Dealing with Construction Permits, Interest Rate Shocks and Macroeconomic Dynamics*

Pedro Gete†

May 2014

Abstract

This paper studies how the costs and time lags in obtaining construction permits affect the response of aggregate consumption, employment in construction and house prices to interest rate shocks. First, I document heterogeneity in those costs among OECD economies with similar levels of mortgage development. Second, I use a general equilibrium model to derive sign restrictions to identify interest rate shocks. Third, I estimate vector autoregressions and identify exogenous interest rate shocks using the theory-consistent sign restrictions. Then, I compare the effects of the shocks in a sample of countries which are heterogeneous in the costs of obtaining the permits. The results show that reductions in interest rates stimulate the economy less in countries with higher costs of obtaining the construction permits. Moreover, the reaction of the economy to interest rate changes is more delayed the longer the time needed to obtain the permits. I discuss the implications of these results for policymakers.

*This research has been generously supported by a grant from the World Bank Group and the Ewing Marion Kauffman Foundation. The findings, interpretations, and conclusions expressed in this paper are entirely those of the author and should not be attributed in any manner to the World Bank Group, or to members of its Boards of Executive Directors or the governments they represent. I thank Asli Demirguc-Kunt, Adrian Gonzalez, Khrystyna Kushnir, Rita Ramalho and participants at the WB Doing Business Conference for comments. Tim Bian provided excellent research assistance.

†Georgetown University and IE Business School. Email: pg252@georgetown.edu

1 Introduction

There is increasing agreement in academia and policy circles that real estate and the construction sector play an important role in the business cycle and in the transmission mechanism of monetary policy, see for example Iacoviello (2010), International Monetary Fund (IMF 2008), or Leamer (2007). This paper shows that the costs associated with obtaining construction permits, and the number of days to obtain those permits, alter the reaction of macroeconomic variables to interest rate shocks. Reductions in interest rates stimulate the economy less in countries with higher costs of obtaining the construction permits. Moreover, the longer the time needed to obtain the permits the more delayed is the reaction of the economy to interest rate changes.

I employ Structural Vector Autoregressions (SVARs) identified with model-consistent sign restrictions. This methodology allows me to identify the causal effect of interest rate shocks. It acknowledges that interest rates may react to other economic shocks, that is why interest rates are estimated in a VAR together with other variables. Then, the exogenous interest rate shocks are identified by imposing restrictions on the comovements between variables (sign restrictions). These restrictions are derived from economic theory and are satisfied only by the interest rate shocks.

To derive the sign restrictions I analyze a dynamic general equilibrium model that is consistent with the macroeconomic literature on the drivers of housing markets.[1] There are two sectors: one sector produces tradable consumption goods, the other is a construction sector that uses land and labor to produce houses. Houses are non-tradable and durable. Since houses are durable, their demand is more interest rate sensitive (Erceg and Levin 2006). I analyze interest rate shocks which may come from monetary policy or from capital flows. I show that, conditional on a negative interest rate shock, consumption and employment in construction

[1] See for example Aspachs-Bracons and Rabanal (2010), Davis and Heathcote (2005), Ferrero (2013), Garriga et al. (2012), Gete (2009), Iacoviello and Neri (2010), or Justiniano et al. (2013) among others.

increase while interest rates and the trade balance go down. Only interest rate shocks generate these patterns. For example, other shocks such as changes in savings motives (the "savings gluts" proposed by Bernanke 2005) would decrease interest rates and stimulate construction, but cause a positive trade balance, as well as negative consumption and employment. No common macroeconomic shocks as productivity, population, bubbles or financial innovation would produce these comovements between variables (see Bian and Gete 2014 for a study of sign restrictions to identify these other shocks).

Once I have the sign restrictions to identify interest rate shocks I estimate vector autoregressions with several variables that could potentially cause the interest rate movements. Then I follow Uhlig (2005), using the algorithm proposed by Rubio-Ramirez et al. (2010), to identify the interest shock as the one whose impulse responses satisfy the model-derived sign restrictions. Usually the SVAR literature identified interest rate shocks with short-run restrictions. But, as discussed by Uhlig (2005), those identification conditions were problematic, many times they were not supported by theory and created puzzles. Faust (1998), Canova and De Nicoló (2002) and Uhlig (2005) advocate sign restrictions as the methodology to identify SVARs in a theory-consistent way.

My data on the costs and time of obtaining the construction permits come from the World Bank Doing Business database. The data are collected from experts in construction licensing (architects, construction lawyers, and construction firms), utility service providers and public officials who deal with building regulations, including approvals and inspections. The data are collected to be comparable across economies; they measure the costs and time required for a business in the construction industry to do the procedures to build a warehouse. These procedures include submitting all relevant project-specific documents (for example, building plans and site maps) to the authorities; obtaining all necessary clearances, licenses, permits and certificates; completing all required notifications; and receiving all necessary inspections. Doing Business also records procedures for obtaining connections for water, sewerage and a fixed landline. The data also account for procedures necessary to register the property so that it can be used as collateral or transferred to another entity.

I restrict my sample to countries included in the IMF Index of financial development of mortgage markets (IMF 2008) because several recent papers have shown that the level of development of mortgage markets alters the reaction of housing variables to interest rate shocks from monetary policy or from capital flows (Assenmacher-Wesche and Gerlach 2010, Calza et al. 2013, Sa et al. 2012). The IMF Index is only available for countries with developed mortgage markets. By restricting my attention to this sample of countries I can assume that differences in mortgage development do not drive my results. Moreover, in the next section I show that countries with similar levels of financial development are heterogeneous in the time and costs of obtaining the construction permits. That is, the frictions measured by The Doing Business data have different information than the level of financial development of the country.

I obtain two main results. First, decreases in interest rates stimulate the economy less in countries with higher costs of obtaining the construction permits because employment in construction reacts less. Second, economic variables take more time to react to interest rate changes in those countries in which it takes more time to get the permits. Thus, my results show that the frictions measured in the Doing Business Database alter the reaction of the economy to interest rate shocks, even if the level of development of mortgage markets is similar.

These results have several implications for policymakers. On one side, larger frictions in obtaining the permits increase the length of the transmission lags from monetary policy to the economy and reduce the effectiveness of monetary policy. Thus, lowering these costs increases the ability of monetary policy to stimulate the economy in a recession. However, for economies subject to capital inflows, these inflows can more easily generate real estate bubbles and overbuilding in countries in which it is easy and quickly to obtain the construction permits. Thus, from a macroprudential view it may be desirable to have some frictions in obtaining these permits to mitigate real estate booms (and then busts) driven by foreign capital inflows and low interest rates. In other words, it is not clear that reducing the frictions in obtaining the permits is necessarily good. Because higher frictions may protect the economy from over-building caused by temporary low interest rates.

This paper contributes to the literature studying real estate markets using SVARs. I show how to derive theory-consistent restrictions to identify interest rate shocks that could be due to monetary policy or capital inflows. Then, I study how their effects depend on the ability to obtain construction permits. Sign restrictions are interesting because by definition they avoid the identification problems associated with SVARs identified with short run restrictions (for example the price puzzle, i.e., inflation increasing after a monetary policy tightening). Sign restrictions, although not yet popular in studying real estate markets, have been applied to study several types of shocks, for example monetary shocks (Canova and Nicolo 2002, Faust and Rogers 2003, Uhlig 2005), global demand and commodity shocks (Charnavoki and Dolado 2014), neutral or investment specific technology shocks (Corsetti et al. 2014, Dedola and Neri 2007, Mumtaz and Zanetti 2012, Peersman and Straub 2009), fiscal shocks (Pappa 2009, Enders et al. 2011) or news shocks (Fratzscher and Straub 2013) among others. Bian and Gete (2014), Gete (2013) and Sa and Wiedalek (2013) are the papers more closely related to this paper. Gete (2013) shows how to decompose the housing demand shock into a bubble shock, a population shock and a credit expansion shock, and how to distinguish them from savings glut shocks. Sa and Wiedalek (2013) compare savings glut shocks and monetary policy in the U.S. Bian and Gete (2014) analyze recent housing dynamics in China using sign restrictions to identify different shocks.

The structure of the paper is the following: Section 2 discusses the database Dealing with Construction Permits and its weak correlation with the IMF Index of financial development of mortgage markets. Section 3 presents the model and derives the sign restrictions. Section 4 discusses the empirical identification. Section 5 shows the results. Section 6 concludes.

2 Heterogeneity in Dealing with Construction Permits

This section shows that the costs of dealing with construction permits from the Doing Business database contain information not captured in the IMF Index of development of mortgage markets (IMF 2008). Several authors have shown that the level of development of mortgage markets measured by the IMF Index alters the reaction of housing variables to interest rate shocks from monetary policy or from capital inflows (Assenmacher-Wesche and Gerlach 2010, Calza et al. 2013, Sa et al. 2012).

Figure 1 plots the IMF Index of financial development of mortgage markets against the costs of obtaining the construction permits (measured in percentage of income). The IMF index is only defined for OECD economies. Given that institutional factors do not change much over time, I take the average across periods of the Doing Business indicators. Figure 2 redoes Figure 1, but I replace the costs of obtaining the construction permits for the days to obtain the permits. Figures 1 and 2 show that countries with more developed mortgage markets usually have less frictions in obtaining construction permits.

Figure 3 redoes Figure 2, but instead uses the number of procedures to obtain construction permits in the x-axis. Figure 3 suggests that the number of procedures to obtain the permits may be larger in countries with advanced mortgage markets. It is unclear if the number of procedures is a relevant variable. It might be that some countries have many procedures that are not very costly and can be done quickly, while other countries have less procedures but they cost more or take more time. Thus, I will not focus on the number of procedures but on the costs and days needed to obtain the permits.

To conclude this section, the correlation between the IMF index and the Doing Business indicators is weak, that is, among countries with similar levels of financial development there are relevant differences in the costs and days to get the construction permits. This result motivates the rest of the paper. The existing literature has only focused on how the level of development of mortgage markets alters the transmission of interest rate shocks. This is the first paper studying how the frictions in obtaining the construction permits matter.

3 A Model to derive the Sign Restrictions

In this section I derive sign restrictions to identify interest rate shocks. I use a small open economy model with two sectors. One sector uses land and labor to produce houses, which are non-tradable and durable. I call this sector construction. The other sector produces tradable consumption goods. I study exogenous interest rates shocks (ϵ_t) which can be interpreted as coming from the Central Bank, or from capital flows.

3.1 Households

Households' per capita utility function is

$$u\left(f(c_t, h_t)\right) = \frac{f(c_t, h_t)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} \tag{1}$$

$$f(c_t, h_t) = ((1-\theta)c_t^{\frac{\varepsilon-1}{\varepsilon}} + \theta h_t^{\frac{\varepsilon-1}{\varepsilon}})^{\frac{\varepsilon}{\varepsilon-1}} \tag{2}$$

where c_t is the consumption of tradable goods, h_t the consumption of housing services, 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 $\theta \in (0,1)$ is a parameter that controls the share of consumption of housing services in total expenditure.

I assume a representative infinitely lived household that maximizes the expected utility of her members

$$\sum_{t=0}^{\infty} E_t \left[\beta^t N_t u\left(f(c_t, h_t)\right)\right] \tag{3}$$

where β is a discount factor and N_t the population size. We can define aggregate variables as

$$C_t = N_t c_t \tag{4}$$

$$H_t = N_t h_t \tag{5}$$

The household chooses consumption of each good and aggregate bond holdings (B) to maximize (3) subject to the aggregate budget constraint:

$$C_t + B_t + p_{ht}\left(H_t - (1-\delta)\, H_{t-1}\right) + \frac{\psi_B}{2} B_t^2 = (1+i_t)\, B_{t-1} + I_t \tag{6}$$

where p_{ht} is the price of a house in terms of non-durables, δ is the housing depreciation rate, i_t is the exogenous interest rate, I_t is household income that is defined below and that households take as exogenous when making their decisions. The parameter ψ_B is a small bond purchasing cost, this is standard in open economy models with incomplete markets to have a well-determined steady state (Boileau and Normandin 2008).

3.2 Firms

Firms produce housing structures (Y_{st}) and tradable goods (Y_{ct}) using labor supplied inelastically by the households. New housing (Y_{ht}) is produced using the housing structures and land (L)

$$Y_{st} = A_s N_{st}^{\alpha} \tag{7}$$

$$Y_{ct} = A_c N_{ct}^{\alpha} \tag{8}$$

$$Y_{ht} = L^{1-\gamma} Y_{st}^{\gamma} \tag{9}$$

where α, γ, A_s, A_c and L are constants. N_{ct} are the workers allocated to produce the tradable good.

Households own the firm and the land, thus we can define households' income as the total revenues of the firm:

$$I_t = p_{ht} Y_{ht} + Y_{ct} \tag{10}$$

3.3 Market Clearing and Shocks

Labor is mobile between both sectors but not across countries:

$$N_{ct} + N_{st} = N_t \tag{11}$$

Houses are non-tradable. The increase in the housing stock is the new housing produced minus the depreciation:

$$H_t - (1 - \delta) H_{t-1} = Y_{ht} \tag{12}$$

The law of motion for the interest rate shock is

$$\log\left(\frac{i_t}{i^*}\right) = \rho \log\left(\frac{i_{t-1}}{i^*}\right) + \epsilon_t \tag{13}$$

where ϵ_t is the interest rate shock, i^* is the steady-state value, and ρ controls the persistence of the shock.

3.4 Impulse Responses in the Model

The model does not have closed form solutions. I calibrate it as in Bian and Gete (2014). Then I solve it numerically using first-order perturbation methods, Juillard (1996) discusses the details. My goal is to derive identification restrictions that are as robust as possible.

Figure 4 reports the reaction of different variables in the economy to an interest rate shock. When interest rates decrease, the households borrow more, thus the trade balance and the current account become negative. Households' borrowings allow for higher spending. Thus, there is higher demand for housing and consumption since both are normal goods. Housing is more sensitive to interest rates because it is a durable good, thus employment in construction and relative house prices (that is, house prices in terms of consumption goods) increase after a reduction in interest rates.

I will identify interest rate shocks using the comovements shown in Figure 4. After a negative interest rate shock, consumption and employment in construction increase; while the trade balance and the current account decrease. Only shocks generating these comovements are interest rate shocks, because only interest rate shocks generate these comovements. This can be confirmed by comparing Figure 4 with the results of Bian and Gete (2014). Bian and Gete (2014) analyze five other shocks: population, housing preferences, savings gluts, credit shocks and expected higher productivity. Some shocks are related to interest rate shocks, as for example, the "savings gluts" shocks proposed by Bernanke (2005). Savings glut shocks decrease interest rates, but also cause a positive trade balance, as well as negative consumption and employment. Thus, the sign restrictions I derived to identify interest rate shocks are not identifying something different. Shocks as productivity, population, bubbles, savings gluts or financial innovation do not generate the same comovements between variables as those generated by interest rate shocks.

4 Sign Restrictions

This section estimates vector autoregressions and then uses the sign restrictions derived before to identify an interest rate shock.

4.1 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. I follow Uhlig (2005), using an efficient algorithm proposed by Rubio-Ramirez et al. (2010). I start by estimating a reduced form VAR which contains the five variables central for my identification: real final consumption (C), employment in construction (E_h), long term interest rates (i), housing prices (p_h) and the trade balance/GDP ratio $\left(\frac{NX}{GDP}\right)$. I estimate a VAR with four lags that I reformulate into the companion matrix VAR(1) form:

$$Y_t = BY_{t-1} + u_t \tag{14}$$

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

$$Y_t \equiv \begin{bmatrix} \log C_t \\ \log E_{h_t} \\ \log i_t \\ \log p_{h_t} \\ \frac{NX_t}{GDP_t} \end{bmatrix}$$

My sample covers the period 1982:q1 to 2012:q4 for a subset of OECD countries for which I found all these series at quarterly frequency (Canada, France, Germany, Italy, Japan, Spain, UK and USA). Bems et al. (2007) provide several arguments for starting in 1982. First, we want the sample to cover a period when trade was widely liberalized. Also, we also want to avoid the structural break in monetary policy associated with the appointment of Paul Volcker (Clarida et al. 2000). I estimate the VAR in levels of the logs of the variables (except for the interest rates and the ratio Net Exports/GDP for which I do not take logs). I do not model cointegration relationships; Sims et al. (1990) have shown that the dynamics of the system can be consistently estimated in a VAR in levels even in the presence of unit roots. I also include a constant term.

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

$$u_t = A\varepsilon_t, \tag{15}$$

and the objective of the SVAR is to characterize the matrix A. Once A is identified I can study the effect of the structural shocks on the economic variables of interest. The structural shocks ε_t have economic meaning and are orthogonal between them (their variance-covariance matrix is the identity matrix, $E(\varepsilon_t\varepsilon_t') = I$). The matrix A is unique up to an orthonormal transformation, i.e., wherever $QQ' = I$ then $E(u_t u_t') = AQQ'A'$. I search for the set of AQ matrices satisfying (17). I draw 1000 elements of that set.[2]

The sign restriction methodology identifies a set of AQ matrices which is consistent with what theory says should be the sign of the reaction of the economic variables to a structural shock. The impulse responses to the structural economic shocks are

$$\frac{\partial Y_{t+j}}{\partial \varepsilon_t} = B^j A \tag{16}$$

where j is the number of period of the impulse response. Without loss of generality, I assume that the interest shock is the first entry in ε_t. Denoting the ith variable in Y_t by Y_{it}, I impose the following sign restrictions that are consistent with the model of Section 3:

$$\frac{\partial Y_{1t+j}}{\partial \varepsilon_{1t}} > 0,\ \frac{\partial Y_{2t+j}}{\partial \varepsilon_{1t}} > 0, \frac{\partial Y_{3t+j}}{\partial \varepsilon_{1t}} < 0, \frac{\partial Y_{5t+j}}{\partial \varepsilon_{1t}} < 0 \tag{17}$$

where j is the number of quarters during which I impose the sign restrictions. That is, I impose that, conditional on a negative interest rate shock, consumption and employment in construction increase while interest rates and the trade balance go down. I do not impose restrictions on house prices, I left this variable free to check if the identified interest rate shocks

[2] I followed the algorithm of Rubio-Ramirez et al. (2010). That is, without loss of generality, I assume $A = \mathit{chol}(\Sigma)$, 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 (17). If it does, I keep AQ, if not I discard and draw again. I keep drawing until I have 1000 successes.

are consistent with the model. That is, I check if the shock identified as an interest rate shock without using information on house price reaction generates house price movements that are theoretically correct.

4.2 Impulse Responses to an Identified Interest Rate Shock

I estimate a vector autoregression for each country and identify interest rate shocks using the sign restrictions defined in (17). Figure 5 reports the impulse responses for the U.S. Sign restrictions are weak identification restrictions in the sense that they lead to a plurality of candidate structural impulse responses. That is, the methodology identifies a set of impulse responses that are consistent with the restrictions of (17) . All impulses in the set can be called an interest rate shock. Therefore, Figure 5 reports different percentiles of the distribution of impulse responses. In the next section I will focus on the median of the set, as it is standard in the sign-restrictions SVAR literature (see for example Charnavoki and Dolado 2014).

Figure 5 shows that the shocks that I identify as negative interest rate shocks imply increasing house prices. This is an encouraging result because it is what the model implies (Figure 4), and my identification conditions in (17) do not impose any sign restriction on house prices. Thus, the interest rate shocks identified by my SVAR are consistent with what theory says that should be an interest rate shock. This result holds for the other countries in the sample.

5 Results

In this Section I analyze how the costs and time needed to obtain the construction permits alter the reaction of the economy to an interest rate shock identified using the sign restrictions defined in (17). First, I show the results as a function of the level of the costs of obtaining the permits. Second, I focus on how many days are needed to obtain the permits.

5.1 Costs of Obtaining the Construction Permits

I classify as having high costs those countries with costs above the sample median. Countries below the median are classified as low costs. For each country I compute the response of consumption, employment in construction and house prices to a negative interest rate shock as in Figure 5. To focus on a unit-free variable comparable across countries, I compute an elasticity ($\varepsilon_{x,t}$) for each point in time. I define the elasticity in period t of variable X to an interest rate shock i as the ratio of the gross percentage change of variable X_t to the gross percentage change in interest rates:

$$\varepsilon_{x,t} = -\frac{1 + \frac{dX_t}{X_t}}{1 + \frac{di_t}{i_t}} \tag{18}$$

That is, the elasticity is positive if variable X_t increases after a decrease in interest rates. I use gross percentage changes to avoid dividing by zero because in some periods the net percentage change in interest rates $\left(\frac{di_t}{i_t}\right)$ is close to zero.

I average the impulse-response functions from the individual-country VARs to obtain the mean effect of a interest rate shock across countries. As discussed in Assenmacher-Wesche and Gerlach (2010), because my main interest is in the average response to the shocks, this approach is preferable to averaging coefficients across countries and then computing impulse responses at the mean-group estimate. Because of the triangle inequality, calculating the impulse responses at the average coefficients will lead to smaller responses than averaging over the impulse responses.

Figures 6, 7 and 8 show the dynamics of the elasticity of consumption, employment in construction and house prices after an interest rate shock identified according to (17) . In Figures 6 and 7 we see that countries with larger costs of obtaining the construction permits have lower elasticities of consumption and employment in construction when faced with interest rate shocks. That is, lowering interest rates provides both fewer stimuli in consumption, and less employment in construction for countries with high costs of obtaining the permits.

Figure 8 shows that the elasticity of house prices to interest rates is very similar for high and low costs of obtaining the construction permits. In the medium term, house prices react more in countries with high costs because the supply of new construction is lower in countries with high costs (Figure 7 shows less employment in construction). Thus, the smaller change in supply leads to larger reaction in house prices. Even if house prices react more when the costs are high (Figure 8), consumption is reacting less (Figure 6). This last result suggests that employment in construction is more important for consumption dynamics than house prices.

5.2 Days to Obtain the Construction Permits

My goal now is to focus on the relation between the number of days to obtain the permits and the reaction of the economic variables after an interest rate shock. To do so, for each country I compute the response of consumption, employment in construction and house prices to a negative interest rate shock as in Figure 5. Then I record how many quarters it takes to achieve the maximum level of the impulse response. And, for each country in my sample, I plot that variable against the number of days that it takes to obtain the construction permits in that country. Figure 9 plots the results for aggregate consumption. There is a positive relation between the number of days it takes to obtain the permits and the number of quarters it takes to achieve the maximum response. The relation across-countries is highly non-linear and it is not captured well by the correlation coefficient.

Figure 10 redoes Figure 9, but for employment in construction. That is, I record the number of quarters that it takes for the impulse response of employment in construction to achieve its maximum response after an interest rate shock. Figure 10 plots the number of quarters to achieve the maximum response against the number of days to obtain the construction permits. Employment in construction takes more time to react to an interest rate shock when it takes more days to obtain the construction permits. Again, the relation is non-linear across countries as it is shown by the low correlation coefficient.

Figure 11 redoes Figure 10 but for house prices. Now the cross-country pattern is unclear. If the US and Canada are removed, then house prices have more delayed responses to interest rate shocks in countries in which it takes more time to process the permits. However, when the US and Canada are included, the correlation between time to obtain the permits and time to achieve the maximum response in house prices becomes negative.

6 Conclusions

What are the consequences of reducing the costs and days of obtaining the construction permits? This paper shows that those reforms will increase the sensitivity of the economy to interest rate shocks. That is, in countries with higher costs of obtaining the construction permits a reduction in interest rates will provide fewer stimuli in consumption and less employment in construction. In these countries, the reaction of house prices may be larger given that the elasticity of construction is lower. Moreover, the economy reacts in a slower way to interest rate shocks in countries in which it takes more time to obtain the construction permits.

To obtain the previous results, first I derived theory-consistent sign restrictions to identify interest rate shocks. Then, I estimated vector autoregressions and identified interest rate shocks. I focused on countries with similar levels of development of mortgage markets (countries in the IMF Index of financial development of mortgage markets). Several papers have shown that this proxy for financial development alters the reaction of housing variables to interest rate shocks from monetary policy or from capital inflows. I show that frictions in obtaining construction permits also matter for the dynamics of housing and macro variables.

From a policymaker's perspective it is not clear that reducing the costs and days to obtain the construction permits is necessarily optimal. Monetary policy is less useful if the ability to stimulate the economy via interest rates is lower because the costs of obtaining the permits are larger. But, if the country faces reductions in interest rates driven by capital inflows, then higher costs and delays in dealing with construction permits may prevent over-building and over-indebtedness. In other words, the costs and days to obtain the permits may be a macroprudential tool. Further research should examine this tradeoff between monetary and prudential policies.

References

Aspachs-Bracons, O. and Rabanal, P.: 2010, "The Effects of Housing Prices and Monetary Policy in a Currency Union", *International Journal of Central Banking* .

Assenmacher-Wesche, K. and Gerlach, S.: 2009, Financial structure and the impact of monetary policy on property prices, *Swiss National Bank, Working Paper, October* .

Bems, R., Dedola, L. and Smets, F.: 2007, "US Imbalances: The Role of Technology and Policy", *Journal of International Money and Finance* (26 (4)), 523–545.

Bernanke, B.: 2005, "The Global Saving Glut and the US Current Account Deficit", *Sandridge Lecture* .

Bian, T. and Gete, P.: 2014, What Drives Housing Dynamics in China? A Sign Restrictions VAR Approach.

Boileau, M. and Normandin, M.: 2008, Closing international real business cycle models with restricted financial markets, *Journal of International Money and Finance* **27**(5), 733–756.

Calza, A., Monacelli, T. and Stracca, L.: 2013, Housing finance and monetary policy, *Journal of the European Economic Association* **11**(s1), 101–122.

Canova, F. and Nicoló, G.: 2002, "Monetary Disturbances Matter for Business Fluctuations in the G-7", *Journal of Monetary Economics* (49 (6)), 1131–1159.

Charnavoki, V. and Dolado, J. J.: 2014, "The Effects of Global Shocks on Small Commodity-Exporting Economies: Lessons from Canada", *American Economic Journal: Macroeconomics* **6**(2), 207–237.

Clarida, R., Gali, J. and Gertler, M.: 2000, "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory", *Quarterly Journal of Economics* (115 (1)), 147–180.

Corsetti, G., Dedola, L. and Leduc, S.: 2014, "The International Dimension of Productivity and Demand Shocks In the US Economy", *Journal of the European Economic Association* **12**(1), 153–176.

Davis, M. and Heathcote, J.: 2005, "Housing and the Business Cycle", *International Economic Review* **46**(3), 751–784.

Dedola, L. and Neri, S.: 2007, "What Does a Technology Shock Do? A VAR Analysis with Model-Based Sign Restrictions", *Journal of Monetary Economics* (54 (2)), 512–549.

Enders, Z., Müller, G. J. and Scholl, A.: 2011, "How Do Fiscal and Technology Shocks Affect Real Exchange Rates?: New Evidence for the United States", *Journal of International Economics* **83**(1), 53–69.

Erceg, C. and Levin, A.: 2006, "Optimal Monetary Policy with Durable Consumption Goods", *Journal of Monetary Economics* (53 (7)), 1341–1359.

Faust, J.: 1998, "The Robustness of Identified VAR Conclusions about Money". Carnegie-Rochester Series on Public Policy, 49, 207–244.

Faust, J. and Rogers, J. H.: 2003, "Monetary Policy's Role in Exchange Rate Behavior", *Journal of Monetary Economics* **50**(7), 1403–1424.

Ferrero, A.: 2013, "House Price Booms, Current Account Deficits, and Low Interest Rates", (541).

Fratzscher, M. and Straub, R.: 2013, "Asset Prices, News Shocks, and the Trade Balance", *Journal of Money, Credit and Banking* **45**(7), 1211–1251.

Garriga, C., Manuelli, R. and Peralta-Alva, A.: 2012, "A Model of Price Swings in the Housing Market", *FRB of St. Louis Working Paper No* .

Gete, P.: 2009, "Housing Markets and Current Account Dynamics", *PhD Dissertation, University of Chicago* .

Gete, P.: 2014, "Housing Markets and Current Account Dynamics", *SSRN 1558512* .

Iacoviello, M.: 2010, Housing in DSGE models: Findings and new directions, *Housing Markets in Europe*, Springer, pp. 3–16.

Iacoviello, M. and Neri, S.: 2010, "Housing market spillovers: evidence from an estimated DSGE model", *American Economic Journal: Macroeconomics* **2**(2), 125–164.

IMF: 2008, The changing housing cycle and the implications for monetary policy, *World Economic Outlook* **19**.

Juillard, M.: 1996, "Dynare: A program for the resolution and simulation of dynamic models with forward variables through the use of a relaxation algorithm", **9602**.

Justiniano, A., Primiceri, G. E. and Tambalotti, A.: 2013, "Household Leveraging and Deleveraging", National Bureau of Economic Research.

Leamer, E.: 2007, "Housing is the Business Cycle", Paper presented at the "Housing, Housing Finance, and Monetary Policy" Federal Reserve Bank of Kansas symposium, Jackson Hole, WY.

Mumtaz, H. and Zanetti, F.: 2012, "Neutral Technology Shocks and the Dynamics of Labor Input: Results from an Agnostic Identification", *International Economic Review* **53**(1), 235–254.

Pappa, E.: 2009, "The Effects of Fiscal Shocks on Employment and the Real Wage", *International Economic Review* **50**(1), 217–244.

Peersman, G. and Straub, R.: 2009, "Technology Shocks and Robust Sign Restrictions in a Euro Area SVAR", *International Economic Review* **50**(3), 727–750.

Rubio-Ramirez, J. F., Waggoner, D. F. and Zha, T.: 2010, "Structural Vector Autoregressions: Theory of Identification and Algorithms for Inference", *The Review of Economic Studies* **77**(2), 665–696.

Sá, F., Towbin, P. and Wieladek, T.: 2012, Capital Inflows, Financial Structure and Housing Booms.

Sá, F. and Wieladek, T.: 2013, "Capital Inflows and the U.S. Housing Boom".

Sims, C., Stock, J. and Watson, M.: 1990, "Inference in linear time series models with some unit roots", *Econometrica* (58 (1)), 113–144.

Uhlig, H.: 2005, "What are the effects of monetary policy on output? Results from an agnostic identification procedure", *Journal of Monetary Economics* (52 (2)), 381–419.

Figures

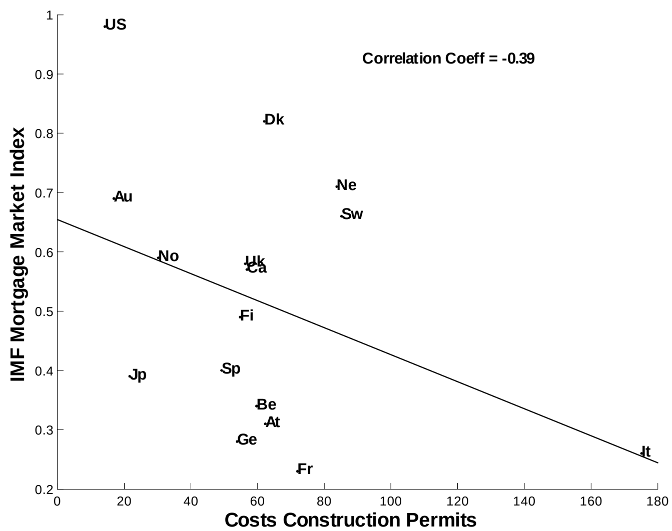

Figure 1: IMF Index of Mortgage Market Development and Costs of Obtaining Construction Permits. Source: IMF (2008) and World Bank Doing Business Database.

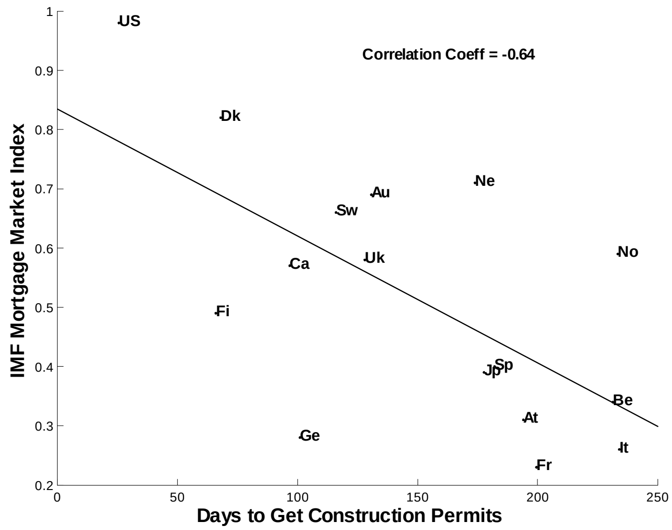

Figure 2: IMF Index of Mortgage Market Development and Number of Days to Obtain Construction Permits. Source: IMF (2008) and World Bank Doing Business Database.

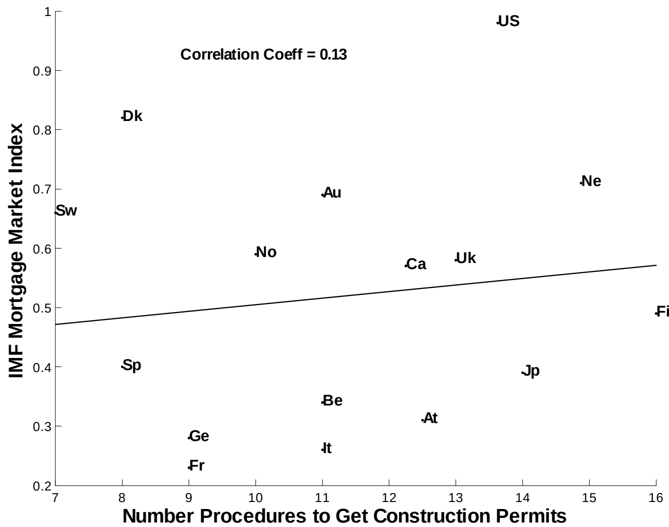

Figure 3: IMF Index of Mortgage Market Development and Number of Procedures to Obtain Construction Permits. Source: IMF (2008) and World Bank Doing Business Database.

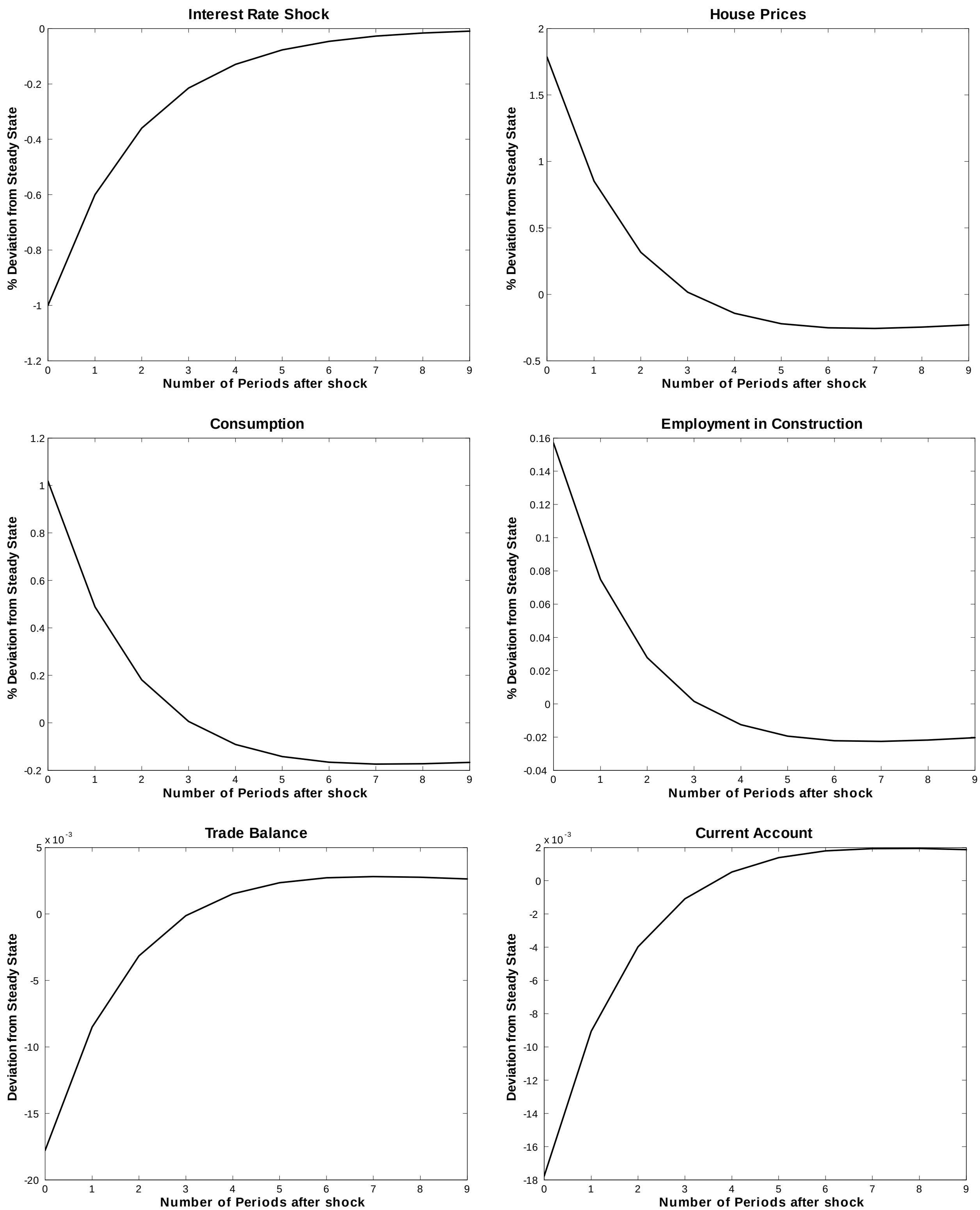

Figure 4: Theoretical Reactions to Interest Rate Shock. This figure plots the reaction of the variables of the model to a drop in interest rates.

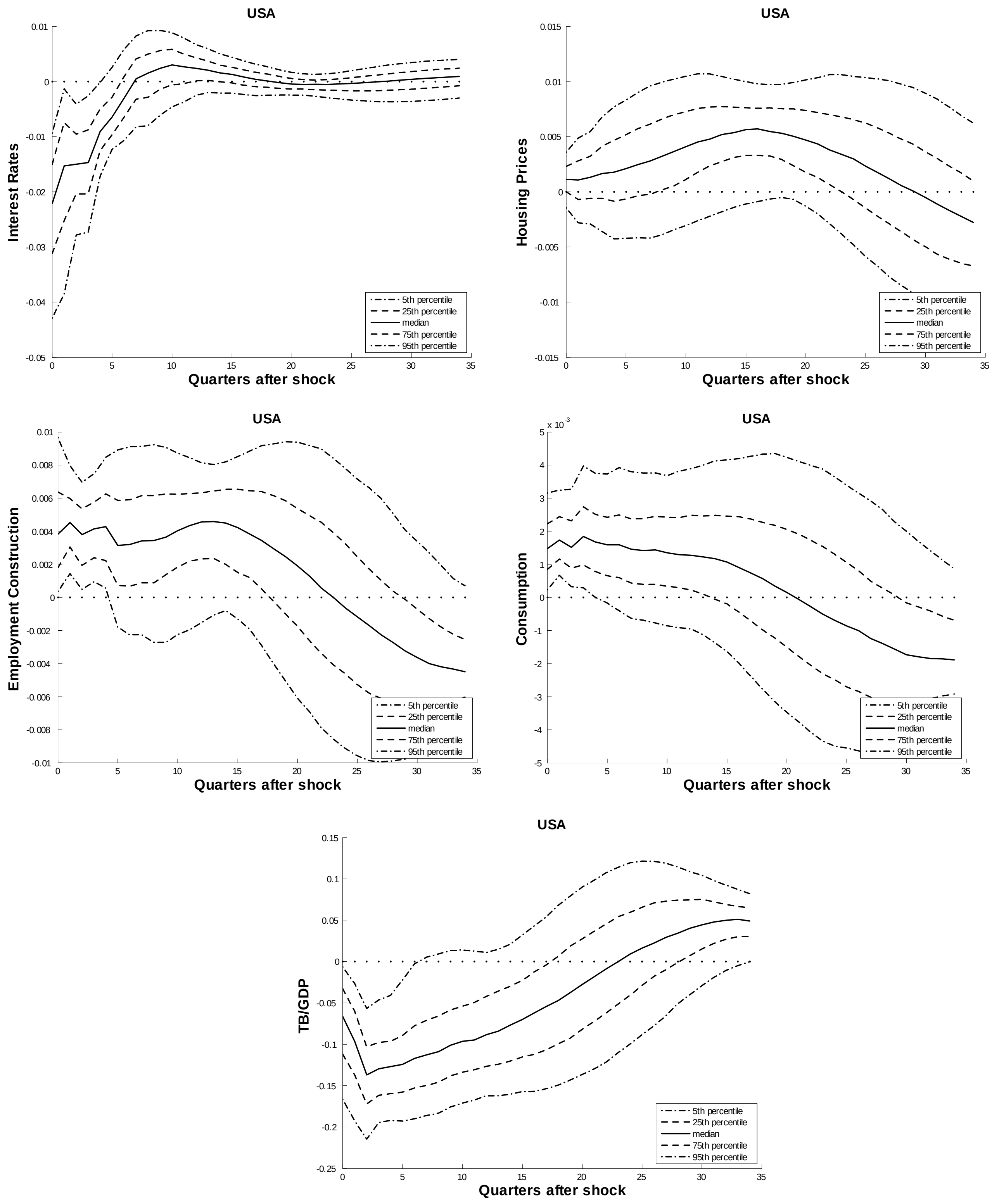

Figure 5: Impulse Responses in the USA to an Interest Rate Shock identified with the Sign Restrictions.

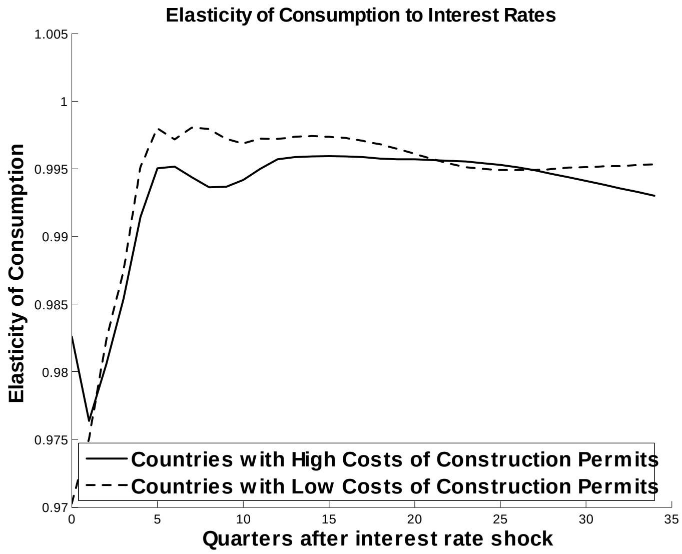

Figure 6: Elasticity of Consumption to an Interest Rate Shock for Different Costs of the Construction Permits.

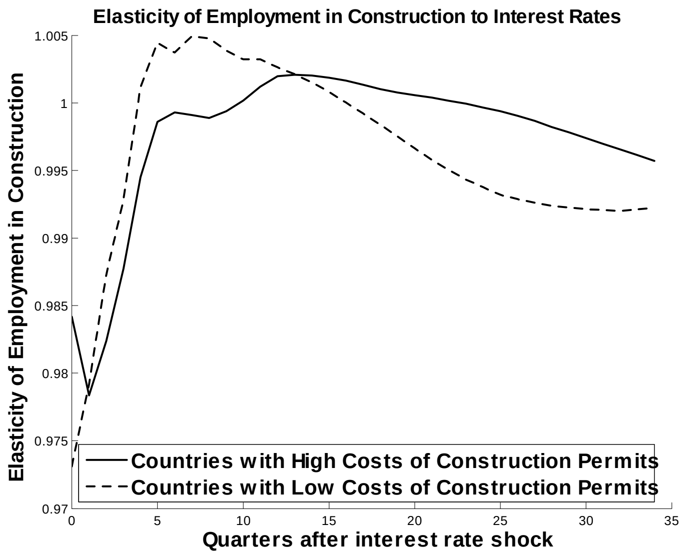

Figure 7: Elasticity of Employment in Construction to an Interest Rate Shock for Different Costs of the Construction Permits.

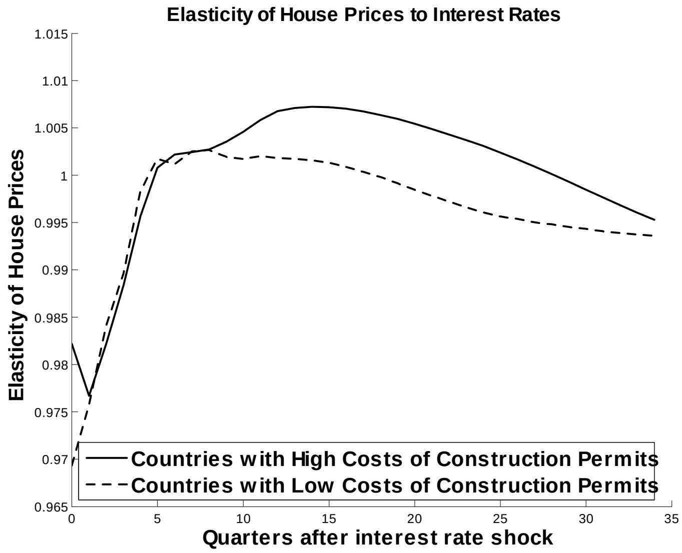

Figure 8: Elasticity of House Prices to an Interest Rate Shock for Different Costs of the Construction Permits.

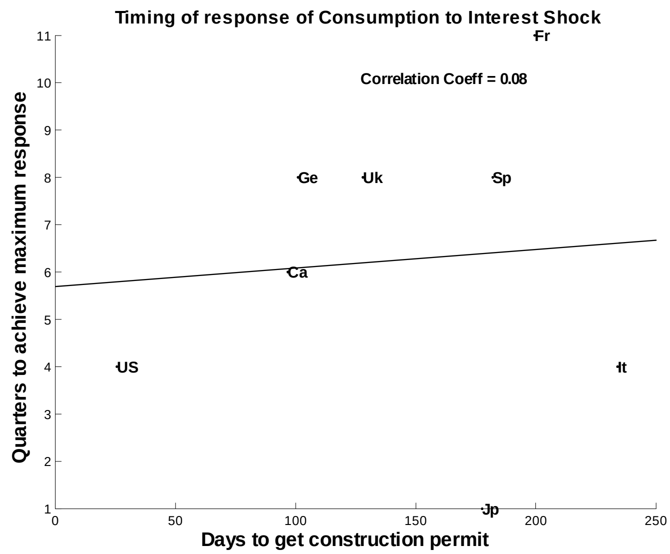

Figure 9: Number of Days to get Construction Permits and Number of Quarters to achieve Maximum Response after Interest Shock.

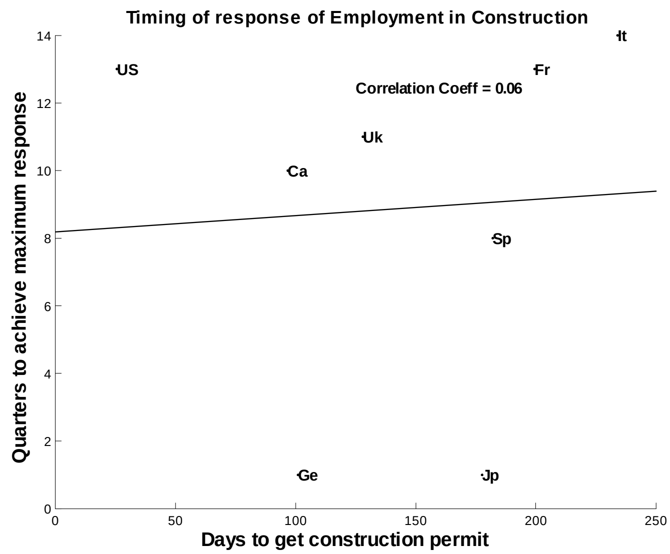

Figure 10: Number of Days to get Construction Permits and Number of Quarters to achieve Maximum Response after Interest Shock.

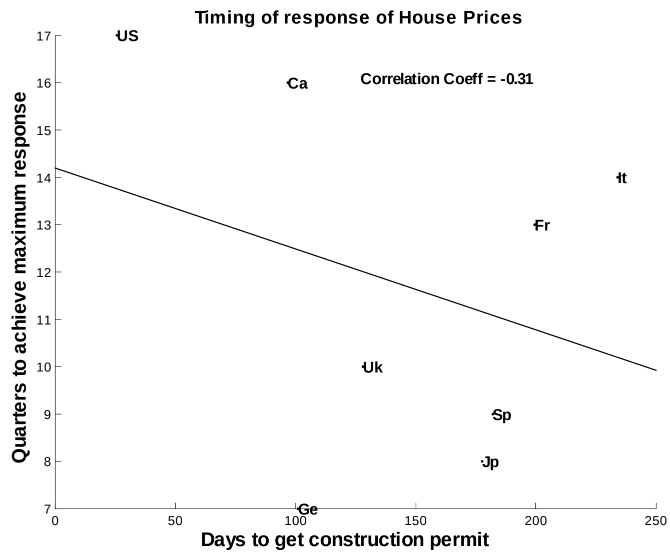

Figure 11: Number of Days to get Construction Permits and Number of Quarters to achieve Maximum Response after Interest Shock.