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EHES Working Papers in Economic History | No. 30

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Abstract

This paper discusses how Spain's urban housing markets reacted to the far-reaching changes that affected the demand for dwellings during the first phase of the ruralurban transition process. To this end, we construct a new hedonic index of real housing prices and assemble a cross-regional panel dataset of price fundamentals. The results of our econometric analysis suggest that urban housing markets did not face supply constraints and responded swiftly to the growing demand for accommodation. In light of this new evidence, we conclude that housing markets were not a burden for Spanish economic development and that Spain's urban infrastructure and institutional framework and were suitable for the housing needs at the time.

JEL codes: N93; N94; R30.

Keywords: Hedonic prices; Demand and Supply of Housing; Regulation in Housing Markets.

Acknowledgements:
The authors acknowledge financial support from the Spanish Ministry of Science and Innovation projects "Consolidating Economics" within the Consolider-Ingenio 2010 Program. Roses also acknowledges support from the project ECO2009-13331-C02-01 and the HI-POD Project, Seventh Research Framework Programme Contract no. 225342. Lampe thanks project ECO2011-25713. The usual disclaimer applies.

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Housing Markets during the Rural-Urban Transition: Evidence from early 20th Century Spain

1. Introduction

Every developed economy has experienced the transition from a rural to an urban society. Typically, during this critical period of economic development, the demand for accommodation rises to unprecedented levels because a massive number of people are redistributed across places and because new families are created during this process. To respond to these demands, the construction industry has to provide an increasing number of homes for the market. To do so, this industry must mobilize sizeable portions of the nation's capital and a large workforce to generate a considerable amount of private wealth. For this reason, housing markets play a decisive role in developing economies, and their failures can profoundly affect a country's overall economic growth and the well-being of its citizens.[1]

The first stage of the English industrial revolution between 1760 and 1830, with its peak in maximum city growth yearly rates at 2.5 per cent in 1821-31, is an obvious historical example of the damaging consequence of failures in housing markets.[2] According to Williamson, despite the rapid growth cities in England and Wales during that period, urbanization and hence industrialization actually were hampered by a combination of "an enormous deficit in social overhead capital stocks"[3] in the form of urban and sanitary infrastructure and underinvestment in housing for individual families. This led to a lack of affordable housing of an appropriate quality and hence to a disproportionate increase in nominal and real housing costs for workers, which consequently (over)crowded their individual dwellings which in turn were penned up in the densely populated "Victorian slums" characterized by two-storey back-to-back housing constructed in the backyards of pre-existing houses. This crowding of and in individual dwelling led to worse sanitary conditions, higher infant and general mortality rates and increased urban disamenity premium for workers in English cities, the main channel through which inefficient housing markets slowed down the pace of industrialization before 1840.[4] In fact, many problems remained pressing until the late 19th century, in part because urban populations kept growing not only because of migration, but due to natural increase in the context of the demographic transition, which had its fertility turning point in Britain around 1880.[5]

1 Malpezzi (1999) provides a review of the evidence on housing markets in developing countries.

2 Williamson (1990), 3.

3 Williamson (1994), 354.

4 Williamson (1994), 348-55, Rodger (1995), 6-12, 18-20, 28-33; Daunton (1983), 15-21, 246-248.

5 Williamson (1990), ch. 2, Easterlin (2000), 7.

Similar patterns of city growth and demographic transition can be found, with some regional variation, in most Northwestern European countries. In most of them, with the notable exception of France, the phase of maximum city growth coincided in with the phases of the demographic transition that imply maximum population growth in the two or three decades prior to 1900.[6] With Britain as a precedent, France, Germany, Scandinavia and the rest of Europe had to "cope with city growth", and, in the late 19th century, developed technologies to limit the potential economic costs and social penalties of an inadequate urbanization process, for example sewage systems to improve sanitary conditions, public lighting and intra-urban transport to maintain spatial coherence of urban areas. These eventually could be applied by latecomers in this process, that is, countries experiencing the rural-urban transition process during the 20th century.

One of these latecomers was Spain, the object of the present study, where both the moment of maximum population growth and maximum city growth, as well as industrialization, happened during the first three decades after 1900, that is, in the period under study here. Urbanization advanced at a flourishing rate (Reher 1986), both through the disproportionate increase of the large metropolis and through the growth of smaller towns and villages into cities. Domestic migration rates, mostly from the agrarian areas in the countryside to industrializing und urbanizing regions reached historically unmatched levels (Silvestre 2005). At the same time, Spain saw its income per capita and total factor productivity increase at unprecedented levels, especially during the 1920s (Prados de la Escosura and Rosés 2009). Increasing internal migration and economic growth were accompanied by a demographic transition, leading to population growth and a rapidly rising number of new families (Pérez Moreda 1985). Each of these factors would increase the demand for urban housing; jointly, they surely presented a substantial challenge to the Spanish housing market, in particular, and the Spain's economy, in general.

Despite its obvious importance, the performance of housing markets during the rural-urban transition has been grossly under-examined by the Spanish literature.[7] This negligence is even more surprising if one considers the existence of an extraordinary and underutilized source,

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6 Williamson (1990), 3; Knodel (1977), 236; Easterlin (2000), 17. Reher (2004) estimates the onset of fertility decline for most of these countries, including France and Britain, as 1900 or later, but nevertheless labels them as 'forerunners'. The only countries with onset of fertility decline before 1900 according to that study were Sweden (1865), Hungary and Uruguay (both 1890).

7 The few studies that exist are mainly devoted to the period from 1840 to 1890. During this time period, the liberalization of the housing markets took place, and urbanization accelerated with the destruction of defensive walls in many cities. See, for example, Ayllón et el. (1989), Galiana and Llop (1989), García Delgado (1992) and Rodríguez Chumillas (1989).

the Registrars' Yearbooks (Dirección General del Registro de la Propiedad y del Notariado), that contains detailed information on housing transactions for all Spanish provinces. The Yearbooks compile data not only on the number and value of the houses sold, but also on the number of mortgages and the value of the mortgaged houses. In historical comparison, the quality of this information is extraordinary, since price underreporting was minimal during the period before the Civil War (Carmona and Rosés 2012). Furthermore, we have also been able to derive good information on the housing stock and its characteristics from Spanish building censuses.

We use this information to construct annual regional and national indices of prices for urban (non-farm) properties in Spain in nominal, real and hedonic terms. These new real and hedonic housing prices indices show a surprising stability during our period. This indicates strongly that the supply of houses responded swiftly to larger shifts in demand. To confirm this circumstantial evidence on the well-functioning of the market, we use a standard textbook model of housing demand augmented by access to finance.[8] The econometric estimation of this model points to a low elasticity of housing prices to changes in permanent income, which the literature associated with an elastic supply of housing. Two factors were crucial for explaining this behavior of Spanish housing supply. First, the institutional framework was sufficiently effective and flexible to make a substantial increase in the number of houses possible. Second, contrary to what happened in England during the Industrial Revolution, infrastructure investments related to urbanization grew faster than Spain's GDP (Herranz, 2004), which enabled the spatial enlargement of cities and the increase in the amount of land to be used for urban development. In addition, as highlighted above, the appropriate technologies could be imported from Britain and other parts of Northwestern Europe. In recent work, Crafts and Leunig (2008) have shown with data for 1906 that trams and other intra-urban public transport made the spatial extension of English Metropolitan areas feasible, solving problems of overcrowding on small space and creating agglomerations with significantly higher productivity as reflected in higher city wages, which represented a sizable positive contribution to the overall British economy.[9] Similar forces must have been at work in Spain.

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[8] In Spain, the financial system underwent major transformations during our period, as banking, financial intermediation and the volume of credits expanded (Martín Aceña, 1985).

[9] Crafts and Leunig (2008) report that city wages increased by 14%, economy wide wages by 11% and overall GDP by 8% in 1906 due to intra-urban public transport. They highlight that these social savings were larger than those created by the inter-urban railway network, which connected cities, but had not been supportive of suburban transportation (Rodger 1995, p. 40, 56-57). But note that despite early

In sum, our evidence indicates that Spanish housing markets did not underperform dramatically during the first phase of the rural-urban transition process.

2. The evolution of housing prices

Using the quantitative information of the Registrars' Yearbooks, we can reconstruct the evolution of Spanish urban housing markets from 1904 to 1934. In the yearbooks, 'urban properties' (*fincas urbanas*) are defined as non-farm real estate property, including land and buildings on it; during our period, only complete properties ('fincas') could be sold. The yearbooks give the total value and number of sales in each province in each year. From this, we calculate yearly nominal average prices per province and for the whole of Spain by dividing the total value by the number of sales. To account for inflation, we also construct real average prices per province using provincial CPI deflators constructed by Rosés and Sánchez-Alonso (2004), which we aggregate into a Divisia index at the national level.[10] Finally, since arguably the characteristics of the average urban property also vary from province to province and over time during the transition process, we have constructed a hedonic index using data from the Spanish housing censuses of 1900, 1910, 1920 and 1930. Concretely, we correct the real urban housing prices at the provincial level for the average number of floors, the average age, the average share of new buildings and the probability of being located in more isolated areas, and then aggregate these provincial hedonic prices into a Divisia index at the national level.[11]

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experiments, especially with horse-drawn omnibuses in London, trams and electrical underground trains did not appear before 1870 (Rodger, pp. 39-40; Daunton 1983, 157).

[10] One might argue that some of our urban (non-farm) properties are located in rural regions (especially in the less urbanized provinces) and therefore their price should be deflated by a rural CPI. While in theory this might be true, in the reality of early 20th Century Spain, rural and urban CPIs at the provincial level were highly correlated and therefore the problem is much less relevant in practice (see Carmona and Rosés 2012 for average farm prices deflated by rural CPIs).

[11] This allows to correct for some of the shortcomings of the Yearbook's price data, e.g., the lack of distinction between new and second-hand properties. Our hedonic index is necessarily based on the assumption that in each year the characteristics of the urban properties sold reflect the average characteristics of the existing stock of buildings, which changes only slowly between census years, thereby making out hedonic adjustments rather conservative. It is likely that further quality adjustments of prices (for example, if we assume that all new houses were traded during the year) would result in even lower price increases. See appendix 1 for technical details.

Figure 1 presents information on the number of houses sold in all of Spain and the six provinces with the most populated cities (i.e., Barcelona, Madrid, Biscay, Seville, Valencia and Saragossa; hereafter: 'six provinces') during this period.

[FIGURE 1]

We divide the evolution in the number of houses sold into three periods. In the first decade of this series (i.e., from 1904 to 1914), approximately 50,000 houses were sold per year. In other words, approximately one per cent of the total housing stock was traded each year.[12] In the following decade, from 1914 to 1924, the number of transactions grew at yearly rates of five per cent. The maximum number of houses sold was reached in 1924, when more than 88,000 houses were traded (i.e., 1.2 per cent of the housing stock was traded in 1920). During the remaining years (i.e., 1925-34), the number of market transactions began to decline, and the share of the stock traded decreased to one per cent in 1930. At the end of our series (i.e., 1934), the number of transactions was similar to the number before World War I (i.e., approximately 50,000 houses were traded). The six most populated provinces' share of the market was not stable. They accounted for one-fourth of the market until 1920, but in the remaining fourteen years, their market share reached approximately thirty per cent of the total.

[FIGURE 2]

Next, we consider the evolution of housing prices in Figure 2. As shown by the figure, successive adjustments in the price indices decreased the growth rates of housing prices. That is, nominal housing prices grew faster than real housing prices, and real housing prices grew faster than hedonic-adjusted real housing prices. From these results, we can infer that inflation was a major mover of housing prices and that the quality of housing increased over the period.

The major breakpoint in the nominal housing index occurred in the middle of the First World War. Until that point, inflation in Spain was relatively low, and real housing prices grew faster than consumer prices (i.e., the real series grew faster than the nominal series). Note that Spain did not adhere to the gold standard over the entire period. In the middle of World War I

[12] More specifically, in 1900, the traded stock represented 1.1 per cent of the total housing stock. In 1910, the traded stock represented 1.0 per cent of the total housing stock. We obtained these figures by dividing the number of houses sold in 1904 and 1910 (interpolated) by the number of houses counted in Spain's 1900 and 1910 censuses, respectively.

(i.e., in 1916), this situation changed, and nominal prices grew faster than real prices. Spanish neutrality during World War I was not accompanied by an increase in real housing prices. The real hedonic price index shows that Spain's housing prices did not recover their pre-war levels until 1920. This result is unexpected given that, because of its neutral status, Spain increased its exports and benefited from the arrival of foreign capital, which sometimes was invested in non-tradable assets, such as houses (Sudrià 1990).

From 1920 to the 1929 crisis, housing prices decreased again. Housing prices did not recover their 1920 level until 1930. Furthermore, the quality of housing increased slightly, as shown by the faster growth of the real index in comparison with that of the hedonic-adjusted index. During the first few years of the Second Republic (1931-1934), housing prices appear to have followed Spain's political cycle. That is, they decreased when a left-wing coalition took control of the government and increased when right-wing parties assumed power.

Huge fluctuations in Spanish housing prices were less than apparent during the period from 1904 to 1934. Yearly movements exceeding ten per cent in either direction (i.e., increases or decreases) were only observed in six of the thirty years (i.e., twenty per cent of all years). In 1915, 1925 and 1928, hedonic-adjusted prices decreased by more than ten per cent, whereas the opposite occurred in 1925, 1930 and 1934. The major increase occurred in 1930, when prices increased by 29 per cent, and the major decrease occurred in 1925, when prices declined by 25 per cent. Observing any sustained increase in housing prices is difficult. Furthermore, if we do not consider the housing prices in 1934 (i.e., an outlier), then housing prices were lower in 1933 than they were in 1904.

A substantial number of studies have shown that housing prices tend to grow faster in large cities, where supply restrictions should be more evident (e.g., Glaeser et al. 2008). For this reason, we compute a Divisia index for the six provinces, which contained the most populated Spanish cities.

[FIGURE 3]

Figure 3 reviews the evolution of the hedonic-adjusted index, which contains the six provinces and the equivalent Spanish index. Our hedonic-adjusted index follows the same pattern as the Spanish index, but the expansion/depression cycles were more pronounced in our index. Therefore, the downturn during the first few years of World War I was more pronounced in the index of the six provinces, as was the subsequent growth in housing prices. In any case, the housing prices do not appear to have grown significantly faster in the long run in the six provinces than in the rest of Spain.

A simple comparison of Figures 1, 2 and 3 offers relevant information on how housing markets worked in Spain. We note that increases in the number of houses traded did not translate into large movements in the hedonic-adjusted housing prices. In particular, during the 1920s, the number of transactions rapidly expanded, but housing prices remained stable in Spain and its six most populated provinces. More importantly, the behaviour of Spain's housing markets follow neither the pattern typical of bubbles, which are characterized by explosive upsurges and sudden downturns in both prices and quantities traded, nor that of fads, which are characterized by slower but more sustained price movements (West 1988).

In this context, a very important question concerns the connection between relatively stable housing prices and the rental market, given the legal restriction that only entire buildings, including the parcels they were build on, could be sold. This made the purchase of apartments in multi-storey buildings impossible. As a consequence, the majority urban dwellers were renters. If the relative price stability of Spanish houses translated into stable rents, this would be further evidence of the absence of housing restrictions to the rural-urban transition. To test this proposition, ideally, we would compare price and rental series and test for co-integration among them. Unfortunately, rent data is scarcer more fragmentary than house prices. We have been able to collect 203 observations[13] of provincial monthly rental prices from 1913 to 1921, referring to rents for one (presumably standard) room, from the Boletín del Instituto de Reformas Sociales. These prices were deflated across time and space by the same consumer price index that we used to adjust the housing prices. From the rent series and our real-hedonic price index we calculate the rent-to-price ratio in every year (R_{it}/P_{it}), which we relate to the rent growth rate for the following period ($g_{i,t+1}$), which is normally one year.[14] Specifically, we estimate the following regression, which is inspired by the present-value model (Clark 1995):

$$(1)\quad g_{i,t+1} = \beta_0 + \beta_1 (R_{i,t} / P_{i,t}) + \varepsilon_i \, .$$

As Clark (1995) notes, this specification ensures that any error in forecasting growth between year t and $t+1$ appears in the residual ε_i and is uncorrelated with the rent-price ratio. If the rent-price ratio is significantly and inversely related to the average future rent growth, then

13 As compared to 1470 observations in our house price dataset.

14 For province years with gaps in the rent series, we calculated the average growth rates among the available data points and compared these rates to the initial rent-price ratios for the corresponding period.

the current rent-price ratio acts a predictor of rent growth during the next period because prices at least partially capitalize on the present value of future rents. As we can see from the results presented in Table 1, this is indeed the case during our period. This provides further evidence that the people renting their urban homes benefited from the price stability in the housing markets because both the rental and housing markets were clearly linked.

[TABLE 1]

3. Economic fundamentals as determinants of housing prices

In light of the rather dramatic changes that occurred during the urban-rural transition process throughout this period, we are quite surprised by the housing market's price stability and rapid adjustments to the growing number of transactions observed in the previous section. Apparently, the market operated smoothly: increasing demand was met by increasing supply, and prices remained stable over the medium time horizon of this paper.

A straightforward way to confirm that Spanish housing markets worked smoothly is to test if their prices were driven by economic fundamentals and to study their corresponding elasticities. To do so, we specify and estimate two inverted housing demand equations. First, we consider the following model of housing demand:[15]

$$(2)\quad Log(\text{Prices})_t = \beta_0 + \beta_1\, log(\text{Y})_t - \beta_2 log(1+\text{HOUSE/POPULATION})_t - \beta_3(\text{RR})_t + \varepsilon_i,$$

where real new house prices (i.e., our Hedonic Index of Housing Prices) are modelled as a function of real GDP per capita (Y), the housing stock per capita (HOUSE/POPULATION)[16]

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[15] See, for example, DiPascuale and Wheaton (1992) and Malpezzi (1999). However, this model underscore two specific features of housing markets have a strong influence on housing demand (e.g., DiPascuale and Wheaton, 1992). First, the relative number of dwellings rises gradually because houses typically have long lives and because the demographic circumstances in individual economies change slowly. As a result, the number of new houses built each year and the demand for new houses are typically a small proportion of the total housing stock. Second, housing demand is segmented because some economic agents market housing as a durable consumer good to homeowners, whereas other economic agents invest in houses to put them on the rent market or as a part of their investment portfolio.

[16] We also experimented with a variable measuring the percentage of young adults (i.e., people 21-30 years old) without significantly different results. Additionally, this variable was highly correlated with the variable HOUSE/POPULATION. Hence, these two variables should not be considered together in regressions.

and the real cost of capital for housing (RR). In other words, we argue that housing demand is a function of permanent income, the user cost of capital, and, crucially, the demographic structure.

This model does not include any variables that capture the effect of credit availability on housing prices. However, because of its high cost in relation to family incomes, housing must be financed. As a result, changes in interest rates and the availability of mortgages may have a substantial effect on housing demand.[17] For this reason, we also consider a modified version of this equation by including a credit availability variable.[18] Thus, we estimate the following equation:

$$(3)\ \ Log(\text{Prices})_t = \beta_0 + \beta_1\, log(\text{Y})_t - \beta_2 log(1+\text{HOUSE/POPULATION})_t - \beta_3(\text{RR})_t + \beta_4 log(1 + \text{CREDIT})_{t-1} + \varepsilon_i,$$

where credit availability (CREDIT) is calculated as the ratio between the number of mortgages and the number of housing transactions at *t-1*.[19]

It should be noted that previous empirical studies on housing demand have shown that the income variable is usually the single most important economic determinant of real housing prices in the long run.[20] Furthermore, long-run income elasticity is higher in constrained areas than in the less supply-restricted areas.[21] In other words, the coefficient of the permanent income variable gives us a crucial clue of if housing supply responds swiftly to demand shocks.

Before we proceed to the econometric estimation of equations 1 and 2, it seems useful to discuss the evolution of the right-hand variables during the period considered here. Permanent income, which is measured as the average income over a given time span, rose during the first third of the 20th century. From 1904 to 1934, per capita GDP rose at an annual rate of 1.15 per cent. The GDP per capita growth rates accelerated slightly during the years prior to World War I. Despite Spain's neutral status during the conflict, its per capita GDP growth rates were negative during the war years. After the war, Spain's economy grew again and then slowed down after 1929.[22] Overall, the rate of growth of per capita GDP was slightly higher than the growth rate of

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17 Malpezzi (1999).

18 Note that several empirical studies (e.g., Fitzpatrick and McQuinn, 2007; McQuinn and O'Reilly, 2008) used alternative versions of the standard model by including different financial variables in their estimated equations.

19 We used the lag to avoid the endogeneity caused by credit lending.

20 See, for example, Case and Shiller (2003) and Holly and Jones (1997).

21 Harter-Dreiman (2004).

22 This evidence is drawn from Prados de la Escosura (2003).

housing prices since the hedonic housing price index grew over the period at a yearly rate of 0.97 per cent and the real housing price index at a yearly rate of 1.12 per cent.

The relation between the demographic structure and the demand for new dwellings is reflected by the ratio between the existing housing stock and the population. In the long run, this relation tends to be in equilibrium, but in the short or medium term, it can be altered by various demand factors (e.g., the demographic transition, migration outflows and migration inflows and urbanization rates) and supply factors (e.g., wars and natural disasters), which decrease the stock of the existing houses. For housing demand, modifications in the age distribution of the population are as important as increases in the absolute number of people. In particular, baby booms cause the number of new families searching for accommodation to increase after twenty years. For this reason, a substantial number of studies have shown that the absolute and the relative number of young adults are prime movers of housing demand.[23]

In the first three decades of the 20th century, Spaniards' demand for housing suffered several major demographic shocks. On the one hand, the demographic transition induced an increase in the number of new families (Pérez Moreda 1985; Reher 2004). On the other hand, many people relocated from the countryside to the cities (Silvestre 2005). In particular, from 1900 to 1930, the share of Spanish population living in cities of more than 50,000 inhabitants increased from the 13.7 per cent to 19.8 per cent.[24] Furthermore, a large percentage of rural migrants to cities were composed of young adults (Silvestre 2005). We observe the impact of this migration by comparing the proportion of young adults in the six provinces with the largest cities, which attracted a considerable proportion of home migrants, with the proportions in the rest of Spain's provinces. From 1900 to 1920, the proportion of young adults in these six provinces remained close to 18 per cent and reached 19 per cent in 1930. However, in the rest of Spain, this proportion was lower. During the studied period, the percentage of young adults never exceeded 16 per cent and even decreased to 14 per cent in the years 1910 and 1920.

This substantial change in demographics was partly counterbalanced by emigration abroad. Furthermore, of all the age groups, young adults participated more actively in international migration (Sánchez-Alonso 2000). Although in absolute numbers, young adults (i.e., the population between 21 and 30 years) increased from approximately 3 million in 1900 to approximately 4 million in 1930, their share of the country's total population was quite stable. Specifically, in 1900, 16.16 per cent of Spain's inhabitants were young adults. In 1910, this

[23] See Mankiw and Weil (1989).

[24] Instead, if we consider population living in cities of more than 10,000 inhabitants, this share grew from the 32.5 to 42.6 per cent (Azagra et al., 2006).

proportion decreased to 14.84 per cent, increased to 15.47 per cent in 1920, and arrived at 16.80 per cent in 1930. The effects of external migrations and the increase in life expectancy likely produced this unexpectedly stable demographic structure.[25]

[TABLE 2]

In Table 2, we present several alternative measures that show the relation between dwellings and population. In Panel A, we discuss the overall measures for Spain, whereas in Panel B, we analyse the six provinces with the largest cities in greater detail and compare them to the rest of Spain. Every measure presented in Panel A shows that the proportion of dwellings to population remained quite stable from 1900 to 1930. Furthermore, Spanish houses were not particularly overcrowded during this period. Specifically, the ratio between dwellings and population indicates that, on average, only 2.2 people lived in each dwelling.[26] In comparison with recent European housing statistics, this ratio is low.[27]

Panel B investigates the impact of increasing urbanization on housing from 1900 to 1930. The impact on the six provinces varied in this respect. In Biscay and Valencia, the ratio between dwelling units and population improved. However, in Madrid and Saragossa, the ratio was stable, and in Barcelona and Seville, the ratio worsened slightly.[28] In any case, despite the rapid demographic changes and urbanization growth, the ratio between dwelling units and population did not dramatically worsen in any Spanish province during the first thirty years of the 20th century.[29]

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[25] The demographic data are drawn from Spanish population censuses (Instituto Geográfico y Estadístico, 1900, 1910, 1920 and 1930).

[26] However, Spanish censuses do not distinguish between buildings devoted to dwellings and those devoted to commerce and workshops. Prados de la Escosura (2003) estimates that approximately 5 per cent of all buildings were devoted to economic activities. Consequently, if we introduce this modification to our calculations, then the initial ratio increases to 2.3 people per dwelling.

[27] In European countries from 1980 to 2003, this ratio oscillated between a minimum of 1.9 (i.e., Sweden in 2003) and a maximum of 3.7 (i.e., Ireland in 1980), with an average value of 2.68 (National Board 2005, table 1.9).

[28] In Barcelona, this ratio decreased by approximately 15 per cent from 1900 to 1930. In Seville, the ratio decreased by approximately 16 per cent during the same period.

[29] From Panel B, one can also observe that the provincial differences in the number of housing units per capita widened. In particular, Madrid appears to have been particularly overcrowded because the ratio implies that approximately six persons lived in each dwelling. In Seville and Biscay, approximately four

The user cost of capital is the price for employing or obtaining one unit of capital services. Studies on the economics of housing have used several alternative measures of the user cost of capital (RR_t).[30] Because of data constraints, we had to choose one of the simplest specifications, which it has been employed by many other scholars.[31] Our equation is as follows:

$$(4)\ RR_t = i_t(1 - T_p)(1 - T_y) + DM - E(p_{t+1})$$

where i_t is the nominal interest rate, T_p is the property tax rate on housing, T_y is the marginal tax rate on income, DM is the depreciation and maintenance rate, and the last term, $E(p_{t+1})$, is the expected capital gain from housing.[32] Figure 4 compares the evolution of the user cost of capital and our hedonic index of housing prices:

[FIGURE 4]

As predicted by housing literature, the negative correlation between housing prices and the user cost of capital can be easily observed. In particular, we found that when the user cost of capital decreased during World War I, housing prices grew. However, we also found that changes in housing prices were less pronounced than changes in the user cost and that the movement of the housing prices followed the fluctuations in user cost with a certain delay.

Finally, we review the evolution of mortgages. Unfortunately, information on the total amount of credit lent to the people who purchased houses from 1904 to 1934 is not readily available. Hence, we have to rely on the annual data regarding the total number of mortgages from the Registrars' Yearbooks. We must note that many mortgages were not issued to finance housing purchases because real estate was sometimes employed as collateral in exchange for consumer and corporate credit. Thus, our information may exaggerate the amount of credit lent

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persons lived in each dwelling, whereas in Barcelona, approximately 3.5 people lived in each dwelling. Valencia and Saragossa had numbers similar to those prevalent in the rest of Spain.

30 As in other cross-sectional studies of housing demand (e.g., Capozza et al. 2002), we do not have regional information on the user cost of capital. Thus, we had to employ a national version of the user cost of capital equation, which ignores the regional differences in consumer prices, depreciation, risk premium, taxation and maintenance costs.

31 See Dougherty and Van Order 1982; Mankiw and Weil 1989; Hwang and Quigley 2006.

32 Mankiw and Weil (1989) computed $E(p_{t+1})$ to be the average rate of change in the GNP deflator over the past two years.

for housing transactions. Nevertheless, to investigate the evolution of housing credit, we will consider two different indicators: the number of new mortgages and the ratio between the number of new mortgages and the number of housing transactions. Overall, the number of new mortgages grew from 1904 to 1934. By the end of the period, the number of mortgages had multiplied by 1.25, which implies that the average annual growth rate was 0.75 per cent. However, the 1934 value was not the maximum for our period, which was obtained in 1930. If we consider this year to be the peak, then the number of new mortgages grew 1.6 times since 1904, which implies an annual growth rate of approximately 1.9 per cent. Our period also shows a pronounced cyclical component. The number of new mortgages decreased from 1904 to 1919, after which the number increased at faster rates until arriving at a peak in 1927. With the exception of the year 1930, the number decreased afterwards. The ratio between mortgages and housing transactions declined from 1908 to 1919, when the ratio attained its minimum value. Then the ratio experienced an intense boom that ended abruptly in 1927-29. In 1930, the ratio returned to its highest level, but in 1931, it began to decrease again. In any case, the ratio was higher at the end of the period than at the beginning. This finding indicates that the amount of mortgage financing increased overall throughout the period. In sum, both indicators show that credit for housing grew over the period, but that the amount of available credit also exhibited a strong cyclical component.

[FIGURE 5]

Now, we estimate equations (2) and (3) by utilizing panel-data econometrics because we do not have yearly information on the evolution of the housing stock per capita. Specifically, we have information for 49 provinces and 4 benchmarks (1900, 1910, 1920 and 1930). We conduct three types of estimations: weighted OLS estimates with robust standard errors (columns 1-2), GLS random-effects estimates with robust errors (columns 3 and 4)[33] and instrumental variables with weighted OLS and GLS random-effects estimates that use *t-1* observations as the instruments (columns 5 and 6).[34] The estimations of these equations are presented in the following table:

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[33] One advantage of the random-effects estimation method is that it controls for unexpected (normally distributed) changes in demand and amenities, which are not captured in the standard textbook model and may distort the coefficients.

[34] We also tested the fixed-effects GLS regressions, but an F-test of the significance of these factors does not allow them to be used at conventional confidence levels.

[TABLE 3]

The variables habitually show the expected sign (i.e., positive in Y and CREDIT but negative in HOUSE and RR), and the coefficients suggest that the elasticities were of reasonable size. Note that IV estimations (columns 5 and 6) confirm the robustness of our other econometric results. However, the variable RR is insignificant in the equations that include random effects and/or the CREDIT variable. The explanation for this finding is straightforward. Our RR variable is correlated with CREDIT[35], and the RR's influence on house prices is captured by the random-effects specification. Because the variable CREDIT exhibits provincial variability and because it is robust to the inclusion of random effects, we will use the results from column (4) in our discussion.

In our preferred estimation (column 4), the income elasticity is 0.47. This elasticity is practically identical to the elasticities obtained by Capozza et al. (2002) for 62 metro areas in the US (0.45) from 1979 to 1995 and significantly lower than those obtained by Meese and Wallace (2003) for a supply-constrained area (e.g., Paris (0.65)). This result strongly confirms our previous finding: Spanish markets work smoothly and housing supply adjusted reasonably well to the enormous demand shocks that happened during this period. Note also that the substantive significance corresponding to the estimated coefficients for real GDP per capita and housing stock per capita almost cancel each other out.[36] On the other hand, the estimated coefficient for *CREDIT*, which is close to 1, seems to indicate that there were credit constraints at work in the Spanish housing market during our period. However, assessing the full significance of this result and the mechanisms behind it would surpass the scope of the present paper.

4. Accounting for housing supply

After reviewing the evidence on housing prices and demand, we consider in this section the evolution of housing supply. Housing supply rose during the studied period (Tafunell 2005;

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[35] A simple linear regression shows that CREDIT is partly explained by and inversely correlated with user costs because simple user cost is a real measure of interest rates, which are inversely correlated with the demand for credit.

[36] We calculate substantive significance as the corresponding change to the dependend variable of a one standard-deviation change in each explanatory variable, i.e., by multiplying the coefficient by the standard deviation. The result is 0.157 for *Y* and -0.143 for *HOUSE/POPULATION*.

Prados de la Escosura 2003).[37] However, the supply of new houses showed considerable cyclical deviations from the prevailing trend.[38] We can easily observe four pronounced cycles within these thirty years. Specifically, housing supply grew until World War I, decreased during the war years, and experienced an intense boom that began in 1918 and abruptly ended in 1929-30. Then from 1930 to 1934, the construction of new houses returned to their initial low levels.[39] Note that from 1930 to 1931, the production of new houses plummeted by an enormous 44 per cent! Interestingly, Spain shared the same building boom experienced by the United States, Canada, Germany and Finland during the 1920s (Ball and Wood, 1999). Each of these countries also experienced a halt in construction due to the Great Depression. Figure 6 indicates that housing supply appears to adjust after a certain delay to changes in permanent income. In particular, permanent income grew faster than housing supply from 1914 to 1923, whereas the opposite occurred during the following six years (i.e., from 1924 to 1930). Over the entire period (i.e., from 1904 to 1934), the total housing stock grew much faster than GDP per capita (i.e., 2.36 per cent versus 1.15 per cent). Note that this result is in line with our previous evidence on the stability of housing prices and the low elasticity of housing prices respect to changes in permanent income.

[FIGURE 6]

In the basic model of housing economics, housing prices in the long run will change in accordance with the construction costs (Meen, 2002). That is, the observed rise in housing prices is due solely to the rise in construction costs. However, our evidence clearly shows that, although real construction costs rose, particularly after 1920, hedonic housing prices in Spain remained stable or even decreased (see Figure 7 below).

[FIGURE 7]

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[37] The few studies available on construction licenses for new houses have also underlined the rapid increase in the number of new houses constructed during the period. See Fernández Clemente and Forcadell (1992) on Zaragoza, Gómez Mendoza (1986) on Madrid, Sorribes (1992) on Valencia and Tafunell (1992) on Barcelona.

[38] The same has occurred throughout the history of OECD countries (Ball and Wood 1999).

[39] Growth rates were 1.4 per cent per year from 1904 to 1914, 9.2 per cent per year from 1914 to 1918, 7.7 per cent per year from 1919 to 1930 and 16.2 per cent per year from 1930 to 1934.

This unexpected result, in light of the standard housing-supply model, can only be caused by two factors: a substantial increase of total factor productivity (TFP) in the housing industry and/or a decrease in the prices of land marked for housing development.[40] These two factors may also interact with one another. To fully explain housing prices, the yearly rate of TFP growth must be equal to 1.43 per cent, but the TFP growth rate of the Spanish economy was only 0.59 per cent.[41] As a result, TFP growth in housing alone is unlikely to explain the decrease in housing prices during this period. The question of why prices of land for housing development decreased remains to be answered. Because cities mainly expand in the long run by increasing the amount of land that can be used (see, for example, Leunig and Overman 2008), institutional restrictions and infrastructure investments are central in housing supply expansion.[42]

There are no reasons to think that Spanish policy impeded the free operation of the housing markets and the continuous expansion of the housing supply. The main role of the Spanish government in housing markets during the period under study was to enforce property rights while its participation as housing developer was very limited and circumstantial. The Liberal reforms in the first half of the 19th century created an institutional framework that eliminated restrictions on real estate sales and established freedom of contract. On the one hand, ownership laws created a dual market of owners and renters, the latter of whom comprised the majority of the Spanish population.[43] The regulations on the leasing market protected the landlords more than the renters, who had relatively few rights. This disparity caused dysfunctions and affected the quality of the housing but facilitated the transference of property (Martínez Alcubilla 1892-94, 696). On the other hand, the regulation of land for urban development did not restrict the continuous increase in the amount of land available for new dwellings. During the

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40 Unfortunately, information on the prices of land marked for housing development is not already available, but we have information on the prices of agricultural land. Our information on agricultural land indicates that their prices increased slightly throughout the entire period (Carmona and Rosés 2012).

41 Prados de la Escosura and Rosés (2010).

42 Obviously, cities and villages can also expand by maintaining the constructed area while increasing the urban density. We can obtain indirect evidence regarding this process by examining the evolution of the number of floors per building. In Spain, this ratio increased from 1.65 in 1900 to 1.72 in 1930 (a mere 4 per cent). That is, increases in urban density appear to have played a secondary role in the expansion of the Spanish housing market.

43 Spanish law did not allow the ownership of land to be held separately from the ownership of rights over that land, and as a result, the floors of any building and its land had to have only one owner. This restriction prevented workers, particularly those in cities, from becoming homeowners and generated a large rental market.

second half of the 19th century, a series of laws created development plans for major Spanish cities. The plans' successful reforms forced the developers and builders to pay for the construction of streets and other urban infrastructure in exchange for tax exemptions (Bassols 1973). However, the acceleration of urban growth in Spanish cities during the turn of the century rendered the new expansion plans obsolete and the available land for new construction scarce.[44] The developers and constructors tried to bypass this restriction by increasing the cities' density (e.g., by increasing the number of floors or constructing in the space between houses) or by expanding accommodation to the suburbs, an area that was not regulated by urbanization plans. Spanish law allowed owners to build houses on their land without asking the government for permission and without size restrictions in areas outside of the plan's jurisdiction (Nuñez Granés 1920, 12).

[FIGURE 8]

Because the public sector is traditionally tasked with providing infrastructure for housing (e.g., transport, water and sanitation), few households directly provide their own infrastructure (Malpezzi 1999). Spain's investment in infrastructure rose significantly over the studied period at an average of more than 3 per cent per year. Figure 8 shows that these investments grew at a faster rate than the housing supply. However, not all types of investments grew at the same rate. Interestingly, during the first few decades of the 20th century, the types of investment that grew fastest were related to housing development. These infrastructure investments included urban transport, sanitation, roads, water, electricity and communications. For example, investment in urban transport grew at 5.2 per cent per year from 1890 to 1930, and investment in water infrastructures and sanitation grew at 6.17 per cent per year, whereas railway investment experienced negative growth rates (Herranz 2004, 93). In sum, this rapid increase in infrastructure investment likely facilitated the expansion of cities and the amount of land available for urban development, which may have restricted the number of upsurges in housing prices.[45]

5. Conclusions and suggestions for further research

Our aim in this paper was to analyze how the housing markets responded to the dramatic increase in demand for accommodation during the rural-urban transition period. This increased demand is an important challenge for any country's economy. The economic costs of any failure

[44] For example, in 1900, Madrid doubled the urbanized surface area and practically exhausted the land available for new houses.

[45] Cf. the results by Crafts and Leunig (2008) referred to in the introduction above.

in the housing markets could have been enormous and, thus, severely harmful to Spain's prospects for economic growth. Inefficiencies in the housing markets can generate not only an inelastic supply of new dwellings but also insufficient market transactions with respect to housing demand and any future run-up of housing prices, which can develop into asset bubbles. Such problems in the housing markets can easily affect the rest of the economy through three main channels. First, the scarcity of housing, the low liquidity of housing assets and/or their excessive price can delay structural change by imposing severe restrictions on labour migration (Muellbauer and Murphy 2008). Second, if housing transactions absorb too much capital because of overvalued house prices, then the growing demand for capital from the housing market can generate a 'crowding-out effect' that leads to increasing overall interest rates and absorbed savings (i.e., expanding foreign debt), which may reduce the economy's stock of productive capital (Weale 2007). In the historical episode examined in this study, because housing represented a large share of Spain's total capital investments, this negative effect could have been amplified such that Spain's GDP growth rates would have been dramatically affected (Prados de la Escosura and Rosés 2010). Finally, scholars have widely recognized that collapses of housing bubbles are commonly associated with significant disruptions to the domestic financial system and the real economy (Honohan and Klingebiel 2003). However, we showed that this negative scenario did not occur in Spain, where a prompt supply response to major demand shifts occurred during the first three decades of the 20th century.

The evidence supporting this strong assertion is remarkable. First, we showed that real housing prices, particularly hedonically adjusted prices, did not grow over the time period considered in this article. Second, our econometrically estimated, long-run income elasticity of demand is similar to the demand prevalent in the less supply-restricted areas. Third, over the entire period, the housing stock grew much faster than the principal source of housing demand, GDP per capita. Finally, we show that housing markets enjoyed long-frequency efficiency because the existing housing prices accurately forecasted future rents.

Why were Spanish housing markets not constrained by their supply? Interestingly, real construction costs grew faster than real housing prices. Thus, these costs do not explain this conundrum. We speculate that the increase in the availability of land for new homes, which was induced by rapid infrastructure investments and the flexible and efficient institutions governing the housing markets, lie behind this expansion of the housing supply.

Several topics related to the Spanish housing markets during the rural-urban transition period merit further investigation. First, we can obtain further evidence of the efficiency of Spanish housing markets by studying the market's regional dimension. We can also test whether housing markets were regionally integrated and whether upturns and downturns were transmitted regionally. Additionally, we can test for the presence of bubbles in housing prices. The evidence presented above indicates that, if bubbles existed in Spain, then they were regional in nature and not nationwide, such as the bubble experienced in Spain during the last few years. Finally, we showed that credit availability (i.e., the mortgage market) played a relevant role in forming housing prices and that the relative number of mortgages grew over the period. Nevertheless, we still know little about the Spanish mortgage markets. Future researchers may consider investigating the supply/demand of credit, the implication of banks and private lenders, and the role played by banking and mortgage regulations.

Appendix 1: The Hedonic Index of Spanish Housing markets

Similar to many other goods, urban real estate properties and the houses on them differed in characteristics and quality, and the characteristics of the houses sold on the market varied from one period to another. Therefore, indices based on the mean observed trading prices are not representative of the population of dwellings and might not be comparable over time or between places. Alternative indices based on median transaction prices are less sensitive to outliers in observed transactions from year to year, but are still subject to selectivity bias, as the average quality of the dwellings sold on the market may change over time (Gouriéroux and Laferrère 2009). In this situation, scholars have long recognized the theoretical advantage of hedonic methods for computing housing price indices (Case et al. 1991; Diewert 2006). Ideally, one should observe a representative sample of all individual transactions and their characteristics that are relevant for analysis via the hedonic method. Unfortunately, doing so is impossible for houses from the distant past, in our case because the sources only offer the average prices of the houses sold. In addition, we can only observe the standard/average characteristics and quality of the entire sample/stock of dwellings. Therefore, to make hedonic adjustments, we have to assume that our dwellings are in some way a representative sample of the whole population. However, because potential buyers react to soaring prices by demanding lower quality (and vice versa for decreasing prices), our indices might overestimate the downward and upward movements of the housing prices. The same effect would follow from overcrowding with tenants as a consequence of inelastic supply of housing with respect to migration or population growth, which would increase the depreciation of overcrowded properties. Also, an estimated 5% of our urban properties can be expected to have been used commercially (Prados de la Escosura 2003), thereby augmenting its value; since the distribution of these commercially uses properties would be unequal across Spain (higher in the more urbanized areas) and become more unequal during the urban-rural transition, here again we would find an argument for understating price movements with our hedonic adjustment. As a consequence, our adjustments will not overestimate changes in housing characteristics in the long-run, thereby causing price movements likely to remain large, biasing our data against our hypothesis.

Therefore, aware of the limitations of our data, we have calculated our hedonic price index in three successive steps. First, we checked the consistency of the original data on nominal sales volumes and sales numbers at the provincial level. We also calculated the average nominal prices of each province and year using the value and number of sales for urban properties (i.e., *fincas urbanas*) in which a price was actually paid (i.e., we did not consider inheritances or other properties that were not transferred through sales). To present the index, we interpolated the data from 1909 and 1910, when no sales records were published. While preparing the hedonic index, we treated the values for these years as missing. We also corrected other values from the original publication because the figures were highly implausible (i.e., they diverged by more than 2 standard deviations from the arithmetic mean of the real prices for the whole period).[46]

We then converted the average nominal prices per province into average real PPP prices (e.g., Barcelona 1910=100) using the province-specific urban consumer price indices from Rosés and Sánchez-Alonso (2004). This consumer price index is comprehensive because it collects information on food, textiles, housing equipment, fuel prices and housing rents. As we will see later, this correction accounts for the bulk of the differences between the reported nominal indices and the hedonic real indices.

However, because we expect important differences between the characteristics of the average property sold in provinces with low levels of urbanization and industrialization and those of the average property sold in large and industrialized metro areas, we must correct the prices not only for PPP differences but also for the different characteristics of the properties themselves. In the literature, this type of adjustment is called the "hedonic pricing method". Basically, this method is a two-step procedure that departs from the idea that the price of an urban property is actually a function of the bundle of prices for each relevant feature of a property (e.g., its location, size, number of stories, and age). The hedonic correction consists of two steps. First, we regress the prices of urban properties on measures of the different

[46] This effort resulted in 33 corrections for the values of the time period from 1904-1931. No corrections were made for the period from 1932-1934. Most of the corrections were made for small provinces. The maximum number of corrections per province is 3 for Gipuzkoa (1924, 1925 and 1929) and Navarre (1904, 1919 and 1929). The list of all corrections is available from the authors upon request.

characteristics such that the effects of each characteristic on the final price are estimates of the price elasticities with regard to the changes in each characteristic. We then use the coefficients of this regression to calculate the price of a reference property in each province, which has baseline characteristics. By doing so, the properties sold in the different provinces become comparable. To perform these tasks, we follow Gouriéroux and Laferrère's (2009) approach, which calculated hedonic indexes for real estate properties in modern-day France based on information about the characteristics of the individual properties and their sales from French notaries. However, we do not have information on the individual buildings. Rather, we only have information on the average prices and characteristics per province. Thus, we have to modify their approach accordingly.

Following Gouriéroux and Laferrère (2009), we assume that age, number of floors and location (e.g., which province and the average degree of agglomeration) are the most important characteristics. We first reconstruct the average age, the average share of new buildings, the average number of floors, and the average per centage of isolated buildings (i.e., those located in "settlements" with less than 5 buildings) per province and year, as explained in the following.

To reconstruct the average age per province, we use information on the increases in the housing stock in the years 1900, 1910, 1920, and 1930. During these years, the inhabited buildings census provides the number of buildings per province. Because of the lack of provincial data before 1900, we assume that a uniform age distribution of buildings initially existed across the provinces. We reconstruct this distribution based on the figures of gross capital formation in dwellings for the whole of Spain from Prados de la Escosura's (2003, table A7-2a) study. We assume that the percentage of buildings between the ages of 0-70 in the year 1900 is represented by the relative gross capital formation in each year from 1850 to 1900. We assumed that the housing stock in 1850 that emerges from re-extrapolating the stock in 1850 with the gross capital formation growth rates was built with a uniform distribution. We derived our assumption of 70 years of service for the age of each building from Prados de la Escosura and Rosés (2010). We extrapolate the stock in each year with the compound growth rate per province, which we calculated based on the census value before and after each year. We then defined the share of new buildings as the net number of new buildings in each year plus the number of buildings from the initial (1900) distribution that "retired" as they became older than 70 years. We calculated the average age based on the initial distribution and the share of new buildings after 1900. We can see that in 1904, the average age is still grouped quite closely around our uniform initial estimate of 31.1 years in 1900 for all provinces, with a minimum of 30.2 years for the province of Oviedo (i.e., Asturias) and a maximum of 32.8 years for the province of Lerida. In 1934, the minimum value is 24.5 years for Madrid, and the maximum value is 37.1 for Cadiz. Because our hedonic regressions include fixed effects per province, we are measuring the increasing deviation from the mean rather than the absolute average age, which is much more vulnerable to our assumption. Additionally, because the relation between average age and price might not be (log) linear, we also add the average share of new buildings per year to the regressions.

We can also calculate the second characteristic, the average number of floors, based on the information in the inhabited building censuses, which state the number of buildings that had 1 floor, 2 floors and 3 floors or more.[47] "More than 3 floors" is refined to 3, 4, and 5 floors or more in the 1930 census. We use the average of the latter and assume "5 and more" to be 5 to calculate the province-specific meaning of "3 and more". Between the census years, we interpolate with compound growth rates. In 1904, the (unweighted) average number of floors is 1.88 per building, with a maximum of 2.82 for Gipuzcoa and a minimum of 1.32 for Huelva.[48] In 1934, the minimum was 1.37 for Huelva, and the maximum was 2.92 for Gipuzcoa.

In the same manner, we also calculate the average share of isolated, inhabited buildings as a proxy for urban density. According to the censuses, these buildings are located in agglomerations of less than five dwellings. On average, this share is the lowest in Salamanca (i.e., 3.8 per cent) and the highest in Gipuzcoa (i.e., 46.7 per cent). This discrepancy clearly shows the different settling patterns across Spain.

As a second correction for the location effect, we include province-specific fixed effects into our regression by controlling for all types of differences that are fixed over time. Using these variables, we estimate a frequency-weighted panel GLS regression. The weights are the average number of sales per province over the whole period, which is a reasonable choice given that the prices we have are the average prices for the number of buildings. Because the panels estimator that we use requires the use of constant frequency weights over time, we use the average here. The results are reported in Table A1:

[TABLE A.1]

All coefficients are precisely estimated and show the expected signs. That is, the prices are higher for provinces that have, on average, buildings with more floors, more recently constructed buildings, buildings that are not isolated and a larger share of new buildings. Based on these

47 This information was collected from the *Anuario Estadístico de España*.

48 Actually, the lowest value was 1.1 to 1.2 for the Canary Islands, which have been excluded from our indices because of a lack of CPI.

results, we calculate in accordance with Gouriéroux and Laferrère (2009, 210) the log hedonic price $\widetilde{p}_{j,t}$ as the difference between the observed prices $p_{j,t}$ and the characteristics weighted by their coefficients. We assume that the weights are stable over time. This equation is calculated as the following:

(1A) $$\ln(\widetilde{p}_{j,t}) \cong \ln(p_{j,t}) - \sum_{k=1}^{K} \hat{\beta}_{k,s} X_{k,j,t} = \ln\left(\frac{p_{j,t}}{EXP\left(\sum_{k=1}^{K} \hat{\beta}_{k,s} X_{k,j,t}\right)}\right)$$

In our case, we calculate the equation as the following:

(2A) ln (hedonic price)= ln [(real average price)/(exp (1.230846 * ln (floor) + -0.4347637 * ln (age) + -1.61455 * (share isolated) + 8.607792 * (share new))]

We then calculate the hedonic price index for every province j by the difference of the logs I t/1904, j = exp(lnhedonicreal t,j – lnhedonicreal 1904, j) and rebase the index to 1904=100. Based on these calculations, we calculate the Törnquist index, which is an approximation of the Divisia index in which the shares of expenditure (i.e., the real value of total sales per province) are used as weights (see Hulten 2008), for the whole of Spain, with the exclusion of the Canary Islands, and for the six most populated provinces.

Appendix 2: Descriptive Statistics of the Variables

[TABLE A.2]

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Table 1. The Test of the Present Value Model

Method	**WLS**	**GLSre**	**GLSfe**
	(1)	(2)	(3)
Constant	0.145[a]	0.145[a]	0.320[a]
	(0.037)	(0.023)	(0.685)
(R_{it} / P_{it})	-8.668[a]	-8.668[a]	-20.569[a]
	(2.523)	(1.493)	(4.654)
N	203	203	203
F-test / Chi^2	11.80	24.63	19.52
R^2 / overall R^2	0.09	0.09	0.09

Notes: GLSfe is generalized least squares with fixed-effects.

Sources: See text.

Table 2. The Dwellings-Population Ratio, 1900-1930

	1900	1910	1920	1930
A. Spanish data	(1)	(2)	(3)	(4)
a) Houses per capita	0.2714	0.2684	0.2609	0.2632
b) Dwelling Units per capita	0.4493	0.4553	0.4467	0.4537
c) Houses per adult	0.4122	0.4123	0.3945	0.3885
d) Dwelling Units per adult	0.6823	0.6996	0.6756	0.6698
B. Provinces (Dwelling units per capita)				
Barcelona	0.3321	0.3229	0.2973	0.2881
Madrid	0.1748	0.1890	0.1669	0.1719
Seville	0.3061	0.3027	0.2650	0.2560
Valencia	0.4181	0.4333	0.4396	0.4417
Biscay	0.1985	0.2230	0.2160	0.2350
Saragossa	0.5904	0.5967	0.5700	0.5886
Remaining provinces	0.4801	0.4865	0.4859	0.5010

Notes: Dwellings units are computed by multiplying the number of houses by the estimated number of floors per house. See the appendix 1 for more details.

Sources: Number of houses from *Anuario Estadístico de España* and population from population censuses (Instituto Geográfico y Estadístico, several years).

Table 3. The Determinants of Hedonic Housing Prices, 1900-1930

Method	**WLS**	**GLSre**	**WLS**	**GLSre**	**IV-WLS**	**IV-GLSre**
	(1)	(2)	(3)	(4)	(5)	(5)
Constant	4.694[a]	6.703[a]	4.517[a]	5.268[a]	5.610[a]	5.455[a]
	(0.585)	(0.839)	(0.639)	(1.127)	(0.554)	(0.795)
log(Y)$_t$	0.894[a]	0.421[a]	0.551[a]	0.476[a]	0.371[a]	0.390[a]
	(0.079)	(0.118)	(0.113)	(0.114)	(0.095)	(0.090)
log(1+HOUSE/POPULATION)$_t$	-2.844[a]	-1.564[b]	-2.683[a]	-1.273[b]	-2.751[a]	-1.073[b]
	(0.418)	(0.716)	(0.373)	(0.611)	(0.370)	(0.529)
(rr)$_t$	-0.144[b]	0.004				
	(0.056)	(0.033)				
log(1+CREDIT)$_{t-1}$			1.291[a]	0.825[b]	1.325[a]	1.006[a]
			(0.253)	(0.363)	(0.239)	(0.230)
N	192	192	192	192	192	192
F-test / Chi^2	79.25	23.04	70.38	32.29	69.24	49.17
R^2 / overall R^2	0.55	0.27	0.60	0.40	0.57	0.39

Notes: We have observations for 1904, 1910, 1920 and 1930. WLS is weighted least squares with weights given by the mean number of houses sold. GLSr e is generalized least squares with random-effects. IV-WLS is instrumental variables weighted least squares. IV-GLSre is instrumental variables generalized least squares with random-effects. All standard errors are robust. [a] indicates significant at 1 per cent level and [b] indicates significant at 5 per cent level.

Sources: See appendix for dependent and CREDIT variables; Y is drawn from Rosés et al. (2010); see Table 1 for HOUSE and Figure 4 for RR.

Table A.1. Estimation of determinants of the Hedonic Index

	Coefficient	Std. Err.	T	P>/t/
	(1)	(2)	(3)	(4)
Ln(floors)	1.230	0.015	77.58	0.000
Ln(age)	-0.437	0.004	-99.85	0.000
Share isolated	-1.614	0.010	-149.73	0.000
Share new	8.607	0.048	178.51	0.000
Constant	8.744	0.048	178.51	0.000
F-test	17450.24			0.000
R^2 overall	0.30			

Notes: We estimate the equation 1A. The method of estimations is GLS with fixed effects. Regression is weighted by the mean number of houses sold. The number of observation is 1344 (48 groups x 28 years).

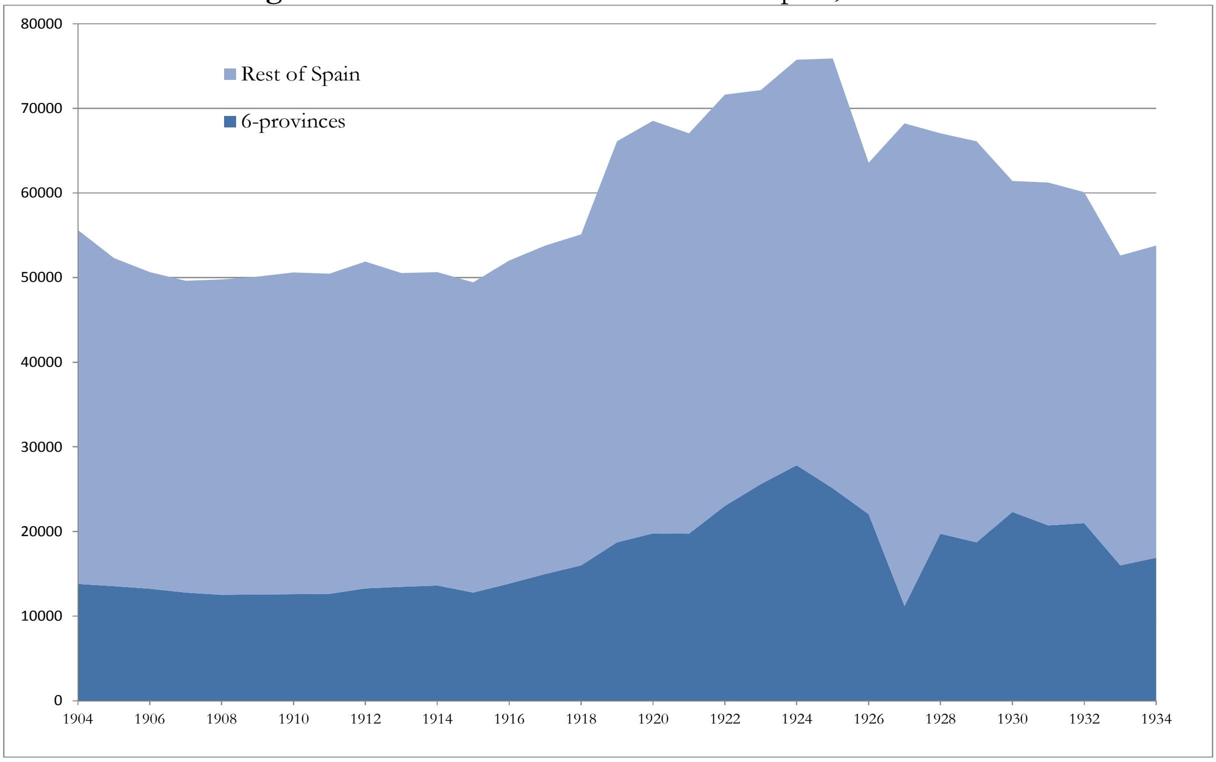
Sources: See appendix 1.

Table A.2. Descriptive Statistics of the Variables

	Obs.	Mean	Std. Dev.	Min	Max
	(1)	(2)	(3)	(4)	(5)
Housing Hedonic Price	192	8.774	0.689	7.510	10.785
log(Y)$_t$	192	6.303	0.331	5.446	7.253
log(1+HOUSE/POPULATION)$_t$	192	0.408	0.113	0.161	0.611
(rr)$_t$	192	2.986	3.125	-0.282	6.869
log (1+CREDIT)$_{t-1}$	192	1.249	0.185	1.059	1.847

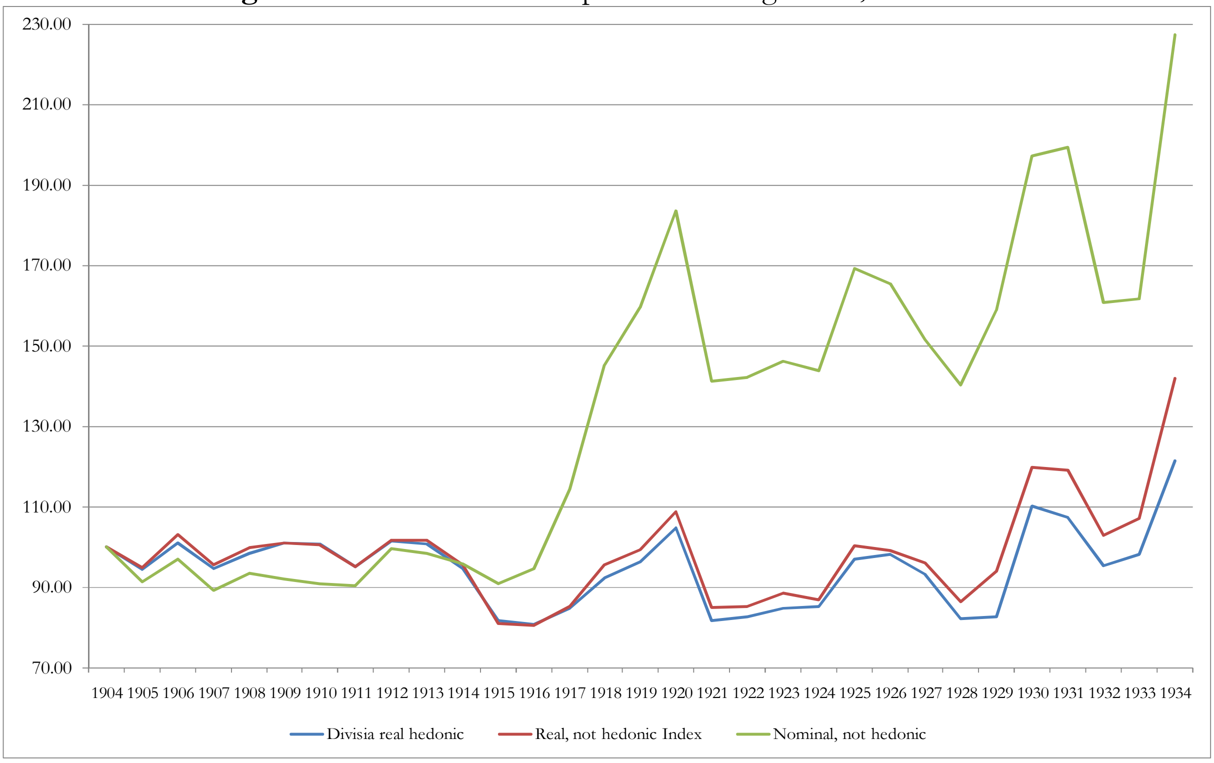
Sources: See table 2 and text.

Figure 1. The Number of Houses Sold in Spain, 1904-1934



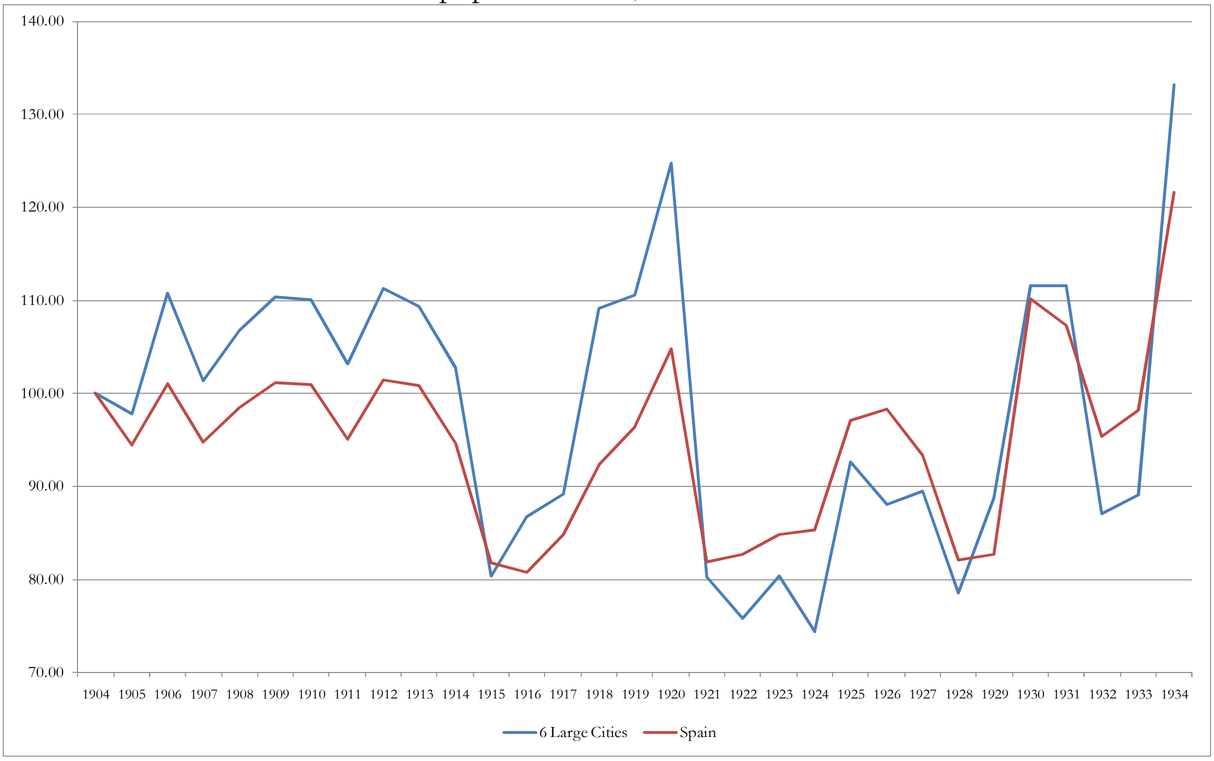
Sources: see appendix.

Figure 2. The Evolution of Spanish Housing Prices, 1904=100



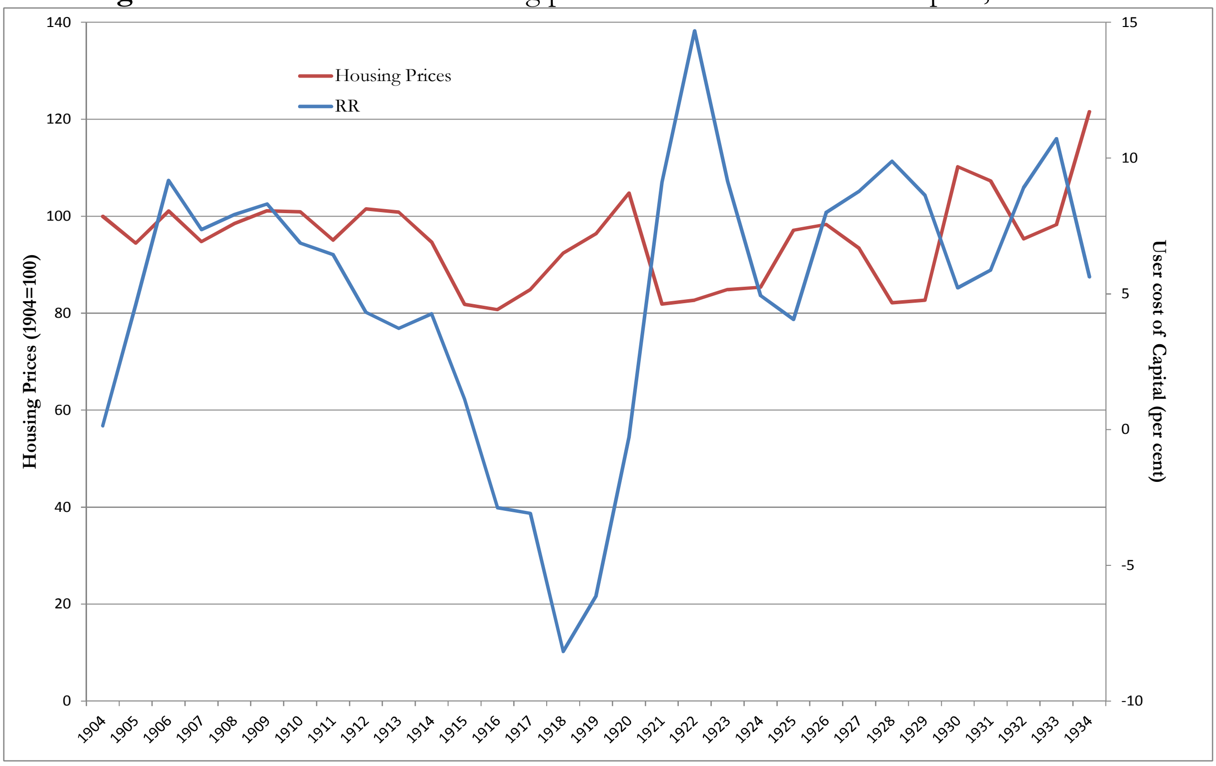
Sources: see appendix.

Figure 3. The Evolution of Housing Prices in Spain and the six provinces containing the most populated cities, 1904=100



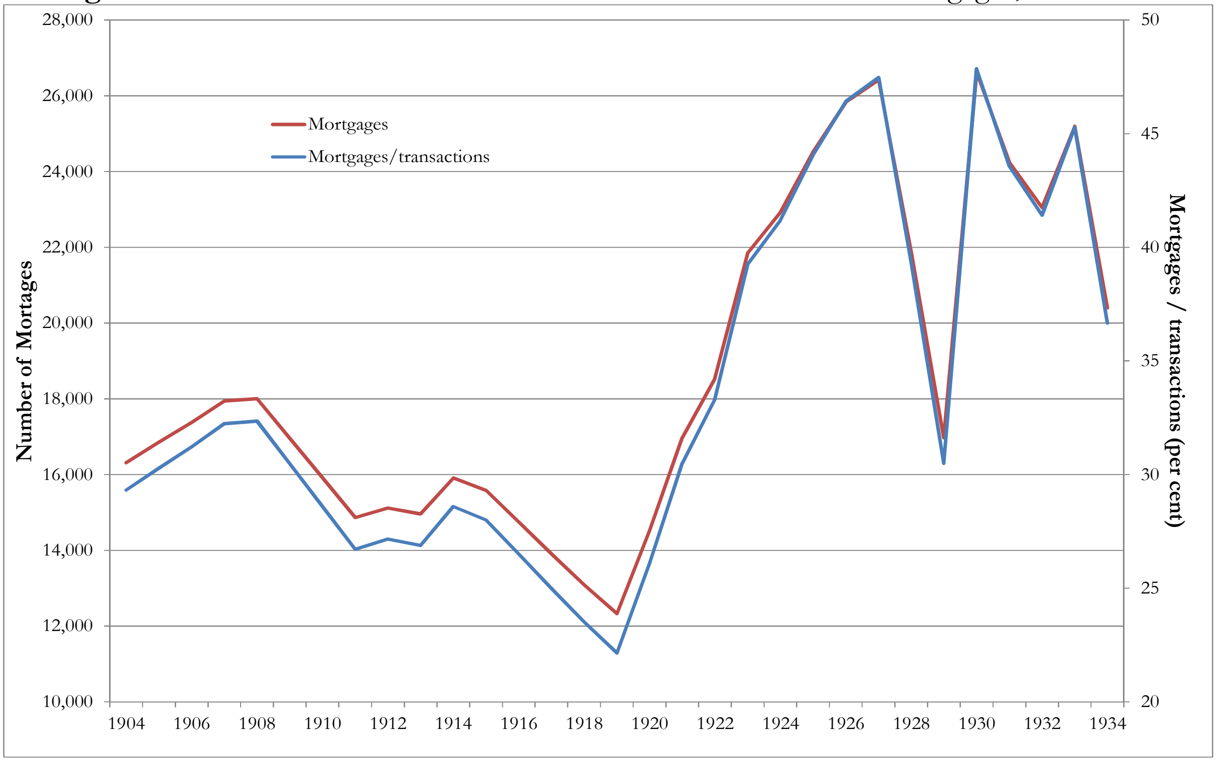
Sources: see appendix.

Figure 4. The evolution of Housing prices and the User Cost of Capital, 1904-1934



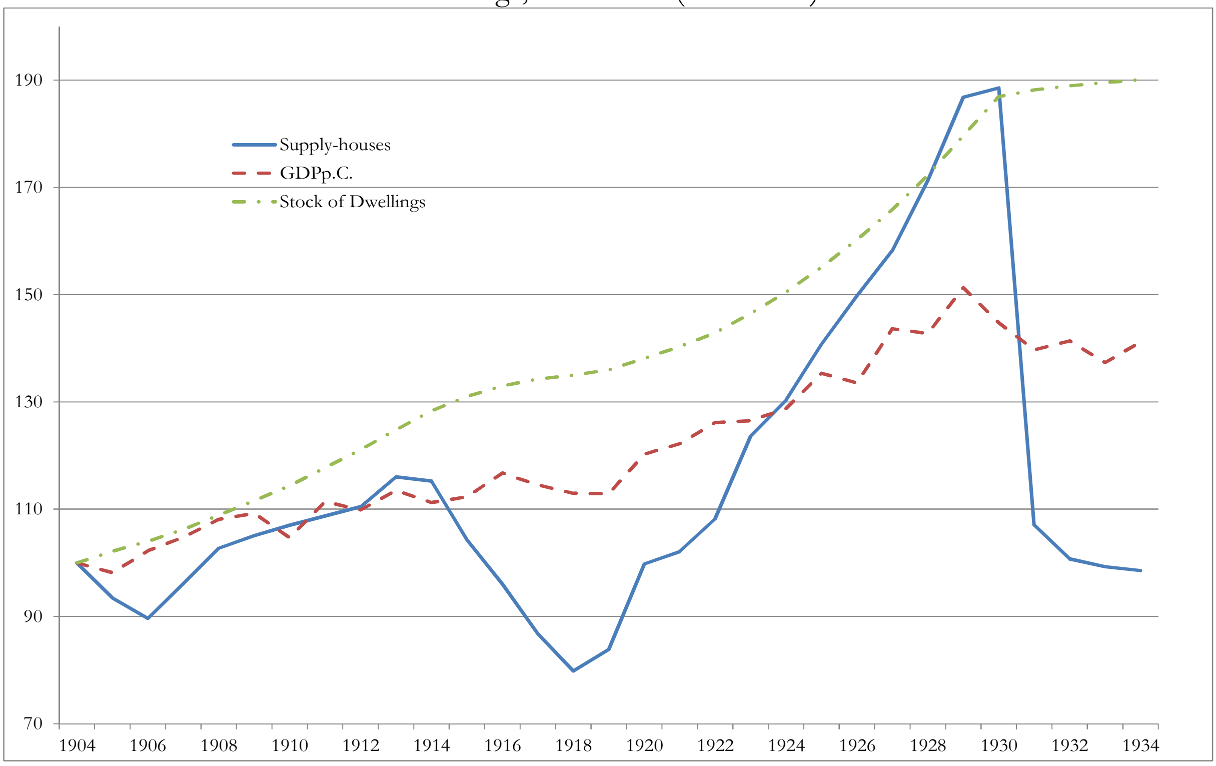
Sources: see appendix for housing prices. The user cost of capital is computed with equation 1. The nominal interest rate is drawn from Martín Aceña and Pons (2005), the property tax rate on housing from *Anuario Estadístico*, and GDP deflator and maintenance prices from Prados de la Escosura (2003). The marginal tax rate on income is set equal to zero and the depreciation to 1.3 per cent.

Figure 5. The Evolution of the Absolute and Relative Number of Mortgages, 1904-1934



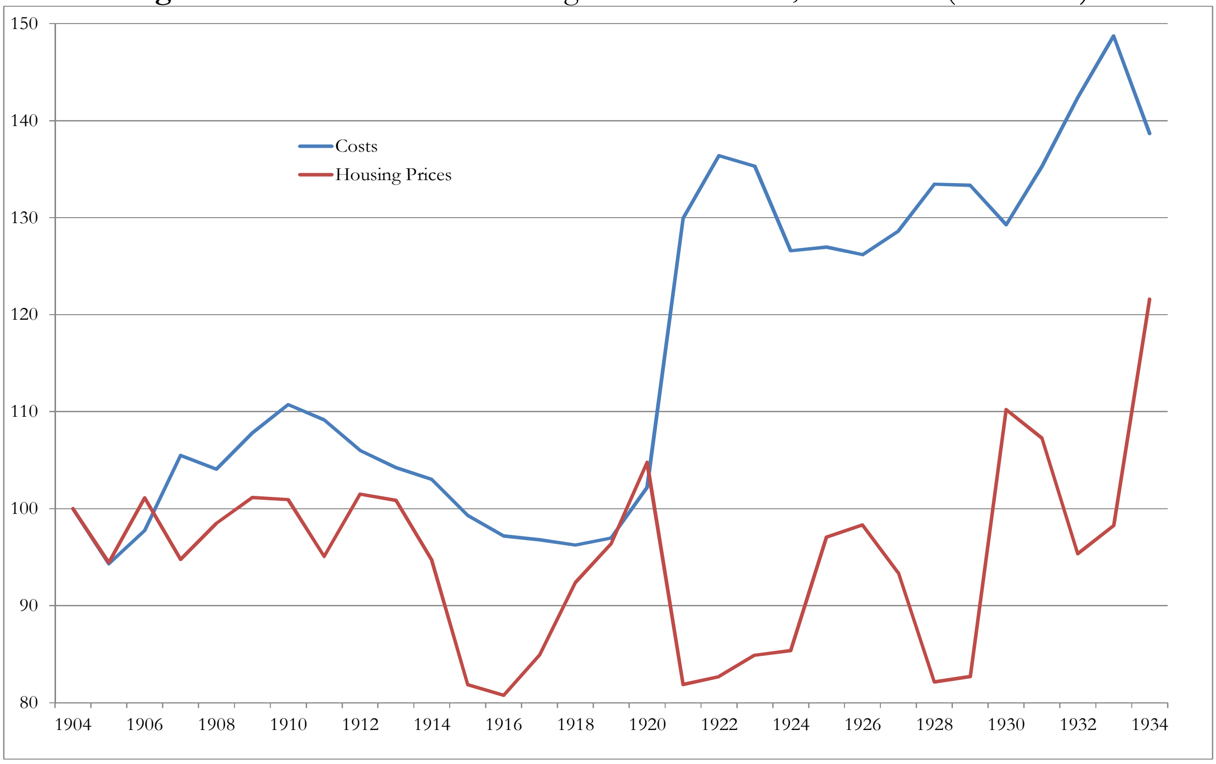
Sources: see appendix.

Figure 6. The evolution of the Supply of New Houses, Permanent Income and the Stock of Dwellings, 1904-1934 (1904=100)



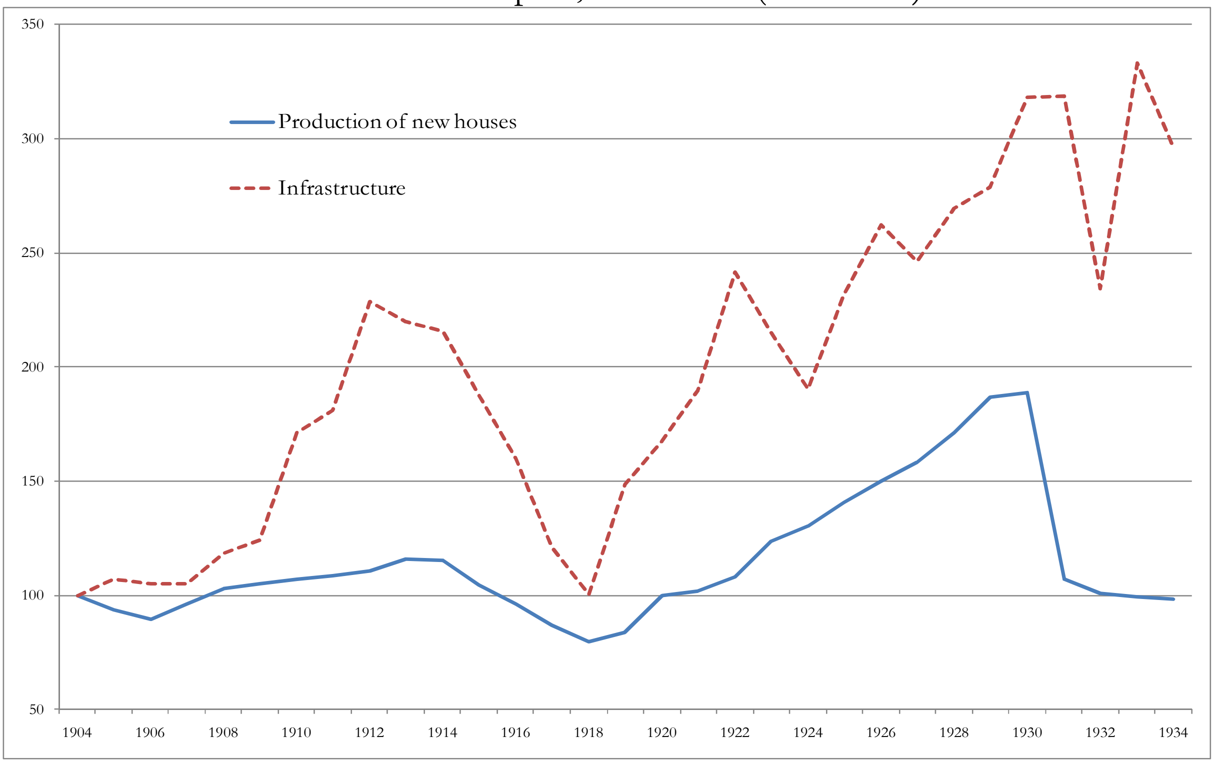
Sources: The stock of Houses is drawn from Prados de la Escosura and Rosés (2010) and per capita GDP and supply of houses from Prados de la Escosura (2003).

Figure 7. The evolution of Housing Costs and Prices, 1904-1934 (1904=100)



Sources: Housing prices from appendix and Housing Costs from Prados de la Escosura (2003).

Figure 8. The evolution of the Supply of New Houses and Infrastructure investment in Spain, 1904-1934 (1904=100)



Sources: Production of new houses is drawn from Prados de la Escosura (2003) and infrastructure from Herranz (2004).

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