

Housing Demand, Savings Gluts and Current Account Dynamics*

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Abstract

I show that, across and within countries, both the expansion and shrinking of the Global Imbalances since the mid 1990s are strongly correlated with the dynamics of housing markets. Then I study a quantitative model which can account for both the dynamics of housing and the global imbalances without any role for exchange rate driven expenditure switching. Housing demand drivers (population, LTV, housing expectations) alone imply counterfactual interest rate dynamics. Savings glut shocks alone generate the wrong housing price-to-rent ratios. Both types of shocks need to be combined. 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.

Keywords: Housing Markets; Current Account; Global Imbalances.

JEL Classification: F32, G28, R21

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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 and exchange rate adjustments have played a limited role. What caused the opening and narrowing of the imbalances are still open questions in academia. In policy circles, a related question is whether the narrowing is temporary or permanent (IMF 2014).

This paper connects the dynamics of the global imbalances with those of housing markets. First, I document that there is a strong negative correlation between housing and the current account both within and across countries for the last two decades. Second, I show that a two-country model with a housing sector can account for the joint dynamics if it is driven by both housing demand and savings glut shocks. Neither housing demand nor a savings glut alone can explain the data. Finally, I use the model to study whether the narrowing of the global imbalances is temporary or permanent given that in the short-term the most popular housing demand drivers are expected to be weak.

For the last two decades there has been considerable heterogeneity in the dynamics of housing markets and the current account in OECD economies. 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

To analyze the previous facts, I study a two-country model with housing. The model has only one tradable good. The dynamics of the current account are driven by expenditure expansion or reduction. There is no role for exchange rate adjustments to induce expenditure

¹For 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.

switching and affect the current account. 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 example, 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 such as construction. Trade deficits decouple consumption from production, 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.² 2) Changes in collateral requirements (loan-to-value, LTV). Several authors have argued that looser credit standards helped feed the housing boom, and then their reversal led to the subsequent bust.³ 3) Changes in housing price expectations. An increasingly large literature provides evidence that homebuyers' beliefs played a key role in recent housing dynamics.⁴

I input into the model the dynamics for population, LTVs and housing price expectations observed in OECD economies since the mid-1990s. The model then 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, the housing demand drivers generate counterfactual increases in interest rates because credit demand increases. When I add a credit supply shock (a foreign savings glut) to the simulations, 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. This is because a drop in interest rates especially stimulates the constrained households, who value the flow of housing (rental rate) more highly than they value the stock (housing prices). Thus, the model suggests that we need both housing demand and savings glut shocks to account for the data. Exchange rate-induced expenditure switching does not seem 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

²Otterstrom (2015) or Saiz (2007) among others.

³See for example Corbae and Quintin (2015), Favilukis et al. (2015) or Kermani (2012).

⁴Cheng et al. (2014), Foote et al. (2012), Garriga et al. (2012), Gelain et al. (2015), Ling et al. (2015), Soo (2013), and Van der Cruysen (2014), among others.

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.

The paper proceeds as follows. Section 2 surveys the related literature. Section 3 documents three facts about housing and current account dynamics in OECD countries. Section 4 describes the model and Section 5 the calibration. Section 6 analyzes the main mechanisms that connect housing and current account dynamics. Section 7 has the quantitative exercise and Section 8 the counterfactual experiment. Section 9 concludes.

2 Related literature

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.

There are a few papers that address the link between housing markets and the global imbalances. Aizenman and Jinjark (2014) and this paper are the first papers to document the strong correlation between housing and current account dynamics during both the housing boom and bust periods. Aizenman and Jinjark (2014) 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. The rest of the literature has focused on the period pre-2007. 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. Ferrero (2013), also using a two-country version of Iacoviello (2005), studies the impulse response of housing and the current account 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.

3 Some Facts about Housing and Current Account Dynamics

Figure 1 plots the current account dynamics of a sample of OECD economies. Since the mid-1990s several countries had large and persistent current account deficits. This is what is called the global imbalances. Most current account deficits have decreased significantly since 2007. The U.S. does not appear to be a special case; its current account dynamics have been similar to those of several other countries.

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.^{5,6} Figure 2 shows wide cross-country heterogeneity in the dynamics of housing variables (residential investment, housing prices and employment in

⁵Housing variables and the current account had monotonic behavior between these dates.

⁶The 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.

construction). For example, countries like Spain or the U.S. have had large housing booms since the mid-1990s to around 2006. Meanwhile, real housing prices and residential investment decreased in countries like Germany and Switzerland, among others. Housing dynamics reversed after 2006, when housing markets collapsed in countries like Spain and the U.S. and started to rise in the countries that did not experience a boom in the previous decade. Countries that experienced housing booms also had larger current account deficits.

Figure 2 highlights that during both the periods of expanding and shrinking global imbalances, there is a negative cross-country correlation between housing variables and the current account. Moreover, the current account reversals coincided with the decline in housing markets.⁷ The heterogeneity within Europe is especially interesting, because the European Union as a whole had a nearly balanced current account.

Figure 3 looks at within-country correlations. It confirms the strong negative correlation between housing and current account dynamics.

4 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.

4.1 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 ($\beta_p > \beta_i$).⁸ 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

⁷Anecdotal evidence suggests that emerging markets also followed the patterns reported in Figure 3.

⁸This is a standard mechanism to allow for credit relations in which the impatient household borrows from the patient household (Iacoviello 2005).

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 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 ϕ 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.

4.1.1 Domestic Patient Households

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

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

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

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

where σ is the elasticity of intertemporal substitution as well as the inverse of the coefficient of relative risk aversion. ε 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:

$$\begin{aligned} C_{d,t}^p &= (1 - \phi) N_{d,t} c_{d,t}^p, \\ H_{d,t}^p &= (1 - \phi) N_{d,t} h_{d,t}^p, \\ B_{d,t}^p &= (1 - \phi) N_{d,t} b_{d,t}^p, \end{aligned}$$

and

$$\hat{B}_{d,t} = (1 - \phi) N_{d,t} \hat{b}_{d,t}.$$

$\hat{b}_{d,t}$ is the patient households' per capita holdings of the international bond, and $b_{d,t}^p$ is the per capita holdings of domestic bonds.

The budget constraint for the representative domestic patient household is

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

where $q_{d,t}$ is the price of a domestic house in terms of tradable goods, δ 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), ψ_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:

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

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

4.1.2 Domestic Impatient Households

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

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

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

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 ($b_{d,t}^i$) to maximize (5) – (6) subject to her aggregate

budget constraint:

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

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

$$b_{dt}^i = \frac{-m_t E_t (q_{d,t+1} h_{dt}^i)}{R_t}. \quad (8)$$

4.2 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:

$$Y_{Td,t} = N_{Td,t}^\alpha, \quad (9)$$

$$Y_{sd,t} = [N_{sd,t}^\alpha]^\gamma L_d^{1-\gamma}, \quad (10)$$

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

where α, γ, τ 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 (ψ_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:

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

4.3 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 $(\hat{b}_{f,t})$ to maximize

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

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

subject to her aggregate budget constraint:

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

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:

$$Y_{Tf,t} = N_{Tf,t}^{\alpha}, \quad (16)$$

$$Y_{sf,t} = [N_{sf,t}^{\alpha}]^{\gamma} L_f^{1-\gamma}, \quad (17)$$

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

where $N_{Tf,t}$ and $N_{sf,t}$ are the 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:

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

4.4 Market Clearing

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

$$N_{Td,t} + N_{sd,t} = N_{d,t}, \quad (20)$$

$$N_{Tf,t} + N_{sf,t} = N_{f,t}. \quad (21)$$

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

$$H_{d,t}^i + H_{d,t}^p - (1 - \delta) (H_{d,t-1}^i + H_{d,t-1}^p) = Y_{hd,t}, \quad (22)$$

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

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

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

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

$$B_{d,t}^p + B_{d,t}^i = 0. \quad (24)$$

Market clearing in international bonds implies:

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

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

$$TB_{d,t} = Y_{Td,t} - Y_{ad,t} - C_{d,t}^p - C_{d,t}^i - (1 - \phi) N_{d,t} \frac{\psi_B}{2} (\hat{b}_{d,t})^2 - \frac{\psi_n}{2} (N_{sd,t} - N_{sd,t-1})^2.$$

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

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

5 Calibration

I calibrate the model using aggregate and micro data from OECD countries, although for some series only U.S. data were available. Table 1 summarizes the parameters. 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 ($\hat{B}_d = 0$). I assume that

one period in the model is one year.

1. *Exogenously selected parameters.* For the intertemporal elasticity of substitution (σ), 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 the 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 (β^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 β^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 in which 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 (this is the most important marginal group of home buyers), as computed by Duca et al. (2011). I normalize the 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:⁹ 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).

6 Impulse Responses

To illustrate how the model connects housing and current account dynamics, this section analyzes impulse responses to expected housing prices for different values of the parameters. First, Figure 4 focuses on the elasticity of housing supply.¹⁰ When the land share in structures is high (γ is low) housing supply is inelastic since most of the structures are land, which is exogenously fixed. In that case, an increase in expected house prices does not lead to much

⁹That is, $N_d = N_f, L_d = L_f$.

¹⁰All 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.

new building, nor does it lead to labor reallocation towards housing construction. Figure 4 shows that the current account reacts more when housing supply is elastic. This is because construction needs tradable goods (housing appliances), 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.

Figure 5 reports the responses to the same shock as in Figure 4 but alters the share of impatient households (ϕ). The current account reacts much more when the share of impatient households is large. Expectations of increases in housing prices lead 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.¹¹ Housing prices (the value of the housing asset) increase less than housing rents (the value of the housing flow) because the collateral channel encourages consumption by the impatient households, who value the durable good less.

7 Simulations

In this section I input the exogenous shocks into the model and report the reactions of its endogenous variables comparing them with data.¹² 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 the ability of the model and its driving forces to account for both housing and current account dynamics.

¹¹The 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.

¹²The model is solved using a nonlinear Newton-type algorithm (Adjemian et al. 2011) for a perfect foresight version.

7.1 Driving Forces

This is how I use the data to discipline the exogenous shocks:

1) For housing price expectations I use 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.¹³ 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. Figure 6 compares the expectations of real housing prices (dashed lines) for each county with the realized housing prices (solid lines).¹⁴ The figure compares both levels (top panel) and growth rates (bottom panel). Households underestimated housing price growth until 2005. Figure 7c contains the exact expectations that the model uses and also the data from Figure 6. I give exogenous shocks to housing price expectations to force the model to generate expectations like those from the Case et al. (2012) survey.¹⁵

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. I assume that the population does not change after this date.

3) For LTV (variable m_t) I make the model to follow the median LTV series for first-time home buyers estimated by Duca et al. (2011) for the U.S. This is reported in Figure 7b. The data 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 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

¹³To 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.

¹⁴I computed the realized prices using housing prices from Freddie Mac and inflation from the Bureau of Labor Statistics.

¹⁵Technically, when I input price expectations in the Euler equations I replace $q_{d,t+1}$ by an expected price $q_{d,t+1}^e = q_{d,t+1} + e_t$. Then, I input a series of e_t shocks such that $q_{d,t+1}^e$ 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.

assumed that the agents take the 2006 LTV levels as permanent.

4) To discipline the foreign discount factor shocks, I impose that the model generates real interest rates with a downward trend as in Figure 9d. In the case with only the savings glut shock, the housing expectations are fully rational and endogenous; that is, there are no expectations shocks (model line denoted as "Model, savings glut").

7.2 Endogenous Dynamics

Figure 8 contains the endogenous reaction of the model when I input the three housing demand driving forces discussed before. 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 Spain, the U.K. and the U.S., which are countries representative of the housing boom and bust. The positive comovement of housing prices and quantities suggests that it is demand, and not productivity, that drove the dynamics.

Figures 8e) and 8f) show that the housing demand drivers generate dynamics for the current account consistent with the data. As 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. 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.

However, the model with only housing demand drivers generates counterfactual dynamics for the real interest rates. Higher housing demand increases credit demand and interest rates rise to achieve equilibrium. This result suggests that we need more than housing demand drivers to account for the data. This is explored in Figure 9.

Figure 9 contains three sets of shock. One set has only the three housing demand drivers (line "Model, housing drivers") of Figure 8. The second set only has a shock to the foreign

discount factor (line "Model, savings glut"). The third set of shocks is the combination of the housing and savings glut shocks (line "Model, housing drivers + savings glut").

The savings glut shock by construction replicates the dynamics of real interest rates. The foreign country becomes more patient and interest rates fall between both domestic patient and impatient households (Figure 9a). Higher demand for savings from the foreigners leads to lower rates. This can generate an increase in demand for housing and a current account deficit. However, the savings glut shock alone cannot explain the data. They cannot get the comovement between housing prices and price-to-rent ratios right. This is because the drop in interest rates especially stimulates the impatient households, who value the flow of housing (rental rate) more highly than they do the stock (housing prices). Thus, savings glut shocks alone lead to counterfactual housing price-to-rent ratios. 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 housing price-to-rent ratio and of housing prices.¹⁶

Thus, to account for all the dimensions of the data, we need to combine housing demand and savings glut shocks. The expectations of higher house prices from the Case et al. (2012) survey allow the model to get right the housing price-to-rent ratio because encourage demand for homeownership, not for rental. Foreign demand for savings lowers interest rates.

8 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 10 analyzes the implications of this new environment for current account dynamics. It compares the combination of the housing and savings glut shocks that provide the best match to the data ("Model, housing drivers + savings glut"), with two counterfactuals. In both counterfactuals LTV is fixed at 80% and the savings glut and population dynamics are as in Figure 9. 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 10 shows that, even if the savings glut persists, lower housing demand translates into

¹⁶Shocks to the preferences for housing, which drive housing dynamics in most of the macro-housing literature, also generate counterfactual price-to-rent ratios and interest rates because they increase the preference for the housing flow.

lower housing dynamics and a smaller current account deficit. Thus, 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. The weak housing demand will lead to lower real interest rates.

9 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 to explain all dimensions of the data we need to combine housing demand and savings glut shocks. Housing demand shocks (population, LTV, housing expectations) alone lead to counterfactual interest rates. Savings glut shocks alone generate the wrong housing price-to-rent ratios. Combining both set of shocks can generate housing booms and busts together with the emergence and contraction of large current account deficits similar to the OECD data. 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

| <i>Description</i> | <i>Parameter</i> | <i>Value</i> |
|---|-------------------------------------|--------------|
| Patient households' discount factor | β^p | 0.97 |
| Impatient households' discount factor | β^i | 0.85 |
| Share of impatient households | ϕ | 0.4 |
| Intertemporal elasticity of substitution | σ | 0.5 |
| Intratemporal elasticity of substitution | ε | 0.4 |
| Housing depreciation rate | δ | 0.02 |
| Ratio of housing appliances over structures | $\frac{1}{\tau}$ | 0.2 |
| LTV parameter | m | 0.92 |
| Share of housing services in utility | θ | 0.18 |
| Labor share in production | α | 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^{-6} |
| Labor adjustment cost | ψ_n | 7 |
| Adjustment cost on international bond | ψ_B | 0.008 |

Figures

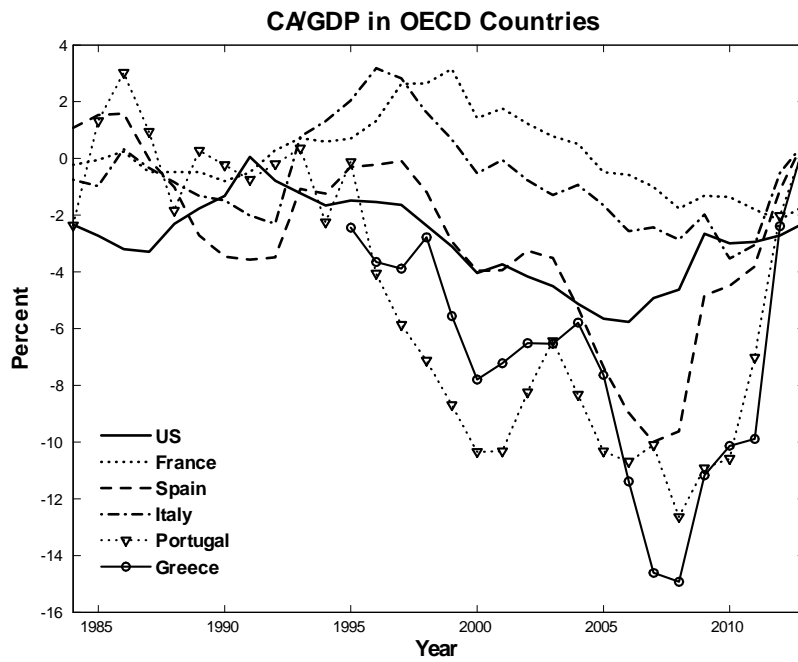


Figure 1. Current Account to GDP for some OECD Countries.

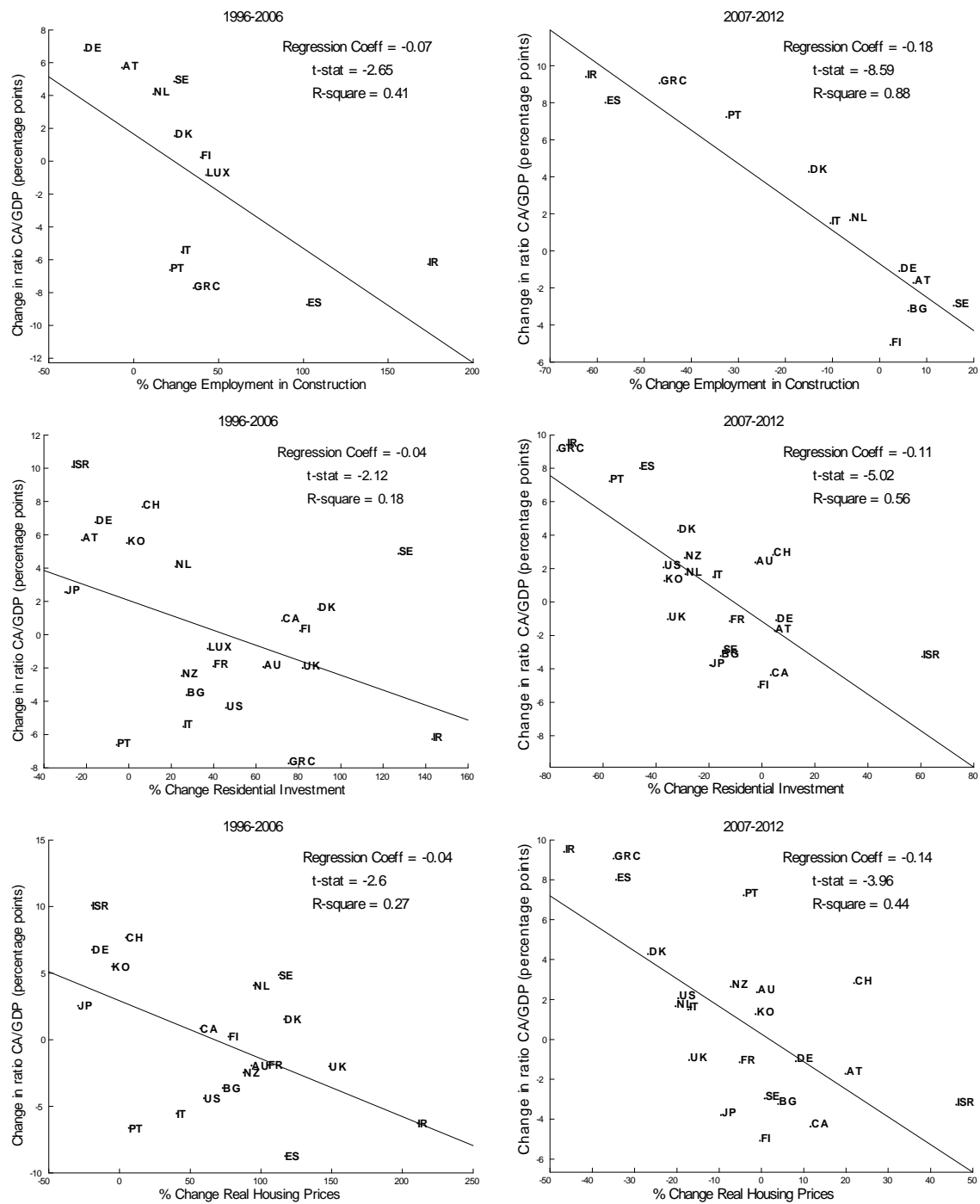


Figure 2. Cross-Country Correlations between Changes in the Current Account to GDP ratio and Changes in Housing Variables. The first row is the scatter-plot of the change in the current account to GDP ratio against the change in the share of employment in construction. The second and third rows replace 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.

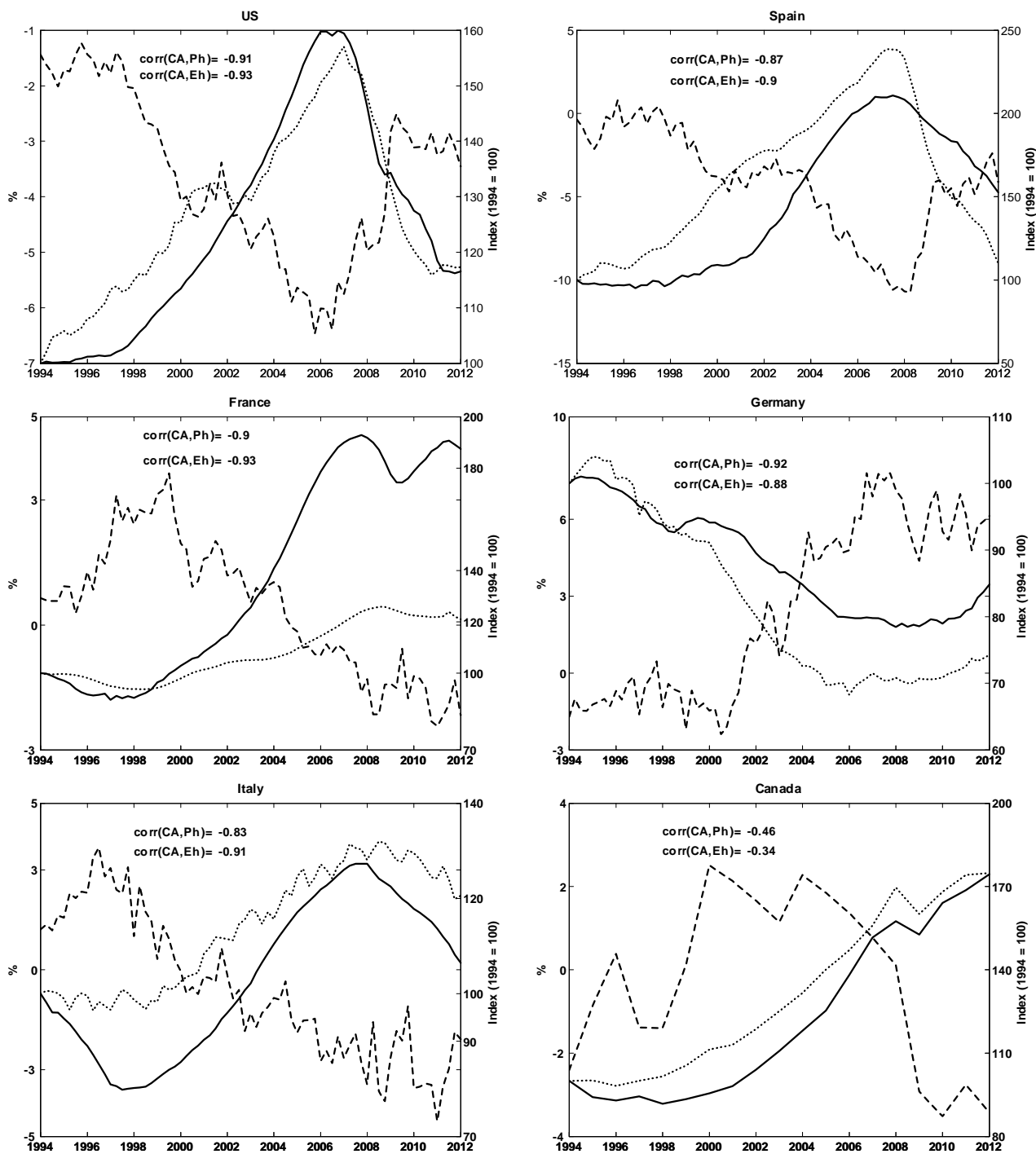


Figure 3. Within-Country Correlations between the Current Account (CA), Employment in Construction (Eh) and Housing Prices (Ph). Each panel shows the dynamics of the current account to GDP ratio (dashed line with scale in the left axis), employment in construction (dotted line with scale in the right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

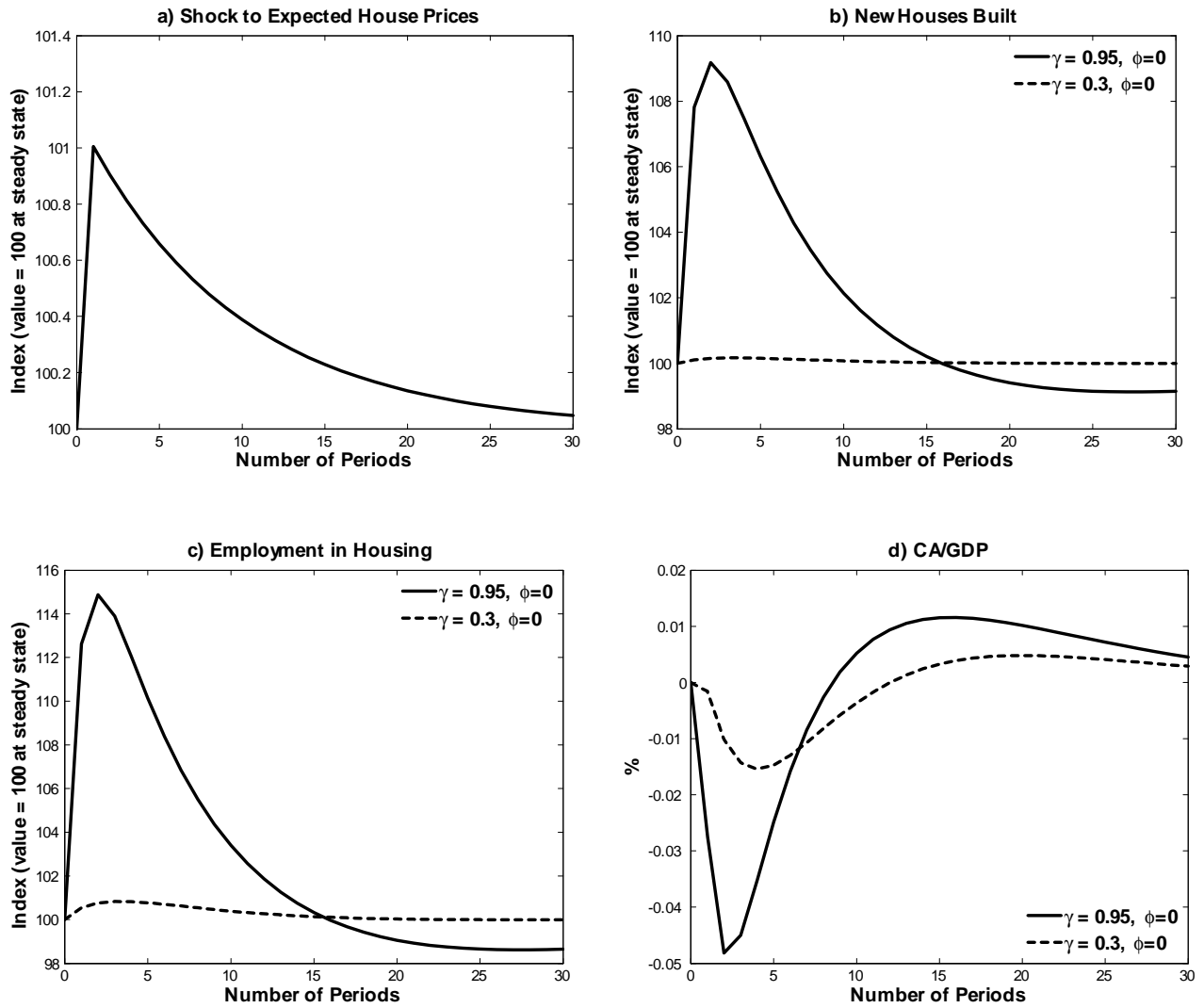


Figure 4. Responses for different housing supply elasticities. These panels compare impulse responses to an increase in the expectations of domestic housing prices when the supply of new structures is elastic (low land share, high γ) and when it is not (low γ). All panels are for the domestic economy.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

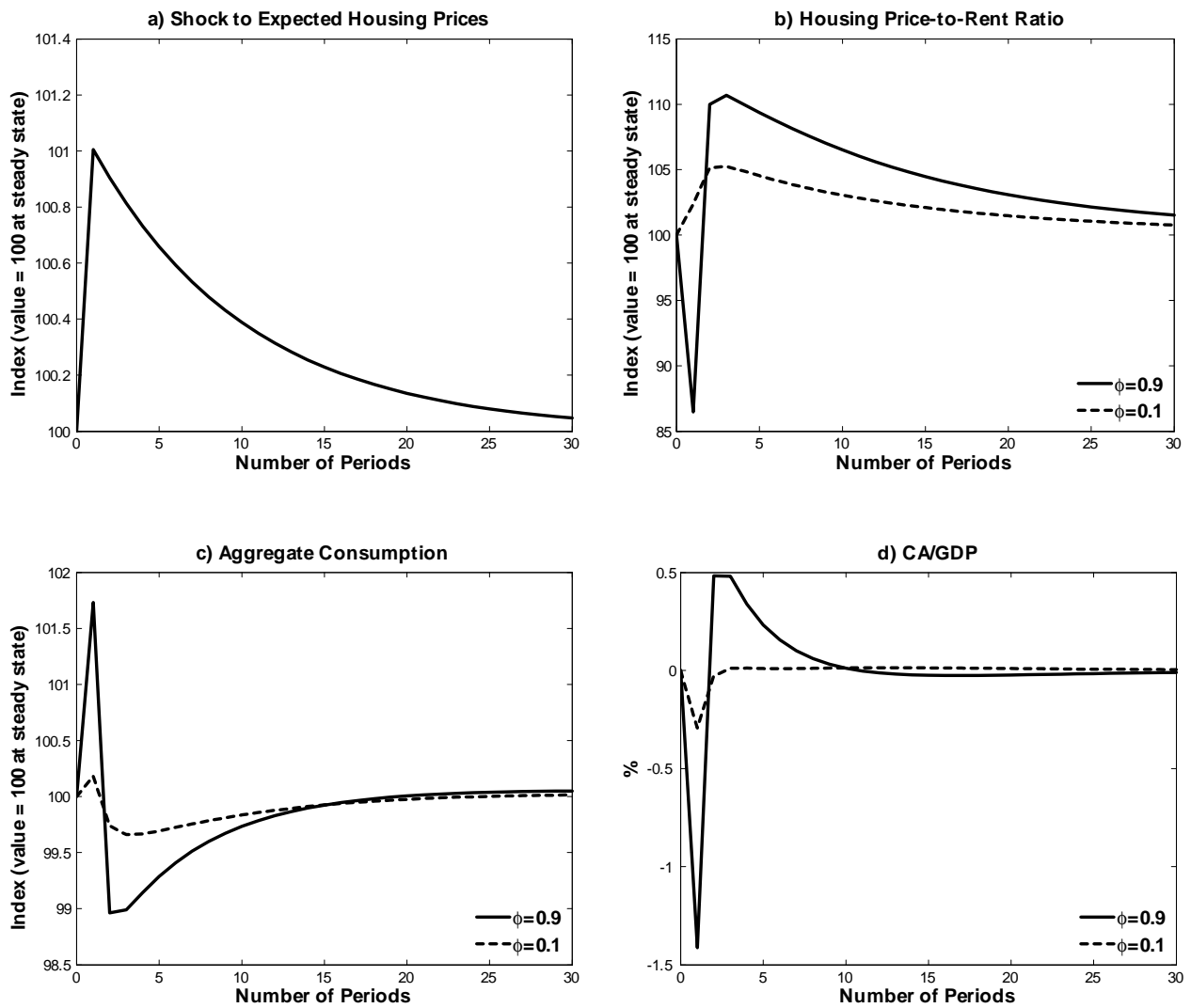


Figure 5. Responses for different share of households being constrained. The panels compare impulse responses to an increase in the expectations of domestic housing prices when the share of the population composed by impatient households (ϕ) is high or low. All panels are for the domestic economy.

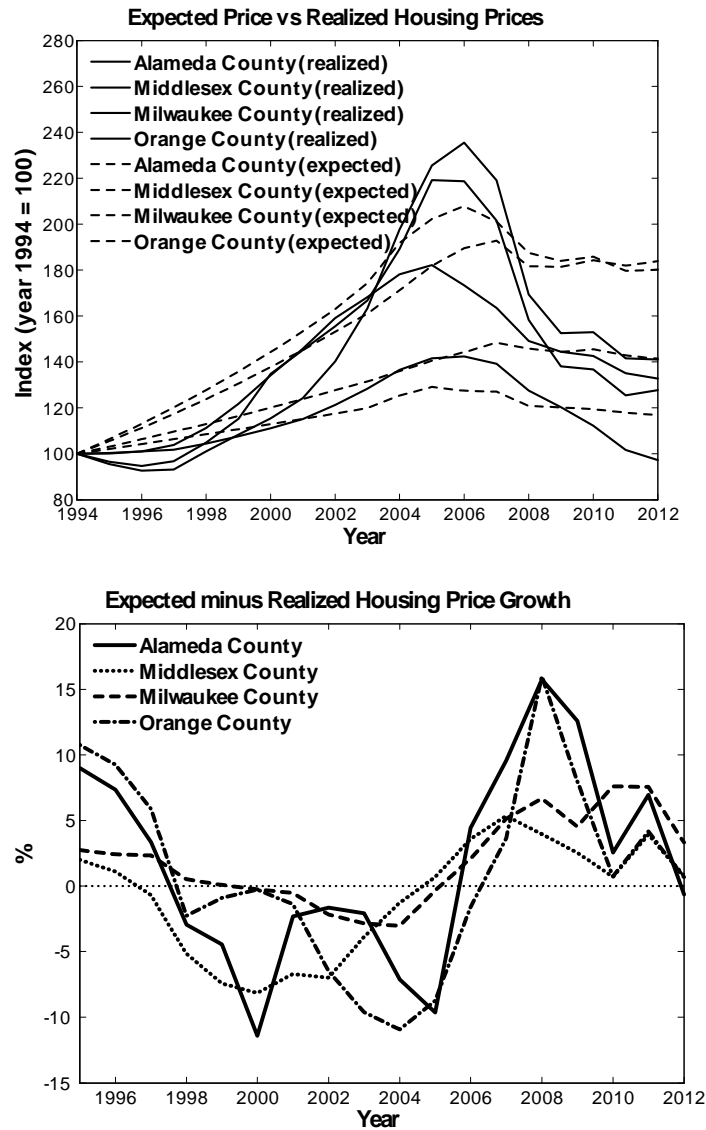


Figure 6. Comparing house price expectations from Case et al. (2012) with realized house prices. The top panel compares the survey data on real house price expectations (dashed lines) from Case et al. (2012) with the realized real house prices for those U.S. counties. The bottom panel redoes the same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

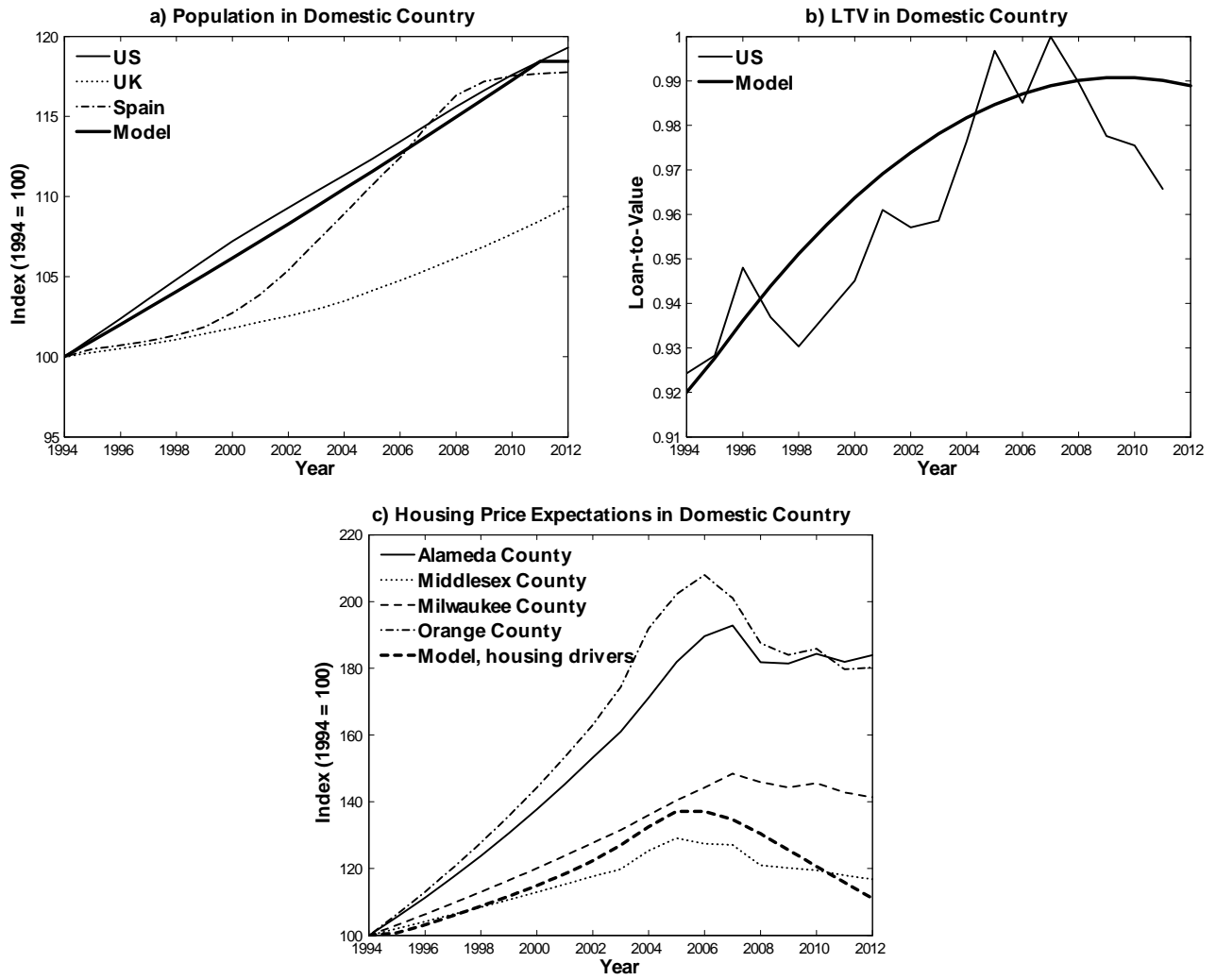


Figure 7. Housing Demand Drivers. These panels plot the driving forces for housing demand. The series are compared with their data counterparts.

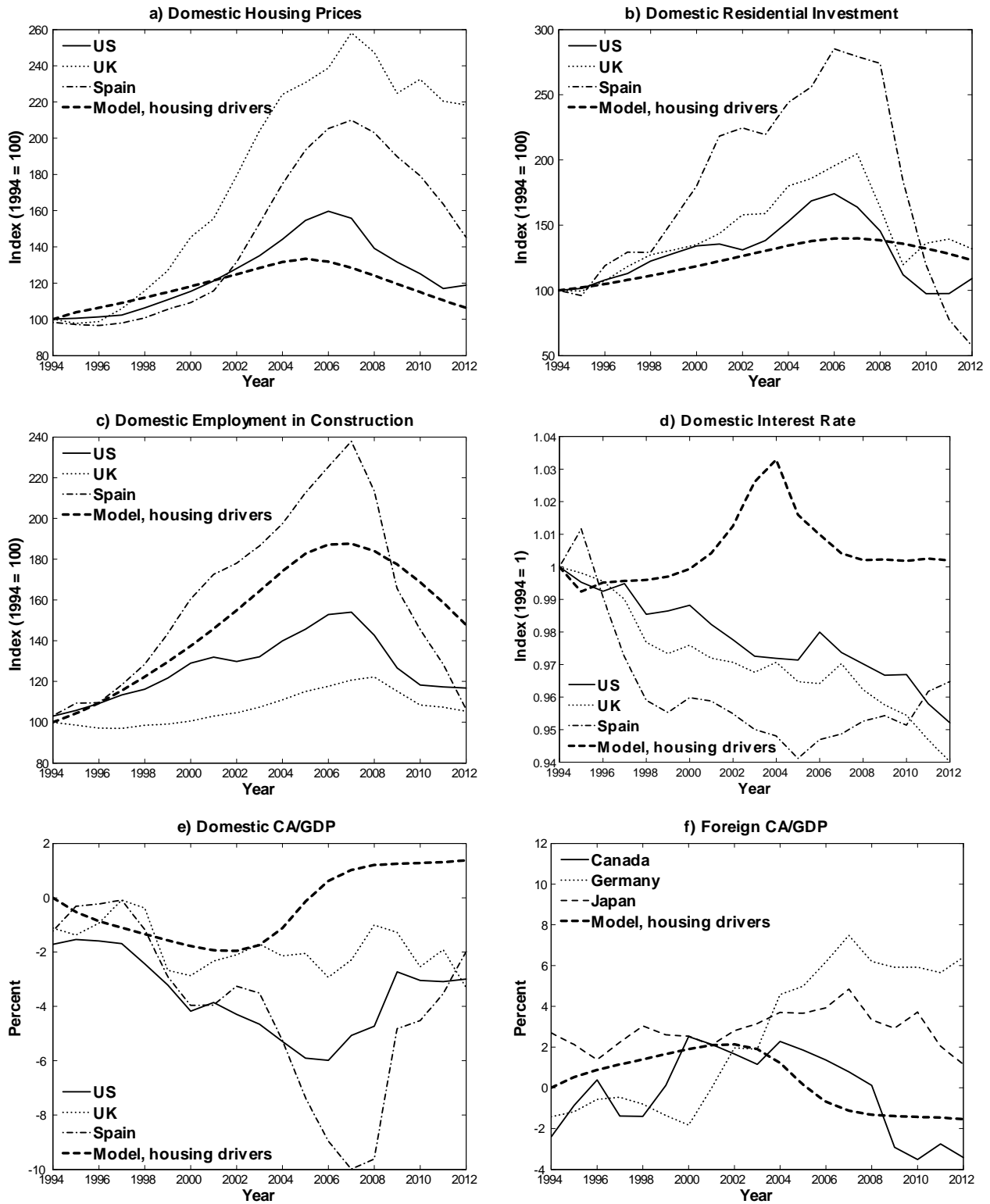


Figure 8. Data vs Model driven by Housing Demand. This figure compares the data with the model driven by the housing demand drivers of Figure 7.

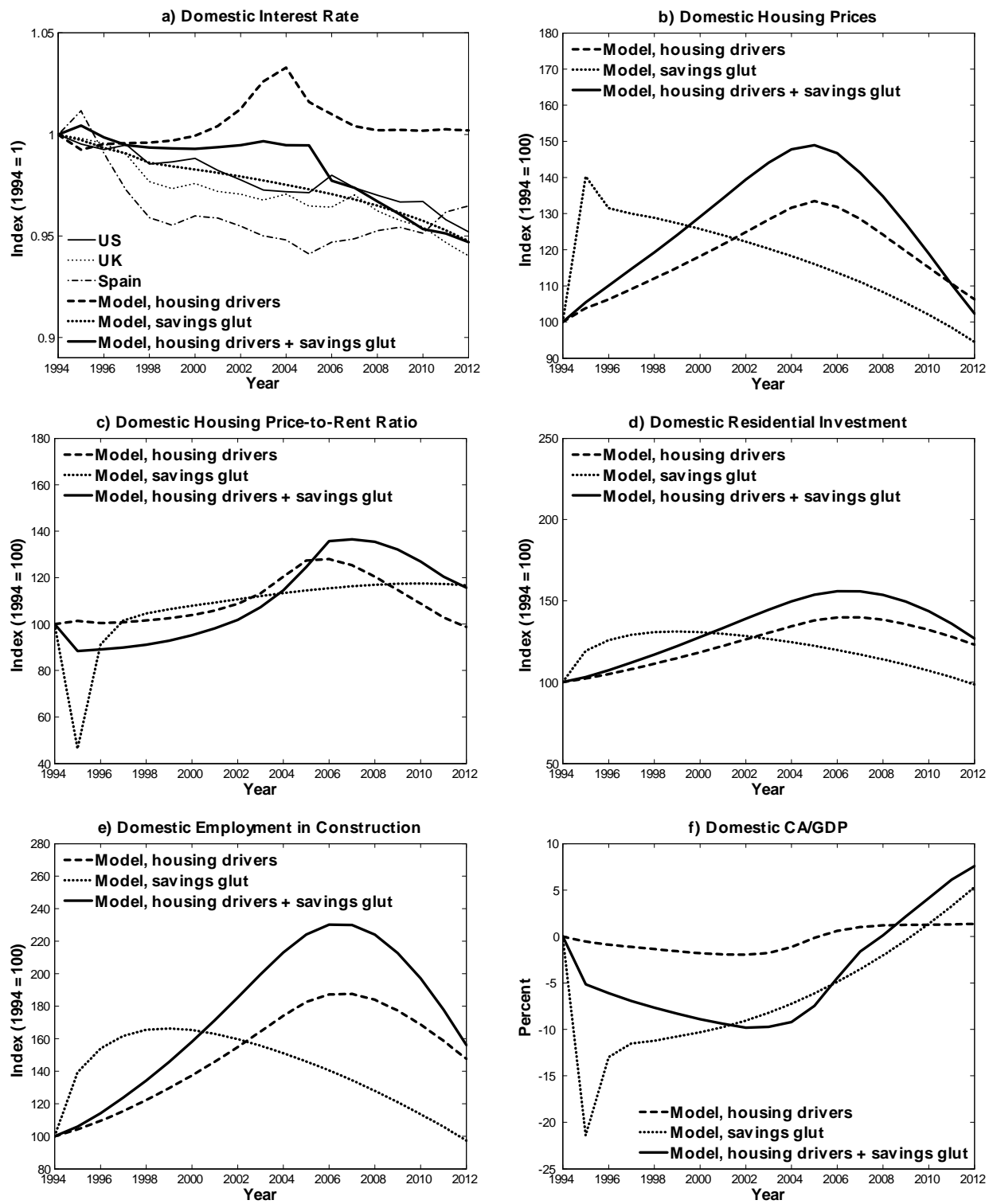


Figure 9. Model driven by Housing Demand and Savings Glut Shocks. The panels compare the dynamics for the model line "Model, housing drivers" of Figure 8 versus two cases: only savings glut shocks as drivers, and the combination of both housing and savings glut shocks.

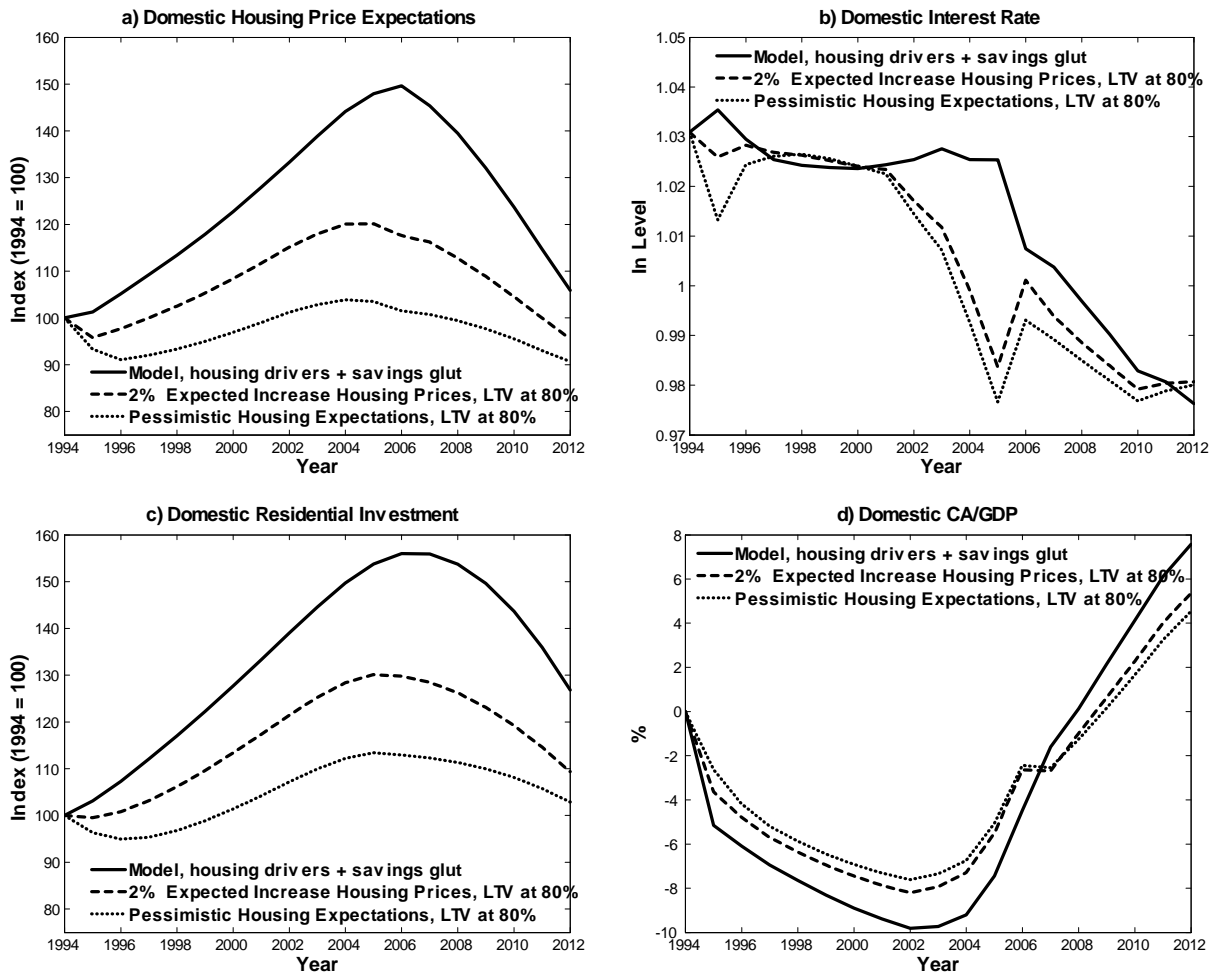


Figure 10. Counterfactuals. The panels compare the dynamics for the model line "Model, housing drivers + savings glut" of Figure 9 versus two counterfactuals in which LTV is regulated at 80% and expectations of housing prices are either pessimistic or grow at 2%.