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Juan Carmona Pidal, Markus Lampe and Joan R. Rosés

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JEL Classification: N93, N94, R30

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Spanish Housing Markets during the First Phase of the Rural-Urban Transition Process

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 the implications of their failures can be serious. Failure can profoundly affect a country's overall economic growth and the well-being of its citizens. However, at the same time, housing markets cannot develop in isolation. The institutional framework must be sufficiently developed to allow for the construction of new dwellings and the transfer of real estate among economic agents. Additionally, the government and/or financial markets must be able to mobilize the necessary capital to finance the nation's growing housing needs and to build the new infrastructures that will sustain the housing boom.¹

In Spain, the first phase of the rural-urban transition process took place during the first third of the 20th century, when urbanization rates increased at a flourishing rate (Reher, 1986).² Simultaneously, many dramatic changes transformed every facet of the Spanish economy. Spain experienced rapid economic growth in that GDP per capita and TFP growth increased at unprecedented rates during this period, especially during the 1920s (Prados de la Escosura and Rosés, 2009). Domestic migration rates exploded, and many people moved from the countryside to the cities (i.e., from agrarian areas to industrializing regions) (Silvestre, 2005). The financial system underwent major transformations, as banking, financial intermediation and the volume of credits expanded (Martín Aceña, 1985). Infrastructure investments grew faster than the GDP and necessitated a considerable amount of private and public capital (Herranz, 2004). Because the

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

² From 1900 to 1930, the share of Spanish population living in cities of more than 50,000 inhabitants increased from the 13.74 percent to 19.82 percent. Instead, if we consider population living in cities of more than 10,000 inhabitants, this share grew from the 32.45 percent to 42.62 percent (Azagra et al., 2006).

demographic transition occurred at the same time as these economic developments, the number of new families rose rapidly (Pérez Moreda, 1985).

How did the Spanish housing market react to these major economic and demographic transformations? What happened to housing transactions and prices? How did the housing supply cope with the increasing demand for accommodation? What role did public authorities play in the housing market? How did the institutions and regulators behave during this time? Were housing markets efficient or did they impose an enormous burden on the country's economic growth? These questions are central not only for our understanding of the Spanish housing markets but also for our comprehension of Spain's economic evolution during this period. In addition, based on the Spanish historical experience, we can extract several suggestions that may prove to be useful for future housing policies in developing countries.

We must emphasize that the economic costs of any failure 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 further develop into asset bubbles. Such problems in the housing markets can easily affect the rest of the economy. In particular, there are three broad consequences of housing market failures. First, 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). Second, the scarcity of housing, the low liquidity of housing assets and/or their excessive price can delay needed structural changes by imposing severe restrictions on labor migration (Muellbauer and Murphy, 2008). 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).

Despite its obvious importance, the performance of housing markets during the rural-urban transition period has been grossly under-examined by the Spanish literature.³ This

³ 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

negligence is even more surprising if one considers that we have an extraordinary and underutilized source, the Registrars' Yearbooks, that contains detailed information on housing transactions for all Spanish provinces (Dirección General del Registro de la Propiedad y del Notariado). This source compiles 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. This information is of rare quality because price underreporting was minimal during the period before the Civil War (Carmona and Rosés, 2011). Furthermore, we have also derived good information on the stock of the houses and several of their characteristics from the Spanish population censuses.

Our paper has four major objectives. First, we attempt to develop sufficient knowledge on the evolution of housing transactions and prices during the rural-urban transition period. In the following step, we present evidence on housing demand and develop a simple econometric model to explain how housing prices were determined. Then we discuss why the housing market was not supply-constrained. In particular, we consider the role played by the institutional and regulatory frameworks. Finally, we consider whether Spanish housing markets worked efficiently during this time period. Our main conclusion indicates that housing markets responded quite well to the growing demand for accommodation and can be considered to have been efficient. Therefore, we argue that they likely did not constitute a dramatic burden for Spanish economic growth.

2. The evolution of housing transactions and prices

Using the quantitative information of the Registrars' Yearbooks (see appendix), we can reconstruct the evolution of the Spanish housing markets from 1904 to 1934. 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

defensive walls in many cities. See, for example, Ayllón et al. (1989), Galiana and Llop (1989), García Delgado (1992) and Rodríguez Chumillas (1989).

other words, approximately one percent of the total housing stock was traded each year.⁴ In the following decade, from 1914 to 1924, the number of transactions grew at yearly rates of five percent. The maximum number of houses sold was reached in 1924, when more than 88,000 houses were traded (i.e., 1.2 percent 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 percent 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 percent 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 (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

⁴ More specifically, in 1900, the stock trade represented 1.1 percent of the total housing stock. In 1910, the stock trade represented one percent 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.

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 percent in either direction (i.e., increases or decreases) were only observed in six of the thirty years (i.e., twenty percent of all years). In 1915, 1925 and 1928, hedonic-adjusted prices decreased by more than ten percent, whereas the opposite occurred in 1925, 1930 and 1934. The major increase occurred in 1930, when prices increased by 29 percent, and the major decrease occurred in 1925, when prices declined by 25 percent. 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.

[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 and 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 behavior 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 light of the rather dramatic changes that occurred during the urban-rural transition process throughout this period (see introduction), we are quite surprised by the housing market's price stability and rapid adjustments to the growing number of transactions. By and large, the market operated smoothly (i.e., increasing demand was met by increasing supply, and prices remained stable over the medium time horizon of this paper). To make sense of our findings, we must examine in greater detail the determinants of the market's evolution and the institutional framework under which they operated. We will perform this task in the following pages.

3. A model of housing prices

In this section, we specify and estimate house price equations to explain the price stability observed in the previous section. Despite the various characteristics of housing demand,⁵ scholars have agreed upon a standard textbook model (e.g., DiPasquale and Wheaton, 1992; Malpezzi 1999). In this model, housing demand is a function of permanent income, the user cost of capital, local factors (e.g., amenities and employment opportunities) and, crucially, the demographic structure. This standard 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 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 (Malpezzi, 1999). For this reason, 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. In this study, we will review the evolution of the different variables comprising the standard textbook model and its extended version. Additionally, we will perform econometric analysis of both models.

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 percent. The GDP per capita growth rates accelerated slightly during the years prior

⁵ Every introductory textbook in real estate indicates that several specific features of housing markets have a strong influence on housing demand (e.g., DiPasquale and Wheaton, 1992). We underscore two of them. 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.

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 1929.⁶ Not all Spanish provinces followed the same pattern of economic development. From 1904 to 1930, four Spanish provinces experienced negative per capita GDP growth rates, 17 had positive growth rates at less than one percent per year, and the remaining 18 grew at yearly rates faster than one percent. As a result, the dispersion of per capita GDP, which is measured by the coefficient of variation, grew until 1920 and then decreased thereafter. However, the dispersion in 1930 was still higher than it was in 1910.⁷

Studies on the economics of housing have used several alternative measures of the user cost of capital (RR_t). Because of data constraints, we had to choose one of the simplest specifications, which has been employed by many other scholars (e.g., Dougherty and Van Order, 1982; Mankiw and Weil, 1989; Hwang and Quigley, 2006). Our equation is as follows:

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

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, $E(p_{t+\tau})$, is the expected capital gain from housing. Mankiw and Weil (1989) computed $E(p_{t+\tau})$ to be the average rate of change in the GNP deflator over the past two years. 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.

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, this relation can be altered by various demand factors (e.g., the demographic transition, migration outflows and migration

⁶ This evidence is drawn from Prados de la Escosura (2003).

⁷ The source of these calculations is the background data from Rosés et al.'s (2010) study.

inflows) and supply factors (e.g., wars and natural disasters), which decrease the stock of the existing houses. For housing demand, modifications in the age 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 relative number of young adults are prime movers of housing demand (Mankiw and Weil, 1989).

In the first three decades of the 20th century, Spaniards' demand for housing suffered two major demographic shocks. On the one hand, the demographic transition induced an increase in the number of new families (Pérez Moreda, 1985). On the other hand, many people relocated from the countryside to the cities (Silvestre, 2005). This substantial change in demographics was partly counterbalanced by emigration abroad. Furthermore, of all the demographics, young adults participated more actively in this process (Sánchez-Alonso, 2000). Although in absolute numbers, young adults (i.e., the population between 21 and 30 years old) 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 percent of Spain's inhabitants were young adults. In 1910, this proportion decreased to 14.84 percent, increased to 15.47 percent in 1920, and arrived at 16.80 percent in 1930. The effects of external migrations and the increase in life expectancy likely produced this unexpectedly stable demographic structure.⁸

A large percentage of rural migrants 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 percent and reached 19 percent in 1930. However, in the rest of Spain, this proportion was lower. During the studied period, the percentage of young adults never exceeded 16 percent and even decreased to 14 percent in the years 1910 and 1920. In other words, the reallocation of labor likely increased the proportion of people looking for accommodation more in the six provinces than in the rest of the country.

[TABLE 1]

⁸ The demographic data are drawn from Spanish population censuses (Instituto Geográfico y Estadístico, 1900, 1910, 1920 and 1930).

In Table 1, we present several alternative measures that show the relation between dwellings and population. Our objective is to discover whether the housing supply was responsive to the growing demand for dwellings. In Panel A, we discuss the overall measures for Spain, whereas in Panel B, we analyze our six provinces in greater detail and compare them with the rest of Spain. Every measure presented in Panel A shows that the proportion of dwellings per population remained quite stable from 1900 to 1930. Furthermore, Spanish houses were not particularly overcrowded during this period. Specifically, the ratio between the dwellings and the population indicates that, on average, only 2.2 people lived in each dwelling.⁹ In comparison with recent European housing statistics, this ratio is low.¹⁰

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 the dwelling units and the population improved. However, in Madrid and Saragossa, the ratio was stable, and in Barcelona and Seville, the ratio worsened slightly.¹¹ In any case, the housing supply was able to accommodate the rapid demographic changes and the ratio between the dwelling units, and the population did not dramatically worsen in any Spanish province during the first thirty years of the 20th century.¹²

[FIGURE 5]

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

⁹ 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 percent 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.

¹⁰ 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).

¹¹ In Barcelona, this ratio decreased by approximately 15 percent from 1900 to 1930. In Seville, the ratio decreased by approximately 16 percent during the same period.

¹² 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 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.

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 is sometimes employed as collateral in exchange for consumer and corporate credit. Thus, our information may exaggerate the amount of credit lent for housing transactions. Regardless, to investigate the evolution of housing credit, we will consider two different indicators (see Figure 5 above): 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 growth rates were 0.75 percent. However, the year 1934 was not the peak of the growth period. Rather, the peak 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 a yearly growth rate of approximately 1.9 percent. This growth period also had 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 has decreased since then. 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, these two indicators both show that credit for housing grew over the period but that the amount of available credit also showed a strong cyclical component.

After reviewing the evolution of the different components of housing demand, we will proceed with a more formal analysis of their contribution to the formation of housing prices. Our main equation for housing prices is based on the standard textbook model and consists of an inverted demand equation, as shown by the following:

$$(2) \text{Log(Prices)}_t = \beta_0 + \beta_1 \log(Y)_t - \beta_2 \log(1 + \text{HOUSE})_t - \beta_3 (\text{RR})_t + \varepsilon_t$$

Real new house prices (i.e., our Hedonic Index of Housing Prices) are modeled as a function of real GDP per capita (Y), the housing stock per capita (HOUSE)¹³ and the real cost of capital for housing (RR). As in other cross-sectional studies of housing demand (e.g., Capozza et

¹³ 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 . Hence, these two variables should not be considered together in regressions.

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.

Furthermore, we also estimate a modified version of the standard textbook model by including a credit availability variable. Thus, we calculate the following:

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

where credit availability (CREDIT) is calculated as the ratio between the number of mortgages and the number of housing transactions at $t-1$.¹⁴

We estimated 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. We develop three different types of estimations: weighted OLS estimates with robust standard errors (columns 1-2), GLS random-effects estimates with robust errors (columns 3 and 4)¹⁵ and instrumental variables with weighted OLS and GLS random-effects estimates that use $t-1$ observations as the instruments (columns 5 and 6).¹⁶ The estimations of these equations are presented in the following table:

[TABLE 2]

The variables habitually showed the expected sign (i.e., positive in Y and CREDIT but negative in HOUSE and RR), and the coefficients suggest that reasonable elasticities exist. Note that IV estimations (columns 5 and 6) confirm the robustness of our other econometric results. However, the variable RR was insignificant in the equations that included random effects and/or the CREDIT variable. The explanation for this finding is straightforward. Our RR variable is correlated with CREDIT¹⁷, and the RR variable's influence on housing prices is captured by the

¹⁴ We used the lag to avoid the endogeneity caused by credit lending.

¹⁵ 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.

¹⁶ 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.

¹⁷ 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.

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 prior empirical studies on housing demand, the income variable is usually the single most important determinant of real housing prices in the long run (e.g., Case and Shiller, 2003, and Holly and Jones, 1997). Furthermore, Harter-Dreiman (2004) showed that long-run income elasticity is higher in constrained areas than in the less supply-restricted areas. 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)) as well as those obtained by Conefrey and Fitz Gerald (2009) for contemporary Spain (1.13) and Ireland (0.99), both of which are supply-constrained housing markets. Because the mean value of Y is 6.3 (see appendix 2), it contributes (i.e., $6.3 \times 0.47 = 2.96$) more to an explanation of higher housing prices than the difference between mean prices and the estimated constant ($8.77 - 6.05 = 2.72$). In other words, the income variable alone is able to explain long-run housing prices.

The pressure to increase housing prices as a consequence of permanent income growth is counterbalanced by the supply response of the housing market, as shown by the variable HOUSE. Because the mean value of HOUSE is 0.41, its contribution to the aforementioned explanation is -0.52 (-1.26×0.41), which reduces by one fifth the impact of Y . In contrast, the variable CREDIT has a positive impact on prices. Its elasticity is quite high (1.09), and its contribution is 0.23 (1.09×0.21), which practically halves the beneficial effects of the variable HOUSE.

The implications of our estimations are highly relevant to this paper's topic. Above all, the Spanish housing market was not particularly constrained by its supply. Figure 6, which compares the evolution of Spain's housing supply with the country's GDP per capita, confirms our assertion:

[FIGURE 6]

Housing supply rose during the studied period (Tafunell 2005; Prados de la Escosura 2003).¹⁸ However, the supply of new houses showed considerable cyclical deviations from the

¹⁸ The few studies available on 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

prevailing trend.¹⁹ 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.²⁰ Note that from 1930 to 1931, the production of new houses plummeted by an enormous 44 percent! 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 production because of 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 the GDP per capita (i.e., 2.36 percent versus 1.15 percent).

4. Why were Spanish housing markets not constrained by their supply?

Three factors are considered essential for determining the housing supply: (1) construction costs, (2) infrastructure investment and (3) institutions and regulations within the housing markets, which can facilitate or delay the construction of new dwellings. 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, this model ignores the spatial nature of housing markets and possible institutional restrictions to housing supply.

[FIGURE 7]

The evidence clearly shows that, although real construction costs rose, particularly after 1920, hedonic housing prices remained stable or even decreased (see Figure 7 above). In light of the standard housing-supply model, this unexpected result can only be caused by two factors: a spectacular increase of TFP in the housing industry and/or a decrease in the prices of land

Zaragoza, Gómez Mendoza (1986) on Madrid, Sorribes (1992) on Valencia and Tafunell (1992) on Barcelona.

¹⁹ The same has occurred throughout the history of OECD countries (Ball and Wood, 1999).

²⁰ Growth rates were 1.4 percent per year from 1904 to 1914, 9.2 percent per year from 1914 to 1918, 7.7 percent per year from 1919 to 1930 and 16.2 percent per year from 1930 to 1934.

marked for housing development.²¹ 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 percent, but the TFP growth rate of the Spanish economy was only 0.59 percent.²² As a result, the TFP growth in housing alone is unlikely to explain the decrease in housing prices during this period. The question of why the prices of land for housing development decreased remains to be answered.

[FIGURE 8]

The spatial nature of the housing market increases the importance of infrastructure investments because cities expand in the long run by increasing the amount of land that can be used (see, for example, Leunig and Overman, 2008).²³ 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 percent 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 percent per year from 1890 to 1930, and investment in water infrastructures and sanitation grew at 6.17 percent 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. However, the conversion of agricultural or waste land into urbanized land required a satisfactory institutional and regulatory framework.

²¹ 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, 2011).

²² Prados and Rosés (2010).

²³ 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 percent). That is, increases in urban density appear to have played a secondary role in the expansion of the Spanish housing market.

To enhance the efficiency of the housing markets, contract law and land use regulation²⁴ should be enacted in accordance with a list of requirements.²⁵ In particular, property rights should be transparent, enforceable, and derived from a social consensus, and participants should agree with the final arbiter of disputes (Malpezzi, 1999). With regard to housing transactions, property rights should be easily and fully transferrable from sellers to buyers (Jaffe and Louziotis, 1996). In the case of tenancy markets, the following conditions must be fulfilled: tenant and landlord rights must be well-defined; there must be clear remedies for violations by either party; and rights and obligations should be freely negotiated such that they represent the outcome of a competitive market process (Malpezzi, 1999). Additionally, the possibility and causes of eviction in the rental market should be clearly enumerated (Jimenez, 1984). Finally, to facilitate the external financing of housing transactions, laws should allow foreclosures for unpaid debts or other violations of ownership obligations (Malpezzi, 1999).

To develop enforceable and transparent property rights, a country must first create a system that allows for the formal registration of real estate property. In Spain, the traditional registration system of real estate property was based on a network of notaries. The notary verified the property rights and drafted the legal sales contract and the deed. However, the system was expensive, lacked transparency and was highly decentralized. Furthermore, the information about the owners was sometimes imperfect. To increase the efficiency of the registration process, the Bourbons created a government-sponsored system of mortgage registry (i.e., the *Contaduría de Hipotecas*) in 1768 (Peset, 1978: 699). The new registration system was cheap and reduced information and transaction costs, but it was not universal or even widely used. Finally, in 1865, the old local system of ownership registration was replaced by a two-step registration system, which solved the disputes about property rights, provided legal backup to any transaction²⁶ and was similar to the French system.²⁷ This institutional setting was characterized by a network of notaries with a local monopoly on the registration of real estate transactions. The parties (i.e.,

²⁴ According to Malpezzi (1999), contract law is a body of law that regulates the formation and enforcement of contracts. Specifically, in the case of real estate, contract law deals with the transfer and allocation of property and property rights as well as the disputes regarding those rights. Land use regulation comprises the body of formal (i.e., law, regulations) and informal (i.e., custom) rules that governs the use of those rights. These regulations generate several different instruments, such as zoning ordinances, subdivision regulations, building and housing codes and private deed restrictions.

²⁵ For example, see Alchian and Demsetz (1973), Coase (1960), Demsetz (1967), Williamson (1975) and Malpezzi's (1999) survey.

²⁶ Carmona and Rosés (2011).

²⁷ See Gouriéroux and Laferrère (2009) for information on the French system.

usually the buyer) sent the records to the Real Estate Register, which collected the stamp duty on behalf of the government. This institution offered a cheap, universal and homogeneous system of public registration for all properties, even those not sold (Bono, 1979).

Similar to many European countries, Spain experienced Liberal reforms in the first half of the 19th century that eliminated restrictions on real estate sales and established freedom of contract. The new authorities also derogated the remaining feudal rights and many of the old forms of housing tenancy. However, 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. This new legal framework was enforced with few changes for more than a century and was not eliminated until the early years of Franco's regime.²⁸

The Liberal Revolution also contributed to the construction of the modern housing market through the Residential Tenancies Act.²⁹ This law fully liberalized the lease contract such that it no longer had any restrictions in price and duration (Martínez Alcubilla, 1892-94). Evicting renters only required 40 days notice, and if the house was sold to a third party, then the leasing contract could be cancelled without compensation (Martínez Alcubilla, 1892-94: 696). Critics claimed that the Residential Tenancies Act gave too much power to landlords and failed to protect the poor, and as a result, the demand for rent control increased (Ortego, 2006). Several proposals regarding rent control were approved by the Spanish Parliament, but their effectiveness was limited (Bassols, 1973: 230; Ortego, 1973: 74). In particular, high inflation rates during World War I (i.e., rents doubled in five years) led to a new regulation, the Royal Decree of June 21th, 1920, which restricted increases in rent and established special boards to revise all evictions (Martínez Alcubilla, Appendix 1921, ECR 419).³⁰ However, this regulation was not enforced, and rents continued to grow (Ayuntamiento de Madrid, 1929: 168).

In sharp contrast to the regulations affecting ownership registry, real estate transference and the renting markets, the regulation of land use changed substantially from the Liberal Revolution to the Civil War (i.e., from mid-19th century to 1936). This regulation was modified because of demands from two groups with contradictory interests. On the one hand, landlords

²⁸ The Royal Order of October 26th 1939 reformed article 396 of the Civil code and the 8th article of the Mortgage Act.

²⁹ The Royal Order of April 9th 1842 updated the law on June 8th, 1813.

³⁰ Note that these increases were well below the growth of the consumer price index, which more than doubled from 1914 to 1920 (see the data in Prados de la Escosura's study (2003)).

and developers criticized the absence of new soil for new houses. On the other hand, social reformers and labor organizations complained about the lack of affordable housing for poor workers and the poor hygienic conditions of crowded cities. Several studies from different periods (Comisión de Reformas Sociales, 1985; Hauser, 1902; Instituto de Reformas Sociales, 1920, 1921; Ayuntamiento de Madrid, 1929) have criticized the high rents, poor housing quality and deplorable sanitation conditions in Spain's urban areas. In particular, these studies decried the presence of dwellers in basements, dark houses and homes and rooms shared by different families as well as the practice of sublet renting. The critics proposed two types of reforms: limitations on rents, which were not implemented (see above), and different measures for increasing the supply of land available for new houses in growing cities (Academia de Ciencias Morales y Políticas, 1863). Successive reforms conducted by different governments facilitated the expansion of soil for urbanization.

The first zoning measure approved by the Spanish government was a development plan for Madrid and Barcelona (i.e., el Plan del Ensanche de Madrid y Barcelona), which were the largest and the fastest growing cities in Spain in 1864. The main objectives of the plan were to regulate the characteristics of new houses and to promote the rapid construction of new homes in response to the growing demand for accommodation (Bassols, 1973: 252-7). The law established legal mechanisms and institutions (i.e., urbanization committees) to coordinate the establishment and financing of the necessary infrastructure for the new urbanization process. The committees benefited from an arbitrary expropriation system and received government subsidies through tax exemptions (Bassols, 1973). This model facilitated urban development but was inflexible. The plan was not adjusted to changes in the urban environment, which soon rendered the plan obsolete. In addition, the plan did not offer enough fiscal revenue for financing the expansion of the cities and the concomitant increase in infrastructures. During the last quarter of the 19th century, a series of laws in 1876 and 1892 tried to solve both problems and created development plans for other major Spanish cities, such as Bilbao and Valencia. 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 soil for new construction scarce.³¹ 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

³¹ For example, in 1900, Madrid doubled the urbanized surface area and practically exhausted the soil available for new houses.

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). Contemporary reports highlight the disorder of the construction process and the lack of infrastructure that predominated in these new urban developments, which became increasingly abundant.³²

In sum, Spanish housing policy was based on free markets. The Liberal Revolution created an institutional framework that defined property rights and facilitated the operation of the housing markets. 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. 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. On the other hand, the regulation of land for urban development did not impede the continuously increasing amount of available land for new dwellings. When the soil for regulated urban development became increasingly scarce, the developers moved to the suburbs. In the suburbs, regulations simply did not exist, but the ownership of houses was recognized by the authorities. Therefore, 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.

4. Were Spanish housing markets efficient?

Apparently, all previous evidence indicates that Spanish housing markets worked quite well and responded to the growing demand for accommodation. To confirm this strong statement, we apply a simple formal test on the efficiency of the housing market. Developed by Clark (1995) and based on the present value model, this test is adequate for measuring long-frequency efficiency with panel data information, which is the type of evidence that is readily available in Spain.³³

³² From 1904 to 1924, the Instituto de Reformas Sociales made numerous reports and proposed reforms for what they understood to be one of the biggest problems of the working population. The Instituto de Reformas Sociales proposed increasing the developable surface area to reduce the density and to increase the quality of public services. Some projects were launched, but they were not successful or produced low-quality housing.

³³ Articles testing the high-frequency (e.g., quarterly) efficiency of housing typically reject the implications of the present value model. See, for example, Case and Shiller (1989, 1990), Mankiw and Weil (1989) and

According to the present value model, housing prices should depend on the current level of rents and the expected rent growth. In other words, prices at least partially capitalize on the present value of future rents. Specifically, if prices are high relative to rents (i.e., the rent-price ratio is low), then the increases in rent during the subsequent period tend to be larger than if housing prices are low relative to rents (i.e., the rent-price ratio is high). From an empirical standpoint, this implication suggests that, across all areas, the current rent-price ratio should act as a predictor of rent growth during the next period. Furthermore, if this straightforward version of the present model holds, then Spanish housing markets enjoyed long-frequency efficiency (i.e., they were efficient).

This study uses figures on mean rent and real mean housing prices to examine this hypothesis by estimating the cross-sectional regressions of rent growth between the years t and $t + 1$ on the rent-price ratio in year t . For housing prices, we use our real, quality-adjusted (i.e., hedonic) prices, which we combine with the provincial data on rents per month for one (presumably standard) room from the Boletín del Instituto de Reformas Sociales. These prices were deflated by the same consumer price index that we used to adjust the housing prices (from Rosés and Sánchez-alonso, 2004). The data on rents from 1913 to 1921 are available, with gaps in the data varying by the provinces. We relate the real, quality-adjusted, rent-to-price ratio in every year to the rent growth rate for the following period, which is normally one year.³⁴ Specifically, we estimate the following regression:

$$(4) \quad g_{i,t+1} = \beta_0 + \beta_1 (R_{it} / P_{it}) + \varepsilon_i$$

where $g_{i,t+1}$ is the yearly real rent growth in province i between years t and $t + 1$, and R_{it}/P_{it} is the rent-price ratio for province i in year t . As Clark (1985) 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 present value holds, then the rent-price ratio should be

Poterba (1991). As noted by Clark (1995), these articles reject the implications because factors such as transactions costs may prevent arbitrage from eliminating the short-term predictability of the returns, whereas over long periods, transactions costs diminish in importance, and arbitrage may eliminate the long-term predictability of the returns.

³⁴ 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.

significantly and inversely related to the average future rent growth. The results of the different specifications of equation 4 are presented in Table 3:

[TABLE 3]

The variable R_t/P_t exhibited the expected negative sign and was significant in every specification. As a result, consistent with the predictions of a simple formulation of the present value model, the current rent-price ratio is significantly and negatively related to average future rent growth across all provinces. Thus, the results presented here provide considerable evidence of low-frequency efficiency in Spain's rental and housing markets. An interesting extension of this result is that the people renting houses (i.e., the majority of the urban population and practically all of the urban working classes) benefited from the price stability in the housing markets because both the rental and housing markets were clearly linked by fundamentals.

7. Conclusions

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. If housing supply does not respond swiftly to the growing demand for accommodation, then the demand can hinder economic growth by draining excessive funds away from productive investment, delaying needed structural changes and provoking asset bubbles. However, we showed that this 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, the houses differed in characteristics and quality. Additionally, 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 extreme observed transactions 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 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. However, our indices will not overestimate the long-run tendencies of housing prices.

We 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 the urban properties (i.e., *fincas urbanas*) in which a price was actually paid (i.e., we did not consider inheritances or other properties that are 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).³⁵

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 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

³⁵ 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. 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 percentage 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.³⁶ “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.³⁷ 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 percent) and the highest in Gipuzcoa (i.e., 46.7 percent). 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 results, we calculate in accordance with Gouriéroux and Laferrère (2009: 210) the log hedonic price $\tilde{p}_{j,t}$ as the difference between the observed prices $p_{j,t}$ and the characteristics weighted by

³⁶ This information was collected from the *Anuario Estadístico de España*.

³⁷ 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.

their coefficients. We assume that the weights are stable over time. This equation is calculated as the following:

$$(1A) \quad \ln(\bar{P}_{j,t}) \cong \ln(P_{j,t}) - \sum_{k=1}^K \hat{\beta}_{k,s} X_{k,j,t} = \ln\left(\frac{P_{j,t}}{\text{EXP}\left(\sum_{k=1}^K \hat{\beta}_{k,s} X_{k,j,t}\right)}\right)$$

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

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

We then calculate the hedonic price index for every province j by the difference of the logs $\ln I_{j,t}/1904$, $j = \exp(\ln \text{hedonicreal } t,j - \ln \text{hedonicreal } 1904, j)$ 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 Dwellings-Population Ratio, 1900-1930

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

Method	WLS (1)	GLSre (2)	WLS (3)	GLSre (4)	IV-WLS (5)	IV-GLSre (5)
<i>Constant</i>	4.694 ^a (0.585)	6.703 ^a (0.839)	4.517 ^a (0.639)	5.268 ^a (1.127)	5.610 ^a (0.554)	5.455 ^a (0.795)
<i>log(Y)_t</i>	0.894 ^a (0.079)	0.421 ^a (0.118)	0.551 ^a (0.113)	0.476 ^a (0.114)	0.371 ^a (0.095)	0.390 ^a (0.090)
<i>log(1+HOUSE)_t</i>	-2.844 ^a (0.418)	-1.564 ^b (0.716)	-2.683 ^a (0.373)	-1.273 ^b (0.611)	-2.751 ^a (0.370)	-1.073 ^b (0.529)
<i>(rr)_t</i>	-0.144 ^b (0.056)	0.004 (0.033)				
<i>log(1+CREDIT)_{t-1}</i>			1.291 ^a (0.253)	0.825 ^b (0.363)	1.325 ^a (0.239)	1.006 ^a (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. GLSre 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 3. The Test of the Present Value Model

Method	WLS (1)	GLSre (2)	GLSfe (3)
<i>Constant</i>	0.145 ^a (0.037)	0.145 ^a (0.023)	0.320 ^a (0.685)
(R_{it} / P_t)	-8.668 ^a (2.523)	-8.668 ^a (1.493)	-20.569 ^a (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: See table 2. GLSfe is generalized least squares with fixed-effects.

Sources: See text.

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

	Coefficient (1)	Std. Err. (2)	T (3)	P>/t/ (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).

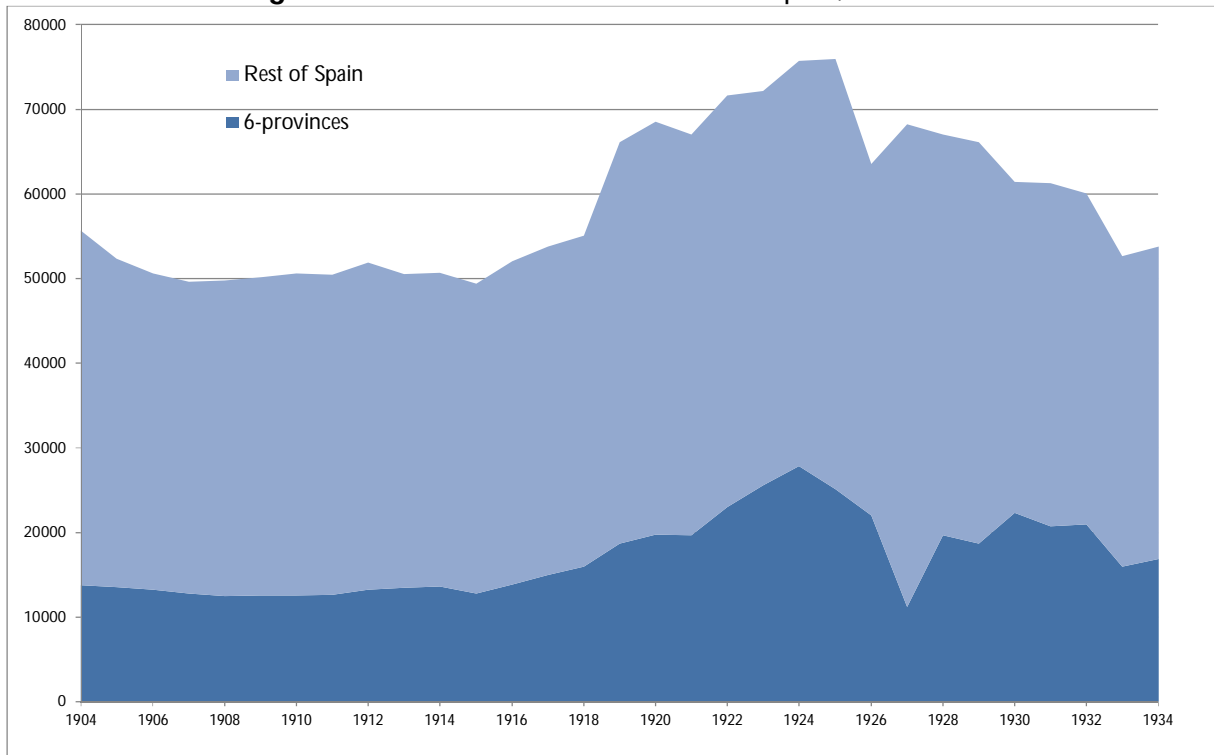
Sources: See appendix 1.

Table A.2. Descriptive Statistics of the Variables

	Obs. (1)	Mean (2)	Std. Dev. (3)	Min (4)	Max (5)
<i>Housing Hedonic Price</i>	192	8.774	0.689	7.510	10.785
$\log(Y)_t$	192	6.303	0.331	5.446	7.253
$\log(1+HOUSE)_t$	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

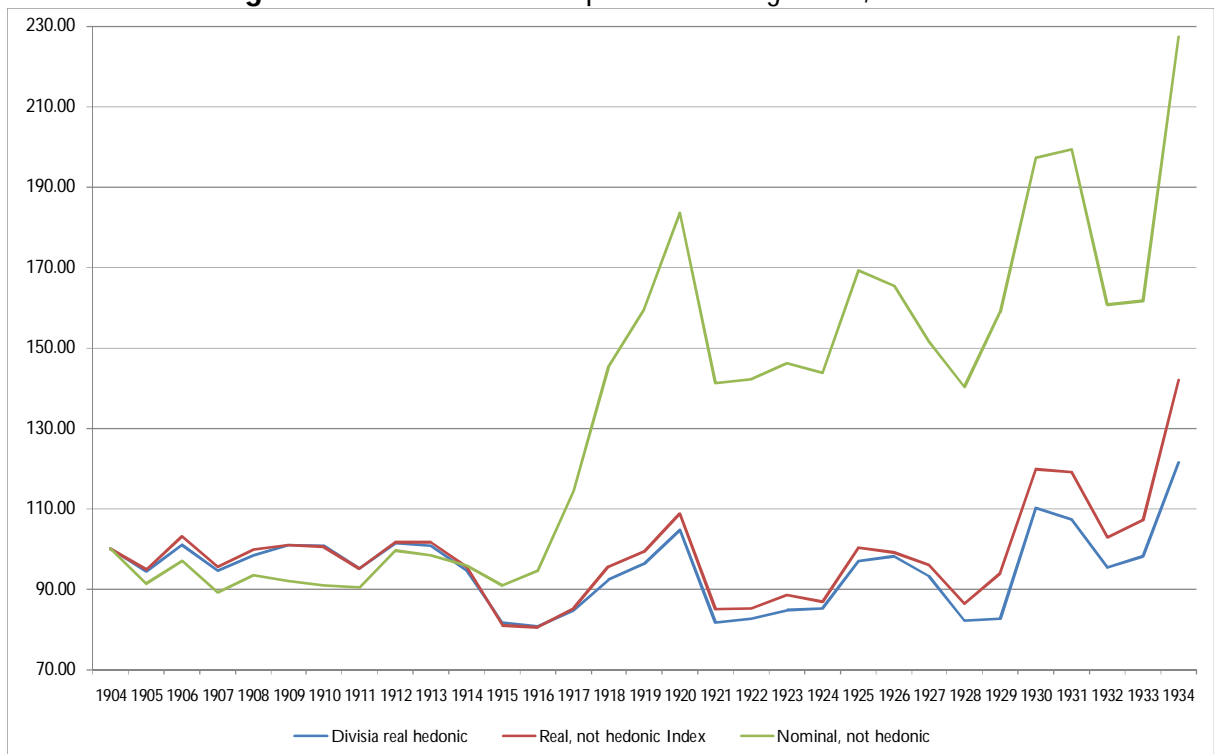
Sources: See table 2.

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



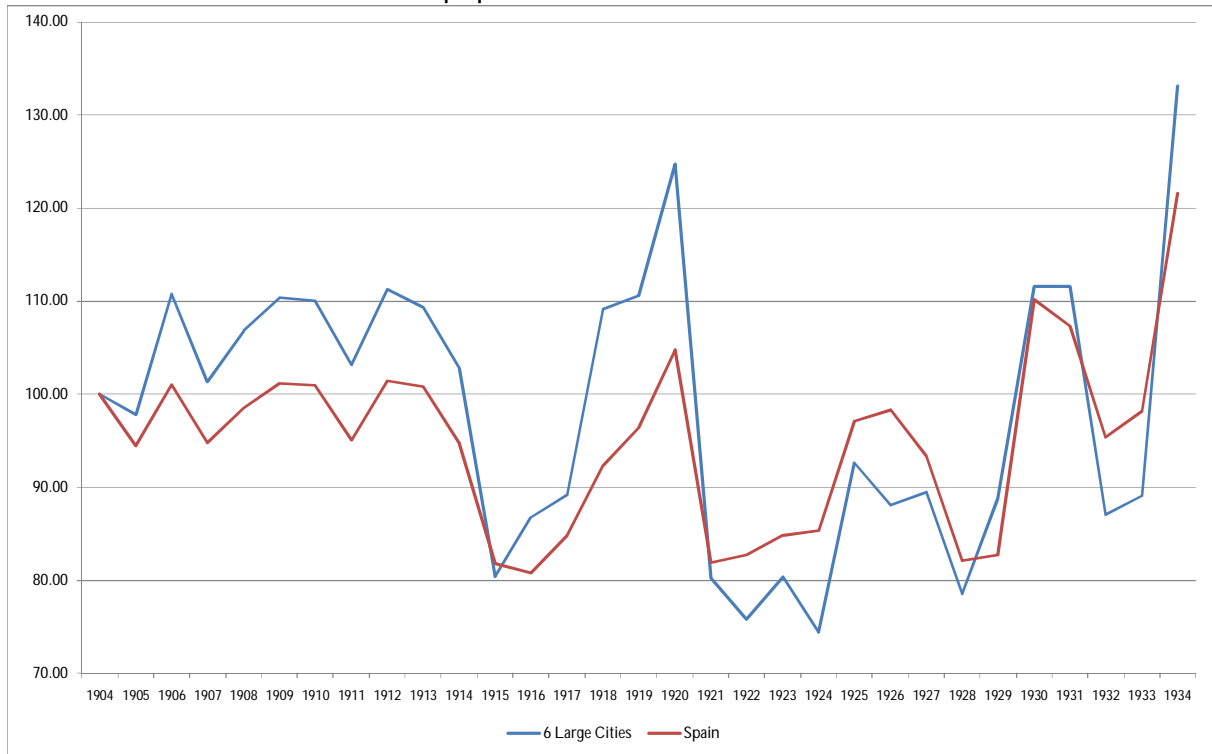
Sources: see appendix.

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



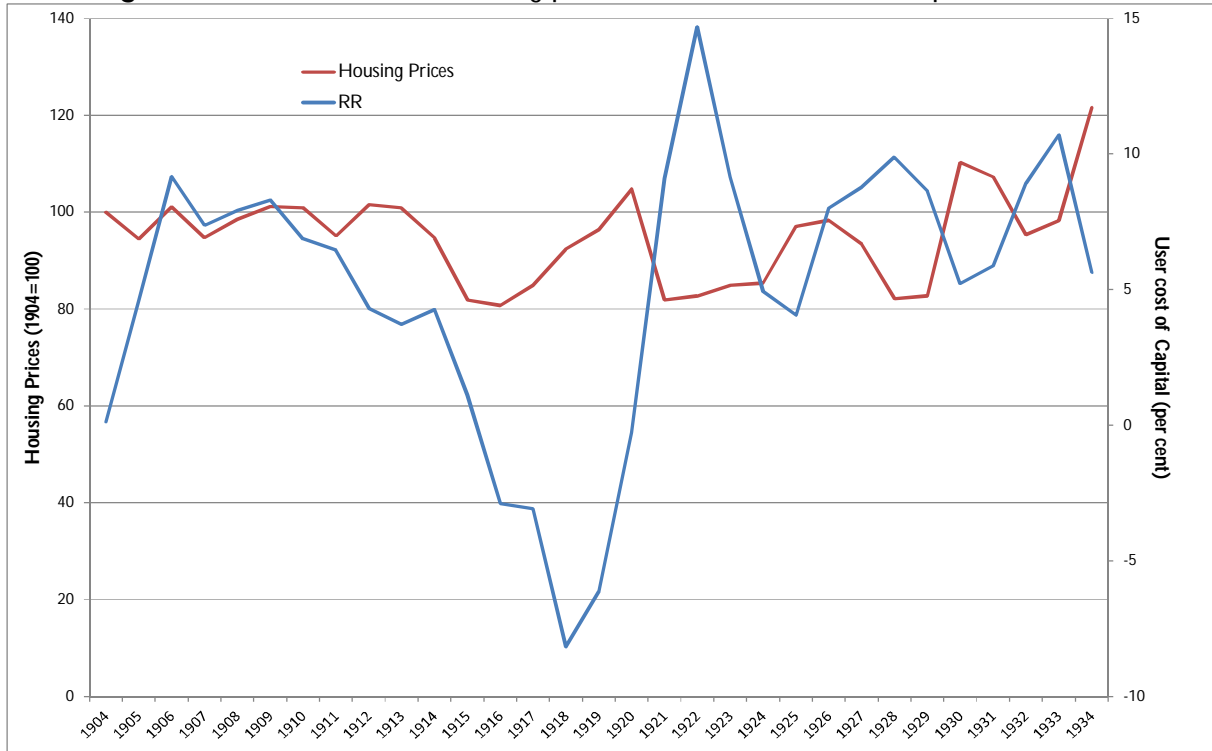
Sources: see appendix.

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



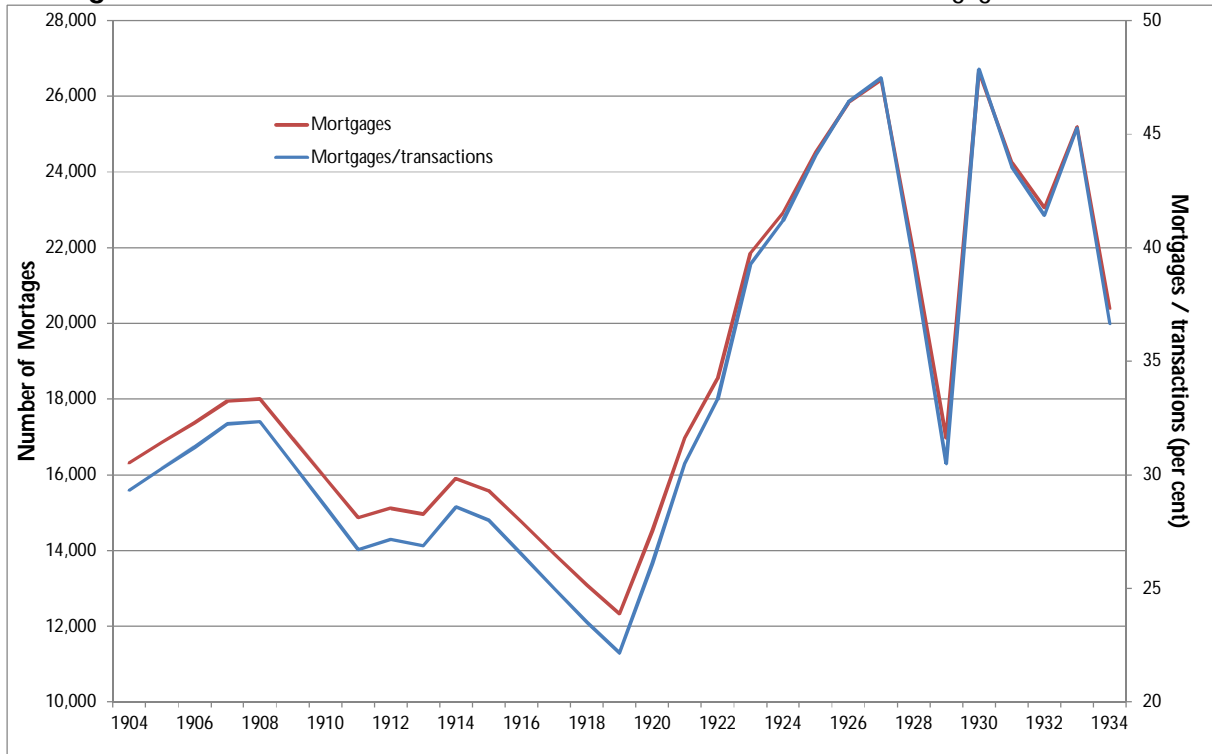
Sources: see appendix.

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



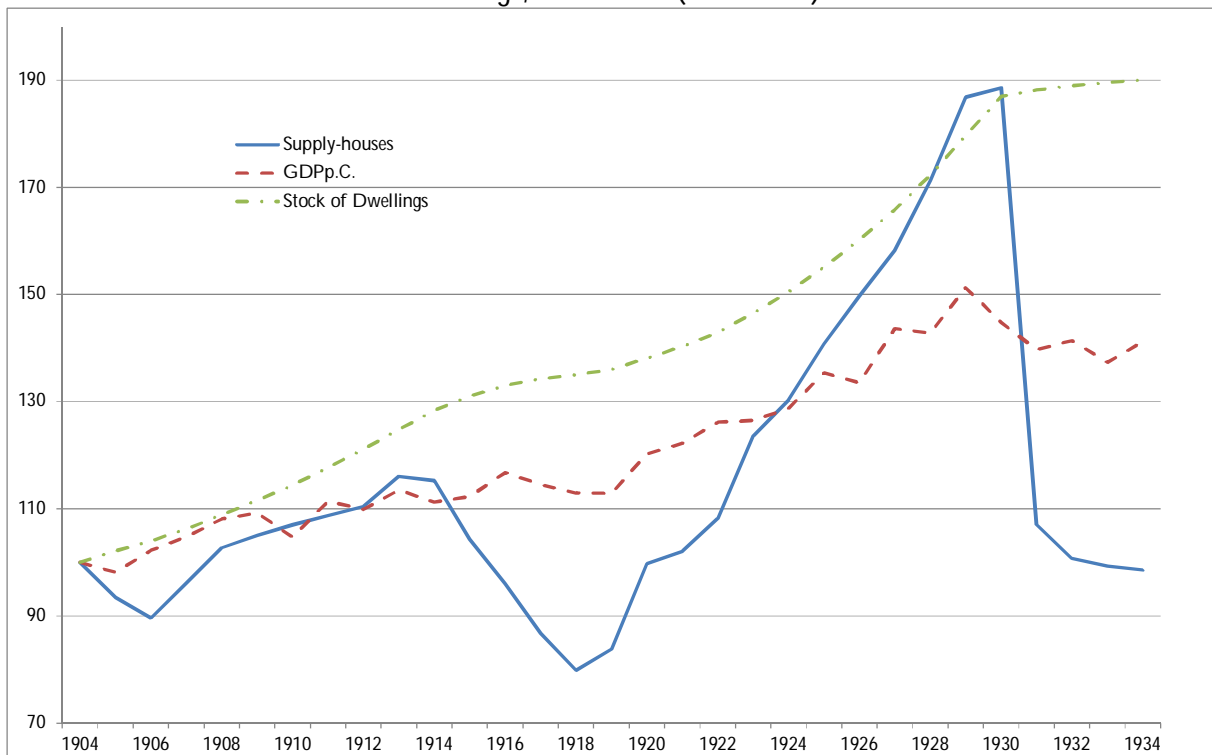
Sources: see appendix for housing prices. The user cost of capital is computed with equation 1. The nominal interest rate is drawn from Martín Aceña and Pons (2005), the property tax rate on housing from *Anuario Estadístico*, and GDP deflator and maintenance prices from Prados de la Escosura (2003).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



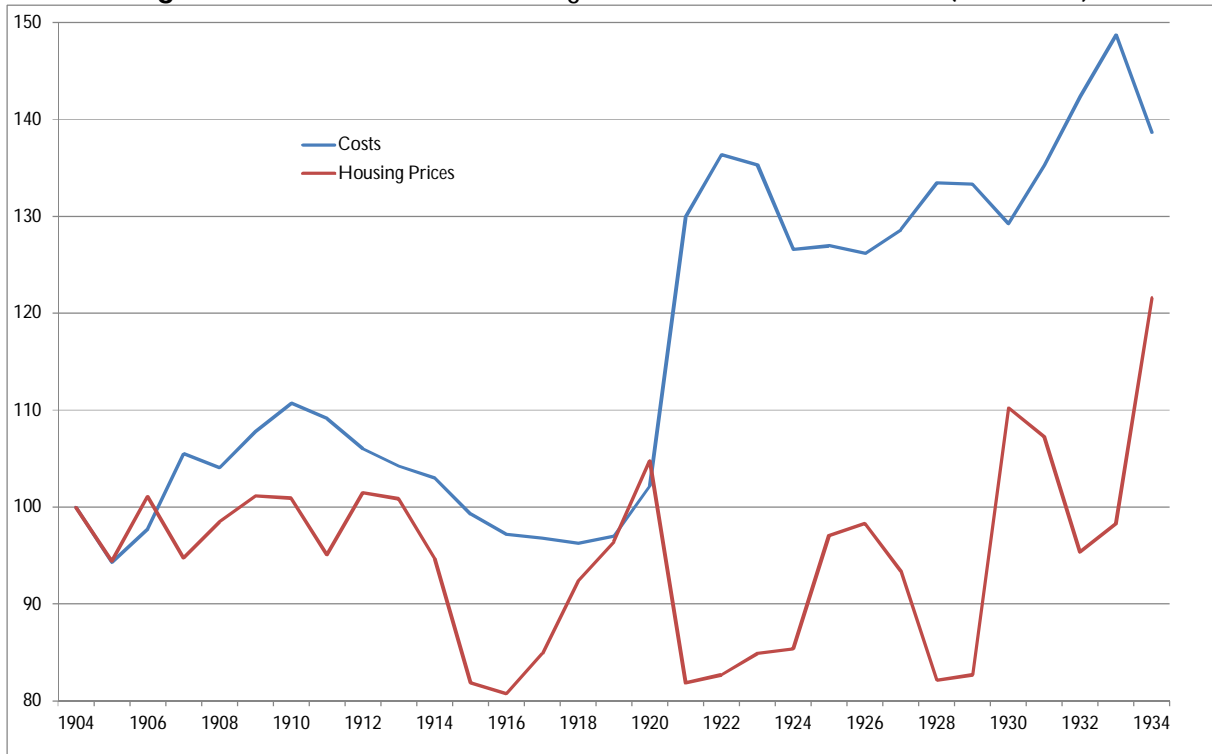
Sources: see appendix.

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



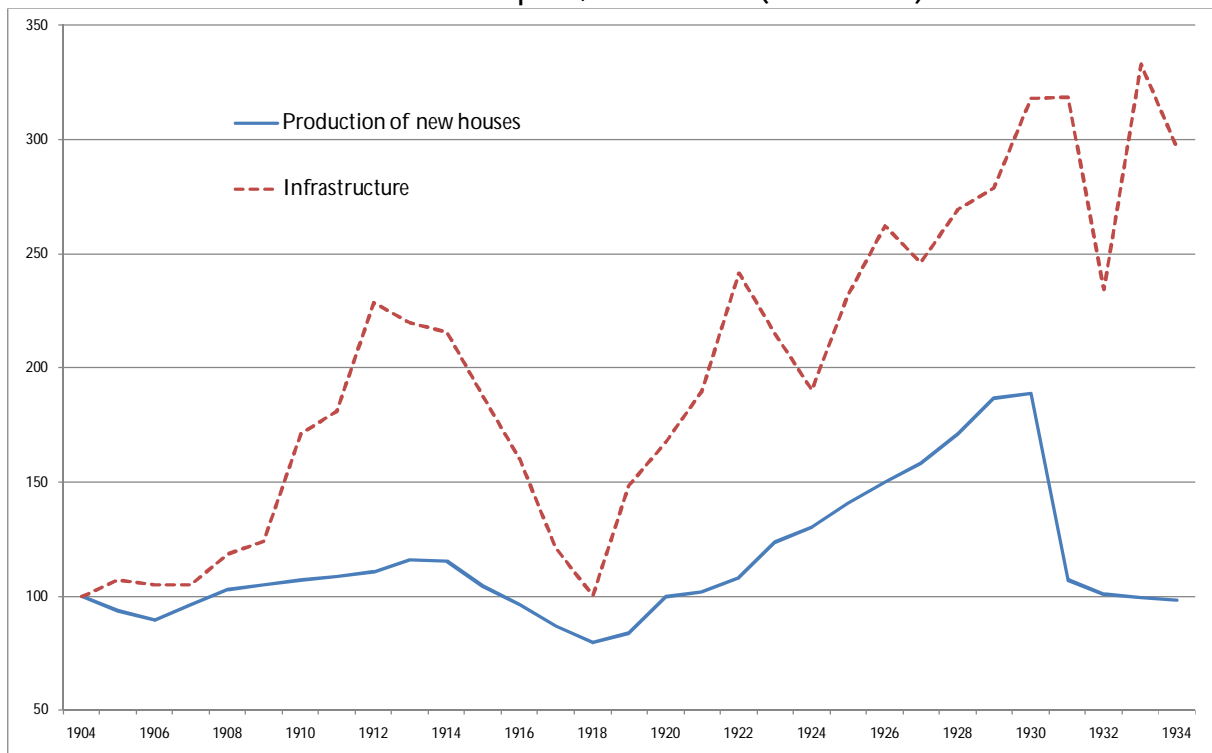
Sources: The stock of Houses is drawn from Prados de la Escosura and Rosés (2010) and per capita GDP and supply of houses from Prados de la Escosura (2003).

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).