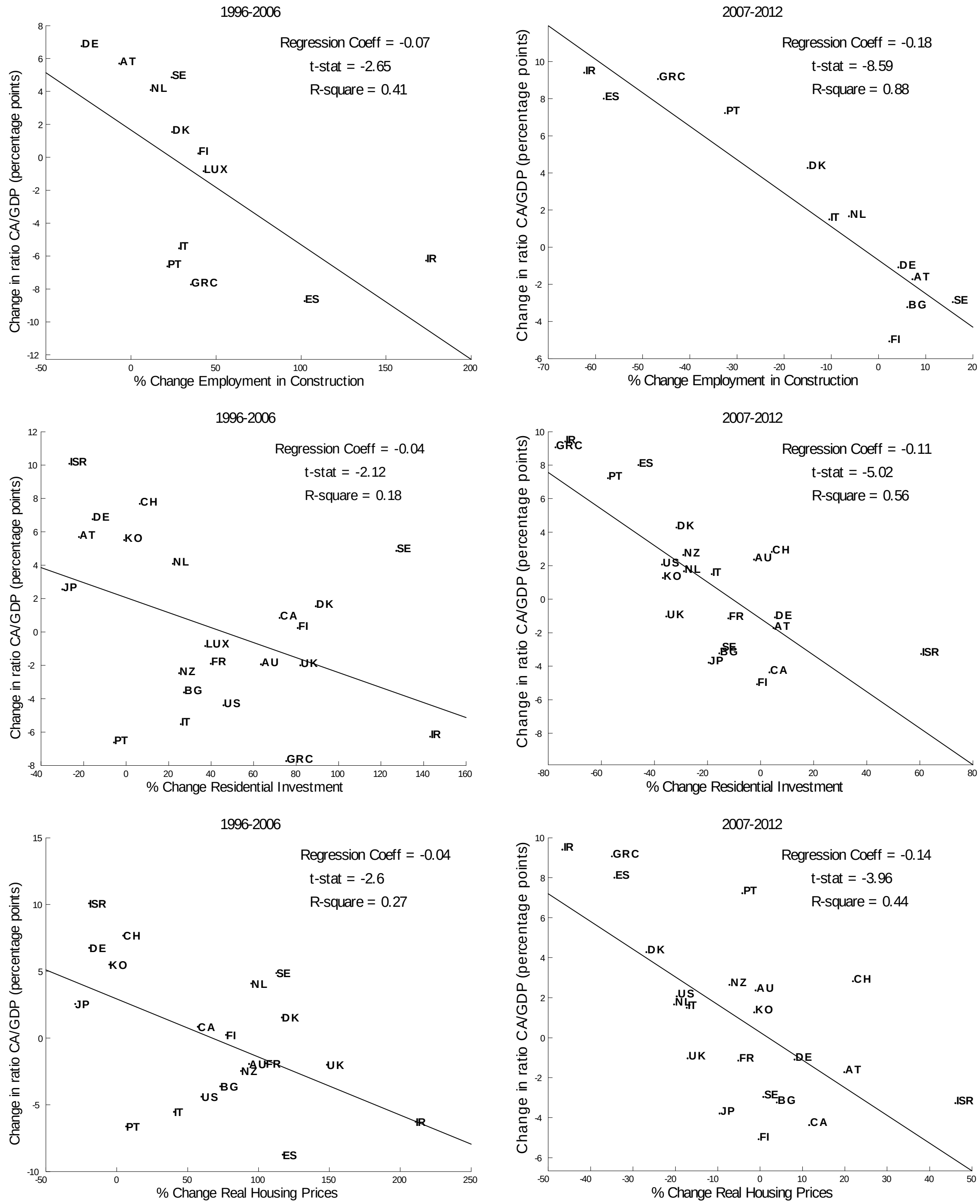


**Figure 2. Cross-Country Correlations between Changes in the Current Account to GDP ratio and Changes in Housing Variables.** The first row is the scatter-plot of the change in the current account to GDP ratio against the change in the share of employment in construction. The second and third rows replace the x-axis with the change in residential investment and with the change in housing prices, respectively. The left column shows the 1996-2006 period, while the right column displays the 2007-2012 period. Data source: OECD.

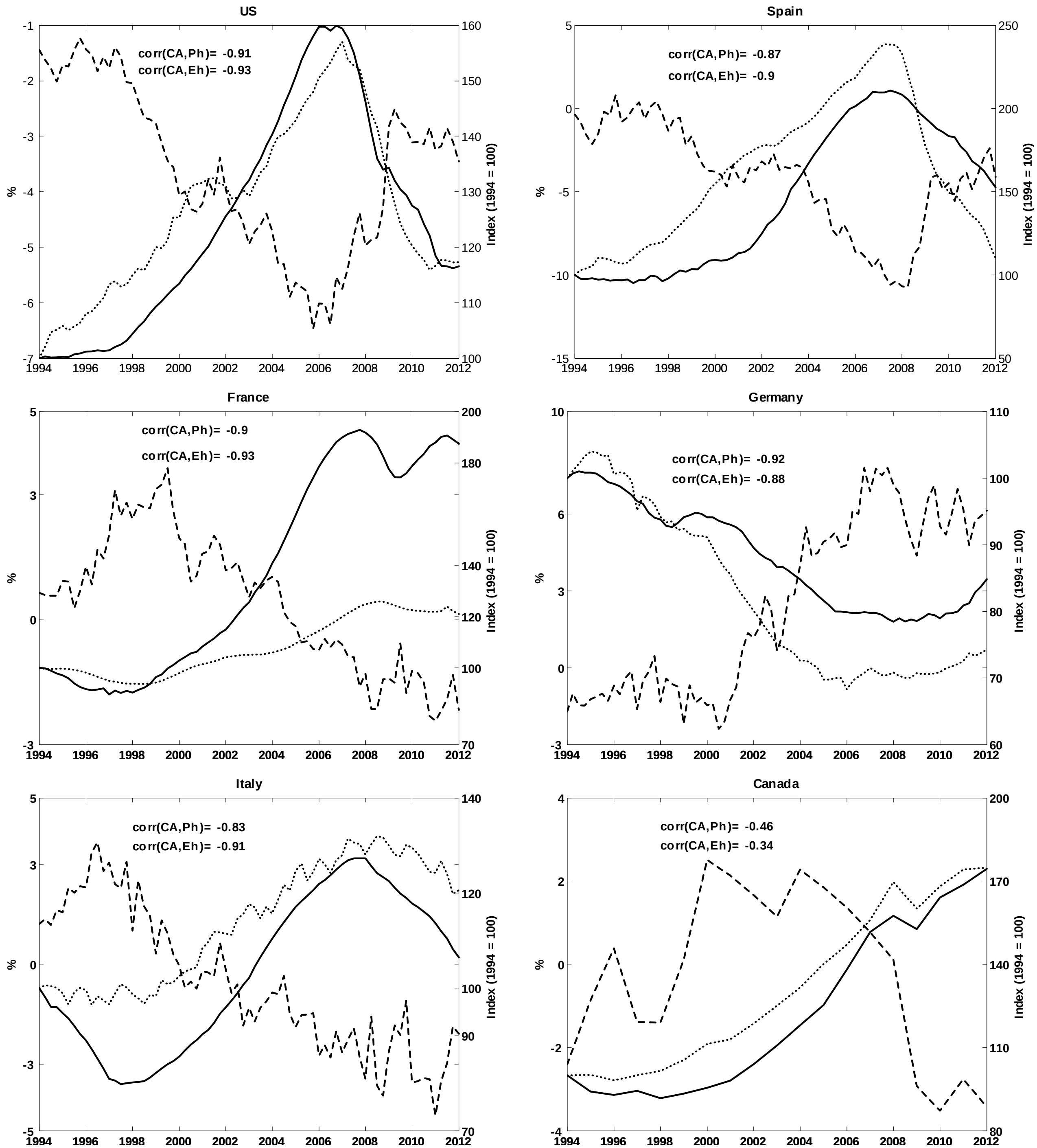


**Figure 3. Within-Country Correlations between the Current Account (CA), Employment in Construction (Eh) and Housing Prices (Ph).** Each panel shows the dynamics of the current account to GDP ratio (dashed line with scale in the left axis), employment in construction (dotted line with scale in the right axis) and housing prices (solid line with scale in the right axis) in an OECD country. The correlations are also displayed. Data source: OECD.

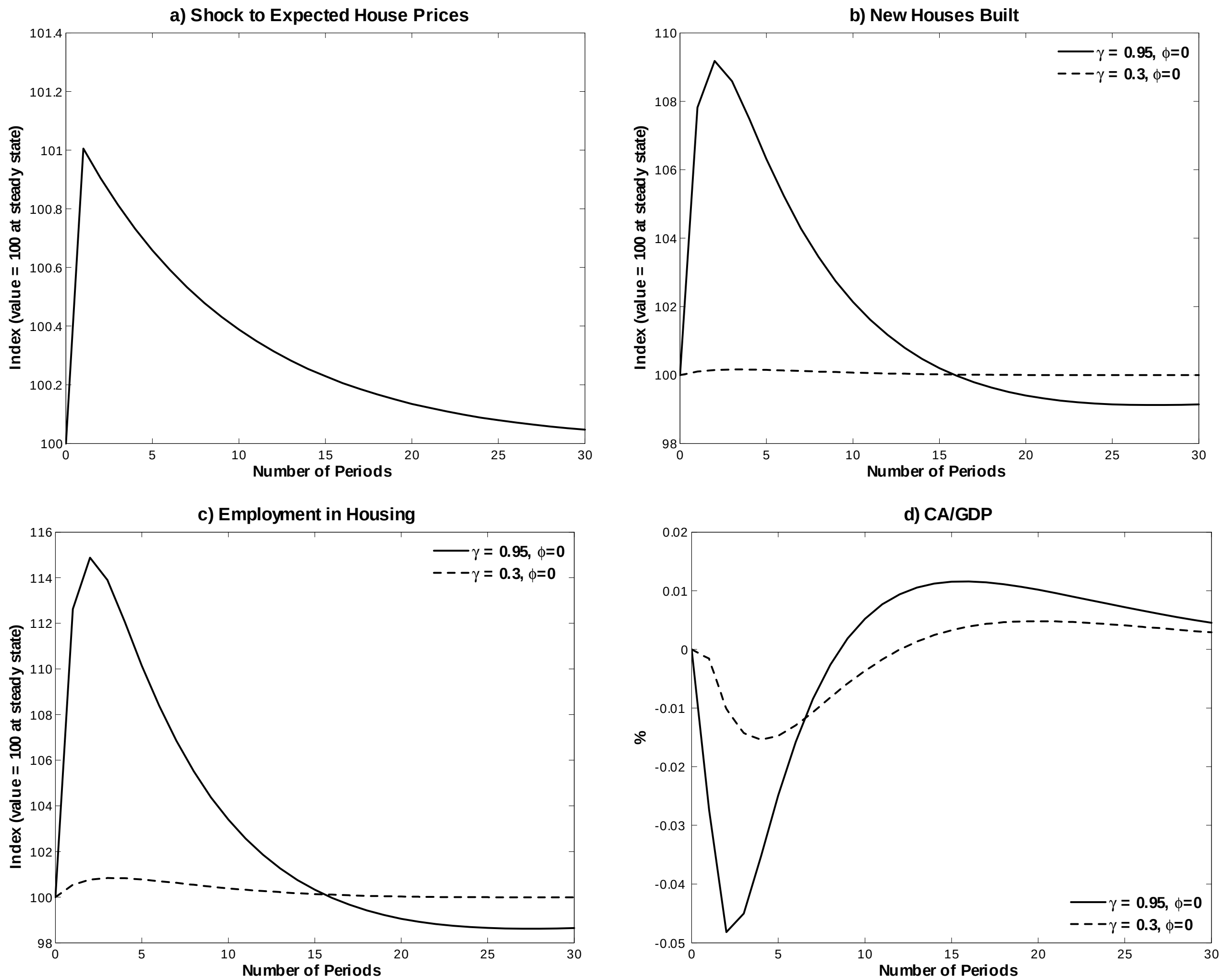


**Figure 4. Responses for different housing supply elasticities.** These panels compare impulse responses to an increase in the expectations of domestic housing prices when the supply of new structures is elastic (low land share, high $\gamma$) and when it is not (low $\gamma$). All panels are for the domestic economy. In all panels there are no impatient households ($\phi = 0$) to shut down the collateral channel.

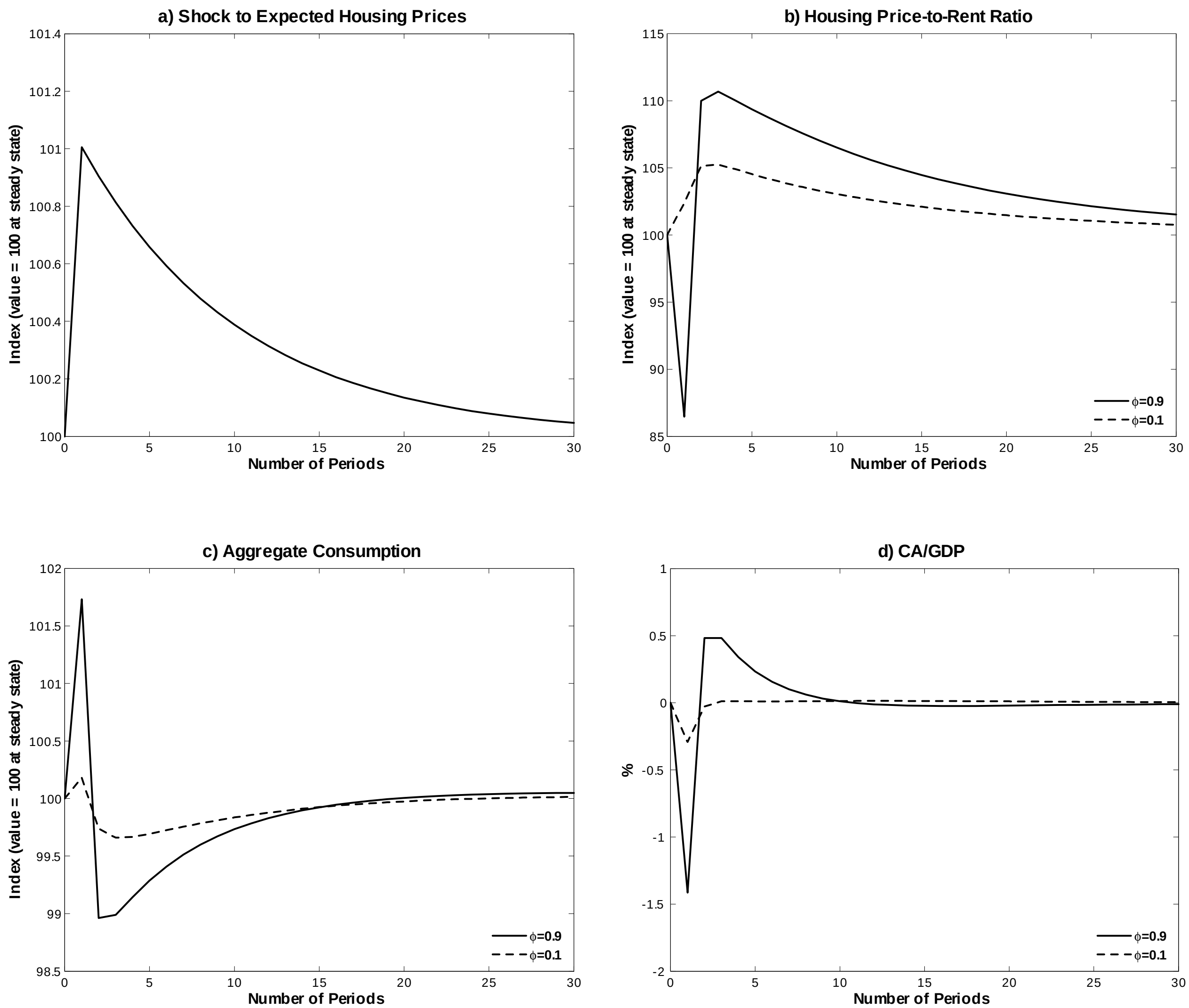


**Figure 5. Comparative statics on population share of impatient households.** This figure compares impulse responses to an increase in the expectations of domestic housing prices when the share of the population composed by impatient households ($\phi$) is high or low. All panels are for the domestic economy.

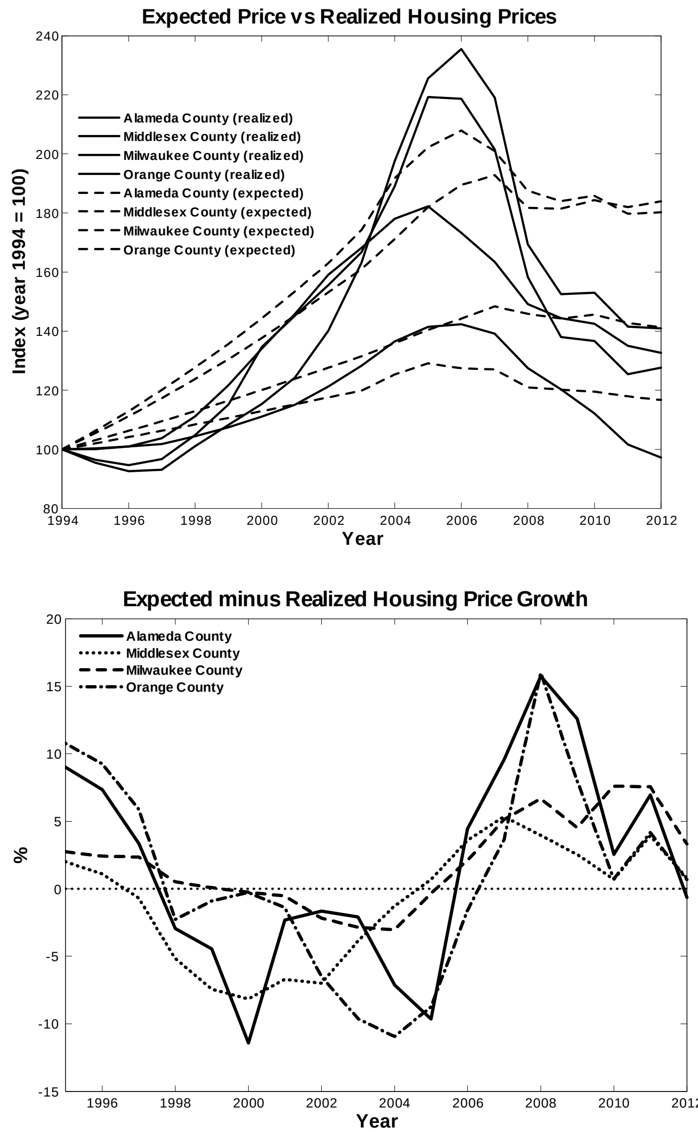


**Figure 6. Comparing expectations from Case et al. (2012) with realized house prices.** The top panel compares the survey data on real house price expectations (dashed lines) from Case et al. (2012) with the realized real house prices for those counties. The bottom panel redoes the comparison for the growth rate of house prices.

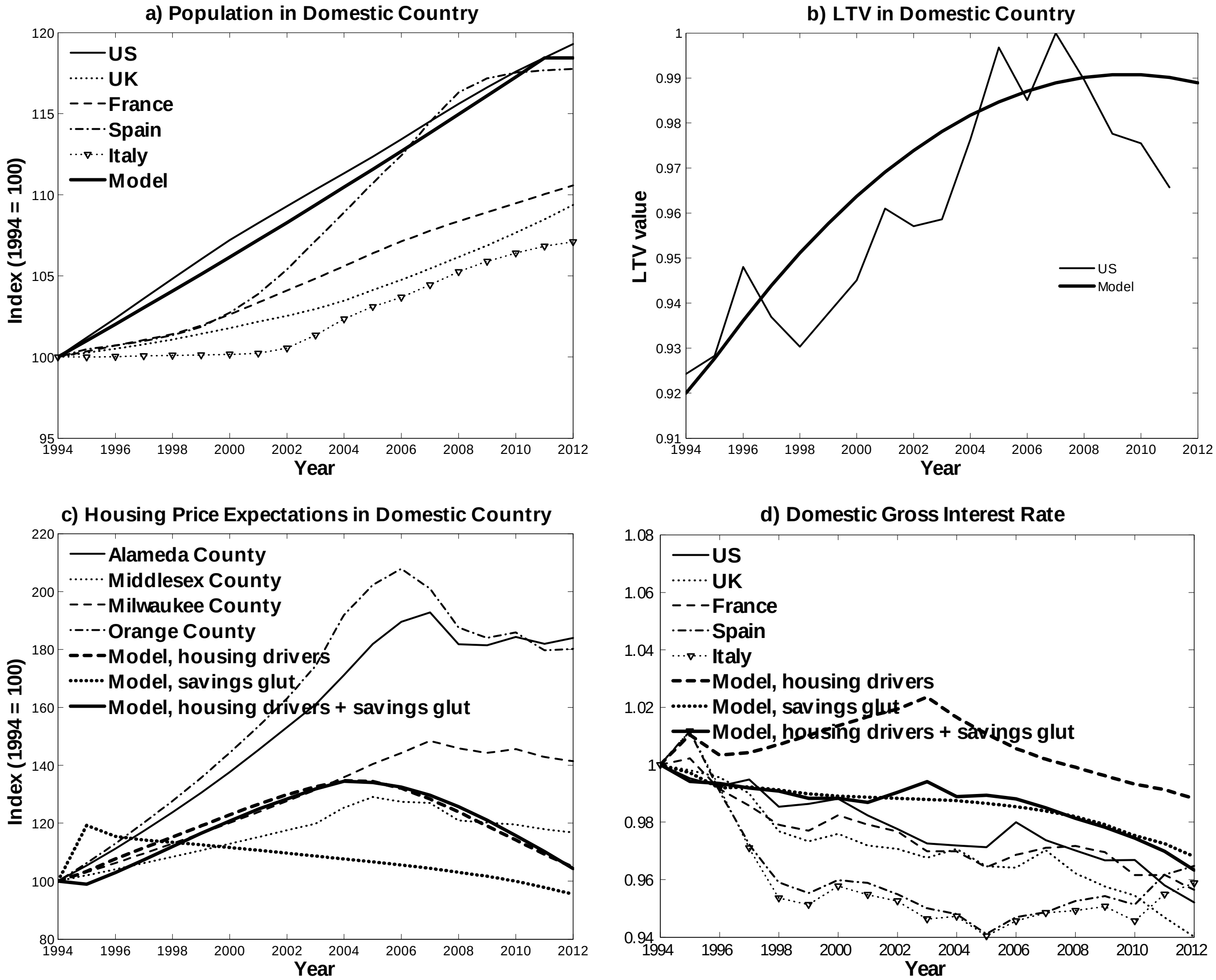


**Figure 7. Driving Forces in Model Simulations.** These panels plot the driving forces of the model. The model dynamics are exogenous in Panels a), b), in c) for the housing drivers and in d) for the savings glut. The model line "Model, housing drivers" refers to the simulations with the three housing shocks. The model line "Model, savings glut" refers to the simulations with only the shock to the foreign discount factor. The model line "Model, housing drivers + savings glut" refers to the combination of the housing and savings glut shocks. The series are compared with their data counterparts.

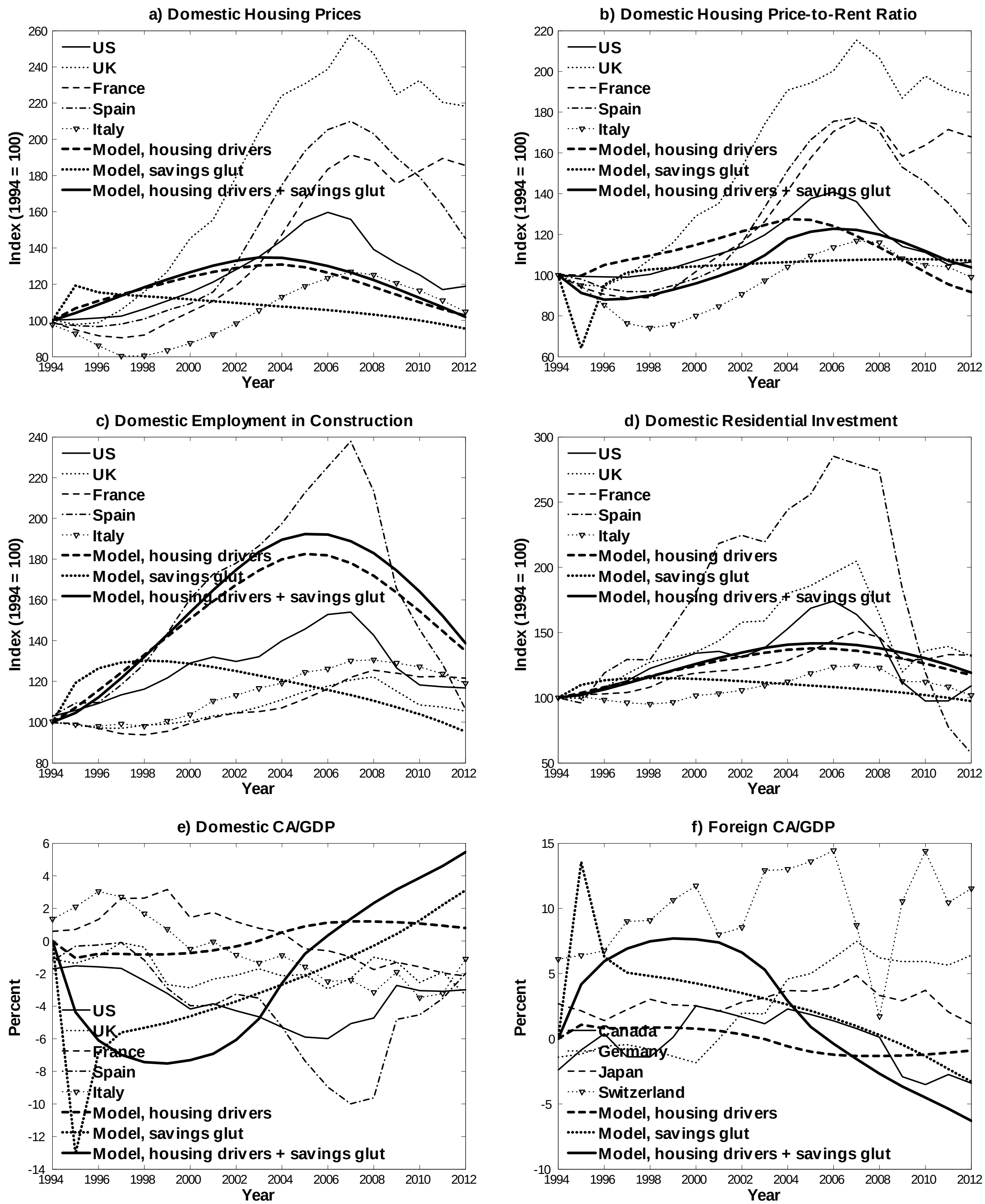


**Figure 8. Data vs Endogenous Model Dynamics.** This figure compares the endogenous model dynamics for the three set of shocks described in Section 6.

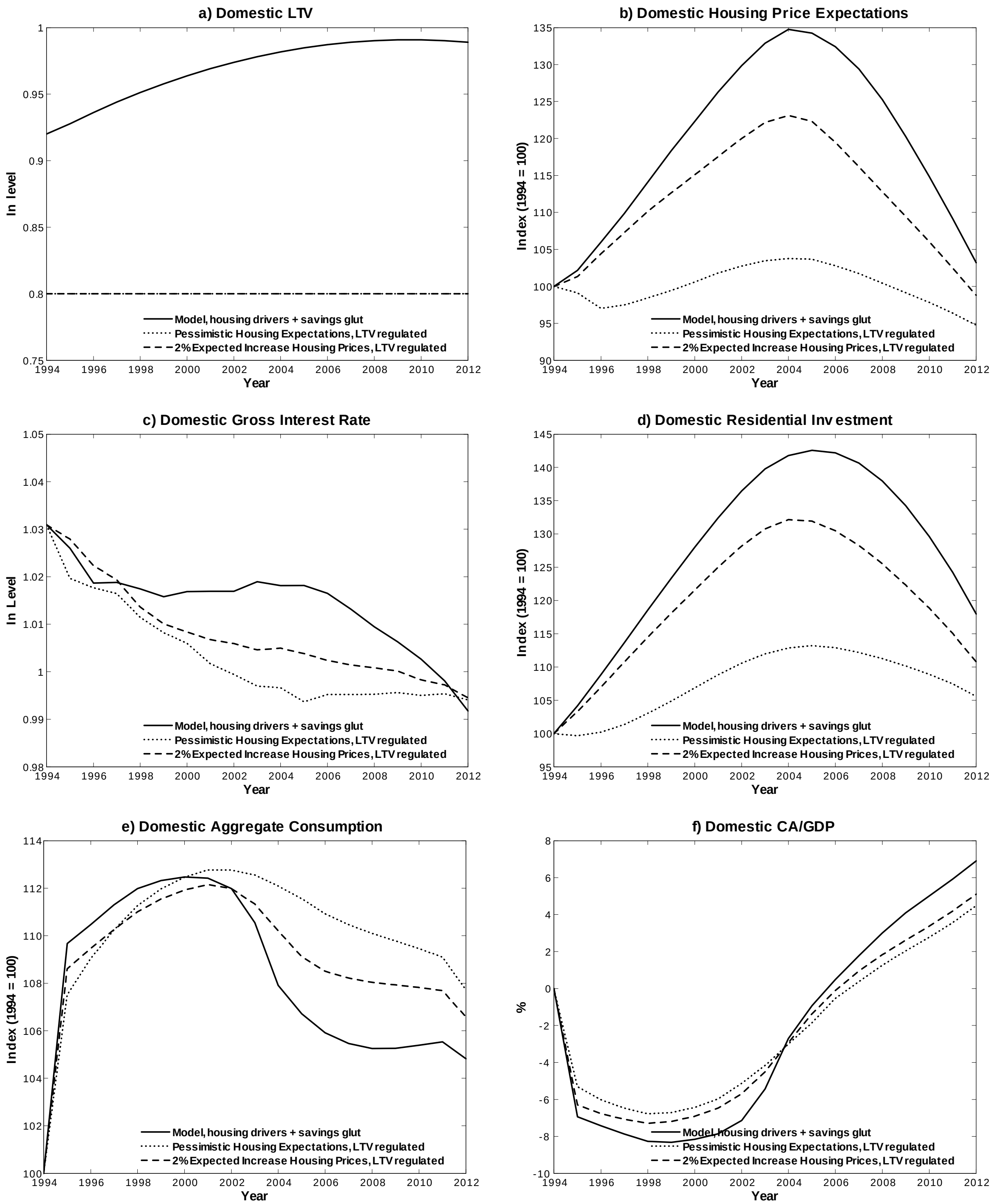


**Figure 9. Counterfactuals.** The panels compare the dynamics for the model line "Model, housing drivers + savings glut" of Figure 8 versus two counterfactuals in which LTV is regulated at 80% and expectations of housing prices are either pessimistic or grow at 2%.