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**Abstract**

Over the last decade house prices increased remarkably in many countries. However, while in several countries there was an employment boom in the construction sector, in others the share of employment in this sector did not significantly change. In this paper we estimate a model of labor demand in the construction sector, featuring building constraints, which explains many of the international differences in the response of sectoral reallocation of employment to house prices. Countries with more building possibilities (Spain, Sweden and the US) have a high sectoral reallocation of employment, and display larger elasticities of labor demand in the construction sector with respect to house prices than countries that seem to have fewer building possibilities (Belgium, the Netherlands, and the UK). Nevertheless, our estimates imply that, for the whole economy, the elasticity of labor demand with respect to house prices is broadly similar across countries.

**JEL Classification**: R32, J23

**Keywords:** House prices, labor demand, sectoral reallocation of labor.

# 1 Introduction

House prices have been on the rise since the mid-1990s in many Western countries. However, while in some countries there was an employment boom in the construction sector, in others the share of employment of this sector did not significantly change. As seen in Figure 1, with house prices increasing more or less across the board over the last decade, the share of employment in the construction sector rose significantly in Spain, the US, and, to a lesser extent, in the UK, while it decreased in Austria, Belgium, and France. This shows dissimilar patterns in the sectoral reallocation of economic activity which is also noticeable in housing investment. Since the early 1990s housing investment, as a proportion of GDP, increased by 1.2 p.p. in Spain, and by 0.5 p.p. in the US, while it decreased in the UK, Sweden, Netherlands, Italy, France and Belgium.[1]

This observation suggests two questions. The first one is about the reasons for cross-country differences in the response of sectoral reallocation of employment into the construction sector to changes in house prices. The second concerns whether these different responses of sectoral labor reallocation to changes in house prices have implications for the aggregate evolution of employment, for the evolution of other macroeconomic variables, and for the employment consequences of a house price reversal.[2]

[1] Using time series data for the 1970-1999 period, Girouard and Blöndal (2001) find strong positive correlation between housing investment and real house prices in Belgium, Denmark, the Netherlands and Spain, and only very weak correlation in the US, Japan, France, and Norway.

[2] The following quote uses the US example to illustrate the type of problems that may arise:

"On the surface, America's housing boom looks more modest that those elsewhere... On the other hand, the property boom has probably caused a bigger misallocation of resources in America because of the response of borrowers, savers and investors. Residential investment has risen to 6% of GDP, close to a record. Add in the wealth effects from rising home values and the boost to spending from mortgage-equity withdrawal, and housing accounted for an astonishing 50% of GDP growth in the first half of this year... Since 2001 more than half of all private jobs created have been in housing-related industries... The American economy's addiction to housing leaves it exposed not only to a cooling of property prices, but also to long-term costs... it diverts resources away from more productive sectors and by fueling consumer spending it exacerbates America's economic imbalances." (The Economist, September 2005).

In this paper we provide an answer to the first question and draw some implications from our results with regard to the second. The idea is that the observed heterogeneity in sectoral employment responses to changes in relative house prices is associated with cross-country differences in opportunities of production in the construction sector.

Specifically, we estimate the impact of house prices on sectoral labor demand reallocation using a sample of nine countries over the period 1980-2003[3]. To this end we present a simple model of labor demand, where we allow, in a flexible way, for the existence of cross-country differences in building possibilities. One might think of land availability issues, whether physical or restricted by planning restrictions, urban developments, and other regulations, as the factors determining production possibilities in the construction sector.[4]

The model is taken to the data to assess, first, how changes in house prices would affect labor demand reallocation across sectors, and second, to guide the estimation of the effects of house prices on labor demand in construction, depending in both cases on building possibilities. To empirically account for building constraints, since these are not directly observable, we use a corrected measure of population density (namely, population density per square km and the percentage of households living in houses, as opposed to flats). It turns out that the consideration of building possibilities in the construction sector in this way not only renders the coefficients of house prices in labor demand equations statistically significant, but also explains a great deal of the cross-country variation in the labor demand elasticity with respect to house prices in the construction sector. We find

[3] The inclusion of countries in the sample is only restricted by availability of time series data on house prices from a single source and of other variables needed in our model, namely sectoral employment data. The nine countries in the sample are: Austria, Belgium, France, Itlay, Netherlands, Spain, Sweden, UK, and US. However we have also done some robustness checks using alternative house price country data from Girouard et al. (2006)

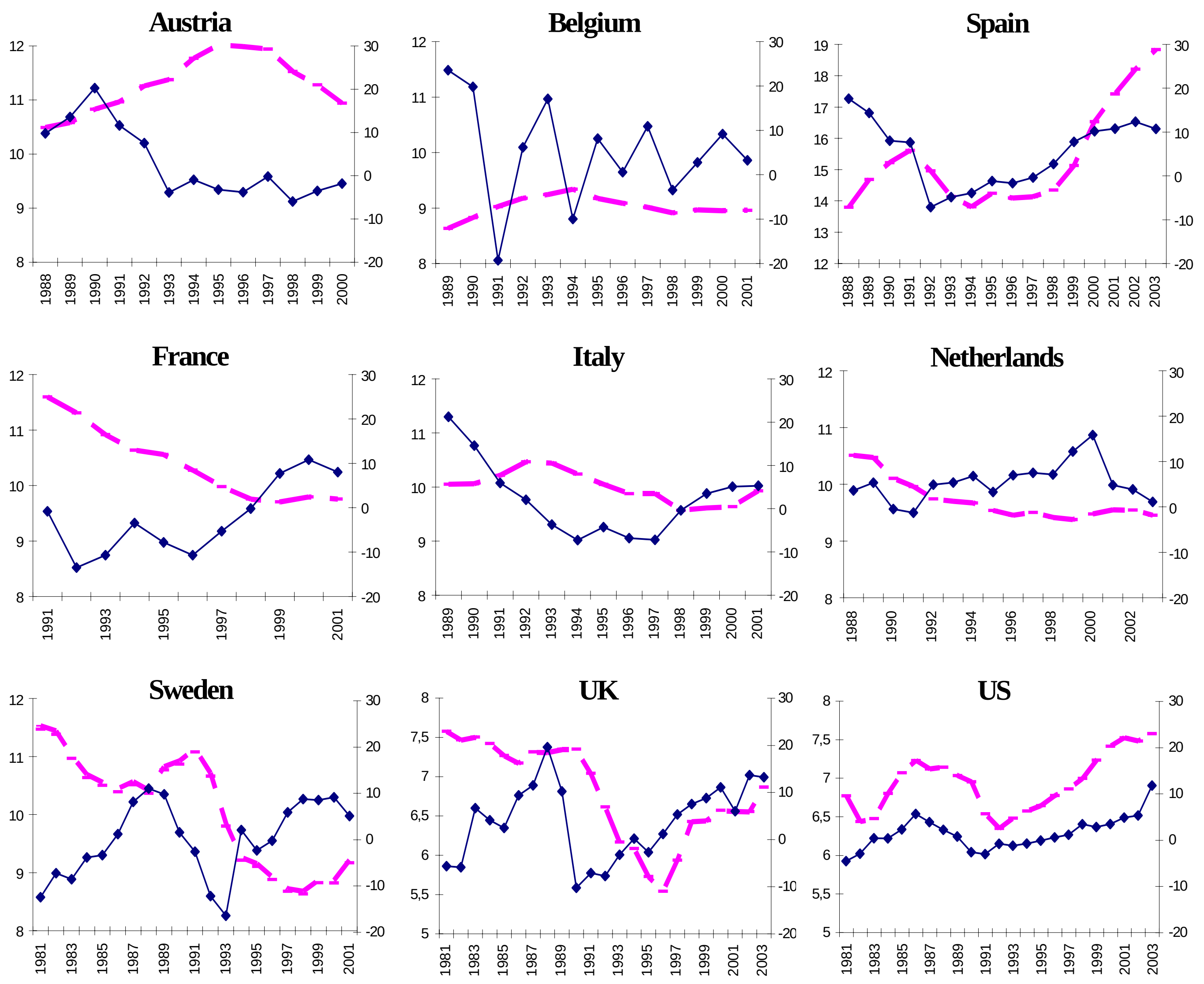
[4] In another context, Glaeser et al. (2005a) argue that, in the US, restrictions to building possibilities are relevant for explaining the recent rise in house prices.

that there are countries with high reallocation of labor demand (Spain, US, and Sweden), where a rise in house prices of 1% would imply a change in the ratio of labor demand in the construction sector to labor demand in the rest of the economy of about 0.5%, while the rise in labor demand in the construction sector would be around 1%. At the other extreme, there are countries with fewer building possibilities (Belgium, the Netherlands, and the UK) where a similar rise in house prices would imply a reallocation of labor demand away from the construction sector to the rest of the economy, while the rise in labor demand in the construction sector would be around 0.4%. Finally, there is some, but not much, reallocation of employment into the construction sector after a rise in house prices in Austria, France, and Italy, where a rise in house prices of 1% would imply a change in the ratio of labor demand in the housing sector to labor demand in the rest of the economy of about 0.25%, while the rise in labor demand in the construction sector would be around 0.7%. According to these results, the implied elasticity of aggregate labor demand with respect to house prices ranges between 0.47, in Belgium and the Netherlands, and 0.54 in Spain and Sweden.

Our results can be read as complementary to those of some previous studies aimed at estimating the price elasticity of supply in housing markets. This literature has followed two routes. First, some studies have used time series data to gauge the response of new residential construction to house price (see, for instance, Malpezzi and Maclennan, 2001). Secondly, within a given country, some studies have exploited the regional variation in house prices and construction activity to measure the price elasticity of supply in the construction sector (see, for instance, Glaeser et al., 2005b, Saks, 2005, and Vermeulen and van Ommeren, 2006). To the best of our knowledge, our results are the first arising from cross-country comparisons of the response of activity in the construction sector to house prices, taking into account international differences in building possibilities.

The structure of the paper is as follows. In Section 2 we lay out the model and present its empirical counterpart. In Section 3 we discuss estimation and the empirical results, and comment on some macroeconomic implications of the response of the sectoral reallocation of employment to a house price boom. Final remarks are in the last section.

**Figure 1. House price growth (%, blue diamond-right-hand scale) and the share of employment in the construction sector (%, dashed line-left-hand scale)**



## 2 House prices and labor demand

In this section we present a simple model of labor demand whose distinctive feature is the existence of building constraints in the construction sector. We use this model to assess, first, how changes in house prices would yield labor demand reallocation across sectors, and, second, to guide the estimation of the effects of house prices on labor demand in the construction sector.

We assume that the economy consists of two sectors: a construction sector, $H$, and a non-durable consumption goods and services sector, $R$ (i.e. the rest of the private sector economy). To capture the heterogeneity in the construction sector across countries we consider that for each country $j$, the housing activities are geographically located across several areas, $i = 1, ..., L$, each characterized by different building possibilities, $Y^*_{H,i}$. These building possibilities depend on land availability, planning restrictions, urban developments, regulations, etc.

Hence, assuming for simplicity that labor is the only production factor, the housing production possibilities are described by the following technology[5]

$$Y_{H,i} = \min\left(N_{H,i}^{\alpha_H}, Y^*_{H,i}\right) \tag{1}$$

where $Y_{H,i}$ and $N_{H,i}$ denote housing production and employment in area $i$, $Y^*_{H,i}$ represents building possibilities in area $i$, and $0 < \alpha_H < 1$. The non-durable consumption goods and services sector production function is given by

$$Y_R = N_R^{\alpha_R} \tag{2}$$

where $Y_R$, $N_R$ denote, respectively, output and employment in this sector, and $0 < \alpha_R < 1$.

[5] To simplify the notation we drop the subscripts time, $t$; and country, $j$. Later on we will introduce these two subscripts to the empirical model.

In the absence of adjustment costs, the labor demand equation for the construction sector, whenever the building possibility constraint is not binding, is given by

$$N_{H,i} = \left(\frac{1}{\alpha_H}\frac{W_{H,i}}{P^e_{H,i}}\right)^{\frac{1}{\alpha_H - 1}} \quad if \quad Y_{H,i} < Y^*_{H,i} \tag{3}$$

while in the rest of the economy, labor demand is given by

$$N_R = \left(\frac{1}{\alpha_R}\frac{W_R}{P_R}\right)^{\frac{1}{\alpha_R - 1}} \tag{4}$$

where $W_R$ and $W_H$, and $P_R$ and $P^e_H$ refer, respectively, to nominal wages and prices in both sectors. Insofar as there are long lags in the planning and production of houses, the construction of housing would depend on future expected prices, not necessarily current ones (this is what we indicate by the superscript $e$ in $P^e_H$). Notice that the previous expression (3) only applies for the case $Y_{H,i} < Y^*_{H,i}$, while whenever $Y_{H,i} \geq Y^*_{H,i}$ labor demand in the construction sector does not depend on house prices as it is constrained to be

$$N^*_{H,i} = (Y^*_{H,i})^{\frac{1}{\alpha_H}} \tag{5}$$

In the aggregate, for a given country, employment in the construction sector is the sum of employment across unconstrained ($c_i = 0$) and constrained ($c_i = 1$) areas:

$$N_H = \sum_{c_i=0} N_{H,i} + \sum_{c_i=1} N^*_{H,i}$$

Hence,

$$\frac{\partial \log N_H}{\partial \log P_H} = \sum_{c_i=0} \frac{N_{H,i}}{N_H}\left(\frac{\partial \log N_{H,i}}{\partial \log P_H}\right) + \sum_{c_i=1} \frac{N^*_{H,i}}{N_H}\left(\frac{\partial \log N^*_{H,i}}{\partial \log P_H}\right)$$

assuming, as an approximation, $c_i$ constant . Thus, since the price elasticity in the constrained areas is equal to zero, letting $Z^* = \sum_{c_i=1} \frac{N^*_{H,i}}{N_H}$, we have

$$\frac{\partial \log N_H}{\partial \log P_H} = \sum_{c_i=0} \frac{N_{H,i}}{N_H} \left( \frac{1}{1-\alpha_H} \right) = (1 - Z^*) \left( \frac{1}{1-\alpha_H} \right)$$

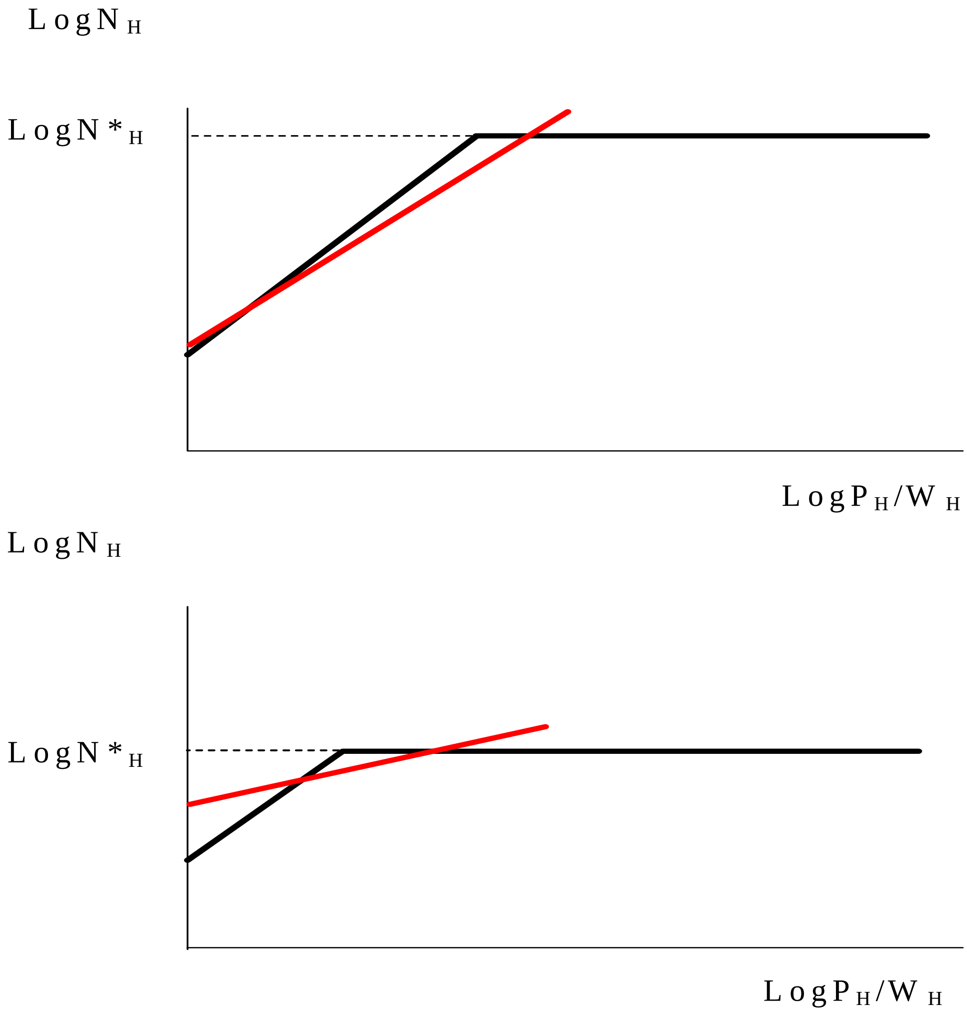
By integrating the previous expression, we obtain

$$n_H = k_H(Z^*) + \frac{1}{1-\alpha_H}(1 - Z^*)\left(p^e_H - w_H\right) \tag{6}$$

where lower cases correspond to the log of the variables, and $k_H$ is an intercept that depends on $Z^*$. Obviously, $Z^*$ reflects the importance of building constraints, which conceivably are determined by land availability, planning restrictions, regulations regarding urban developments, etc. Notice that building constraints affect both the level and the elasticity of labor demand with respect to house prices in the construction sector: the more binding building constraints are, the smaller the elasticity of labor demand in the construction sector with respect to house prices and the the larger the level of labor demand in the construction sector are.

Figure 2 gives a graphical illustration of equation (6). In the two panels of the Figure, the kinked schedule represents labor demand in the construction sector for a *particular area* within a given country, while the (non-kinked) linear schedule represents total labor demand in the construction sector obtained by aggregation of *all the areas* of the country. In the top panel of the Figure, we display the situation in which building possibilities are greater, so that building constraints are binding only in a small proportion of areas. Hence, aggregation across areas gives an aggregate labor demand equation for the whole country with an elasticity of labor demand in the construction sector with respect to $(p^e_H - w_H)$, close to that implied by the unconstrained production function $(\frac{1}{1-\alpha_H})$. By contrast, in the bottom panel, the situation is one of lower building possibilities, so that constraints are binding in a large proportion of areas and the overall elasticity of labor demand in the construction sector with respect to product wages is much smaller than that implied by the unconstrained production function.

**Figure 2. Theoretically kinked labor demand (black line) and smoothed estimated labor demand (red line).**



As for the consumption sector, the labor demand schedule takes the following simple form

$$n_R = k_R + \frac{1}{1-\alpha_R}\left(p_R - w_R\right) \tag{7}$$

where $k_R$ is a positive constant.

**Sectoral composition of labor demand.** We transform the non-linear schedule for labor demand in the construction sector into an empirical equation for estimation of the effect of house prices on relative labor demand as follows. First, we assume perfect labor mobility, so that $w_H = w_R$,[6] and the same elasticity of output to employment in both sectors, $\alpha_H = \alpha_R = \alpha$. Second, as explained above, we take an aggregate index of building constraints, $N_H^* = \sum_i N_{H,i}^*$, as the relevant threshold for labor demand in the construction sector. Under these two assumptions, the previous expression, (6) and (7) can be combined to yield

$$\begin{aligned} n_H - n_R &= \left\{ \begin{array}{ll} \frac{1}{(1-\alpha)}(p_H^e - p_R) & if\ Y_H < Y_H^* \\ n_H^* - \frac{1}{(\alpha-1)}\log\frac{1}{\alpha} - \frac{1}{(1-\alpha)}\left(p_R - w_R\right) = n_H^{**} & if\ Y_H \geq Y_H^* \end{array} \right\} = \\ &= k_H - k_R + \frac{1}{1-\alpha}(1-Z^*)\left(p_H^e - p_R\right) \end{aligned}$$

For empirical implementation, ideally we would like to have a battery of indicators of the building restrictions. Conceivably, these restrictions are determined by land availability, planning restrictions, urban developments, etc. Since some of these variables are hardly observable while others can only be very poorly measured, in our empirical

[6] Time series for sectoral wages at the yearly frequency are not available for many countries. Using National Accounts data, we have computed compensation per employee in the construction sector and in the rest of the economy for the countries in our sample. Over the period 1980-2003 the ratio of compensation per employees in both sectors does not show any significant trend or cyclical fluctuations which could be associated with changes in house prices.

strategy we estimate the following relative demand equation:

$$n_H(j) - n_R(j) = \gamma_0 + \gamma_0' Z(j) + \gamma_1 \left(p_H^e(j) - p_R(j)\right) + \gamma_1' Z(j) \left(p_H^e(j) - p_R(j)\right) \quad (8)$$

where $\gamma's$ are parameters and the vector $Z(j)$ contains variables that measure building constraints in country $j$. Specifically, we use $Z(j) = \log(density_t(j) * \%in\ houses(j))$, where the variable *density* corresponds to the population density per square km and *%in houses* represents the percentage of households living in houses (as opposed to flats).[7] In some specifications we also include, together with the variable previously defined, wages in the manufacturing sector relative to consumption prices (which is a component of the $k_R$ term).

**Labor demand in the construction sector.** With a similar strategy, it is relatively straightforward to estimate the elasticity of labor demand in the construction sector with respect to house prices. To obtain an expression of labor demand in the construction sector, we take logs in the previous expression (3) and rewrite unrestricted labor demand in the construction sector as follows:

$$n_H(j) = k_H + \beta(j) \left(p_H^e(j) - p_R(j) + p_R(j) - w_H(j)\right)$$

which allows us to decompose the effects of wages in two terms. The first is related to variation in the relative price of housing, and the second is the real wage in the construction sector measured in units of the price of the non-construction sector of the economy. Hence, as above we proceed to introduce building constraints and specify the following labor demand equation, with restrictions, for the construction sector:

$$\begin{aligned} n_H(j) = {} & \beta_0 + \beta_0' Z(j) + \beta_1 \left(p_H^e(j) - p_R(j)\right) + \beta_1' Z(j) \left(p_H^e(j) - p_R(j)\right) + \\ & + \beta_2 (w_H(j) - p_R(j)) + \beta_2' Z(j)(w_H(j) - p_R(j)) \end{aligned} \quad (9)$$

[7] See the data Appendix for the definitions and sample averages of these two variables.

which differs from expression (8) since the presence of real wages in construction allows us to identify how variation in house prices translates into variations in the labor demand of the construction sector.

Two comments about the estimation of equation (9) are in order. The first concerns the absence of time series data on wages in the construction sector -other than those that could be constructed from National Accounts data using compensation of employees divided by employment which are clearly deficient for the estimation of labor demand equations. The second regards the fact that, while non-observed factors that may vary over time but affect labor demand in all sectors would drop out from the estimation of equation (8) in relation to the sectoral composition of labor demand, this would not be the case for equation (9).

Finally, the two elasticities estimated from equations (8) and (9) can be combined to gauge the impact of house prices on aggregate labor demand. Let $\epsilon_{HR}$ be the elasticity of the ratio of labor demand in the construction sector to labor demand in the rest of the economy, and $\epsilon_H$ and $\epsilon_R = \epsilon_H - \epsilon_{HR}$ be, respectively, the elasticity of labor demand in the construction sector and the elasticity of labor demand in the rest of the economy, all of them with respect to house prices. Then, the elasticity of aggregate labor demand with respect to house prices, $\epsilon_N$, is given by

$$\epsilon_N = \left(1 - \overline{\frac{N_R}{N}}\right)\epsilon_H - \overline{\frac{N_R}{N}}\epsilon_R \qquad (10)$$

where $(1 - \overline{\frac{N_R}{N}})$ is the share of total employment in the construction sector.

Since our main objective is to understand cross-country differences in the response of sectoral labor demand to house prices, we focus on long-run elasticities. Thus, the previous model and its empirical counterparts abstract from adjustment costs. Moreover, we are skeptical, with the type of data at our disposal, about being able to identify adjustment costs in employment as distinct from serial correlation in unobservables.

# 3 Empirical implementation and results

This section presents some estimates of the elasticity of labor demand with respect to house prices based on the time series evidence of nine countries.

**House price data.** The choice of countries is only conditioned by the availability of house prices and other variables needed to estimate our labour demand equations. For each country we have restricted ourselves to house price data from a single source and definition. In this way we avoid splicing them to other series with different definitions and/or coverage to artificially obtain longer series of data. Furthermore, only countries with at least twelve yearly observations have been included. The countries in our sample are Austria, Belgium, France, Italy, Netherlands, Spain, Sweden, the UK, and the US. The sample period available for each country is indicated in the bottom panel of Table 1. The source of the house price data we use for each country are detailed in Appendix I. However, we have also used an alternative data set taken from Girouard et al. (2006) to check for the robustness of our results.[8]

**Sectoral composition of labor demand.** First, in Table 1 we present the results from estimating equation (8) for the sectoral composition of labor demand, defined as (the log of) the ratio of labor demand in the construction sector to labor demand in the non-farm, private sector of the economy minus labor demand in the construction sector.

Columns (1), (2), and (3) display results from OLS estimation of alternative specifications of the baseline model. Column (1) shows that the elasticity of relative labor demand with respect to relative house prices is, overall, small and barely statistically significant. This is not surprising since, as seen in Column (1) in the bottom panel of the Table, this elasticity varies noticeably across countries when separately estimated for

[8] We are grateful to an anonymous referee for guiding our attention to this data set.

each of them.

Columns (2) and (3) give the results for the specification including the building constraint variable, $Z$. The intercept with the corrected density variable is not statistically significant, so we drop this variable in the rest of the specifications. Notice that country fixed effects are included in all the panel estimations and probably they capture already part of this additive effect. However, the inclusion of this variable interacted with house prices not only renders the coefficient of house prices statistically significant, but also explains a great deal of the cross-country variation in the elasticity of the ratio of labor demand in the construction sector to labor demand in the rest of the economy with respect to house prices. At the bottom of the Table, in Columns (2) and (3), we report the estimates of the elasticity that would result from the common specification that includes the interaction of $Z_t(j)$ with house prices. As can be seen, the two specifications in Columns (2) and (3), i.e. those including the interaction of $Z_t(j)$ with house prices, provide close estimates to those in Column (1) that show the elasticities estimated separately for each country.

To further explain some of the remaining cross-country differences in the response of sectoral reallocation of labor demand to house prices there are some likely candidates, such as the extent of non-habitable areas (e.g. the case of Sweden) or planning restrictions (e.g. UK). As for non-habitable areas, we have used a crude index, such as regional population densities weighted by regional population, obtaining no significant changes with respect to the results reported in Table 1. We have also used an alternative measure that takes into account the extent of deserts in each country (which is relevant for the US, where they account for 9% of the territory, implying that the corresponding value for the corrected measure of population density changes from 27.8 to 30.5), finding not significantly different results either. Other factors that might affect the stringency of building constraints are hardly measurable, preventing us from further pursuing these issues.[9]

We noticed the presence of auto-correlation in the residuals, which could be due either to the presence of omitted dynamic effects of house prices or to auto-correlated unobserved determinants of relative employment. In the first case we would include the lagged dependent variable or distributed lags of house prices. In the second, we would correct standard errors or perform GLS estimation. However, when including one lag of house prices we found no evidence of exponentially declining distributed lags. We therefore correct panel standard errors to allow for an estimated AR(1) structure of the residuals.

We perform some further estimation to gauge the robustness of the results. Column (4) shows that, allowing for country specific business cycles, by including GDP (in logs) interacted with country dummies,[10] the estimated elasticities are, in general, larger, statistically significant in all cases (except for the individual estimation in Sweden and the UK), and that the explanatory power ($R^2$) increases, while the estimated residual auto-correlation of the model is reduced. As before, cross-country heterogeneity in this regard is reasonably well captured by our measure of building possibilities (see Column (5)). We performed other robustness exercises (whose results are not included in Table 1). In particular, we extended the number of countries of the analysis by including Australia and Switzerland.[11] Overall, we find no differences with respect to the results obtained from the initial sample of nine countries. We also use alternative series of house prices

[9] Gyourko, Saiz and Summers (2006) construct, for the US, an index of stringency of local regulation regarding building constraints. To do so, they perform a nationwide survey in over 2,600 communities. We are not aware of the existence of similar indexes for other countries that could be used in an international comparison of the effect of house prices on labor demand in the construction sector.

[10] Note that, given the inclusion of country fixed effects, this variable captures the effect of deviations of GDP from country means.

[11] The drawback of including these countries is that available data on sectoral employment only allow for measurement of relative employment in the construction sector as the ratio of employment in the construction sector to total employment, including the public sector, and not relative to employment in the non-farm, private sector of the economy as is the case for the rest of the countries.

that are available for Italy and the US. Again, the results for the panel estimates remain qualitatively unchanged.

Finally, in Columns (6) and (7) we explore the idea that, given production lags in the construction sector, what really affects employment is expected prices rather than current prices. We take as expected prices at time $t$ the realized prices at $t+1$. We instrument this price variable with relative house prices at time $t$. Both in the separate estimation for each country and in the common specification introducing the corrected density variable interacted with house prices, the IV estimated elasticities of the sectoral composition of labor demand to house prices are, in general, slightly larger than the OLS ones, ranging from -.13, in the Netherlands to 0.66 in Sweden.

Hence, according to the results in Table 1, countries could be grouped into three categories. First, there are countries with high reallocation of labor demand (Spain, US, and Sweden), where a rise in house prices of 1% would imply a change in the ratio of labor demand in the construction sector to labor demand in the rest of the economy of about 0.5%. At the other extreme, there are countries with negative elasticities, e.g. Belgium, the Netherlands, and the UK, where a rise in house prices would imply a reallocation of labor demand away from the construction sector to the rest of the economy. Not surprisingly, these are the countries with the lowest indexes of building possibilities (see Table in the Appendix). Finally, there is some, but not much, reallocation of employment towards the construction sector after a rise in house prices in Austria, France, and Italy, where a rise in house prices of 1% would imply a change in the ratio of labor demand in the housing sector to labor demand in the rest of the economy of about 0.25%.[12]

**Labor demand in the construction sector.** We now turn to the estimates of labor demand in the construction sector, following equation (9). In this specification, and

[12] Standard errors for these elasticities, calculated taking into account correlations between the parameters involved, are presented in Table 4.

to control for the cost of capital, we also include the lagged interest rate as a regressor. As the coefficient of the interaction of the building constraint variable with wages turned out to be non-significant, we report results from specifications where this interaction is not included.

The results are displayed in Table 2.[13] In the first two columns we report OLS estimates of equation (9) for labor demand in the construction sector. The estimated overall elasticity is around .54 and is statistically significant although, as with the estimation of sectoral composition of labor demand, we find substantial heterogeneity across countries in the elasticity of labor demand in the construction sector with respect to house prices (as seen in Column (1) at the bottom of the Table). And, also as before, building constraints, as measured by our corrected density variable, contribute a long way to explaining these cross-country differences in elasticities. In this case, the corrected density variable entered additively also helps to explain cross-country differences in the level of labor demand in the construction sector.

In the rest of the columns of the Table we report IV estimates, instrumenting real wages in the construction sector by wages in the manufacturing sector obtained from Labor Costs Surveys.[14] When instrumenting wages, whether including business cycle effects or not (Columns (3) and (4)), results are very similar to those obtained with OLS estimation. When we take expected prices at time $t$ as the realized prices at $t+1$ and instrument this price variable with relative house prices at time $t$, the individual country elasticities implied by these IV are, in absolute value, slightly larger, ranging from about .46 in the Netherlands to about 1.33 in Sweden.

[13] As in the previous table, we correct panel standard errors to allow for an estimated AR(1) structure of the residuals.

[14] Given the lack of a survey-based measure of wages in the construction sector, our wage variable in the construction sector was constructed as the ratio between compensation of employees in building and construction and the number of employees in building and construction, multiplied by the average actual annual hours worked per person in dependent employment (see the Appendix for details).

Overall, and not surprisingly, the countries with high sectoral reallocation (Spain, the US and Sweden) are also the countries where labor demand in the construction sector is more elastic with respect to house prices, displaying point estimates around 1. On the contrary, countries with either nil or negative sectoral reallocation (Belgium, the Netherlands and the UK) display a lower elasticity of labor demand in the construction sector with respect to house prices of around 0.4. In the middle group (Austria, France and Italy), this elasticity is about 0.7.

**Some additional IV estimates.** Since in our panel estimates we are including country fixed effects, we are allowing for house prices to be correlated with unobserved country factors that do not vary over time. In Table 3 we aim to control for further endogeneity of house prices using external instruments for relative house prices. The instruments are the real interest rate lagged one period, the loan-to-value ratio interacted with lagged real interest rate, and the percentage of owner-occupied housing interacted with our adjusted density measure.[15] These variables have explanatory power in explaining the evolution of house prices (in deviations from time means). In particular, the within groups $R^2$ is 0.48 for house prices, and 0.56 for the interaction of house prices and our adjusted density measure.

Although IV estimates of the implied elasticities are slightly larger than those obtained by OLS estimation, the main result is qualitatively similar to that obtained with the estimation procedures described above: the overall elasticity is not statistically significant when no building constraints are considered (Columns (1) and (4)), while the inclusion of the interaction of building constraints with relative house prices yields statistically

[15] There seem to be grounds for considering that real interest rates affect labor demand in the construction sector and labor demand in the rest of the economy in a similar way. Thus, they would have no role when analyzing labor demand in the construction sector relative to labor demand in the rest of the economy, aside from its effect on house prices.

significant coefficients and contributes to explaining the cross-country differences in the estimated elasticities (Columns (2), (3) and (5)). However, the results are unstable depending on the exact choice and specification of the instruments (e.g. log vs. level, etc.)

**Using alternative data.** To check the robustness of our findings to the countries and time periods included we have used an alternative database on house prices for 18 countries compiled by Girouard et al. (2006). These data feature also longer time series obtained by splicing data from 1970 with BIS data when the main source was not available.

From the initial 18 countries, four countries are lost because there are no comparable sectoral employment data (Canada, Australia, New Zealand, Korea), and one (Switzerland) because for lack of information on the percentage of houses vs. flats. Among the 13 resulting countries Germany and Ireland have data for 11 years. Estimating a specification similar to Table 1 column (2) we obtain an estimated effect for house prices of 0.96 (t-ratio=6.1) and for the interaction of house prices with our density corrected measure -0.09 (t-ratio=4.9), confirming the role of building restrictions in the response of relative employment in construction to house prices in line with our main estimates.

We have also estimated this specification using a modified version of this alternative data set, using only the periods where the data come from one single series for each country, as detailed in the Appendix of Girouard et al (2006), with no splicing to obtain longer series. The estimated effects for house prices and its interaction with the corrected density measure are 1.37 (t-ratio 7.3) and -0.14 (t-ratio 6.9), respectively. Re-estimating a labor demand equation of the type in Table 2 with these alternative data would narrow further the number of countries and time periods due to the difficulty in obtaining comparable sectoral wages across countries and long consistent time-series for interest rates for all countries.

Finally, in our main data we have three countries (Austria, Belgium, and France) for which the house price data refer to the capital city of the country instead of the whole country. We have re-estimated Table 1 column (2) specification excluding those three countries and the two house prices coefficients of interest are 1.18 (t-ratio 6.4) and -0.23 (t-ratio 6.2).

Overall therefore we believe our results are quite robust to the countries and time period considered.

**The implied impact of house prices on aggregate employment.** From the previously estimated elasticities, $\epsilon_H$ and $\epsilon_{HR}$, the house price elasticity of labor demand in the rest of the economy, $\epsilon_R$, and of aggregate labor demand, $\epsilon_N$, (see equation (10)) follow. We report all these elasticities in Table 4. The elasticity of labor demand in the rest of the economy with respect to relative house prices turns out to be very similar across countries (0.48). This is because the coefficient of our corrected density variable interacted with relative house prices turns out to be almost equal in the two estimated equations, namely the share equation (-0.222) and the labor demand equation for the construction sector (-0.224). This probably reflects the fact that labor demand outside the construction sector changes with house prices mostly for reasons unrelated to building constraints, such as income effects, etc.

Hence, aggregate labor demand elasticity with respect to relative house prices differs across countries only to the extent that labor demand elasticity in the construction sector varies as well. However, as the share of construction employment is relatively small, this aggregate labor demand elasticity is broadly similar across countries, ranging from 0.47 in Belgium and the Netherlands to 0.54 in Spain and Sweden.[16]

[16]The corresponding standard errors are computed, in all cases, taking into account the correlations

The estimated elasticities presented above only reflect the labor demand effects of changes in house prices. A general equilibrium computation of the impact of shocks to house prices on aggregate employment would need to account for the responses of prices to income -as implied, for instance, by wealth effects that increase consumption and aggregate demand- and the responses of wages to changes in employment, i.e. the slope of the labor supply schedule.[17]

**Why does sectoral reallocation matter?** We have found that a rise in house prices increases labor demand in the construction sector more in those countries where building constraints seem to be less binding. In these countries, the rise in labor demand in the housing sector brings about a higher degree of sectoral employment reallocation into the construction sector.

The scale of sectoral employment reallocation into the construction sector after a house price boom is important for at least three reasons. First, as sectors differ in their level of productivity, sectoral employment reallocation temporarily affects productivity growth through an employment composition effect. Moreover, insofar as sectors differ in their rates of productivity growth, sectoral employment composition also determines long-run productivity growth for the same reason.

Besides composition effects, there are other motives for believing that a rise in housing prices could have an effect on the productivity of all the sectors. If investors are short-sighted, the rise in profitability in the construction sector may preclude some long-run profitable investments in other more productive activities, hence slowing down productivity growth. In fact, countries with a higher employment share in the construction

between the parameters involved.

[17]In Appendix II we further elaborate on this issue and provide such a computation. Using plausible parameters for the inverse of the Frisch labor supply elasticity and the elasticity of housing prices to income, we obtain that the elasticity of aggregate employment with respect to house prices would be around 0.2.

sector seem to have experienced less productivity growth over the 1990-2004 period, both in terms of labor productivity growth and of TFP growth. Whether this negative correlation is simply the result of a composition effect, arising from productivity growth being lower in the construction sector, or, additionally, there is some negative effect on the productivity growth of other sectors, as a consequence of allocating more resources to the construction sector, is an issue beyond the scope of this paper. In any case, it is conceivable that significant increases in labor demand in the construction sector following a boom in relative house prices could come at some cost, for instance, in the form of lower productivity growth.

In this regard, it is tempting to use an analogy here with the so-called "Dutch disease".[18] One could think of a boom in house prices and the subsequent sectoral reallocation of labor in the same vein as what happens after the discovery of some "natural resource". In both cases, there is booming activity (be it construction or the extraction of the natural resource) entailing a shift in production into that activity, so that its share of employment rises. In the case of the construction boom, this effect would be larger in countries with more building possibilities. There would also be a rise in aggregate demand, increasing the demand for labor in non-tradeable services further shifting labor away from the rest of the tradeable sectors. This reallocation of labor and the rise in house prices could also lead to a rise in the price of non-tradeable services, and, thus, an appreciation of the real exchange rate that would impair the competitiveness of the tradeable goods sector.[19]

In contrast, there is the alternative view that a rise in house prices could lead to a

[18] For the "classical" version of the model of the Dutch Disease, see Corden and Neary (1982).

[19] See Caballero and Lorenzoni (2006) for a formal exposition of the adjustment to a persistent misalignment in relative prices between tradeables and non-tradeables, when the tradeables sector is subject to borrowing constraints. Their model can also be applied to discuss the consequence of a persistent misalignment of house prices when borrowing constraints in the construction sector are less tight than in the rest of the economy.

more efficient allocation of resources, insofar as housing can be used as collateral and there are frictions in imperfect financial markets (see, for instance, Ventura 2003). Under this view the positive wealth shock, brought about by the rise in house prices, increases consumption and investment, and raises efficiency, as the allocation of investment improves. It also creates incentives for labor-augmenting innovations and economic reforms, so that the rate of economic growth rises. Nevertheless, if there are differences in productivity growth across sectors, a boom in asset prices, even with imperfect capital markets, may have different effects depending on the sectoral labor reallocation that they imply.

Finally, a large reallocation of employment towards the construction sector implies the need to undo such reallocation once property prices adjust to their long-run steady growth path. Conceivably, then some resources might not be easy to reallocate back in other sectors after a fall in house prices.

Having focused on long-run labor demand elasticities, our analysis has little to say about the dynamics of sectoral employment reallocation after changes in relative house prices. However these adjustment costs are conceivably higher in countries with labor market institutions characterized by stricter employment protection legislation and generous non-employment benefits. Apart from labor market institutions that may retard the necessary employment adjustment to a house price reversal, it is also noteworthy that at least two of the three countries with a recent employment boom in the construction sector have also had high immigration rates, with immigrants being over-represented in employment in the construction sector. Thus, in these countries, there could be other margins of adjustment and the composition of immigration, its origin and the return patterns of immigrants could also be relevant for the response of sectoral and aggregate employment in the event of a house price reversal.

# 4 Concluding remarks

We have presented international evidence regarding the relationship between house prices and labor demand in the construction sector, both with regard to employment reallocation between sectors and in absolute terms. Following the observation that there seem to be substantial cross-country differences in the time series correlation of house prices and the sectoral composition of employment, we have estimated a model of relative labor demand for the construction sector featuring building constraints. As a proxy of building possibilities, we have used population density adjusted by the proportion of the population living in houses as opposed to flats. This constraint, thus measured, goes a long way to explaining cross-country differences in the elasticity of relative labor demand in the construction sector with respect to house prices. Countries with a low value of the adjusted density variable display much reallocation of employment between construction and the rest of the economy and large elasticities of labor demand in the housing sector with respect to house prices. On the contrary, countries with a high value of the adjusted density variable display no reallocation and low elasticities of labor demand in the housing sector with respect to house prices. In both cases, our estimates imply a value for the labor demand elasticity of aggregate employment with respect to house prices that is broadly similar across countries.

Finally, we have pointed out a negative association between a higher share of employment in the construction sector and low productivity growth over the period 1990-2004. This fact suggests that, in some, countries house price increases may have negative consequences in the allocation of investment.

## Appendix I: Data Description

- **House Prices**

We detail the sources and precise definitions of data that we use for each country. When more than one alternative is available we say so, and explain the reasons for our choice. A basic concern in constructing this data set was time series coherency for each country, thus avoiding the use of splicing from different sources.

- Austria: Price per square meter for all dwellings, Vienna, 1987-2000. Source: Vienna Real Estate Federation

- Belgium: Price per square meter, Brussels, 1988-2001. Source: Stadim

- Spain: Price per square meter for all dwellings, National, 1987-2003. Source: Ministerio de Fomento. Other series are available from the same source, e.g. for dwellings over a year old, but given the importance of new housing in Spain we chose the series for all dwellings. Furthermore, a longer series (from 1976) for Madrid only is available (source: Tecnigrama) but a national coverage from 1987 was judged preferable.

- France: Index for existing flats (hedonic), Paris, 1990-2002. Source: Insee. An alternative very short series (starting in 1996) for the whole of France is available from Insee.

- Italy: Price per square meter for all dwellings, 13 cities, 1988-2001. Source: Nomisma. A long series exists starting in 1965 from Consulente. The Bank of Italy has corrected its varying geographical coverage over time but within city weights were not judged reliable prior to 1986.

- Netherlands: Average transaction prices of existing dwellings, National 1980-2003. Source: Dutch National Bank (before 1992 based on Dutch Association of Real Estate Agents)

- Sweden: Real estate price index for owner occupied one or two dwelling buildings, National, 1975-2001 (some control for quality). Source: Statistics Sweden

- UK: Mix-adjusted average for single family homes, second hand, National, 1980-2003. Source: Office of the Deputy Prime Minister. Halifax and Nationwide produce hedonic house price indices based on mortgages approved only by them.

- US: Repeated sales index for single family homes, National, 1975-2003. Source: OFHEO. The Census Bureau produces a shorter series (from 1979) for new one-family houses sold (hedonic). The National Association of Realtors constructs a series for existing dwellings, without quality adjustment, only available by subscription.

- Australia: Index for established houses (some mix-adjustment), Sydney, 1986-2002. Source: Australian Bureau of Statistics. From the same source there is an index constructed as a weighted average of 8 city indices (including Sydney) but it is not clear up to what extent this reflects differences between cities.

- Switzerland: Mix-adjusted indices for single family homes, National, 1970-2003. Source: Swiss National Bank and Wüest & Partner.

We collected house price data for other countries but did not include them in our final data set mainly because there were too few observations available. In particular these are: Denmark (National, Statistical Institute, from 1992 when last methodological change), Finland (National, Statistics Finland, new index starts in 2000), Germany (good quality data including East Germany start in 1995, 50 cities from West Germany and 10 cities from East Germany, Bundesbank with data from Bulwien and Partner), Greece (Athens from 1994, Bank of Greece with data from Property Ltd.), and Norway (National, second hand dwellings, Statistics Norway, from 1992). For Portugal there is a long housing series from 1988 (although 14 regions were added in 1994) computed by the Banco de Portugal with data provided by the Newsletter Confidencial Imobiliário but no long comparable sectoral employment data. Finally, Japan was not included because the data refer to land prices.

- **Percentage of households living in houses**: % of households living in houses (as opposed to flats), 2001. Source: Eurostat and American Housing Survey

- **Loan to value ratio**: Source: BIS, except for Austria which is from European Central Bank (2003), "Structural Factors in the EU Housing Markets"

- **Interest rate: 3 months interbank interest rate**, Source: Reuters, except Austria, 3 months money market interest rate, Source: Eurostat, and Sweden Treasury discount notes 3 months, source: Statistics Sweden

- **Total employment:** Employment in Non-farm business sector (activities NACE C_K), Source: Eurostat.

- **Employment in construction:** Total employment in construction, Source: Eurostat.

- **Wage in construction:**

  Numerator: Compensation of employees in building and construction (national currency), Source: National Accounts, Ameco.

  Denominator: Employees in building and construction, Source: National Accounts, Ameco, multiplied by Average actual annual hours worked per person in dependent employment, Source: OECD from national labor Force Surveys.

- **Hourly earnings in manufacturing:** Index, Source :OECD, Main Economic Indicators.

- **Population density**: Population per square km. Source: US Bureau of the Census International Data Base

- **Weighted regional population densities**: Regional population densities weighted by corresponding population. Source: Eurostat (level 2 NUTS) and U.S. Census Bureau

- **Percentage of owner occupied housing:** Source: ECB (2003) "Structural factors in EU Housing Markets" except for U.S. which is from Census of Population and Housing, U.S. Census Bureau.

| | Population density (Population per square km) (1) | Share of households living in houses (as opposed to flats) (2) | $\log((1) \times (2))$ $Z$ |
|---|---|---|---|
| Austria | 95.4 | 0.491 | 3.85 |
| Belgium | 334.1 | 0.797 | 5.58 |
| Spain | 79.4 | 0.402 | 3.46 |
| France | 106.5 | 0.640 | 4.22 |
| Italy | 194.4 | 0.359 | 4.25 |
| Netherlands | 448.6 | 0.682 | 5.72 |
| Sweden | 21.0 | 0.672 | 2.65 |
| UK | 239.2 | 0.816 | 5.27 |
| US | 27.8 | 0.700 | 2.97 |

(1) Averages throughout the sample period.

# Appendix II: A general equilibrium computation of the impact of house prices on employment

The estimated elasticities presented above only reflect the labor demand effects of changes in house prices. But there are other effects at work determining the response of aggregate employment. As house prices rise, consumption increases and this sustains a higher level of aggregate demand and, hence, a higher level of aggregate employment.[20] There could be also some multiplier effects: more employment creation leads to a rise in family income, an increase in aggregate demand and, hence, in overall employment, which adds up to the rise caused by wealth effects. Additionally, home-owners have had the option of borrowing against the capital gains produced by the price increase. Moreover, the response of employment depends on the evolution of wages and, thus, on labor supply effects. Hence, a general equilibrium computation of the impact of shocks to house prices on aggregate employment would need to account for the responses of prices to income -as implied, for instance, by wealth effects that increase consumption and aggregate demand- and the responses of wages to changes in employment, i.e. the slope of the labor supply schedule.[21]

The purpose of this Appendix is to provide a simple computation of the general equilibrium response of employment to changes in house prices. In addition to the labor demand estimates, we add two equations describing the responses of prices to income (wealth) as well as a labor supply schedule. To facilitate the computation, we will assume a closed economy with fixed capital at the firm level, and a production technology linear in labor. All the following equations are in logs.

First, our estimates for the following demand equation imply[22]

$$n = \epsilon_N \, \widetilde{p} - wp \tag{11}$$

where $\widetilde{p}$ and $wp$ represent the relative price, $p_H - p_R$, and real wages $(w - p_R)$, respectively; $\epsilon_N$ is the elasticity of demand to the housing prices (see expression (10) in the main text). The elasticity of aggregate labor demand to real wages is taken to be -1, as indicated by the results presented in Table 2.

We add a labor supply equation relating real wages to income and labor as follows:[23]

$$wp = c + \varphi n + \vartheta$$

where $c$ represents consumption, and $\vartheta$ captures the exogenous labor supply shifter. The coefficient $\varphi$ is the inverse of the Frisch labor supply elasticity. Under the assumptions

[20] There is extensive literature on the magnitude of these wealth effects. See, for instance, Hoynes and McFadden, 1997, Giroaurd and Blöndal, 2001, Catte et al., 2004, Carroll, 2004, Juster et al. 2004, and Bover 2005.

[21] In Appendix II we provide such a computation. Using plausible parameters for the inverse of the Frisch labor supply elasticity and the elasticity of housing prices to income, we obtain that the elasticity of aggregate employment with respect to house prices would be around 0.2.

[22] For simplicity, we eliminate the corresponding time subscripts.

[23] The formal derivation of this expression is straighforward for preferences satisfying balanced growth conditions, e.g. $E_0 \sum_{t=0}^{\infty} \beta^t [\log(C_t) + \frac{\vartheta_t}{1+\varphi} N_t(h)^{1+\varphi}]$

of a linear production function and fixed capital, the previous expression can be written as follows,

$$wp = (1 + \varphi)n + \vartheta \tag{12}$$

Finally, we append a price equation relating the relative price to demand pressures, as follows:

$$\widetilde{p} = \phi y + \mu \tag{13}$$

where the parameter $\phi$ measures the response of housing prices to income - as implied, for instance, by wealth effects that increase consumption and aggregate demand-, and $\mu$ is an exogenous shifter that relates to changes in interest rates, land conditions, and taxes.

From expressions (11)-(13) it is straightforward to obtain the following expression for the elasticity of employment to changes in prices, i.e.

$$\varepsilon = \frac{\epsilon_N}{2 + \varphi - \epsilon_N \phi} \tag{14}$$

Given the estimates in Table 4 of the parameter $\epsilon_N$, we can compute $\varepsilon$ given the values of the parameters $\varphi$ and $\phi$. As a plausible benchmark, we set $\varphi = 1$, a value which is in line with most of the business cycle literature (see, e.g. Cooley and Prescott (1995)). We set our baseline value for the elasticity of housing prices to income ($\epsilon_N \phi$) to be equal to 0.75, which more or less resembles the evidence presented in Girouard et al. (2006). Thus, with $\epsilon_N$ around 0.5, we will have that $\varepsilon$ would be 0.22.

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**Table 1. The Effects of House Prices on Relative Employment in Construction (1980-2003)**

$$n_{H,t}(j) - n_{R,t}(j) = \gamma_0 + \gamma_0' Z_t(j) + \gamma_1 \left(p^e_{H,t}(j) - p_{R,t}(j)\right) + \gamma_1' Z_t(j) \left(p^e_{H,t}(j) - p_{R,t}(j)\right)$$

| Dependent Variable: $n_{H,t}(j) - n_{R,t}(j)$ | OLS Estimates | | | | | IV Estimates | |
|---|---|---|---|---|---|---|---|
| | | Base Models | | Allowing for Country Specific Business Cycle Effects | | Using $(p_{H,t+1}$-$p_{R,t+1})$ Instrumented with $(p_{H,t}$-$p_{R,t})$ | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **Panel of Countries[1]** | | | | | | | |
| $p^e_{H,t}$-$p_{R,t}$ | .077 (1.63)[2] | 1.139 (6.52) | 1.147 (6.50) | .176 (4.09) | .832 (4.93) | .084 (1.60) | 1.349 (5.67) |
| $Z_t(j)\left(p^e_{H,t}\text{-}p_{R,t}\right)$ | – | -.213 (5.31) | -.222 (5.59) | – | -.143 (3.86) | – | -.259 (5.01) |
| $Z_t(j)$ | – | -.462 (1.23) | – | – | – | – | – |
| $R^2$ | .93 | .95 | .95 | .96 | .97 | – | – |
| $R^2$(within groups) | .03 | .33 | .29 | .50 | .58 | – | – |
| **Individual Countries[3]** | | | | | | | |
| Austria (1987-2000) | .223 (3.88) | .318 | .292 | .243 (4.04) | .283 | .319 (2.75) | .354 |
| Belgium (1988-2001) | .091 (1.98) | -.053 | -.094 | .085 (2.65) | -.035 | .150 (1.69) | -.095 |
| Spain (1987-2003) | .608 (10.9) | .399 | .377 | .648 (12.03) | .338 | .645 (13.90) | .455 |
| France (1990-2001) | .378 (7.11) | .238 | .209 | .486 (10.64) | .230 | .492 (3.52) | .257 |
| Italy (1988-2001) | .132 (1.94) | .232 | .204 | .136 (2.46) | .225 | .223 (1.95) | .251 |
| Netherlands (1987-2003) | -.109 (3.96) | -.085 | -.127 | -.115 (2.32) | .014 | -.105 (4.29) | -.134 |
| Sweden (1980-2001) | .286 (1.47) | .575 | .560 | .123 (0.74) | .455 | .356 (1.25) | .665 |
| UK (1980-2003) | -.164 (1.77) | .013 | -.025 | .065 (0.99) | .080 | -.155 (1.78) | .015 |
| US (1980-2003) | .548 (4.86) | .505 | .487 | .292 (4.14) | .407 | .435 (5.16) | .581 |

Notes: (1) All estimates include country fixed effects. The total number of observations is 149. The variable $Z_t(j)$=log (density × % in houses) -see also Data Appendix-. The variable $p^e_{H,t}(j) - p_{R,t}(j)$ corresponds to $p_{H,t}(j) - p_{R,t}(j)$ except for the results in columns (6) and (7). (2) t-ratios robust to AR(1) autocorrelation in parenthesis. (3) The estimates of the effect provided for individual country in the specifications that include the interaction of $Z_t(j)$ with $\left(p^e_{H,t}(j) - p_{R,t}(j)\right)$ (columns 2, 3, 5, and 7) are obtained using the mean of $Z_t(j)$ for each country.

**Table 2. The Effects of House Prices on the Level of Employment in Construction (1980-2003)**

$$n_{H,t}(j) = \beta_0 + \beta_0' Z_t(j) + \beta_1 \left(p^e_{H,t}(j) - p_{R,t}(j)\right) + \beta_1' Z_t(j) \left(p^e_{H,t}(j) - p_{R,t}(j)\right) - \beta_2 \left(w_{H,t}(j) - p_{R,t}(j)\right)$$

| Dependent Variable: $n_{H,t}(j)$ | OLS Estimates | | IV Estimates | | |
|---|---|---|---|---|---|
| | Base Models | | Instrumenting wage in construction[4] | Col. 3 with country specific b.c. effects | Using $\left(p_{H,t+1}\text{-}p_{R,t+1}\right)$ instrumented with $p_{H,t}\text{-}p_{R,t}$ |
| Panel of Countries[1] | 1 | 2 | 3 | 4 | 5 |
| $p^e_{H,t}\text{-}p_{R,t}$ | .544 (8.16)[2] | 1.583 (6.65) | 1.636 (6.61) | 1.432 (6.55) | 2.089 (5.77) |
| $Z_t(j)\left(p^e_{H,t}\text{-}p_{R,t}\right)$ | – | -.223 (4.39) | -.224 (4.30) | -.191 (4.09) | -.286 (3.99) |
| $Z_t(j)$ | – | 1.432 (3.33) | 1.622 (3.47) | 1.462 (3.58) | 1.383 (2.27) |
| $w_{H,t} - p_{R,t}$ | -.829 (5.65) | -1.028 (7.37) | -1.253 (4.96) | -1.046 (4.20) | -1.511 (4.26) |
| Real interest rate$_{t-1}$ | -.014 (2.96) | -.011 (2.64) | -.0116 (2.65) | -.005 (1.29) | -.012 (2.15) |
| $R^2$ | .99 | .99 | | | |
| $R^2$(within groups) | .48 | .66 | | | |
| Individual Countries[3] | | | | | |
| Austria (1987-2000) | .179 (5.22) | .726 | .775 | .698 | .990 |
| Belgium (1988-2001) | .164 (2.86) | .339 | .386 | .367 | .493 |
| Spain (1987-2003) | 1.066 (14.14) | .812 | .861 | .771 | 1.100 |
| France (1990-2001) | .373 (9.77) | .643 | .691 | .626 | .883 |
| Italy (1988-2001) | .230 (1.95) | .637 | .686 | .622 | .876 |
| Neherlands (1980-2003) | .635 (18.16) | .310 | .357 | .342 | .457 |
| Sweden (1983-2001) | 1.197 (6.68) | .993 | 1.043 | .926 | 1.332 |
| UK (1980-2003) | .667 (4.76) | .408 | .455 | .426 | .582 |
| US (1980-2003) | 2.623 (5.65) | .922 | .971 | .865 | 1.241 |

Notes: (1) All estimates include country fixed effects. The total number of observations is 153. The variable $Z_t(j)$=log (density $\times$ % in houses) -see also Data Appendix-. The variable $p^e_{H,t}(j) - p_{R,t}(j)$ corresponds to $p_{H,t}(j) - p_{R,t}(j)$ except for column (5)). (2) t-ratios robust to AR(1) autocorrelation in parenthesis. (3) The estimates of the effect provided for individual country in the specifications that include the interaction of $Z_t(j)$ with $\left(p^e_{H,t}(j) - p_{R,t}(j)\right)$ (all columns except col.1) are obtained using the mean of $Z_t(j)$ for each country. (4) To instrument wage in construction we use wage in manufacturing obtained directly from surveys.

## Table 3. Some additional IV estimates

| Dependent Variable: | Relative Employment $n_{H,t}(j)-n_{R,t}(j)$ | | | Level employment in construction $n_{H,t}(j)$ | |
|---|---|---|---|---|---|
| | Instruments: (density × % in houses), interest rate $_{t-1}(ri1)$, loan to value ratio$\times ri1$ | | | Instruments: wage manufacturing, log(density × % in houses), loan to value ratio$\times ri1$, % ooh∗log(dens.×% houses) | |
| | 1 | 2 | 3 | 4 | 5 |
| Panel of Countries[1] | | | | | |
| $p^e_{H,t}$-$p_{R,t}$ | -.114 (1.10) | 2.471 (2.75) | – | 2.614 (1.71) | – |
| $Z_t(j)\left(p^e_{H,t}\text{-}p_{R,t}\right)$ | – | -.478 (2.84) | – | -.448 (1.35) | – |
| $p^e_{H,t+1}$-$p_{R,t}+1$ | – | – | 2.505 (2.15) | – | 2.374 (1.83) |
| $Z_t(j)\left(p^e_{H,t+1}\text{-}p_{R,t+1}\right)$ | – | | -.483 (2.22) | – | -.385 (1.41) |
| $Z_t(j)$ | – | – | – | 1.763 (3.08) | 1.571 (2.42) |
| $w_{H,t}-p_{R,t}$ | – | – | – | -1.075 (2.28) | -1.212 (2.34) |
| Real interest rate$_{t-1}$ | – | – | – | -.012 (2.35) | -.013 (2.17) |

Notes: (1) All estimates include country fixed effects. The total number of observations is 146 for columns 1, 2, and 3, and 153 for columns 4 and 5. The variable $Z_t(j)$=log (density × % in houses) -see also Data Appendix. (2) t-ratios robust to AR(1) autocorrelation in parenthesis

**Table 4. Various employment elasticities with respect to house prices**

| | $\epsilon_H$ | $\epsilon_{HR}$ | $\epsilon_R = \epsilon_H - \epsilon_{HR}$ | $\overline{\left(\frac{N_R}{N}\right)}$ | $\epsilon_N = (1 - \overline{\left(\frac{N_R}{N}\right)})\epsilon_H + \overline{\left(\frac{N_R}{N}\right)}\epsilon_R$ |
|---|---|---|---|---|---|
| | 1[(1)] | 2[(2)] | 3 | 4 | 5 |
| Austria | .775 (.06) | .292 (.06) | .483 (.05) | .887 | .516 (.05) |
| Belgium | .386 (.05) | -.094 (.05) | .480 (.05) | .910 | .471 (.05) |
| Spain | .861 (.07) | .377 (.07) | .483 (.06) | .840 | .541 (.06) |
| France | .691 (.05) | .209 (.05) | .482 (.04) | .895 | .504 (.04) |
| Italy | .686 (.05) | .204 (.05) | .482 (.04) | .899 | .502 (.04) |
| Netherlands | .357 (.06) | -.127 (.06) | .484 (.05) | .907 | .472 (.05) |
| Sweden | 1.043 (.10) | .560 (.10) | .483 (.08) | .898 | .540 (.07) |
| UK | .455 (.05) | -.025 (.05) | .480 (.04) | .932 | .479 (.04) |
| US | .971 (.09) | .487 (.09) | .484 (.07) | .931 | .518 (.07) |

Notes: (1) From Table 2 column 3 .(2) From Table 1 column 3 .
Standard errors are in brackets. For columns (1) and (2) standard errors are calculated taking into account correlations between the two parameters involved (not AR(1) corrected). For columns (3) and (5), standard erors are calculated taking into account correlations between the four parameters involved (not AR(1) corrected).

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