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Cities

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## DECOMPOSING THE IMPACT OF IMMIGRATION ON HOUSE PRICES *

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ABSTRACT: An inflow of immigrants into a region impacts house prices in three ways. For a fixed level of local population, housing demand rises due to the increase in foreign-born population. In addition, immigrants can influence native location decisions and induce additional shifts in demand. Finally, changes in housing supply conditions can in turn affect prices. Existing reduced form estimates of the effect of immigration on house prices capture the sum of all these effects. In this paper I propose a methodology to identify the different channels driving the total effect. I show that, conditional on supply, total changes in housing demand can be decomposed into the sum of direct immigrant demand and indirect demand changes from relocated population. The size and sign of the indirect demand effect depends on the impact of immigration on native mobility. I use Spanish data during the period 2001-2012 to estimate the different elements of the decomposition, applying an instrumental variables strategy to obtain consistent coefficients. The results show that overlooking the impact of immigration on native location induces a sizeable difference between the total and the immigrant demand effects, affecting the interpretation of the estimates.

JEL Codes: J61, R12, R21

Keywords: Immigration, housing, Spain, instrumental variables

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# 1 Introduction

The study of the local economic impact of immigration in the receiving regions has been a very active area of research in the last 25 years. Large immigration inflows impact the spatial distribution of population within a country as the location choices of the foreign-born change the composition and size of local population. The arrival of new immigrants directly increases the population of the receiving region. In addition, they can influence the location decisions of natives, indirectly changing the population size in all locations. Immigrants can be different from natives in their level of skills (Lewis & Peri, 2015). These changes impact local labour markets, affecting average wages and employment rates. Changes in the labour market conditions interact with other economic aspects such as productivity or skills composition, and can ultimately influence growth and welfare. Recently, research has focused on the impact of immigration on a richer set of economic and social outcomes like productivity, school choices, public finances and spending or crime[1]. Given the unprecedented level of immigration inflows in Spain in the 2000s, a number of empirical works have analysed the impact of immigration on various economic outcomes[2].

A small number of papers have provided evidence on the impact of immigration on (consumption) goods prices (Lach, 2007; Cortés, 2008; Zachariadis, 2011, 2012; Frattini, 2014). Zachariadis (2012) discusses three theoretical effects of an increase of low-skilled immigration on prices: increase in aggregated demand (positive), increase in the search of low-priced goods (negative) and increase in supply of cheap labour for the production of labour-intense goods and services (negative). Empirically, these papers have mostly found net negative effects. In the case of housing, which is by nature an inelastic good, the adjustment of its costs to an increase of local population might be different[3]. For a given housing supply and local population stock, following an increase in foreign-born population, intensified spatial competition on the consumption of housing services may initially push prices up. The total impact depends also on the response of housing supply conditions and on any additional changes in local population following the immigration inflow. The sign and magnitude of the reduced-form coefficient is thus ambiguous.

Existing evidence for the US (for example Saiz, 2003, 2007; Ottaviano & Peri, 2012a) has found positive estimates of immigration on both rents and prices[4]. A handful of papers (Hatton & Tani, 2005; Saiz & Wachter, 2011; Accetturo et al., 2014; Sá, 2015) have in contrast estimated negative impacts of immigration on average house prices, in particular when focusing on small areas. The displacement of (wealthy) natives from these neighbourhoods is the main argument used to explain these negative findings but, except in Sá (2015), this effect has not been directly estimated in the data. In the case of Spain, a few papers have studied the role of immigration on housing markets (Talavull de la Paz, 2003; Sosvilla-Rivero, 2008; García-Montalvo, 2010; Nicodemo & Raya, 2012). González & Ortega (2013) provide estimates of the impact of immigration on Spanish house prices and construction over the period 2000-2010, but their aim and approach is different from those of the present paper[5].

[1] Pekkala-Kerr & Kerr (2011); Ottaviano & Peri (2013); Borjas (2014) and Chiswick & Miller (2015) summarize the existing evidence.

[2] Most of the papers have focused on the labour market impacts (Bentolila et al., 2008; Carrasco et al., 2008; González & Ortega, 2010; Amuedo-Dorantes & de la Rica, 2011; Farré et al., 2011; Amuedo-Dorantes & Rica, 2013), but a number of contributions have studied other aspects like the effect of immigration on the output mix (Requena et al., 2009), trade (Peri & Requena, 2010), productivity (Kangasniemi et al., 2012), local public spending (Jofre-Monseny et al., 2016), school choices (Farré et al., 2015) or crime (Alonso-Borrego et al., 2012). See De la Rica et al. (2014) for a recent revision of this literature.

[3] Throughout the paper I refer generally to house prices including rental and transaction prices. When I refer to house prices as opposed to rents, the term corresponds to transaction prices.

[4] Other studies include Stillman & Maré (2008) who provide positive impact estimates for New Zealand; Degen & Fischer (2009) who find positive effects for Switzerland; Akbari & Aydede (2012) find positive but small impacts in Canada; Frostad (2014) estimates the impact in Norway; and Kürschner (2017) for Germany. More recently, Tumen (2016) study the impact of the Syrian refugees inflow on Turkish housing rents and finds a positive effect on high quality units and no effect on low-quality units.

[5] In their paper the authors use population as the main regressor and estimate the direct immigrant impact on the two outcomes. However, they do not specifically investigate the impact of native mobility in the interpretation of estimates

My paper adds to this literature and, in addition to estimating the reduced-form coefficients, I focus on the identification and estimation of the channels driving the total effect. To do this, I exploit data Spanish regional (province) data on immigrant inflows and housing costs (prices and rents) during the period 2001–2012.

To disentangle the mechanisms behind the total impact, I proceed in three steps. First, I estimate a similar specification to Saiz (2007). I regress the annual local house cost growth on normalised immigration inflows or an immigration rate, which is defined as the change in foreign-born population divided by the beginning-of-the-year local population. I obtain estimates for both house (transaction) prices and rents. To be able to make causal claims about the estimates, I use a modified version of the standard immigration shift-share instrument (Card, 2001). The preferred estimated elasticities are approximately 0.8% for rents and 3.1% for house prices[6]. These coefficients correspond to the total effect. Next, I explicitly test the impact of immigrant inflows on native mobility and, consistently with existing estimates for Spain (Fernández-Huertas et al., 2009), I find that immigrants attract natives to areas in which they locate (approximately 35 natives for each 100 immigrants). This sizeable co-location estimate is unusual, but not unique in the literature[7].

Given this finding, I argue that overlooking the impact of immigration on native location induces a sizeable difference between the total and the immigrant demand effects, affecting the interpretation of the estimates. Section 2.4 shows that this difference is due to the additional changes in demand from relocated population. These additional changes can be positive or negative, depending on the sign of the impact of immigration on native mobility. To identify the impact of immigration on prices that is only due to increased immigrant housing demand ("partial" effect), in the last step I use population growth rate as the main regressor. I then re-estimate the coefficient using solely the variation on population growth which is due to exogenous location of immigrants (predicted by the instrument). The estimated immigrant demand elasticities using this methodology are 0.6% for rents and around 2.9% for house prices. As demonstrated algebraically, the comparison of the empirical estimates shows that the difference between both types of estimates corresponds exactly to the increase in demand from natives locating in the region contemporaneously to the immigrant inflow.

I furthermore explore the impact that controlling for changes in housing supply have on the estimates and I find that they have very little effect on the coefficients. When the effect of supply conditions is partialled-out, the impacts correspond to total and immigrant demand changes. My results are robust across specifications, to the use of different data sources, of different definitions of the instrument and remain very similar when using 5-year differences instead of year-to-year variations. Finally, in Section 4, I propose a simple model to explain the mechanisms behind the results: an inflow of immigrants increases housing costs in the receiving region but, due to the specialisation of natives and immigrants on different production sectors, it also attracts natives to the region, increasing house costs even further. The model predicts that the total demand effect would be larger than the immigrant demand effect, which is what I find in the empirical exercise.

The current paper makes several contributions. First, by combining the estimating equations, I show that the coefficient that captures total demand changes can be formally decomposed as the sum of direct (immigrant) demand changes plus induced demand shifts from relocated population. This is the first paper to provide causal estimates of all the elements of the decomposition, and in particular, to identify the relationship between them. This decomposition provides a framework for an improved economic interpretation of total impact coefficients. Secondly, in order to make causal claims about the estimates, I construct a shift-share instrument that combines historical immigrant location patterns with predicted national inflows by country of origin obtained from a push-factors gravity model. This is an improved version of the standard ethnic networks instrument widely used

which is central for the analysis in my paper and do not provide a detailed discussion on the channels driving the net results.

[6] Directly comparable to Saiz (2007) estimates of around 0.9% for rents and 3.3% for prices and similar to other existing estimates.

[7] Mocetti & Porello (2010) and Wozniak & Murray (2012) find similar size estimates of co-location of natives and immigrants.

in the immigration literature (Card, 2001) and it is the first time it is applied to Spanish data. Thirdly, in my estimations I control for the role of changes in housing supply conditions either by using time-invariant local supply-related attributes or by directly controlling (and instrumenting) for changes in housing stocks. By doing this, my estimates correspond to demand impacts, which makes their interpretation more straightforward. Finally, I estimate the effects of immigrants not only on transaction house prices, but also on rents. Given that renting is the primary housing tenancy mode for recently arrived immigrants, it is important to also uncover their impact on Spanish rental costs[8], and this is the first paper that provides such evidence.

The results of this paper highlight the importance of taking into account the impact of immigration on local population mobility when interpreting its effect on local aggregated outcomes. Total demand changes are the result of direct and indirect demand changes, and if these have opposing signs, the net estimates might be close to zero but masking sizeable partial adjustments. The impact of displacement on the identification of aggregate effects gained renewed interest after the publication of Borjas (2003). This paper criticized regional immigration studies of the labour market impacts of foreign-born inflows, claiming that the United States worked as a single labour market and that the existence of displacement hindered the estimation of regional effects. This question has been discussed in the immigration literature but this is the first paper to directly address it both formally and empirically. Most existing papers (Saiz, 2007; Cortés, 2008; González & Ortega, 2013) rely on the existing US evidence[9] to argue that native area displacement due to immigration is small or not large enough to cancel out increased demand stemming from increased area population so its impact on the estimates is irrelevant. My findings suggest that the impact of immigrants on native location is of greater importance than it has driven attention to in the literature, and imply that one needs to provide estimates of its size when making claims about its role on the estimation of the effects. This issue is not unique to the analysis of the impact on housing prices, but also applies to any setting where displacement might affect the estimation of local treatment effects. Meaningful economic interpretation of the parameters require that we better understand the different partial effects behind the total effect coefficients.

The rest of the paper is organised as follows. Section 2 describes the methodology: the empirical specification is explained in 2.1, the identification strategy in 2.2, the discussion on how to identify the effect of foreign-born demand in 2.3 and the formal decomposition of the total effect into its elements is exposed in section 2.4. Section 3 presents the regression results. Section 4 develops a simple theoretical model to provide insights on the channels driving the empirical finding. Section 5 discusses the validity of the instrumental variables strategy and provides a large set of robustness checks. Finally, Section 6 concludes.

# 2 Methodology

## 2.1 Empirical specification

In order to estimate the causal effect of changes in foreign-born population on house prices growth, I use a linear empirical specification similar to Saiz (2007):

$$\Delta \log\left(hpr_{i,t}\right) = \beta \left(\frac{\Delta FB_{i,t-1}}{POP_{i,t-2}}\right) + \phi' Z_i + \delta' \Delta X_{i,t-2} + \lambda_t + \gamma_{r/i} + \varepsilon_{i,t} \tag{1}$$

The geographical units of observation are the 50 Spanish provinces $i$, which are grouped into 17 regions $r$[10]. $t$ denotes time periods (years). $\Delta \log(hpr_{i,t})$ is the change of the natural logarithm of house

[8] According to data from the 2007 National Immigration Survey – "*Encuesta Nacional de Inmigrantes*, 70% of those arrived after 2001 live in rented properties.

[9] See Peri & Sparber (2011) for a recent critical review of this literature.

[10] Provinces correspond to the European NUTS3 and (autonomous) regions to NUTS2. I exclude the African territories due to their historical particularities and the lack of reliable data.

prices (transaction or rental prices) in province $i$ during year $t$, $\Delta FB_{i,t-1}/POP_{i,t-2}$ is the normalised immigration inflow during $t-1$ ($N\Delta FB_{i,t-1}$), $\lambda_t$ are time fixed effects, $\gamma_{r/i}$ are area fixed effects (either NUTS2 or NUTS3), $Z_i$ is a matrix of province time-invariant attributes and $\Delta X_{i,t-2}$ is a matrix of province time-varying controls. Finally, $\varepsilon_{i,t}$ is the random error term.

The independent variable of interest is the normalised immigration inflow (or immigration growth rate): it is defined as the (net) inflow of immigrants into province $i$ during a given period divided by the province initial population). The inflow of immigrants during $t-1$ is calculated as the (net) change in the foreign-born population between the end of $t-1$ and the end of $t-2$[11]. Population in $t-2$ denotes the stock of total residents (natives and foreign-born) at end of period $t-2$. Given the nature of housing services, the main specification uses the immigration inflows lagged one period with respect to changes in prices.

Using normalised immigration inflows instead of (log) net inflows as the measure of "immigration" eliminates any unobservables that might equally affect both the numerator (immigration inflow) and the denominator (original province population). Standardising immigration inflows by initial population stock deals with the fact that regions of different sizes have different population and house price dynamics (Card, 2001; Peri & Sparber, 2011; Wozniak & Murray, 2012). Scale effects can induce spurious correlation between higher inflows and higher price changes. This correlation could arise due to the fact that the average and standard deviation of both variables are likely to be proportional to the total population in the province[12]. In this set-up the coefficient of interest is interpreted as a semi-elasticity: an increase in the rate of one percentage point has effect on the change in prices of $\beta$ percentage points[13].

In order to estimate the parameter of interest $\beta$ consistently I start by using a first-differences specification and a large set of control variables and time and area fixed effects. The first differences setting of equation (1) eliminates any unobservable province characteristics which might be correlated with the level of house prices and the level of foreign-born population in the province. Time fixed effects $\lambda_t$ control for common shocks affecting the growth of prices of all provinces in Spain in a given year. There could still exist some unobserved factors at the area level which are correlated with changes in house prices and changes in foreign-born stocks. Not including these would bias the estimation of $\beta$. To tackle this issue, first I include area fixed effects $\gamma_{r/i}$. In some specifications I use region (NUTS2) fixed effects ($\gamma_r$) and in the most demanding specification I include province (NUTS3) fixed effects ($\gamma_i$). This specification corresponds to a first differences fixed effects estimation (e.g. growth regression fixed effects[14]).

Vector $Z_i$ contains time-invariant province attributes. These variables control for the fact that provinces with different levels of the time-invariant characteristics might have different growth trends in the house prices levels and in the stocks of foreign-born population. When region fixed effects ($\gamma_r$) are also included, the province attributes control for differential growth trends of the provinces around their common regional trend. Some of these attributes are time-invariant and some correspond to pre-period values (2001 or before). There are four sets of province attributes included: location/amenities attributes, socio-economic attributes, geography/land regulation attributes and housing market attributes. Adding controls for changes in housing supply would reduce omitted variable bias related to factors driving both immigration and dwelling construction. Once this bias is reduced, the coefficient of the normalised immigration inflow variable would correspond to a (total or immigrant) demand estimate and be conditioned-out from any (time-invariant) effects related to changes in the

[11] The Spanish administrative population data is dated on the $1^{st}$ of January. Referring to the end of $t-2$ is equivalent to referring to the beginning of $t-1$. The equivalent inflow would be the (net) change between January of $t$ and January of $t-1$

[12] In addition to the standarisation, I control for the effect of initial population trends by either including it directly in the specifications or by using province-fixed effects.

[13] Additionally, this format allows a more straightforward comparison to existing estimates in papers that have used a similar specification.

[14] Wozniak & Murray (2012) use a similar specification and refer to it as the "random trend model for panel data" (Wooldridge, 2002)

housing supply. When I use province fixed effects, I control for all time-invariant attributes, so all the province attributes included in $Z_i$ drop.

Finally, vector $\Delta X_{i,t-2}$ contains time-varying characteristics (change between $t-3$ and $t-2$). I control for changes in average output, wages and education levels, unemployment rate, conditions in the financial sector, infrastructure endowments and sectoral composition. If the variables included in $X_{i,t-2}$ are "bad" controls –variables that could well be outcome variables in equation (1) (Angrist & Pischke, 2009)–, their inclusion would not reduce the omitted variable bias. To mitigate this potential problem, I use a lag with respect to immigration inflow variable, so the variables are measured one year before the immigrants locate in the province. Hence, I use changes in the variables during $t-2$, one period before the inflows ($t-1$) and two periods before the change in prices ($t$).

### 2.2 Instrumental variables strategy

Even after including area dummies and controls, consistent estimation of $\beta$ requires the regressor of interest to be uncorrelated with the time-varying part of the error term (local time-varying shocks affecting price growth and immigrant location at the same time). There is no prior on the direction of the bias. The estimated $\beta$ could be upward biased if immigrants are going to provinces with positive shocks or unobserved better economic prospects, while it would be downward biased if, for some reason, immigrants locate in province in which prices are growing slower (conditional on all the time-varying and time-invariant controls). To deal with the identification problem I use an instrumental variables (IV) strategy. I construct the instrument adapting the "shift-share" methodology, which has extensively been used before, for instance by Card (2001), Ottaviano & Peri (2006) or Peri (2009). Intuitively, a province-year prediction of the foreign-born stock is constructed by distributing year-to-year variation of the national totals (the "shift") across different locations, using some pattern (the "share"), to allocate this magnitude.

The normalised immigration inflow (change in foreign-born population) in equation (1), $N\Delta FB_{i,t-1}$, is defined as the immigration inflow during $t-1$ divided by total population (foreign-born plus natives) at the end of $t-2$. The inflow of immigrants during $t-1$ is calculated as the (net) change in the (end-of-the-year) foreign-born population between $t-2$ and $t-1$. Denoting foreign-born population stock as $FB$ we can express the normalised change in province $i$ as:

$$N\Delta FB_{i,t-1} = \frac{\Delta FB_{i,t-1}}{POP_{i,t-2}} = \frac{\Delta FB_{i,t-1}}{FB_{i,t-2} + NAT_{i,t-2}} = \frac{FB_{i,t-1} - FB_{i,t-2}}{FB_{i,t-2} + NAT_{i,t-2}} \tag{2}$$

The most common immigration shift-share instrument exploits the fact that, to take advantage of social and economic established networks, immigrants tend to disproportionately locate in areas where immigrants from the same nationality or ethnicity have located before (ethnic networks instrument). To predict current location patterns, I use historical location patterns to construct the "share" distribution. For the national yearly immigration inflow, I use different approaches (details below). In order to compute a prediction (2), I predict the stock of foreign-born by year and nationality, and I sum these predictions to calculate the total province foreign-born stocks. I also use it in denominator as part of total population.

To impute the yearly immigrant population by province and by nationality of origin, I first calculate the share of immigrants (over the total number in Spain) that were located in that province in the base year[15]. The main base year used for "past" location patterns is 1991. I denote provinces with $r$[16], time periods with $t$, nationalities or ethnic groups with $n$ ($N$ being the total number of nationalities). This share is the proportion of immigrants located in a particular province $i$ over the total immigrants

[15] The list of the nationalities used appears in Table A.2.

[16] $i$ is the specific province for which we are calculating the share and $R$ is the 50 provinces in Spain

from the same nationality located in Spain in 1991:

$$share^n_{i,1991} = \frac{FB^n_{i,1991}}{\sum_r^R FB^n_{r,1991}} = \frac{FB^n_{i,1991}}{FB^n_{Spain,1991}} \tag{3}$$

To obtain yearly predictions of the number of immigrants by nationality $n$, I multiply expression (3) by the annual national stock of immigrants of nationality $n$. This stock is calculated adding the number of foreign-born of that nationality in all provinces in Spain except $i$, in year $t$. I exclude province $i$ from the summation to avoid using the stock I am trying to instrument for in the construction of the prediction of foreign-born. This stock is province-nationality specific because for each province $i$ we exclude its own foreign-born stock:

$$FB^n_{Spain\_i,t} = \sum_{r \neq i}^R FB^n_{r,t} \tag{4}$$

The imputed foreign-born stock of a specific nationality $n$ in province $i$ at time $t$ is thus calculated allocating yearly total national stocks (4) weighted by its historical share (3):

$$imp\_FB^n_{i,t} = \left(FB^n_{Spain\_i,t}\right) * share^n_{i,1991} \tag{5}$$

To calculate the imputed total (all nationalities) foreign-born stock in province $i$ at time $t$, I sum (5) across nationalities:

$$imp\_FB_{i,t} = \sum_n^N \left(imp\_FB^n_{i,t}\right) \tag{6}$$

Note that the instrument is constructed from combining nationality-specific predictions in every province (a weighted sum of the national-minus-province inflows using the nationality 1991 stock as weights). As the estimated specification (1) includes year and province fixed effects (or region and province attributes), a shift-share that did not have this province-specific nationality-mix aggregation would be highly or completely collinear with the fixed effects. Moreover, this construction allows to account for the fact that different provinces would have different treatment levels depending on the nationality mix of the foreign-born inflow.

In order to obtain the first instrument for the normalised immigration inflow as defined in expression (2), this imputed inflow is divided by the imputed population (imputed foreign-born plus native stock) in province $i$ at the beginning of the period $t-1$. The instrument is constructed as follows:

$$IV1\_N\Delta FB_{i,t-1} = \frac{(imp\_FB_{i,t-1} - imp\_FB_{i,t-2})}{imp\_FB_{i,t-2} + NAT_{i,t-2}} = \frac{imp\_\Delta FB_{i,t-1}}{imp\_POP_{i,t-2}} \tag{7}$$

For this instrument to be valid it has to be sufficiently correlated with the immigration rate but uncorrelated with the local shocks that affect house price variation, conditional on the controls and area and time fixed effects. The relevance of the instrument can be assessed by the value of the F-statistic of the instrument in the first stage of the 2-stage-least-squares (2SLS) regressions, and additionally by using weak identification tests[17].

The validity of the instrument relies on the two components of (5) being uncorrelated to local shocks related to the outcome variable. Regarding the local share of immigrants by nationality in the base year, the exclusion restriction requires that the only channel through which foreign-born geographical distribution in 1991 affects current changes in house prices is through its influence on shaping the current immigrants location patterns, conditional on controls. In other words, the unobserved factors determining the location of immigrants in one province with respect to another in the base year (1991) have to be uncorrelated with the relative economic prospects of the two provinces during the period of analysis (2001-2012). I consider 1991 to be separated enough from 2001 for this

[17] All the result tables in section 3 provide the Kleinbergen-Paap statistic (test of weak identification), which is robust to non-i.i.d error terms, and corresponds roughly to the t-stat of the included instruments in the first-stage to the square. In some tables we also include the first-stage coefficients.

condition to be valid[18]. In the robustness checks, I calculate the imputed figures using older base years (1985 and 1981), even if the instrument become weaker, the results hold.

A good instrument requires that the total national flow of immigrants in a given year to be exogenous to specific province unobservable local shocks. This condition depends on how the current national stock of immigrants of nationality $n$ is constructed. First, to avoid using the actual inflow for that we want to instrument for in the construction of our prediction (just scaled by $share^{n}_{i,base}$), term (4) is defined as the total inflow of immigrants from nationality $n$ coming to Spain at time $t$ minus the inflow of immigrants from nationality $n$ coming to province $i$ at time $t$. Yet, we still require this term to be orthogonal to current local shocks. This assumption may be violated if location in provinces other than $i$ is correlated with unobservable economic conditions of province $i$ at a given point in time $t$. This is plausible, specially if our spatial units are small and the economic conditions that attract immigrants are spatially correlated. For example, the economic condition in "economically big" provinces (like Madrid or Barcelona) could influence the total number of immigrants deciding to come to Spain, even if they end up locating somewhere else (based on their ethnic networks).

To solve this issue, a similar strategy to Saiz (2007) and Ortega & Peri (2009) is adopted. I compute the yearly predicted total stock and inflow of immigrants by country of origin from the results of a gravity model which depends only on push factors. These predictions replace term (4) in equation (5). Details of this procedure are given in the Appendix (section A.2.1). Using the predictions from estimating equation (A.1) in (A.2) to obtain (A.3), I redefine the instrument as:

$$IV2\_N\Delta FB_{i,t-1} == \frac{imp\_pred\_\Delta FB_{i,t-1}}{imp\_pred\_FB_{i,t-2} + NAT_{i,t-2}} \tag{8}$$

However, a final issue with the construction of (8) might still make the instrument invalid. Total population stock, which appears in the denominator, is the result of the sum of the foreign-born (imputed prediction) plus the natives. As discussed in Section 2.3, the number of total natives residing in a given province might depend on the number of foreign-born in the same location or on unobservables correlated with house price growth. For this reason, I use a similar shift-share strategy to compute a prediction for the location of natives $pr\_NAT_{i,t-1}$, based on past location patterns. Details on this procedure are given in the Appendix (section A.2.2). Replacing the actual native stock by its imputed number in equation (8), I finally define the main instrument as:

$$IVmain\_N\Delta FB_{i,t-1} == \frac{imp\_pred\_\Delta FB_{i,t-1}}{imp\_pred\_FB_{i,t-2} + imp\_NAT_{i,t-2}} \tag{9}$$

I use $IVmain\_N\Delta FB_{i,t-1}$ in the main IV estimation results and different versions of it in the robustness checks. In section 5.1 I discuss and test the validity of this instrumental variables approach and in section 5.2 I check if the results are robust to using different definitions of the shift and share in the construction of the instrument.

### 2.3 Identifying the impact of immigrant demand on prices

The IV estimation of the $\beta$ coefficient of (1) yields consistent estimates of the total impact of immigration on prices. The sign and magnitude of this coefficient is a priori ambiguous. Foreign-born population inflows, by increasing local population, can have an immediate positive impact on house prices growth. The economic intuition behind this is a simple demand-supply result. For a given level of population in a region, after a large immigration inflow, increased competition in housing markets forces both newly arrived immigrants and stayers to bid higher to buy or rent existing properties. Keeping supply constant, a positive immigration inflow into a region is directly translated into an

[18] Between 1991 and 2001 there was an important economic crisis (1992-1993) followed by economic recovery and growth (from 1997). It is unlikely that 1991 immigrants were able to predict these future shocks (or any other shock not captured in the area/time fixed effects) ten years before our period of analysis starts.

increase in demand of housing services, pushing up prices. But as native mobility and supply adjust, the sign of the net impact is unclear.

This is the intuition behind the model developed in Saiz (2007). An increase in foreign-born population in a given location raises total population and then pushes demand and prices in the "short run". The total net impact ("long-run") on prices also depends on changes on housing consumption (density), on housing supply (construction) and on the mobility of natives or previous residents (displacement) following the immigration inflow [19]. Unless we partial-out these adjustments, an estimate of $\beta$ in equation (1) would capture the combination of all these mechanisms. The use of instrumental variables and controls yields unbiased estimates of the (reduced-form) total effect coefficient, but it does not help with interpreting the channels behind it. It has been argued that the changes in demand induced by relocated population cannot be separately identified from changes in immigrant demand. In this section I propose an empirical method to isolate the immigrant demand effect (immigrant demand) from the total effect. Section 2.4 presents the formal decomposition of the total effect into its components.

The total demand effect of immigration inflows on any local economic outcomes depends on what the most of the literature has called "native displacement". The role of native mobility having an effect on the estimates of the regional labour market impacts of immigration has been widely discussed (Hanson, 2009; Peri & Sparber, 2011). When estimating local average impacts of immigration inflows, one needs to take into account that changes in population in a given area affect the whole regions-cities system equilibrium. The relocation of population across regions within a country would hinder the identification of any area-level effects, as the effects would dissipate throughout the country. If large population outflows are triggered by immigration, the net area impact would tend towards zero. When displacement exists, cross-region regressions would underestimate the effect of immigrants on local outcomes (Peri & Sparber, 2011). In the analysis of the impact of immigration on local labour market outcomes, the existence of native displacement has been used as an explanation for the lack of robust estimates of the impact of immigration on wages across US labour markets (Borjas, 2006).

As in the case of labour markets, native mobility affects the estimation of the average effect of immigration on local house prices. Any reduced-form estimate would be the net result of changes in housing demand which stems from the newly arrived population plus any changes in demand related to natives relocation. The impact of mobility on the interpretation of the reduced-form area estimates is generally inferred from the sign of the total estimate. In the case of the impact on house prices, if the reduced-form estimate is positive it is assumed that natives are little or not displaced by immigrants (González & Ortega, 2013). The sign of the total effect is also interpreted as a test of "native complete displacement" (Saiz, 2007). The impact of immigrants on native mobility is generally not directly investigated in these studies [20].

In contrast, I estimate the effect of immigration inflows on native location decisions. As suggested by Peri & Sparber (2011) to test the impact of immigration on native mobility I use a normalised change in native population in the left-hand-side of a specification similar to (1) and estimate:

$$\left(\frac{\Delta NAT_{i,t}}{POP_{i,t-1}}\right) = \alpha \left(\frac{\Delta FB_{i,t}}{POP_{i,t-1}}\right) + \gamma_t + \gamma_{r/i} + \phi' Z_i + \delta' \Delta X_{i,t-1} + \varepsilon_{i,t} \tag{10}$$

[19]The theoretical discussion in Saiz's paper uses short-run and long-run adjustments terms. As explained by the author, by short-run he refers to a situation where native mobility and housing supply cannot adjust and by long-run when they do. In the empirical results of his paper he uses both annual first-differences models and decennial long-differences models, but the interpretation of the coefficient is always the same – the total (reduced-form) effect. In fact, as discussed in Lewis & Peri (2015), when economists analyses the "short-run" effects of immigrants they try to isolate the consequences of immigration on one variable keeping the rest fixed. They claimed that this should be called the "partial" effect. In this paper I refer to total effect when we allow for adjustments in the three dimensions and to immigrant demand effect ("partial") as the direct increase in demand from recently arrived immigrants.

[20]One exception is Sá (2015), who estimates the total effect of immigrants on UK house prices and, when investigating the channels driving her negative results, also estimates the impact of immigrations on native mobility. She finds both coefficients to be (largely) negative but, contrary to me, she does not study the relationship between them.

where the variables in the right-hand-side denote the same elements as in equation (1). The sign and size of $\alpha$ captures the relationship between immigration inflows and native location. If the estimated $\alpha$ is negative this would indicate that natives are leaving the regions where the immigrants locate: displacement would be complete if $\alpha = -1$ or less than proportional if $-1 < \alpha < 0$[21]. If natives are attracted to the same regions as immigrants $\alpha > 0$. If no causal relationship exists between immigration and native location, we can be quite certain that, conditional on housing supply, coefficient $\beta$ in equation (1) is only capturing the effect of (increased demand from) immigration on prices. In this case, the immigrant demand and total impact would be the same, conditional on changes in housing supply. However, if a sizeable causal relationship exists, we need to be more cautious about the interpretation of the results.

I discuss the estimation of equation (10) in section 3.3. To obtain consistent estimates of $\alpha$ I use the same first-differences instrumental variables as in the estimation of (1). I find robust positive co-location between immigrants and natives and the IV coefficients are around 0.34[22]. This result might seem surprising, as most of the literature assumes that local residents might "fly-out" to other areas due to increased competition for jobs and in the consumption of local amenities and housing [23]. However, this assumption relies on immigrants and natives being homogenous in characteristics. Immigrants and natives of similar characteristics (for example low-skilled) could be competing for the same (low-paid) jobs, thus we can expect immigrants to have some displacement effects on natives within narrowly defined labour market. If immigrants are heterogeneous and complementary to natives they might mitigate the displacement effect or even co-locate in the same regions as natives.

Recent papers (Ottaviano & Peri, 2008; Peri & Sparber, 2009; Manacorda et al., 2012; Peri, 2012; Ottaviano & Peri, 2013; Ottaviano et al., 2013) have argued that, if native and immigrants are imperfect substitutes and specialise in different tasks, immigrants can promote efficient task specialisation and have a productivity-enhancing effect, increasing native wages. Immigrant and natives could also complement each other if they consume different goods (Mazzolari & Neumark, 2012). Natives could also co-locate with immigrants if these are attractive to them because they provide cheaper labour-intense goods (as suggested by Cortés, 2008) or because they generate positive externalities on natives wages or rents (Ottaviano & Peri, 2006, 2007). More generally, one can think that increased population in a region after the immigrant inflow would create more jobs and wealth via local multipliers (Moretti, 2010).

Some contributions highlight the importance of taking into account the income/skill level of native and immigrants when looking at displacement effects. Mocetti & Porello (2010) find positive associations between immigrant inflows and highly-educated natives and they suggest that this is due to potential complementarities. Wozniak & Murray (2012) also find that positive co-location between low-skilled immigrant and natives and displacement between high-skilled ones[24]. In order to explain the sign of my results I present a simple spatial equilibrium model in Section 4 that predicts co-location of native and foreign-born workers if they both specialise in different types of goods.

The other two channels of adjustments that we need to consider when trying to isolate immigrant demand are changes in housing density and changes in housing supply. Table 1 displays the total population and the number of residential dwellings in the 50 provinces of study for every year between 2001 and 2012. The table shows the rate of total housing stock over total population. Housing density

[21] As discussed earlier, the native or foreign-born inflow is defined as the change in numbers during $t$ while population in $t$ refers to the stock at the beginning of the year (January).

[22] In their report, Fernández-Huertas et al. (2009) provide some evidence on the relationship between immigration and native location. They find positive correlations between 0.1 and 0.4, although they claim that this size is negligible and cannot have any considerable impact on the estimation of local effects of immigration. They conclude that these results show at least no-displacement of natives. González & Ortega (2013) also argue that native displacement would have no impact on the area level estimates. My results in Section 3.3 suggest differently.

[23] See for example Card (2001); Hatton & Tani (2005); Card (2007); Saiz & Wachter (2011); Accetturo et al. (2014); Fernández-Huertas et al. (2015). Despite this perception, there is still little evidence on significant displacement, at least in the US Peri & Sparber (2011).

[24] Other papers that have found positive or non-negative impacts between immigration and native employment are Basso & Peri (2015) and Beerli & Peri (2015).

remained relatively stable during the period, increasing only 0.026 units in over 10 years[25]. These numbers suggest that, if anything, intensive construction together with large immigrant inflows kept the rate of houses/population relatively constant over the period. Given how stable average density has remained over time we expect that either the province-specific attributes or the province-specific fixed effect would be capturing anything correlated with housing cost growth and changes in housing density. Table 1 also shows that a large number of new housing units were constructed between 2001 and 2012, over 6 million (and in the census data almost 4 million of main homes between 2001 and 2011). We would expect that this substantial increase in supply would, at least partially, mitigate the rise in prices caused by the increase in demand. House construction could also be correlated with immigration inflows if immigrants locate in areas where house construction is higher (due to job opportunities or more availability of housing).

[TABLE 1 AROUND HERE]

I account for the effect of housing supply on house prices in two ways. Firstly, in the estimation of (1) I include a large set of time-invariant province attributes related to housing supply (geography, land regulation and housing market characteristics). As the model is estimated in first differences, these variables control for differential trends correlated to both immigration inflow and house price changes. However, if we want to isolate the impact of immigration on house prices via its demand impact (e.g. keeping housing supply constant) we would need to include time-varying changes in housing supply as an additional control variable. This variable would remove the bias arising from the fact that immigrants might be locating in areas where construction is growing faster (to work in this sector or due to higher availability of homes) and that house construction also affects housing costs via increasing supply of housing units. Including time-varying supply changes in the estimation of equation (1) as an additional control is very problematic, because even if lagged, housing construction is a "bad" control given that construction is directly affected by immigration[26]. In Section 3.5, I include time-varying housing supply (log changes of stock of dwellings) and deal with the bad control problem using an instrumental variables (IV) strategy. When I control for housing supply changes, the estimated coefficient $\beta$ captures only the total demand effect (instead of the the total effect). Yet, including this control does not affect the main estimates, so I refer to the total demand and total effect indistinctively in what follows.

Once we have considered the impact of native mobility and changes on supply conditions on the total estimates, we need to design a method to isolate the impact of immigrant demand. Even conditional on supply changes, the total (demand) effect would be capturing the net change in demand from foreign-born and natives. It has been argued that the impact of immigrant demand cannot be separated from other demand changes induced by native population adjustments (Saiz, 2007), affecting the interpretation of the estimated elasticities[27]. To identify the variation in total population that arises from immigrant inflows, I replace normalised immigration inflows in (1) by a normalised population inflow variable[28] and estimate the effect of changes in population using solely the variation which is due to exogenous location of foreign-born (predicted by the instrument). I construct an instrument to predict the location of immigrants based on past ethnic networks (details on its construction in Section 2.2). I estimate the following specification:

$$\Delta \log \left(hpr_{i,t}\right) = \beta \left(\frac{\Delta POP_{i,t-1}}{POP_{i,t-2}}\right) + \phi' Z_i + \delta' \Delta X_{i,t-2} + \lambda_t + \gamma_{r/i} + \varepsilon_{i,t} \tag{11}$$

In the results section I show that there is an empirical relationship between the $\beta$ coefficients of

[25] If we examine differences in average dwelling occupancy using 2001 and 2011 Census data we find a similar picture.

[26] In particular because González & Ortega (2013) find that immigrants have a positive causal impact on housing construction.

[27] *"There is no way to separate the effect of increased housing demand (immigration) from the potential decreased demand associated with potential native out-migration. Part of the local response to the treatment (immigration) can occur through native out-migration. In this case, we need to be careful about the interpretation of the coefficient of immigration on rents."* (Saiz, 2007, pg. 348).

[28] Which in practice corresponds to the population growth rate.

equations (1), (10) and (11). The following section derives the decomposition of the total (demand) effect algebraically.

### 2.4 Decomposition of the effect of immigration on house prices

In this section I formalise a decomposition of the total impact into a direct immigrant demand effect and an indirect demand effect (induced by the impact of immigrants on native location). As controlling for changes in housing supply does not impact the coefficients substantially (Section 3.5) we can exclude the impact of housing supply in the discussion without loss of generality. The (simplified) version of equations (1), (10) and (11) is[29]:

$$\begin{aligned} \textit{Total effect:}\quad & \Delta \log\left(hpr_{i,t}\right) = \beta_1 N\Delta FB_{i,t-1} + ... + \epsilon^1_{i,t} = \beta_1 N\Delta FB_{i,t-1} + \theta^1_{i,t} && (12)\\ \textit{Native mobility:}\quad & N\Delta NAT_{i,t-1} = \beta_2 N\Delta FB_{i,t-1} + ... + \epsilon^2_{i,t} = \beta_2 N\Delta FB_{i,t-1} + \theta^2_{i,t} && (13)\\ \textit{Immigrant demand:}\quad & \Delta \log\left(hpr_{i,t}\right) = \beta_3 N\Delta POP_{i,t-1} + ... + \epsilon^3_{i,t} = \beta_3 N\Delta POP_{i,t-1} + \theta^3_{i,t} && (14) \end{aligned}$$

where $\log\left(hpr_{i,t}\right)$ stands for growth of housing costs (transaction or rents) in region $i$ at time $t$ and $N\Delta FB_{i,t-1}$ is the normalised change in foreign-born population (immigration inflow) in region $i$ at time $t-1$ (similarly for natives $NAT$ and total population $POP$). $t$ corresponds to the period 2002–2012. $\epsilon^x_{i,t}$ are the error terms in the different equations. In the main results $\Delta$ corresponds to annual differences, but the results of this section also hold for longer differences. I group all the controls, area/time dummies and errors in terms $\theta^x_{i,t}$.

Note that at a point in time total population changes are just is the sum of foreign-born and natives changes (all normalised):

$$N\Delta POP_{i,t-1} = N\Delta FB_{i,t-1} + N\Delta NAT_{i,t-1} \tag{15}$$

From equation (12) the total impact of immigration inflows on house prices is:

$$\frac{\partial \Delta \log\left(hpr_{i,t}\right)}{\partial N\Delta FB_{i,t-1}} = \beta_1 \tag{16}$$

Using (15) in equation (14) I obtain:

$$\Delta \log\left(hpr_{i,t}\right) = \beta_3 N\Delta POP_{i,t-1} + \theta^3_{i,t} = \beta_3\left(N\Delta FB_{i,t-1} + N\Delta NAT_{i,t-1}\right) + \theta^3_{i,t} \tag{17}$$

If I replace $N\Delta NAT_{i,t-1}$ by equation (13) I get:

$$\Delta \log\left(hpr_{i,t}\right) = \beta_3 N\Delta FB_{i,t-1} + \beta_3\beta_2 N\Delta FB_{i,t-1} + \beta_3\theta^2_{i,t} + \theta^3_{i,t} \tag{18}$$

When I differentiate (18) with respect to the immigration inflow I obtain:

$$\frac{\partial \Delta \log\left(hpr_{i,t}\right)}{\partial N\Delta FB_{i,t-1}} = \beta_3 + \beta_3\beta_2 \tag{19}$$

From equating (16) and (19) I obtain the following decomposition of the total effect:

$$\beta_1 = \beta_3 + \beta_3\beta_2 = \beta_3\left(1 + \beta_2\right) \tag{20}$$

This decomposition only holds if $\theta^1_{i,t}$, $\theta^2_{i,t}$ and $\theta^3_{i,t}$ do not directly depend on $N\Delta FB_{i,t-1}$ so their partial derivatives in (16) and (18) are zero. In other words, (20) holds for consistently estimated coefficients. Expression (20) shows that the total effect of immigration on housing costs $\beta_1$ can be decomposed into a direct immigrant demand effect ($\beta_3$) and an indirect demand effect ($\beta_3\beta_2$). The

[29] Given that the same covariates are included in all three equations, to simplify exposition I do not include the controls and fixed effects in the expressions.

indirect demand effect is the product of the change in native population that happens due to the immigrant inflow $(\beta_2)$ and the immigrant demand effect $\beta_3$. Therefore $\beta_3$ can be interpreted as a "general demand" coefficient (elasticity of the prices with respect to changes in population) which in our setting is estimated from an exogenous change in the foreign-born population (predicted by the ethnic enclaves instrument).

If we ignore the impact that native mobility has on changing the total demand in the region via its impact on natives mobility, we could assume that $\beta_1$ and $\beta_3$ are the same and that $\beta_1$ corresponds to the price-population elasticity. In reality, only the second coefficient corresponds to the this elasticity, while the total (demand) impact includes changes in demand from the exogenous change in population (from the immigrant inflow) and from endogenous change in (native) population. $\beta_3$ is theoretically unambiguously positive (for an inelastic normal good, an increase in demand should push prices up), while the sign and size of $\beta_1$ depends on the term $(1 + \beta_2)$, which captures the impact of native mobility on additional changes in local demand. This term could be negative (if immigrants displace natives more than one-to-one), positive but smaller than one (if immigrants displace natives but not one-to-one), one (if immigrants have no impact on native mobility) or greater than one (if immigrants and native co-locate). As discussed Saiz (2007), it is true that estimating $\beta_1$ to some extent is informative of the impact of immigration on native mobility. However, the interpretation of this coefficient as a price-elasticity is not exact unless we have some information about $\beta_2$. The decomposition clarifies this issue and the results in this paper provide the first joint estimates of all three effects (total, induced and immigration demand) in a relevant context. Expression (20) formalises the main result of this paper and provides a framework for a better interpretation of the reduced-form estimates available in the literature.

# 3 Results

## 3.1 Data and descriptive statistics

To carry out the empirical analysis I used data from multiple sources. Immigrant and population data comes from the Municipal Register (*Padrón Municipal*), which keeps an annual record of all registered individuals in a municipality over time regardless of their legal immigration status. This is the most reliable source to study the impact of the size of immigration on area economic outcomes. House house price data was obtained from Uriel-Jiménez et al. (2009), who provide an improved version of the Housing Department Average Province House Price Index[30]. Data on rents was obtained combining data from the Housing Department and the National Institute of Statistics. Finally, data on the controls comes from several sources including the National Institute of Statistics, the Housing Department, the European Environmental Agency, the 2001 Census and the *La Caixa* Spanish Economic Yearbook. Full details on the data sources are provided in Section A.1 in the Appendix. The full list of controls is provided in the descriptive statistics table (Table A.1) and in the results table notes.

To investigate the impact of immigration on housing costs, I exploit a panel dataset for Spanish provinces (NUTS3) for the period 2001-2012. The period of analysis is very suitable to study this question because large immigration inflows were coupled with a period of housing sector boom (2001–2007) followed by a bust (2008–2012). Figure 1 shows the evolution of immigrant stocks and inflows and of housing costs during these years. Foreign-born stock increased from below 2 million people in 2001 to over 6.7 million in 2012, an increase of almost 250%. In these years, the share of foreign-born over total population rose almost 10 percentage points (from 4.8% to 14%). Between 2001 and 2008, the annual inflows of foreign-born were over 400,000 persons per year, and even after the start of the recession they remained between 70 and 100,000[31]. At the same time until 2008,

[30] The *Ministerio de Vivienda* was absorbed by the Ministry of Public Works *Ministerio de Fomento* in 2010. The data is very similar and I check the robustness of the results to using the Public Works data series in section 5.2.

[31] The three spikes in the inflows in figure 1(b) correspond to three events described in Bertoli et al. (2013): the 2000 law which allowed access to municipality public services when registered, the 2004 illegal immigration amnesty and the

average local housing costs increased considerably, in particular house prices. As the bottom panels of the figure show, during the housing boom years average house prices increased around 108%, and even with the fall that followed, on average they increased almost 65% during the 2001–2012 period. For rents, the increase was of around 37% between 2001 and 2012, around 30% until 2008. The annual increase slowed down after 2008 but nevertheless remained slightly above 1%[32].

[FIGURE 1 AROUND HERE]

Figure A.2 depicts maps with values of four variables for the 50 Spanish provinces. The different colours represent the 5 quantiles of the values of the mapped variable. Map (a) depicts the spatial distribution of foreign-born stocks in 2001 while map (b) depicts the distribution of the change in the stocks between 2001 and 2012. We can see that at the beginning of the period of analysis the immigrants where concentrated mostly on the Mediterranean coast, Madrid and Galicia [33], while new immigrants settled in those areas around Madrid and Barcelona but also largely in Castilla and Aragón (in fact, if we look at the growth rates of foreign-born stocks, the largest ones are concentrated around Madrid). Regarding the growth in housing costs, which are shown in maps (c) and (d), while rents increased the most in Madrid and Barcelona and areas around them, house prices increased the most in the South of Spain (Andalucía, Extremadura, Castilla-la-Mancha) and the periphery of Barcelona. When put together, there is no clear spatial pattern connecting the location of immigrants and housing cost growth so we need to turn to the regression analysis in order to be able to extract meaningful conclusion.

### 3.2 Effect of immigration on house prices

Table 2 presents the ordinary-least-squares (OLS) results of the estimation of equation (1), for rents (top panel) and for (transaction) house prices (bottom panel)[34]. As explained in section 2.3, in this case $\beta$ corresponds the total demand estimate and captures the combined impact of changes in demand from immigrants and natives[35]. These results are obtained using data on annual changes on prices during the period 2002-2012 and data on the immigration rate lagged one period (2001-2011). In all specifications the standard errors are clustered at the province level and robust to heteroskedasticity. I include time dummies to control for national shocks. Each column presents a specification that includes different sets of controls and dummies. Specifications range from more to less demanding in terms of data variation: OLS results (column 1) to first differences province fixed effects model (column 8). The list of control variables is specified in table A.1 and in the notes of table 2, and it is the same in all tables unless specified. Coefficient $\beta$ is a semi-elasticity and it can be interpreted as the growth of housing costs in percentage points for a 1 percentage point (0.01) increase in the rate.

[TABLE 2 AROUND HERE]

The first column of Table 2 shows the results obtained when we only include year dummies. This simple correlation is 0.34 for rents and 0.6 for house prices. In columns 2 to 7, I include time-varying controls lagged two periods (2), region (NUTS2) dummies (3) and, subsequently, province location and amenity attributes (4), province socio-economic attributes (5), province geography and land re-

accession of Romania and Bulgaria to the EU in 2007. These policy changes cannot be used for identification in our context as they were expected and some of them would only apply to particular nationalities in particular years. See Bertoli et al. (2011) and Bertoli et al. (2013) for more discussion.

[32]Rents are based on the whole stock of properties available for renting (the already rented and the just rented), and are tightly connected to national CPIs, so the scope for growth is smaller than in the case of house prices. Conversely, the changes on house prices depend solely on new properties sold. Therefore, one can expect the increase on house prices to be much more volatile than that of rents.

[33]This is partly due to residential migrants from rich EU countries, while most of the migrants after 2001 where economic migrants from Latin America, the North of Africa and Eastern Europe.

[34]For presentation purposes, I do not report the coefficients for the control variables and the fixed effects.

[35]To the extent that the time-invariant house supply controls fully control for growth in supply. We will see in section 3.5 that controlling for time-varying housing supply changes does not substantially affect the estimates, conditional on all the controls and fixed effects.

gulation attributes (6) and province housing market attributes (7). All models have high explanatory power (the $R^2$ range between 60-70% for rents and is around 85% for prices). By adding controls, the coefficient increases moderately for rents, and it doubles for house prices. Column 8 presents the first-differences province fixed effect estimates. The coefficients are larger than in column 7, but not statistically different. This suggests that the large set of province attributes capture almost all the time-invariant province characteristics correlated with prices and immigration growth. In the last column the estimated elasticities are around 0.46 for rents and for transaction is 1.2. These numbers are smaller than those in Saiz (2007). Nevertheless, they just correspond to partial correlations between prices and immigration growth.

In order to be able to make causal claims about the estimates, I implement the IV strategy explained in section 2.2. Table 3 presents the results using the instrument as defined in equation (9). This table has the same structure as the previous one. The predicted stocks and inflows of foreign-born by nationality used in the computation of $IVmain\_N\Delta FB_{i,t-1}$ come from the gravity model estimation, in particular from columns 1 and 5 in Table A.3. In these results, year 1991 is used as the base year for the predicted location patterns of both natives and foreign-born. Time fixed effects are included in all the specifications and the standard errors are clustered at the province level. The tables display a test of the strength of the instruments (F-stat Kleibergen-Paap). As expected, in all specifications the standard errors increase when using instrumental variables.

[TABLE 3 AROUND HERE]

For both house prices and rents, the estimated coefficients of immigration inflows are larger than in Table 2. This suggests that immigrants are moving, conditional on the controls and the area fixed effects, to provinces which are experiencing negative shocks in the growth of rents, and therefore the estimates of Table 2 are downward biased. Given that we are controlling for a wide set of time-varying economic factors and time-invariant attributes, it is quite reasonable that, conditional on all these controls, immigrants locate in places where housing is more affordable[36]. In addition, as discussed above, the down-ward bias of the OLS estimates could be due to measurement error, either due to poorly measured raw population register number or due to the fact that the total foreign-born number masks substantial nationality-mix heterogeneity across provinces and the IV better captures the average treatment effect. In all cases the instrument is strong. The Kleibergen-Paap F-stat is always over 10 and above the Stock-Yogo critical values. The table also reports the first-stage coefficients, that indicate that the shift-share instrument predicts approximately half of the actual immigration rate (the $R^2$ of the first-stage is also high, between 0.5 and 0.73%).

For rents, the estimates elasticity in column 7 is around 0.8 and the coefficient is insignificant in column 8. The standard errors of both estimates are very similar but the coefficient decreases substantially when province fixed effects are included. This specification is very demanding and, given that rental price growth correlates highly with inflation, it is likely that the province fixed effect absorb most of the variation in rental prices growth. As column 7 already includes a large set of province attributes, I consider this specification almost as robust as that of column 8. In fact, for prices the coefficients in the last two columns are practically the same. For house prices the elasticities range between 2 (column 4) and 3.1 (column 8) and the coefficient is highly significant even in the most demanding specification. As rents are insignificant in column 8, without loss of generality for house prices, in the following sections I consider the results of column 7 for rents as the preferred estimates and the ones from column 8 for house prices. Previous research has found estimates of positive sign and similar magnitude. The coefficients for both house prices are very similar to existing IV estimated elasticities, such as Saiz (2007) (who finds 0.9 for rents and 3.2 for prices), Degen & Fischer (2010) who find 2.7 for Swiss prices, González & Ortega (2009) who find 3.2 for house prices and Ottaviano & Peri (2007) who find 0.7 for rents and between 1–2 for prices.

[36] González & Ortega (2013) and Farré et al. (2011) find the same direction for the OLS-IV bias.

### 3.3 Effect of immigration on native location

Section 2.3 discusses the issues related to the interpretation of the coefficient $\beta$ when we do not take into account natives mobility. If immigrants do not affect native location choices, conditional on changes in supply[37], $\beta$ captures the effect of increased immigrant demand. However, if immigrants have a substantial effect on native location decisions, the total $\beta$ would be also affected by local changes in native demand. Depending on the sign of the effect, the immigrant demand estimate would be above or below the total one. In order to uncover if this is the case, the first step is to study the relationship between natives and immigrant location decisions. In this section, I estimate the causal relationship between native location and immigration inflows.

[TABLE 4 AROUND HERE]

Table 4 shows the results of the estimation of equation (10). Columns have the same structure as tables 2 and 3, but now the top panel shows the OLS/FE results and the bottom panel shows the IV results. The time period of analysis is now 2001–2011. The first-stage is exactly the same as in table 3. I find positive significant impacts of immigrant inflow on native inflow in all specifications, both in the OLS and in the IV results. As before, when instrumenting the immigration rate, the coefficients increase substantially. My preferred estimates are those of columns 7 and 8. These estimates predict that for each 100 immigrants locating in a given province in a given year, around 35 natives locate in the same province. The IV results Table 4 control for endogenous co-location of natives and immigrants and thus the effect of immigrants on native location can be interpreted as causal.

Finding substantial immigrant-native co-location is different from other estimates in the literature[38]. My findings however suggest that natives and immigrants are contemporaneously co-locating in the same provinces. As discussed in section 2.3, immigrants and natives might be heterogeneous in skills levels and tastes. Immigrants might be regarded as complementary to natives and thus positively affect their location decisions. Recently, the immigration impacts literature has focused in the research of these complementarities (Ottaviano, 2014). Besides enhancing productivity through improved task specialisation (Peri, 2012), immigrants might have desirable attributes for natives. For example if immigrants are specializing in producing goods and services which are desirable for natives (Ottaviano et al., 2013), increasing their consumption opportunities (Mazzolari & Neumark, 2012) or allowing female workers to increase their labour supply (Barone & Mocetti, 2011). In order to provide a better understanding of the co-location finding, section 4 develops a simple theoretical framework where natives and immigrants specialise in different sectors (high-skill natives in the tradable sector and low-skill immigrants in the non-tradable local services sector)[39]. In the model, an inflow of immigrants reduces the price of local services making locations more attractive to natives, who co-locate with the immigrants.

In addition, Fernández-Huertas et al. (2009) find a comparable result for a long-differences estimation from population growth regressed on the immigration rate for the period 2001-2008. Their prediction is of 11 natives for each 100 immigrants. This number is similar to my OLS results. They argue that this number is sufficiently small to have an impact on compensation or reinforcement

[37] In the results of Section 3.4, supply is already taken into account by including of time-invariant supply-related controls. As shown in Section 3.5, when I directly include house construction, the coefficients remain unchanged. For this reason, in the following I refer to the estimate that takes into account native mobility as the immigrant demand effect without loss of generality.

[38] Most of the literature compares immigrants and natives which have comparable occupation or skill levels and thus expecting displacement is more correct in this context.

[39] The data I use in this paper does not allow to perform the analysis on the impact of immigrants on native location by skill level as for example in Mocetti & Porello (2010) and Wozniak & Murray (2012). The alternative source for immigration data, the Spanish Labour Force Survey (*"Encuesta de Población Activa"*), despite containing information on the education level attained by workers aged 16 or more, does not provide information on immigrants by country of origin so the instrument cannot be constructed. While it would be interesting to analyse this, the aim of the paper is different. With regards to housing consumption, we could expect high and low skill immigrants to consume different type of housing. In my case, the IV strategy captures the local average treatment effect, the average impact across skill groups, which is sufficient for the purpose of the paper.

of the impact of immigration inflows on the housing or the labour markets[40]. I find the size of the co-location to be substantially larger, suggesting that any demand impact of immigrants had on the housing markets would be amplified by the arrival of natives. I investigate this possibility in the following section.

### 3.4 Effect of immigration on house prices revisited

In this section I apply the methodology explained at the end of Section 2.3 to isolate the effect that can be attributed to increases in immigration demand only. I use population growth rate as the main regressor in equation (11) and instrument it with expression (9). The instrument predicts exogenous foreign-born location, conditional on controls and fixed effects. By doing this, the instrumented population growth variable used in the second stage only captures changes in population due to immigrant inflows and thus isolates the impact on house prices that stem from changes in foreign-born demand. By doing this, the estimated coefficient corresponds to a direct demand (price-population) elasticity. Given the strong immigrants-natives co-location result of the previous section, we expect the parameter $\beta$ to be smaller than the one found in table 3, because it would be only capturing the effect of immigration through their effect on population changes.

[TABLE 5 AROUND HERE]

The results of using this strategy are presented in Table 5. The instrument is very strong in all specifications, as shown in the test of weak identification row. My preferred specifications are those of columns 7 and 8 which use the most demanding set of area fixed effects and province attributes. The estimated elasticities in these columns are around 0.6 for rents and between 1.6 and 2.3 for house prices[41]. The coefficients estimated in Table 5 are around 35% larger than those of table 3, in line with the co-location effect estimated in the native mobility results in table 4. In fact, if we replace the estimated coefficients in expression (20), we find that the additional demand from natives corresponds to 0.22 for rental prices and 0.79 for transaction prices, and that the decomposition is exact. This shows that in our setting, beyond the immigrant demand impact, increased demand from natives had an additional impact on house prices.

### 3.5 The role of housing supply

Depending on adjustment of housing supply, increases in housing demand following the immigrant inflows would have different effects on house prices. In this section, I explore the role played by housing supply on potentially mitigating the increase in prices[42]. In the previous results, the role of changes in supply is already partially taken into account when I include province attributes related to the changes in supply conditions (geography/land regulation and housing market characteristics) or province fixed-effects. In this section, I directly investigate the mitigating impact that time-varying supply changes might have on house prices by including the growth in the stock of dwellings as an additional control variable. Here, I control for changes in housing supply in order to remove omitted variable bias from the demand estimates. I am not interested on the specific estimated coefficient of this variable but on the effect that introducing it has on the immigration and population rate coefficients.

[TABLE 6 AROUND HERE]

The results are presented in Table 6. Columns 1–4 show the results for rents (specification with

[40] The difference in the results could be due to the fact that these authors do not use instrumental variables in their estimation and they use long differences between 2001 and 2008, so they only have 52 observations. In fact, when they perform the estimation at the municipality level, using over 8,000 observations, they find very similar estimates to mine.

[41] González & Ortega (2013) find an elasticity of around 0.98 using data from 2000-2008. Their specification and set of controls and fixed effects are slightly different.

[42] This analysis applies mostly to the effect on house prices. The impact of housing construction on rents is less straightforward, even if dwellings must always be bought before they go to the rental market.

region dummies and province attributes) and columns 5–8 for (transaction) prices (specification with province fixed effects). The impact for the total demand (immigrant rate) is shown in the top panel and for the immigrant demand (population rate) in the bottom panel. All the specifications instrument the rate with the immigration shift-share instrument. Columns 1 and 5 present the baseline specifications of tables 3 and 5 of columns 7 (rents) and 8 (prices). In columns 2 and 6 I add changes in log housing stock (in $t-2$) as an additional control variable. This coefficient is significant at 5% level for rents on the top panel (total impact) but insignificant in the bottom one. It is always insignificant for house prices (and very close to zero). The coefficients remain very similar even if I remove all the supply-related province attributes from the specifications.

Using the growth of housing stock as an additional control variable is highly problematic. Even if lagged two periods with respect to the outcome variable, and one period with respect to the immigrant and population rates, this variable is likely to be endogenous. Unobservable province trends could be affecting both the growth in prices and the construction of new housing units, particularly in a context of housing market boom where there were expectations of high capital gains. As the results in González & Ortega (2013) suggest, immigrants also have a direct impact on dwelling construction, so the growth of housing stock is a "bad" control by definition[43]. To deal with this, I construct an instrument for the stock of housing in a given province. I use a similar instrument as in Saiz (2010), a shift-share type instrument for changes in housing stock. I construct a predicted stock of housing combining the province national share of developable land in year 2000 (initial spatial distribution – the share) and changes in total annual national stock (excluding the own province changes – the shift[44]). The results are very similar if we use 1990 availability of developable land.

In columns 3/7 I use the predicted change in log housing stock IV as an additional control and in 4/8 I use it to instrument for the time-varying change in housing supply. The housing-supply IV is very strong (Kleinbergen-Paap values between 48-58). All along the coefficients of the impact of the rates on housing costs remain very similar to the baseline estimates, particularly for house prices. These results suggest that changes in housing supply did not have any major impacts on the demand estimates (neither the total or the immigrant demand ones). We need to keep in mind that there are already a large set of controls included in the specifications that are likely already capturing a substantial share of the variation due to changes in housing supply. It is then not so surprising to find insignificant coefficients in this variable. In addition, table 1 shows that, despite the level of construction was very high during the period of analysis, it was coupled with such a high level of population growth that the house per person rate remained almost unchanged during the period. Even if many houses were constructed during this period, the population inflows were so substantial that increases in supply did not decrease the pressure of demand on housing costs [45]. Given that controlling for housing supply does not seem to have any large effect on the baseline estimates, the total effect and the total demand effect are the same in my data.

# 4 Theoretical Model

In this section I propose a simple spatial equilibrium model to explain the results presented in Section 3. I find that the total effect is larger than the immigrant demand because of increased induced demand by relocated natives and that both effects are positive. While the literature largely assumes that

[43]Table A.6 in the Appendix shows the results of regressing the immigration rate or the population growth on change in housing stock (columns 4 and 5 of the table) using my data. The coefficients are positive and significant, particularly for the direct immigrant effect.

[44]I exclude the own province stock from the national stock for two reasons: to avoid using the exact figure I am trying to instrument for in the calculation of the predicted stock and to have province-specific time variation that is not fully collinear with the included time and province fixed effects.

[45]We could also argue for a limited effect of construction via a high number of non-occupied dwellings. According to Census data, 15% of the housing stock was empty in 2001. Although there are no official statistics, in 2010 the government recognised the existence of around between 700,000 empty houses, while non-official statistics quantify this number between 1.7 and 3 millions in 2008 (at the peak of the boom) and at least 1.5 millions in 2010 (after the crisis started).

natives would be displaced from a region where a large inflow of immigrants arrive, I find a strong robust co-location effect. Recent theoretical and empirical developments have focused on analysing the impact of immigrants on the labour markets from a general equilibrium approach where we take into account the specialisation, skill-mix and technological changes that come about with immigrant inflows (Lewis & Peri, 2015; Peri, 2016). Some authors have proposed models predicting positive impacts of immigration on firm performance via production complementarities (Ottaviano & Peri, 2012b) and thus a native wage-enhancing effect of immigration. Existing theoretical models of the impact of immigration on house prices allow for potential co-location of immigrants and natives if some sort of complementarity (via production or consumption) exists (Saiz, 2007; Sá, 2015).

The model proposed below is a special case of a general model with two type of workers: native and foreign-born. When each type of worker specialises in one sector (tradable or non-tradable) and a change in the conditions in the source country pushes immigrants to the receiving country, the model predicts an increase on local rents and native and immigrant contemporaneous co-location. This result is consistent with the empirical findings of the previous sections and with existing evidence for Spain that native and workers specialise in different sectors (Amuedo-Dorantes & de la Rica, 2011; De la Rica et al., 2014) and that foreign-born workers provide cheaper local services (González & Ortega, 2010; Farré et al., 2011). The model can be also be generalised to include a second tradable good which is produced only with foreign-born labour, in which case the model predicts that an inflow of immigrants increases rents, decrease native wages and crowds-out native labour in the receiving region[46].

## 4.1 Model Set-up

I present here a one-region (in our case province) model where a worsening in economic conditions in the country of origin generates an inflow of immigrants into the region. This fits well with the empirical instrumental variables strategy used in this paper where the inflow of immigrants is predicted using a push-factors gravity model (which captures the changes in conditions in origin) and the specific number of immigrants that locate in a particular region depends on local factors. The model is suitable for an immigration wave where immigrants move from their country of origin to a specific region and not when they move within regions of the receiving country[47].

In this set-up the spatial equilibrium for immigrants is determined by comparing the receiving city conditions with those of the sending country. After the inflow of foreign-born population settles in the region, how the wages, native population and rents (housing costs) react depends on whether the foreign-born population is employed in the tradable sector or not. In the case presented in this section foreign-born workers only work in the non-tradable services sector, while all the tradable good is produced with native labour. This assumption generates model predictions which fit the empirical results obtained above.

Let us assume a region $r$ where two goods are produced, a tradable one $C$ and a non-tradable one $S$. The third good is non-tradable housing $H$, which is just an endowment. There are two types of labour in the economy: native labour $L^n$ and foreign-born labour $L^f$. All the tradable good is produced with native labour and all the non-tradable good is produced with foreign labour[48]. The production functions of these goods are:

$$Y_c = (L_c^n)^\alpha (N_c)^{1-\alpha} \tag{21}$$

$$Y_s = A_s L_s^f \tag{22}$$

[46] A full depiction of this model and its predictions is available upon request. The model could also be extended to add the Ottaviano & Peri (2012a) set-up where natives with different levels of skills would specialise in different sectors and the inflow of (low-skilled) immigrants would have differential effects on the wages and housing consumption decisions for both types of natives (high and low skilled).

[47] Which was the case during the immigration wave in Spain during the 2000s.

[48] In here I discuss the tradable and non-tradable sector produced with native and foreign-born workers but we could also think about a tradable high-skill and non-tradable low-skill sector where immigrants would provide low-skill labour.

where $Y_c$ is the total production of good $C$, $Y_s$ is the total production of good $S$, $N_c$ is the second factor of production in the tradable good sector and $\alpha$ and $(1-\alpha)$ are the input shares in the Cobb-Douglas tradable good production function. $A^s$ is the non-tradable good specific productivity shifter (exogenous).

Individuals, both foreign and natives, yield utility from the consumption of three goods: the tradable good $C$, the non-tradable good $S$ and housing $H$. The utility function is Cobb-Douglas and the shares of consumption of the goods are $\beta$, $\gamma$ and $(1-\beta-\gamma)$:

$$u = c^{\beta} s^{\gamma} h^{1-\beta-\gamma} \tag{23}$$

Natives earn wages $w_n$ and foreign-born workers earn (nominal) wages $w_f$, and they have no other sources of income. Rents (housing costs) are denoted by $\pi$. Prices of goods are given and denoted by $p_c$ and $p_s$. The endowments of the second production factor and of housing stock are denoted by $\overline{N}_c$ and $\overline{H}$. The outside-option level of utility for native and foreign-born workers are given by $\overline{u}$ and $\overline{u}_f$. The relationship between the native and foreign-born baseline utility level is given by expression (A.6) and discussed in section A.3.

The equilibrium of the economy is characterised by the following equations:

$$\textit{ZPC1:}\quad p_c = \frac{w_n}{\alpha}\left(\frac{N_c}{L^n}\right)^{\alpha-1} \tag{24}$$

$$\textit{ZPC2:}\quad p_s = \frac{w_f}{A_s} \tag{25}$$

$$\textit{MCC1:}\quad w_f L^f = \gamma\left[w_n L^n + w_f L^f + \pi\overline{H}\right] \tag{26}$$

$$\textit{MCC2:}\quad \pi\overline{H} = (1-\beta-\gamma)\left[w_n L^n + w_f L^f + \pi\overline{H}\right] \tag{27}$$

$$\textit{SEC1:}\quad \overline{u} = \frac{w_n}{p_c^{\alpha} p_s^{\gamma} \pi^{1-\beta-\gamma}} \tag{28}$$

$$\textit{SEC2:}\quad \overline{u}_f = \frac{w_f}{p_c^{\alpha} p_s^{\gamma} \pi^{1-\beta-\gamma}} \tag{29}$$

Equations (24) and (25) are the zero profit conditions (ZPC) for the tradable and non-tradable goods $C$ and $S$, and equations (26) and (27) are the market clearing conditions (MMC) for the non-tradable goods $S$ and $H$. Equations (28) and (29) define the spatial equilibrium conditions (SEC) where the optimality conditions for the maximisation problem of consumption for natives $n$ and foreign-born workers $f$ are equal to their outside-option level of utility $\overline{u}$ and $\overline{u}_f$.

By combining the MCC (26) and (27) we obtain:

$$w_f L^f = \frac{\gamma}{1-\beta-\gamma}\pi\overline{H} \tag{30}$$

$$w_n L^n = \frac{\beta}{1-\beta-\gamma}\pi\overline{H} \tag{31}$$

From the ZPC of the tradable sector (24) we derive the demand for native labour, decreasing in $w_n$:

$$L^n = \left[\frac{p_c\alpha}{w_n}\right]^{\frac{1}{1-\alpha}} N_c \tag{32}$$

By replacing (32) into (31) we obtain:

$$\frac{(p_c\alpha)^{\frac{1}{1-\alpha}} N_c}{w_n^{\frac{\alpha}{1-\alpha}}} = \frac{\beta}{1-\beta-\gamma}\pi\overline{H} \tag{33}$$

Using the SEC (28) and (29) into (33) we obtain:

$$\frac{(p_c\alpha)^{\frac{1}{1-\alpha}} N_c}{\left(\frac{\overline{u}}{\overline{u}_f} w_f\right)^{\frac{\alpha}{1-\alpha}}} = \frac{\beta}{1-\beta-\gamma}\pi\overline{H} \tag{34}$$

From the ZPC (25) and combining it with the SEC (29) we obtain:

$$w_f = \left[\frac{p_c^{\beta}}{A_s^{\gamma}}\right] \overline{u}_f^{\frac{1}{1-\gamma}} \pi^{\frac{1-\beta-\gamma}{1-\gamma}} \tag{35}$$

Combining equations (34) and (35) and solving for rents we have the following:

$$\pi = \Phi_1 \overline{u}_f^{-\frac{\gamma\alpha}{(1-\gamma)(1-\alpha)+\alpha(1-\beta-\gamma)}} \tag{36}$$

Finally, using equations (35) and (36) we can solve for the foreign-born workers wages $w_f$:

$$w_f = \left[\Phi_2 \overline{u}_f^{\frac{(1-\gamma)(1-\alpha)+(1-\gamma)\alpha(1-\alpha-\beta)}{(1-\gamma)(1-\alpha)+\alpha(1-\beta-\gamma)}}\right]^{\frac{1}{1-\gamma}} \tag{37}$$

where $\Phi_1$ and $\Phi_2$ are functions of prices, parameters and endowments.

## 4.2 Equilibrium adjustments to immigrants inflows

A decrease of the outside-option $\overline{u}_f$ for the foreign-born workers has the following effects:

$$\begin{array}{rcl} \Downarrow \overline{u}_f \longrightarrow \Downarrow w_f & & (equation\ 37) \\ \Downarrow \overline{u}_f \longrightarrow \Uparrow \pi & & (equation\ 36) \\ \Uparrow \pi \longrightarrow \Downarrow w_n & & (equation\ 33) \\ \Downarrow w_n \longrightarrow \Uparrow L^n & & (equation\ 32) \\ \Downarrow w_f \ \Uparrow \pi \longrightarrow \Uparrow L^f & & (equation\ 30) \end{array}$$

Intuitively, a worsening in the (economic) conditions in the countries of origin of the foreign-born workers decreases the value of their outside option ($\overline{u}_f$) and workers would migrate to the region. For a given housing stock and housing quality, housing rents $\pi$ increase. Equation (36) predicts that the increase in foreign-born population decreases nominal wages $w_f$ and thus make the non-tradable services cheaper (ZPC 25). Foreign-born workers would be willing to work in the region for lower *real* wages. They enter the region until (equation 29) is in equilibrium.

The decrease in the price of local services makes the region more desirable for natives, who enter the region until (equation 28) is in equilibrium again. This in turn increases rents even further and decreases native nominal wages[49]. However, the *real* wages of natives are unchanged as local non-tradable prices have become cheaper after the foreign-born inflow. In the new equilibrium the region has increased foreign-born and native population, higher rents and lower nominal wages for natives and foreign-born[50]. The real wages for natives are the same or higher than before (depending on how much immigrants decrease local service prices and what share are these on the consumption

[49]In the long run housing supply can change, either directly with the construction of new dwellings, or indirectly by increasing the density inside the dwellings (quality of housing can also be affected as noted by Saiz & Wachter (2011)). To make the model more intuitive we assume that housing stock is fixed. In the empirical exercise the results suggest that conditioning out for changes in housing supply does not change the demand impact of immigration on prices so this assumption is compatible with the empirical framework.

[50]Which are not necessarily the same as they work in different sectors and their level depends on parameter values.

of natives). Appendix Section A.3 presents a brief model extension to explain why immigrants of different origins might locate in provinces in different proportions, providing a theoretical micro-foundation for the use of the ethnic networks shift-share instrument.

# 5 Robustness

## 5.1 IV strategy validity discussion

In this section I discuss the validity of the instrumental variables strategy implemented in the results section. Two conditions must apply for the shift-share prediction to be an appropriate instrument. For the exclusion restriction to be valid, conditional on all controls, the only channel through which the predicted immigrant stocks affect the housing costs growth has to be via its effect on current immigrant stocks (by nationality). This implies that historical settlement of immigrants by nationality in the base year has to be sufficiently lagged that, conditional on controls, it is orthogonal to unobservables correlated with current housing costs growth (exogeneity). At the same time, the instrument has to be sufficiently strong in its prediction of the current immigrant location patterns (relevance). I provide two pieces of evidence to test these conditions. The first one relates to the exogeneity of the instrument and the second one, to its relevance.

My base year, 1991, is 10 years before my observation period starts, which is substantially longer than in other applications[51]. However, one could still think of unobservable shocks correlated with housing costs and location decision of immigrants that existed in 1991 that still affect both aggregates today (even conditional on all the region trends and province attributes/fixed effects). To test this, similarly to Farré et al. (2011)[52], I regress the provincial share of foreign-born population in 1991 on the 1990-91 economic conditions and then the change in this share during my observation period (2001-2012) on these same variables. The aim of this exercise is to show that the determinants of the geographical distribution of the mass of foreign-born workers in 1991 does not perfectly predict the location during my period of study. The results are shown in table 7.

[TABLE 7 AROUND HERE]

The regression includes the 50 provinces observations and a constant, so all the values are relative to the national mean. I include the log of disposable income, the log of average wage (region wage bill over workers), the share of different sectors (agriculture, services and industry) in the regional value-added (the exclude category is the construction sector), the unemployment rate for natives and foreign-born workers, the log housing density (number of residential housing units over area) and the share of built-up land over total land (to control for urbanisation). The model has high predictive power ($R^2$ is around 0.75) and most of the regressors are significant. When I regress this same set of variables on the change of foreign-born over population over the 2001-2012 period none of the coefficients is significantly different from zero. This test is supportive of the appropriateness of using 1991 as base year. In fact, the empirical exercise is even more demanding because most of these 1991 conditions would be captured in the region and province attributes/fixed effects. In case we consider 1991 still to close to the start of the period, in the robustness checks provided in the next section I also use 1985 and 1981 as based years to construct the instrument (which remains strong) and the results remain fairly similar.

The second exercise is to construct instruments with placebo shifts or placebo shares and combine them with the actual share or shifts (the ones used in the construction of the instrument of section 3). We use these placebo instruments to check if the results hold. This test relates to the relevance of the instrument. The purpose of this is to prove that it is the exact combination of the (nationality-specific) 1991 location patterns and the gravity predicted national inflow that produces a reliable

[51]For example Saiz (2007) uses data from 1985–1998 and the base year is 1983 and Sá (2015) uses data from 2003 and the base year is 2001.

[52]These authors use a very similar instrument and an extensive discussion on the appropriateness of this instrument (relevance and exogeneity) is available in their paper.

strong instrument. I show the results of this exercise in table 8. The top panel shows the results for rents and the bottom one for house prices. I only show the results for the immigrant demand results, but the insignificance of the placebo instruments is the same for the total demand results. The first column shows the baseline estimates, which uses the instrument where the share is based on the 1991 provincial foreign-born stocks by nationality and the shift is based on the gravity estimates of columns 1 and 5 of table A.3.

[TABLE 8 AROUND HERE]

In the first three columns I change the province share and interact it with the gravity national prediction (baseline shift). In column 2 I randomly distribute each nationality immigrants across provinces and I multiply this random allocation by the gravity-model predicted annual inflow by nationality. In column 3 I use nationality-province immigrant stock information from the 1930 census. This shows that such older past location patters do not have any predictive power for the current ones. In column 4 I use a land-use share based on data from the Corine 2000 dataset. I calculate the share of forest land (column 3) in the province with respect to the total in that category in the whole of Spain and use that share to distribute the national inflow and stock of immigrants. None of the coefficients for the population rate are significantly different from zero. In the remaining columns I use the 1991 location patterns and change the component of the instrument that provides time variation (the shift).

In the last four columns of the table I use the 1991 share (baseline share) and interact it with a placebo annual shift. In columns 5 to 7 I use the immigrants by nationality (inflow and stock) going to different OECD countries during the study time period (2001-2011). I use the inflows to the USA (column 5), to Australia and New Zealand (column 6) and to Japan (column 7). The coefficients for the population rate regressor are highly insignificant. Finally, in column 8 I use the annual growth in province population predicted by the natural movement of population (births-deaths). I do not want to use internal (native) migration driven population changes as we have seen in section 3.3 they are causally related to the immigrant inflows. The coefficient of interest is also highly insignificant. These results show that is it precisely the combination of a relevant share and a relevant shift that gives raise to a strong instrument that predicts the annual location of immigrations by nationality in each of the provinces.

### 5.2 Additional results

In this section, I present additional results in order to check the robustness of the findings. I present the most of the alternative estimates using the population rate regressor (immigrant demand) but the results are also robust for the total demand estimates. As no substantial effect of controlling for time-varying housing supply was found, I compare the results with the baseline estimates of columns 7 and 8 of table 5, e.g. 0.61 for rents and 2.28 for house prices. The results for rents are displayed in table 9 and for house prices in table 10. Column 1 top panel in both tables shows the baseline elasticity estimate. Note that the Kleibergen-Paap statistics are not the same in both tables because for rents I include NUTS2 dummies and province attributes and for prices I include NUTS3 dummies.

[TABLES 9 and 10 AROUND HERE]

The top panel of tables 9 and 10 changes the shift used in the construction of the instrument of expression (9). In the baseline results we use the gravity predicted annual inflow with country and year fixed effects (column 1 and 5 in table A.3). In columns 2 and 3 I use the actual annual inflow to Spain by nationality, including (2) and excluding (3) the own province value. The coefficients are similar but slightly larger than in the baseline estimates. In columns 4 to 6 I use predicted national immigration totals from different specifications of the gravity model that vary in the inclusion of different sets of area and year dummies. I check the robustness to including country dummies but excluding year dummies (4), to using nationality group and year dummies (5) and to only use nationality group dummies (6). The results only hold in column when we use country dummies for the estimates, and the instruments become too weak otherwise.

In columns 1 to 3 of the middle panel of these tables I check the robustness of the results to changing the base year used to distribute the national immigrant inflow across provinces based on historic ethnic settlements. The baseline results use immigrant stocks by province and nationality in 1991, using 104 different nationalities. In column 1 I use 113 nationalities and the census 2001 location patterns and, as expected, the instrument is very strong and the coefficients decrease with respect to the baseline estimates. However, it is unlikely that 2001 settlements are unrelated to 2001-2012 shocks even conditional on controls. In columns 2 and 3 I use data from 1985 (Annual Statistical Yearbook) –62 nationalities– and 1981 (Census) – 74 nationalities– to construct the share. The results are not robust for rents but for prices they remain significant and the coefficient is quite similar when using 1981 census data. In columns 4 to 6 of the middle panel I add additional area controls. In column 4 I add NUTS1 linear trends, in column 5 NUTS1*year dummies and in column 6 NUTS2 linear trends. The results remain very similar.

In the bottom panel I carry out two additional exercises. In columns 1-3, I change the denominator used in the construction of instrument (9). In the baseline results to compute the imputed initial population figures I use the native imputed stock using 1991 location patterns (constructed as explained in section A.2.2 in the Appendix) and the gravity-model immigration stock. In here I use either the actual population of the province (1), the actual natives combined with the imputed immigrant stock population (2) or the imputed immigrant stock and the imputed native stock using 1981 census data (3). The results are fairly robust for rents and very robust for house prices. In the last 3 columns of the bottom panels, I use an alternative instrument based on the gateways/ports of entry[53]. The intuition is that different nationality immigrants will locate disproportionaby in regions which are more accessible to them. I first locate 50 ports of entry using 6 different travel modes (listed in table A.4). For 113 nationalities I calculate the share of immigrants in 2000 that used those different modes of transportation using data from the National Immigrant Survey 2007. This gives me nationality-specific variation which is necessary in order to avoid perfect collinearity with the province attributes and fixed effects of specification (1). Then, for each province in Spain I calculate a weighted-by-road-distance and port size (using data on air and boat passengers in 2001) nationality-specific accessibility index. I calculate a weighted measure of how accessible a province is for each nationality from all the ports of entry, where the numerator is the port-size and the denominator is share of migrants that use that particular mode. I normalise this province accessibility measure and use it to distribute the nationality-specific gravity-model inflow/stock in every year 2001 to 2011.

Unfortunately as shown in column 4, in my setting this instrument is very weak (the Kleinbergen-Paap statistic is very low). However, I can use this gateways-based share to construct a second instrument with completely different sources of variation than the one used for the baseline results. This allows me to run Hansen exogeneity test[54]. The results of using these additional instruments are presented in columns 5 and 6 of the bottom panel. For the second instrument I use the gateways accessibility shares and for the shifts I use the number of immigrants going to countries with similar economic and amenity characteristics as Spain (EU15 South European countries –column 5– or Portugal-Greece-Italy –column 6–). The columns show the combined instruments F-test which is in both cases over 10 and the coefficients of both instruments in the first stage. The results are very similar to the baseline ones and more importantly, the exogeneity of instruments Hansen test statistics is well above 0.05.

Tables A.5 to A.8 in the Appendix provide additional results[55]. For comparability all tables reproduce the baseline estimates for house prices and rents. Table A.5 checks the robustness of estimates to using alternative population measures. The first four columns show results for the total effect and

[53]In a similar manner to González & Ortega (2013).

[54]The Hansen test cannot be run using a second instrument based on the same sources of variation, either the shift or the share, as this would just be a very similar version of the same instrument and not genuinely an additional one.

[55]In unreported results, I also check if the results hold when I remove the 2 and 3 largest and smallest provinces in terms of initial stock and shares of foreign-born, and they do.

the last found for the immigrant effect. Column 2 uses working-age foreign-born population, column 3 foreign population and column 4 working-age foreign population. The coefficients are smaller but similar to the baseline estimate of column 1. Column 6 shows the results using the working-age total population. As expected, the estimates using a sub-population group are smaller but similar to the baseline of column 5.

In table A.6 I use alternative outcomes. In columns 2 and 3 I use quarterly house price data from the Spanish Public Works Department data (*"Ministerio de Fomento"*) (the annual average and the second quarter average). The results are practically unchanged with respect to the baseline estimate of column 1. In columns 4 and 5 I show the results using the log change in housing stock as the outcome variables (using the NUTS2 dummies/province attributes NUTS3 dummies). I find a coefficient of around 0.9 significant at 10% level for the total effect and of around 0.7 and significant at 5% for the immigrant effect. These results, in line with existing findings, suggests that the immigrant inflow was also responsible for the construction of housing units.

### 5.3 Timing of the adjustments

In this section, I explore the timing of the adjustments for all three sets of results. In Table A.7, instead of one-year differences as in the main results, I use five-year long-differences (LD) to construct the immigration and population rates and the instrument. The outcome variables also correspond to 5-year growth rates. There are two main changes in the estimated specification. First, because the LD setting allows for the adjustments in prices from the inflows to take place at any time during the 5-year time period, I do not impose any lag structure in the specification. Therefore, in these results the long-difference changes in the outcomes and main regressors are contemporaneous. Secondly, given that I only have 100 observations in the data (2011/06 and 2006/01 differences), I cannot use all the controls and area dummies as in the FD results without losing all the variation in the data. However, I still include a large set of controls which are listed in the notes of the table. The results of this table show that the main results hold when allowing for longer periods for the adjustments to take place. The instrument is still strong and the Kleinbergen-Paap statistics well above the 10 rule-of-thumb threshold. The coefficient for native mobility is very similar to those estimated using FD. The total and immigrant demand effects are larger for rents and smaller for prices, but similar and not statistically different from the FD estimates. If we use the coefficients of Table A.7, the decomposition expression (20) is still valid. The findings of this exercise show that, similarly to Saiz (2007), the estimates in the LD set up are consistent with the FD results and, more importantly, the decomposition of the total impact into a direct and indirect demand effect still holds when we change the periodicity of the adjustments. This

I perform a second exercise to study the timing of the adjustments. The results are shown in Table A.8. Here, I test the robustness of the results to using a contemporaneous, one lagged or two-lagged inflow of immigrants, using them one at a time or combined. I present the results for the immigrant effect. There are three panels in the table: the top one is for rents, the middle one for house (transaction) prices and the bottom one for native mobility. The baseline results correspond to column 2 for rents and prices and to column 1 for native mobility. Column 1 shows the coefficient using the contemporaneous rates: the results on rents remain significant and very similar to the baseline, but they are insignificant (and quite imprecise) for prices. This result is reasonable given that one would expect some lag of time between arriving into the country and investing in a property[56]. The main results for prices are show in column 2. When I add a second lag in column 3, both coefficients are weakly significant for rents but just the first lag remains significant for house prices. In column 4 I add the contemporaneous rate to the lagged one, and in column 5 I add both the contemporaneous

[56]This could not be the case for some immigrant nationalities like EU15 immigrants from Germany or the UK who migrate to Spain for retirement and to buy property. However, I do not consider residential-retiree immigration to be a large phenomenon during the period of study. As discussed in De la Rica et al. (2014) most of the immigration during the study period came for working reasons. Moreover, as seen in table A.5, the coefficients are very similar (a bit smaller) if we focus on working-age population which excludes retirement immigrants.

and the second lag. In these two columns, it is always the value in $t - 1$ which causally affects prices in $t$. With respects to native mobility, the results of the bottom panel show that it is always the contemporaneous rate that influences changes in native location. These results suggest that my chosen specifications are those that best capture the timing of the effects.

# 6 Conclusions

This paper draws the attention to a highly overlooked issue in the estimation of average area effects of immigration: the role of local population displacement on the adjustment of local demand and prices. The total impact of increases of foreign-born population on housing markets results from a combination of their impact on housing demand, their impact on native mobility and their impact on housing supply. The estimation of well-identified reduced-form effects is with no doubt of interest for policy makers. However, previous research has shown the importance of taking into account the role of (population) displacement when estimating the impact of local policy interventions (Blundell et al., 2004; Einio & Overman, 2016). As well as the net impact, we might be interested on understanding the mechanisms driving the total adjustment. This is the first paper that provides joint estimates of the total price impact of immigration and of all its components and, in doing so, provides a better understanding of the impact of changes in population on local house prices. I use Spanish data during a housing boom and bust and a period of unprecedented immigration inflows to obtain my results.

In his seminal paper on the effect of immigration on house prices Saiz (2007) argues that there is no way to separate the estimate of increased housing demand from immigrants from additional changes in demand associated with changes in (local) native population. I this paper, I propose a methodology to precisely identify this coefficient. I do this in three steps. I first estimate the total impact of immigration on house prices using a specification similar to his, which corresponds to the total net impact. To obtain consistent estimated elasticities I use a first-differences instrumental-variables strategy. The specifications control for housing supply conditions in order for the coefficients to capture demand changes. In my preferred results, the elasticities are 0.8 for rental prices and 3.1 for house (transaction) prices. In order to identify the potential wedge between the total and immigrant demand estimates, I then estimate the impact of immigration on native mobility. I find a robust sizeable co-location effect of around 35 natives for 100 immigrants. Finally, I propose a strategy to pin down the direct impact of immigrant demand on housing costs. I use population growth as the main regressor and instrument it with a prediction of the immigration inflows and stocks based on exogenous variation. This allows me to exploit only the variation in population growth which stems from immigration. The estimated elasticities are 35% smaller than the total estimates (0.6 for rents and 2.3 for prices).

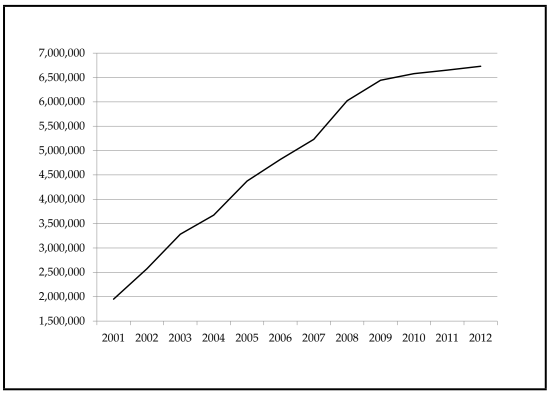
A formal decomposition of the total (demand) impact obtained from combining the estimating equations is presented in the paper. Total changes in demand are the net result of direct demand changes (price-population elasticity) plus any additional changes in demand from relocated population. The sign of the second component depends on the impact of immigrants on native location decisions. I show that this decomposition holds exactly when I use my consistent estimates. Additional demand from relocated natives increases the direct demand effect in 0.2 percentage points for rents and 0.8 percentage points for prices, around 25% of the total effect. In order to explain the mechanisms driving the empirical results I propose a simple spatial equilibrium model. My results are robust to changes in the construction of the instrument and to using longer lags in the calculation of the time differences.

During the period of analysis, 2001 to 2012, the total growth of house prices was around 52% and for rents of around 31%. The cumulated change in the immigration rate during the period was of around 8.8%. If we use the estimated elasticities from Section 3, the predicted average total effect of the change in immigration rate on house prices is of around 27 percentage points (pp) and of around 7.4 pp for rents. These numbers imply that immigration was responsible for an important share of the actual housing cost growth, especially for prices (52% for prices and 24% for rents). Around a third of the effect can be attributed to additional changes in demand from relocated population. In order to contextualise the magnitude of the effects, if we were to give the province with the smallest change in immigration rate (Cáceres, 1.7%) the growth of the province with the largest rate (Guadalajara, 19.3%), it would have experienced an additional increase in rents and prices of 15 and 54 pp with respect to its actual predicted change (1.4 and 5 pp).

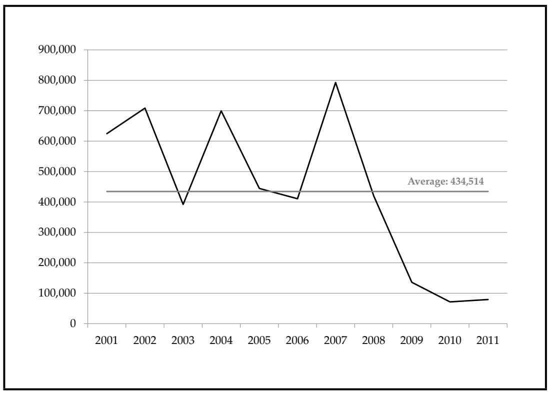
My results highlight the importance of using a correct framework to interpret the coefficients. Equation (20) shows that the net sign of the total effect is the results of direct demand impacts (which we expect to be positive) and induced demand changes. These changes can be positive or negative depending on the relationship between immigrant and native location decisions. When we only estimate the total effect and make claims about the sign of the second term of the decomposition, we could be misinterpreting the mechanisms driving the total adjustments. Local outcomes would be differently affected by immigration inflows depending on the size and sign of the native-immigrant location. Displacement effects can also be relevant in other contexts such as the estimation of immigrants on local crime rates (Buonanno et al., 2011; Alonso-Borrego et al., 2012; Bell et al., 2013). By disentangling the different channels through which immigration affects house prices, I provide not only the size of the causal effect but also a meaningful economic interpretation of the estimates. A correct understanding of the channels driving the total impact is essential for better policy design.

# Figures and tables

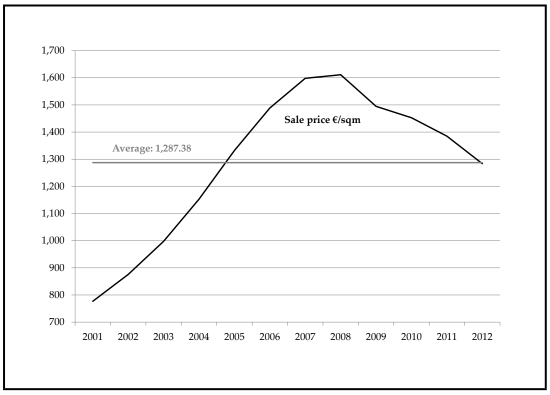
**Figure 1:** Immigrantion and house prices over time



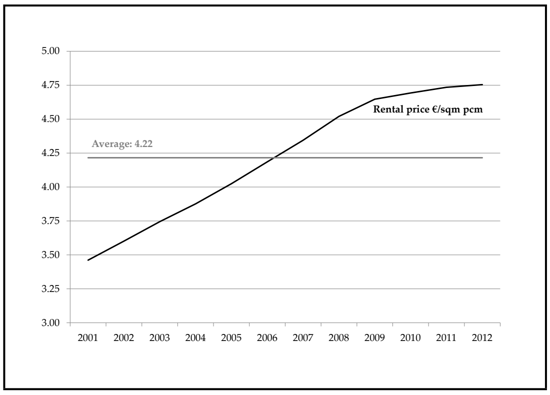

(a) Foreign-born stocks




(b) Foreign-born inflows




(c) House sale prices




(d) House rental prices

**Table 1:** Residential density in Spain 2001-2012

| Year | **Population** | **Housing stock** | **Stock over population** |
|---|---|---|---|
| 2001 | 40,972,359 | 20,988,378 | 0.512 |
| 2002 | 41,692,558 | 21,440,413 | 0.514 |
| 2003 | 42,573,670 | 21,878,187 | 0.514 |
| 2004 | 43,055,014 | 22,368,785 | 0.520 |
| 2005 | 43,967,766 | 22,877,640 | 0.520 |
| 2006 | 44,566,232 | 23,443,569 | 0.526 |
| 2007 | 45,054,694 | 23,983,886 | 0.532 |
| 2008 | 46,008,985 | 24,518,341 | 0.533 |
| 2009 | 46,593,673 | 24,856,498 | 0.533 |
| 2010 | 46,864,418 | 25,054,029 | 0.535 |
| 2011 | 47,029,641 | 25,196,069 | 0.536 |
| 2012 | 47,100,501 | 25,328,848 | 0.538 |

Source: Department of Housing and Population Registers

**Table 2:** Total effect estimates – OLS/FE results

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| ***Change in log rents in t*** | | | | | | | | |
| Immigration rate (t-1) | 0.340*** | 0.289** | 0.308*** | 0.455*** | 0.487*** | 0.464*** | 0.461*** | 0.467*** |
| | [0.127] | [0.119] | [0.109] | [0.105] | [0.113] | [0.112] | [0.113] | [0.113] |
| Adjusted $R^2$ | 0.57 | 0.58 | 0.59 | 0.63 | 0.64 | 0.66 | 0.66 | 0.68 |
| ***Change in log prices in t*** | | | | | | | | |
| Immigration rate (t-1) | 0.604** | 0.540* | 0.697** | 0.862*** | 1.188*** | 1.232*** | 1.241*** | 1.249*** |
| | [0.285] | [0.292] | [0.314] | [0.293] | [0.321] | [0.336] | [0.336] | [0.337] |
| Adjusted $R^2$ | 0.85 | 0.85 | 0.86 | 0.86 | 0.86 | 0.86 | 0.86 | 0.86 |
| Observations | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 |
| Year dummies | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Time-var controls (t-2) | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Area dummies | | | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS3 |
| Location/Amenities | | | | ✔ | ✔ | ✔ | ✔ | |
| Socio-economic | | | | | ✔ | ✔ | ✔ | |
| Geography/Regulation | | | | | | ✔ | ✔ | |
| Housing Market | | | | | | | ✔ | |

*Notes*: Significance levels: * p<0.05, ** p<0.01, *** p<0.001. t=2002/2012. Clustered (province) standard errors in brackets. NUTS2 corresponds to regions (CCAA) and NUTS3 corresponds to provinces. The dependent variable is the change in log province house rents (top panel) and in house prices (bottom panel), between t/t-1. The immigration rate corresponds to the inflow of foreign-born population in t-1 over population at the beginning of t-1/end of t-2. *Time-varying controls* (lagged two periods t-2/t-3) include change in log GDP per capita, change in log number of credit establishments, change in share of saving banks, change in unemployment rate, change in log average wage, change in average years of education (employed), change in proportion of WAP with no studies, change in log urban infrastructure capital, change in log transport infrastructure capital, change in share employed in primary sector, change in share employed in secondary sector, change in share employed in non-tradable services and change in share employed in tradable services. *Location/Amenities* attributes include coast dummy, length of coastline, log of average temperature in January, log of average rain precipitation in January, log distance to Madrid, log distance to Barcelona, log of total area, log of area of natural parks, log number of retails shops, log number of restaurants and bars, index of the importance of the tourism sector and log number of doctors (all in 2000). *Socio-Economic* attributes include log of population, share of foreign-born population, employment rate of foreign-born population, share of single person households, average household size, share of households with children (socio-economic attributes - all in 2001). *Geography/Regulation* attributes include share of developable land in 2000, average terrain ruggedness index, average terrain height index, altitude range (max-min), number of localities with 10,000 inhabitants in 2000, share of population living in cities with 50,000+ inhabitants in 2000, share of municipalities with a comprehensive planning law in 1999, share of municipalities with no planning law in 1999, share of population living in towns with a right-wing party major in 2001. *Housing market* attributes include share of population who rent, share of secondary family homes, share of empty family homes (all in 2001).

**Table 3:** Total effect estimates – IV results

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| ***Change in log rents in t*** | | | | | | | | |
| Immigration rate (t-1) | 0.683** | 0.620* | 0.838** | 0.734** | 0.947** | 0.852** | **0.834**** | 0.509 |
| | [0.290] | [0.350] | [0.393] | [0.369] | [0.470] | [0.411] | **[0.406]** | [0.379] |
| ***Change in log prices in t*** | | | | | | | | |
| Immigration rate (t-1) | -0.320 | -1.080 | 0.823 | 2.044** | 3.046** | 3.024*** | 3.045*** | **3.073***** |
| | [0.696] | [1.052] | [0.758] | [0.924] | [1.214] | [1.173] | [1.175] | **[1.170]** |
| ***First-Stage: Immigration rate in t-1*** | | | | | | | | |
| Immigration rate IV (t-1) | 0.553*** | 0.429*** | 0.431*** | 0.470*** | 0.431*** | 0.481*** | 0.480*** | 0.502*** |
| | [0.113] | [0.106] | [0.082] | [0.092] | [0.100] | [0.109] | [0.109] | [0.114] |
| FS Adjusted $R^2$ | 0.47 | 0.53 | 0.65 | 0.70 | 0.72 | 0.73 | 0.73 | 0.73 |
| Test weak identification | 23.11 | 15.40 | 24.91 | 22.94 | 16.37 | 16.64 | 16.47 | 18.05 |
| Observations | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 |
| Year dummies | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Time-var controls (t-2) | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Area dummies | | | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS3 |
| Location/Amenities | | | | ✔ | ✔ | ✔ | ✔ | |
| Socio-economic | | | | | ✔ | ✔ | ✔ | |
| Geography/Regulation | | | | | | ✔ | ✔ | |
| Housing Market | | | | | | | ✔ | |

*Notes*: Controls and specification as in Table 2.

**Table 4:** Native mobility test – OLS and IV results

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| ***Native rate in t - OLS/FE*** | | | | | | | | |
| Immigration rate (t-1) | 0.468*** | 0.376*** | 0.280*** | 0.252*** | 0.187*** | 0.163*** | 0.168*** | 0.172*** |
| | [0.088] | [0.078] | [0.065] | [0.040] | [0.038] | [0.036] | [0.036] | [0.036] |
| Adjusted $R^2$ | 0.27 | 0.36 | 0.57 | 0.75 | 0.84 | 0.86 | 0.85 | 0.87 |
| ***Native rate in t - IV*** | | | | | | | | |
| Immigration rate (t-1) | 0.534*** | 0.272 | 0.391*** | 0.284** | 0.354*** | 0.324*** | 0.353*** | 0.346*** |
| | [0.164] | [0.201] | [0.144] | [0.135] | [0.134] | [0.122] | [0.126] | [0.122] |
| Test weak identification | 23.11 | 15.40 | 24.91 | 22.94 | 16.37 | 16.64 | 16.47 | 18.05 |
| Observations | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 |
| Year dummies | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Time-var controls (t-2) | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Area dummies | | | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS3 |
| Location/Amenities | | | | ✔ | ✔ | ✔ | ✔ | |
| Socio-economic | | | | | ✔ | ✔ | ✔ | |
| Geography/Regulation | | | | | | ✔ | ✔ | |
| Housing Market | | | | | | | ✔ | |

*Notes*: Controls in Table 2, except that now t=2001/2011. First-stage coefficients are the same as in Table 3.

**Table 5:** Immigrant demand effect estimates – IV results

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| ***Change in log rents in t*** | | | | | | | | |
| Population rate (t-1) | 0.445** | 0.487* | 0.602** | 0.571** | 0.699** | 0.643** | **0.616**** | 0.378 |
| | [0.173] | [0.257] | [0.268] | [0.277] | [0.332] | [0.291] | **[0.279]** | [0.273] |
| ***Change in log prices in t*** | | | | | | | | |
| Population rate (t-1) | -0.209 | -0.849 | 0.591 | 1.592** | 2.249*** | 2.284*** | 2.251*** | **2.284***** |
| | [0.464] | [0.902] | [0.547] | [0.679] | [0.830] | [0.799] | [0.778] | **[0.780]** |
| ***First-Stage: Population rate in t-1*** | | | | | | | | |
| Immigration rate IV (t-1) | 0.848*** | 0.546*** | 0.600*** | 0.604*** | 0.584*** | 0.637*** | 0.649*** | 0.675*** |
| | [0.157] | [0.166] | [0.115] | [0.111] | [0.118] | [0.121] | [0.122] | [0.129] |
| F-Stage Adjusted $R^2$ | 0.34 | 0.45 | 0.65 | 0.72 | 0.77 | 0.80 | 0.81 | 0.81 |
| Test weak identification | 28.22 | 10.17 | 24.77 | 26.13 | 21.58 | 23.92 | 24.23 | 25.89 |
| Observations | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 |
| Year dummies | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Time-var controls (t-2) | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Area dummies | | | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS3 |
| Location/Amenities | | | | ✔ | ✔ | ✔ | ✔ | |
| Socio-economic | | | | | ✔ | ✔ | ✔ | |
| Geography/Regulation | | | | | | ✔ | ✔ | |
| Housing Market | | | | | | | ✔ | |

*Notes*: Controls as in Table 2 but now the population rate is the inflow in population during t-1 over the original province population at the beginning of t-1 (population growth rate).

**Table 6:** Effect of controlling for housing supply on the estimates

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | ***Change in log rents in t*** | | | | ***Change in log prices in t*** | | | |
| Immigration rate (t-1) | 0.834** | 0.642* | 0.704* | 0.668* | 3.073*** | 3.085*** | 3.036*** | 3.021*** |
| | [0.406] | [0.371] | [0.372] | [0.370] | [1.170] | [1.150] | [1.069] | [1.120] |
| Log change housing stock (t-2) | | 0.143** | | 0.118 | | -0.012 | | 0.052 |
| | | [0.071] | | [0.075] | | [0.627] | | [0.818] |
| Log change housing stock IV (t-2) | | | -3.409* | | | | -1.508 | |
| | | | [1.951] | | | | [23.833] | |
| Test weak-identification IMMR | 16.47 | 16.66 | 17.06 | 19.81 | 18.05 | 19.19 | 19.9 | 23.9 |
| Test weak-identification HOUS | | | | 51.61 | | | | 57.48 |
| | ***Change in log rents in t*** | | | | ***Change in log prices in t*** | | | |
| Population rate (t-1) | 0.616** | 0.505* | 0.548* | 0.527* | 2.284*** | 2.324*** | 2.285*** | 2.285*** |
| | [0.279] | [0.286] | [0.282] | [0.284] | [0.780] | [0.803] | [0.763] | [0.829] |
| Log change housing stock (t-2) | | 0.119 | | 0.091 | | -0.054 | | -0.002 |
| | | [0.077] | | [0.083] | | [0.629] | | [0.841] |
| Log change housing stock IV (t-2) | | | -2.594 | | | | 0.067 | |
| | | | [2.210] | | | | [24.423] | |
| Test weak-identification IMMR | 24.23 | 21.68 | 22.53 | 24.75 | 25.89 | 26.47 | 27.74 | 30.02 |
| Test weak-identification HOUS | | | | 45.58 | | | | 53.34 |
| Area dummies | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS3 | NUTS3 | NUTS3 | NUTS3 |
| All province attributes | ✔ | ✔ | ✔ | ✔ | | | | |
| Observations | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 |

*Notes*: Columns 1–4 include all the province attributes as in Table 2. Columns 5–8 include NUTS3 fixed effects instead. All columns include time-varying controls and time fixed effects. When using the housing supply IV the share of developable land is removed from the province attributes.

**Table 7:** IV validity checks: Base-year validity regressions

| | (1) | (2) |
|---|---|---|
| | Share of FB in 1991 | Change share FB 2001-2012 |
| Log disposable income | -0.007** | -0.001 |
| | [0.003] | [0.011] |
| Log of average wage | -0.039** | -0.069 |
| | [0.016] | [0.064] |
| Share of agriculture in VA | -0.284*** | 0.397 |
| | [0.095] | [0.423] |
| Share of services in VA | -0.111 | 0.458 |
| | [0.079] | [0.332] |
| Share of industry in VA | -0.161** | 0.403 |
| | [0.075] | [0.293] |
| Natives unemployment rate | -0.02 | -0.19 |
| | [0.024] | [0.146] |
| Immigrants unemployment rate | -0.080** | -0.173 |
| | [0.031] | [0.156] |
| Log housing density | 0.016*** | 0.005 |
| | [0.003] | [0.014] |
| Share of built-up land over total | -0.293** | 0.223 |
| | [0.127] | [0.398] |
| Constant | 0.520*** | 0.306 |
| | [0.155] | [0.679] |
| Observations | 50 | 50 |
| Model F-test | 11.57 | 6.63 |
| Adjusted $R^2$ | 0.74 | 0.38 |

*Notes*: Source data: Census 1991, Spanish Regional Accounts, Corine Landcover 1990. VA stands for Value Added. Economic values in 1991, share of build-up land in 1990. The omitted category is share of construction in VA.

**Table 8:** IV validity checks: Placebo shift-share instrument results

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | **Baseline** | **Different Shares & gravity** | | | **Census 1991 & different Shifts** | | | |
| | c91&grav | random | c1930 | forest | USA | AUS&NZ | JPN | NATU GR |
| ***Change in log rents in t*** | | | | | | | | |
| Population rate (t-1) | 0.616** | 1.833 | -1.175 | 2.779 | 0.657 | -0.061 | 1.564 | 0.307 |
| | [0.279] | [1.828] | [2.225] | [2.840] | [1.930] | [0.399] | [1.224] | [0.857] |
| Test weak identification | 24.23 | 1.57 | 0.38 | 1.15 | 0.57 | 2.98 | 0.93 | 7.49 |
| Area dummies | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS2 |
| All province attributes | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| ***Change in log prices in t*** | | | | | | | | |
| Population rate (t-1) | 2.284*** | 9.556 | 4.473 | 7.6 | 10.559 | 2.394 | 3.854 | -0.537 |
| | [0.780] | [5.813] | [8.925] | [5.944] | [11.221] | [2.637] | [5.354] | [3.343] |
| Test weak identification | 25.89 | 1.68 | 0.37 | 1.09 | 0.98 | 3.12 | 1.07 | 6.83 |
| Area dummies | NUTS3 | NUTS3 | NUTS3 | NUTS3 | NUTS3 | NUTS3 | NUTS3 | NUTS3 |
| Observations | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 |

*Notes*: Top panel results include NUTS2 dummies and all province attributes as in Table 2. Bottom panel results include NUTS3 dummies. All specifications include year dummies, time-varying controls and NUTS2 time trends.

**Table 9:** Robustness checks: immigrant demand on rents

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | **Baseline** | **Spain** | **Spain2** | **GRAV c3** | **GRAV c2** | **GRAV c4** |
| Population rate (t-1) | 0.616** | 0.686** | 0.754** | 0.615* | 0.09 | 0.142 |
| | [0.279] | [0.279] | [0.339] | [0.363] | [0.433] | [0.597] |
| Test weak identification | 24.23 | 21.16 | 16.27 | 14.36 | 5.56 | 4.92 |
| | **Eth 2001** | **Eth 1985** | **Eth 1981** | **NUTS1 tr** | **NUTS1 yrD** | **NUTS2 tr** |
| Population rate (t-1) | 0.519*** | 0.167 | 0.127 | 0.590** | 0.583** | 0.648** |
| | [0.167] | [0.246] | [0.365] | [0.300] | [0.283] | [0.271] |
| Test weak identification | 172.63 | 46.66 | 14.56 | 20.17 | 24.16 | 25.41 |
| | **Den POP** | **Den NAT** | **Den NAT81** | **GatesIV** | **2 IVs EU** | **2 IVs P–I–G** |
| Population rate (t-1) | 0.775** | 0.989** | 0.837** | 2.789 | 0.595** | 0.616** |
| | [0.372] | [0.481] | [0.395] | [6.534] | [0.273] | [0.277] |
| Test weak identification | 27.79 | 18.11 | 29.52 | 0.22 | 13.57 | 12.45 |
| Test over identification | | | | | 0.59 | 0.96 |
| FS Ethnic IV | | | | | 0.642*** | 0.644*** |
| FS Gates IV | | | | | 0.016* | 0.009 |
| Observations | 550 | 550 | 550 | 550 | 550 | 550 |

*Notes*: All specifications include NUTS2, year dummies and province attributes. Province attributes as in Table 2.

**Table 10:** Robustness checks: immigrant demand on house prices

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | **Baseline** | **Spain** | **Spain2** | **GRAV c3** | **GRAV c2** | **GRAV c4** |
| Population rate (t-1) | 2.284*** | 2.415*** | 2.548** | 3.407* | -0.951 | -2.195 |
| | [0.780] | [0.887] | [1.024] | [1.933] | [1.849] | [3.344] |
| Test weak identification | 25.89 | 22.61 | 17.58 | 15.07 | 6.23 | 5.61 |
| | **Eth 2001** | **Eth 1985** | **Eth 1981** | **NUTS1 tr** | **NUTS1 yrD** | **NUTS2 tr** |
| Population rate (t-1) | 1.574*** | 1.348* | 1.998** | 2.386*** | 2.289*** | 2.323*** |
| | [0.447] | [0.814] | [0.938] | [0.820] | [0.806] | [0.764] |
| Test weak identification | 188.21 | 50.19 | 14.24 | 21.96 | 26.46 | 26.81 |
| | **Den POP** | **Den NAT** | **Den NAT81** | **GatesIV** | **2 IVs EU** | **2 IVs P–I–G** |
| Population rate (t-1) | 2.027** | 2.069* | 2.781*** | 21.436 | 2.239*** | 2.308*** |
| | [0.927] | [1.173] | [0.991] | [37.550] | [0.773] | [0.783] |
| Test weak identification | 30.88 | 21.18 | 32.19 | 0.21 | 14.63 | 13.34 |
| Test over identification | | | | | 0.67 | 0.62 |
| FS Ethnic IV | | | | | 0..668*** | 0.667*** |
| FS Gates IV | | | | | 0.015* | 0.009 |
| Observations | 550 | 550 | 550 | 550 | 550 | 550 |

*Notes*: All specifications include NUTS3 and year dummies.

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# Appendix

## A.1 Data

### A.1.1 Data sources

The spatial unit of analysis in the paper is the province (NUTS3). I exclude Ceuta and Melilla because of their particular history and lack of data. I use data from 2002 to 2012 – the population data is dated in January so it refers to the beginning of the period.

I use data on total, foreign-born and native population from the Spanish population municipality registers (yearly). The number of residents in a municipality is registered by the city councils in an administrative register called the Municipal Register (*Padrón Municipal*). An annual record of the municipal register, dated on the $1^{st}$ January of each year, is obtained from its updates. This dataset provides precise information on the population figures, on a yearly basis. It is also more accurate than other population sources because it collects the total number of foreign-born residents even if they are illegal immigrants[57]. Immigrants are identified using foreign-born population (by country of birth), not nationality. The figures are dates at the beginning of the natural year ($1^{st}$ of January).

Even if this data is available since 1996, I focus on the period after 2001 for several reasons. First, Fernández-Huertas et al. (2009) and Bertoli et al. (2011) recommend the use of population data coming from the population registers (*Padrón*) from 2001 because its reliability improves after that year. Secondly, it is after 2001 that the stock of foreign-born starts increasing significantly. It could be the case that most entries started in 2001 or that the stocks started to be correctly measured after that year. To mitigate measurement error I then focus on 2001-2012 for the main analysis. Thirdly, the rents data is only available from 2001 so focusing on this time period allows us to compare the rental and sale prices results over the same time period. Finally, using the housing boom and bust allows adoption of a demanding estimation strategy as there is more variance in the house price growth data.

House price data comes from Uriel-Jiménez et al. (2009), published by the Valencian Institute of Economic Research (henceforth IVIE) jointly with the BBVA Foundation (FBBVA). The database covers the period 1990-2007 and the IVIE prices are calculated using the original data from the (previously) Spanish Housing Department (*Ministerio de Vivienda*). The Housing Department (now inside Public Works Department) official data provides the average price per square meter on dwellings sales in the private sector. It is provided every quarter for all the provinces. The IVIE dataset of house prices is constructed by weighting the official prices provided by the Housing Department to take into account the location of the dwelling and when it was built. As the IVIE data is only available until 2007, the dataset was expanded to 2012 by applying the provincial price growth rates from the Housing Department official data series and adjusting the series for changes in base years. Data on rental prices comes from the Housing Department and the National Institute of Statistics (*INE*). I combine data from the National Observatory of Rented Properties (*Observatorio Estatal de la Vivienda en Alquiler*) and the consumer price indices (CPI provinces - rents component) to calculate the average rental price per square meter of the each province, from 2001 to 2012.

As a control and to construct the housing supply changes instrument I use the share of developable land in the province. The share of developable land in 2000 is obtained combining "developable" categories from the EU EEA Corine Land Cover 2000 dataset. Total area and total developable area[58] were calculated using GIS and raster maps of land use year for 2000, provided by the *Corine*

[57]However, it has two disadvantages. For confidentiality issues, data availability on the characteristics of the population is limited (only age, gender and nationality). In addition, the immigration figures may be over-estimated because immigrants have to actively cancel their register when they move out of the country (if they move within the country their new register cancels out the old one). For this reason, it is a good source to study the effect of immigration inflows but not so good for outflows.

[58]The categories included in developable land are: Green urban areas, Non-irrigated arable land, Permanently irrigated land, Rice fields, Vineyards Fruit trees and berry plantations, Olive groves, Pastures, Annual crops associated with permanent crops, Complex cultivation patterns, Land principally occupied by agriculture, Agro-forestry areas, Broad-leaved forest, Coniferous forest, Mixed forest, Natural grasslands, Moors and heartland, Sclerophyllous vegetation and Burnt

Land Cover data project (European Environment Agency). The proxy for land regulation variables in 1999 (*Planes Generales de Ordenamiento Urbanístico*) is obtained from the Urban Areas Digital Atlas *Atlas Digital de las Areas Urbanas - ADAU*, published by the (previously known as) Spanish Housing Department (*Ministerio de Vivienda*). The data on housing stocks was also obtained from this Department. Data on the political party of the major of the municipalities was obtained from the Public Administration Department (*Ministerio de Política Territorial y Administración Pública*). I calculated the stock of dwellings in the different years combining data from the Spanish Housing Department. Data on the housing stock is available from 2001. Using the entry and exit flows, I calculated a rate of depreciation and I updated the stock of the dwellings combining the depreciation rate and construction of dwellings data.

I also use time-invariant province characteristics (attributes) in the specifications without province fixed effects. There are four sets of province attributes included: location-amenities attributes, socio-economic attributes, geography and land regulation attributes and housing market attributes. A large set of time-varying provincial variables are also included in the estimations. Summary statistics for these variables (and the year in which they are measured) provided in table A.1.

The data sources for the attributes and time-varying controls variables are diverse and most of them were obtained from the Spanish National Statistics Institute (INE) and the 2001 Census. Other sources include the National Geographical Institute, *La Caixa* Spanish Economic Yearbook (*La Caixa Anuario Económico de España*), Banking Annual Yearbook (*Anuario de la Banca*), Bank of Spain Statistics (*Banco de España*), the 1991, 2001 and 2011 Population and Dwelling Censuses, the Housing Department (now Public Works Department), the IVIE-BBVA Human Capital Statistics (*Estimación de las Series de Capital Humano 1964-2013*), the IVIE-BBVA Regional Capital Stock Statistics *(Series históricas de capital público en España y su distribución territorial (1900-2012))*, the Spanish Regional Accounts (*Contabilidad Regional de España*).

Data for the IV validity regressions comes from the OECD International Migration Statistics, the EU EEA Corine Land Cover 1990 and the Spanish National Statistics Institute. Data for the construction of the gateways instrument comes from the Spanish Port Authority (*AENA*), the INE National Immigrant Survey 2007 (*Encuesta Nacional de Inmigrantes*), the National Ports Statistics Yearbooks (*Anuarios Estadísticos Puertos del Estado*) and an online road atlas for ports-entry distances. The list of ports was selected looking at several sources with the main ports, airports, stations and roads and looking at those that were larger, busier and closer to the border countries.

### A.1.2 Additional descriptive statistics

The period of analysis of this paper is very suitable to study the impact of immigration on housing costs due to the large immigration wave that Spain experienced during the 2000s and the housing boom and bust that happened during the same period (2000-2007 and 2008-2012). Table A.1 contains summary statistics of all the variables for the 50 provinces over the 11-year period (2002–2012 for the prices and 2001–2011 for the population variables) i.e, for the all the 550 observations of the pooled panel. The mean total change in log (annual growth) for rents is almost 3%, while for house prices it is around 5%. Average annual provincial population growth was around 1%, while the immigration rate is around 0.9%. This indicates that most of the local population changes were due to the immigration rate. The table also displays the summary statistics for the province time-invariant attributes and the time-varying controls.

Figure 1 in section 3.1 provides some indicators on the evolution of immigrant inflows/stocks and of house prices and rents during the 2001–2012 period. Figure A.1 provides additional descriptive indicators. Panel (a) shows the evolution of the share of foreign-born population. During the period it increased from below 5% to over 14%, particularly until 2008. Panel (b) provides some information about the stock and inflow of immigrants from different nationality groups between 2001 and 2012 (as listed in table A.2). We see that the largest sending group was Latin-America, with over 1.5 million

areas.

people over the period, followed by Eastern-Europe (over 1 million), other norther EU15 countries (over 0.5 million) and north African countries (around 0.5 million). These four origin groups, which are very different in terms of geography and cultural background, account for 3.5 million immigrants over the period, almost 75% of the inflows. The bottom two panels of figure A.1 show the evolution of housing units, both the stock and the changes (construction). In addition, Table 1 depicts the actual numbers of housing stock during the period 2001 to 2012. Both together show the impressive amount of housing constructed during this period in Spain. During the period over 4 million housing units were built, an average of almost 400,000 per year. The trend changed sharply in 2008, when even if still high, the annual units completed decreased from over half a million to approximately 100,000.

## A.2 Further details on the construction of the instrument

### A.2.1 Gravity estimations

In order for the instrument to be valid, both terms in expression (5) have to be orthogonal to local shocks related to immigration inflows and house price growth. Local shocks have a direct impact on total immigration inflows to Spain as these depend on national shocks which are just a combination of local shocks. For this reason, instead of directly using national inflows by nationality in (5), I construct a prediction based on factors that are plausibly exogenous to local shocks. Following Saiz (2007) and Ortega & Peri (2012), I use a gravity-type model that only contains push-factors from origin to predict the total inflow from nationality $n$ to Spain in a given year $t$[59]. The estimated equation is:

$$\ln\left(FB\_inflow_{from\_n\_to\_Spain,t}\right) = \rho' \ln\left(ECON_{n,t-1}\right) + \omega' \ln\left(GEO_n\right) + \gamma_g + \lambda_t + \xi_{n,t} \tag{A.1}$$

where $ECON_{n,t-1}$ is a matrix of (lagged) time-varying economic conditions of the sending country (log of gross domestic output in real terms, log of total population, percentage of urban population, percentage of internet users, an index of globalisation and dummy of belonging to the EU27). $GEO_n$ is a matrix of time-invariant geographic characteristics of the sending country (log of distance to Spain, log of area, number of cities, latitude and longitude and dummies for common language, common border and common colonial past with Spain). I include year dummies $\lambda_t$ and country-group dummies $\gamma_g$ (the groups appearing in table A.2). I can alternatively include country dummies, which drops the time-invariant variables. I estimate a similar model using foreign-born stocks on the left hand side (in this case the economic variables are lagged two years because population is measure on the $1^{st}$ of January). The time period is 2001 to 2011.

The economic and institutional variables come from the World Bank World Development Indicators and Governance, the Globalisation Indices come from the Swiss Economic Institute (KOF Globalization Index), information on EU and EUROZONE membership comes from Wikipedia, the Major Episodes of Political Violence variables come from the Centre for Systemic Peace and the geographical and distance variables come from *Centre d'Études Prospectives et d'Informations Internationales - CEPII*.

Data is available for the 113 countries (the source countries in the Population Registers data are 119, including 6 categories for "other" and "stateless/unknown") of table A.2, which represent more than 99% of the inflows into Spain for the period. Results for different specifications are showed in table A.3, for the total national inflows (columns 1-4) and for the national foreign-born stocks (columns 5-8). The specifications include country and country-group dummies alternatively, and the two first columns include year dummies while the last two do not include them. All the models have high predictive power.

From the results in Table A.3 I recover the predicted inflows to and predicted stocks of foreign-born in Spain from nationality $n$ for every year 2001-2011. I use the prediction from estimates from column 1 for the construction of the instrument, and I use the rest of the specifications estimates

[59] And equivalently for imputed predicted stocks.

for the robustness checks of section 5.2. These are combined with the share by province in 1991 in a similar manner as in (5). The imputed predicted foreign-born inflow for each nationality $n$ to each province $i$ at time $t$ becomes:

$$imp\_pred\_FB\_inflow^{n}_{i,t} = \left(pred\_FB\_inflow^{n}_{Spain,t}\right) * share^{n}_{i,1991} \tag{A.2}$$

The total imputed predicted inflow to each province $i$ at time $t$ is defined as the sum of (A.2) across nationalities:

$$imp\_pred\_FB\_inflow_{i,t} = \sum_{n}^{N} \left(imp\_pred\_FB\_inflow^{n}_{i,t}\right) \tag{A.3}$$

I use the lagged (A.3) in the construction of instrument (9).

### A.2.2 Prediction for native location

I use past census data to predict the numbers of natives residing in province $i$ in year $t$. Total natives in a province are the sum of those born and residing there and those who were born somewhere else in Spain and have moved there. I use an strategy that follows the same intuition as the shift-share immigration instrument. In contrast to the immigrants prediction, in this case we need to predict both magnitudes, i.e. stayers and movers. Therefore, we need to define a historical share and a time-varying shift for both types of natives. Instead of countries, the origin-destination geographical units are now the Spanish provinces. I use the province of birth of the native in the same way as the nationality in the case of foreign-born. The strength of the instrument is now based on the historical (im)mobility persistence of different Spanish locations (for stayers) and the "ethnic" networks (for movers). Some regions have historically had larger mobility propensities (Galicia), and some bilateral internal migration flows are based on historical location patterns (for example Galicians in Madrid or Andalusians in Cataluña).

A person born in a given province $b$ can either stay where he/she was born (stayers) or can move and reside in a different province $i \neq b$ (movers). $R$ is the total number of provinces in Spain in which natives can locate. For consistency, I use native location patterns from census 1991 as base year. I define the share of stayers in province $i$ as the proportion of natives born and living in a province over all the natives born in the province (regardless of where they reside) in 1991 (I also use 1981 in the robustness checks). In this case, the province of birth and residence is the same, i.e $i = b$. The stayers share is defined as follows:

$$share^{b}_{i(i=b),1991} = \frac{natives^{b}_{i=b,1991}}{\sum_{i}^{R} natives^{b}_{i,1991}} \tag{A.4}$$

Share (A.4) is multiplied by the total natives that are living in the same province where they were born in year $t$. This gives the predicted number of stayers in a given province $i$ in year $t$.

The share of movers is calculated differently. For a given province of birth $b$ there are 49 potential province destinations where the mover can reside. I therefore need to calculate further 49 shares which represent the proportion of movers residing in a specific province $i$ over the total number of movers originating from province $b$. The movers share is defined as proportion of natives born in $b$ but residing in $i$ over all the natives born in $b$ but residing somewhere else:

$$share^{b}_{i(i\neq b),1991} = \frac{natives^{b}_{i\neq b,1991}}{\sum_{i\neq b}^{R} natives^{b}_{r,1991}} \tag{A.5}$$

Share (A.5) is multiplied by the total number of natives living outside the province they were born in year $t$ (subtracting the natives living in the province for which we want to calculate the prediction, similarly to the case of the foreign-born prediction). This predicts the number of natives born in $b$ living in province $i$ (where $i \neq b$) in year $t$. For a given province of birth, there are 49 movers predictions.

To obtain the number of natives living in each province $i$ at time $t$, I sum the prediction for stayers and the 49 predictions for each potential province of residence (movers) in each year. This gives $imp\_natives_{i,t}$ which is used in the construction of (A.3).

## A.3 Model extension: explaining heterogenous location patterns

The discussion in section 4 gathers all foreign-born workers under the common subscript $f$ so it applies to each source-country separately. But in reality the province foreign-born population is the sum of immigrants from a variety of nationalities, and in each region the composition of the inflow and stock of foreign-born workers can be different. The average impact of the immigration wave on the average housing costs depend on the local mix of nationalities. In order to allow for heterogeneity in the location patterns of immigrants by nationality we define the foreign-born workers outside-option $\overline{u}_f$ as follows:

$$\overline{u}_f = \frac{\overline{u}}{\psi(\frac{1}{\overline{u}_f^*}, A_r)} \tag{A.6}$$

For foreign-born workers, the baseline (native) outside-option utility level $\overline{u}$ is normalised by the function $\psi$ which is a measure of the relative "attractiveness "of a particular region $r$ relative to the foreign-born worker's source country. This measure of relative attractiveness is itself related to two arguments:

- the "un-attractiveness "of the source country measured by $\frac{1}{\overline{u}_f^*}$ where $\overline{u}_f^*$ can be interpreted as some measure of utility available in the source country.
- the "attractiveness "of each region $r$ to foreign-born workers, codified in an (exogenous) amenity endowment $A_r$. This can be interpreted as an ethnic specific amenity, say the presence of a pre-existing community *"à la Card"*.

Assuming super-modularity about $\psi$ assures that attractive locations become relatively more attractive when push factors in the source country become stronger. This is given by:

**Assumption 1: Monotonicity of $\psi$**

$$\frac{\partial\psi(.,.)}{\partial(\frac{1}{\overline{u}_f^*})} > 0$$

$$\frac{\partial\psi(.,.)}{\partial(A_r)} > 0$$

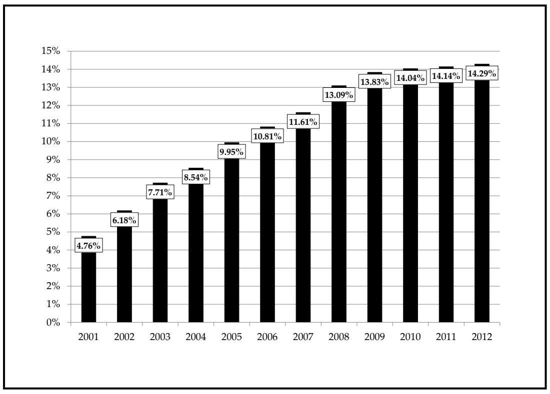
**Assumption 2: Supermodularity of $\psi$**

$$\frac{\partial^2\psi(.,.)}{\partial(\frac{1}{\overline{u}_f^*})\partial(A_r)} > 0$$

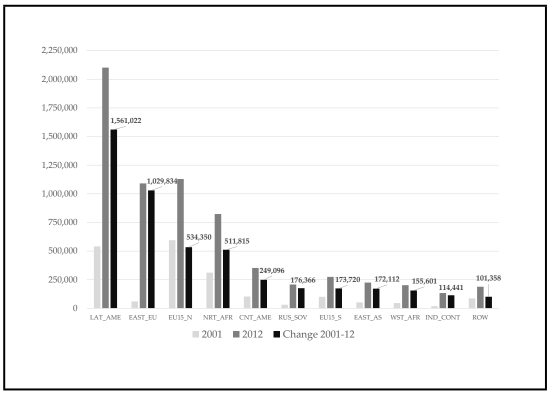
This set-up provides micro-foundation for why $\overline{u}_f$, even in spatial equilibrium, might differ across regions (i.e. the complementarity of push factors in the source-country and region-specific pull factors such as the presence of a pre-existing community). In consequence, for the same push factors in two different source countries, immigrants of different nationalities would locate in different proportions across different regions. When the attractiveness of source countries falls ($\overline{u}_f^*$ falls), high $A_r$ locations attract large numbers of immigrants and all the mechanisms highlighted in section 4.2 operate. For low $A_r$ locations, the effects are weaker for the same fall in $\overline{u}_f^*$. In addition, this expression also formalises the channels through which the *shift-share* instrument discussed in section 2.2 predicts the changes in foreign-born population of a particular nationality in each province and year: a combination of an exogenous time-varying nationality specific push-component (predicting the number of immigrants coming to Spain in a given period – the shift) and time-invariant nationality-specific province preference (predicting the amount of immigrants that will locate in a particular region – the share).

## A.4 Additional figures and tables

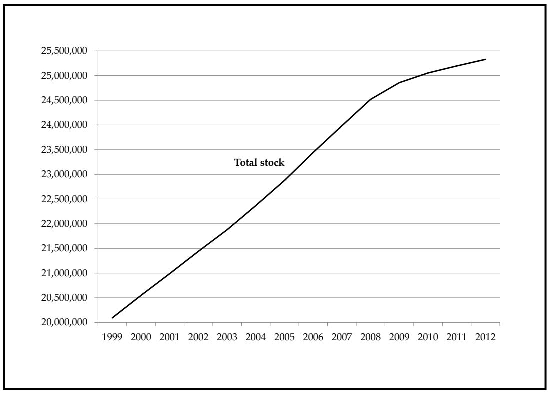
**Figure A.1:** Foreign-born shares and housing over time



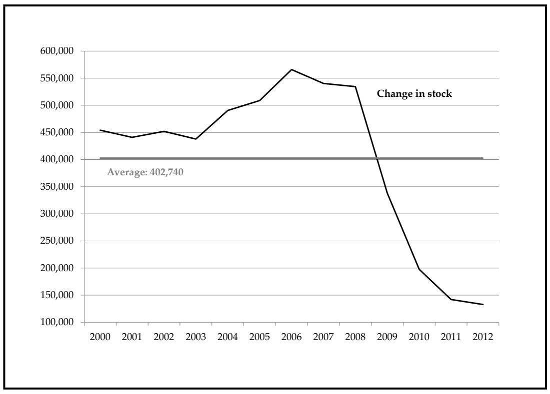

(a) Share of foreign-born population




(b) Foreign-born stocks and inflows by nationality

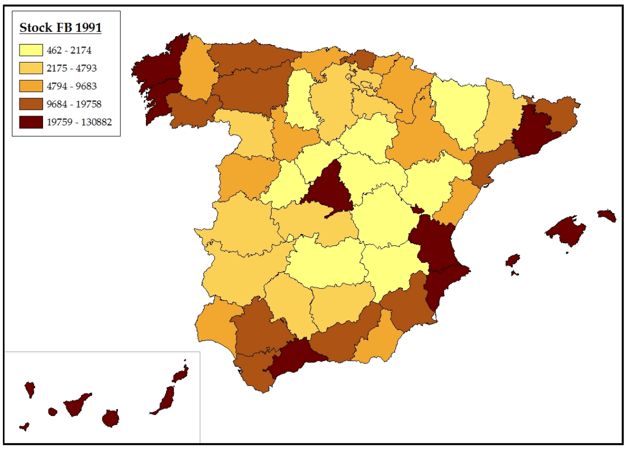



(c) Housing stock

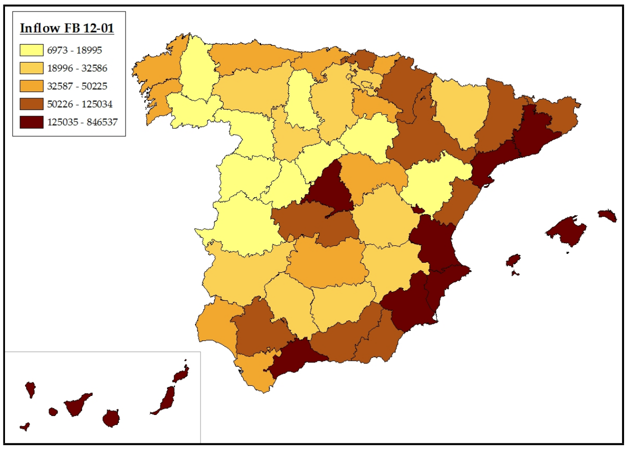



(d) Housing stock annual changes

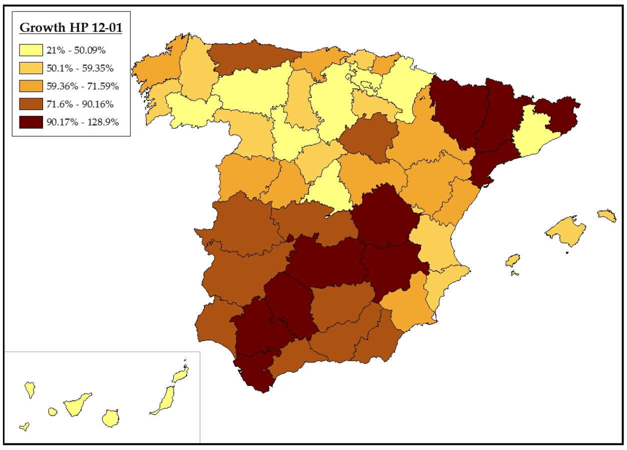
**Figure A.2:** Spatial distribution of immigrant population and housing costs growth



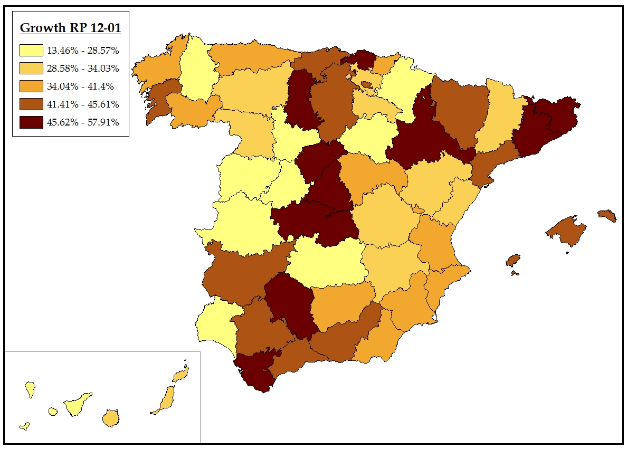

(a) Foreign-born population in 2001




(b) Foreign-born population change 2001-2012




(c) House prices growth 2001-2012




(d) House rents growth 2001-2012

**Table A.1:** List of variables with summary statistics

| VARIABLES | TIME PERIOD | MEAN | STD. DEV. | MIN | MAX |
|---|---|---|---|---|---|
| ***Housing cost and population rates*** | | | | | |
| Change in log rent prices | 2002/01–2012/11 | 0.0285 | 0.0174 | -0.014 | 0.083 |
| Change in log transaction prices | 2002/01–2012/11 | 0.0474 | 0.0941 | -0.157 | 0.276 |
| Inflow of population over population | 2001–2011 | 0.0105 | 0.0125 | -0.012 | 0.061 |
| Inflow of foreign-born over population | 2001–2011 | 0.0089 | 0.0082 | -0.005 | 0.046 |
| Inflow of natives over population | 2001–2011 | 0.0016 | 0.0063 | -0.017 | 0.031 |
| ***Time-varying controls*** | | | | | |
| Change in log current GDP per capita | 2000/99-2010/09 | 0.0419 | 0.0380 | -0.086 | 0.132 |
| Change in log of number of credit establishments | 2000/99-2010/09 | 0.0053 | 0.0295 | -0.126 | 0.098 |
| Change in share of savings banks | 2000/99-2010/09 | 0.0042 | 0.0248 | -0.313 | 0.049 |
| Change in unemployment rate | 2000/99-2010/09 | 0.0035 | 0.0302 | -0.134 | 0.097 |
| Change average years of education employed | 2000/99-2010/09 | 0.1245 | 0.1826 | -0.267 | 0.229 |
| Change share of WAP without studies | 2000/99-2010/09 | -0.0133 | 0.0336 | -0.071 | 0.060 |
| Change in log average wage | 2000/99-2010/09 | 0.0356 | 0.0218 | -0.029 | 0.119 |
| Change in log urban infrastructure capital | 2000/99-2010/09 | 0.0695 | 0.0544 | -0.038 | 0.357 |
| Change in log transport infrastructure capital | 2000/99-2010/09 | 0.0735 | 0.0431 | -0.035 | 0.370 |
| Change share employed primary | 2000/99-2010/09 | -0.0035 | 0.0140 | -0.074 | 0.081 |
| Change share employed secondary | 2000/99-2010/09 | -0.0036 | 0.0147 | -0.045 | 0.051 |
| Change share employed non-tradable services | 2000/99-2010/09 | 0.0023 | 0.0131 | -0.037 | 0.049 |
| Change share employed tradable services | 2000/99-2010/09 | 0.0068 | 0.0191 | -0.067 | 0.060 |
| Change in log stock of total housing | 2000/99-2010/09 | 0.0204 | 0.0099 | 0.000 | 0.072 |
| ***Province attributes*** | | | | | |
| Coastal dummy | Time-invariant | 0.4400 | 0.4968 | 0.000 | 1.000 |
| Length of coastline in kms | Time-invariant | 1.5682 | 2.8197 | 0.000 | 14.280 |
| Log average temperature in January | Time-invariant | 1.9595 | 0.4623 | 1.078 | 2.903 |
| Log average rain precipitation in January | Time-invariant | 3.7124 | 0.5835 | 2.777 | 5.364 |
| Log of distance to Madrid | Time-invariant | 5.7916 | 0.6483 | 3.517 | 6.581 |
| Log of distance to Barcelona | Time-invariant | 6.3134 | 0.7632 | 3.531 | 7.158 |
| Log of total province area | Time-invariant | 9.0934 | 0.5450 | 7.589 | 9.989 |
| Log of area of national parks | 2000 | 11.0181 | 1.1309 | 8.501 | 12.622 |
| Log of number of retail shops | 2000 | 9.4060 | 0.7779 | 7.745 | 11.511 |
| Log of number of restaurants and bars | 2000 | 8.1272 | 0.9008 | 5.697 | 10.347 |
| Tourism importance index | 2000 | 19.9704 | 32.0339 | 1.270 | 163.290 |
| Log of number of doctors | 2000 | 7.5119 | 1.0932 | 3.332 | 10.232 |
| Log of population (Padron) | 2001 | 13.2241 | 0.8402 | 11.422 | 15.496 |
| Share of foreign-born population (Padron) | 2001 | 0.0371 | 0.0254 | 0.006 | 0.088 |
| Employment rate of foreign-born (Census) | 2001 | 0.0354 | 0.0244 | 0.009 | 0.107 |
| Share of single-person households | 2001 | 0.2130 | 0.0270 | 0.158 | 0.266 |
| Average household size | 2001 | 2.8363 | 0.1553 | 2.621 | 3.207 |
| Share of households with children | 2001 | 0.4018 | 0.0538 | 0.294 | 0.549 |
| Share of developable land (Corine) | 2000 | 0.8542 | 0.0736 | 0.466 | 0.961 |
| Average ruggedness index | Time-invariant | 110.3139 | 48.2490 | 31.030 | 247.614 |
| Average height index | Time-invariant | 95.1959 | 39.7684 | 20.394 | 165.226 |
| Altitude max-min difference | Time-invariant | 19.0384 | 6.7611 | 3.190 | 37.150 |
| Number of localities with over 10k inhabitants | 2000 | 12.7200 | 12.5030 | 1.000 | 65.000 |
| Share of population living in cities of 50k+ inhab | 2000 | 0.3842 | 0.1904 | 0.000 | 0.845 |
| Share of municipalities with general planning | 1999 | 0.1085 | 0.1101 | 0.005 | 0.471 |
| Share of municipalities with no planning | 1999 | 0.2211 | 0.2179 | 0.000 | 0.770 |
| Share of population in right-wing major towns | 2001 | 0.5444 | 0.2521 | 0.017 | 0.879 |
| Share of population who rent | 2001 | 0.0915 | 0.0286 | 0.058 | 0.187 |
| Share of secondary family homes | 2001 | 0.1896 | 0.0893 | 0.045 | 0.424 |
| Share of empty family homes | 2001 | 0.1485 | 0.0241 | 0.085 | 0.191 |
| Share of employment in construction | 2001 | 0.1261 | 0.0209 | 0.083 | 0.170 |
| Share of social housing units | 2000 | 0.1284 | 0.0969 | 0.000 | 0.351 |

**Table A.2:** List of countries of origin and nationality groups

| Country | Nationality Group | Country | Nationality Group |
|---|---|---|---|
| Austria | EU15 NORTH | Angola | REST OF AFRICA |
| Belgium | EU15 NORTH | Cameroon | REST OF AFRICA |
| Denmark | EU15 NORTH | Congo | REST OF AFRICA |
| Finland | EU15 NORTH | Ethiopia | REST OF AFRICA |
| France | EU15 NORTH | Guinea Bissau | REST OF AFRICA |
| Iceland | EU15 NORTH | Kenya | REST OF AFRICA |
| Liechtenstein | EU15 NORTH | South Africa | REST OF AFRICA |
| Luxembourg | EU15 NORTH | Zaire | REST OF AFRICA |
| Norway | EU15 NORTH | Costa Rica | CENTRAL AMERICA AND CARIBBEAN |
| Netherlands | EU15 NORTH | Cuba | CENTRAL AMERICA AND CARIBBEAN |
| United Kingdom | EU15 NORTH | Dominica | CENTRAL AMERICA AND CARIBBEAN |
| Germany | EU15 NORTH | El Salvador | CENTRAL AMERICA AND CARIBBEAN |
| Sweden | EU15 NORTH | Guatemala | CENTRAL AMERICA AND CARIBBEAN |
| Switzerland | EU15 NORTH | Honduras | CENTRAL AMERICA AND CARIBBEAN |
| Cyprus | EU15 SOUTH | Nicaragua | CENTRAL AMERICA AND CARIBBEAN |
| Greece | EU15 SOUTH | Panama | CENTRAL AMERICA AND CARIBBEAN |
| Ireland | EU15 SOUTH | Dominican Republic | CENTRAL AMERICA AND CARIBBEAN |
| Italy | EU15 SOUTH | Mexico | LATIN AMERICAN AND BRAZIL |
| Portugal | EU15 SOUTH | Argentina | LATIN AMERICAN AND BRAZIL |
| Andorra | EU15 SOUTH | Bolivia | LATIN AMERICAN AND BRAZIL |
| Bulgaria | EU27 EAST EUROPE | Brazil | LATIN AMERICAN AND BRAZIL |
| Hungary | EU27 EAST EUROPE | Colombia | LATIN AMERICAN AND BRAZIL |
| Poland | EU27 EAST EUROPE | Chile | LATIN AMERICAN AND BRAZIL |
| Romania | EU27 EAST EUROPE | Ecuador | LATIN AMERICAN AND BRAZIL |
| Malta | REST OF EUROPE | Paraguay | LATIN AMERICAN AND BRAZIL |
| Latvia | REST OF EUROPE | Peru | LATIN AMERICAN AND BRAZIL |
| Estonia | REST OF EUROPE | Uruguay | LATIN AMERICAN AND BRAZIL |
| Lithuania | REST OF EUROPE | Venezuela | LATIN AMERICAN AND BRAZIL |
| Czech Republic | REST OF EUROPE | Canada | USA AND CANADA |
| Slovakia | REST OF EUROPE | United States of America | USA AND CANADA |
| Albania | BALKANS AND TURKEY | China | CHINA AND FAR ASIA |
| Bosnia Herzegovina | BALKANS AND TURKEY | Philippines | CHINA AND FAR ASIA |
| Croatia | BALKANS AND TURKEY | Indonesia | CHINA AND FAR ASIA |
| Slovenia | BALKANS AND TURKEY | Japan | CHINA AND FAR ASIA |
| Serbia and Montenegro | BALKANS AND TURKEY | South Korea | CHINA AND FAR ASIA |
| Macedonia | BALKANS AND TURKEY | Thailand | CHINA AND FAR ASIA |
| Turkey | BALKANS AND TURKEY | Vietnam | CHINA AND FAR ASIA |
| Algeria | NORTH AFRICA | Bangladesh | INDO CONTINENT |
| Egypt | NORTH AFRICA | India | INDO CONTINENT |
| Morocco | NORTH AFRICA | Nepal | INDO CONTINENT |
| Tunisia | NORTH AFRICA | Pakistan | INDO CONTINENT |
| Burkina Faso | WEST AFRICA | Saudi Arabia | MIDDLE EAST AND ARAB |
| Benin | WEST AFRICA | Iraq | MIDDLE EAST AND ARAB |
| Cape Verde | WEST AFRICA | Iran | MIDDLE EAST AND ARAB |
| Cote d'Ivoire | WEST AFRICA | Israel | MIDDLE EAST AND ARAB |
| Gambia | WEST AFRICA | Jordan | MIDDLE EAST AND ARAB |
| Ghana | WEST AFRICA | Lebanon | MIDDLE EAST AND ARAB |
| Guinea | WEST AFRICA | Syria | MIDDLE EAST AND ARAB |
| Guinea Equatorial | WEST AFRICA | Ukraine | RUSSIA AND EX-SOVIET UNION |
| Liberia | WEST AFRICA | Moldova | RUSSIA AND EX-SOVIET UNION |
| Mali | WEST AFRICA | Belarus | RUSSIA AND EX-SOVIET UNION |
| Mauritania | WEST AFRICA | Georgia | RUSSIA AND EX-SOVIET UNION |
| Nigeria | WEST AFRICA | Armenia | RUSSIA AND EX-SOVIET UNION |
| Senegal | WEST AFRICA | Russia | RUSSIA AND EX-SOVIET UNION |
| Sierra Leone | WEST AFRICA | Kazakhstan | RUSSIA AND EX-SOVIET UNION |
| Togo | WEST AFRICA | Australia | OCEANIA |
| | | New Zealand | OCEANIA |

**Table A.3:** Gravity equations immigrant inflow and stock by country

| *Log number of immigrants from country n to/in Spain in t* | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | INFLOW DURING T | | | | STOCK IN JAN T | | | |
| Lag1/2 Log current | -0.673 | -0.658** | -0.755 | -0.658** | 0.048 | -0.390 | 0.599** | -0.399 |
| GDP in Bill USD | [0.538] | [0.301] | [0.471] | [0.304] | [0.237] | [0.274] | [0.271] | [0.273] |
| Lag1/2 Log of GDP | 0.970 | 0.659 | 0.679 | -0.153 | 0.220 | 0.689 | -0.341 | 1.017*** |
| Deflator | [0.618] | [0.478] | [0.582] | [0.385] | [0.298] | [0.437] | [0.337] | [0.353] |
| Lag1/2 Log population | 1.639 | 0.793** | 0.285 | 0.796** | -2.852*** | 0.705** | -0.803 | 0.719** |
| in 1000s | [1.352] | [0.318] | [1.307] | [0.323] | [0.678] | [0.312] | [0.718] | [0.309] |
| Lag1/2 Life expectancy | 0.164** | -0.001 | 0.028 | -0.020 | 0.069* | 0.004 | 0.120** | 0.011 |
| in years | [0.078] | [0.040] | [0.081] | [0.039] | [0.040] | [0.032] | [0.049] | [0.032] |
| Lag1/2 Percentage of | -2.835 | 0.804 | -1.388 | 0.667 | -1.536 | 0.746 | -2.240* | 0.767 |
| agricultural land | [2.244] | [0.590] | [2.233] | [0.600] | [1.139] | [0.558] | [1.282] | [0.552] |
| Lag1/2 Percentage of | 4.951 | 2.920*** | 0.561 | 2.945*** | 0.791 | 2.900*** | 3.860** | 2.852*** |
| urban population | [3.087] | [0.988] | [2.763] | [1.004] | [1.667] | [1.032] | [1.748] | [1.028] |
| Lag1/2 Internet take-up | -0.516 | 0.729 | -2.111*** | -0.693 | -1.301*** | 0.482 | 0.160 | 1.097** |
| per 100 people | [0.642] | [0.764] | [0.448] | [0.624] | [0.317] | [0.554] | [0.227] | [0.461] |
| Lag1/2 Unemployment | 3.317* | 4.197** | 3.178* | 4.251** | -0.045 | 5.188*** | -0.439 | 5.199*** |
| rate total | [1.872] | [1.830] | [1.806] | [1.818] | [0.787] | [1.679] | [0.936] | [1.677] |
| Lag1/2 Share Services | -2.257 | 1.590 | -0.941 | 1.603 | -1.382 | 1.648 | 0.680 | 1.785 |
| in Value-Added | [1.971] | [1.686] | [1.926] | [1.715] | [1.605] | [1.267] | [1.624] | [1.232] |
| Lag1/2 Share Industry | -1.852 | 4.377** | 0.810 | 4.426** | -2.203 | 4.330*** | -0.499 | 4.457*** |
| in Value-Added | [2.053] | [1.979] | [1.977] | [1.974] | [1.665] | [1.494] | [1.695] | [1.459] |
| Lag1/2 Index of political | 0.003 | 0.038*** | -0.002 | 0.035*** | 0.003 | 0.038*** | 0.008 | 0.039*** |
| globalisation | [0.009] | [0.010] | [0.009] | [0.010] | [0.005] | [0.010] | [0.006] | [0.009] |
| Lag1/2 Index of social | -0.005 | -0.014 | -0.005 | -0.012 | -0.004 | -0.017 | 0.010 | -0.018 |
| globalisation | [0.015] | [0.017] | [0.017] | [0.017] | [0.008] | [0.016] | [0.009] | [0.016] |
| Lag1/2 Index of economic | 0.016 | -0.013 | 0.017 | -0.014 | 0.013** | -0.009 | 0.021*** | -0.005 |
| globalisation | [0.011] | [0.012] | [0.011] | [0.012] | [0.006] | [0.011] | [0.006] | [0.010] |
| Source contry belongs to | 0.697*** | 0.738** | 0.998*** | 1.007*** | 0.419*** | 0.803*** | 0.471*** | 0.786*** |
| the European Union | [0.228] | [0.288] | [0.244] | [0.286] | [0.135] | [0.294] | [0.126] | [0.277] |
| Source contry belongs to | 0.103 | -0.080 | -0.134 | -0.280 | 0.084 | -0.227 | -0.046 | -0.226 |
| the Euro Zone | [0.282] | [0.298] | [0.336] | [0.294] | [0.107] | [0.308] | [0.115] | [0.305] |
| Log distance from source | | -1.909*** | | -1.887*** | | -1.627*** | | -1.625*** |
| country capital to Madrid | | [0.519] | | [0.539] | | [0.511] | | [0.502] |
| Log area in square | | 0.260* | | 0.242* | | 0.025 | | 0.027 |
| kilometres | | [0.135] | | [0.139] | | [0.134] | | [0.132] |
| Number of cities in | | -0.074 | | -0.078 | | -0.065 | | -0.068 |
| Henderson data | | [0.051] | | [0.052] | | [0.051] | | [0.050] |
| Spanish is spoken by | | 0.117 | | -0.024 | | -0.349 | | -0.324 |
| at least 20% population | | [0.999] | | [0.957] | | [0.925] | | [0.947] |
| Source country | | -0.309 | | -0.213 | | 0.022 | | 0.053 |
| is contiguous to Spain | | [0.544] | | [0.568] | | [0.562] | | [0.542] |
| Source country was ever | | 0.963 | | 0.901 | | 1.146 | | 1.148 |
| a Spanish colony | | [0.884] | | [0.831] | | [0.884] | | [0.903] |
| Observations | 1015 | 1015 | 1015 | 1015 | 1243 | 1243 | 1243 | 1243 |
| Area dummies | Country | NatiGro | Country | NatiGro | Country | NatiGro | Country | NatiGro |
| Year dummies | ✔ | ✔ | | | ✔ | ✔ | | |
| F-test model | 22.53 | 18.14 | 7.16 | 12.58 | 32.22 | 25.80 | 22.24 | 23.28 |
| Adjusted $R^2$ | 0.88 | 0.65 | 0.85 | 0.62 | 0.98 | 0.72 | 0.97 | 0.72 |

*Notes*: Clustered (country) standard errors in brackets. t=2001/2011. The number of countries in the sample is 113. Note that sometimes country inflows are zero or negative so the number of observations in columns 1-4 is smaller than in columns 4-8. EU/EUROZONE membership dummy changes over time as new countries join the Union. NatiGro refers to nationality groups as defined in Table A.2. Columns 2, 4, 6 and 8 include longitude and latitude of the country centroid in degrees. All models include WB Governance indicators and Major Episodes of Political Violence variables. The economic explanatory variables are lagged one or two periods depending on the variable used on the LHS (inflow or stocks). Significance levels: * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

**Table A.4:** Robustness checks: list of ports of entry

| Mode | Gate Name | Mode | Gate Name |
|---|---|---|---|
| Raft | Las playitas en Fuerteventura | Boat | Puerto de Alicante |
| Raft | Punta de Tarifa | Boat | Puerto de Santa Cruz de Tenerife |
| Raft | Playa del Ingles Las Palmas | Boat | Puerto de Bilbao |
| Walk | Puesto fronterizo Ceuta | Boat | Puerto de A Coruña |
| Walk | Puesto fronterizo Melilla | Boat | Puerto de Malaga |
| Plane | Aeropuerto de Madrid-Barajas | Boat | Puerto de Valencia |
| Plane | Aeropuerto de Barcelona-El Prat | Boat | Puerto de Ceuta |
| Plane | Aeropuerto de Palma de Mallorca | Road | La Jonquera |
| Plane | Aeropuerto de Malaga | Road | Irun/Hendaya |
| Plane | Aeropuerto de Gran Canaria | Road | Roncesvalles |
| Plane | Aeropuerto de Tenerife Sur | Road | Candanchu |
| Plane | Aeropuerto de Alicante | Road | Puigcerda |
| Plane | Aeropuerto de Lanazarote | Road | Valenca, Portugal |
| Plane | Aeropuerto de Ibiza | Road | Badajoz |
| Plane | Aeropuerto de Fuerteventura | Road | Ayamonte |
| Plane | Aeropuerto de Menorca | Rail | Latour de Carol |
| Plane | Aeropuerto de Tenerife Norte | Rail | Portbou/Cerbere |
| Plane | Aeropuerto de Bilbao | Rail | Canfranc |
| Plane | Aeropuerto de Valencia-Manises | Rail | Hendaya |
| Plane | Aeropuerto de Sevilla | Rail | Vigo/Tui |
| Plane | Aeropuerto de Santiago de Compostela | Rail | Fuentes de Ouoro |
| Boat | Puerto de Barcelona | Rail | Valencia de Alcantara |
| Boat | Puerto Bahia de Algeciras | Rail | Badajoz |
| Boat | Puerto de Santander | Rail | Madrid Estacion de Atocha |
| Boat | Puerto de Almeria-Motril | Rail | Barcelona Estacion de Francia |

**Table A.5:** Robustness checks: other population measures

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| ***Change in log rents in t*** | | | | | | |
| Rate (t-1) | 0.834** | 0.807** | 0.789** | 0.747** | 0.616** | 0.566** |
| | [0.406] | [0.390] | [0.389] | [0.376] | [0.279] | [0.259] |
| Test weak identification | 16.47 | 17.45 | 16.54 | 13.31 | 24.23 | 21.36 |
| ***Change in log prices in t*** | | | | | | |
| Rate (t-1) | 3.073*** | 2.976*** | 2.908*** | 2.755** | 2.284*** | 2.119*** |
| | [1.170] | [1.116] | [1.112] | [1.091] | [0.780] | [0.728] |
| Test weak identification | 18.05 | 19.05 | 18.28 | 14.71 | 25.89 | 22.45 |
| Population variable | FBORN | WAFB | FOREIGN | WAFOR | POP | WAP |
| Observations | 550 | 550 | 550 | 550 | 550 | 550 |

*Notes*: All specifications include time-varying controls and year dummies. Top panel includes NUTS2 dummies and all province attributes. Bottom panel includes NUTS3 dummies.

**Table A.6:** Robustness checks: other outcomes

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| ***Total effect*** | | | | | |
| Immigration rate (t-1) | 3.073*** | 2.983*** | 3.479*** | 0.890* | 0.902* |
| | [1.170] | [1.049] | [1.176] | [0.492] | [0.495] |
| Test weak identification | 18.05 | 18.05 | 18.05 | 18.05 | 16.47 |
| ***Immigrant effect*** | | | | | |
| Population rate (t-1) | 2.284*** | 2.217*** | 2.586*** | 0.662** | 0.667** |
| | [0.780] | [0.716] | [0.782] | [0.325] | [0.324] |
| Test weak identification | 25.89 | 25.89 | 25.89 | 25.89 | 24.23 |
| Observations | 550 | 550 | 550 | 550 | 550 |
| LHS variable | HP IVIE | HP AVER | HP 2Q | HSTOCK | HSTOCK |
| Area dummies | NUTS3 | NUTS3 | NUTS3 | NUTS3 | NUTS2 |

*Notes*: All specifications include year dummies.

**Table A.7:** Robustness checks: long-differences

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | **RENTS** | **HPRICES** | **NAT MOB** | **RENTS** | **HPRICES** |
| Immigration rate (LD5) | 0.985*** | 2.315* | 0.355** | | |
| | [0.371] | [1.211] | [0.155] | | |
| Population rate (LD5) | | | | 0.727*** | 1.709* |
| | | | | [0.271] | [0.884] |
| ***First Stage Coefficients*** | | | | | |
| Immigration rate IV (LD5) | | 0.579*** | | 0.784*** | |
| | | [0.086] | | [0.159] | |
| Test weak identification | | 28.4 | | 15.12 | |

*Notes*: Both the outcomes and the population/immigration rates are calculated using 5-year time differences for the same time periods. The sample period is 2011/2001, with two long differences for years 2001/06 and 2006/01. The number of observations is then 100. The estimations include NUTS2 and time dummies, time-varying controls (log GDPpc, log average wage, log infrastructure capital, sectoral structure employment shares) and province attributes (location/amenities).

**Table A.8:** Robustness checks: timing

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| ***Change in log rents in t*** | | | | | |
| Population rate (t-2) | | | 0.350* | | 0.343 |
| | | | [0.206] | | [0.276] |
| Population rate (t-1) | | 0.616** | 0.573* | 0.517* | 0.617* |
| | | [0.279] | [0.318] | [0.291] | [0.332] |
| Population rate (t) | 0.531** | | | 0.395 | 0.508 |
| | [0.252] | | | [0.255] | [0.371] |
| Area dummies | NUTS2 | NUTS2 | NUTS2 | NUTS2 | NUTS2 |
| Test weak identification | 22.48 | 24.23 | | | |
| Test weak identification CONT | | | | 11.35 | 6.74 |
| Test weak identification ONE LAG | | | 11.91 | 21.9 | 14.42 |
| Test weak identification TWO LAGS | | | 19.64 | | 14.02 |
| ***Change in log prices in t*** | | | | | |
| Population rate (t-2) | | | 1.327 | | 1.481 |
| | | | [1.030] | | [1.131] |
| Population rate (t-1) | | 2.284*** | 1.679** | 1.841*** | 1.599** |
| | | [0.780] | [0.675] | [0.566] | [0.685] |
| Population rate (t) | 1.597 | | | 0.812 | -0.256 |
| | [1.342] | | | [1.546] | [1.319] |
| Area dummies | NUTS3 | NUTS3 | NUTS3 | NUTS3 | NUTS3 |
| Test weak identification | 26.64 | 25.89 | | | |
| Test weak identification CONT | | | | 12.65 | 7.56 |
| Test weak identification ONE LAG | | | 13.08 | 24.46 | 16.29 |
| Test weak identification TWO LAGS | | | 22.01 | | 16 |
| ***Native population rate*** | | | | | |
| Immigration rate (t-2) | | | -0.037 | | -0.094 |
| | | | [0.088] | | [0.095] |
| Immigration rate (t-1) | | 0.075 | -0.01 | 0.00 | -0.02 |
| | | [0.086] | [0.078] | [0.086] | [0.089] |
| Immigration rate (t) | 0.349*** | | | 0.309*** | 0.297** |
| | [0.127] | | | [0.118] | [0.116] |
| Area dummies | NUTS3 | NUTS3 | NUTS3 | NUTS3 | NUTS3 |
| Test weak identification | 16.8 | 17.49 | | | |
| Test weak identification CONT | | | | 8.72 | 4.96 |
| Test weak identification ONE LAG | | | 9.23 | 10.4 | 6.99 |
| Test weak identification TWO LAGS | | | 10.8 | | 7.21 |
| Observations | 500 | 550 | 500 | 500 | 450 |

*Notes*: All specifications include time-varying controls and year dummies. The sample period is 2002/2012 for house prices and 2001/2011 for native mobility.

**2013**

**2013/1, Sánchez-Vidal, M.; González-Val, R.; Viladecans-Marsal, E.:** "Sequential city growth in the US: does age matter?"
**2013/2, Hortas Rico, M.:** "Sprawl, blight and the role of urban containment policies. Evidence from US cities"
**2013/3, Lampón, J.F.; Cabanelas-Lorenzo, P-; Lago-Peñas, S.:** "Why firms relocate their production overseas? The answer lies inside: corporate, logistic and technological determinants"
**2013/4, Montolio, D.; Planells, S.:** "Does tourism boost criminal activity? Evidence from a top touristic country"
**2013/5, Garcia-López, M.A.; Holl, A.; Viladecans-Marsal, E.:** "Suburbanization and highways: when the Romans, the Bourbons and the first cars still shape Spanish cities"
**2013/6, Bosch, N.; Espasa, M.; Montolio, D.:** "Should large Spanish municipalities be financially compensated? Costs and benefits of being a capital/central municipality"
**2013/7, Escardíbul, J.O.; Mora, T.:** "Teacher gender and student performance in mathematics. Evidence from Catalonia"
**2013/8, Arqué-Castells, P.; Viladecans-Marsal, E.:** "Banking towards development: evidence from the Spanish banking expansion plan"
**2013/9, Asensio, J.; Gómez-Lobo, A.; Matas, A.:** "How effective are policies to reduce gasoline consumption? Evaluating a quasi-natural experiment in Spain"
**2013/10, Jofre-Monseny, J.:** "The effects of unemployment benefits on migration in lagging regions"
**2013/11, Segarra, A.; García-Quevedo, J.; Teruel, M.:** "Financial constraints and the failure of innovation projects"
**2013/12, Jerrim, J.; Choi, A.:** "The mathematics skills of school children: How does England compare to the high performing East Asian jurisdictions?"
**2013/13, González-Val, R.; Tirado-Fabregat, D.A.; Viladecans-Marsal, E.:** "Market potential and city growth: Spain 1860-1960"
**2013/14, Lundqvist, H.:** "Is it worth it? On the returns to holding political office"
**2013/15, Ahlfeldt, G.M.; Maennig, W.:** "Homevoters vs. leasevoters: a spatial analysis of airport effects"
**2013/16, Lampón, J.F.; Lago-Peñas, S.:** "Factors behind international relocation and changes in production geography in the European automobile components industry"
**2013/17, Guío, J.M.; Choi, A.:** "Evolution of the school failure risk during the 2000 decade in Spain: analysis of Pisa results with a two-level logistic mode"
**2013/18, Dahlby, B.; Rodden, J.:** "A political economy model of the vertical fiscal gap and vertical fiscal imbalances in a federation"
**2013/19, Acacia, F.; Cubel, M.:** "Strategic voting and happiness"
**2013/20, Hellerstein, J.K.; Kutzbach, M.J.; Neumark, D.:** "Do labor market networks have an important spatial dimension?"
**2013/21, Pellegrino, G.; Savona, M.:** "Is money all? Financing versus knowledge and demand constraints to innovation"
**2013/22, Lin, J.:** "Regional resilience"
**2013/23, Costa-Campi, M.T.; Duch-Brown, N.; García-Quevedo, J.:** "R&D drivers and obstacles to innovation in the energy industry"
**2013/24, Huisman, R.; Stradnic, V.; Westgaard, S.:** "Renewable energy and electricity prices: indirect empirical evidence from hydro power"
**2013/25, Dargaud, E.; Mantovani, A.; Reggiani, C.:** "The fight against cartels: a transatlantic perspective"
**2013/26, Lambertini, L.; Mantovani, A.:** "Feedback equilibria in a dynamic renewable resource oligopoly: pre-emption, voracity and exhaustion"
**2013/27, Feld, L.P.; Kalb, A.; Moessinger, M.D.; Osterloh, S.:** "Sovereign bond market reactions to fiscal rules and no-bailout clauses – the Swiss experience"
**2013/28, Hilber, C.A.L.; Vermeulen, W.:** "The impact of supply constraints on house prices in England"
**2013/29, Revelli, F.:** "Tax limits and local democracy"
**2013/30, Wang, R.; Wang, W.:** "Dress-up contest: a dark side of fiscal decentralization"
**2013/31, Dargaud, E.; Mantovani, A.; Reggiani, C.:** "The fight against cartels: a transatlantic perspective"
**2013/32, Saarimaa, T.; Tukiainen, J.:** "Local representation and strategic voting: evidence from electoral boundary reforms"
**2013/33, Agasisti, T.; Murtinu, S.:** "Are we wasting public money? No! The effects of grants on Italian university students' performances"
**2013/34, Flacher, D.; Harari-Kermadec, H.; Moulin, L.:** "Financing higher education: a contributory scheme"
**2013/35, Carozzi, F.; Repetto, L.:** "Sending the pork home: birth town bias in transfers to Italian municipalities"
**2013/36, Coad, A.; Frankish, J.S.; Roberts, R.G.; Storey, D.J.:** "New venture survival and growth: Does the fog lift?"
**2013/37, Giulietti, M.; Grossi, L.; Waterson, M.:** "Revenues from storage in a competitive electricity market: Empirical evidence from Great Britain"

**2014**

**2014/1, Montolio, D.; Planells-Struse, S.:** "When police patrols matter. The effect of police proximity on citizens' crime risk perception"
**2014/2, Garcia-López, M.A.; Solé-Ollé, A.; Viladecans-Marsal, E.:** "Do land use policies follow road construction?"
**2014/3, Piolatto, A.; Rablen, M.D.:** "Prospect theory and tax evasion: a reconsideration of the Yitzhaki puzzle"
**2014/4, Cuberes, D.; González-Val, R.:** "The effect of the Spanish Reconquest on Iberian Cities"
**2014/5, Durán-Cabré, J.M.; Esteller-Moré, E.:** "Tax professionals' view of the Spanish tax system: efficiency, equity and tax planning"
**2014/6, Cubel, M.; Sanchez-Pages, S.:** "Difference-form group contests"
**2014/7, Del Rey, E.; Racionero, M.:** "Choosing the type of income-contingent loan: risk-sharing versus risk-pooling"
**2014/8, Torregrosa Hetland, S.:** "A fiscal revolution? Progressivity in the Spanish tax system, 1960-1990"
**2014/9, Piolatto, A.:** "Itemised deductions: a device to reduce tax evasion"
**2014/10, Costa, M.T.; García-Quevedo, J.; Segarra, A.:** "Energy efficiency determinants: an empirical analysis of Spanish innovative firms"
**2014/11, García-Quevedo, J.; Pellegrino, G.; Savona, M.:** "Reviving demand-pull perspectives: the effect of demand uncertainty and stagnancy on R&D strategy"
**2014/12, Calero, J.; Escardíbul, J.O.:** "Barriers to non-formal professional training in Spain in periods of economic growth and crisis. An analysis with special attention to the effect of the previous human capital of workers"
**2014/13, Cubel, M.; Sanchez-Pages, S.:** "Gender differences and stereotypes in the beauty"
**2014/14, Piolatto, A.; Schuett, F.:** "Media competition and electoral politics"
**2014/15, Montolio, D.; Trillas, F.; Trujillo-Baute, E.:** "Regulatory environment and firm performance in EU telecommunications services"
**2014/16, Lopez-Rodriguez, J.; Martinez, D.:** "Beyond the R&D effects on innovation: the contribution of non-R&D activities to TFP growth in the EU"
**2014/17, González-Val, R.:** "Cross-sectional growth in US cities from 1990 to 2000"
**2014/18, Vona, F.; Nicolli, F.:** "Energy market liberalization and renewable energy policies in OECD countries"
**2014/19, Curto-Grau, M.:** "Voters' responsiveness to public employment policies"
**2014/20, Duro, J.A.; Teixidó-Figueras, J.; Padilla, E.:** "The causal factors of international inequality in co2 emissions per capita: a regression-based inequality decomposition analysis"
**2014/21, Fleten, S.E.; Huisman, R.; Kilic, M.; Pennings, E.; Westgaard, S.:** "Electricity futures prices: time varying sensitivity to fundamentals"
**2014/22, Afcha, S.; García-Quevedo, J,:** "The impact of R&D subsidies on R&D employment composition"
**2014/23, Mir-Artigues, P.; del Río, P.:** "Combining tariffs, investment subsidies and soft loans in a renewable electricity deployment policy"
**2014/24, Romero-Jordán, D.; del Río, P.; Peñasco, C.:** "Household electricity demand in Spanish regions. Public policy implications"
**2014/25, Salinas, P.:** "The effect of decentralization on educational outcomes: real autonomy matters!"
**2014/26, Solé-Ollé, A.; Sorribas-Navarro, P.:** "Does corruption erode trust in government? Evidence from a recent surge of local scandals in Spain"
**2014/27, Costas-Pérez, E.:** "Political corruption and voter turnout: mobilization or disaffection?"
**2014/28, Cubel, M.; Nuevo-Chiquero, A.; Sanchez-Pages, S.; Vidal-Fernandez, M.:** "Do personality traits affect productivity? Evidence from the LAB"
**2014/29, Teresa Costa, M.T.; Trujillo-Baute, E.:** "Retail price effects of feed-in tariff regulation"
**2014/30, Kilic, M.; Trujillo-Baute, E.:** "The stabilizing effect of hydro reservoir levels on intraday power prices under wind forecast errors"
**2014/31, Costa-Campi, M.T.; Duch-Brown, N.:** "The diffusion of patented oil and gas technology with environmental uses: a forward patent citation analysis"
**2014/32, Ramos, R.; Sanromá, E.; Simón, H.:** "Public-private sector wage differentials by type of contract: evidence from Spain"
**2014/33, Backus, P.; Esteller-Moré, A.:** "Is income redistribution a form of insurance, a public good or both?"
**2014/34, Huisman, R.; Trujillo-Baute, E.:** "Costs of power supply flexibility: the indirect impact of a Spanish policy change"
**2014/35, Jerrim, J.; Choi, A.; Simancas Rodríguez, R.:** "Two-sample two-stage least squares (TSTSLS) estimates of earnings mobility: how consistent are they?"
**2014/36, Mantovani, A.; Tarola, O.; Vergari, C.:** "Hedonic quality, social norms, and environmental campaigns"
**2014/37, Ferraresi, M.; Galmarini, U.; Rizzo, L.:** "Local infrastructures and externalities: Does the size matter?"
**2014/38, Ferraresi, M.; Rizzo, L.; Zanardi, A.:** "Policy outcomes of single and double-ballot elections"

**2015**

**2015/1, Foremny, D.; Freier, R.; Moessinger, M-D.; Yeter, M.:** "Overlapping political budget cycles in the legislative and the executive"
**2015/2, Colombo, L.; Galmarini, U.:** "Optimality and distortionary lobbying: regulating tobacco consumption"
**2015/3, Pellegrino, G.:** "Barriers to innovation: Can firm age help lower them?"
**2015/4, Hémet, C.:** "Diversity and employment prospects: neighbors matter!"
**2015/5, Cubel, M.; Sanchez-Pages, S.:** "An axiomatization of difference-form contest success functions"
**2015/6, Choi, A.; Jerrim, J.:** "The use (and misuse) of Pisa in guiding policy reform: the case of Spain"
**2015/7, Durán-Cabré, J.M.; Esteller-Moré, A.; Salvadori, L.:** "Empirical evidence on tax cooperation between sub-central administrations"
**2015/8, Batalla-Bejerano, J.; Trujillo-Baute, E.:** "Analysing the sensitivity of electricity system operational costs to deviations in supply and demand"
**2015/9, Salvadori, L.:** "Does tax enforcement counteract the negative effects of terrorism? A case study of the Basque Country"
**2015/10, Montolio, D.; Planells-Struse, S.:** "How time shapes crime: the temporal impacts of football matches on crime"
**2015/11, Piolatto, A.:** "Online booking and information: competition and welfare consequences of review aggregators"
**2015/12, Boffa, F.; Pingali, V.; Sala, F.:** "Strategic investment in merchant transmission: the impact of capacity utilization rules"
**2015/13, Slemrod, J.:** "Tax administration and tax systems"
**2015/14, Arqué-Castells, P.; Cartaxo, R.M.; García-Quevedo, J.; Mira Godinho, M.:** "How inventor royalty shares affect patenting and income in Portugal and Spain"
**2015/15, Montolio, D.; Planells-Struse, S.:** "Measuring the negative externalities of a private leisure activity: hooligans and pickpockets around the stadium"
**2015/16, Batalla-Bejerano, J.; Costa-Campi, M.T.; Trujillo-Baute, E.:** "Unexpected consequences of liberalisation: metering, losses, load profiles and cost settlement in Spain's electricity system"
**2015/17, Batalla-Bejerano, J.; Trujillo-Baute, E.:** "Impacts of intermittent renewable generation on electricity system costs"
**2015/18, Costa-Campi, M.T.; Paniagua, J.; Trujillo-Baute, E.:** "Are energy market integrations a green light for FDI?"
**2015/19, Jofre-Monseny, J.; Sánchez-Vidal, M.; Viladecans-Marsal, E.:** "Big plant closures and agglomeration economies"
**2015/20, Garcia-López, M.A.; Hémet, C.; Viladecans-Marsal, E.:** "How does transportation shape intrametropolitan growth? An answer from the regional express rail"
**2015/21, Esteller-Moré, A.; Galmarini, U.; Rizzo, L.:** "Fiscal equalization under political pressures"
**2015/22, Escardíbul, J.O.; Afcha, S.:** "Determinants of doctorate holders' job satisfaction. An analysis by employment sector and type of satisfaction in Spain"
**2015/23, Aidt, T.; Asatryan, Z.; Badalyan, L.; Heinemann, F.:** "Vote buying or (political) business (cycles) as usual?"
**2015/24, Albæk, K.:** "A test of the 'lose it or use it' hypothesis in labour markets around the world"
**2015/25, Angelucci, C.; Russo, A.:** "Petty corruption and citizen feedback"
**2015/26, Moriconi, S.; Picard, P.M.; Zanaj, S.:** "Commodity taxation and regulatory competition"
**2015/27, Brekke, K.R.; Garcia Pires, A.J.; Schindler, D.; Schjelderup, G.:** "Capital taxation and imperfect competition: ACE vs. CBIT"
**2015/28, Redonda, A.:** "Market structure, the functional form of demand and the sensitivity of the vertical reaction function"
**2015/29, Ramos, R.; Sanromá, E.; Simón, H.:** "An analysis of wage differentials between full-and part-time workers in Spain"
**2015/30, Garcia-López, M.A.; Pasidis, I.; Viladecans-Marsal, E.:** "Express delivery to the suburbs the effects of transportation in Europe's heterogeneous cities"
**2015/31, Torregrosa, S.:** "Bypassing progressive taxation: fraud and base erosion in the Spanish income tax (1970-2001)"
**2015/32, Choi, H.; Choi, A.:** "When one door closes: the impact of the hagwon curfew on the consumption of private tutoring in the republic of Korea"
**2015/33, Escardíbul, J.O.; Helmy, N.:** "Decentralisation and school autonomy impact on the quality of education: the case of two MENA countries"
**2015/34, González-Val, R.; Marcén, M.:** "Divorce and the business cycle: a cross-country analysis"

**2015/35, Calero, J.; Choi, A.:** "The distribution of skills among the European adult population and unemployment: a comparative approach"
**2015/36, Mediavilla, M.; Zancajo, A.:** "Is there real freedom of school choice? An analysis from Chile"
**2015/37, Daniele, G.:** "Strike one to educate one hundred: organized crime, political selection and politicians' ability"
**2015/38, González-Val, R.; Marcén, M.:** "Regional unemployment, marriage, and divorce"
**2015/39, Foremny, D.; Jofre-Monseny, J.; Solé-Ollé, A.:** "'Hold that ghost': using notches to identify manipulation of population-based grants"
**2015/40, Mancebón, M.J.; Ximénez-de-Embún, D.P.; Mediavilla, M.; Gómez-Sancho, J.M.:** "Does educational management model matter? New evidence for Spain by a quasiexperimental approach"
**2015/41, Daniele, G.; Geys, B.:** "Exposing politicians' ties to criminal organizations: the effects of local government dissolutions on electoral outcomes in Southern Italian municipalities"
**2015/42, Ooghe, E.:** "Wage policies, employment, and redistributive efficiency"

## 2016

**2016/1, Galletta, S.:** "Law enforcement, municipal budgets and spillover effects: evidence from a quasi-experiment in Italy"
**2016/2, Flatley, L.; Giulietti, M.; Grossi, L.; Trujillo-Baute, E.; Waterson, M.:** "Analysing the potential economic value of energy storage"
**2016/3, Calero, J.; Murillo Huertas, I.P.; Raymond Bara, J.L.:** "Education, age and skills: an analysis using the PIAAC survey"
**2016/4, Costa-Campi, M.T.; Daví-Arderius, D.; Trujillo-Baute, E.:** "The economic impact of electricity losses"
**2016/5, Falck, O.; Heimisch, A.; Wiederhold, S.:** "Returns to ICT skills"
**2016/6, Halmenschlager, C.; Mantovani, A.:** "On the private and social desirability of mixed bundling in complementary markets with cost savings"
**2016/7, Choi, A.; Gil, M.; Mediavilla, M.; Valbuena, J.:** "Double toil and trouble: grade retention and academic performance"
**2016/8, González-Val, R.:** "Historical urban growth in Europe (1300–1800)"
**2016/9, Guio, J.; Choi, A.; Escardíbul, J.O.:** "Labor markets, academic performance and the risk of school dropout: evidence for Spain"
**2016/10, Bianchini, S.; Pellegrino, G.; Tamagni, F.:** "Innovation strategies and firm growth"
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