Immigration and Housing Booms: Evidence from Spain

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Abstract: Most of the countries that experienced a housing market boom over the last decade simultaneously received large immigration flows. This paper provides empirical estimates of the effect of immigration on house prices and residential construction activity using data for Spain over the period 2000-2010. Spain is a particularly relevant case study because of the spectacular housing market boom (and bust) and the large immigration wave experienced during the 2000's. Additionally, we can benefit from the availability of high-quality, annual data on immigrant concentration, house prices and the stock of housing. We exploit the variation in immigration across Spanish provinces and adopt an instrumental-variables approach, where we use the classical ethnic networks instrument in combination with a new instrument based on the geographical accessibility of each Spanish province from the point of view of each immigration origin country. Our estimates suggest a sizeable causal effect of immigration. Between 2000 and 2010, immigration led to an average 1.5% *annual* increase in the working-age population. This in turn led to an annual increase in housing prices ranging from 1.5 to 2.3%, and to ~~an~~ annual increase in the stock of housing units ranging from 1.2 to 1.5%. In conclusion, our estimates imply that immigration was responsible for about 25% of the increase in prices and 60% of the increase in the stock of housing.

Keywords: Housing, Immigration, Construction, Spain.

JEL Codes: F22, J61, R21, R23, R31.

1. Introduction

Over the early 2000's many countries experienced a pronounced boom in house prices, in what The Economist labeled "the biggest bubble in history".[1] In real terms, house prices between 1995 and 2005 increased by 60% in the US, more than 100% in the UK, and 80% in Australia.[2]

The causes of these housing booms are still not well understood. Many factors seem to have played a role: unprecedented low interest rates, deregulation in the mortgage market, rising income, irrational exuberance, and so on. We propose an additional, demographic factor that may have contributed significantly to the rise in house prices in some countries. Many developed countries experienced large migration inflows during the same period, which may have boosted the demand for housing. Figure 1 shows the relationship between the percent change in (real) house prices from 2000 to 2005 and the change in the foreign-born share of the population in 10 OECD countries. Countries that received larger immigrant inflows also experienced higher increases in the price of housing in real terms.

To investigate the role played by immigration in the recent housing market booms, we focus on the case of Spain, which offers a particularly well-suited opportunity for identifying and estimating the effect of interest. Between 1998 and the peak of the boom in 2008 (see Figure 2.1), housing prices in Spain increased by 175%, from 760 to 2,100 euros per square meter (Spanish Ministry of Housing).[3] In comparison, house prices in the US increased by 104% between the peak in 2007 and ten years earlier (Freddie Mac CMHPI).[4] The large increase in housing prices in Spain is even more striking when we take into account the intense residential

[1] "The global housing boom", June 16th, 2005.
[2] Source: Bank for International Settlements real house price data 1970-2006.
[3] Over the same time period the total percentage increase in the consumer price index in Spain was 61.5%. That is, an average annual inflation rate of 4.9%.
[4] Freddie Mac's Conventional Mortgage Home Price Index (CMHPI) provides a measure of housing price inflation in the US. For more details see http://www.freddiemac.com/finance/cmhpi.

construction activity during the same period. Between 1998 and 2008, the share of construction in Spain's GDP increased by four percentage points, reaching 10.7% in 2008.[5] The annual flow of new dwellings increased from below 250,000 units in 1998 to 600,000 units at the peak between years 2006 and 2008 (Figure 2.2). Between 2008 and 2010 the housing market in Spain plummeted. Average housing prices and the annual flow of housing units fell rapidly.

We hypothesize that immigration may explain Spain's larger housing market boom, relative to the US and other European countries. Between 1998 and 2008, Spain received a stunning wave of immigration, topping international rankings both in absolute terms and relative to population. In this period the foreign-born share in the working-age population increased from 2 to 16% (Figure 3.1). In absolute terms, the foreign-born population increased from barely 0.5 million to 5 million over the course of the decade. These inflows led to vigorous population growth, ranging between 1.5% and 2% between 1998 and 2008. Figure 3.2 illustrates this point. It also makes clear that immigration was the fundamental drive behind total population growth in this period. Since 2008 immigration flows and population growth have come to a sudden stop and the foreign-born share has stabilized around 16%.

The mechanism we have in mind is simple: the large increase in the working-age, foreign-born population would have dramatically boosted the demand for housing. According to the National Immigrant Survey, almost 40% of all immigrants were homeowners in 2007. Additionally, the increased demand for housing rentals is likely to have stimulated the demand for purchases of new housing units as an investment.

[5] The GDP share of the construction sector in the US ranged between 4.1% and 4.9% over the period 1998-2008. For the EU15, it increased from 5.5% to 6% between 2000 and 2005.

We focus on two outcomes: housing prices and changes in the stock of housing units, which mainly reflects the construction of new residential units.[6] Methodologically, we exploit the large regional variation in immigration flows across Spain and use instrumental variables to identify the causal effect of immigration, both on house prices and on housing supply at the regional level. Our instrumental-variables strategy combines the use of two instruments: the classic ethnic networks instrument (Card, 2001) and a novel instrument based on the accessibility of each Spanish province from the point of view of each immigration country of origin. The latter instrument is meant to exploit identifying variation arising from immigration flows from new countries of origin. By construction, this source of variation is not used by the ethnic networks instrument. We think that this instrument may prove helpful for other countries with relatively recent experience as immigration-destination countries.

Based on our instrumental variables estimates, immigration into a province leads to sizeable increases in both the price of housing and in construction activity. A migration-driven 10% increase in population leads to an increase in house prices of 10 to 16% in the following year, and an 8.4 to 10% increase in the number of dwellings (due to new construction activity).

This paper makes several. First, Spain is an interesting episode that has not been examined, characterized by large variation both in housing market outcomes and in immigration flows. Second, we study both the effects on housing prices, as is common in the US literature, but also on the stock of housing units. This provides a more comprehensive picture of how the housing market responded to the immigration shock. Finally, our data allow us to measure housing market outcomes and regional immigrant concentration annually with high, as opposed to having

[6] We cannot study housing rents as the data are not available. This is not a terrible omission because the rental market in Spain is relatively small, as a result of many decades of heavy regulation. According to the 2001 Census, only 11% of the Spanish population lived in rental units in 2001.

to rely on decennial Census data, as is typically the case in the literature.[7] This allows us to compare long-differences estimates with analysis carried out at an annual frequency.

Methodologically, our paper is closely related to the literature studying the causal effects of immigration on housing prices and rents in the US using a spatial correlations approach.[8] Saiz (2007) estimates the effects of immigration on housing prices and rents in US metropolitan areas. According to his instrumental variables estimates, an immigration flow that increases population by one percent leads to a 1% increase in rents and a 3% increase in house prices.[9] Ottaviano and Peri (2007) investigate empirically the effects of immigration on the labor and rental markets using data for US states.[10] Their estimates suggest that the rent-elasticity of immigration is around 0.7, and between 1 and 2 for housing prices. Greulich et al. (2004) focus on the housing consumption patterns of immigrants.[11] Our paper is also related to two other strands of literature. First, it relates to the recent work on the effects of immigration on the price level and, in particular, on the prices of non-traded goods. Some important recent contributions are Cortes (2008) for the US and Frattini (2009) for the UK.[12] Second, our paper also touches upon the recent literature studying the effects of the recent wave of immigration on the Spanish labor market. Some important contributions are Carrasco, Jimeno and Ortega (2008), Amuedo-Dorantes and De la Rica (2007, 2010, 2011a, 2011b), Farre et al (2011), or Gonzalez and Ortega (2010), among others.

[7] In the labor market context, Aydemir and Borjas (2005) have argued that measuring immigrant concentration using the usual samples of Census data may lead to severe attenuation bias in the estimates. Arguably, our estimates based on Registry data do not suffer from this bias (Farre, Gonzalez and Ortega, 2009).
[8] See Dustmann, Frattini and Glitz (2008) for an overview of the spatial correlations approach and alternative approaches to estimating the effects of immigration.
[9] Saiz (2003) analyzes the effect of the 1980 Mariel Boatlift on Miami's housing market.
[10] Ottaviano and Peri (2005, 2006) also study the relationship between immigration and housing prices, although that is not the main focus of those papers.
[11] These authors also examine the effect of immigration on housing rents across US metropolitan areas, but they do not address endogeneity problems.
[12] Lewis (2003) analyzes the effects of immigration on the structure of production of US states, distinguishing between traded and non-traded sectors.

The remainder of the paper is organized as follows. Section 2 describes the spatial correlations approach and our instruments. Section 3 presents our data sources and descriptive statistics for the main variables used in the analysis. Section 4 contains our main results and sensitivity analysis, and Section 5 concludes. Figures and tables are located at the end of the paper.

2. Methodology

2.1. Specifications

We estimate the impact of immigration on prices and quantities in regional housing markets. We consider two dependent variables: the annual log change in the average price per square meter of housing (in euros), $\Delta \ln P_{r,t,}$ and the change in the log of the stock of housing units, $\Delta \ln H_{r,t}$, in province r and year t. In terms of notation we will use R to denote a larger regional unit that incorporates several provinces. Our main explanatory variable is the annual log change in total population ($\Delta \ln Pop_{r,t}$), but we also present results for the increase in the foreign-born population relative to total population one year earlier ($\Delta M_{r,t}/Pop_{r,t-1}$). Specifically, our regression models for housing prices and quantities are, respectively,

$$\Delta \ln P_{r,t} = \alpha_R + \lambda_t + \mu_{R*}t + \beta \Delta \ln Pop_{r,t} + X'_{r,t}\,\gamma + \delta \ln P_{r,t-1} + \varepsilon_{r,t}, \quad (1)$$

$$\Delta \ln H_{r,t} = \alpha_R + \lambda_t + \mu_{R*}t + \beta \Delta \ln Pop_{r,t} + X'_{r,t}\,\gamma + \delta \ln H_{r,t-1} + \varepsilon_{r,t}, \quad (2)$$

where α_R is a region-specific intercept, λ_t are year dummies, μ_R*t is a region-specific linear time trend, intended to capture regional business cycles, and $X_{r,t}$ is a vector of control variables. In some specifications the regional level will be provinces (50 units) while in others it will be larger regional units (9 units). Note that each regression model includes the lagged dependent variable as a regressor. It is also worth noting that our specifications are already in changes. Thus

they allow for time-invariant, province-specific factors that affect the level of housing prices and quantities. In all specifications, the vector X_{it} includes the change in the employment-population ratio in the province. In additional robustness models, it also includes differential time trends for coastal provinces or an interaction between the initial average housing price and a time trend. Throughout all models we cluster standard errors by province and weight observations by the province's working-age population.

The main coefficient of interest is β, the price-population (quantity-population) elasticity. The magnitude of these coefficients will depend on how elastic the short-run housing supply is. We note that, by using total population growth (including both immigrants and natives) as our main explanatory variable, our estimates are unaffected by the degree of native displacement triggered by immigration.[13]

2.2. Endogeneity and Instruments

Despite controlling for regional trends and changes in labor market conditions at the province level, estimation of β in regression models (1) and (2) by OLS may still suffer an endogeneity bias. The sign of the bias is difficult to predict ex ante. Suppose that, for some reason, a province becomes more attractive. As a result, the demand for housing in that province would increase, leading to higher prices, and, simultaneously, more population (native and foreign-born) would flow into the region. This would induce an upward bias in OLS estimates of β in (1) and (2). However, the bias could well go in the opposite direction. Since we are controlling for economic conditions in the province, it is reasonable to expect that native and foreign-born migrants alike will choose provinces where house prices are rising more slowly, among locations with similar changes in employment rates.

[13] Most existing estimates of native displacement are close to zero. See Card (2001) for the US or Gonzalez and Ortega (2010) for Spain.

In order to overcome the potential endogeneity problem, we follow an instrumental variables approach. Specifically, we rely on two instruments: one based on the settlement patterns of previous immigrants (ethnic networks) and another based on the geographical accessibility of each region (gateways). The main reason to rely on the additional instrument is that migration from several source countries was a novelty for the case of Spain. For example, prior to the period that we study, extremely few Eastern Europeans or Ecuadorians had ever migrated to Spain. As a result, the regional variation in immigration flows from these countries of origin cannot be captured by the ethnic networks instrument. As we explain below, our new instrument, besides being plausibly exogenous, allows us to use this source of variation in the data. We believe that our instrumental-variables approach can be useful for any other countries where immigration flows, at least from some regions of origin, is relatively new.

Ethnic networks. This instrument was first introduced in Card (2001), building on a more primitive earlier version by Altonji and Card (1991), and it has been used in the context of housing markets by Saiz (2007) and Ottaviano and Peri (2007). In essence, it is a predictor for actual population growth (immigrant inflows) into a province, using historical information on immigrant networks defined by country of origin. We expect current location decisions of migrants to be influenced by the location decisions of earlier migrants from the same country of origin. If those previous immigrant settlements were established far back enough in time, their geographical distribution should be uncorrelated with the current province-level distribution of shocks to the demand for housing.

Specifically, we define the following predictor of the current stock of foreign-born population in province i and year t:

$$ZN_{r,t} = \sum_{c} \left(\frac{FB_{c,r,t_0}}{FB_{c,t_0}} \right) \cdot FB_{c,t}, \qquad \text{for } t_0 < t, \qquad (3)$$

where $FB_{c,i,t0}$ is the number of individuals born in foreign country c that inhabited province i in some base year t_0. Thus, the term in parenthesis is the share of c-born individuals that lived in each province in the base year, which provides a measure of the size of that source country network in each province. The only time-varying term in (3) is $FB_{c,t}$, the stock of individuals originated from country c that live in Spain in year t. Hence, an inflow of, say, Polish immigrants into Spain in 2006 will lead to a *predicted* contemporaneous increase in the Polish population in each province in proportion to the size of the Polish enclave in that province in the base year. In practice, we instrument the change in log population, $\Delta \ln Pop_{r,t}$, using the change in the predicted foreign-born population relative to total population in the province in the previous year, $\Delta Z_{r,t}/Pop_{r,t-1}$.

Gateways. Let us now turn to the gateways instrument. The main idea is to exploit the differences in physical accessibility across Spanish provinces. Immigrants enter Spain either by land, sea, or air, and the most common mode of transportation varies widely by country of origin. We consider three main dimensions of accessibility: the existence and size of airports and ports in the province, as measured by passenger traffic in a pre-sample year, and distance to France (and hence the rest of Europe) along the major highways. Given these infrastructures, when there is a surge in immigration from, say, Morocco (presumably driven by economic conditions at origin), those provinces that are more accessible from Morocco will be expected to receive larger inflows. In this example provinces with ports in along the Mediterranean coast will be particularly attractive.

More specifically, the construction of the gateways instrument involves three steps. First, let us define $a_{r,m}$ as the *accessibility of province r through transportation mode m*, where m = air, sea, land, and the sum across all provinces equals one (for each m). The accessibility terms by air and sea are giving by the share of all arrivals into Spain that entered through province r by plane or boat, in year 1999. For the land transportation mode $a_{r,land}$ is defined as the distance from province r's capital city to the city of Girona (close to the French border and right by the main highway connecting Spain and France), normalized in a way that the sum (across provinces) of all these terms adds up to one.

Second, we obtain information on how important each model of transportation is for each country of origin. More specifically, for each mode of transportation m and country of origin c, we define *preference of origin country c for transportation mode m* (denoted by $b_{m,c}$) as the share of all individuals born in country c that entered Spain using transportation mode m in a given year.[14] By construction, these terms also add up to one (across modes of transportation, for any given origin country c).

Third, we now multiply the previous two terms to obtain a province-source country specific term indicating the degree of accessibility by each mode of transportation of each Spanish province from the point of view of each country of origin. By adding up across modes of transportation we obtain *the overall degree of accessibility of each Spanish province from each country of origin*. That is, $\gamma_{r,c} = a_{r,land}\, b_{land,c} + a_{r,sea}\, b_{sea,c} + a_{r,air}\, b_{air,c}$.

The final step is analogous to the construction of the ethnic networks. We use the matrix of $\gamma_{r,c}$ terms to build a predictor of the current stock of foreign-born population in province i and year t:

[14] This information is obtained from the National Immigrant Survey, a large detailed survey of the immigrant population in Spain that was carried out only in year 2007.

$$ZG_{r,t} = \sum_{c} \gamma_{r,c} FB_{c,t}, \qquad \text{for } t_0 < t. \qquad (3)$$

Within-province changes over time in ZG are the basis for our gateways instrument. Consider some economic, social or political event in, say, Ecuador, that triggers a wave of migration out of the country.[15] Our predictor will suggest that if many Ecuadorians choose Spain as their destination, those provinces that are usually gateways for Ecuadorians (mainly, those with an important international airport) will receive a large inflow of Ecuadorians, for reasons uncorrelated with local economic conditions.[16]

3. Data and Descriptive Statistics

3.1. Data sources and variable definition

The two dependent variables, (change in log) house prices and housing stock at the province and year level, are constructed from official data made publicly available by the Spanish Housing Ministry.[17] The data on prices per square meter are provided at the quarterly level; we use only 2nd quarter prices in order to minimize seasonality. The price data include sales of both new and old dwellings. The data on quantities measure the stock of housing units as well as the number of new dwellings completed during a given year. We use both to construct the estimated change in (log) stock.

We measure total (working-age) population and foreign-born population by province and year using the Local Population Registry provided by the National Statistical Institute.[18] Since

[15] Bertoli et al (2011) studies in detail the reasons for the surge, and sharp posterior decline, in Ecuadorian migration to Spain.
[16] As a check, we note that the average across years and provinces for the gateways instrument has to be roughly similar with the average for the networks instrument. After all, both instruments are weighted sums of the Spain-wide stocks of foreign-born by year and region of origin. The Appendix contains the data sources used in the construction of the gateways instrument.
[17] See www.mviv.es.
[18] See www.ine.es.

these data contain the whole population, not just a sample, we are able to measure local immigrant shares accurately for all years in our period of study. These data are available from 1998 onward. Because of changes in the design of the Local Population Registry, the population count in year 1999 is abnormally low. It implies lower native population than the previous or the following years. As a result, the reported 1999-2000 population increase is abnormally high.[19] As a result, we focus our analysis on the period 2000-2010.

Since our population data refer to January 1st of each year, our main explanatory variable is in effect lagged by half a year with respect to the housing market variables. For instance, the number of dwellings built during 2008 (second quarter) is estimated to be a function of the increase in the foreign-born population in the province between January 1st, 2007 and January 1st, 2008.[20]

As main macroeconomic control, we use the male employment-population ratio (EPR), constructed from Spanish Labor Force Survey data. Finally, the networks instrument is constructed using Registry data to measure the national annual migration inflow by country of origin, and 1991 Census data to construct early migrant settlement patterns by province, also by source country.[21] Since the 1991 Census captures immigrants that arrived in Spain in 1990 or earlier, the lag with respect to our period of interest is between 8 and 18 years. The gateways instrument uses data from the 2007 National Immigrant Survey as well as a variety of other sources listed in the Appendix.

[19] In addition the implied change in total population in this year is much larger than the change in the foreign-born population, which is completely out of line with the demographic trends of the period we are considering (see Figure A2 in the Appendix).
[20] We also experiment with more lags of the explanatory variables (see robustness checks in section 4.4).
[21] The 1991 Census groups countries of origin for the foreign-born population into 16 broader "regions".

3.2. Descriptive Statistics

Table 1 contains the summary statistics for all variables used in the analysis. The number of observations is 500, that is, 50 Spanish provinces, times the 10 one-year intervals from 2000 to 2010.[22]

The average increase in housing prices across provinces and years was 7 log-points per year. Panel 1 of Figure 2 shows that the average (national) price level was 760 euros per square meter in 1998, reaching almost 2,100 euros in 2008. This implies a 175% increase over the 1998-2008 period. The annual growth rate was on average above 10% during the boom years. It started below 5% in 1998, increased steadily to reach 19% in 2003, and fell sharply after 2005. By the end of 2008, housing prices had started to fall, a fall that continued until 2010.

There was a great deal of variation across provinces in both the initial level and the change in prices over the period. Between 1998 and 2008, the total price increase at the province level ranged from 526 to 2,074 euros (with a median of 1,057 euros). Madrid and Barcelona (the two most populated metropolitan areas) were among the top 5 provinces in terms of price increases during the period.

New construction activity increased the stock of housing units by an average of about 2.3 log-points each year. Panel 2 of Figure 2 illustrates the large construction boom in terms of the number of new dwellings built annually. Roughly 225,000 new dwellings were built nationally in 1998. Construction activity increased practically in every year until peaking at 600,000 units in 2006, and started falling after that, with the fall accelerating in 2009. The total increase in construction activity between 1998 and 2008 amounted to an impressive 262%. There was also

[22] We omit from the analysis the two Spanish provinces located in North Africa (Ceuta and Melilla). They are very small in size and outliers regarding the foreign-born share.

an increase in new dwellings per capita. In 1998, 8 new dwellings were completed per 1,000 working-age individuals. The analogous figure was 20 in 2006.

Residential construction activity also varied a lot across provinces. Roughly speaking, construction of new housing was most intense along the Mediterranean coast and around Madrid. Between 1998 and 2008, the number of new dwellings built by province ranged from about 12,000 to more than 450,000. In terms of absolute figures, construction was the largest in Barcelona and Madrid. However, once we normalize by initial population, the flow of new construction in these two provinces is less impressive (below the 30th percentile).[23]

Turning to population changes (our main explanatory variable), provincial working-age population increased by an average of 1.4 log-points a year. Essentially all of this population increase can be attributed to immigration (see panel 3 of figure 2). The immigrant share in provinces' population increased by about 1.5 percentage points per year. The foreign-born share in the working-age population increased from 2 to 16% nationally between 1998 and 2008, as illustrated by Figure 3.1. In levels, the foreign-born, working-age population increased from less than 500,000 to 5 million, while the total working-age population increased from 26.7 to 31.3 million (see Figure A1). This implies that immigration was responsible for 98% of total population growth during the period (see Figure 3.2). The main countries of origin of the foreign-born population were Romania (the source country of 12% of all immigrants), Morocco (11%) and Ecuador (8%), followed by the UK (6%), Colombia (5.5%) and Argentina (4.8%).[24] In the 2008 cross-section, the foreign-born share ranged from 4 to 27% across provinces (Figure 4). Immigrant concentration was highest along the Mediterranean coast, in the islands and around Madrid.

[23] This may reflect space constraints in high-density urban areas. The unavailability of land provides greater incentives to reform older housing units rather than demolishing older units and replacing them with new buildings.
[24] Local Population Registry, 2008.

Figure 5 provides a graphical illustration of the correlation between immigration inflows and the housing market variables. The horizontal axis (in both panels) is the change in (log) working-age population between 2000 and 2010, by province. The values range from close to 0 to almost 50 log-points. In the first panel, the vertical axis shows the change in (log) housing prices during the period. We also include a linear fit. There is a clear positive association between population growth (immigration) and housing prices. The slope coefficient is significant at the 95% confidence level and implies a price-population elasticity of 0.4. In the second panel, the vertical axis reports the change in the (log) number of dwellings during the decade. Provinces with higher migration inflows were also characterized by higher residential construction activity, with a quantity-population elasticity of 0.5 (also significantly different from zero).

In the next section, we provide a more formal analysis by estimating equations (1) and (2) at an annual frequency and accounting for the potential endogeneity issues by using instrumental variables.

4. Results

This section presents our estimates for the effects of immigration on housing markets, both regarding prices and quantities. We begin by presenting the OLS results, and then discuss the first-stage and the IV estimates.

4.1. OLS results

4.1.1 House Prices

Our dependent variable is the annual change in log price of housing (per square meter) in a province. The main explanatory variable is the change in log population (see equation 1). Table 2 (first row) reports our OLS estimates. Column 1 reports the basic specification, including only

year dummies as controls. Column 2 controls for the change in the employment-population ratio in the province, as well as the level of (log) housing prices, lagged one period. Specification 3 adds regional dummies in an attempt to capture unobservable geographical differences in trends, due to, for example, changes in policies or regulations across different regional governments.[25] This is our preferred specification. Specifications 4 and 5 contain additional controls, respectively including 50 province dummies instead and region-specific linear trends in price changes.[26] Finally, columns 6 to 8 replicate specifications 3 to 5 for the period 2001-2008, where we leave out the years of the housing bust. During these years the economy was severely distressed and net foreign migration into many provinces became negative or zero. All our regressions are population-weighted, and we report heteroskedasticity-robust standard errors clustered by province.

The estimated coefficient for our main explanatory variable is 0.466 in the basic specification (column 1), and highly significant. Including the controls increases it size slightly (0.596). We next add macro-region dummies (column 3), which delivers a price-population elasticity equal to 0.496 in our preferred specification, which is statistically significantly different from zero. When we add province dummies the estimated coefficient rises to 0.87 (column 4) and falls to 0.28 when we replace them by regional trends (on the change of log prices). When we restrict the estimation sample to the years prior to 2009, our preferred specification remains almost unchanged at 0.468 (column 7). The coefficients on columns 7 and 8 are also very similar to

[25] We partition the 50 provinces into 9 regions. Our partition is constructed as follows. If an autonomous community has more than three provinces we define it as a regions. Otherwise we aggregate autonomous communities by regional proximity. The resulting nine regions are: (1) Catalunya, (2) Valencia and Murcia, (3) Andalucia, (4) Castilla La Mancha and Madrid, (5) Castilla Leon and Extremadura, (6) Galicia, Asturias and Cantabria, (7) Basque country, Navarra and La Rioja, (8) Aragon, and (9) Canary and Balearic islands.

[26] While these two specifications allow us to absorb additional potentially confounding effects, they are also overly demanding on our data and may increase the noise to signal ratio.

those obtained in the comparable estimates based on the same specifications (columns 4 and 5). In short, based on our preferred estimates the OLS price-population elasticity is around 0.5.

4.1.2 Construction of new dwellings

The dependent variable is now the annual change in the log stock of housing in a province. The main explanatory variable is again the change in log population. The second row of Table 2 reports the OLS estimates. The estimated coefficient is 0.38 in the basic specification (column 1), and highly significant. Including the controls again increases its size slightly (0.48). In our preferred specification (column 3), the estimated quantity-population elasticity is 0.384 and is estimated with high precision. The inclusion of province dummies (column 4) renders the coefficient small and insignificant and the inclusion of regional trends (on the changes in housing stock) deliver an elasticity of 0.466 (column 5). Again, the estimation of the specifications in columns 3 through 5 on the pre-2009 sample delivers very similar results.

4.2. First-stage regressions

Table 3 reports the first-stage regressions associated with our main specifications. The dependent variable is the annual change in log total population in a province. The main explanatory variable is the instrument: the change in the predicted foreign-born population relative to the total initial population, either based on "networks" (columns 1 and 2) or on "gateways" (columns 3 and 4), or both (columns 5 and 6).[27] We report the results for our preferred specification, containing year dummies, 9 region dummies and controls, for the full period and for pre-2009.

The first panel presents the first-stage corresponding to the price regressions.[28] Both instruments are strongly significant and lead to F-statistics above 10 in every specification. Both

[27] See section 2 for the exact definition of the instruments.
[28] The only difference between the first-stage regressions for prices and quantities is that the former controls for the lagged log price and the latter for the lagged log stock of housing.

instruments are stronger for the 2000-2008 sub-period, compared with including 2009-2010. It appears that networks and gateways are better at explaining immigrant location patterns at arrival versus return migration patterns.[29] The first-stage results for the quantities specifications are reported in the second panel. The patterns are very similar: both instruments are strong, especially when we exclude 2009 and 2010 data. Coefficients range from 0.25 to 0.47 for the networks IV, and from 0.05 to 0.29 for the gateways one.

Thus, our instruments are able to predict current annual population changes and satisfy the standard relevance requirement.[30] The strength of the networks instrument is mainly driven by two immigrant groups: South Americans and Moroccans. These two source regions were among the most frequent both in 1991 and in recent inflows, and early enclaves seem to have played a role. In 1991, 18.5% of the foreign-born population was of South American origin, while 14% were from Morocco. Well represented were also several EU countries, such as France (16% of the foreign-born population), Germany (10%) and the UK (8%). In 2008, South Americans made up 33% of all immigrants, while Moroccans were 11%.[31]

While early immigrants of all origins were likely to settle in Madrid or Barcelona, in 1991 there were some differentiated country-specific location patterns. For instance, important Moroccan communities were already established in some provinces in the South-Eastern coast (Malaga hosted 10% of all Moroccan immigrants, and Alicante, 4%), probably based on both geographical proximity and a flourishing tourism sector. South American immigrants, on the

[29] Since the beginning of 2009 net immigration flows into Spain fluctuate around zero. We also note that while the Population Registry reflects arrivals very accurately, departures are recorded with some noise as many immigrants do not report the departure.

[30] When we include province dummies or linear regional trends our instruments weaken substantially. While theoretically preferable those specifications turn out to be excessively demanding on our data. Our specifications are comparable to others in the literature in terms of fixed effects and trends.

[31] Other EU countries were represented in much lower proportions, with the UK as the most numerous one at 6% of the foreign-born population. For update figures on Spanish immigration see http://www.inside.org.es/spanish-immigration-figures/ .

other hand, had sizeable settlements in the Canary Islands (10% of South American immigrants lived in the province of Tenerife), as well as in the North-West (6% in Pontevedra and 5.5% in Coruna). These patterns are likely to be related to the out-migration of Spaniards from those regions to South-America in the early twentieth century. The 2008 regional distribution of immigrants by country of origin shows some persistence in the destination choices of South American and Moroccan immigrants, although some newly popular regions had emerged. Madrid and Barcelona remain at the top, but for Moroccans, they are followed by Murcia and Malaga, with Alicante in 7th place. As for South Americans, Tenerife ranks 7th, while Pontevedra and Coruna remain in the top third of the distribution. These patterns suggest that early immigrant networks likely played a significant role in the location decisions of more recent South American and Moroccan immigrants.

As described earlier, our gateways instrument is an aggregation of three predictors for the change in the foreign-born population. Each of these predictors is based on a mode of transportation, namely, by air travel, sea travel and accessibility from Europe via major highways. In auxiliary regressions (available upon request) we find that the components of the instruments that have predictive power are those based on air travel and accessibility by highways. Sea travel is quantitatively too small to have any explanatory power.

4.3. IV results

Let us now turn to the IV estimates, displayed in Table 4, which has the same structure as Table 3 (first-stage regressions). The OLS estimates for the same identical specifications can be found in columns 3 and 6 of Table 2.

4.3.1 House prices

The networks instrument results (columns 1 and 2 of Table 4) lead to estimated effects that almost double in magnitude the corresponding OLS estimates, with point estimates implying a price elasticity almost equal to 1. However, standard errors are high, and the IV coefficients in these columns are not statistically different from 0.

The gateways instruments leads to coefficients between 0.73 and 1 (columns 3 and 4), statistically significant in the specification for the 2000-2008 subperiod. Finally, columns 5 and 6 report the results obtained when we instrument using both the networks and gateways instruments. Now the estimated effects range between 0.87 and 1. Again we obtain significant estimates only when restricting to the sample years prior to the housing bust. As noted earlier years 2009-2010 were characterized by a very large recession and generally distressed labor and housing markets. It is worth noting that the IV point estimates for the price elasticities are very similar across the six specifications.

In sum, the IV results suggest that the price-population elasticity is slightly below one.

4.3.2 Construction of new dwellings

We now turn to the effects of immigration on residential construction. Our dependent variable is now the change in the log of the number of housing units built (see equation 2). The main explanatory variable is again the change in log total population in the province. The results can be found in the second row of Table 4.

The networks IV results (columns 1 and 2) suggest a high elasticity of construction activity with respect to population changes, with coefficients around 1.1-1.2 (statistically significant). Magnitudes are smaller and not statistically significant when we use the gateways instrument alone (columns 3 and 4. Finally, when we use both instruments jointly (columns 5 and 6), the

estimates are close to 1 and again significant at conventional levels. As before, the estimates are more precise (in terms of standard errors) in the years prior to the housing (and labor) market bust. We also note that the IV coefficients are always higher than the corresponding OLS (see Table 2, columns 3 and 6).

In sum, our preferred IV results suggest that both the price and quantity population elasticities are around one. That is, immigration-driven population growth leads to roughly proportional increases in housing prices and in the stock of housing units in the short run. Next section discusses the results of several additional specifications, including additional controls and longer-than-annual changes.

4.4. Additional specifications and robustness checks

This section reports the results of our sensitivity analysis on the main findings presented above. We focus on the specification that includes region dummies and years 2001-2008 (column 6 in Table 2), and on the IV results based on both instruments jointly (column 6 in Tables 3 and 4).

Table 5 reports the results of several additional specifications for both prices and quantities (OLS and IV). As a benchmark for comparison, column 1 reports our preferred estimates for the effects on housing prices (top panel) and on the stock of housing units (bottom panel). We report 8 variations on the baseline specification. Columns 2 and 3 use, as the main explanatory variable, changes in immigrant population instead of total population. Column 2 defines it as the change in the foreign-born (working-age) population over total population in the previous year, and column 3 uses the change in the immigrant share. The resulting IV estimates are very similar to the baseline results.[32]

[32] Note that only the coefficients on column 2 are directly comparable to those in column 1. They should be interpreted as the percentage increase in prices or quantities resulting from an increase in the foreign-born population equal to one percent of the total population.

Column 4 lags population growth by one year, since both construction and prices may take longer than 1 year to react to new arrivals. The resulting coefficients are slightly higher and remain quite precisely estimated. All our specifications include the lagged level of the dependent variable (quantities or prices) as a control. In column 5, we instrument this lagged level with its previous lag (à-la Anderson- Hsiao). Our conclusions remain fairly robust. Our main population counts include only working-age adults. Children are implicitly assumed to always share housing with at least one adult. However, the omission of the elderly may not be innocuous, especially since a considerable number of older (retired) foreigners from other EU countries have moved to Spain in recent years, potentially contributing to increasing housing demand. Specification 6 thus includes individuals aged 65 and above in our population counts. The results show that this omission barely affects our results.

Column 7 includes as an additional control a binary variable indicating provinces with access to the coast ("beach"), interacted with a linear time trend. This is meant to capture a potential long-term increase in the demand for vacation houses. Our IV coefficients are slightly lower in this specification, but remain large and strongly significant.

Since one may worry that our results could be driven by the largest metropolitan areas in Spain, specification 8 drops the provinces containing Madrid and Barcelona, by and large Spain's two biggest cities, from the analysis. While the effect on quantities is unchanged, the estimated effect on prices is slightly lowered (from 1 to 0.78), suggesting that Madrid and Barcelona play an important role in understanding the impact of immigration on house prices. Finally, in column 9 we include an interaction term between initial price levels in each province and a linear time trend, in order to capture long-term trends in prices. The estimated effects remain significant for both prices and quantities, although the magnitude is reduced in the price

specification. In sum, our main results are robust to the previous sensitivity checks. Our IV estimated elasticities are around 1, both for prices and quantities, compared to point estimates around 0.5 in OLS.

As a final sensitivity analysis, we report a series of estimates based on long (5-year) differences. The OLS and IV results of the long-differences analysis are reported in Tables 6A and 6B, respectively. In OLS the price coefficients range from 0.4 to 1.2 and the quantities coefficients between 0.25 to 0.9.

Table 6B presents our IV estimates. Columns 1 and 2 use the ethnic networks instrument. Columns 3 and 4 use the gateways instrument, and columns 5 through 7 use both instruments jointly. The latter is our preferred set of estimates. We note that column 6 now includes province fixed effects. Column 7 estimates the model taking into account that the lagged dependent variable is an additional source of endogeneity. We do so following Anderson and Hsiao (1982), which in our case is equivalent to the estimator proposed by Arellano and Bond (1991). In general the IV coefficients are again larger than their OLS counterpart, as was the case with the annual regressions. The estimated price elasticities are now around 1.5. As for quantities, the preferred IV estimates are below one, in the 0.7-0.8 range. In sum, the magnitudes are thus similar to those obtained from the year-to-year regressions. These results suggest that measurement error in the year-to-year variables is not a large concern.

5. Conclusions

We show that Spain's large immigration wave during the 2000's had large effects on the housing market, both on prices and quantities. By our measures the effects on the housing market were proportional to the demographic consequences of the immigration wave. Hence, to a large extent,

the reason why the housing boom was larger in Spain than in the US and in other European countries is due to the larger inflows of immigrants, relative to population.

Between 1998 and 2008, the average Spanish province received an immigrant inflow amounting to about 17% of its initial working-age population (net inflows were effectively zero in 2009 and 2010). We estimate that, over the whole decade, this population inflow increased house prices and the stock of housing by at least the same amount. Overall we conclude that immigration was responsible for about 25% of the increase in housing prices and more than 50% of the increase in the housing stock.

Overall, immigration affected the housing market both through demand and supply. Immigrants increased the demand for housing, either directly as homeowners or indirectly as renters.[33] But, in addition, a large fraction of the (male) immigrants that arrived in Spain over the last decade became employed in the construction sector.[34] In the absence of immigration, the supply of housing would probably have been much more inelastic, limiting construction activity and resulting in an even larger increase in the price of housing.

[33] According to the 2001 Census, 42% of Spanish residents with foreign nationality (which can be thought of as recent immigrants) were homeowners.

[34] In 2008, about 600,000 foreign-born individuals were employed in construction, amounting to 25% of total employment in the sector (Labor Force Survey 2008). In the same year, employment in construction was 12% of total employment in the economy.

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Table 1. Descriptive statistics (2001-2010)

Variable	Mean	Std. Dev.	Min	Max
Change in log of housing price				
ΔlnP	0.0701	0.0860	-0.1682	0.3192
Change in log of housing stock				
ΔlnQ	0.0228	0.0125	0.0037	0.0922
Change in log of population				
ΔlnPop	0.0147	0.0136	-0.0146	0.0696
Change in immig. over lagged pop.				
$\Delta M/Pop_{t-1}$	0.0147	0.0107	-0.0102	0.0596
Change in immigrant share				
Δ(M/Pop)	0.0127	0.0087	-0.0079	0.0463
Networks instrument	0.0114	0.0144	-0.0500	0.0709
Gateways instrument	0.0112	0.0208	-0.1163	0.1295
Lagged employment-pop ratio	0.5051	0.0585	0.3285	0.6299
Lagged log price	7.27	0.44	6.17	8.03
Lagged log stock	13.36	0.92	10.94	14.77

Note: The number of observations is 500, corresponding to 50 provinces and year-to-year changes from years 2001 through 2010. We report population-weigthed averages. The price of housing is measured in euros per square meter. The stock of housing is reported in units of housing. *M* is the foreign-born, working-age population in a given province and year, *Pop* is the total working-age population of the province (natives plus immigrants). The instruments are defined in the Methodology section. The *Networks* instrument is the predicted annual change in the foreign-born population based on the 1991 regional distribution of immigrants by country of origin. The *Gateways* instrument is the predicted annual change in the foreign-born population based on the accessibility of each Spanish province by air, land and sea.

Table 2. OLS results, prices and quantities

Coefficients reported for main explanatory variable:
Change in log total population

Dependent variable	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Change in log price	0,466 ***	0,596 ***	0,496 **	0,87 ***	0,28 *	0,468 **	0,616 **	0,38 ***
	(0,153)	(0,196)	(0,244)	(0,255)	(0,153)	(0,234)	(0,298)	(0,141)
Change in log quantity	0,378 ***	0,478 ***	0,384 ***	0,046	0,466 ***	0,409 ***	0,045	0,463 ***
	(0,109)	(0,110)	(0,127)	(0,092)	(0,148)	(0,144)	(0,115)	(0,159)
N	500	500	500	500	500	400	400	400
Years	2001-10	2001-10	2001-10	2001-10	2001-10	2001-08	2001-08	2001-08
Region dummies (9)	N	N	Y	N	Y	Y	N	Y
Province dummies (50)	N	N	N	Y	N	N	Y	N
Region trends	N	N	N	N	Y	N	N	Y
Controls	N	Y	Y	Y	Y	Y	Y	Y

Note: All specifications include year dummies and are weighted by working-age population in the province. Standard errors are clustered by province. One asterisk indicates significance at the 90% level, two indicate 95%, and three, 99%. Control variables include the change in the employment-population ratio in the province, and lagged log price (in the price specifications) or lagged log quantity (in the quantities specifications).

Table 3. First-stage regression results

Dep. var.: Change in log population

	1	2	3	4	5	6
Prices						
Networks instrument	0,255 ***	0,374 ***			0,196 ***	0,264 ***
	(0,062)	(0,079)			(0,068)	(0,079)
Gateways instrument			0,123 ***	0,341 ***	0,082 **	0,274 ***
			(0,036)	(0,056)	(0,035)	(0,051)
F excluded instruments	17	22,6	11,7	37,2	10,4	26,7
Quantities						
Networks instrument	0,288 ***	0,474 ***			0,252 ***	0,387 ***
	(0,060)	(0,069)			(0,065)	(0,074)
Gateways instrument			0,105 ***	0,291 ***	0,047 *	0,164 ***
			(0,032)	(0,052)	(0,029)	(0,045)
F excluded instruments	23	47	11,1	30,8	12,4	32,1
N	500	400	500	400	500	400
Years	2001-10	2001-08	2001-10	2001-08	2001-10	2001-08
Instrument	networks	networks	gateways	gateways	both	both

Note: All specifications include year dummies, macro-region dummies (9) and controls, and are weighted by working-age population in the province. Standard errors are clustered by province. One asterisk indicates significance at the 90% level; two indicate 95%; and three, 99%. Control variables include the change in the employment-population ratio in the province, and lagged log price (in the price specifications) or lagged log quantity (in the quantities specifications). The instruments are defined in the Methodology section. The Networks instrument is the predicted annual change in the foreign-born population based on the 1991 regional distribution of immigrants by country of origin. The Gateways instrument is the predicted annual change in the foreign-born population based on the accessibility of each Spanish province by air, land and sea.

Table 4. Instrumental-variables estimates, Housing prices and quantities

Coefficients reported: Change in log population

Dependent variable	**1**	**2**	**3**	**4**	**5**	**6**
Change in log price	0,959	0,927	0,731	1,043 **	0,866	0,997 **
	(0,984)	(0,596)	(0,703)	(0,419)	(0,803)	(0,424)
Change in log quantity	1,193 **	1,121 **	0,428	0,664	1,05 *	0,986 **
	(0,596)	(0,487)	(0,535)	(0,527)	(0,578)	(0,491)
N	500	400	500	400	500	400
Years	2001-10	2001-08	2001-10	2001-08	2001-10	2001-08
Instrument	networks	networks	gateways	gateways	both	both

Note: All specifications include year dummies, macro-region dummies (9) and controls, and are weighted by working-age population in the province. Standard errors are clustered by province. One asterisk indicates significance at the 90% level; two indicate 95%; and three, 99%. Control variables include the change in the employment-population ratio in the province, and lagged log price (in the price specifications) or lagged log quantity (in the quantities specifications). The instruments are defined in the Methodology section. The Networks instrument is the predicted annual change in the foreign-born population based on the 1991 regional distribution of immigrants by country of origin. The Gateways instrument is the predicted annual change in the foreign-born population based on the accessibility of each Spanish province by air, land and sea.

Table 5. Robustness checks, prices and quantities

Exp. var.: Change in log pop.

	Baseline		ΔM/pop		Δ(M/pop)		Lagged pop		A-Hsiao		All ages		Beach*t		Exc. M&B		P0*t	
	1		2		3		4		5		6		7		8		9	
Prices OLS	0,468	**	0,574		0,754	*	0,639	*	0,468	**	0,629	**	0,394	*	0,319	*	0,445	***
	(0,234)		(0,344)		(0,448)		(0,365)		(0,234)		(0,271)		(0,217)		(0,178)		(0,160)	
Prices IV	0,997	**	1,129	**	1,506	**	1,264	**	1,133	**	1,049	**	0,961	**	0,775		0,569	*
	(0,424)		(0,530)		(0,694)		(0,537)		(0,448)		(0,525)		(0,422)		(0,483)		(0,331)	
Quantities OLS	0,409	***	0,378	**	0,363		0,435	***	0,409	***	0,495	***	0,366	***	0,541	***	0,403	**
	(0,144)		(0,184)		(0,218)		(0,099)		(0,144)		(0,162)		(0,119)		(0,141)		(0,155)	
Quantities IV	0,986	**	1,067	*	1,409	*	1,193	*	0,905	**	1,057	**	0,899	**	1,118	**	0,901	*
	(0,491)		(0,619)		(0,850)		(0,614)		(0,446)		(0,517)		(0,449)		(0,546)		(0,522)	
N	400		400		400		400		400		400		400		384		400	
Years	2001-08		2001-08		2001-08		2001-08		2001-08		2001-08		2001-08		2001-08		2001-08	

Note: All specifications include year dummies, macro-region dummies (9) and controls, and all but spec. 9 are weighted by working-age population. Standard errors are clustered by province. One asterisk indicates significance at the 90% level; two indicate 95%, and three, 99%. Control variables include the change in the employment-population ratio in the province, and the lagged level of the dependent variable (lagged log price or lagged log quantity).

Column 2: Main explanatory variable, change in immigrant population over previous year population (instead of change in log of total pop).
Column 3: Main explanatory variable, change in immigrant share (instead of change in log of total pop).
Column 4: Main explanatory variable (change in log of total pop) lagged one year.
Column 5: Lagged level of the dependent variable instrumented with previous lag (Anderson-Hsiao instrumental-variables estimator).
Column 6: All ages included in population, instead of only working-age.
Column 7: Additional control, dummy for coastal provinces interacted with linear trend.
Column 8: Madrid and Barcelona (biggest cities) excluded from sample.
Column 9: Additional control, initial price interacted with linear trend.

Table 6. Long-differences estimates, Housing prices and quantities

A. OLS estimates

OLS **Dependent var.**	1	2	3	4	5
Change in log prices	0.513** [0.200]	0.877** [0.329]	0.818* [0.415]	1.241** [0.485]	0.413* [0.233]
Change in log quantities	0.483*** [0.115]	0.629*** [0.161]	0.761*** [0.154]	0.250 [0.299]	0.929*** [0.200]
N	100	100	100	100	100
Controls	N	Y	Y	Y	Y
Region dummies (9)	N	N	Y	N	Y
Province dummies	N	N	N	Y	N
Region trends	N	N	N	N	Y

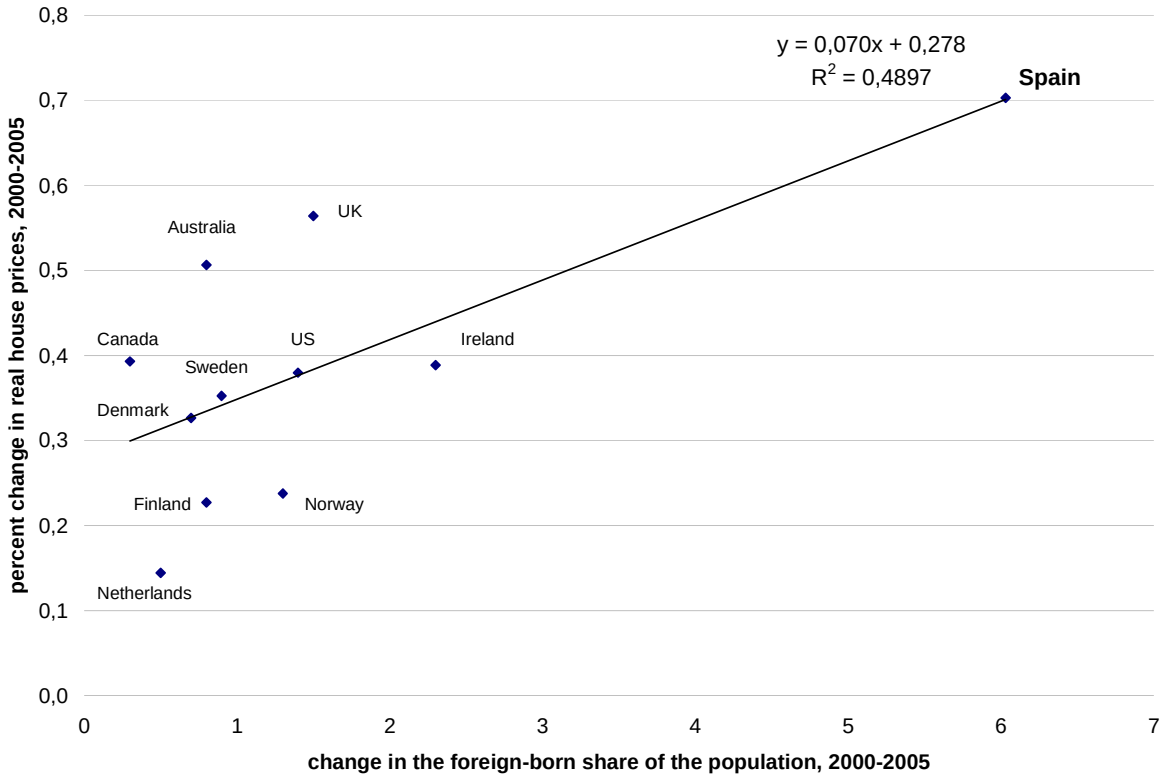
Note: The regressions are based on 3 long-differences, using only observations for years 2000, 2005 and 2010. All specifications include year dummies and are weighted by working-age population in the province. Standard errors are clustered by province. One asterisk indicates significance at the 90% level; two indicate 95%, and three, 99%. Control variables include the change in the employment-population ratio in the province, and the lagged log price or lagged log quantity in the price and quantity regressions, respectively.

B. Instrumental-variables estimates

IV	1	2	3	4	5	6	7
Change in log prices	1.625*	1.522***	0.758	1.962***	1.398*	1.559***	1.637**
	[0.874]	[0.414]	[0.783]	[0.298]	[0.808]	[0.390]	[0.702]
Change in log quantities	1.361**	0.855***	0.828	0.568*	1.329**	0.839***	0.718***
	[0.573]	[0.305]	[0.527]	[0.296]	[0.567]	[0.302]	[0.204]
N	100	100	100	100	100	100	50
Instrument	networks	networks	gateways	gateways	both	both	both
Controls	Y	Y	Y	Y	Y	Y	N
Region dummies (9)	Y	N	Y	N	Y	N	N
Province dummies	N	Y	N	Y	N	Y	Y
Region trends	N	N	N	N	N	N	N

Note: The regressions are based on 3 long-differences, using only observations for years 2000, 2005 and 2010. All specifications include year dummies and are weighted by working-age population in the province. Standard errors are clustered by province. One asterisk indicates significance at the 90% level; two indicate 95%, and three, 99%. Control variables include the change in the employment-population ratio in the province, and the lagged log price or lagged log quantity in the price and quantity regressions, respectively. Specification 7 uses the Anderson-Hsiao estimator, which here is identical to the Arellano-Bond estimator, and does not control for the change in the employment-population ratio.

Figure 1. Immigration and house prices (11 OECD countries, 2000-2005)

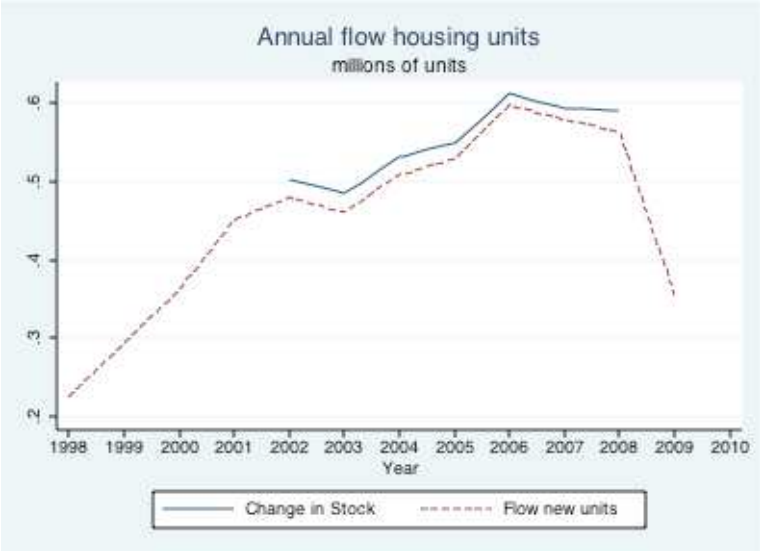


Sources: Migracion Policy Institute (www.migrationpolicy.org) and Bank for International Settlements (www.bis.org).

Figure 2. Housing prices and quantitites, 1998-2010.

Figure 2.1. Average price per square meter of housing in euros (2nd quarter)

Figure 2.2. Flow of new dwellings completed and annual change in stock of units.



Source: Spanish Ministry of Housing.

Figure 3: Immigration and population growth.

Figure 3.1. Foreign-born share in the working-age population, 1996-2010.

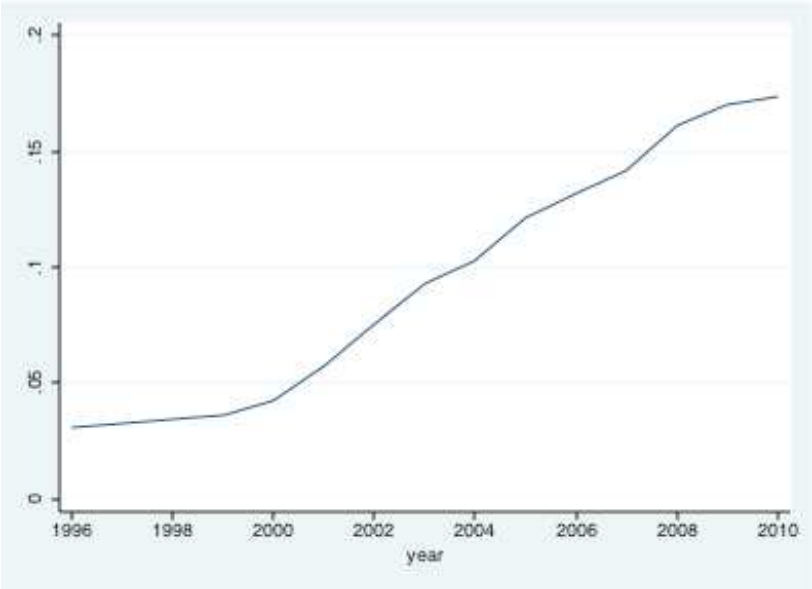
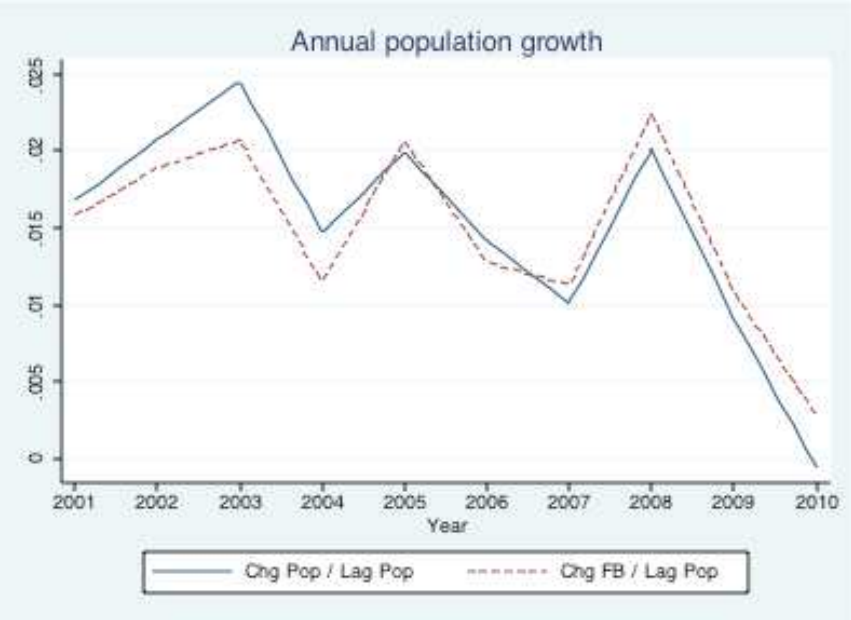
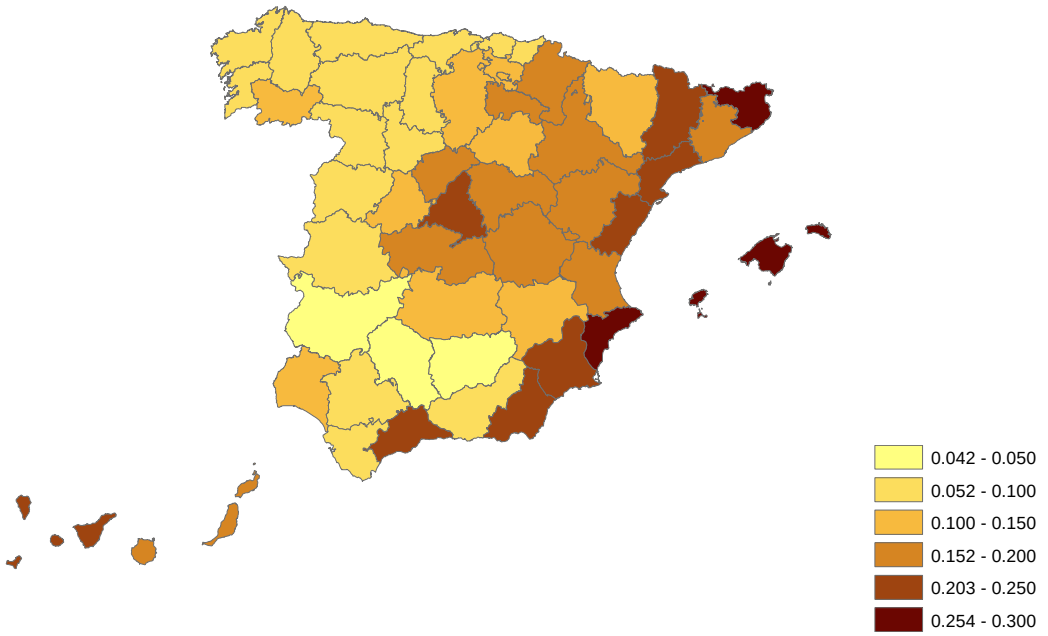


Figure 3.2. Annual population growth and contribution of the foreign-born population.



Source: Local Population Registry.

Figure 4. Immigrant concentration by province, 2008



Note: The figure displays the foreign-born share in the working-age population by provinces in Spain, as of January 1st, 2008 (Local Registry data).

Figure 5. Growth in average housing price and in stock of housing, 2000-2010.

Figure 5.1. Log change in average housing prices.

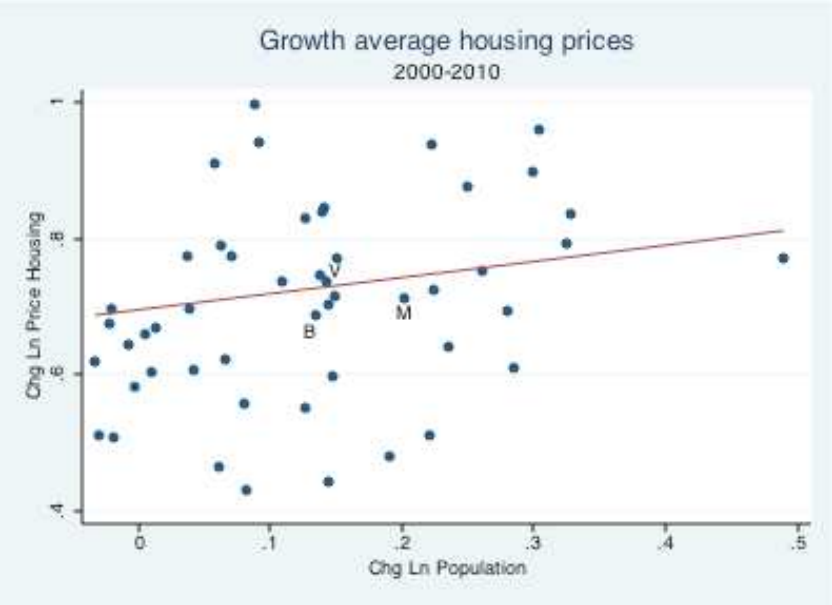
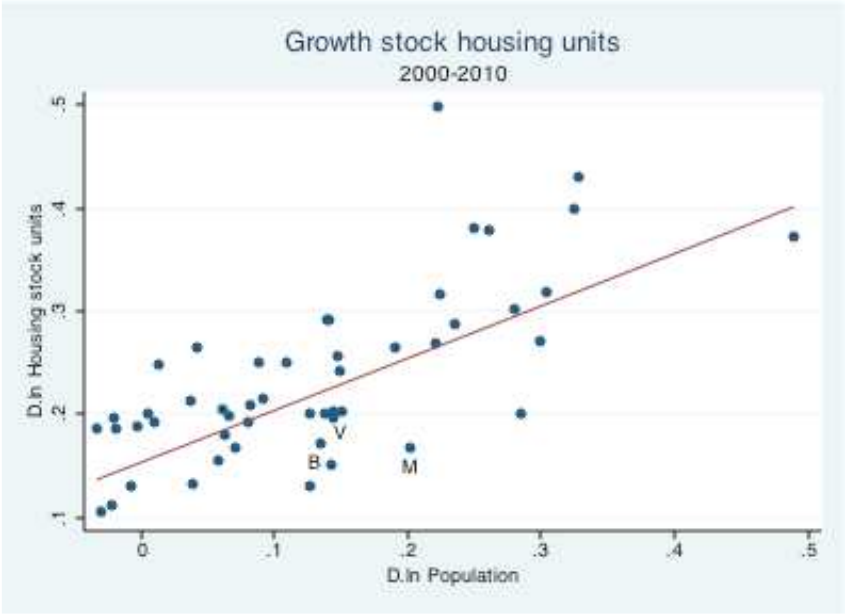


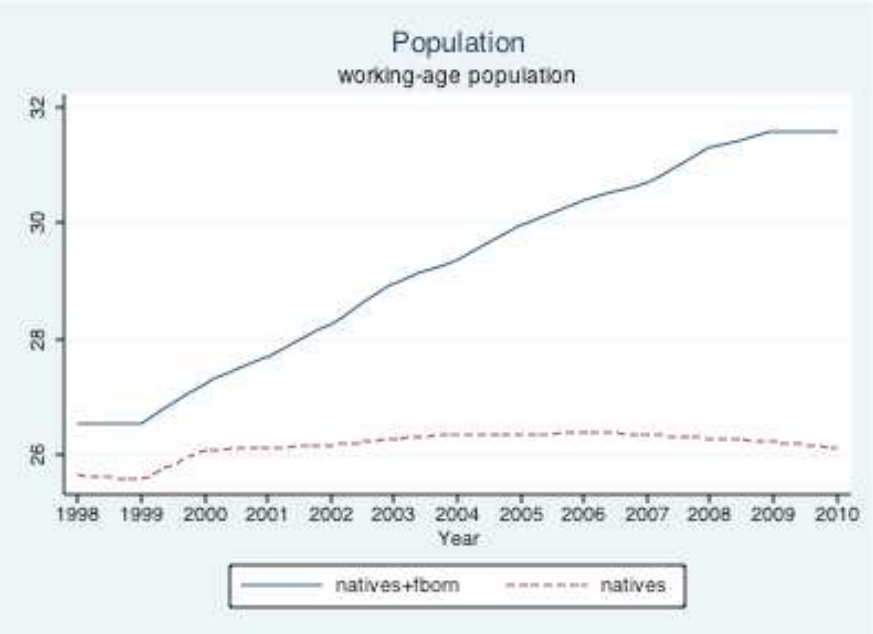
Figure 5.2. Log change in stock of housing units.



Note: Population-weighted linear fits shown. Fifty provinces (Ceuta and Melilla excluded). In price regression, slope coefficient is 0.41 with robust standard error 0.13. In housing stock, regression slope coefficient is 0.52 with robust standard error 0.07. Housing stock is the variable that is constructed on the basis of the annual flows. Note: M stands for Madrid, B for Barcelona and V for Valencia.

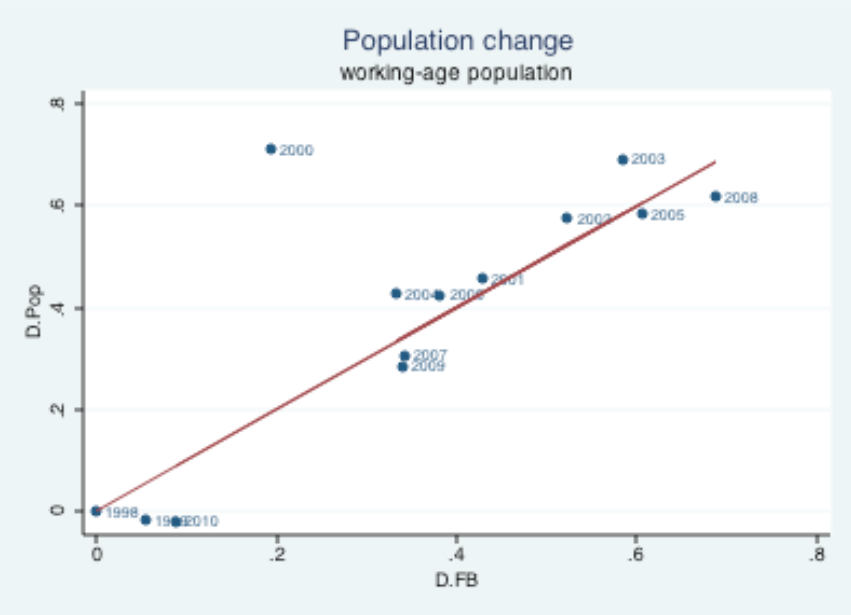
APPENDIX FIGURES

Figure A1. Total and native working-age population, 1998-2010



Source: Local registry data.

Figure A2. Annual total population change and change in the foreign-born population.



Source: Local registry data

Data Appendix

Data sources used in the construction of the gateways instrument.

Land. We use distance from the capital city in each province to Girona, as a proxy for distance to France along a major highway.

Air. We use data on passengers landing in each province in Spain in year 1999 provided by AENA. We add up all airports for provinces with multiple airports.

Sea. We use data on passengers arriving by boat in 1998, as provided by the government www.puertos.es.

Foreign-born population. We use the micro-data of the Continuous Population Registry.