Land Use Regulations and House Prices: An Investigation for the Spanish Case*

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ABSTRACT

This paper analyzes the determinants of the growth of housing prices at the municipal level during the recent housing Spanish boom. In particular, we consider explicitly the effect of land use regulation on housing prices. We also consider the effect of immigration and employment growth at the municipality level. The results show that neither land availability nor the growth in the number of immigrants has any statistically significant explanatory power for the growth rate of prices at the municipal level. Only the proportion of rental housing and the initial level of prices have a statistically significant effect on the growth of house prices. Therefore, although some popular explanations for the housing price boom is Spain are the effect of a large flow of immigrants and the scarcity of land, the data do not support these interpretations. The scarce explanatory power of these variables also indicates that a large proportion of the movement in prices in the period of study was due to common factors to all the municipalities and not idiosyncratic or local factor.

JEL: R14, R21, R31.
Keywords: housing prices, regulations, local factors.

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1. INTRODUCTION

The fast growth rate of housing prices in Spain during the period 2001-07 was a matter of preoccupation for economic authorities and public opinion alike. Many factors have been associated with this phenomenon: the reduction in the interest rates, the increase in income per capita, the relaxation of credit conditions for mortgages, the demographic growth, due mostly to immigration, and the increase in the employment rate. However, prices are determined by the interaction of demand and supply and the previous factors are only related with the demand. What is the influence of the supply in this process? If supply is slow to adjust to demand, because of constrains like zoning, long periods for obtaining administrative permits, etc., then a demand push will lead to a high increase in prices. This was the case during the 1987-91 boom cycle. At the beginning of the cycle time, the number of yearly houses initiated was around 250,000. During the boom period it grows up to 350,000. This slow reaction of supply versus a strong demand generated three consecutive years of growth rate of prices over 20% in nominal terms. The recent period of expansion is very different with respect to the reaction of supply. During the period 1999-2006 the number of yearly initiated houses grew from around 500,000 up to 867,000. Nevertheless, the increase in prices during the recent housing boom in Spain has been as intense[1] as in the previous expansionary period.

The process of setting house prices is very different in periods of stability from what happen in periods of strong expansion. During stable periods the price of housing is set by adding up the "industrial profit" (the name use in the sector) plus the cost of land, materials and labor. In periods of high demand of housing, the prices are set at the maximum level that a standard family can pay for a mortgage given the average income, the current interest rate, and the average maturity of mortgages. It is true that the price of land increases fast in periods of expansion but this is the outcome, and not the cause, of the expectations of increase in housing prices. The price of developable land incorporates the expectations of future house prices increases. It is also the case that the bargaining

1. If we consider the increase in real prices the inflationary process during the period 2000-2006 was more intense than the process during the previous housing boom.

power of land owners versus developers increases when housing demand is very high. Therefore, the demand for land is clearly a derived demand from the demand of housing. This is quite obvious if one looks at the increase in the price of rural land when the frontier of urbanization is moved.

This implies a very pro-cyclical behaviour of the land ~~repercussion on~~ the price of housing. In periods of stability the proportion of the price of land over the price of housing is around 20-25%. In strong expansion of the residential construction sector the repercussion of land could reach 55-60% of the total price[2].

In addition there is evidence that a substantial fraction of the increase in housing prices during the last expansionary cycle was attributable to national, or common, factors and not to local factors like relative land scarcity. For instance, Del Negro and Otrok (2007) show that, while historically most of the variation in house prices in the US was driven mainly by local (for instance state-specific) components, a large proportion of the movement in prices in the period 2001-05 was common to all the states and not idiosyncratic.

Despite these arguments, many analysts and economists have blamed the increase house prices on the increase of the price of land. The lack of correlation between land supply and the growth of house prices would not be enough to claim that land availability does play a significant role in the process of increase of prices we have observed recently in the housing market. It could be the case that the aggregate price is mostly affected by the impact of rapid growth of prices in cities where the supply of land is most constrained. Gyourko, Mayer and Sinai (2006) argue that a combination of increasing scarcity of land in certain cities and a growing number of high income families nationally could explain why some cities present very high growth rate of housing prices. To investigate this point further, in this paper we consider the effect of land supply and demand factors on house prices using information from municipalities. As the revision of the literature shows, the main problem with this kind of exercises is to construct a measure of supply

2. Montalvo (2000) shows this effect for several years in the Spanish economic cycle. Davis and Heathcote (2007) calculate the evolution of the land's share of home value in the U.S. from 1975 until 2006. Their estimation shows a low level at the end of recession of about 18-32% while in the peak of the cycle land's share goes up to 40-45%. See Davis and Palumbo (2008) for a calculation at the level of large U.S. cities. For a recent estimation of the land's share of home values in Spain see Uriel (2009).

constrains. We gather information on different classes of land produced by zoning regulations and run several econometric exercises to uncover any relevant impact of the proportion of different ~~legal~~ types of land on house prices.

The paper is divided in six sections. Section 1 is this introduction. Section 2 presents a summary of the literature on the impact of land restrictions on house prices. Section 3 summarizes alternative indicators of land restrictions that have been proposed in the literature. Section 4 discusses the data and the econometric strategy using the availability of vacant urban land as the proxy for land regulation. Section 5 considers the estimation using an alternative proxy for land availability, programmed developable land, to measure the importance of local land regulations. Section 5 presents also the estimation using several instruments to deal with the likely endogeneity of some of the explanatory variables. Section 6 summarizes the main findings of this research.

2. LAND RESTRICTIONS AND HOUSE PRICE INFLATION

The economic literature on the explanation of the evolution of house prices has constructed econometric models where ~~the~~ most of the determinants are demand-driven. Demographics, income per capita, interest rates, etc. have been the leading explanations for the increase of house prices. In some occasions, econometric specifications have included supply-related factors, usually associated with the cost of construction materials, wages in the housing sector, etc. Topel and Rosen (1988) estimated the supply elasticity as the relationship between the logarithm of investment and the logarithm of house prices at the aggregated level of the U.S. They find that supply elasticity ranged between 1.4 and 2.2. Poterba (1991) uses the growth rate of real construction cost to estimate the supply elasticity of housing. He argues that a 1 percent rise in real construction cost is associated with a 0.97 percent rise in real median house prices. If construction costs are disaggregated, then all the effect is coming from the installation cost (mainly wages of construction workers) while the coefficient on material is not significant. This implies some questions on the direction of causality. To overcome this problem Poterba (1991) presents the results of some instrumental

variables estimations where the coefficient on the growth rate of real construction cost is positive and significant although a bit smaller (0.75-0.8) than in the OLS regressions.

The measurement of the effect of government regulation on housing prices is much more difficult since, opposite to construction costs, it is difficult to measure the extent of land regulations. Given these problems the standard methodology uses a differences estimator to compare prices in two areas with different zoning regulations. Katz and Rosen (1987) estimate that prices in communities of San Francisco were there was a growth's moratoria, or growth management control plans, in the 80's were 40% higher than in the control communities. The measurement of these regulations is even more complicated if one wants to consider all possible regulations (including environmental laws, etc.). However, in a recent survey, Quigley and Rosenthal (2005) argue that the net effect of land regulations may be only symbolic. Quigley and Rosenthal (2005) show that some studies find a significant effect of regulations restrictions on land usage and housing prices but a substantial number of studies finds no effect or a very limited one.

Glaeser, Gyourko and Saks (2006) use a trick to measure the extent of regulation. They concentrate on Manhattan where regulations are very strict and the quality of cost measures is quite good. Glaeser, Gyourko and Saks (2006) argue that land shortages limit certain types of developments in Manhattan but builders can add an extra floor if it is profitable. Therefore, to calculate the marginal cost of building a new apartment they do not need to include land purchase or preparation costs. They find that market prices in Manhattan ($600 per square foot) almost triple the marginal cost of production ($200) during many years. Since this arbitrage opportunity should imply an increase in the height of building, the large difference between marginal cost and price must be the result of regulations that effectively cap the height of buildings in many areas.

However, this large difference between marginal cost and prices is not evenly distributed around cities in the U.S. In areas like Los Angeles, Oakland, San Francisco and San Jose the gap is between 30% and 50% of the median house price. This gap is larger than the one observed in Boston, New York City or Washington D.C. In a somehow related explanation, Gyourko, Mayer and Sinai (2006) claim that land restrictions and the increase in skewness

of income distribution have generated "superstar cities". Sorting of high-income families and scarce land in the most desirable places leads to cities with housing prices much high than the corresponding marginal cost. This means that the gap in house prices between the "superstar cities" and other local housing markets widens the most.

Recent estimations have emphasized the importance of controlling for the possible endogeneity of some of the explanatory variables. Ihlanfeldt (2007) considers the effect of land use regulation on housing and land prices. He argues that land regulations could generate an endogeneity problem: first, residents of community with higher housing prices may pressure for more restrictive regulations (reverse causation); second, the measure that Ihlanfeldt (2007) uses to proxy the degree of land regulation (number of restrictions in each municipality) has a high degree of measurement error. Since the biases arising from these two sources are of different sign, nothing can be said about the final effect on the size of the estimate. Saiz (2007) uses the increase in immigrants as a determinant of the growth rate of rents (and housing prices). Obviously, immigrants will tend to locate themselves in areas where rents (or house prices) are low. This effect generates endogeneity problems in the estimation. Both authors solve these endogeneity problems using instruments in a two stages least squares estimation. Ihlanfeldt (2007) uses as instruments the lag value of the community characteristics at the time the land use plan was approved by the State. Saiz (2007) proposes two instruments for the increase in the number of immigrants: one is the "shift share" prediction of the inflow of immigrants by city and year[3]. The second instrument is the predicted number of immigration inflows by country and year (obtained using the characteristics of the countries of origin). With this prediction Saiz (2007) uses the share of immigrants from that country that decided to settle in a particular city in 1983 to obtain the forecast of the number of immigrants by nationality and metropolitan area.

3. The rationale for this instrumental variable is the fact that the overall number of legal immigrants in the U.S. depends on political and administrative decisions.

3. THE MEASUREMENT OF LAND REGULATIONS

The quantitative measurement of land regulation is a very difficult task. That is the reason why, even though land regulations are potentially very important to model real estate markets, there are very few studies with broad indices of land restrictions. Cities and metropolitan areas have many different types of regulations that affect the usage of land. The arguments used to impose these types of restrictions are three: the optimization of urban infrastructure, the control of urban population growth and the protection of natural spaces.

The basic problem to measure the extent of land regulation is the procedure of aggregate restrictions that are very different in nature. Following Quingley and Rosenthal (2005) these regulations can be classified in six groups: population control (caps on growth or permits); floor space control (commercial, industrial, not-for-urban use land); infrastructure control (water supply, distribution and treatment quality, etc.); zoning control; political control; and general controls.

Since the number and types of land regulations is so large in the US, the construction of an index that considers all of them is quite complex and requires, most of the time, specific surveys. There are three well-known surveys. The Wharton Urban Decentralization Project was designed in 1989 to measure the land use regulations across cities. Directors of city planning of 3,000 communities were asked to fill this questionnaire. The response rate was 40%. Malpezzi (1996) constructed several indices out of this questionnaire and he showed that only the AIP index had a statistically significant effect on rents. Secondly, Godschalk and Hartzell (1992) build a survey similar to the one used by the Wharton group. They sent 306 surveys and got a 44% response rate. The questions included the percentage of land currently developable; the receptiveness to future growth; the difficulty of expanding land supply; and the time of decision for major projects. Finally, the 2002 survey of Xing, Hartzell and Godschalk (2002) was sent to 2,000 planning directors (response rate of the mail survey was 51%; the internet survey had less than 20%). The basic variables used to construct the indices of restrictiveness are: percentage of applications for development that are approved; average review period for a project; per-

centage of applications to expand the supply of developable land that is approved; percentage of total land in the municipality that is developable; difficulty to expand the supply of developable land; and development management tools usage.

4. HOUSE PRICES AND AVAILABILITY OF LAND IN THE SHORT RUN

The estimation of the effect of land regulation on house prices is difficult. First of all, we need to calculate an operational variable to reflect land regulations. In the previous sections we described several approaches to deal with the measurement of regulation at the municipal level. In the Spanish case land regulation is a complex set of rules that depend on state laws, regional laws and administrative acts of the municipalities. There are several alternative indicators that could reflect the extent of land regulation. One possibility is the ratio of vacant urban land over total urban land (VACANT). This ratio measures the availability of land that can be relatively quickly transformed in houses. In this section we discuss the effect of urban vacant land (VACANT) on the increase of housing prices during the period 2001-05[4]. Section 5 discusses the impact of other two indicators based on the classification of land.

We use municipalities as the unit of study. There is not information on the specific regulations of different municipalities in terms of development timings (time for approval of new projects, densities, etc.). In addition, even in the same city, there are no consistent rates. For instance, many times the density depends on negotiations between city authorities and developers.

There is an indicator available for all the municipalities of Spain which is urban vacant land[5]. The ratio of vacant over total urban land is an indicator of land availability in the short run. We will consider only the amount of vacant land available at the beginning of the period in order to avoid any type of endogeneity caused by

4. The year 2007 should not be used because of the impact of the change in the Land Law and the new valuation system for land in the different stages of development. It is also convenient to avoid the inclusion of the data from the year 2006 since there was some anticipation of the new valuation rules (the bill was discussed during 2006).

5. See http://atlas.vivienda.es.

the production of urban land caused by the increase in housing prices.

Strictly speaking we will like to have a forward looking variable and, therefore, and indicator that contemplates the land available for future development instead of the land already available in the form of vacant land. In addition, Montalvo (2000) finds no correlation between the price of residential land and the number of years needed to exhaust the urban vacant land given the growth rate of population in municipalities of more than 20,000 inhabitants[6]. Therefore, there is limited hope to find a strong relationship between vacant urban land and prices since a somehow similar exercise did not produce a positive result in the past.

Obviously the availability of land is not the only relevant variable in the explanation of the increase of house prices across these municipalities. But many of the relevant variables are not city-specific (interest rates, mortgage conditions, tax advantage, etc.). Besides the availability of land, the variables that could explain the cross section variation of the growth of house prices are the growth of income per capita and the evolution of demography. Unfortunately, there is no information on income per municipality in Spain. In addition, there could be an endogeneity problem if we use the contemporaneous information on the growth rate of income. Instead, we could use the total employment growth over the period 2001-05 but we would have the same endogeneity problem. To avoid that effect, we use the growth of employment during the previous decade (1991-2000) using the information of the 1991 and the 2000 Census. This variable controls for trends in employment based on lag growth is common to many recent studies, specially related with the effect of immigration on employment growth[7].

We include also the growth in the number of immigrants as a demand factor: it contributes to the demographic pressure and it could be interpreted a proxy for the growth rate of income, given that it is reasonable to assume that immigrants will flow to

6. The data were produced by the Dirección General de Vivienda, Urbanismo y Arquitectura en 1995.

7. See Reed and Danzinger (2007). Card and Lewis (2005) use this variable as an instrument for contemporaneous growth rate in employment.

municipalities with the highest growth rates and the best job opportunities.

The size of the rental market is another possible determinant of the growth of housing prices. We measure this variable (RENT) as the proportion of rental units over total available units. In municipalities with a large rental market at the beginning of the period we expect to find a slower growth rate of prices than in places with a very small rental market. This variable is constructed from the 2000 Census.

Finally, since an important determinant of the growth of prices has been the availability of credit we include the price of housing in the initial period. Since house prices are set to the maximum purchasing power of an average family given income and mortgage conditions, people will tend to avoid living in places where the level of house prices is very high and tend to move to satellite town where prices are still low in relative terms. But by doing this, they can generate an inflationary process more intense than the one in the towns with high prices to begin with. The estimation in first differences eliminate the city-specific characteristics that affect the housing price level and maybe correlated with the pattern of immigration settlement. We use long differences between 2001 and 2005, the period of highest growth rate of housing prices in recent years.

The basic regression is:

$$\ln PH_{05} - \ln PH_{01} = \beta_0 + \beta_1 (\ln IMM_{05} - \ln IMM_{01}) + \beta_2 (\ln POP_{05} - \ln POP_{01})$$
$$+ \beta_3 (\ln EMP_{91} - \ln EMP_{01}) + \beta_4 VACANT_{01i} + \beta_5 RENT_{01i} + \beta_6 \ln PH_{01} + \varepsilon_i$$

where PH are house prices, IMM is the number of immigrants, POP is the size of total population, EMP is the number of workers, VACANT is the ratio of vacant urban land over urban land, and RENT is the share of the rental market[8]. The initial level of house prices tries to control for potential differences across municipalities based on other variables not included in the regression. Exploiting the persistence in city specific employment

8. Unfortunately there is no information on potentially different financial conditions by municipalities.

trends, we use the employment creation in the previous decade as proxy for the generation of new employment and the general economic condition of business. We have to be careful with the growth in employment during the previous decade since some new municipalities are created by breaking up a large municipality present in the Census of 1991. For instance, in Madrid, Tres Cantos was created as an independent municipality from Colmenar Viejo in 1991. In Barcelona there are three cases of new municipalities created between 1991 and 2001: Badia de Valles (1994), Palma de Cervello (1998) and Sant Julia de Cerdanyola.

There are 8,108 municipalities in Spain. Table 1 present the basic statistics of the variables. There is a large reduction in the sample size of municipalities for which there is availability of house prices. This is the most restrictive variable. The data come from the price index of the Ministerio de Vivienda, based on the aggregation of appraisal prices.

Table 1 shows the rapid growth of housing prices during the period of study. The unweighted average shows that housing prices almost double during the period. The average growth of immigrants in the period was quite impressive. The unweighted proportion of rental units (RENT) at the beginning of the period was very low, and around 5%. If we calculate the weighted average using the population of each municipality, then the rental market represents 11.4% of the total market. This level is higher than the unweigthed value but, still, it is very low for international standards. Finally, the average proportion of vacant land over total urban land is 27%, while the median is 24%. If we weight by the size of the population then the average reaches 34.8%. These indicators seem to point out that there is a large heterogeneity on the proportion of vacant urban land over total urban land across municipalities as a function of their size. Figures 2 and 3 confirm this hypothesis. Figure 2 shows that small municipalities (population less than 20,000) have a distribution of vacant land moved to the left with respect to the same distribution for large municipalities (population more than 100,000).

Table 1.
Basic statistics

VAR	OBS	Mean	Sd
Growth PH	357	0.92	0.27
Growth POP	8055	0.02	0.18
Growth IMM	5799	3.72	7.26
Growth EMP_{t-1}	8071	0.21	0.65
PH01	357	897.60	295.81
RENT	8108	0.05	0.05
VACANT	7580	0.27	0.18

Sources: Ministerio de Vivienda, Census (1991, 2000) and Atlas Digital de Areas Urbanas de España.

Figure 1.
Histogram of the ratio of vacant land over total urban land

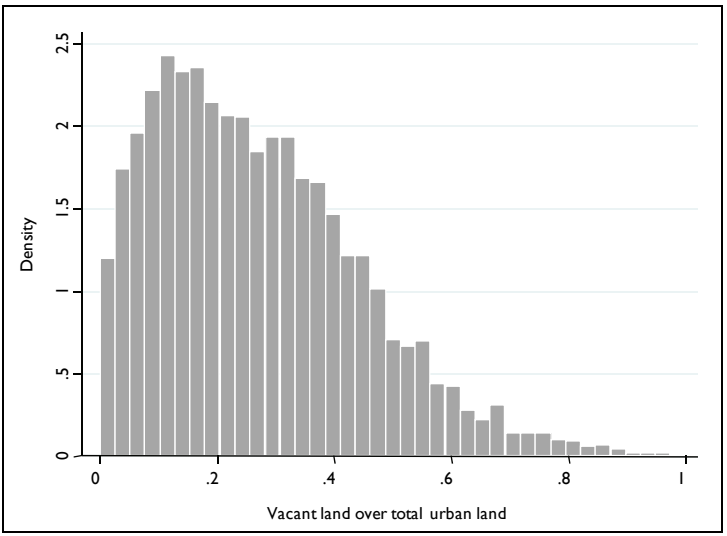


Figure 2.
Kernel density estimation (population less than 20,000)

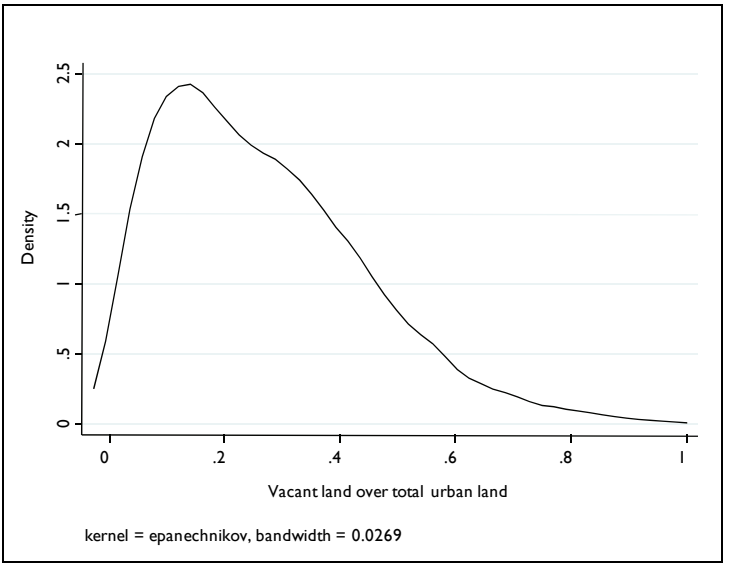


Figure 3.
Kernel density estimation (population more than 100.000)

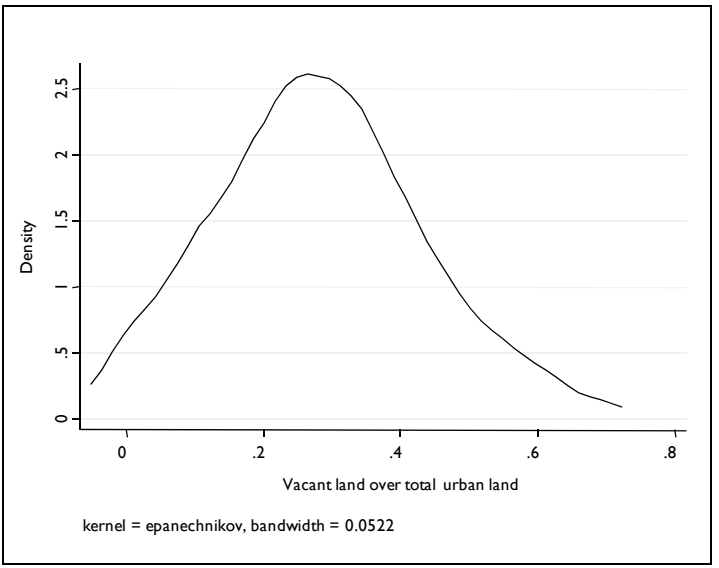


Table 2.
Correlation across prices, vacant land and immigrants

	$\Delta lnIMM_{01-05}$	$VACANT_{01}$	$Ln(PV)_{01}$
$\Delta lnIMM_{01-05}$	1		
	5650		
$VACANT_{01}$	0.097*	1	
	5225	7580	
$Ln(PH)_{01}$	-0.280*	-0.042	1
	357	342	357

* Significant at 5% level

Table 3.
Results of the basic specification

	(1)	(2)	(3)	(4)	(5)
$\Delta lnIMM_{01-05}$	0.051	0.011	0.006		-0.005
	(1.62)	(0.67)	(0.36)		(0.26)
$\Delta lnPOP_{01-05}$	0.166*	0.607*	0.492*	0.57*	0.574*
	(7.27)	(7.75)	(5.73)	(4.83)	(4.64)
$\Delta lnEMP_{91-01}$				-0.039	-0.029
				(0.94)	(0.64)
$PRENT_{01}$		-0.384*	-0.451*	-0.481*	-0.410*
		(3.11)	(3.56)	(3.96)	(2.92)
$VACANT_{01}$			0.110	0.109	0.098
			(1.90)	(1.89)	(1.70)
CONS	0.523*	0.611*	0.543*	0.617*	0.972*
	(24.4)	(20.5)	(16.2)	(22.2)	(20.5)
$Ln(PH)_{01}$					-0.053*
					(2.02)
N	356	356	342	341	341
R2	0.07	0.15	0.16	0.16	0.17

Absolute t-statistics between parentheses. * Significant at the 5% level.

Table 2 shows the simple correlation between the increase in immigrants, the proportion of vacant land over total urban land and the price of housing. Since they are correlations it is difficult to claim any direction of causality. For instance, the growth of immigrants is more intense in municipalities with a higher proportion of vacant land and with lower prices. However, the price of housing is unrelated with the availability of urban vacant land since the correlation is not significantly different from 0.

Table 3 contains the basic regressions. In the first regression only the growth of population is statistically significant. Nevertheless, the explanatory level of regression (1) is low. The proportion of rental units over the total housing stock is negative and statistically significant, column 2, implying that in municipalities which have a higher level of rental market in the initial year of the sample the growth of prices has been more moderate than in municipalities with small rental market. In addition, including this new variable multiplies by more than 2 the explanatory power of the regression. In column (3) we include the proportion of vacant land as an additional explanatory variable. It turns out not to be significantly different from 0 at the usual level of significance. In the case we were willing to move to a 10% level of significance, the positive sign of the estimated coefficient would be opposite to the extended view that land scarcity increases house prices. Column (4) omits the growth of immigrants and includes the trend in economic activity. As before only the growth rate of population and the proportion of the rental market are statistically significant. The trend in economic activity does not have any explanatory power. The results are unchanged if we included together the variables for immigration and growth of employment in the previous period, and we add the initial level of house prices (column 5). The initial level of prices is statistically significant which implies some price convergence among the municipalities. Therefore, the results of this section indicate that only the growth rate of population, the initial level of prices and the proportion of the rental market have a significant effect on the growth of prices at the municipal level.

5. HOUSE PRICES AND THE AVAILABILITY OF LAND IN THE MEDIUM RUN

One of the most relevant elements of land regulation in Spain is the legal classification system. This legal classification of land was particularly important for urban development before the new Land Law of 2007. The classification of land determines, among other elements, the criteria for its valuation. In the Spanish system before 2007, when a new set of state land regulation ("Ley del Suelo") was enacted[9], there was a class of land classified as urban ("suelo urbano"), a class that allowed development but was not developed ("urbanizable") and a class specially protected which could not be developed ("especialmente protegida"). Urban land reflects past development. In the previous section we used the division between used and vacant urban land to construct an indicator of land regulation, or land availability. However, the expectations on the price of land are forward looking and, therefore, they already discount the price of urban vacant land. Future development, and therefore availability of land in the medium run, depends on the proportion of land that allows development over total land not yet developed, and not on the amount of urban vacant land. Therefore, we can construct several alternative indices of regulatory restrictions based on the classification of land. We use as the main index the ratio of programmed (or delimited land) over non-urban land. Other two possible indices are the ratio of land available for development which is already programmed (or delimited) over total land minus not developable land. It is also possible to construct this index using the ratio of all developable land (programmed or not) over total land minus not developable land. The developable not programmed land (or not delimited), in principle, could be developed but does not allow immediate development without a change in the municipal land development plan[10]. Opposite to the case of vacant urban land, there is no homogeneous dataset that contains all the information on the

9. Ley 8/2007, enacted July 1, 2007.

10. The results obtained using these alternative indices are similar to the ones reported in the regressions of this section.

size of each category of land for the Spanish municipalities. In some regions it is possible to find (at least in the form of polygons in a map) the size of the plots classified by legal land type. We have gather information on the size of each class of land in municipalities of Barcelona[11] and Madrid, when available. Our basic indicator in this section is the ratio of programmed developable land over non-urban land (REG). This indicator measures the possibility of development of land in the medium run[12] as a proportion of the total area of the municipality that could potentially be developed[13]. We are interested in capturing the effect of the future (medium run) availability of land on the growth rate of house prices. As in the previous exercise the price of housing by municipalities restricts the size of the sample[14].

Table 4.
Basic statistics

	N	Mean	Std.
Growth PH	82	1.01	0.18
Growth POP	486	0.19	0.20
Growth IMM	449	3.19	4.39
Growth EMP_{t-1}	486	0.76	0.87
PH_{01}	82	1144.1	251.4
BAR	486	0.63	0.06
RENT	486	0.12	0.06

The basic statistics for the relevant variables in the municipalities of the two provinces are included in Table 4. The price of housing in the municipalities of the provinces of Madrid and Barcelona for which there is information on prices has double

11. There is also information on the classification of land for the rest of Catalonia although, as we will see, there is no information on prices for many of those cities.

12. Non-programmed, or non-delimited land, imply a long period until actual development.

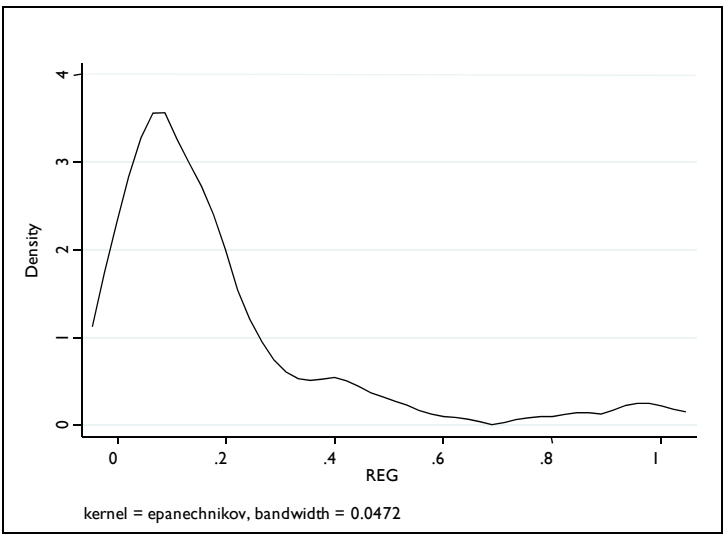
13. This assumes that protected areas could potentially change their status.

14. In a few municipalities there is information on prices but not on the classification of land.

from 2001 until 2005. The average initial price of housing was 1,144 euros/m^2. The average growth of population has been 19% mostly due to the impact of immigrant. The number of immigrants in the cities included in the sample was more than 4 times large in 2005 than in 2001. The employment during the period 1991 and 2001 grow also very fast (79%) due to the dra–matic reduction in the unemployment rate, the increase in the participation rate and job creation.

Table 4 includes also some other explanatory variables like the dummy BAR which takes value 1 for municipalities in the province of Barcelona, and the proportion of rented units over total number of units. The proportion of municipalities included in the sample which are located in the province of Barcelona is 63%. The average proportion of rented units in 2001, initial year for the calculation of growth rates, is 12%. This proportion is well above the proportion calculated in the previous section using all the municipalities.

Figure 4.
Kernel estimation of the index REG



However, we can see that there is information on prices in only 82 municipalities. For those places the index REG (delim-ited developable land over non-urban land) has an average of

18%. If we also include non-delimited developable land the average index goes up to 31%. Figure 4 presents the distribution of the index REG for the municipalities of Barcelona and Madrid that have information on prices and land classification.

The basic regression is:

$$\ln PH_{05} - \ln PH_{01} = \beta_0 + \beta_1(\ln IMM_{05} - \ln IMM_{01})$$
$$+ \beta_2(\ln POP_{05} - \ln POP_{01}) +$$
$$+ \beta_3(\ln EMP_{91} - \ln EMP_{01}) + \beta_4 REG_{00i} + \beta_5 \ln REN T_{01} + \varepsilon_i$$

where REG is the ratio of programmed developable land over non-urban land.

Table 5.
Results of the basic specification

	(1)	(2)	(3)	(4)	(5)	(6)
ΔlnIMM$_{01-05}$	0.03	0.03	0.05	0.03	0.03	-0.00
	(1.06)	(1.11)	(1.39)	(0.64)	(0.63)	(0.04)
ΔlnPOP$_{01-05}$		0.05	-0.13	-0.02	-0.03	-0.22
		(0.35)	(0.66)	(0.10)	(0.14)	(1.26)
ΔlnEMP$_{91-01}$			0.07	0.03	0.04	0.01
			(1.27)	(1.06)	(0.57)	(0.24)
REG$_{00-01}$			-0.03	-0.06	-0.05	-0.00
			(0.64)	(1.27)	(1.03)	(0.16)
PRENT$_{01}$				-0.57^	-0.57^	-0.02
				(2.11)	(2.12)	(0.07)
BAR					0.01	-0.00
					(0.47)	(0.08)
Ln(PH)$_{01}$						-0.29^
						(5.44)
R2	0.01	0.01	0.05	0.11	0.11	0.39
N	73	73	73	73	73	73

Absolute t-statistics between parentheses^

Table 5 presents the results of estimation of the basic specification. Column 1 shows that the increase in immigrants by municipality does have any explanatory power in the explanation of the differential growth rate of prices across municipalities. Adding the change in the log of population does not improve the goodness of fit of the regression, which is around 1% (column 2). In column 3 we have added the growth rate of employment during the previous decade and the variable REG. The estimator of the coefficient of the employment variable is not statistically significant. The REG variable is also not statistically significant. Adding the growth rate of employment and the REG variable, though, increases the R^2 to 5%. Column 5 includes an additional variable in the specification: the proportion of rental housing in total housing at the beginning of the period. The inclusion of this variable generates a noticeable increase in the goodness of fit of the model up to 11%. In addition, the new variable is statistically significant at the usual level and it has the expected sign: the larger was the rental market at the beginning of the period the smaller are the increase in prices observed afterwards in the municipalities.

The results of the first five columns of Table 5 are somehow disappointing. The explanatory power of the variables included in the regressions is low and only the coefficient on the initial proportion of the rental market is statistically significant at the standard level. However, we should notice several facts: first of all we are estimating a cross section in first differences, which usually leads to low levels of explanatory power. Second, and more important, the evolution of financial variables (interest rates, credit conditions, etc.) is critical to explain the evaluation of housing prices in Spain during the period 2001-05. But these variables are not city-specific and, therefore, its effect is embedded in the constant of the model, which is positive and highly significant. This means that the results in Table 5 should be interpreted as the power of the included variables to explain differences across municipalities in the growth of house prices after conditioning for common effects. The lack of explanatory power reflected in Table 5 implies that local conditions are not very relevant to explain the increase in prices observed in the period of study. A substantial fraction of the increase is attributable to

national factors (interest rate, return of alternative assets, etc.). These results are consistent with the finding in Del Negro and Otrok (2007) on the relative importance of local versus common factors in the explanation of the growth of house prices in the U.S. in the same period.

One possible problem with the results in columns 1 to 5 of Table 5 is the fact that the change in total population, the increase in immigration and the change in employment may have a high correlation. In fact the growth rate of population is highly, significantly, and positively correlated with the growth rate of employment and immigration[15]. However, the exclusion of the growth rate of population does not have any relevant effect on the significance of the remanding parameters. The only variable that is still significant is the ratio of rental over total housing (results not shown in the table).

The regressions in columns 1 to 5 do not consider the effect of the initial level of prices on the municipalities (PH01). We have argued that the process of prices formation in the housing market during expansions implies a process of convergence (under some conditions): the prices will grow faster in places where the initial price was lower. Additionally, immigrants will tend to locate in places that create a lot of employment and have low levels of housing prices (or rents). If we fail to include the initial level of prices we will generate a bias in the estimators for the correlation between the change in the number of immigrants and the initial level of prices. Based on these considerations column 6 of Table 5 includes the initial level of house prices. Column 6 shows several interesting results. First, the goodness of fit has increased drastically with respect to the previous columns. Second, the coefficient of the initial level of prices is negative and statistically significant which indicates signs of convergence[16]. Finally, the inclusion of the initial level of house prices eliminates the statistical significance of the parameter on the rental market variable.

15. The growth rate of population has a high degree of correlation (0.66) with the employment generated over the previous decade.

16. Montalvo (2001) finds no signs of convergence in house prices between 1987 and 2000 using regional data instead of municipal data.

6. LOOKING FOR INSTRUMENTS

The basic regression presents some econometric problems. Immigrants may look for municipalities where housing prices grow slowly and, therefore, the estimates of the previous regressions will be biased. This endogeneity problem could explain the scarce explanatory power of the growth rate of immigrants. For this reason we search for instruments that could explain the evolution of immigrants but are not correlated with unobservable factors that could impact directly on the increase of prices. This is not an easy task. For this reason we look in the literature for instruments used in the past as appropriate for the arrival of immigrants. An initial instrument for the growth of immigration by municipality is the proportion of immigrants in the initial year (2001). The rational for this choice is the following: the density of immigration in a city is a supply push factor for immigration in the future, since social networks are an important factor in the decision of location of the immigrants (Card and Lewis 2005 or Reed and Danzinger 2007). However, the initial proportion of immigrants in a particular municipality may have also a negative effect on the flow of new immigrants. The labor market for jobs usually held by immigrants is also more crowed the higher is the proportion of immigrans in the population. It is theoretically possible that cities with an initially high proportion of immigrants may be less attractive for new immigrants, since the type of jobs usually available for immigrants may be already covered. Therefore, the relationship between the proportion of immigrant in the initial period and the growth of immigrants from the first to the last period is an empirical question.

Table 6 contains the results of the estimation using as an instrument for the growth rate of immigrants the proportion of immigrants over total population in the initial year (PIMM). The first two rows present summary statistics of the first stage regression. The partial R^2 and the F indicator show the relevance of the instrument in the context of this estimation. The second part of Table 6 presents the estimation of the parameters. The only coefficient that is statistically significant is the proportion of rental over total housing, as it was when we use least squares as the estimation procedure. If we include the initial level of

house prices then, as in the case of OLS, the only statistically significant coefficient is the one on that variable. The growth rate of immigrants is not significant in any of the specifications[17].

To capture the easiness of finding jobs of the immigrants in a municipality we consider another instrument for the increase in the number of immigrants. Since the participation rate of male immigrant in the labor force is very high in all the cities we use the participation rate of female immigrants (FEMP) as a proxy for the availability of jobs for immigrants in a particular municipality[18]. Columns 3 and 4 of Table 7 present the results of the IV estimation using both instruments (PIMM and FEMP). The results are essentially identical to the reported in columns 1 and 2. If we consider the regression that includes the initial level of prices, then only this variable is statistically significant with a negative sign.

Table 6.
Instrumental variables estimation

	Inst=PIMM	Inst=PIMM	Inst=PIMM,FEMP	Inst=PIMM,FEMP
Partial R^2	0.38	0.36	0.40	0.41
F (ex. Inst.)	41.56	39.01	23.23	23.39
$\Delta lnIMM_{01-05}$	0.05	-0.01	0.00	-0.01
	(0.48)	(0.21)	(0.00)	(0.29)
$\Delta lnEMP_{91-01}$	0.02	-0.03	0.01	0.04
	(0.59)	(0.90)	(0.29)	(0.96)
REG_{01}	-0.06	-0.01	-0.07	-0.01
	(1.25)	(0.38)	(1.44)	(0.40)
$RENT_{01}$	-0.57	-0.12	-0.63	-0.13
	(2.12)	(0.54)	(2.35)	(0.57)
$Ln(PH)_{01}$		-0.28		-0.29
		(5.46)		(5.50)

17. González and Ortega (2009) claim that the immigration process had an important effect on prices. They also use instrumental variables. However they work with a panel of regions instead of a cross-section of municipalities.

18. Notice that the effectiveness of such an instrument will depend on the distribution of nationalities of immigrants since some cultures are more restrictive than other with respect to female work.

We have run some robustness test to assess the estimators in the previous tables. In particular, we have estimated the standard model using province specific coefficients for the size of short-term developable land over total land[19]. In principle, since there is a ~~Federal~~ Land Law and also regional laws, the impact of the amount of short-term developable land could be different for municipalities belonging to different regions. However, the estimation of a specification with province-specific parameters for the amount of developable land shows that we cannot reject the null hypothesis that both parameters are the same. In any case, the rest of the estimated parameters take values similar to the ones in the previous tables: if the initial level of prices is not included in the regression then only the proportion of renting over total housing is statistically significant. Otherwise, when the initial level of prices is included, this one is the only significant variable.

7. CONCLUSIONS

This paper presents an analysis of the determinants of the growth of house prices in the Spanish municipalities in the period 2001-05. We pay special attention to the effect of land regulations and its outcome, land availability, on the increase of house prices in the expansionary period of the beginning of the new century.

There are several ways of summarizing the information on the strictness of land regulations. Whenever there are many different indicators the question becomes how to integrate then into a single index. Most authors have just counted the number of restrictions in each municipality. This produces a quite arbitrary metric to measure land regulations. In addition, in the Spanish case there is a clear lack of homogenous and reliable information on the many techniques used for land regulations at the municipal level. However, it seems reasonable to argue that the basic objective of land regulations is to restrict the availability of land. Therefore, we could use a measure of the outcome of land regulations (availability of land) instead of the inputs (alternative legal techniques to constrain development). We

19. Results under request.

consider two indices of land availability. In the short run we could consider the availability of vacant land. In the medium run the relevant variable is the programmed developable land. In the regressions we also include most of the house demand variables considered in this literature. We should notice several caveats. The results could be different if we use other proxies for land regulation. But, as we argued before, it is not clear why the number of regulatory techniques should reflect the extent of regulatory constrains better than land availability. We should also notice that several municipalities located close to each other may have quite different ratios of vacant urban land, or developable land. Therefore, it could be the case that land available in a close by municipality has also an impact on house prices in a different municipality. We postpone dealing with this externality to future research.

The results of our empirical exercises indicate that neither the growth of immigrants nor the availability of land at the beginning of the period have any significant effect on the growth of house prices at the municipal level. The proportion of rental over total housing is always statistically significant if we do not include the initial level of house prices. The larger is the proportion of rental units the slower is the growth rate of house prices. However, if we include the initial level of house prices and consider the proxy for medium run availability of land, then only this variable is statistically significant, showing a clear process of price convergence.

The implications of these results are important. First of all, land availability does not seem to have any explanatory power on the growth of housing prices. We have argued in previous research (Montalvo 2003, 2006) that land prices are determined by the expected price of the houses that will be built in a land plot. In periods of boom, demand determines prices and the land prices residual, determined by a bargaining process between land's owners and developers/builders. If land regulations were important, today's availability of land should drive tomorrow's housing prices, given the long lags in the construction of houses. However, we find no evidence of this effect. Quingley and Rosenthal (2005) argue that in general the economic literature fails to find a direct causal effect of land use and growth control on house prices. They interpret this result as meaning that "local regulation is symbolic, ineffectual, or only weekly enforced".

Secondly, and opposite to a very popular view, immigrants do not seem to push up house prices, at least using municipal level data. The growth rate of immigrants does not have any statistically significant power in the explanation of the growth rate of house prices[20]. We should notice that immigration represent an increase in potential demand of housing, but not necessarily on effective demand, which is mediated by financial conditions. Third, prices have grown faster in municipalities with initially low housing prices. The econometric evidence shows a strong process of convergence[21].

Finally, the lack of explanatory power of many of the variables included in the regressions could be due to the presence of powerful aggregate, or common, effects. In this case, the reduction in interest rates, the relaxation of mortgage conditions or the return on alternative investments (like stock markets) affect all the municipalities and can explain most of the increase in house prices. Since we have long differences in house prices at the municipal level the impact of each of these financial conditions (which are common to all the municipalities) cannot be separately identify.

20. Aggregate data produce similar results (Montalvo 2007).

21. This convergence process was not clear several years ago (Montalvo 2001) although the estimation used regional data instead of municipal level housing prices.

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