Housing Markets and Current Account Dynamics

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Abstract

This paper makes a theoretical and an empirical contribution to the debate on what caused the "global imbalances". On the empirical side, I provide different types of evidence to support that housing demand shocks (shocks to the aggregate marginal rate of substitution between housing and tradables) help to explain the global imbalances. On the theory side, I show that shocks to the demand for housing generate trade deficits without need for the standard ingredients used by others to model housing (wealth effects or trade in capital goods). I model housing as a durable and nontradable good. Countries import tradable goods during periods when more domestic labor is devoted to produce nontradables to smooth consumption between tradables and nontradables. Housing booms are larger if the country can run a trade deficit because the deficit lowers the opportunity cost of building, which is the foregone consumption of tradable goods due to reallocation of labor to the construction sector. Concerning the empirical evidence, I first document that over the last decade there has been a strong cross-country correlation between housing variables and current account dynamics. Second, I show that using the cross-country dynamics of employment in construction as the explanatory variable, the model generates current account dynamics matching recent global imbalances. Finally, I use sign restrictions implied by the model to estimate a vector autoregression and identify the effects of housing demand shocks on the U.S. trade deficit. The results suggest that housing shocks matter for current account dynamics.

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1 Introduction

What explains recent current account dynamics? This question has attracted a lot of attention because in the decade previous to the recent financial crisis, the U.S. and some other developed economies run large and persistent current account deficits, often referred to as "global imbalances". This paper makes a theoretical and an empirical contribution to the debate. On the empirical side, I provide different types of evidence to support that housing demand shocks (shocks to the aggregate marginal rate of substitution between housing and tradables) help to explain the global imbalances. On the theory side, I show that shocks to the demand for housing generate trade deficits without need for the standard ingredients used by others to model housing (wealth effects or trade in capital goods). I model housing as a durable and nontradable good. Countries import tradable goods during periods when more domestic labor is devoted to produce nontradables to smooth consumption between tradables and nontradables. Housing booms are larger if the country can run a trade deficit because the deficit lowers the opportunity cost of building, which is the foregone consumption of tradable goods due to reallocation of labor to the construction sector.

Housing demand shocks are an unexplored explanation for the global imbalances that is appealing for three reasons[1]. First, as I document in Section 2, there are large cross country differences in housing dynamics and these differences strongly correlate with current account dynamics (especially for housing quantities, such as labor share in construction or value added by this sector). Alternative theories of the global imbalances have problems explaining the substantial heterogeneity in the current account dynamics of developed and emerging economies[2]. Second, a large part of the current account deficits were financed through sales of mortgage related products (Shin 2008 discusses the U.S. case, The Telegraph 2008 the Spanish case). It is unclear why, in the absence of shocks increasing the demand for funds from the housing sector, foreigners should express such a strong preference for mortgage products, especially when in most countries they contained low quality subprime assets not backed up by public guarantees. Finally, housing shocks may have important aggregate implications because the

[1] To my knowledge only Matsuyama (1990), Punzi (2008) and Aizenman and Jinjarak (2009) have related housing and current account dynamics. Matsuyama (1990) is a theoretical study of the current account consequences of income effects on residential investment. Punzi (2008) is a two country version of Iacoviello (2005) model of housing wealth effects. Aizenman and Jinjarak (2009) document a strong positive association between current account deficits and the appreciation of real estate prices.

[2] For example, theories based on differences in financial development or in income growth face the problem that several countries similar across these dimensions had very different current account patterns (Eichengreen 2006, Gruber and Kamin 2009, Roubini 2006). Models focused on U.S.-specific factors cannot explain why large and persistent deficits have not being a U.S. specific pattern, i.e., several other developed economies have had a similar persistent downward trend, with deficits reaching similar levels of GDP.

housing sector is large. For example, in the U.S. from 2001 to 2006, the housing contribution to total employment was at least 28% from residential construction and at least 41% when mortgage finance, real estate agents, construction materials etc. are included (The Economist 2005; Roubini 2006b).

In this paper I take housing demand shocks as exogenous. Several papers discuss the need for housing demand shocks to understand the cross country heterogeneity in housing dynamics[3]. Other papers provide candidates for a housing demand shock: bubbles, demographic changes, innovation in mortgage markets, loosened lending standards, public policies to increase homeownership rates or preference changes between single and multi-unit houses. In this paper I do not try to separate these hypotheses[4].

The two standard ways to connect housing and the trade balance are trade on investment goods (trade deficits generated by investment booms), and aggregate wealth effects of housing on consumption. The model that I present does not have aggregate wealth effects, nor capital goods. Instead, it focuses on consumption smoothing across goods. These features are appealing for two reasons. First, there is a lack of consensus on the magnitude and sign of aggregate housing wealth effects (see, for discussion, Buiter 2008, Muellbauer 2007 and Kiyotaki et al. 2007; Congressional Budget Office 2007 surveys recent U.S. studies). Second, in the U.S. net imports of capital goods account for a smaller fraction of the deficit dynamics than do net imports of consumption goods. Net imports of consumer goods are twice the net imports of capital goods and their downward trend has accelerated since the mid 1990s. This fact suggests that consumption smoothing may be a more important driving force of trade deficits that capital dynamics. Moreover, most of the capital employed to build houses is not tradable. Burstein et al. (2004) report that the share of construction gross output attributable to tradable materials was at most 24% in France in 1995, 19% in the U.K. in 1998 and 31% in the U.S. in 1997.

I setup a simple model to illustrate why consumption smoothing across goods and the opportunity costs associated with building are enough to generate trade deficits after a housing shock. There are two goods in the model, houses and tradable goods. Houses are nontradable

[3]Mayer and Hubbard (2008) discuss that economic growth and interest rates alone cannot explain recent housing dynamics. For example, several countries with low interest on mortgages did not see much house price appreciation, and others saw house prices and construction continually rising, even as real mortgage rates were increasing. DSGE models of housing attribute a significative part of the recent housing dynamics to domestic preference shocks (Aspachs-Bracons and Rabanal 2009; Iacoviello and Neri 2010).

[4]As additional evidence, Doms and Krainer (2007) examine data from American Housing Surveys between 1997 and 2005 and report a substantial increase in the share of household income devoted to housing and the propensity for households to own their homes. They find that these results hold true across all income quintiles, ages and education levels. They do not depend on market location; that is, the higher expenditures do not simply reflect higher house prices, but a general increase in the demand for housing.

and durable. Each country has a fixed supply of labor that can allocate to produce either tradable goods or new houses. The tradable good is identical for both countries, thus there is only intertemporal trade. I assume exogenous shifts of the aggregate preferences towards housing. These shifts increase the demand for housing relative to other goods. To increase the quantity consumed the economy has to move labor from producing tradable goods to constructing houses. This labor reallocation implies the opportunity cost of building new houses, which is the foregone production of tradable goods. Trade deficits lower this cost because they decouple consumption from production. By importing consumer tradables the economy can reduce its production of tradables while still consuming them. Thus trade deficits allow for smooth consumption across goods while building more at a faster pace. Hence housing booms are larger when the economy can run a trade deficit.

I provide two types of evidence to support that housing demand shocks help to explain recent global imbalances. First, in a parameterized version of the model, housing shocks that match the observed cross-country dynamics of housing quantity variables generate current account dynamics matching recent global imbalances. That is, using the housing variables as explanatory variables, the model predicts global imbalances similar to those observed in the data.

Second, the model provides three identification restrictions for a housing demand shock: conditional on a positive shock, the correlation between the shock, interest rates and residential investment is positive. Moreover, the conditional correlation of the shock with tradable consumption is negative. These sign restrictions differ from those implied by alternative global imbalances explanations, for example the "savings glut hypothesis" predicts decreases in interest rates (Caballero et al. 2008), while technology shocks predict positive comovement of housing and tradable consumption (Aspachs and Rabanal 2008). I use these sign restrictions to estimate a vector autoregression and identify the effects of housing shocks on the U.S. trade deficit. The results suggest that housing shocks matter for current account dynamics.

The paper proceeds as follows. Section 2 documents some facts on housing and current account dynamics. Section 3 describes the model. In Section 4, to illustrate the essence of the mechanism I first characterize the equilibrium of a two period model with full housing depreciation, and then I parameterize the model of Section 3 and perform impulse response analysis. Section 5 shows how the model can account for recent patterns of global imbalances. In Section 6, I estimate a vector autoregression using the sign restrictions implied by the model. Section 7 concludes.

2 Motivating facts

In this section I present four types of evidence motivating my model. First, over the period of the global imbalances there has been substantial heterogeneity in the current account dynamics of developed economies with several countries running large and persistent deficits. Second, over this period there is a strong negative cross-country correlation between housing and current account dynamics. Third, net imports of consumer goods are twice the net imports of capital goods and their downward trend has accelerated since the mid 1990s. Fourth, around the mid 90s housing variables decoupled from the business cycle, while total consumption expenditure and durable consumption expenditure did not.

2.1 Two facts about current account dynamics

First, large and persistent deficits are not a U.S. specific pattern, as Figure 1 illustrates. Several other developed economies have had a persistent downward trend similar to that of the United States, with deficits reaching similar levels of GDP.

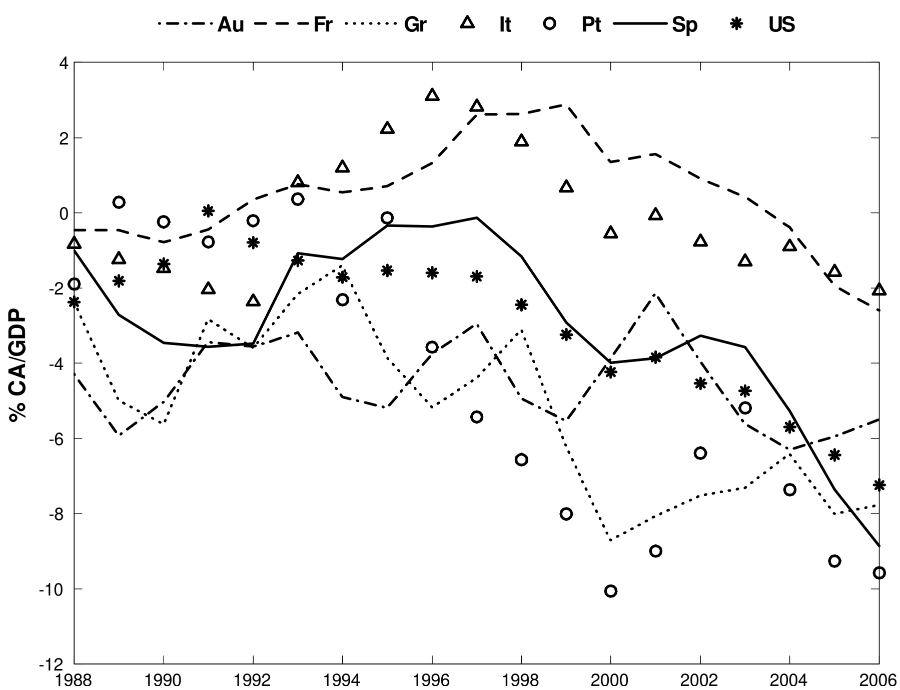

Fig. 1. Ratio of current account to GDP for Australia, France, Greece, Italy, Portugal, Spain, and the U.S.

Second, there has been substantial heterogeneity in the current account dynamics of developed economies. Table 1 reports this: while the countries on the left panel moved into surpluses, those in the right panel moved into deficits. The heterogeneity within Europe is especially interesting, because the European Union as a whole had a nearly balanced current account[5].

Table 1: Current account as % of GDP

Rising surpluses			Growing deficits		
	1994	2006		1994	2006
Austria	-1.47	1.9	Australia	-4.9	-5.49
Germany	-1.41	4	France	0.54	-2.59
Japan	2.75	3.9	Ireland	2.69	-1.04
Korea	-0.95	1.6	Italy	1.18	-2.07
Netherlands	4.75	9.52	Spain	-1.23	-8.86
Switzerland	6.22	13.5	Portugal	-2.31	-9.58
Canada	-2.3	3.34	UK	-0.99	-2.45
Sweden	1.13	6.7	USA	-1.71	-7.24

2.2 Housing and current account dynamics

Global imbalances grew almost monotonically from the mid 1990s to the mid 2000s. OECD data show a strong negative cross-country correlation between housing and current account dynamics over this period. The correlations are particularly strong for variables related to the quantity of housing, such as the share of labor employed in construction or the value added by this sector, and are weaker for price variables, such as the real price of housing. Figure 2 illustrates these facts for a sample of seventeen OECD countries between 1994 and 2006. Given the trend behavior of the time series, I concentrate on the changes between these two dates. This provides a good idea of the size of the changes.

The three panels of Figure 2 plot on the vertical axis the change in percentage points in the

[5]There is also a puzzling pattern among emerging economies (IMF 2008). Most of Emerging Asia moved into current account surpluses while emerging Europe moved into current account deficits. In this paper I only used data from the OECD. Anecdotal evidence suggests that emerging markets also followed the patterns reported in Figure 2.

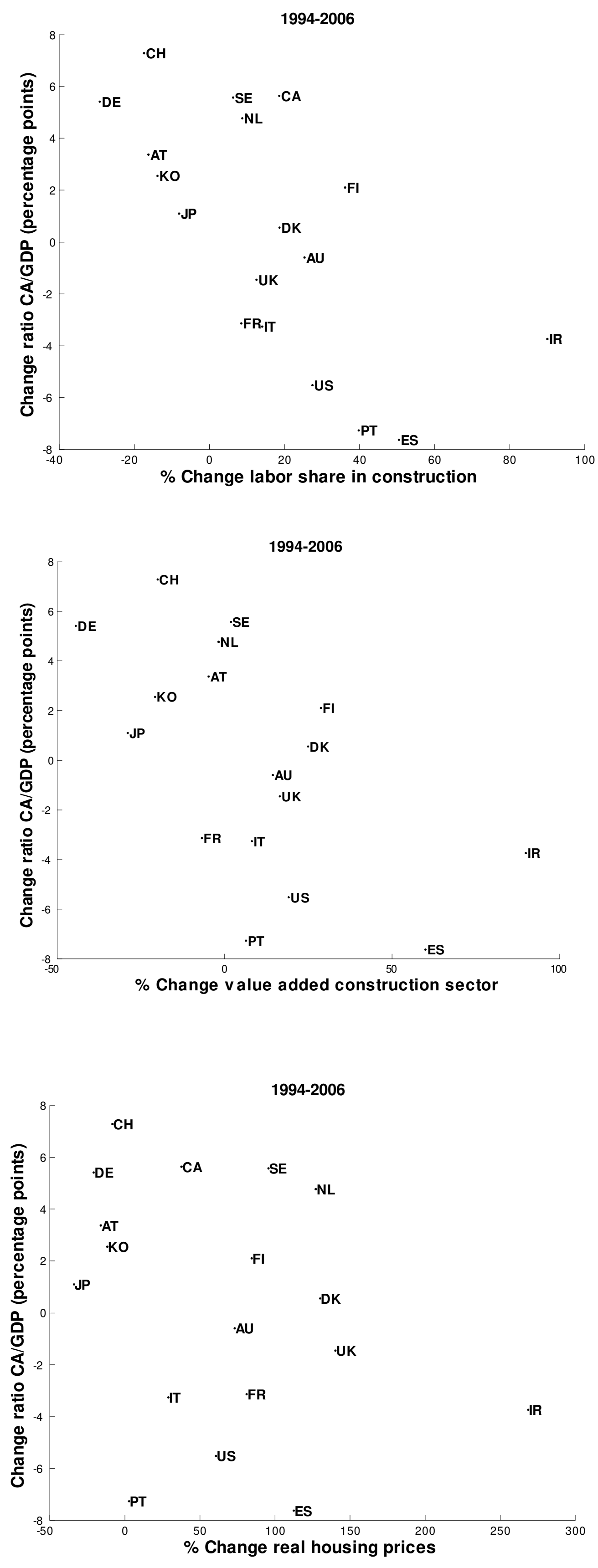

Fig. 2. Percentage changes in labor share in construction, in value added by construction, and in real housing prices versus the percentage-points change in the ratio of the CA to GDP

current account to GDP ratio. The top, middle and bottom panels plot respectively on the horizontal axis the percentage change in the labor share in construction, the percentage change in the share of value added by the construction sector and the percentage change in an index of real housing prices. Countries that experienced housing booms also had larger current account deficits. The scatterplots also show substantial heterogeneity in the behavior of housing markets among OECD countries. The model in this paper uses this heterogeneity to explain the differences in current account balances reported in Table 1.

2.3 The importance of consumption goods in the U.S. trade deficit

Net imports of capital goods account for a smaller fraction of the deficit dynamics than do net imports of consumption goods. This is shown in Figure 3, which decomposes the time series for the U.S. trade balance in goods in different groups: autos, capital goods, consumption goods and energy. Net imports of consumer goods are twice the net imports of capital goods and their downward trend has accelerated since the mid 1990s. This fact suggests that consumption smoothing may be a more important driving force of trade deficits than capital dynamics.

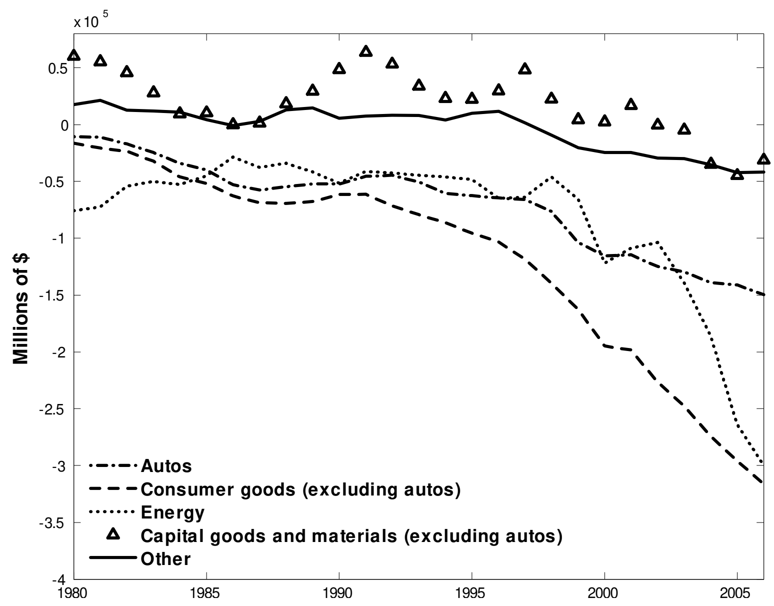

Fig. 3. Decomposition of the U.S. trade balance in goods by type of good

2.4 Housing decoupled from the cycle

Housing variables are highly cyclical, but during the last decade they have been relatively decoupled from the business cycle in the U.S. and other OECD countries. Figure 4 illustrates this fact for the U.S. It compares the time series for the ratio of residential investment to GDP, with the business cycle defined as the deviation from a Hodrick-Prescott trend. The turning points of both series roughly coincided from 1970 to the mid-1990s, but then housing dynamics fell strikingly out of step with the business cycle until the mid-2000s. Girouard et al. (2006) report similar evidence for the OECD.

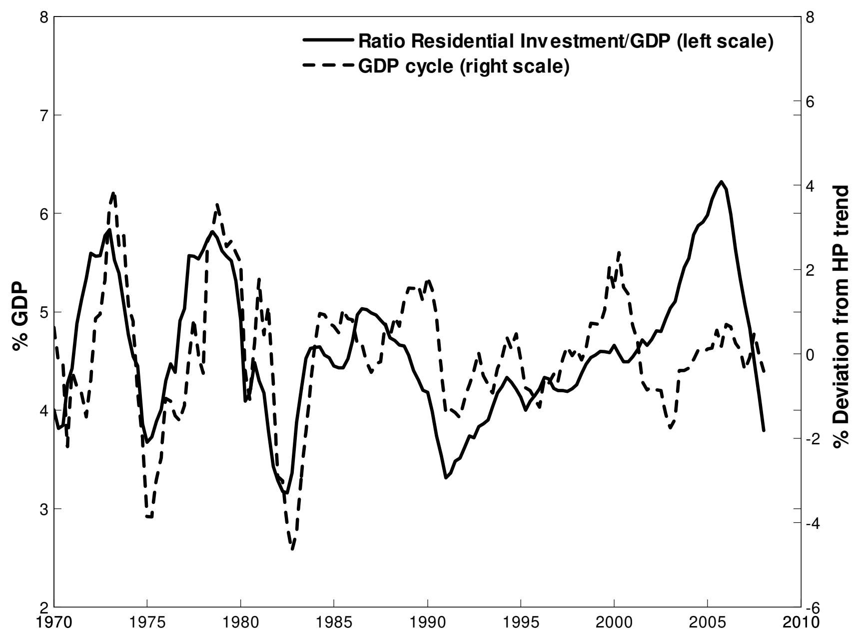

Fig. 4. Ratio of residential investment to GDP versus the real GDP cycle (HP filtered with lambda 1600). U.S. quarterly data.

Table 2 reports the cross correlations with GDP at different annual lags for residential investment, total consumption expenditure and durable consumption expenditure. Durable consumption expenditure and residential investment historically had similar cycles as they have similar sensitivity to interest rates (Erceg and Levin 2006, Leamer 2007). Until the mid-1990s all three series were strongly correlated with the business cycle. But then GDP's correlation with residential investment decreased dramatically. This did not happen for total consumption expenditure or for durable consumption expenditure. Housing decoupled from the business cycle while expenditures in total and durable consumption did not. I interpret this decoupling as evidence of housing specific shocks since popular sources of economic fluctuations, such as technology, oil, money, fiscal and aggregate demand cannot account for it.

Table 2: Cross Correlation with output at different lags

	1970-1995						
	-3	-2	-1	0	1	2	3
Residential investment	-.13	.39	.81	.82	.22	-.26	-.55
Consumption	-.21	.24	.73	.95	.58	.13	-.26
Consumer durables	.1	.53	.84	.84	.31	-.21	-.53
	1995-2006						
	-3	-2	-1	0	1	2	3
Residential investment	-.42	.06	.23	.18	-.11	-.3	-.16
Consumption	-.82	-.51	.21	.77	.86	.63	.14
Consumer durables	-.81	-.29	.4	.68	.65	.48	.08

Note. U.S. annual data. Real variables filtered with the Hodrick Prescott filter, lambda=400

3 The Model

In this section I describe a simple model that is consistent with the previous facts: increases in the demand for housing will imply trade deficits through net imports of consumption goods to smooth consumption.

3.1 Technology and preferences

There are two countries with the same preferences and technologies. Labor (n) is the only production input, it can be used to produce new houses (y_h) or tradable goods (y_c). The tradable good is identical for both countries, hence there is only intertemporal trade. The production functions in country i are

$$y_{iht} = An_{iht}^{\alpha} \tag{1}$$

$$y_{ict} = n_{ict}^{\alpha} \tag{2}$$

where $\alpha \in (0,1)$.

Houses (h) are durable and nontradable. They give a flow of housing services proportional to the stock. Houses can be consumed in the same period as they are built (in the next section I will calibrate the model to a five year period). The stock of houses depreciate geometrically at rate $\delta_h \in (0, 1)$, and its law of motion is

$$h_{it} = (1 - \delta_h)h_{it-1} + y_{iht} \tag{3}$$

Labor is mobile between both sectors with no adjustment costs, but it cannot move between countries. Feasibility implies that world production of tradable goods must equal world consumption of tradable goods. Moreover, labor allocated to each sector must sum to the total labor endowment (n_i). The resource constraints are

$$\sum_i c_{it} = \sum_i y_{ict} \tag{4}$$

$$n_{iht} + n_{ict} = n_i \tag{5}$$

There is an infinitely lived representative household in each country who enjoys consumption of housing and tradable goods without any home bias. They supply labor inelastically in their home country. The representative household in country i maximizes utility over consumption of housing services (h_{it}) and tradable goods (c_{it})

$$\sum_{t=0}^{\infty} \beta^t u\left(c_{it}, h_{it}\right) \tag{6}$$

I assume the standard constant relative risk aversion functional form over a constant elasticity of substitution aggregator of housing services and tradable consumption

$$u\left(c_{it}, h_{it}\right) = \frac{\left(((1 - \theta_{it})c_{it}^{\frac{\varepsilon-1}{\varepsilon}} + \theta_{it}h_{it}^{\frac{\varepsilon-1}{\varepsilon}})^{\frac{\varepsilon}{\varepsilon-1}}\right)^{1-\frac{1}{\sigma}}}{1 - \frac{1}{\sigma}} \tag{7}$$

where σ is the elasticity of intertemporal substitution (IES) 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 consumption (SES), and $\theta_{it} \in (0, 1)$ is a country-specific parameter that controls the share of consumption of housing services in total expenditure.

3.2 Equilibrium

Since there are no distortions, the set of competitive equilibria can be traced out by solving for the Pareto optima. Thus, a competitive equilibrium is the solution to the problem of a world planner who maximizes the weighted utility of both countries

$$\sum_{t=0}^{\infty}\sum_{i}\lambda_i\beta^t u\left(c_{it},h_{it}\right)$$

subject to equations $(1)-(5)$ for country weights λ_i. I focus on the equilibrium associated with $\lambda_1=\lambda_2=1$. These weights give the same allocations that arise in a competitive equilibrium in which the representative household in country i has no initial debts, owns the initial stocks of houses in country i, and all the labor income in country i.

If we denote by φ_{it} the Lagrange Multiplier associated with (3), the FOCs of the problem are

$$u_c\left(c_{1t},h_{1t}\right)=u_c\left(c_{2t},h_{2t}\right) \tag{8}$$

$$\varphi_{it}=u_h\left(c_{it},h_{it}\right)+\beta(1-\delta_h)\varphi_{it+1} \qquad i=1,2 \tag{9}$$

$$\varphi_{it}\frac{y_{iht}}{n_{iht}}=u_c(c_{it},h_{it})\frac{y_{ict}}{n_{ict}} \qquad i=1,2 \tag{10}$$

Equation (8) implies that both countries must value equally one extra unit of the tradable good in equilibrium. Equation (9) captures that the marginal utility of the durable good expands over several periods. Finally, equation (10) says that at any interior equilibrium each country must be indifferent between allocating labor to one sector or to the other, i.e. the marginal utility of housing multiplied by the labor productivity in that sector must equal the marginal utility of tradable consumption multiplied by the labor productivity in the tradable sector.

4 Increases in Housing Demand and Trade Deficits

This section studies the effects of transitory shocks that increase the preference for housing relative to tradable goods. I first characterize the equilibrium of a two period model with full housing depreciation. This exercise illustrates the key ingredients of the mechanism: the nontradability of housing and a low intratemporal elasticity of substitution between housing and tradable consumption. To consume more houses, the country must build them, hence reducing production of tradable goods and creating trade deficits to smooth consumption across goods. I confirm these results by solving numerically a parameterized version of the model of Section 3 and performing impulse response analysis.

4.1 A two period model with no durable good

In this subsection I consider a two period version of the model with full housing depreciation, $\delta_h = 1$. When $\frac{N_1}{N_2}$ is very small we can think of country 1 as a small open economy, i.e. shocks in country 1 have no effect on the world interest rate (R). For the rest of the subsection I focus on country 1 hence I drop the notation i. I will compare the differences between the equilibrium in a closed economy and that in a small open economy after an unanticipated change in the share of housing in the first period utility (θ_1). In the closed economy the interest rate is endogenous while in the small open economy it is exogenous.

Also, to reduce notation I assume that the household in country 1 is both the producer and the consumer. Thus, in the competitive equilibrium she maximizes

$$U(c_1, h_1, c_2, h_2) \equiv u(c_1, h_1) + \beta u(c_2, h_2) \tag{11}$$

subject to the intertemporal budget constraint in terms of tradable goods

$$c_1 + \frac{c_2}{R} = y_{c1} + \frac{y_{c2}}{R} \tag{12}$$

and to equations $(1), (2), (5)$ and

$$h_t = y_{ht} \qquad \text{for } t = 1, 2 \tag{13}$$

The FOCs are the Euler equation and the equalization of the marginal rate of substitution with the marginal rate of transformation

$$u_c(c_1, h_1) = \beta R u_c(c_2, h_2) \tag{14}$$

$$u_h(c_t, h_t)\frac{y_{ht}}{n_{ht}} = u_c(c_t, h_t)\frac{y_{ct}}{n_{ct}} \qquad \text{for } t = 1, 2 \tag{15}$$

In a closed economy there is not an option to transfer tradable consumption across periods, so production and consumption of tradable goods must be equal in every period

$$c_t = y_{ct} \qquad \text{for } t = 1, 2 \tag{16}$$

The equilibrium of the closed economy in period 1 is characterized by

$$\frac{u_h(y_{c1}, y_{h1})}{u_c(y_{c1}, y_{h1})} = \frac{n_{h1}}{y_{h1}} \frac{y_{c1}}{n_{c1}} \tag{17}$$

The upper left panel of Figure 5 graphs this condition. The left hand side of equation (17) is the slope of the indifference curve, which, at the initial equilibrium point A, is tangent to the Frontier of Possibilities of Production (FPP), whose slope is the right hand side of equation (17).

An unexpected increase in θ_1 decreases the slope of the indifference curves as graphed in the upper right panel of Figure 5. The household now likes housing more, hence she asks for more tradable goods per unit of housing. The shift of the indifference curves moves the equilibrium from point A to point B, where consumption of housing services is higher $\left(\tilde{h}_1^c > h^*\right)$ and consumption of tradable goods lower $(\tilde{c}_1^c < c^*)$. There are two reasons why consumption of tradable goods is lower. One comes directly from the preference shock; the household now likes tradable goods relatively less, hence she consumes less of them. The second comes from the opportunity cost of building, to increase the consumption of housing services the country needs to move along the FPP, reducing production of tradable goods.

The closed economy is a sequence of static problems. An increase in θ_1 does not alter second period variables. The unexpected increase in θ_1 moves the closed economy equilibrium from point A to point B, but c_2^c remains at steady state value c^*. I am interested in the case when the marginal utility of tradable consumption in the first period increases after the increase in θ_1, i.e., when even if the preference shock makes tradable goods less appetizing, their marginal value in period 1 increases because the household likes to smooth consumption across goods. In this case the preference shock would increase the autarky interest rate, which from equation (14) can be defined as

$$R^{aut} \equiv \frac{u_c(\tilde{c}_1^c, \tilde{h}_1^c)}{\beta u_c(c^*, h^*)} \tag{18}$$

This is what the lower right panel of Figure 5 plots. The preference shock increases the marginal utility of a tradable good in period 1. To ensure that the closed economy does not transfer tradable goods across periods the interest rate, which is the slope of the intertemporal budget constraint, increases.

For preferences (7) the marginal utility of tradable consumption in the first period is

$$u_c(c_1, h_1) = (1 - \theta_1) C_1^{\frac{1}{\varepsilon} - \frac{1}{\sigma}} c_1^{\frac{-1}{\varepsilon}} \tag{19}$$

$$C_1 \equiv ((1 - \theta_1) c_1^{\frac{\varepsilon - 1}{\varepsilon}} + \theta_1 h_1^{\frac{\varepsilon - 1}{\varepsilon}})^{\frac{\varepsilon}{\varepsilon - 1}} \tag{20}$$

When the SES (ε) equals the IES (σ) preferences are separable and $u_c(c_1, h_1)$ only depends on the SES. The lower the SES, the less willing the household is to substitute housing and tradable consumption within the period. As plotted in the upper right panel of Figure 5, the unexpected increase in θ_1 increases h_1 and decreases c_1. This result holds for any parameter value consistent with the concavity of the FPP and the convexity of the indifference curves. The more concave the FPP, the higher the drop in c_1, since more resources need to reallocate to produce an extra unit of housing. In addition, the lower the SES, the more likely that the decrease in c_1 increases $u_c(c_1, h_1)$ and autarky interest rates. Low SES households dislike unbalanced consumption across goods, thus an extra unit of tradable good is valued more when building houses is forcing the economy to reduce production and consumption of tradables.

When preferences are not separable ($\varepsilon \neq \sigma$), equation (19) shows that there may be a trade-off between intertemporal and intratemporal smoothing. Smoothing across goods may imply unbalanced consumption across periods, something disliked by agents with low IES. Depending on the value of the parameters it may happen that the increase in θ_1 decreases the marginal utility of tradable consumption. From now on I will assume that the parameters satisfy the conditions for $u_c(\tilde{c}_1^c, \tilde{h}_1^c)$ to increase as θ_1 increases.

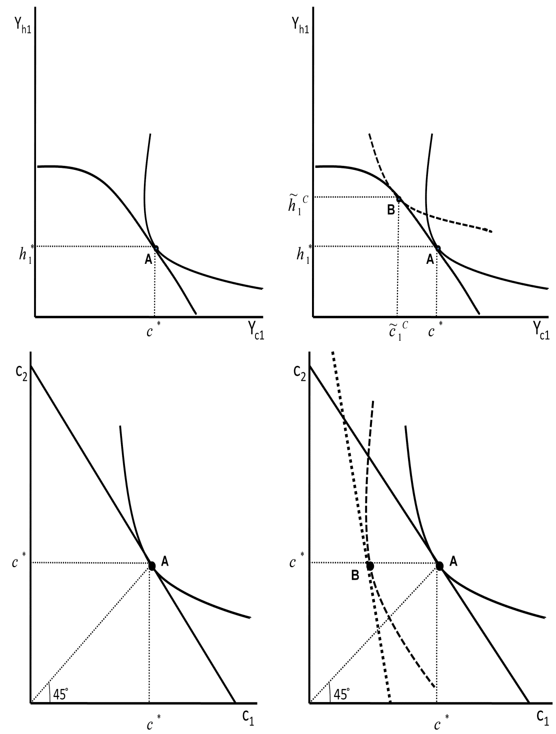

Fig. 5. The two period model with no durable good: the closed economy

If in the small open economy, or in a two country model, an increase in θ_1 does not increase interest rates to the new autarky level then the country will borrow and run a trade deficit. The trade deficit allows better consumption smoothing across goods in the open economy. Figure 6 depicts this case. The increase in θ_1 shifts the marginal rate of substitution as in the closed economy, but for the small economy the interest rate is exogenous and does not change. The slope of the intertemporal budget constraint remains the same, although the budget constraint shifts because both Y_{c1} and Y_{c2} will change. Now the economy does not have to move to point B, where consumption equals production. The small economy can instead consume at the point C while producing at the point D of the upper right panel of Figure 6 if it respects its intertemporal budget constraint (12), FOC (15) only requests that the slope of the indifference curve is the same at both points. Point C was not available for the closed economy because implies a transfer of tradable goods across periods. Interest rates raised to prevented this.

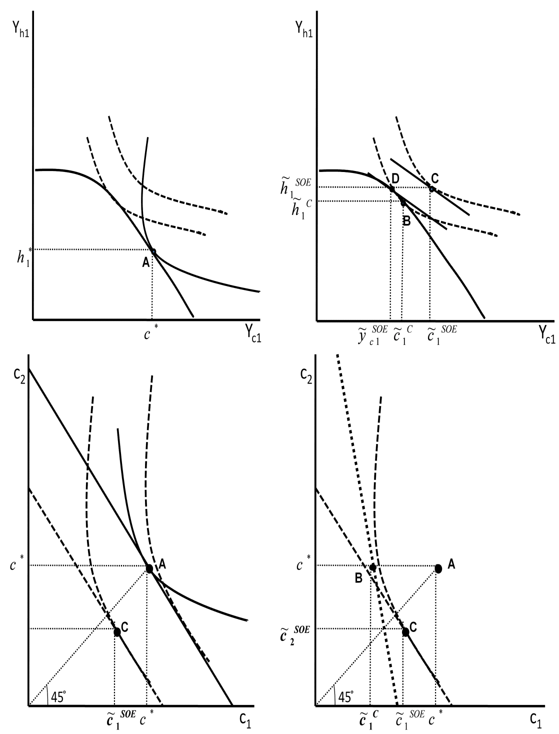

Fig. 6. The two period model with no durable good: the small open economy

4.2 Impulse responses in the full model

The full model of section 3 does not have a closed form solution. In this subsection I show that for reasonable parameterizations increases in the demand for housing generates trade deficits through net imports of consumption goods to smooth consumption.

I calibrate a world with two symmetric countries ($i = 1, 2$) that face different housing shocks. If both countries face shocks of the same size, they are like closed economies. I assume that both countries have the same population size. This allows me to study how domestic shocks affect the trade partners. The length of a period in the model is five years. There are two sets of parameters to choose:

1. Preference parameters: I assume the value for risk aversion standard in the real business cycle literature, $\frac{1}{\sigma} = 2$. Concerning the intratemporal elasticity of substitution between housing and tradable goods (ε) some papers have estimated a related concept, the elasticity of substitution between housing and nonhousing consumption. For example Davidoff and Yoshida (2008) obtain estimates ranging from 0.4 to 0.9 and Kahn (2008) provides evidence based on both aggregate and microeconomic data that is less than one. Tesar (1993) estimates the elasticity between traded and nontraded goods to be 0.44. I use $\varepsilon = 0.9$. For the unconditional mean of the share of housing in the economy I set $\theta_i^* = 0.2$. This number is consistent with recent data on the weight of the housing sector in the U.S. economy (The Economist 2005, Roubini 2006b).

2. Technology parameters: I assume the same labor share across sectors and set it to the standard $\alpha = 0.67$. I choose the discount factor to match a steady state interest rate of 10%. For the depreciation of the stock of houses I use the five year equivalent of 2% annual depreciation, $\delta_h = 0.1$, which is consistent with the BEA (2004) report that annual depreciation rates for one-to-four-unit residential structures are between 1.1% and 3.6%. Concerning the scale parameters I normalize n to 1 so n_h is the labor share in construction. I set A to be 1/30, which gives a construction labor share of 14% in a steady state with zero trade balance.

To illustrate the mechanics of the model, in period zero I give an unanticipated housing preference shock to country 1 that increases θ_1 from its unconditional mean θ^* to $\theta_1 = 0.5$. If country 2 had a shock of the same size then both countries would behave exactly as if they were closed economies.

After a housing preference shock, the country wants to consume more housing services. Since these are not tradable, the country needs to build more houses. This implies reallocating labor to the construction sector and sacrificing production of tradable goods. This happens both in the open and in the closed economy. The open economy can decouple consumption decisions from production decisions because it can import tradables for consumption. But the closed economy cannot. In the closed economy, building more houses requires reducing tradable consumption. This is an implicit adjustment cost, because housing services and tradable consumption are complements the household wants to smooth consumption across goods. The open and closed economies react differently to the same housing shock. Both reduce tradable consumption and reallocate labor towards construction. But the open economy runs a trade deficit importing tradables for consumption. This enables a smaller reduction in tradable consumption and increased consumption of housing services. These dynamics are shown in Figure 7.

Two prices govern the competitive equilibrium of this economy: i) the relative price of housing services in terms of consumer tradables; ii) the real interest rate, the price of one unit of the tradable good today in terms of tradable goods tomorrow. The housing shock implies an increase in the demand for housing. This translates into higher housing prices and construction. But although the shock reduces preferences for tradable goods, tradables are valuable because they allow smoothing of foregone consumption due to reallocation of labor to housing. The increase in intertemporal demand requires interest rates to rise. In an open economy, interest rates jump less than in a closed economy because country 2, by financing a trade deficit, helps to satisfy demand for tradables in country 1.

The model is a representative agent model and housing is not tradable. There are no wealth effects from a housing shock. But this does not preclude the housing boom from causing a trade deficit. Trade deficits and housing reactions are quantitatively large in the model. This happens because there are no frictions and because markets are complete. Finally, the dynamics are short-lived, because the absence of frictions allows the economy to reallocate resources quickly. In a couple of periods it has built the desired housing stock.

4.3 Summarizing the implications of the model

To sum up, the model's predictions after a housing shock are as follows:

First, trade deficits arise in periods of housing boom. The next section builds on this prediction to show that the model, using housing variables as explanatory variables, generate current account dynamics that match the recent global imbalances.

Second, housing booms are larger in open economies that can run trade deficits. This prediction is confirmed by recent housing dynamics in the OECD. Girouard et al. (2006) document

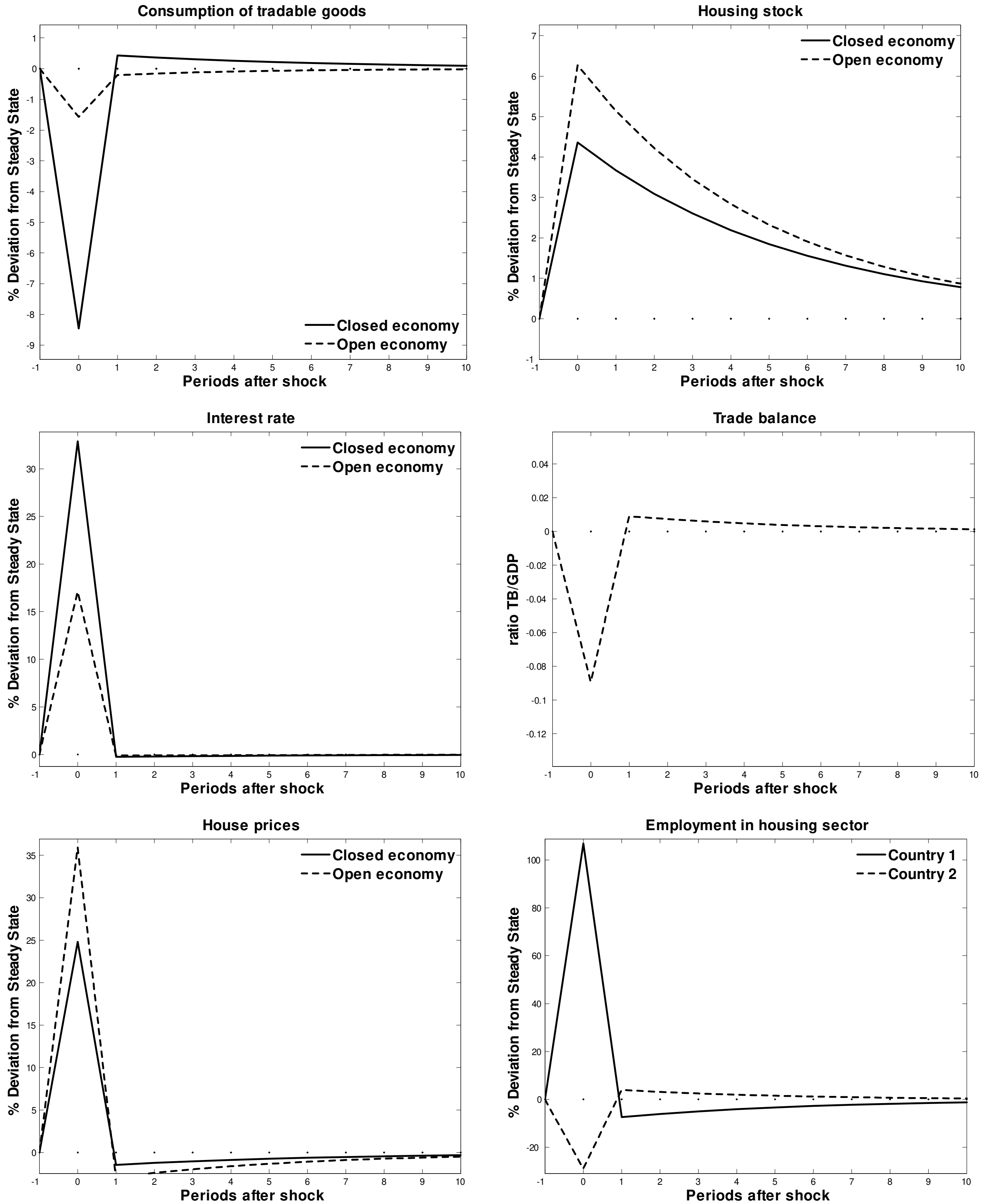

Fig. 7. Theoretical responses to an unexpected housing shock in country 1

more generalized housing upswings across OECD countries in recent years than in the past. These upswings coincided with the OECD opening to trade with non-OECD economies and starting to run an aggregate trade deficit.

Third, conditional on a shock that raises the demand for housing the correlation between the shock, interest rates and residential investment is positive. This conditional correlation is negative with tradable consumption. In Section 6, I use these sign restrictions to estimate a vector autoregression and identify the effects of housing specific shocks on the U.S. trade deficit.

5 The Model and The Global Imbalances

I now consider if the model can rationalize recent global imbalances. I show that it can account for Figure 2 using the housing variables as explanatory variables.

I perform the following experiment with the parameterized model of Section 4.2. I assume that country 1 experiences a housing shock while country 2 does not. I simulate a series of positive shocks in country 1 and obtain the reaction in both countries of the labor share in construction, the production of new houses and the trade balance from the steady state to the peak of the housing boom. For the current parameterization this happens in the first period, i.e. in five years, because in the absence of frictions the country can build very quickly. To label the countries of Figure 2 as country 1 or country 2 I assume that positive housing movements in Figure 2 come from country 1. Negative movements come from country 2. This introduces a kink at zero in my simulation because, except for the trade balance, countries 1 and 2 do not react symmetrically to a country 1 shock, as shown in the lower right panel of Figure 6. The asymmetry arises because labor is nontradable. Country 1 adjusts via two channels after the shock: it reallocates resources between its two sectors, and it runs a trade deficit, which implies resource reallocation in country 2. These two channels are not symmetric because labor can only be reallocated domestically.

Figure 8 plots the results of my simulation. The top panel graphs the global imbalances predicted by the model for a series of shocks that trace out the observed movements in the labor share employed in construction between 1994 and 2006, as displayed on the horizontal axis. The middle panel follows the same procedure but matches the change in the value added by the construction sector observed in the data. The third panel matches the observed movements in the housing prices. In all the simulations, countries with positive housing movements are considered to be country 1 in the model. For both the value added and the labor share employed in construction, the model generates current account dynamics very similar to the observed

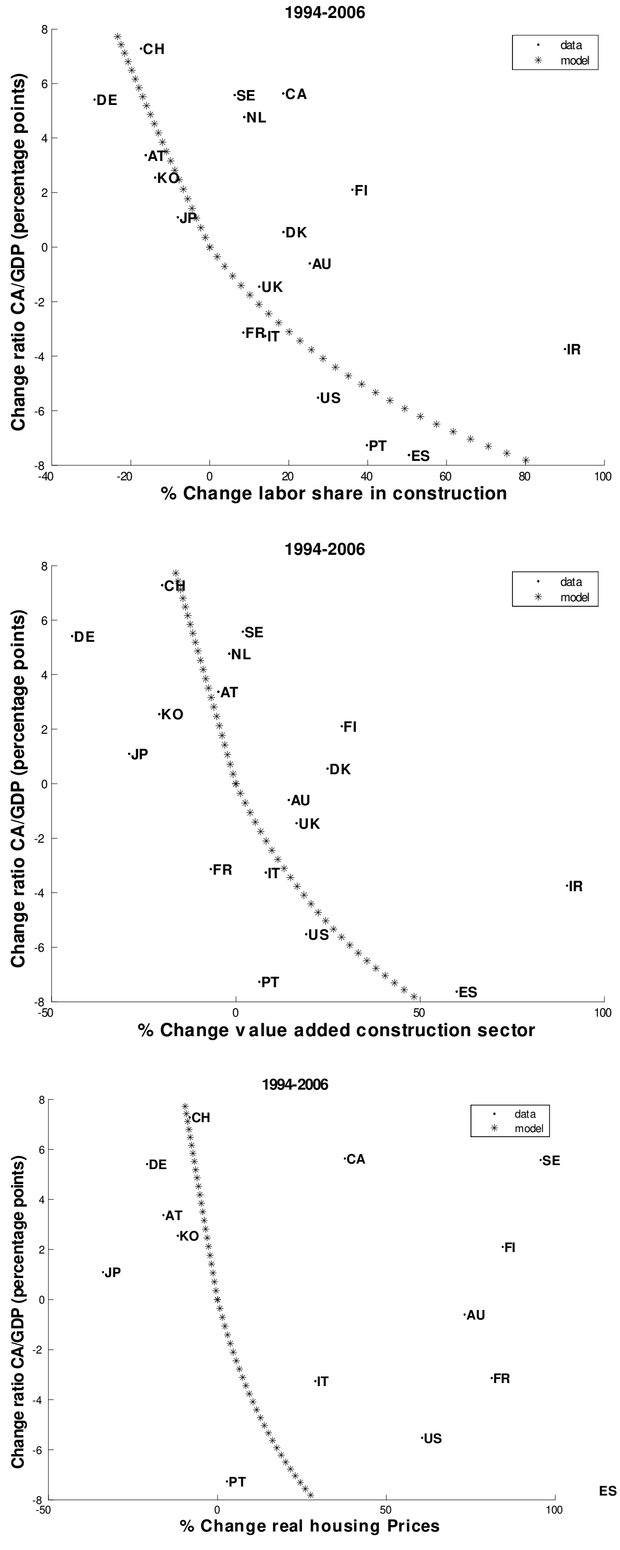

Fig. 8. Data and model-predicted global imbalances

global imbalances. I interpret this as support for housing shocks as a driver of current account dynamics.

6 Sign Restriction Identification

The model in Section 4.2 provides three identification restrictions for a housing demand shock: conditional on a positive shock, the correlation between the shock, interest rates and residential investment is positive. Moreover, the conditional correlation of the shock with tradable consumption is negative. These sign restrictions differ from those implied by alternative theories proposed to explain the global imbalances, for example the savings glut shocks predict decreases in interest rates, technology shocks imply comovement of housing and tradable consumption. Standard economic shocks like aggregate demand, fiscal, money, oil, and technology shocks also do not imply these reactions. This section exploits these sign restrictions to identify housing shocks from the forecast errors of a reduced form vector autoregression.

6.1 Methodology

Faust (1998), Canova and De Nicoló (2002) and Uhlig (2005) have proposed different ways to impose sign restrictions directly on impulse responses to identify economic shocks in a structural vector autoregression (SVAR). I will follow Uhlig (2005), using an efficient algorithm proposed by Rubio-Ramirez et al. (2005) [6]. I start by estimating a reduced form VAR on U.S. data, which contains the four variables central for my identification: real residential investment (I_h), real tradable consumption (C), long term interest rates proxied by the 10 year Treasury (LTR) and the trade balance/GDP ratio $\left(\frac{NX}{GDP}\right)$. I also include the variables commonly used in the SVAR literature to identify other economic shocks: relative price of equipment (pe), non farm business labor productivity (z), total government fiscal deficit (G),the price level (P), and the Fed Funds rate (FF).

I estimate a VAR with four lags that I reformulate into the companion matrix VAR(1) form:

$$Y_t = BY_{t-1} + u_t \tag{21}$$

where $E\left(u_t u_t'\right) \equiv \Sigma$ and

[6] See Dedola and Neri (2007) for a recent survey of sign restriction identification and its advantages.

$$Y_t \equiv \begin{bmatrix} \log pe_t \\ \log z_t \\ G_t \\ \log P_t \\ FF_t \\ \log C_t \\ \log I_{h_t} \\ LTR_t \\ \frac{NX_t}{GDP_t} \end{bmatrix}$$

I assume that the forecast errors (u_t) and the structural shocks (ε_t) are related by

$$u_t = A\varepsilon_t \tag{22}$$

where $E(\varepsilon_t \varepsilon_t') = I$. This implies that $\Sigma = AA'$. The impulse responses to the economic shocks are

$$\frac{\partial Y_{t+j}}{\partial \varepsilon_t} = B^j A \tag{23}$$

I want to identify the column of A associated with the housing shock. Without loss of generality, I assume that the housing shock is the first entry in ε_t. Denoting the ith variable in Y_t by Y_{it}. I impose the following sign restrictions

$$\frac{\partial Y_{6t+j}}{\partial \varepsilon_{1t}} < 0, \ \frac{\partial Y_{7t+j}}{\partial \varepsilon_{1t}} > 0, \frac{\partial Y_{8t+j}}{\partial \varepsilon_{1t}} > 0 \tag{24}$$

where j is the number of quarters during which I impose the sign restrictions. These sign restrictions are derived from the model of Section 4 after a shock to the marginal rate of substitution between housing and tradable consumption. In the model the number of quarters during which the restrictions hold depends on the calibration. Hence I will compare the results using different horizons. I do not impose any restriction on $\frac{NX_t}{GDP_t}$, since this is the variable of interest.

The matrix A is unique up to an orthonormal transformation, i.e., wherever $QQ' = I$ then $\Sigma = AQQ'A'$. I need to search for the set of AQ matrices satisfying (24). I draw 1000 elements of that set.[7]

[7] I followed the algorithm of Rubio-Ramirez et al. (2005): without loss of generality, I assume $A = chol(\Sigma)$, then I draw a matrix X, whose cells come from a standard normal distribution. Then I compute the QR decomposition of X. I normalize the diagonal of R to be positive and check if AQ satisfies (24). If it does, I keep AQ, if not I discard and draw again. I keep drawing until I have 1000 successes.

6.2 Results

My sample covers the period 1982:q1 to 2006:q4. Bems et al. (2007) provide several arguments for starting in 1982, and I use their series for the price of equipment. They make two main arguments. First, we want the sample to cover a period when trade was widely liberalized. Second, we also want to avoid both the structural break in monetary policy associated with the appointment of Paul Volcker (Clarida et al. 2000) and the structural break in the price of equipment reported by Fisher (2006).

I estimate the VAR in levels of the logs of the variables (except for the Fed Funds rate, the ratio Net Exports/GDP and the Net Government Deficit, for which I do not take logs). I do not model cointegration relationships, Sims et al. (1990) have shown that the system's dynamics can be consistently estimated in a VAR in levels even in the presence of unit roots. I also include a constant term. I use three proxies for tradable consumption: consumer durables, consumer nondurables excluding energy related goods, and the sum of the previous two.

Figure 9 reports the range of impulse responses for the ratio Trade Balance/GDP to a positive housing shock. Sign restrictions are weak identification restrictions in the sense that they lead to a plurality of candidate structural impulse responses. Figure 9 plots the set of impulse responses satisfying the restrictions. The first column has the sign restrictions imposed for one year, the second for two. The top row uses consumer durables as a proxy for tradable goods. The middle row uses consumer non-durables excluding gasoline, fuel, oil, and other energy goods. The bottom row uses consumer durables plus non durables excluding energy related goods. The results mostly confirm that housing shocks imply a trade deficit.

To assess the quantitative importance of housing shocks for net export dynamics, I compute the percentage of the variance of the trade balance forecasting error that is attributable to a positive housing shock. Figure 10 contains the results at different time horizons for the sign restrictions imposed for four and eight quarters respectively. I report the results for the same three proxies of consumer tradables. Housing shocks may be important driving forces of current account dynamics.

Finally, in Figure 11 I use equation (22) to plot the time paths of the housing shocks for each proxy of tradable consumption and for the sign restrictions imposed for four and eight quarters, respectively. Two results seem robust to the different specifications: the volatility of the shocks increased in the early 2000s and there were some large spikes during this period.

7 Concluding Remarks

This paper makes a theoretical and an empirical contribution to the debate on what caused the global imbalances. I document that over the last decade there has been a strong cross-country correlation between housing variables and current account dynamics. I present a simple model that shows that increases in the demand for nontradables relative to tradables imply trade deficits to smooth consumption between tradables and nontradables. I focus on housing, which I model as a durable nontradable good. Then I provide two types of evidence that housing demand shocks, shocks to the aggregate marginal rate of substitution between housing and tradables, help to explain recent global imbalances. A parameterized version of the model, for observed cross-section housing movements, generates trade balance dynamics consistent with recent OECD current account dynamics. Finally, housing demand shocks identified with model-consistent sign restrictions in a SVAR help to explain the U.S. trade balance.

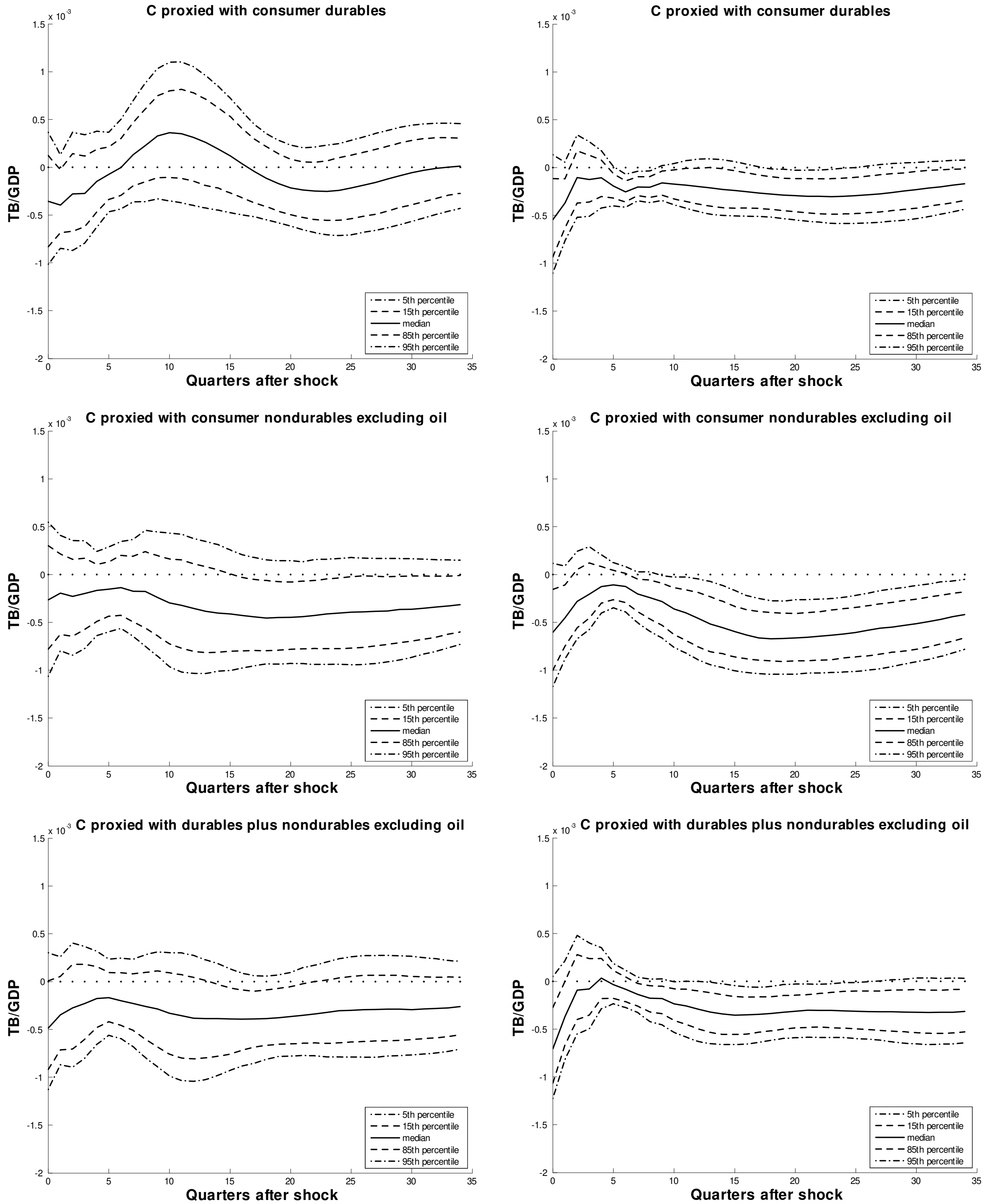

Fig. 9. Range of impulse responses for the ratio Trade Balance/GDP to a positive housing shock

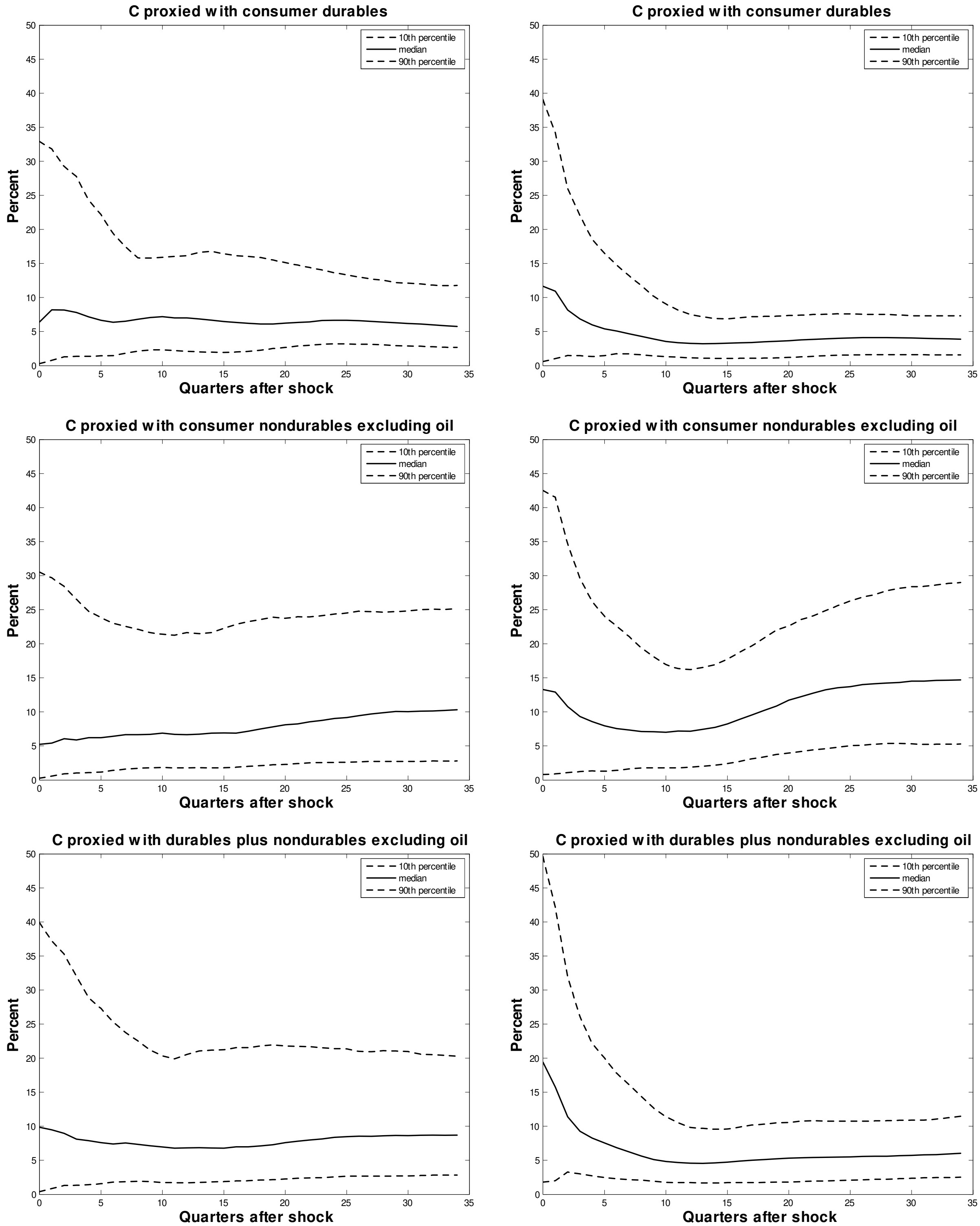

Fig. 10. Range of contribution of housing shocks to the variance of Trade Balance/GDP.

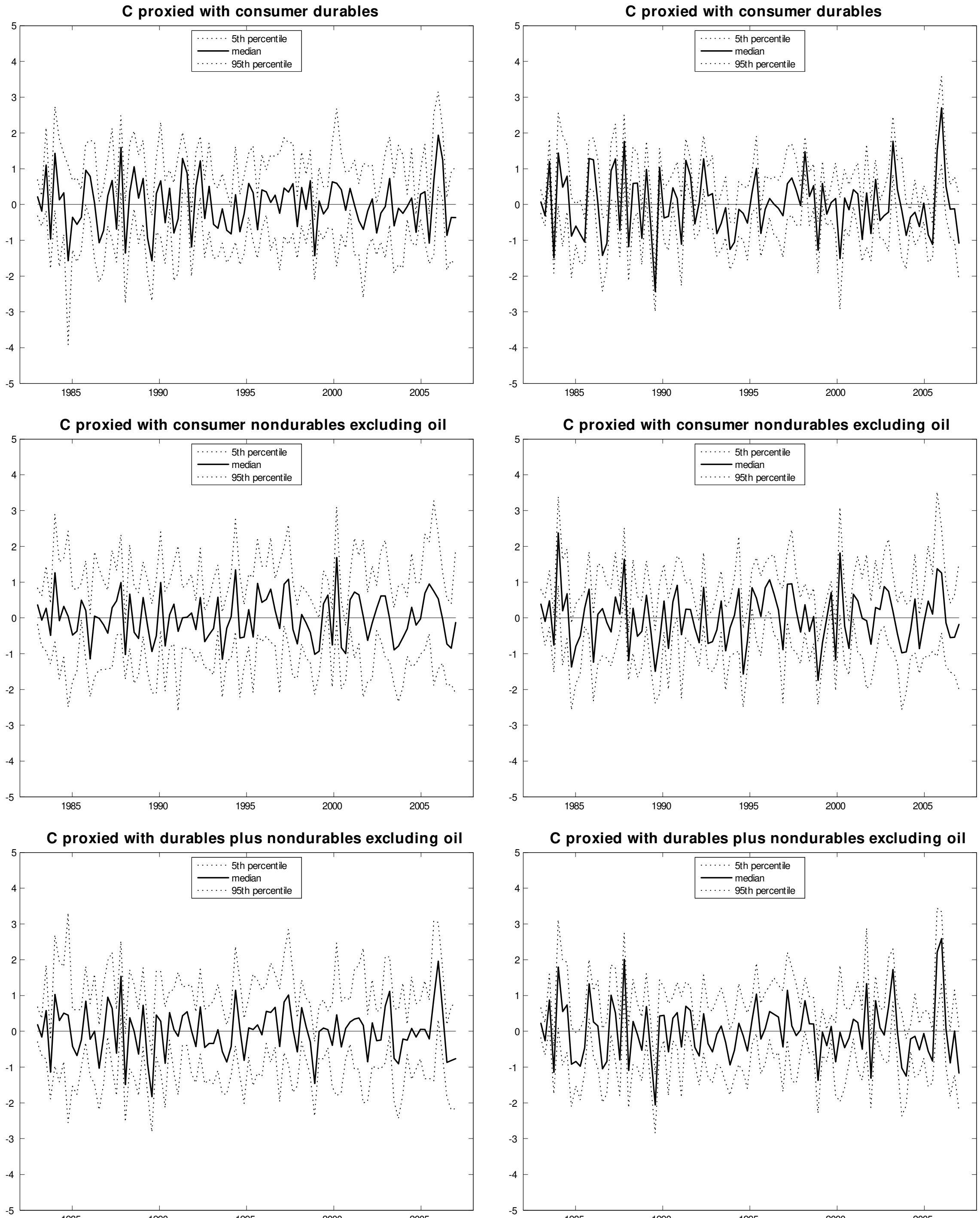

Fig. 11. Range of time paths of housing shocks

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Data sources

The series for current account and gross domestic product in Figures 1 and 2, and Table 1 are from the OECD. The series for labor share and value added from the construction sector are obtained from Datastream, which collects these data from domestic sources. The real house prices have been provided by the Bank of International Settlements and are compiled using national sources.

Figure 4 and Table 2 summarize data series for consumer durables, total consumption, gross domestic product, and residential investment from the NIPA tables published by the BEA (http://www.bea.gov/national/nipaweb/index.asp).

The series in Figure 3 for the trade balance in goods and its decomposition come from Table 2a in the U.S. International Transactions Accounts Data published by the BEA.

In Section 6, I used the series described in Bems et al. (2007) together with data on consumer durables, nondurables and 10 year constant maturity Treasury yields from the FRED database.