Housing supply and prices. Revising the theory

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JEL Classification: R31
Keywords: New housing supply in Spain, supply elasticity

Presented at 13th PRRES Annual Conference

Perth, Western Australia

Abstract

House-building has been very intense in Spain throughout the last 15 years. It has generated an expansion in the residential stock that has been explained as the result of some demand forces playing at the same time and boosting residential market mechanisms during this period. However, in other European countries with similar tensions, the supply side has grown at a considerably lower rate than in Spain, even though residential prices have increased at a similar pace. The behaviour of the factors determining the supply has not been studied deeply. This paper evaluates the sensitivity of housebuilding in Spain between 1987 and 2004 with the aim of explaining its influence on price behaviour. Some different new-supply elasticity measures have been used by the literature. We calculate them for the whole Spanish housing supply using two different techniques, regressions methods on a base of dynamic panel data analysis and error correction models. The results show a supply elasticity of 0.86 for the whole Spanish new housing market. It also contrast that the value for the new supply elasticity change on time and space, so depend of the considered period, being lower during the first part of the 1990's , and also the geographical territory analysed, being higher in those which housing markets are more active. Estimations also allow us to classify the markets between those where housing supply responds to the market-signals and those who don't showing such type of market restrictions or interventions.

. Content

INTRODUCTION

Housing prices in Spain have not stopped growing during the last ten years. The expansion they have gone through has been one of the greatest in Europe (Ball, 2004) and has accelerated since the late 1990s until it reached levels which multiply several times those existing at the moment of the entrance to the Single Market (Exhibit 1) . The responsibility of this behaviour has been analysed basically from the demand side, focusing on the socio-economic changes' impact on the residential market occurred in Spain. A strong and persistent economic growth, a generalisation of the habit to own a secondary home among both Spanish nationals and non-Spanish residents, an the expansion of the labour market, new households creation, the maintenance of tax benefits for ownership, and an active housing policy resulting from the competition between Autonomous Communities could stand out some of the most relevant factors which explain the actual situation on the current Spanish housing market from the demand side.

According to the principles, these tensions have boosted prices making the formers' level grow up rapidly looking like a bubble[1]. This expansive situation is not unique in the European context, as it has taken place in other countries like Ireland, the United Kingdom and the Netherlands, as well as in countries outside Europe like the United States and Australia, but the case of Spain has been peculiar in some respects, namely (1) the fact that price expansion continued in Spain when it had reached a maximum in the rest of countries; and (2) the fact that the Spanish residential increase-in-value cycle was accompanied by a strong building activity, meanwhile in other countries the supply of new units has both gradually diminished or practically non-existent. The situation in the United Kingdom, for instance, reflects the image of a residential market influenced by similar demand impacts than in Spain but with a fairly reduced new housing supply[2]. This difference in the response to market signals is very relevant and has surprised both the British government and the analysts, who are observing the Spanish case in order to understand the keys to the supply's quick response. The intensity of demand factors would apparently justify the strong price growth, like in the United Kingdom, but their persistence along together with the expansion of the supply suggest that other mechanisms may be playing an important role in the Spanish residential market.

The significant reaction of the new supply in Spain, which has reached its historical maxima since the year 2000, at the same time that prices increase, seems to orient the search for reasons toward the supply side.

[1] The caution warning to cover against a bust on a supposed bubble has come some international sources, very prestigious, like The Economist (three specific issues), the International Monetary Fund and the European Central Bank. There is also a response from the internal market from Bank of Spain asking for caution to finance and real estate market players.

[2] See Barker Review, http://www.hm-treasury.gov.uk

In fact, the supply and its sensitivity are attracting more attention time to time. As Backley (1999;25) said, the demand is determined by many factors and influences market mechanisms, but residential prices and housing availability are not necessarily determined by the demand alone and it is necessary to explore the mechanisms operating from the supply side in order to understand price evolution as well as market limitations.

This paper seeks to provide empirical evidence about how the supply influences the behaviour of prices in Spain both in aggregate and geographical point of view. Although the theoretical postulates according to which prices result from changes in the demand are shared in this paper, what it is going to assess here is the role that the supply has played ‘delaying or slowing down’ the price growth. We found that the behaviour of the supply side is not homogeneous across the different Spanish regions. As Ball, 2004 verified, we identify supply elasticities above one in part of the Spanish territory, although there is substantial inelasticity in some communities where prices have increased considerably.

The analysis of the supply is not simple for two main reasons. One is such a lack on fundamentals which are motivating some empirical contributions revisiting the current principles of housing supply. The second one is the data, where an agreement exists reefered to a lack on the quality and structure of the information used, saying that the information is not prepared for robust contrasts that can provide information about the reaction of this part of the market.

Empirical results here add evidence about that the new residential supply sector in Spain has showed higher-than-one elastiticies in some regions where house-building has acted with great dynamism, reacting to the demand impulses and softening the increase of housing prices in Spain. This implies, therefore, that prices would have grown much more than they did if the elasticity would been lower, which could be specially true in those regions with more inelastic new supply.

The paper is structured as follows. The first section shows the theoretical principles that explain the role played by the housing supply in the market equilibrium. The second one describes the situation and evolution of new residential supply in Spain as a whole and in its Autonomous Communities (regions). The empirical model to be estimated for Spain is defined in the third section, after which the results are discussed in the fourth section. Finally, the fifth section offers the conclusions drawn.

1.-The theoretical view about the role of the housing supply

The concept of housing supply refers to that units included on the stock which fulfils the conditions to be demanded in the market. The theory distinguishes between stock, which is the total of units existing in the market, and supply flow, which is the total of units available on the market capable to satisfy the demand. This distinction is relevant, as it suggests two different analytic frameworks, the first one referring to the analysis of the volume of housing services, while the second discriminates between the market of new and existing dwellings, being the latest the common focus used to analyse the supply and its impact on prices. The total supply is generally considered to be a stable proportion of the total stock.

The existing units represent a part of the supply that is not very well known, though it is believed to keep a balance with the total stock and the vacancy level (Maisel, 1963). Because of their relevance and greater volatility, new units are the most often analysed as the main supply component. As a matter of fact, it is believed that the total supply essentially depends on the evolution of new housebuilding as well as on the residential investment rate. Both groups are considered to be a constant proportion of the yearly total stock (new dwellings reach a maximum of 3-3.5% of the stock but there are a few evidence about the weight of existing units with respect to the total supply).

The supply curves are considered rigid in the short run as a result of the special characteristics of housing and its production process (it is a fixed commodity with a difficult and expensive provision, which requires long maturation periods…. Arnott, 1987). Jointly with a lack of information and financial requirements, those features make this market is uncertain and supply is expected to respond slowly to market signals. This means that the supply reacts just partially when changes in the demand occurs, generating an asymmetric response: A positive shock on any demand component cause an upward reaction of prices in the short run meanwhile the housebuilding cannot increase suddenly. The supply increases step by step as the starts are completed or vacant are reducing. If during this period the demand decreases, the supply cannot perform a downward fit, since dwellings cannot be "destroyed" or "removed" from the market, thus generating increase on vacant. During a contraction period, prices do not drop while the total of vacant units increases, since the costs incurred and the chances of a future increase in housing prices persuade owners to maintain the units and not sell underpriced. This is why the response of new housing supply is elastic in the first case but inelastic in the second one (Glaesser, Gyourko & Sacks, 2005).

The interaction of demand and supply, as well as their sensitivity, is therefore a key aspect to understanding price behaviour. According to the literature, although the equilibrium does not take place in the short run because the rigidity of the supply curve, it is afforded in the long run when as the curve has acquiring more flexibility so that adjust is performed 'taking time' (DiPasquale, 1999, although this comment use to appear in nearly all others research, e.g. Meen, 2002 and Topel & Rosen, 1988). This reaction with time perspective implies that the supply curve may have a degree of elasticity that adjusts the market and guides price evolution. Since they depend on both the inputs and the dimension of the construction sector, supply curves with different elasticity levels may exist in the short run from the spatial perspective. In these cases, the impact caused by any changes in the demand on prices can vary depending on this sensitivity and location; i.e. a market with a less rigid supply curve will suffer a lower impact on prices when a demand shock takes place than in the case of a market showing greater supply rigidity (exhibit 2). Supply elasticity is consequently a key factor that allows us to understand one part of the evolution of prices in residential markets.

Various studies have described experiences about the different supply elasticity values; and it is widely recognised that residential supply is flexible in the long run (De Leeuw & Ekanem, 1971, Olsen, 1987, Hanushek & Quigley, 1979, Meen, 2002, Blackley, 1999, Glaeser *et al*, 2005, amongst others), showing a slow return of prices toward the equilibrium. It is generally agreed that short-run supply elasticities are smaller than long-run ones because some time is required for building (Quigley, 1997, Topel & Rosen, 1988, for the US, Malpezzi & MacLennan, 2001, Dipasquale & Wheaton, 1994, Goodman, 2005, and Malpezzi & Vandell, 2002, amongst others). Nonetheless, the international experience shows that, although US researchs do contrast the presence of elastic values in the long-run new supply, this may not be generalised in other world regions experiences. The available studies about Europe give reduced supply elasticities with a value near zero in the case of the UK during the last decade (Meen, 2003, Barker review, 2003, Pryce, 1999, Malpezzi & Maclennan, 2001, Bramley, 2003; 211, Table 1), which means a poor answer from the supply side to a demand impulse resulting on a strong rise on housing prices. The restrictions in the construction sector (because, for instance, an inadequate size on the industry, a restrictive permission system and/or a lack of land) make it also impossible for new units to increase in the medium term, which generates still stronger growths on prices (Barker review, 2003), giving low values for the elasticity.

Table 1 Supply elasticities in the different countries

Type of housing unit	Country	Analysis area	Estimate period	value	author
stock	UK	aggregated	1955-72	0,5-1	Whitehead, 1974
stock	GB	aggregated	1955-76	0,3 (cp) - 0,6 (lp)	Mayes, 1979
stock	UK	districts	1988	0,8	Bramley, 1996
stock	Scotland	city	1998,1992	0,6(boom), 1 (crisis)	Pryce, 1999
stock	UK	aggregated	1976-1999	0,5	Swank et al. 2002
stock	England	Aggregated	1973-2002	0,3	
New dwellings	UK	aggregated		0,5	Mayo & Sheppard, 1991
New dwellings	Germany			2,1	Mayo & Sheppard, 1991
New dwellings	France			1,1	Mayo & Sheppard, 1991
New dwellings	The Netherlands			0,3	Mayo & Sheppard, 1991
New dwellings	Denmark			0,7	Mayo & Sheppard, 1991
New dwellings	United States			1,4	Mayo & Sheppard, 1991
New dwellings	UK	levels		0,36-0,38	Bramley, 2003
		1st. diff		0,585	

- The difficulty to measure the supply curve and elasticity of housing

As it is reflect on table 1, most supply elasticity estimations are very different. Most of the differences come from the way as the supply function is defined. The theory has largely related the supply to determinants of the production function. This link has generated many of the difficulties in calculating and defining a market supply function (Hanusheck & Quigley, 1979), first, because production (starts) is not the only source of supply, second, the un-existence of data available to observe the whole supply as a flow, both the existing ones and the new one (Goodman *et al*, 2005), and, third, the fact of the supply function is local and specific to different regions, in many cases, metropolitan areas[3] (Glaesser, Gyurko & Sacks, 2005, DiPasquale, 1999). This has made that research use, indistinctively, the housing stock as definition of the supply (DiPasquale & Wheaton, 1994, Whitehead, 2004, Mayer & Somerville, 2000, Meen, 2001) or using the new units that arrive at the market, (most of the research share this focus, e.g. Mason, 1977, Malpezzi & Maclennan, 2001, Meen et al, 1998; but Bramley, 2003 used completed units though). This multiplicity of measures has able to produce that the elasticity obtained varies depending on which one has been choosed.

Recently, some research add complexity contrasting how the supply elasticities are estimated as changing on time, reflecting a swing-curves of supply which use to change its responses depending on the different moments of cycle, i.e. defining supply functions as curves which 'move' over time (Pryce, 1999, Bramley, 1993, 2003, Malpezzi & Vandel, 2002).

[3] There are in fact works which estimated supply elasticity at an aggregate national level and by regions obtaining very different elasticity results. For example, Mayer & Somerville, 2000, obtained an elasticity for new dwellings that is overestimated with respect to the results of the calculation carried out in different local areas and underestimates the time required to respond to a price shock.

Other researchs maintain that the difficulty to measure the supply comes from the no standard price and quantity exists in the market because each unit varies in terms of quality and dimensions. The housing supply is also the result of a complex decision-making process in which both builders and homeowners intervene, and there is very small evidence about how each part reacts, since the observation unit hardly ever refers to the supply in statistics (Hanusheck & Quigley, 1979). Therefore, the baseline information is insufficient to conveniently model the supply function.

DiPasquale, 1999, summarised the problems related to the estimation of housing supply into two groups: The first one is the lack of suitable databases due to the information-related problems mentioned above, which is why analysts must face problems linked to quality in the available data and have decided to use basically aggregated information instead of microdata. This use makes lose perspective of the local market where the market balance takes place (Malpezzi & Vandel, 2002, Goodman *et al*, 2005). The second group of reasons is a deficit in the supply explanatory theory, as the foundations are not fully settled yet. There seems to be growing evidence that some of the generally recognised principles may not be so true, like supply is not fixed or supply; functions are elastic in the long run (Meen, 2001) or that the elasticities change in time (Pryce, 1999, Goodman, 2005) and also in space as a result of the action of territorial factors which affect markets locally, like the climate (Fergus, 1999) or the situation (Goodman & Thibodeau, 1998).

Finally, there is agreement, too, on the existence of different market conditions for this sector, on a quasi-monopoly or monopolistic competition basis (Green & Malpezzi, 2003), which determine the degree of reaction of the supply, which can become inelastic as a result of the inflexibility on the supply side sector coming from its inputs (land, materials, labour), or due to the effect of other less-known factors that prove the existence of a market power (concentrated land ownership, reduced number of building firms, land uses under control, restrictive permit system…) as well as the control that developers can apply on the production process with the purpose of adapting the supply to changes in the cycle (Coulson, 1999). All this, along with the asymmetry in the residential market adjustment system, generates disparate, tangled-in-time supply responses (Goodman, 2005, Pryce, 1999) with greater dynamism when positive shocks occurs than negative ones (Glaeser & Gyourko, 2005).

To this set of interactions, the impact that the housing policy has on the supply should be added (Murray, 1999, Malpezzi & Vandel, 2002). The evidence available shows the different effects that some of such measures of policy have on the market. It is widely accepted that, no matter how apparently small the policy actions are and regardless of the measures applied and of their intensity, they cause an overall impact over the market. Their impact will depend on price and income elasticities on demand and supply, and they can provoke relevant changes in the configuration of the area where public dwellings are built (Malpezzi & Vandel, 2002, Whitehead, 2003). This quick review highlights the difficulty to model the housing supply function.

- Defining the supply function

Existing literature about housing supply can be classify around three focus: regarding supply as the result of inputs combination (costs, land and current housing prices, so closed to the function production), regarding supply as the responds of the different local features, and regarding supply as the result of the expected benefits gained by builders or investors.

Mayer & Somerville, 1997, and Somerville, 1999, maintain that the supply is a function of, first, changes in current and lagged prices, second, changes in input's costs and, third, the current and lagged interest rates for building credits. For Goodman, 2005, the supply is a direct function of the stock value and a list of characteristics linked to the territory referring to regional factors such as the climate, and even family size, to quote but a few, which determine the particularities of a town or city. Guirguis *et al*, 2005, sustain that this market largely resembles an asset market, presented long-run housing supply changes as a function of both the flow of dwellings that enter the market and the depreciation of the units.

According to Blackley, 1999, the volume of new housing is measured as the value of (1) private residential construction in real terms, (2) the real price of construction materials, (3) the real salary of workers, (4) farming land, (5) nominal interest rates, (6) the expected inflation rate, (7) the short-run real interest rates, (8) the real residential capital stock, and (9) the real prices of non-residential construction. For Malpezzi & Vandell, 2002, the supply is influenced by the set of construction costs as a whole, the regulations that affect the market, the existing stock, and the group of conditions which determine the moment in the market (like vacancy rates).

Malpezzi & Maclennan, 2001, defined the supply as a function of changes in both the real and the desired stock, which is affected by the evolution of prices, population and transaction costs. In the opinion of Poterba, 1991, new construction is a function of the revenues derived from housebuilding, which is reflected in the cost/price ratio, and of the depreciation rate, being the supply function as the result of forces driven by investment decision in an asset under Tobin's *q* principles. This approach is not the only one along these lines. According to Meen, 2002, the housing supply flow is positively related to real prices, as a proxy of the capital gains, and negatively to the size of the existing housing stock after reducing depreciation. For Mayo & Sheppard, 2001, the housing supply will behave in accordance with the earning obtained by the developer, which in turn is a function of housing prices and construction costs, the former being dependent on the price of land in different locations. Construction controls will become a determining factor for the supply and materialise in the degree of risk assumed by the developer. The inclusion of price and construction costs as referents for the investment decision component can also be found in other research like those by Pryce, 1999 and Dipasquale & Wheaton, 1994, land prices and existing stock being usually included too.

So, summarizing, prices act as a signal that encourages builders to start new housing developments, i.e. prices become an incentive for productive activity. This is the role commonly played by prices in any market and an approach to it from the perspective of the supply. If the supply side reacts to the price-incentive, it could be said that the market perform within an efficiency level. This is the position explaining the free market principles, but in housing markets there are many influences which define non-competitive markets, like rents controls, land use definition or housing policy interventions. According to the references before, we could explain new supply as the market answers to three groups of influences.

First one comes from the own economic features existing in the market, as inputs costs or existing housing, prices to which supply respond to market signals. High significant reactions in this framework, 'like market says', give an idea as how efficient the market perform without interventions, so, as a free-market. Inside these models, the investment decisions process is important and could be shown by the model.

Second group refers to how the supplier structure could modify the general reactions. Then, the existence of a very small number of developers acting on the market or a concentrate structure of land ownership, could create conditions for non-competitive markets through the existence of actors with market power affecting to the equilibrium. In this case, a free-market definition of the supply function could not explain the new housing reactions completely.

Third group refers to *out-of-the-market* interventions, mainly public regulation, as technical rules, land-use controls or permission system, and housing policy tools. Both interact with market mechanism altering housing supply reactions to market incentives.

Any market definition for supply function could give different levels of significance depending on the existence of any influence classify in groups second or/and third. But the economic rationality seems to suggest that, in any case, the 'part of the free-market' existing has to react in some way to changes on market signals.

The factor which measures this reaction is supply price-elasticity. By definition, its value must be positive, measuring the response of the building sector to the price incentive and its evolution, being inelastic if the values reached are below one and elastic otherwise. A lack of reaction or a negative elasticity would make no economic sense from the perspective that is being analysed here[4].

Regarding the market, the factors considered by the literature before to be relevant in the decision to supply (new) housing units to the market would be the following:

1. The supply of housing depends on the developer's returns, which in turn is a function of the prices reached by the dwellings and construction costs, these factors being the ones that determine the incentive for housebuilding ($H_t - H_{t-1} = p_{ht} \cdot q_{ht} - C_t$). The literature approaches earning through the real prices of dwellings[5] although price evolution expectations are also included as an indicator of returns.
2. Construction costs are the second essential determinant for the supply function. The international evidence (Coulson, 1999 *et al.*) sustain that this factors shows a limited significance in the empirical research resulting from errors when measuring and weighting the total costs. These errors disappear after differentiating the three types of costs: the costs associated to materials, those corresponding to wages, and the financial costs (Somerville, 1999[6]).
3. The existing stock is the third indicator. It is often introduced as an endogenous variable because the supply is believed to be related to the amount of units available in the market as well as to the amount of vacancies (Meen, 2003) in what can be described as the way in which these agents react in the residential market.
4. In the analysis of local markets, the supply additionally depends on a set of factors specific to the market that scale it, e.g. population, market activity (transactions), location, market characteristics, etc. (Goodman, 2005[7]). Additional factors included in the second and third group of influences explained above could be caught inside this group.

Thus, following the models proposed by Goodman, 2005, Meen, 2003, Malpezzi & Maclenan, 2000 and Glaeser & Gyourko, 2005, the housing stock supplied at a given moment in time is defined as in (1)

$$(1)\ Q_t^s = f(P_{H,t}, C_t, H_{t-1}, G_t^k, \pi_H) = e^{\alpha 1} P_{H,t}^{\alpha 2} Cm_t^{\alpha 3} Cs_t^{\alpha 4} i_t^{\alpha 5} H_{t-1}^{\alpha 6} [\eta_k G_t^k]^{\alpha 7} \pi_H^{e\,\alpha 8} \varepsilon_t$$

[4] Although it would reflect a situation where the supply is defined by others factors than price, which is the case where the public housing construction has the main part of building.

[5] Malpezzi & Maclennan, 2000, defined it as $Qs = b_0 + b_1 P_h$, and Meen, 2003, as $H. = b_1 g - \delta H$, δ being the depreciation rate.

[6] The definition by Somerville, 1999, is $St = f(\Delta p_t \ldots \Delta p_{t-j}, \Delta c_t, \Delta i_t, \Delta i_{t-1})$. Poterba, 1991 included costs weighting housing prices in the new unit supply function $H_t - H_{t-1} = \phi(P_{H,t}/C_t) - \delta H_{t-1}$,and DiPasquale & Wheaton, 1994 directly defined the disaggregated costs: Hstarts =f (hs, ir sr, pr. land, const. costs, lagged stock),

[7] The supply depends on the stock value and on the specific factors characterising the market: $\ln Q_t^s = \gamma \ln V_t + \Sigma_k \eta_k G_t^k + \varepsilon_t^s$

where:

- $P_{H,t}$ corresponds to housing prices in real terms
- Cm_t corresponds to the costs associated with construction materials
- Cs_t is an indicator of the payment of salaries to construction workers
- i_t reflects the real interest rates paid by developers for building credits
- H_{t-1} is the existing housing stock at the previous moment
- $\eta_k G_t^k$ is a matrix of the regional market characteristics, including physical features as well as other aspects like land and market size
- π_H^e represents developers' expectations regarding inflation
- ε_t is a random term
- $\alpha_{1..8}$ are the estimated parameters. Since models are often defined directly as logarithmic functions, the α are measures of supply elasticity with respect to the different determinants.

2.- The evolution of the housing supply in Spain

This section shows the evolution of residential supply in Spain over a long period of time. Graph 3 shows the building phases in Spain according to their intensity, measure through starts, completed and permission units. There are basically two main expansive periods that have shaped most of the residential stock; the first well-known one went from the early 1960s to the mid 1970s and was the result of a strong and positive combination between demographic and economic growth (Taltavull, 2001), and the second one, still unfinished, started in the mid 1990s, after a short boom (1986-1991) and recession (1992-1994) process, which has beaten the historical house-building maximum. This recent behaviour has generated surprise insofar as it was believed that the existing housing supply and the former house-building rate were sufficient to cover the residential needs of late-twentieth-century. The building activity rate during last ten years has increase beyond the historical average and it was accompanied by a strong increase of real housing prices, especially since 1998, also reaching the maximum, regarding the available information of prices. A very controversy issue not analysed so far is that prices have been pushed up due to the presence of an unstable (speculative) demand or whether reasons associated with supply restrictions were responsible for the increased tension in markets and pushed up prices. A large part of the explanations among the Spanish actors have signed the shortage of land supply (supply input) and land regulations as the principal responsible of the increased of prices, instead the different Autonomous Communities (Regions Authorities) have been changing those laws to flexibly the market during all nineties.

Building dynamism has reached different levels across Spanish regions supporting the idea about the existence of leading regions (Green, 1997, Taltavull, 2000). Some regions (like the Balearics, the Canaries, Cantabria, Castilla-La Mancha, Valencian Community, Murcia and La Rioja) have showed more dynamic housing expansion during the last two decades (Exhibit 3). The concentration of this phenomenon on coastal regions and islands (except for Castilla-La Mancha) indicates that a large part of this supply has been oriented toward a new market (the residential-tourist market or second homes) more related to changes in financial and economic variables than to those affecting demographic variables, more relevant in first-home markets.

Regarding the total figures, new housebuilding has mainly concentrated on four Autonomous Communities throughout the period under study. These four regions are, in order of importance, Andalusia, the Valencian Community, Catalonia and Madrid (Exhibit 4a). A second level of intensity is identified in Communities like Castilla-La Mancha, where the starts reach the Madrid levels during the last years of the sample, Galicia, the Canaries and Murcia. Further behind is the third group of regions, formed by the remaining Autonomous Communities (Exhibit 4b). Some of them, like the Balearics and La Rioja, have experienced a recovery in the final years of the period. Others, like Castilla-León or Asturias, show a reduction in the housebuilding rate. The presence of these different trends within an economic environment in which are shared factors that affect the housebuilding expansion process emphasise the peculiarity of each market, the different intensities found in their demand and the conditions affecting their supply sector.

The coincidence of some regions with a higher intensity in both total and per capita construction (basically the Valencian Community and Castilla-La Mancha) highlights the existence of large markets that, as is the case in other economies, can define the growth trends for prices and building activity.

3.- Empirical exercise

This section provides evidence about price-elasticity values in Spain through the analysis of the housing supply function taking into account the aggregated information at a national and Autonomous Communities (AA.CC. onwards) levels. An estimation of elasticity and supply function values is provided here following the methodology already defined in some previous research like that of Mayer & Somerville, 2000, and applying it to the period of time comprised between 1990 to 2004, that is, fifteen years. The geographical context analysis is confined to the AA.CC. for statistical reasons, since no information with a higher disaggregation level is available allowing to estimate the behaviour in urban areas.

This paper try to find evidence that shows whether the reactions of the housing supply sector in Spain resemble any of the models contrasted in the literature (the US model as opposed to that of the United Kingdom), and whether supply sensitivity is stable or varies as has been highlighted in other studies (Glaeser & Gyourko, 2005 and Pryce, 1999, amongst others).

In this exercise, a housing supply function for Spain's aggregated data is fitted using starts, differentiating for the 1987-2004 and between periods, with the aim of verifying whether, 1) the long-run supply price-elasticity values are elastic (as is argued by Ball, 2004) or inelastic during the period analysed, and if the whole supply model contained in the literature can be explain the Spanish case; 2) If elasticities change with the cycle, so that the reaction of the supply varies in time; this is estimate calculating the short-run elasticities; and 3) if elasticities change in space taking as a reference point the classification by Autonomous Communities, combining characteristics according to their housebuilding intensity. The role of significance is also checked in terms to have a measure about how the market reacts to free signals.

To do that, a restricted supply function is defined from (1), where new building activity reacts to changes in the expected returns, measured through prices, and to the construction costs. New building activity is reached from:

(2) $Q_t^s = [Q_t^{sn}, Q_t^{se}]$, ... Total supply is a combination between new and existing houses to cover the demand.

where,

Q_t^{sn} = starts, new housing

Q_t^{se} = % of stock, γH_t

Supposing that the existing stock supplied is a stable rate of the total stock (which is generally agreeded) , then,

(3) $[Q_t^{sn}, Q_t^{se}] = e^{\alpha 1} P_{H,t}^{\alpha 2} Cm_t^{\alpha 3} Cs_t^{\alpha 4} i_t^{\alpha 5} H_{t-1}^{\alpha 6} [\eta_k G_t^k]^{\alpha 7} \pi_H^{e\,\alpha 8} \varepsilon_t$

(4) $[Q_t^{sn}, \gamma H_t] = e^{\alpha 1} P_{H,t}^{\alpha 2} Cm_t^{\alpha 3} Cs_t^{\alpha 4} i_t^{\alpha 5} H_{t-1}^{\alpha 6} [\eta_k G_t^k]^{\alpha 7} \pi_H^{e\,\alpha 8} \varepsilon_{t,}$

(5) $Q_t^{sn} = e^{\alpha 1} P_{H,t}^{\alpha 2} Cm_t^{\alpha 3} Cs_t^{\alpha 4} i_t^{\alpha 5} (\gamma H_{t,} H_{t-1}^{\alpha 6}) [\eta_k G_t^k]^{\alpha 7} \pi_H^{e\,\alpha 8} \varepsilon_t$

Where the expression $[(\gamma H_{t,} H_{t-1}^{\alpha 6}]$ refers such type of combination between the previous stock and the share supplied on the market. Indirectly, it caught the role of vacant influencing housing starts in the short run equilibrium. In the long term, this factor tends to be zero.

In a model without a geographical differentiation that uses aggregated data, the factors included in G[8] have no explanatory power, then, equation (6) reflects the measurement of the supply of new housing as some of the literature use to apply.

(6) $Q_t^{sn}{}_{in,t} = e^{\alpha 1} P_{H,t}^{\alpha 2} Cm_t^{\alpha 3} Cs_t^{\alpha 4} i_t^{\alpha 5} \pi_H^{e\,\alpha 8} \varepsilon_t$

For convenience purposes, we have transformed this definition into a log-linear model with the aim of obtaining an estimator of elasticities and disaggregated costs, following Coulson, 1999 and Somerville, 1999, so that:

(7) $\text{Ln}(Q_t^{sn}{}_{in,t}) = \alpha_1 + \alpha_2 \ln P_{H,t} + \alpha_3 \ln Cm_t + \alpha_4 \ln Cs_t + \alpha_5 \ln i_t + \alpha_8 \pi_H^e + \nu_t$

this is an expression of the supply of new housing function that relates changes between variables, where elasticity defines the sensitivity of new house-building toward changes in prices. The same as Meen, 2003, we consider in this exercise that factors related to expectations about prices (π_H^e) reflect their influence through changes in the price of dwellings.

Following Guirguis *et al*, 2005, and like DiPasquale & Wheaton, 1994, Mankiw & Weil, 1989, Peek & Wilcox, 1991, Maisel, 1963 and Muth, 1960, did, this exercise used aggregated data to examine the behaviour of the housing supply as it was defined in (6) and (7). The information sources, their periodicity and basic characteristics can be seen on Table A1 in the annex. The period under analysis covers 18 years, from 1987 to 2004[9], and was selected for statistical reasons, as it is the total available in the source of residential prices existing in Spain (Ministry of Housing). The indicator of starts is obtained from the Ministry of Housing's database using the series called 'Municipal house-Building Permits'. The construction costs are obtained from the national database that distinguishes between costs associated with materials and those corresponding to labour, making possible to introduce the Coulson's disaggregation inside the model. The real interest rates are calculated using the mortgage market reference interest rates adjusted by the inflation existing both in each period and each geographical region, so that the model by AA. CC. incorporates the real interest rates associated to housing finance including inflation differences by Spanish regions. All the series except for housing prices have a monthly basis and have to be transformed into quarterly series by means of addition, in

[8] As they are variables such as location on the coast, basic characteristics of the productive system, demographic level, etc.

[9] For AACC, the information is only available for the period 1990-2004, monthly.

the case of dwellings, or according to their value at the end of the period, in the case of costs, price index and interest rates.

Spanish statistics do not register the differences in construction costs by AA.CC. If we take into account that some of these regions are producers, these differences may be relevant but it is not possible to include them here for the above-mentioned reason. Statistics properties of the series used can be found on tables A2 to A4 in the annex.

The time properties of the series used here are checked in order to select the methodology to fit the model (7). The existence of unitary roots in all the variables (Table B in the annex provides probabilities to have unitary roots using both ADF and PP test) determines the VAR as the better methodology to be used to fit the model, but most of the previous literature uses the regression methodology with ARIMA terms to estimations. The two different methodologies provide a different measure of elasticity, different from the theoretical definition, instead they often are used interchangeably. ARIMA model allow to estimate the α_2 directly with the exact economic meaning: it measure the effect of relative changes on prices on relative changes on starts ($\varepsilon_t = [(\Delta(Vivin_t)/(Vivin_t))/(\Delta P_{H,t}/P_{H,t})]=\alpha_2$). The VAR methodology estimate how changes on lagged prices can affect to changes on the differenced starts ($\phi_1 = [(\Delta^2(Vivin_t)/(Vivin_t))/(\Delta P_{H,t-i}/P_{H,t-i})$, and if we calculate the short run effect using a ECM, it also calculate how changes on differenced housing prices affect to changes on the differenced starts ($\gamma_2 = [(\Delta^2(Vivin_t)/(Vivin_t))/(\Delta^2 P_{H,t-i}/P_{H,t-i})]$). The economic meaning of these last two measures is different than the first one. While the first explain how new housing supply reacts to the market signals, the second one (ϕ_1) explain how new housing supply is accelerating (second differences) as a result of the previous (lagged and known) behaviour of prices. It could refer the reactions of builders to their benefit expectations, in which case builder expectations are backward looking. When the lag in this term is for one period, the measure of elasticity given by (ϕ_1) shows a fast reaction of new construction. In the case of the (γ_2), its economic meaning is how second changes (acceleration) on housing prices lagged are affecting to second changes (acceleration) on starts. This definition seems to refer again to a decision making process based on past information and feeding an acceleration on building process, in a way which suggest such type of speculative decision taking from the supply side regarding to price behaviour.

Some research use changes on prices as dependent variable to estimate the price-elasticity (Meen, 2002). This estimations use to be those one based on the builders benefit as the main determinant of new housing supply explained before. In this case, the measure of elasticity is $\delta_2 = [(\Delta(Vivin_t)/(Vivin_t))/(\Delta^2 P_{H,t}/P_{H,t})]$, which could be interpreted as the changes on starts due to acceleration on prices (changes on changes), ie, in what extent builders decide to start construction 'on-time' when they observe the acceleration on prices. This elasticity measure could be catching the existence of such type of expectations (not forward looking) making react very soon to builders but it doesn't seem to refer to an speculative behaviour.

This paper estimate (7) using the four different definitions of elasticity. An ARIMA context is used to calculate ε_t and δ_2 being applied to the aggregate time-series data and also using a dynamic pseudo panel data compose by all AACC aggregate information. So, two estimation are fitted here to obtain the new housing price elasticity (ε_t) for Spanish market: the first one is based on the aggregate time series (the addition of all

AACC data, average housing prices, average construction cost and also the average on real interest rates) and the second one is calculated using a dynamic pool data (pseudo-panel data) constructed by all aggregate information by region (but not the Spanish aggregate), including starts, average new housing prices by region, construction costs and real interest rates estimated using the regional inflation. The aim to do that is to compare the different values of the elasticity obtained in order to avoid aggregation problems. The estimation at regions level is also made regarding the empirical experience which has shown that aggregated data lead the model to overestimate supply elasticities. The exercise also follows to reach the existence of different dynamism levels in the housing supply depending on the region.

In both cases, the estimation uses a heteroskedasticity-corrected Two-Stage Least Square (TSLS) method with an ARMA structure. In the case of the estimation using the dynamic data pool, a TSLS tool with fix effects is used to fit (7). This is done in order to obtain a joint supply price-elasticity for the Spanish market based on the geographical information, as well as an estimator of the regional differences from the supply side. The common parameter for the housing price variable in (7) could be understood as the joint supply elasticity for the whole Spanish housing market, from which the regions can show their differences (fix effect).

We also obtain model estimations period by period, as the literature does, in order to measure changes in elasticity depending on the cycle phases. Three periods are selected, according to the phases followed by the general housing start series, namely 1987-1992, 1993-1998 and 1999-2004.

The second measure of elasticity, δ_2 , is also estimate using TSLS using (7) where housing prices is substituted by a measure of changes on housing prices.

Although the results of the model fitted do not show clearly the presence of non-stationary roots, the dynamic structure exhibit by the variables suggests the possibility of the results obtained in the pool and in the ARIMA models are biased due to the existence of unitary roots, which implies the need to fit the model with a VAR methodology in order to contrast results. Thus, the second method applied here is to estimate error correction vectors for each one of the regions including the aggregated information for Spain. The estimation of elasticity has been explained before. These estimation are fitted in order to compare the relationships and economic explanation capacity they have regarding the conventional concept of elasticity.

Then, summarizing, both econometric techniques are used to obtain, successively:

a) Estimates of new supply-price elasticity taking into account the model defined in (7), that is,

   Model 1: $\mathrm{Ln}\,(Q_t^{sn}{}_{in,t}) = \alpha_1 + \varepsilon_t \ln P_{H,t} + \alpha_3 \ln Cm_t + \alpha_4 \ln Cs_t + \alpha_5 \ln i_t + \nu_t$

   Estimating:

   $\varepsilon_t = [(\Delta(Vivin_t)/(Vivin_t))/(\Delta P_{H,t}/P_{H,t})] = \alpha_2$, which is the conventional supply-price elasticity expression.

   We difference ε_{t1} for the full Spanish model and ε_{t2} for AACC models.

b) Estimates of new supply-changes on prices elasticity as an indicator of sensitivity toward incentives for investment, that is,

   Model 2: $\mathrm{Ln}\,(Q_t^{sn}{}_{in,t}) = \alpha_1 + \alpha_3 \ln Cm_t + \alpha_4 \ln Cs_t + \alpha_5 \ln i_t + \delta_2\, \pi_H^e + \nu_t$

   Estimating:

   $$\delta_2 = [(\Delta(Vivin_t)/(Vivin_t))/(\Delta^2 P_{H,t}/P_{H,t})]$$

c) Two estimations of new housing-price supply sensitivity obtained applying the Error Correction model. An Error Correction model adjusts the following function (model 3):

(8) $\Delta\ln(Vivin_t) = \gamma_1 + \Gamma_1[\ln(Vivin_{t-1}) + \phi_1 \ln P_{H,t-1} + \phi_2 \ln Cm_{t-1} + \phi_3 \ln Cs_{t-1} + \phi_4 \ln i_{t-1} + \phi_5 \ln H_{t-1}] + \gamma_2 \Delta\ln P_{H,t-i} + \gamma_3 \Delta \ln Cm_{t-i} + \gamma_4 \Delta \ln Cs_{t-i} + \gamma_5 \Delta \ln i_{t-i} + \gamma_6 \Delta \ln H_{t-i} + \varepsilon_t$

Where the parameters catching changes in prices would be ϕ_1 y γ_2, with the following expression:

(9) $\phi_1 = [(\Delta^2(Vivin_t)/(Vivin_t))/(\Delta P_{H,t-1}/P_{H,t-1})]$

(10) $\gamma_2 = [(\Delta^2(Vivin_t)/(Vivin_t))/(\Delta^2 P_{H,t-i}/P_{H,t-i})]$

In neither case does the expression correspond to conventional elasticity, as it is explained before. These two parameters reflect different degrees of supply sensitivity taking into account the dynamic properties of the series. These measures are estimated both at an aggregated level for the Spanish economy and at AA.CC's level.

There are a couple of features more to be explained affecting to the estimation process. With the model fitted, most time-series exhibit the existence of a trend on average. This happen in model (1) all period (both estimations) and sub-periods but in 1999-2004, and also in the models by region but in Balearic Islands, Cantabria, Castilla-La-Mancha, Extremadura, Madrid, Murcia, Navarra and La Rioja. After to check their existence and the statistical nature of them, the decision was to include them into the model in order to avoid statistical bias which could modify the values for the estimated parameters.

The second feature is the existence of structural breaks in the models. Structural change has been checked using the Chow's Breakpoint Test and trying the periods where Spanish economy has experience changes on its integration process to Europe (1993, entrance to the Single Market, 1997, start date for nominal convergence to euro, 1998, final date where it was evaluated, 1999, the entrance of peseta into the euro, 2001 and 2002 as dates of the start for euro circulation).

.In the aggregated model, the structural change has permanent effect and it was defined from 2001 onwards, both in the pool and the time-series[10]. We also check the existence of the break region by region founding just seven from sixteen regions analysed, which are Balearic and Canary Islands, Catalonia, Galicia, Madrid, Navarra and La Rioja, Canary Island, Madrid and La Rioja's structural break were located on 2002. Same breaks appeared when model 2 were fitted. These results support to include a dummy variable relating the structural change with permanent effects in the full model and regions models. The clear effect of the structural change disappears if we reduce the sample to 1999-2001 because the small sample to be estimated. The aim of this paper is not to deep on the reasons from this breaks but, for statistical reasons, we have to include them in order to avoid any bias on the parameters looked for.

The results of the empirical models can be found in Tables 2, 3 & 4

4. Empirical results and discussion

[10] Note that the structural change is not included in the estimation by periods

Table 2 shows the elasticity estimation calculated using the data pool by AA.CC.[11] and the time series for the aggregate data. The equations have a high explanatory power and their parameters seem to be reasonably robust. The elasticity-price of the housing supply is low for the whole period 1988-2004 (0.46)[12], with a similar value than the ones obtained in others European experiences. But if the sample is reduced since 1990 to 2004, then the elasticity value obtained is higher (0.86). Both estimation techniques (the pool include data just from regions and the aggregated time series for Spain) give similar result, with a non elastic but close to one elasticity-price of supply during nineties, having very similar significant capacity in both models.

Regarding the supply definition, similar results in the parameters of the others variables are founded in all models fitted, resulting the labour costs the only relevant determinant, with negative sign according to the principles, and no significant result for cost of materials and interest rates.

The role played by costs in the starts' rate determination supports the existing evidence and shows two different behaviours: the persistent relevant of the labour costs and the unclear relationship with the costs of materials. Coherence on the labour costs results into the model, which high elasticity, agrees with the rise on construction wages in the Spanish economy during the analysed period because the rapid expansion on construction and the lack on trained labour. So, this result shows the existence of a roof in the expansion capacity of building sector which tend to stress housing prices from the inputs views. Poor results of real interest rates is significant. In a period with falling interest rates (from 13 to 4%), the null significance of this component means that the financial system for building in Spain just depend a few from external finance's cost. Also, the poor results for material costs has sense in a period with a very stabilised material costs.

Those imply that this industry adapts its productive capacity to market conditions, and just the labour costs are relevant to determine the decision to start new houses. Some explanations have already been given for this behaviour (Coulson, 1999) explaining that builders use to delay or accelerate the construction process depending on the market absorption evolution. Interest rates seems to have strong effect during the period when they have a level upper to 12%, but no relation when they fall down until levels close to 3% (1997-2004).

Results of the models have a high degree of signification, giving a R^2 higher than 0.92 in the pool exercise and that 0.86 in the Arima model (but in the last period). Results could be interpreted as the following: housing starts has growing with a relevant trend, being probably reflect of the demand forces, and adjusting its growth to the behaviour of two main variables, prices, which have playing a role to impulse the new construction at a very high impact (one percent of increase on prices affect to 0.87% of increase on number of starts) from nineties to now; and labour costs, which has a negative effect, very sensible, restraining house-building (one percent of increase on labour costs reduces a 2.32% the housing starts). From 2001 the relationship captures by this model is slowed in a -0.29%.

Regarding the models by periods, we can see how the supply elasticity changes its value when the sample is shared. We share the sample taking into account periods with common features, so we probably define the medium-run fit period for housing supply, that is, the period to complete an endogenous cycle. The value of the elasticity is higher than the average in the two phases from 1993 with different sensibilities which agree to others research findings. It means that the elasticity is not fixed but changes depending on the moment of the building cycle. In the case of Spain, the periods since 1993 have values above one, with a varying

[11] Note that the dynamic pool does not contain any series for total building in Spain, i.e. the information is combined using that of all the regions at the same time.
[12] This refers only to the time-series estimation because the pool has only observations from 1990-2004

elasticity that is collected in the model. The very elastic changes on starts since 1990s could be interpreted as a wide reaction of the building sector to the market signal practically all through the period, despite the limitations in the increase of labour costs and without external restriction of the model. An exception is the 1988-1992 period. At that moment, Spanish economy was implementing the mechanism to the EC entrance (trade policy, agricultural policy and reducing trade barriers to mobility), Monetary Policy (depending on National Bank) had very influence on financial market and capital movements were controlled. Those means that market mechanism were different and it seems to be catch through the estimation during 1988-1992, giving more significance to material costs and mortgage interest rates, both with negative sign as expected and very significant, which appear to have no influence in the whole (and the rest of) period.

In the dynamic panel fit, fixed effects appear as indicators of the regional differences in the building cycle. These indicators invariably show that Autonomous Communities have different rates of reaction of residential supply, classifying the housing market reactions by regions.

The estimate of elasticity by territories can be seen in Table 3. In this case, we estimate model 1 by AA.CC using the regression method (2SLS, two-stages-Least-Square)[13] in which as AR(1) model was fitted, except for Cantabria, with an ARMA (2,2). If the model is considered to reflect the 'free' reaction of new supply to the incentives coming from the market, then it could be accepted that the degree of explanatory on each equation are showing those markets which perform freely and efficiently. A lower capacity to explain the new house building's reaction points to those markets with more intervention on the new supply.

The results of the empirical model show equations with different levels of explanation. Considering that the lower level of explanation, the lower efficiency on the market, we could classify the Spanish housing supply markets as in table 3a .

Table 3a. Summary: Housing supply market efficiency measure

(Degree of model 1's explanation (Adj R2 for AACC))

more than 80%	Andalusia, Castilla-La Mancha and the Valencian Community.
70-80%	Canary Islands, Cantabria, Galicia and Murcia
50-70%	Aragón, Balearic Islands and Catalonia
20-50%	Asturias, Castilla y León, Extremadura, Madrid, Navarra and La Rioja
less than 20%	Extremadura,

Last two cathegories seem to show housing supply markets depending on a multiplicity of variables alien to the model with the effect of reduce the reaction of construction industry to the market signals. Lack of demand, investment reasons, concentrated ownership of land, slow permission system and/or the effect of public (housing) policies, could be a multiplicity of reasons which could explain these results.

The elasticity results are significant except in the cases of Castilla y León, Extremadura and Cantabria. Most common new housing supply elasticity is the elastic case, with values equal or lower than one in two cases, as is shown in Table 3b.

These results support other evidences about the different housebuilding response by geographical contexts, the explanation of which is usually linked to the endogenous characteristics of markets. They support those obtained in the aggregated model, with a great relevance of the negative labour cost fit in the regions where this variable is significant. On the other hand, costs related to materials play an undetermined role in the

[13] Non-stationary roots were found in none of the equations, though root values are located within a wide spectrum ranging from 0 to 0.72

regions' model and are very relevant only in Aragón and Catalonia. Finally, interest rates (*ir*) have a correcting effect on the cycle in very few regions, namely Cantabria, Extremadura, Madrid, Murcia, Navarra and La Rioja.

Table 3b.- Housing supply market reactions to prices- $\varepsilon_{t,1 \text{and} 2}$

housing supply elasticity values. Model 1, AACC

Significant:	
higher than one	Asturias, the Balearics, Catalonia, Castilla-La Mancha, Galicia, Madrid, Navarre, and La Rioja,
0,7-1	Canary Islands and Valencia Community. Also Spain
lower than 0,7	Andalusia, Aragón and Murcia
Non significant	Castilla y León, Extremadura and Cantabria

The lesser importance of *ir* may derive from the fact that no linear relationship in time and space exists between hose-building and interest rates. The non-linearity between these two variables has already been shown in the literature (Maclennan, Muellbauer & Stephens, 1998). The huge variability on the parameters results seem to suggest the relevance of the regional variables to explain the supply curve, as availability of land or others geographical features.

Model 2 estimations of δ_2 sensibility are in Table 4 (sensitivity of starts to changes in housing inflation). Using this variable, model is trying to capture the influence of the capital gains (extra-returns or benefits) on the decision to start to construct taken by the developers (Topel and Rosen, 1988). Both at an aggregated level and by Autonomous Communities, the housebuilding response when prices accelerate is very significant and strongly elastic, taking values close to 4 but for initial period (1.24) and last one which is not significant. Thus, with the exception of the last period, the new housing supply has increased in all building cycle phases more than doubling the effect of acceleration on prices, particularly during the 1990s. It is found again the change on elasticity depending on the period used for the estimation.

The second part of Table 4 shows the regions more sensible (the both group of Islands, and Valencia and Catalonia) where demand and developers may consequently anticipate the evolution of sales when they observe prices with strong reactions. In this case, many regions show no significance or negative sensibility of starts to housing price acceleration. It seems to be that model builders react negatively when prices are accelerating as a indirect reaction to housing demand. Benefit expectations in these cases are so different across regions in Spain.

Now, the results coming from the model 3, fitted using a VEC methodology, are presented. The estimated parameter ϕ_1 $([(\Delta^2(\text{Vivin}_t)/(\text{Vivin}_t))/(\Delta P_{H,t-1}/P_{H,t-1})])$ measures the change in the number of starts (building cycle acceleration) with respect to the increase of prices during the previous period, thus showing a time perspective between construction and prices that can clearly reflect the effect of expectations backward looking. If that is the case, this parameter would be measuring the adjust to price changes of building rate. Positive relationships mean the higher inflation on housing, the stronger growth in building rate, which means a intensive reaction on investment decisions. The value for this measure is 1.21 for the whole Spanish housing supply, meaning a positive and elastic reaction of building being it accelerates with housing inflation rise. By regions, the results show a very high sensitivity in the majority of cases (Table 5a).

Table 5a. Price elasticity of housing supply with lags (model 2-ECM)- ϕ_1	
Significant	
Higher than 3	Canary Is., Castilla La Mancha, Madrid
From 1 to 3	Andalusia, Aragón, Asturias, Cantabria, Cataluña, Extremadura, Galicia, **SPAIN**
Lower than one	Balearic Isl, Valencia Community, Murcia
Non significative	Navarra, La Rioja
	Castilla-León (long term relationship is not significant)

The stronger results for the first group, with sensibilities higher than 3, is surprising. It means the strong incentive to accelerate building which comes from prices inflation during the previous period.

Finally, the housing supply price- elasticity, γ_2 , could be interpreted as the short run elasticity, and it measures the sensitivity between changes in prices and changes on housebuilding occurring withouth permanent effects. On the contrary than the other results, where a general significance is found, this model just give a bundle of significant parameters measuring the sensibility. The lags are been fixed in three, using the Akaike criteria. Just eight regions show significant sensibility, all of them higher than two, and positive but Cantabria and Navarra. These results confirms the existence of a quick reaction of the supply side to changes in prices within the Spanish residential cycle just in a few regions, all of then but Madrid and Castilla La Mancha, with a very narrow housing market.

To summarise these results, it could be said the housing supply in Spain reacts in accordance with the theory and the experience in other countries, although showing particularities due to which it has been considered one of the most dynamic cycles in the Europe of the 1990s. The first particularity is the positive reaction to market signals thanks to which a price-elasticity near one has been shown all through the 1990s, which apparently distinguishes it from other EU countries, like the United Kingdom or the Netherlands, where long-run elasticity is lower (between 0.3 y 0.6). Nonetheless, if we estimate the equation in the longest period available (1988-2004), the elasticity value goes down to 0.46, which is consistent with the values mentioned in other countries. The higher explanation capacity of the models, according to the theory, seems to refer an high degree of efficiency on housing supply market. Calculating the model by periods, the elasticity increases above one, with values ranging between 1.12 and 2.4, depending on the context and the period of analysis, which implies the existence of a high sensitivity in the building cycle when market signals are received, during the last 15 years. It means that the new housing supply curve 'change' its slope on time, 'balancing' itself following the demand pressure. The greater reaction of new housebuilding suggests that the traditionally restrictive factors in this sector (costs, land shortage, limitation of materials and labour, regulation,…) have not acted at all in Spain, permitting a stable expansion during the 1990s, with lower pressure on prices than the market could have experienced with more restrictive supply. This cannot be supported in the case of 1990-1992 when model seems to suggest that traditional limits (costs and interest rates) played an important role to limit new housing supply. The high elasticity is the result of a different behaviour shown by Spanish regions in their housing supply, showing how the supply elasticity also change on space.

The construction-limiting factors are mainly salary costs, which agree with the fact that housebuilding is a highly labour-intensive sector. The interest rates, as a cost, are not significant for developers in Spain during nineties, something that can look surprising taking into account the large capital amounts required, though these results could be explained by the short financing term prior to the subrogation of the credits with a just-interestpaying period (3 years) and the limited weight of financial costs with respect to the total costs. However, there might exist non-linearity between housebuilding and interest rates (and costs associated with materials) that would justify this low ratio.

Three additional price-related sensitivity indicators defined not as the conventional elasticity have been examined in order to detect the degree of response shown by the supply. The three of them (supply elasticity to changes in prices, elasticity of changes in the new supply to changes on one-period lagged prices, long term sensibility of starts acceleration to one period lagged prices and the short-term elasticity that measures the sensitivity of changes in the supply toward changes in prices) reflect strong response reactions in most cases, showing even that the regions with downward cycles react quickly to changes in market signals. There are, however, some cases in which the reaction capacity is very limited or non-existent. These are markets with other explanatory variables different from the supply part.

The empirical model allows to classify those housing markets attending to how their supply performs following the principles, so, by efficiency degree on market's mechanism acting on them. Exhibit 5 represents these groups. A first cluster of regions could be created with those where the start reaction can be foreseen because their closed responses to market mechanism, so, the more efficient ones (Andalucía, Canary Island, Castilla La Mancha, Valencia Community, Galicia, Murcia and the whole Spain). Excluding Valencia, they seems to show fast reaction on building acceleration following changes on prices, referring strong investment reactions 'backward looking'. The second group shows lower explanation capacity but enough to sustain the idea of a new housing supply market performing properly closed to market principles (Cataluña, Cantabria and Balearic Island). Elastic reactions (but in Cantabria) and strong responses of investment could be their common features. Third cluster is composed by the rest of regions where others factors instead the market principles lead the evolution of starts. Some of them are submitted to strong investment pressures showing higher value of the elasticity, as Madrid, but most part of building activity depends of variables omitted in the model. It seems to suggest that Housing Policy interventions, concentration on land ownership or restrictive regulations are strong influence in those markets.

Short run reactions of start's responses as a measure of incentive to benefit increased, can be represented in Exhibit 6 where the significant values of two elasticity measures δ_2 and γ_2 are represented. Note that one difference between both measures is the period when the information about prices comes into the reaction of supply. For instance, Madrid shows very strong short run reactions using past information but not positive one using current information, so, suppliers don't react to current but pass prices changes do not using rational expectations.

Regional and time differences as well as a very dynamism on supply conditions which strong reactions, seems to be the features of the residential supply in Spain during the 1990s. The whole new supply elasticity is high in Spain and it seems to be the result of the answer of market mechanisms in main regions where housing investement has been the leaders in Spain. Most than those regional markets seems to show high efficiency in their new housing supply performance, but not in one important region like Madrid, where the starts cycle seems to be restricted by other non-market factors.

The exercises done here seem to have relevant implications. They suggests that such a rapid new housing supply reactions to changes on prices could have influenced to housing price evolution in the more efficient areas limiting the growth rate during the analysed period in Spain, preventing prices from reaching the level that would correspond to them in a more rigid situation. If that is the case, the price growth observed in Spain could be smaller than the one if the new housing supply was less sensible than shows.

5.- Conclusions

Housing supply behaviour is poor known. Recent literature has been showing how some principles can be not always true specially about how the supply is fix in the short run or elastic in long term. The present paper contributes to the evidence analysing the new housing supply throughout the 1990s and during the first years of the twenty-first century. A new-housing supply model is defined and estimated for the case of Spain with the aim of obtaining an estimate of elasticity from 1987 to 2004 and by periods, in order to check if the elasticity maintain its value and it does not depend of the estimated period. The model is applied to aggregate data for the whole Spain and also by regions (AACC) also to analyse the existing differences among the territory. Then, the changes on time and space of the value of new supply elasticity are estimated in this paper. We have used two econometric tools to estimate the model, the regression method (2SLS) applied to a dynamic panel and to individual time series, and an Error Correction Model. The aim of the paper is to show if Spanish housing markets show special reactions of new supply than in others economies and if they could be a symptom of efficiency on housing market. We have calculated various sensitivity measures similar to the elasticity's definition, finding high values that show a high degree of response to variations in prices, both current and lagged ones, on the building cycle.

The results support the theory, as they show a high explanatory power of the new housing supply. The elasticities obtained vary in time and space, thus reflecting the different economic and local conditions present in the Spanish housing markets. The elasticities estimated are close to one, but when we disaggregate them by periods or Communities, their value exceeds one, which reflects a situation of high price-elasticity in the Spanish new housing supply. The results do allow us to approximate an initial classification of those market with less out-market pressures (more efficient ones) and those where the new supply is determined by other omitted variables., which could be, for instance, more intensive Housing Policy, land ownership control or restrictions in permission system. The high sensitivity identified in the Spanish new housing supply since the 1990s might have softened the pressure on prices exerted by the strong demand forces present in the market. This is also a differential factor with respect to other European countries which, under similar economic circumstances, have experienced growth in prices but not in the new housing supply. The supply conditions during the 1990s may therefore have played a crucial role in the development of the housing market.

Exhibit **1. Building cycles in Spain**

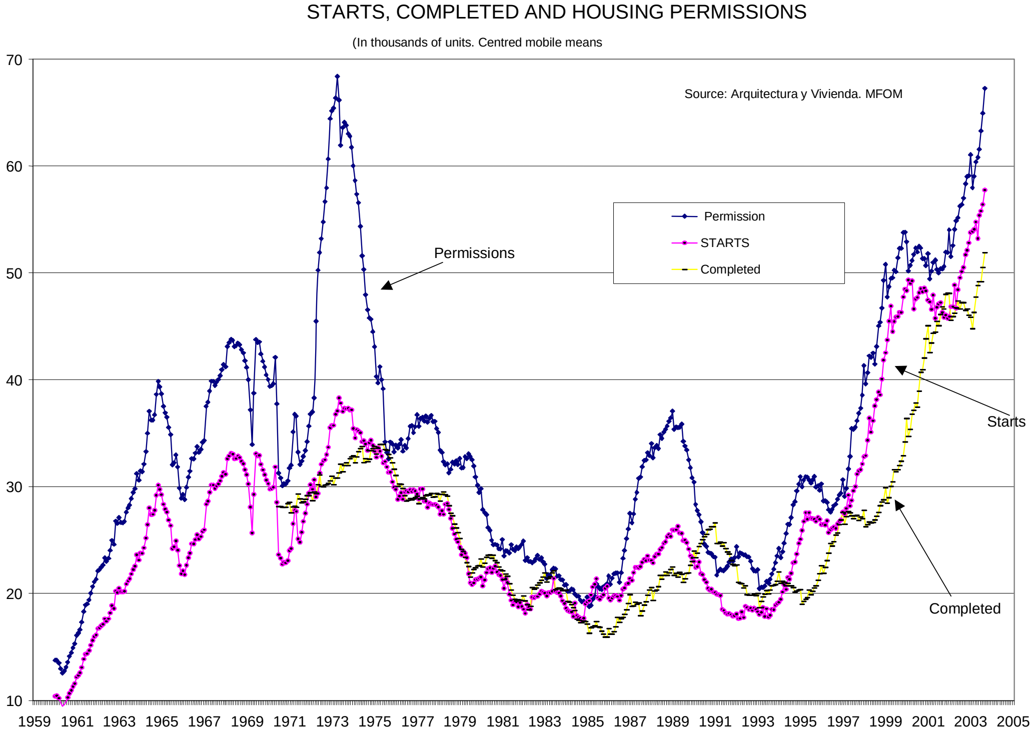


Exhibit 2

SUPPLY FUNCTION AND PRICE REACTION

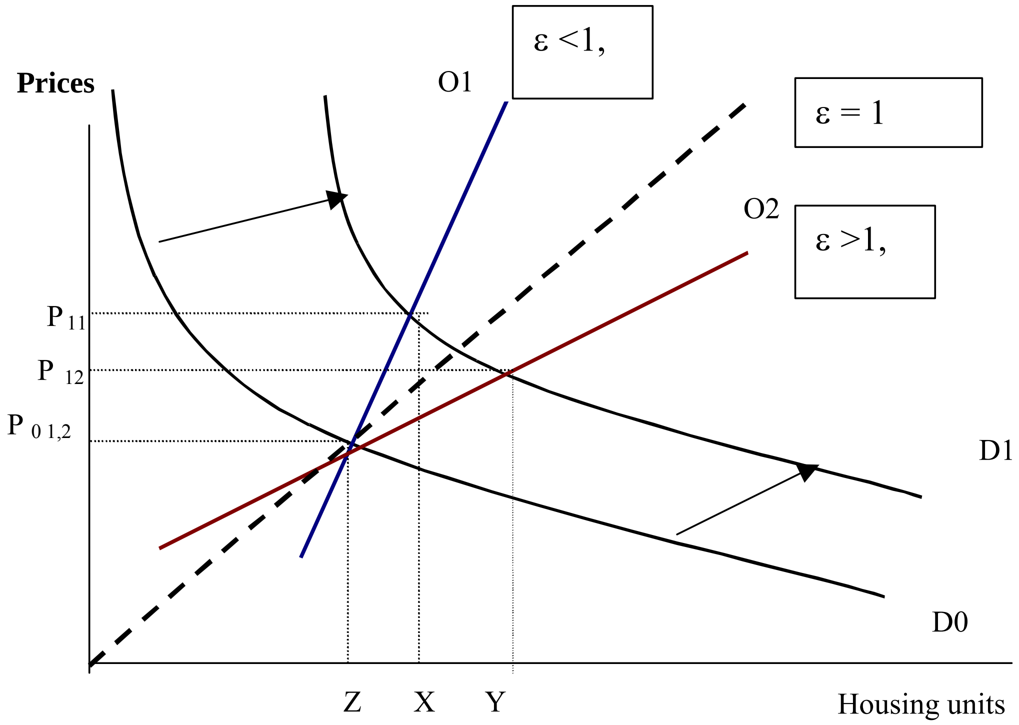


Exhibit 3.- PER-CAPITA STARTS UNITS IN SPAIN

(Housing units per 1,000 inhabitants on average of each period)

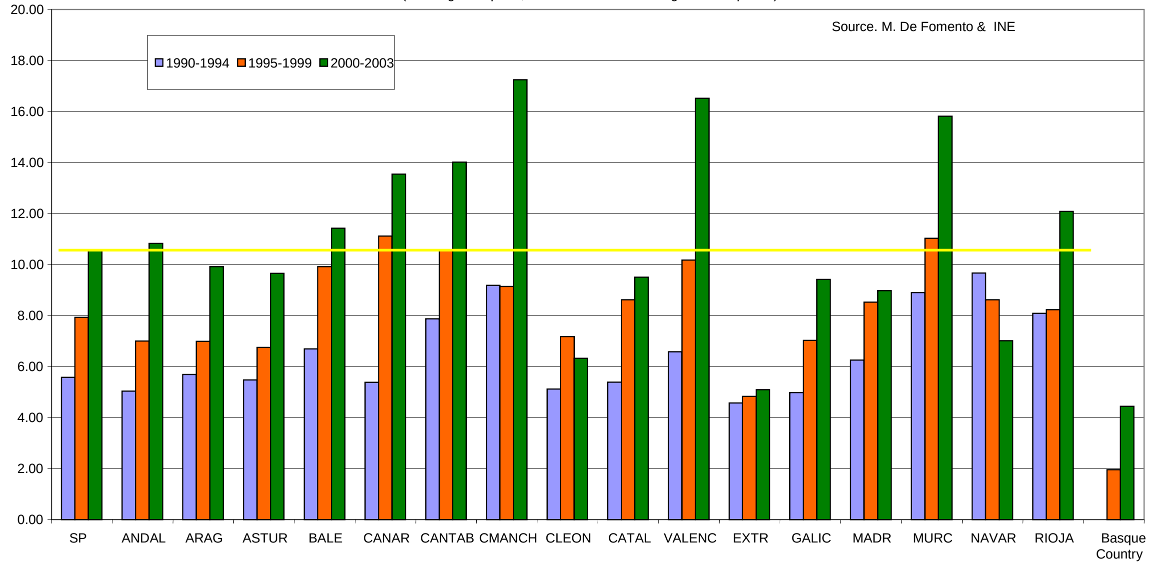


Exhibit 4a. Building activity by Autonomous Communities. Main cycles

(Moving average starts by month)

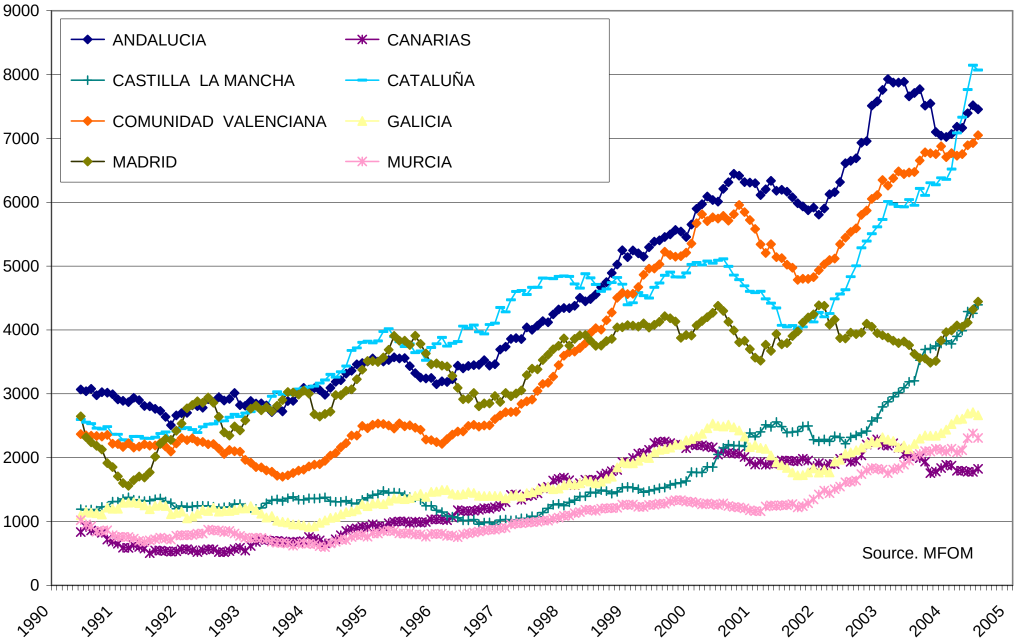
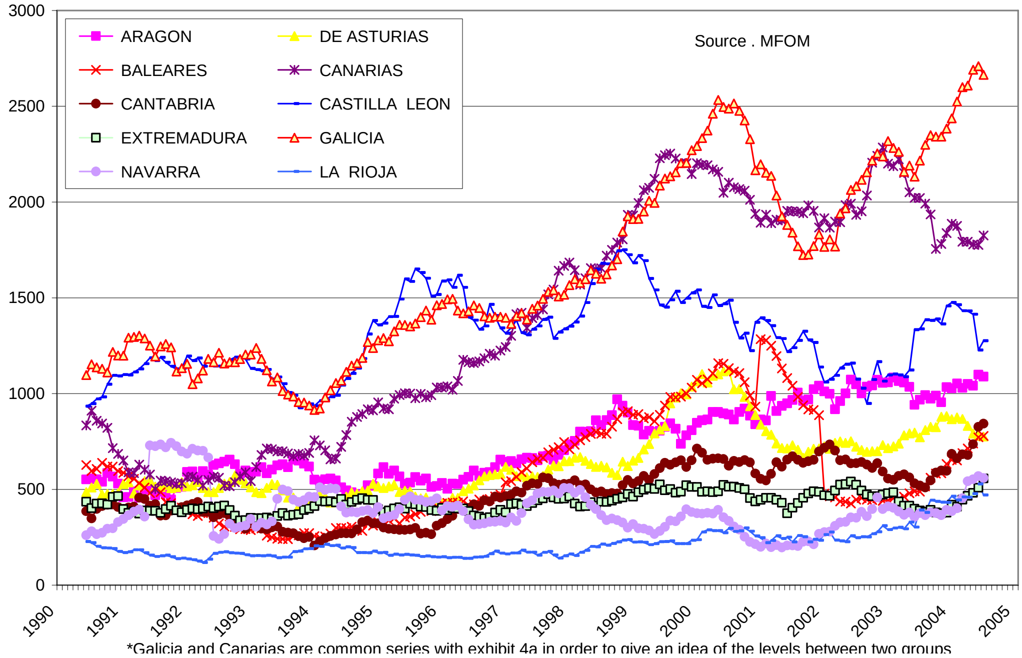


Exhibit 4b. Building activity by Autonomous Communities. Second cycles*

(Moving average starts by month)



*Galicia and Canarias are common series with exhibit 4a in order to give an idea of the levels between two groups

TABLE 2. NEW HOUSING SUPPLY MODEL BY PERIODS. ESTIMATING ε_t FOR SPAIN

2SLS Method. List of instruments $\ln P_{H,t}$, $\ln Cm_t$, $\ln Cs_t$, $\ln i_t$. **t- satistics in italics**

Dependent variable: **LOG of housing starts**

Model 1 estimated: $\ln (Q_t^{sn}{}_{in,t}) = \alpha_1 + \varepsilon_{t1} \ln P_{H,t} + \alpha_3 \ln Cm_t + \alpha_4 \ln Cs_t + \alpha_5 \ln i_t + \nu_t$

Model 1	**DATA POOL BY AA. CC.**				**ESTIMATE FROM THE ARIMA REGRESSION MODEL Models**					
Period	**1990.1-2004.4***	**1990.1-1992.4**	**1993.1-1998.4**	**1999.1-2004.4**		**1987,1-2004,1**	**1990,1-2004,1**	**1988,1-1992,4**	**1993,1-1998,4**	**1999.1-2004.4**
α_1	-0,64	**78,89**	-5,00	3,59	α_1	0		**26,54**		**9,58**
(t)	*-0,25*	*3,25*	*-0,59*	*1,35*	***(t)***	*0*		*6,61*		*1,95*
$\ln P_{H,t}$	**0,87**	-0,62	**2,32**	**1,12**	$\ln P_{H,t}$	**0,46**	**0,86**	**0,85**	**1,40**	**2,38**
(t)	*6,96*	*-1,29*	*5,74*	*3,27*	*(t)*	*2,49*	*3,76*	*2,24*	*5,55*	*2,94*
$\ln Cm_t$	-0,02	**-15,91**	0,66	1,33	$\ln Cm_t$	**3,41**	0,95	**-4,09**	1,46	0,86
(t)	*-0,04*	*-2,63*	*0,72*	*1,71*	*(t)*	*5,42*	*1,42*	*-2,11*	*1,21*	*0,92*
$\ln Cs_t$	**-2,32**	1,19	**-4,62**	**-3,08**	$\ln Cs_t$	**-2,26**	**-2,61**	**-1,71**	**-2,75**	**-6,41**
(t)	*-3,64*	*1,10*	*-4,23*	*-3,15*	*(t)*	*-6,54*	*-2,77*	*-2,13*	*-2,26*	*-2,51*
$\ln i_t$	-0,03	0,01	0,02	-0,04	$\ln i_t$	0,13	-0,07	**-0,67**	-0,04	-0,04
(t)	*-1,45*	*0,04*	*0,19*	*-1,66*	*(t)*	*1,32*	*-0,84*	*-5,90*	*-0,37*	*-0,27*
Trend	5,45	0,41	0,76	no	***Trend***	*4,16*	*4,86*	*1,24*	*5,68*	*-3,11*
(t)	*5,30*	*0,24*	*5,09*	*no*	*(t)*	*2,16*	*2,76*	*2,63*	*2,37*	*-1,28*
dummy2001	-0,29				*dummy2001*	*-0,32*	*-0,28*			
R^2	0,927	0,929	0,952	0,922	R^2	0,891	0,918	0,860	0,876	0,598
Adjusted R^2	0,925	0,917	0,949	0,917	fitted R^2	0,878	0,907	0,801	0,832	0,456
Σe^2	57,36	4,94	16,40	27,11	Σe^2	0,73	0,54	0,06	0,11	0,23
Σe^2 2ª stage	57,43	4,94	16,40	27,11	Σe^2 2ª stage	2,65	2,08	0,06	0,11	0,64
D.W.	2,19	2,12	2,00	2,08	D.W.	1,83	2,14	2,43	1,72	1,91
F-statistic	472,30	80,02	326,52	190,55	Inverted root	0,21	0,2	0	-0,18	-0,14
Fixed effects										
AN	**1,48**	**0,96**	**1,62**	**1,73**						
AR	-0,39	-0,67	-0,25	-0,33						
AS	-0,59	-0,70	-0,70	-0,42						
BA	-0,87	-1,06	-0,90	-0,90						
CA	**0,08**	**-0,49**	**0,12**	**0,23**						
CANT	-1,00	---	-1,29	-0,82						
CLM	0,68	0,00	0,94	1,07						
CLE	0,10	0,10	0,21	-0,03						
CAT	**1,02**	**1,10**	**0,72**	**0,92**						
CV	**1,29**	**0,59**	**1,46**	**1,61**						
EX	-0,50	-1,23	0,17	-0,39						
GA	0,49	0,18	0,47	0,79						
MA	0,57	1,11	-0,13	0,41						
MU	0,26	-0,44	0,67	0,53						
NA	-1,36	---	-1,31	-1,70						
PV	-1,19	---	-1,42	-1,28						
RI	-1,72	-1,31	-1,85	-1,56						
total observations	879	137	383	359						

*The fits for the whole period include a dummy variable which takes value 1 from 2001 to the end, the zero otherwise.
Red values means non significant results
All the equations in the panel incorporate an AR (1) term and, in the case of regression models, an ARMA (1,2).

TABLE 3 .SUPPLY MODEL. ESTIMATION BY AA.CC.***

Structural model, estimating method. **2SLS method. List of instruments LOG(RPRE), LOG(CM), LOG(CS), log(RI). t- statistics in italics. Red: non- significant results**

Model 1 fitted: $\text{Ln}\,(Q_t^{sn}{}_{in,t}) = \alpha_1 + \varepsilon_{t2} \ln P_{H,t} + \alpha_3 \ln Cm_t + \alpha_4 \ln Cs_t + \alpha_5 \ln i_t + \nu_t$

(all fits are white- consistent in heteroskedasticity)

Dependent variable: log starts units

AA.CC.	Andalusia	Aragón	Asturias	Balearics	Canaries	Cantabria	Catalonia	Castilla-La Mancha	Castilla y León	Valenc. Com	Extremadura	Galicia	Madrid	Murcia	Navarra	La Rioja
Period	1990.1-2004.4															
$\ln P_{H,t}$	0,56	0,63	1,43	1,30	0,73	-1,21	2,25	1,62	0,30	0,99	-0,15	1,93	1,45	0,56	1,51	2,47
(t)	*2,55*	*2,48*	*2,54*	*2,05*	*1,82***	*-4,82*	*3,31*	*6,08*	*1,25*	*3,56*	*-0,26*	*5,82*	*2,06*	*2,25*	*2,02*	*2,59*
$\ln Cm_t$	0,63	-3,17	1,63	2,31	0,34	2,54	-4,87	1,60	0,18	1,46	0,08	1,70	-4,92	0,56	0,80	-4,05
(t)	*0,68*	*-2,03*	*1,13*	*0,73*	*0,22*	*2,30*	*-1,79*	*1,32*	*0,18*	*0,77*	*0,06*	*1,92***	*-1,48*	*0,43*	*0,24*	*-1,41*
$\ln Cs_t$	-4,20	-4,26	-8,48	5,74	-3,55	2,17	-3,62	0,56	-2,12	-3,99	-1,47	-1,97	-1,39	0,00	-1,40	-4,72
(t)	*-3,31*	*-2,43*	*-3,01*	*1,24*	*-1,87**	*1,57*	*-1,92***	*0,84*	*-1,64*	*-2,50*	*-0,87*	*-1,62*	*-0,37*	*-0,01*	*-0,53*	*-0,94*
$\ln i_t$	-0,11	-0,07	0,04	0,22	-0,03	-0,20	-0,05	0,04	0,14	-0,02	-0,12	0,01	-0,14	-0,27	-0,21	-0,29
(t)	*-1,59*	*-0,94*	*0,60*	*0,78*	*-0,60*	*-1,99**	*-0,89*	*0,62*	*2,13*	*-0,33*	*-2,25*	*0,15*	*-1,79*	*-1,7*	*-2,78*	*-2,08*
c	6,80	17,48	12,55	-37,98				-19,04		-2,21	13,96	-20,58		-0,21	-7,01	2,23
(t)	*1,52*	*2,53*	*2,96*	*-2,17*				*-4,40*		*-0,30*	*1,12*	*-3,77*		*-0,03*	*-0,61*	*0,20*
Trend	*7,18*	*9,48*	*12,55*	*-3,18*	*8,29*		*12,53*		*9,24*	*6,75*	*0,19*	*5,04*	*14,35*			*9,23*
(t)	*3,40*	*3,00*	*2,96*	*-0,54*	*3,69*		*4,24*		*2,23*	*2,12*	*0,74*	*2,53*	*1,36*			*1,26*
dummy				*2001*	*2002*		*2001*					*2001*	*2002*		*1999*	*2002*
R^2	0,87	0,56	0,47	0,58	0,80	0,74	0,66	0,83	0,37	0,85	0,20	0,80	0,34	0,77	0,34	0,50
Adjusted R^2	0,86	0,51	0,42	0,51	0,78	0,70	0,62	0,82	0,29	0,83	0,08	0,77	0,26	0,75	0,21	0,41
Σ e2	0,90	2,59	3,11	5,65	3,08	1,96	2,41	1,80	2,24	1,56	2,10	1,26	4,03	1,88	3,53	4,78
Σ e2 2nd stage	0,90	2,59	2,39	4,17	2,85	2,09	1,17	1,80	2,20	1,56	2,09	1,09	2,73	1,88	2,92	4,35
Inverted root	0,66	0,00	0,12	0,27	0,31	0,56	0,72	0,28	-0,31	0,41	-0,25	-0,16	0,48	0,13	0,37	-0,09
DW	2,05	1,96	2,01	2,12	2,15	1,74	2,21	2,21	1,90	2,34	2,06	1,91	2,04	1,96	2,07	1,66

*** significant at 5%**
**** significant at 10%**

***** The model for the Basque Country could not be calculated due to lack of statistical information**

TABLE 4.- SENSITIVITY OF THE SUPPLY TOWARD CHANGES IN PRICE VARIATION - δ_2

Dependent variable:
log started units Period d(log real prices)

Model 2: $Ln (Q_t^{sn}{}_{in,t}) = \alpha_1 + \alpha_3 \ln Cm_t + \alpha_4 \ln Cs_t + \alpha_5 \ln i_t + \delta_2 \pi_H^e + \nu_t$

the t-statistic is (t)			δ_t *	(t)
Spain	1987.1-2004.4		4,16	2,16
	1990.1-2004.4		4,86	2,76
	1987,1-1992,4		1,24	2,63
	1993,1-1998,4		5,68	2,37
	1999.1-2004.4		-3,11	-1,28
By Autonomous Communities				
Canaries	1990.1-2004.4		23,31	4,19
Balearics			20,33	4,08
Valencian Community			15,33	3,16
Catalonia			10,05	3
Cantabria			6,7	3,74
Andalusia			5,3	3,21
Castilla-La Mancha			4,49	2,75
Galicia			4,49	2,71
Murcia			4,35	2,34
Aragón			4,11	2,33
Extremadura			-4,79	-2,20
La Rioja			-7,63	-2,1
Asturias			-8,97	-3,24
Madrid			-9,47	-2,63
Castilla y León		no	2,01	1
Navarre		no	1,62	0,33

* $\delta_t = [(\Delta(Vivin_t)/(Vivin_t))/(\Delta^2 P_{H,t}/P_{H,t})]$

TABLE 5 .HOUSING SUPPLY PRICE-ELASTICITY ESTIMATED FROM THE ERROR CORRECTION METHOD, model 3 - ϕ_1 and γ_2

(The number of lags was chosen following Akaike's criterion)

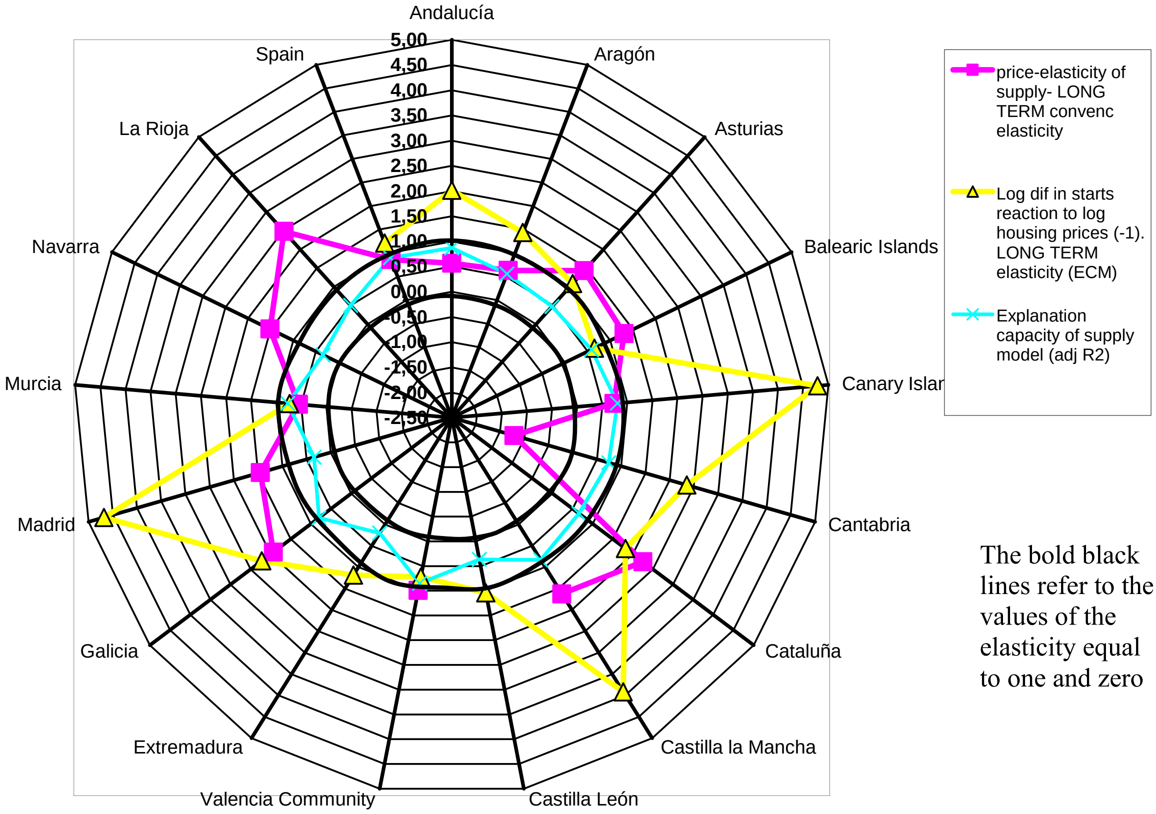
	Spain	By Autonomous Communities. Independent variable d(vivin)															
		Andalusia	Aragón	Asturias	Balearics	Canary Is	Cantabria	Catalonia	Castilla-La Mancha	Castilla y León	Valencia Com.	Extremadura	Galicia	Madrid	Murcia	Navarra	La Rioja
The dependent variable is Δ(log(vivin))	1987.1-2004.4	Period: 1991Q12004Q1															
Variable	D(viv.inic)																
Log(Real prices) (-1) ϕ_1	**1,21**	**2,01**	**1,44**	**1,08**	**0,65**	**4,78**	**2,35**	**1,81**	**3,91**	**1,04**	**0,72**	**1,18**	**2,22**	**4,68**	**0,73**	**-0,15**	**-0,82**
t-statistic	[2,53]	[4,86]	[2,90]	[2,03]	[3,81]	[3,08]	[7,58]	[15,87]	[2,45]	[2,11]	[2,23]	[3,43]	[3,03]	[6,79]	[6,32]	[-0,25]	[-1,90]
Coint. coef.	-0,10	-0,24	-0,24	-0,26	-0,60	-0,12	-0,47	-0,35	-0,11	-0,16	-0,46	-0,86	-0,27	-0,55	-0,70	-0,56	-0,93
	[-2,84]	[-2,86]	[-2,75]	[-2,70]	[-2,41]	[-2,80]	[-3,35]	[-2,99]	[-2,56]	[-1,37]	[-2,33]	[-3,40]	[-2,79]	[-3,77]	[-2,93]	[-3,13]	[-5,37]
Δ(log(Real prices)(t-i) *** γ_2				3,14 (-1)	6,87 (-3)		-3,62 (-2)		3,48(-1)				2,37 (-2)	10,56 (-3)		-5,99(-1)	2,64 (-1)
t-statistic				[1,93]**	[2,58]		[-3,75]		[2,33]				[2,12]	[5,13]		[-2,03]	[1,92]**
				4,07 (-3)										7,65 (-4)			3,54 (-2)
t-statistic				[2,79]										[3,08]			[2,37]
R^2	0,60	0,73	0,68	0,64	0,63	0,63	0,75	0,82	0,62	0,56	0,67	0,53	0,56	0,79	0,72	0,79	0,65
Fitted R^2	0,51	0,58	0,53	0,44	0,38	0,44	0,65	0,73	0,36	0,50	0,46	0,47	0,44	0,58	0,57	0,55	0,52
Σ e2	0,56	0,55	1,98	1,43	2,63	1,48	1,11	0,49	0,97	2,40	0,71	2,66	1,35	0,98	0,70	1,04	2,56
Σ e equation2	0,10	0,14	0,24	0,21	0,33	0,21	0,19	0,12	0,17	0,22	0,16	0,24	0,17	0,21	0,15	0,26	0,29
F-statistic	6,88	4,85	4,45	3,16	2,53	3,31	7,55	8,98	2,40	9,98	3,19	8,96	4,64	3,88	4,96	3,22	4,82
Loglikelihood	745,46	553,23	473,4	513,44	467,94	514,19	434,67	552,24	596,65	454,88	568,11	459,54	533,54	586,10	541,3	410,7	384,74

*** Significant at 5%**
**** significant at 10%**
In red, not significant
(-1) means first lag, (-2) second lag, and (-3) third lag

$\phi_1 = [(\Delta^2(Vivin_t)/(Vivin_t))/(\Delta P_{H,t-1}/P_{H,t-1})]$

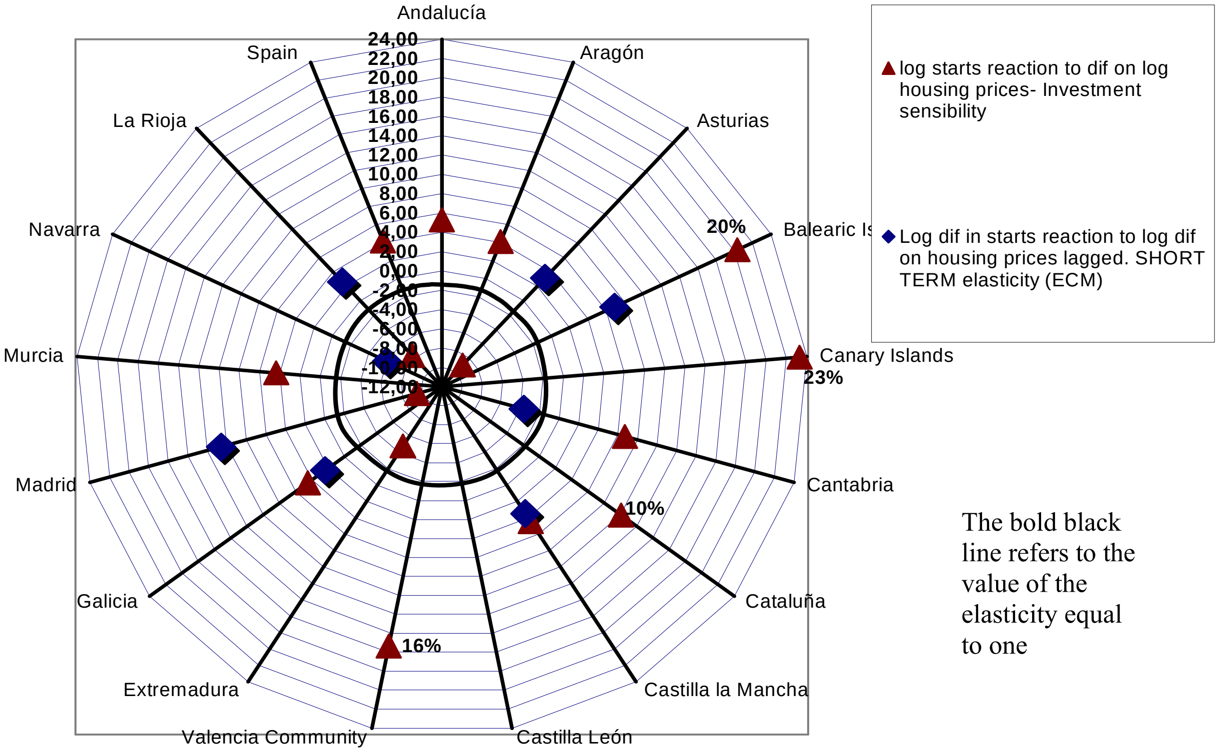
$\gamma_2 = [(\Delta^2(Vivin_t)/(Vivin_t))/(\Delta^2 P_{H,t-i}/P_{H,t-i})]$

Exhibit 5.- NEW HOUSING SUPPLY REACTIONS TO CHANGES ON PRICES. SPAIN AND AA.CC



The bold black lines refer to the values of the elasticity equal to one and zero

Exhibit 6.- NEW HOUSING SUPPLY REACTIONS TO CHANGES ON PRICES. SHORT RUN. SPANISH AUTONOMOUS COMMUNITIES(2)



The bold black line refers to the value of the elasticity equal to one

ANNEX .- STATISTICAL APPENDIX

Table A. Database details

Table A1. Information sources for housing supply

Definition	Name	units	Calculation	Period	Source
Started dwellings	VIVIN	dwellings		1990.1-2004.4	MFOM
Dwelling prices	PRE	euros/m2		1987.1-2004.4	MVIV
Real dwellling prices	RPRE	euros/real m2	PRE/IPC	1987.1-2004.5	
Construction material costs	CM	Index		1987.1-2004.6	MFOM
Labour costs	CS	Index		1987.1-2004.7	MFOM
Mortgage interest rates	i	%		1987.1-2004.8	BDE
Mortgage interest rates	Ri	%	ri=i-infl	1987.1-2004.9	
Consumer prices	CPI	Index		1987.1-2004.10	INE
Inflation	INF	%	IPC/IPC(-4)	1987.1-2004.11	

Each variable is available at an aggregated level and for each Autonomous Community

Table A2. Basic statistics

	VIVIN	PR	CM	CS	I	CPI
Mean	79211,13	78560,08	87,71611	80,64319	9,684444	83,95194
Median	71386,5	67238,5	89,31	82,38	10,125	86,55
Maximum	159864	178093	110,3	112,51	16,76	111,69
Minimum	44533	28989	69,43	46,18	3,31	54,7
Std,Dev,	25924,89	34725,96	10,77831	19,43137	4,599637	16,5567
Skewness	0,859432	1,212823	0,082257	-0,203057	0,050306	-0,175776
Kurtosis	2,944482	3,844523	1,95705	1,963634	1,386751	1,927808
Jarque-Bera	8,872727	19,79094	3,34443	3,71695	7,838083	3,819552
Probability	0,011839	0,00005	0,187831	0,15591	0,01986	0,148114
Sum	5703201	5656326	6315,56	5806,31	697,28	6044,54
SumSq,Dev,	4,77E+10	8,56E+10	8248,206	26808,05	1502,123	19462,82
Observations	72	72	72	72	72	72

Table A3 – CORRELATION MATRIX

	VIVIN	RPR	RI	CM	CS	INF
VIVIN	1,000	0,760	-0,877	0,825	0,772	-0,569
RPR	0,760	1,000	-0,693	0,774	0,756	-0,284
RI	-0,877	-0,693	1,000	-0,925	-0,906	0,679
CM	0,825	0,774	-0,925	1,000	0,978	-0,676
CS	0,772	0,756	-0,906	0,978	1,000	-0,728
INF	-0,569	-0,284	0,679	-0,676	-0,728	1,000

Table B. Unitary root contrast

	ADF					ADF					Philips-Perron		
Series	Prob.	Lag	Max Lag	Obs	Series	Prob.	Lag	Max Lag	Obs	Series	Prob.	Bandwidth	Obs
VIVIN	0.9964	4	11	67	D(VIVIN)	0.0458	3	11	67	D(VIVIN)	0.0001	1.0	70
STOCK	0.9999	5	11	66	D(STOCK)	0.8265	1	11	69	D(STOCK)	0.4458	21.0	70
RPR	0.9981	2	11	69	D(RPR)	0.3240	1	11	69	D(RPR)	0.0025	3.0	70
RI	0.9084	0	11	71	D(RI)	0.0000	0	11	70	D(RI)	0.0000	2.0	70
CM	0.9743	1	11	70	D(CM)	0.0000	0	11	70	D(CM)	0.0000	1.0	70
CS	0.6612	4	11	67	D(CS)	0.0985	3	11	67	D(CS)	0.0001	18.0	70
INF	0.3432	0	11	71	D(INF)	0.0000	0	11	70	D(INF)	0.0000	3.0	70
POB	0.8898	0	11	71	D(POB)	0.0000	0	11	70	D(POB)	0.0000	1.0	70

References

Arnott, Richard, 1987, "Economic Theory and Housing", Handbook of Regional and Urban Economics, vol. II, chap. 24, pp. 959-988

Ball *et al*, 2005, Interim Report about planning system in Europe. Forthcoming

Ball, Michael, 2004, The European Housing Review, 2003, RICS Books, London

Barker, K, 2003, "*Review of Housing Supply. Interim report- Analysis*", HM Treasury, London

Blackley, Dixie M, 1999, "The Long-Run Elasticity of New Housing Supply in the United States: Empirical Evidence for 1950 to 1994", Journal of Real Estate Finance and Economics, 18:1, pp 25-42

Bramley, G. (1993). "Land-Use Planning and the Housing Market in Britain—The Impact on Housebuilding and House Prices," Environment Planning A 25, 1021–1052.

Bramley, Glen, 2003, "Planning regulation and housing supply in a market system", in O'Sullivan T & Gibb, K, *Housing Economics and Public Policy*, Blackwell Publishing, London

De Leeuw, Frank & Ekanem, Nkanta F.(1971), "The Supply of Rental Housing", The American Economic Review, vol.61, Diciembre, pp.806-817.

DiPasquale, D & Wheaton, W, 1994, "Housing market dynamics and the future of housing prices", Journal of Urban Economics, vol. 35, pp.1-28

DiPasquale, D. 1999, "Why don't we know more about housing supply?", Journal of Real Estate Finance and Economics, vol.18, pp.9-23)

European Central Bank, 2003, Structural Factors in the EU Housing Markets, Internal Report, Frankfurt

Glaeser, Edward L, Gyourko, Joseph & Saks, Raven E, 2005, "Urban Growth and Housing Supply", HIER Discussion Paper No. 2,062, SSRN papers series No.658343

Goodman, Allen C, 2005, "The Other Side of Eight Mile: Suburban Population and Housing Supply", Real Estate Economics, vol. 33(3), pp.539-569

Goodman, Allen, C. & Thibodeau, Thomas .G, 1998, "Housing Market Segmentation", Journal of Housing Economics, vol.7, pp.121–143

Green, Richart K, 1997, "Follow the Leader: How Changes in Residential and Non-residential Investment predict Changes in GDP", Real Estate Economics, 25(2), pp.253-270

Guirguis, Hany, S, Giannikos, Christos I & Anderson, Randy I, 2005, "The US Housing Market: Asset Pricing Forecasts Using Time Varying Coefficients", The Journal of Real Estate Finance and Economics, vol. 30(1), pp.33-53

Hanushek, E.A. & Quigley, J.M.(1979), "The Dynamics of the Housing Market: A Stock Adjustment Model of Housing Consumption", Journal of Urban Economics, vol.6(1), pp.90-111.

Iacoviello, Matteo, 2000, "House prices and the macroeconomy in Europe: Results from a structural VAR analysis", European Central Bank Working Paper No.18

Instituto Nacional de Estadística, Boletín Estadístico, http://www.ine.es

Maisel, Sherman J.,1963, "A Theory of Fluctuations in Residential Construction Starts", The American Economic Review, vol. LIII, June, pp.359-383.

Malpezzi, Stephen & Maclennan, Duncan, 2001, "The long-run Price Elasticity of Supply of New Residential Construction in the United States and the United Kingdom", Journal of Housing Economics vol. 10, pp.278-306

Malpezzi, Stephen & Vandell, Kerry, 2002, "Does the low-income housing tax credit increase the supply of housing?", Journal of Housing Economics, vol. 11, pp.360–380

Mason, John, 1977, The Supply Curve for Housing, Real Estate Economics, vol.7 (3), pp. 362-377

Mayer, Christopher J. & Somerville, C. Tsuriel, 2000, Residential Construction: Using the Urban Growth Model to Estimate Housing Supply, Journal of Urban Economics, vol. 48, 85]109

Mayo, Stephen & Sheppard, Stephen, 2001, "Housing Supply and the Effects of Stochastic Development Control", Journal of Housing Economics, vol. 10, pp.109–128

Maclennan, D, Muellbauer, J & Stephens, M. 1998, "Asymmetries in Housing and Financial Markets Institutions and EMU", *Oxford Review of Economic Policy,* vol. 14(3), pp. 54-80

Meen, G and Andrew, M (1998), "Modelling Regional House Prices: A Review of the Literature". Report, Department of the Environment, Transport and the Regions. Reading University papers. May.

Meen, Geoffrey, (2000), "Housing Cycles and Efficiency", Scottish Journal of Political Economy, vol.47 (2), pp.114-140

Meen, Geoffrey, 2002, "An Overview of Issues in Housing Modelling and Policy", The University of Reading paper series. November.

MEEN, Geoffrey,1995, "Cycles and Trends in UK housing", Discussion papers in Urban and Regional Economics No.114. Dtp. Economics press. University of Reading.

Ministerio de Fomento, Estadísticas de Edificación y Vivienda, http://www.mfom.es
Mueller, Glenn, (1999), "Real Estate Rental Growth Rates at Different Points in the Physical Market Cycle", Journal of Real Estate Research, 18(1), pp.131-150
Murray, Michael, P, 1999, "Subsidized and Unsubsidized Housing Stocks 1935 to 1987: Crowding Out and Cointegration," Journal of Real Estate Finance and Economics 18 (1999): 107-124.
Muth, Richard, & Goodman, Allen C, 1989, The Economics of Housing markets, Harwood Academic Publishers, London,
OLSEN, Edgar O.(1987), "The Demand and Supply of Housing Service: A Critical Survey of the Empirical Literature", in MILLS, E.S.(1987), *Handbook of Regional and Urban Economics.* Amsterdam, North-Holland Vol.II, Chap.25, pp.989-1022.
Poterba, James M, 1991, "House Price Dynamics: The Role of Tax Policy and Demography", Brookings Papers on Economic Activity, vol.2, pp.143-203
Poterba, James, M, 1991, "House Price Dynamics: the role of the Tax Policy and Demographics", Brookings Papers on Economic Activity, vol.2, pp.143-183
Pryce, Gwilym, 1999, "Construction Elasticities and Land Availability: a Two-Stage Least-squares Model of Housing Supply Using the Variable Elasticity Approach", Urban Studies, vol.36(13), pp.2,283-2,304
Quigley, John M.(1997), The Economics of Housing,, Edward Elgar Publishing, Massachusetts. Vol. 1 and 2
Sinai, Todd and Waldfogel, Joel, DO LOW-INCOME HOUSING SUBSIDIES INCREASE HOUSING CONSUMPTION? NBER W. PAPER SERIES No.8709, http://www.nber.org/papers/w8709
Somerville, C.Tsuriel, 1999, "Residential Cosntruction Costs and the Supply of New Housing: Endogeneity and Bias in Cosntruction Cost Indexes", Journal of Real Estate Finance and Economics, 18:1, pp.43-62
Somerville, C.Tsuriel, 1999, "The Industrial Organization of Housing Supply: Market Activity, Land Supply and the Size of Homebuilders Firms", *Real Estate Economics*, vol.27(4), pp.669-694
Taltavull, P.(2000), Activity Development Leadership and Geographic Areas in Spain. Journal of Property Investment and Finance, vol.18(3), MCB University Press
Taltavull, P. 2001, Economía de la construcción. Civitas, Madrid.
Taltavull, P, 2003, "La financiación de la vivienda en Europa", Perspectivas del Sistema Financiero, No.78, Funcas, Madrid
Topel, R. and Rosen, S, 1988, "Housing investment in the United States", Journal of Political Economy, vol.96, pp.718-740
Wheaton, William C, 2004, Lecture notes on Real Estate Economics, MIT 11.433/15.021
Whitehead, C., 2003, "The Economics of Social Housing", in O'Sullivan T. & Gibb, K, Housing Economics and Public Policy, Blackwell Publishing, London
Whitehead, C, 2004, Lecture notes on Housing Economics. London School of Economics, London