

Building or Squeezing? How Spain Absorbed Two Immigration Waves

*The Incidence of Population Shocks
in Local Housing Markets*

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ABSTRACT. When a local housing market receives a population shock, the shock is absorbed by new construction, by conversion of the existing stock, by households consuming less space and by the movement of other residents, and prices move until these margins exhaust it. I develop a spatial-equilibrium framework in which these shares have a closed form and sum to one, and I estimate it for Spain's two immigration waves with a 2003–2024 panel of 50 provinces and a shift-share instrument based on settlement by country of birth. In 2003–2008 each unit of inflow was matched by about 0.7 units of new housing. In 2015–2024 the construction margin closed: the dwelling-stock response is zero, and administrative starts and completions respond to inflows only in provinces that came out of the 2008 bust with little unsold new housing. The current wave has been absorbed by squeezing instead. In the population register, persons per household rise by 0.84% for each 1% of population arriving, and each 1% raises rents by about 1% and house prices by about 4% cumulatively. Natives move towards receiving provinces, which amplifies the shock; with that reallocation the model matches the rent response only if space per household is about four times as elastic as standard calibrations assume. Neither topography nor vacant urban land predicts the response across provinces, so the paper reads the collapse between waves as a fall in effective supply elasticity without identifying a single cause. The rent burden falls mainly on the bottom income deciles and on households headed by people under 45.

Preliminary draft. Sections 3–5 derive and calibrate the model; Section 7 estimates it on a 2003–2024 panel of 50 Spanish provinces. Data and code are released as the Project Frontier provincial housing panel (PF-DATA-001). Comments welcome; please do not cite without permission.

Keywords: housing supply elasticity, immigration, crowding, spatial equilibrium, incidence, housing overhang, shift-share. **JEL:** R21, R23, R31, J61, H22.

1 Introduction

Spain is absorbing the largest population inflow in its history while housing supply barely moves. Population reached 49.8 million in July 2026, up 444,000 in a single year, with all of the net increase foreign-born. In 2025 about 240,000 households were formed and 92,000 dwellings completed, and the Banco de España puts the gap between completions and household formation over 2021–2025 at about 750,000 dwellings (Banco de España, 2026, pp. 124–126, 145–146). House prices rose 12.2% in the year to the second quarter of 2026.

The usual question asked of these facts is whether immigration raises house prices. This paper asks a different and, I will argue, more useful question:

When a local housing market receives a population shock, which margin absorbs it: new housing, the existing stock, smaller living space per person, or the movement of other residents? And who pays?

Immigration is the empirical case, but the mechanism is general. A refugee inflow, a university expansion, a technology boom or a wave of remote workers are all population shocks. The question in each case is one of *incidence*: the shock has to be absorbed somewhere, and the interesting object is how its burden is distributed across margins of adjustment and across groups.

The mechanism. I build on the spatial-equilibrium tradition of Rosen (1979), Roback (1982) and Moretti (2011). Arrivals lower local wages slightly and raise housing demand. Construction responds with supply elasticity η . Existing residents compare their wage net of housing costs and some relocate, with mobility κ . The equilibrium price response to an inflow $\tilde{m}$ is

$$\hat{p} = \beta(\eta) \tilde{m}, \quad \beta(\eta) = \frac{1}{\eta + \varepsilon + \kappa \left(\frac{\eta + \varepsilon}{\sigma} + s \right)}, \quad (1)$$

where ε is the price elasticity of housing demand, σ the elasticity of local labour demand and s the housing budget share. Every term in the denominator is an absorption margin. The paper is organised around this single object.

Contributions. The paper makes five contributions.

First, it shows that the quantity margins of adjustment have an exact decomposition. Per unit of shock, new construction absorbs $\eta\beta$, reduced housing consumption per household absorbs $\varepsilon\beta$, and relocation of existing residents absorbs $\kappa\Phi/(1 + \kappa\Phi)$, and these three shares sum to one (Proposition 2). The price is not a margin of absorption in itself. It is the signal that activates the others, and β measures how strongly it must move to do so.

Second, it distinguishes two incidences that the literature usually conflates. The *housing incidence* of a shock is $\partial\hat{p}/\partial\tilde{m} = \beta(\eta)$. The *population absorption* is $\partial\hat{N}/\partial\tilde{m} = 1/(1 + \kappa\Phi)$, the share of a potential inflow that materialises as resident population once residents have responded. A more elastic supply lowers the first and raises the second (Proposition 3). Supply elasticity therefore determines not only what population growth costs existing residents, but how much of it a place can absorb.

Third, it shows that supply elasticity and mobility are substitutes as absorption margins: the more mobile residents are, the less supply elasticity matters for prices (Proposition 4). Local markets therefore differ along two dimensions, the capacity to build and the propensity to move. I summarise the first in a *Housing Absorption Index*, the share of a population shock absorbed by new housing.

Fourth, it extends the framework to three institutional and technological settings. Under rent regulation, the shock is redistributed from the regulated to the free segment. Average rents are unaffected if and only if no regulated stock leaves residential use, so the policy-relevant parameter is that leakage, λ (Proposition 5). Remote workers add housing demand without adding local labour supply, so they push prices more than immigrants of equal number (Proposition 6). Allowing amenities to respond to inflows turns the assumed displacement of natives into endogenous population reallocation of either sign (Proposition 7).

Fifth, it estimates the framework and measures each margin. A single estimating equation recovers the rent and price responses; estimating it for construction, households and population maps the absorption identity onto data. Two margins are measured directly rather than as residuals: construction with administrative starts and completions, and crowding with the number of residents registered per dwelling in the population register. The paper also shows who bears the rent and price responses by income and age.

Spain as a laboratory. Spain received two large immigration waves under very different supply conditions. Between 2003 and 2008 a foreign-born inflow of about 7% of the population was accompanied by a construction boom; between 2015 and 2024 a comparable inflow of about 6% met a housing stock that barely grew. I assemble a panel of 50 provinces from the municipal register, the continuous population statistics, the Ministry of Housing's appraisal and stock series and INE's rental price index. The inflow is instrumented with a leave-one-out shift-share based on settlement patterns by country of birth. The instrument for the second wave passes standard pre-trend tests; for the first it does not, a point I return to.

Findings. Five results stand out. First, the construction margin closed. In the first wave each unit of inflow was matched by about 0.7 units of new housing; in the second the dwelling-stock response is zero and the implied short-run supply elasticity is indistinguishable from zero. Second, where construction survived is informative. Administrative starts and completions still respond to inflows in provinces that came out of the 2008 bust with little unsold new housing (0.33 and 0.22 per unit of inflow) and not at all where the bust left the most (0.07 and 0.04). The unsold homes themselves were not drawn down by inflows. The legacy of the bust appears to have switched off building where it was deepest without providing housing where demand arrived. Third, the current wave has been absorbed by squeezing. In the population register, persons per household rise by 0.84% for each 1% of population arriving, a direct measurement of the margin that the accounting identity identifies as the residual. Fourth, each 1% of population arriving raises rents by about 1% cumulatively and prices by about four times as much, so a large part of the price response is capitalised expected growth. Fifth, inflows do not displace natives; Spain-born adults move towards receiving provinces. Relocation therefore amplifies rather than absorbs the shock. Recalibrated with that sign, the

model matches the rent response only if space per household is about four times as elastic as the standard calibration assumes, which is the squeezing result in the model's own terms.

What the paper does not claim. The paper does not argue that immigration explains Spain's housing crisis. Its estimates concern the *relative* response of provinces that received more immigrants. They say nothing about the national level of prices, which is driven by income, the user cost of capital, credit and native household formation as well as by population. The question is narrower and more defensible: given a migration-induced demand shock, which margin absorbed it, and why did that change between waves? The paper also does not claim to have identified why the construction margin closed. What is identified is the collapse itself. Reading it as a fall in supply elasticity η is the model's interpretation; the cross-sectional tests of that reading, with topography and with vacant urban land, are weak or wrong-signed, and many things changed between 2008 and 2015, including credit, developers' balance sheets and the user cost. The unsold-stock evidence narrows the candidates without settling the question.

Roadmap. Section 2 places the paper in the literature. Section 3 presents the model and its main propositions. Section 4 adds rent regulation, remote work, endogenous reallocation and immigrant construction labour. Section 5 calibrates the model to Spain. Section 6 sets out the estimating equation and identification strategy, and Section 7 reports the estimates, including the overhang mechanism, the direct measure of crowding, the recalibrated model and the distribution of the burden. Section 8 compares the same shock under alternative policies. Section 9 concludes. Appendix C contains the rent-regulation calibration.

2 Related literature

The paper connects four literatures.

Spatial equilibrium and the incidence of local shocks. In the framework of Rosen (1979) and Roback (1982), wages and housing costs adjust across locations until mobile workers are indifferent, so local shocks are capitalised into prices. Moretti (2011) develops the version with imperfect mobility and an upward-sloping housing supply curve that underlies the model here. Notowidigdo (2020) studies the incidence of local labour demand shocks across skill groups. This paper studies the mirror image, a local population shock, and asks how its incidence is distributed across margins of adjustment. The intuition goes back to Ricardo (1817): when population grows and good land is scarce, the surplus accrues to its owners. Spatial equilibrium adds what Ricardo lacked, namely mobility, a supply elasticity and an estimable model.

Housing supply elasticity. Glaeser et al. (2006) show that the same demand shock produces population growth in elastic places and price growth in inelastic ones. Saiz (2010) measures geographic constraints on supply and shows that they predict local elasticities. Glaeser and Gyourko (2018) review the consequences of constrained supply, and Hsieh and Moretti (2019) quantify its aggregate cost through spatial misallocation. The present paper takes that insight

to a migration shock. It shows that elasticity governs the population absorbed as well as the price response, and that its effect depends on resident mobility.

Immigration and housing. Saiz (2003) finds sizeable rent increases in Miami after the Mariel boatlift, and Saiz (2007) finds that an inflow equal to 1% of a US city's population raises rents by about 0.9% and prices by about 3%. Accetturo et al. (2014) find that immigration raises average prices in Italian cities but lowers them in the neighbourhoods where immigrants settle, as natives move out. Sá (2015) finds negative effects on house prices in England and Wales, driven by native out-migration. For Spain, González and Ortega (2009) attribute about a 52% price increase and 37% of new construction to the 1998–2008 wave. Sanchis-Guarner (2023), using a shift-share instrument on provinces over 2001–2012, estimates that a one-point increase in the immigration rate raises rents by about 0.8% and sale prices by about 3%, and that roughly 35 natives settle in receiving provinces for every 100 immigrants. That co-location finding motivates the reallocation extension in Section 4.3.

Rent regulation and remote work. Autor et al. (2014) show that the end of rent control in Cambridge, Massachusetts, raised the value of decontrolled and nearby properties. Diamond et al. (2019) show that rent control in San Francisco protected incumbent tenants but reduced rental supply by 15% as landlords converted units, raising market rents. The leakage parameter λ in Section 4.1 formalises that conversion channel. Mondragon and Wieland (2022) attribute a substantial share of recent US house-price growth to the shift to remote work. The extension in Section 4.2 shows why a remote worker raises local prices more than a local worker.

Shift-share identification. The empirical design uses the settlement-based instrument of Card (2001). Recent work clarifies the conditions for its validity (Goldsmith-Pinkham et al., 2020; Borusyak et al., 2022), its standard errors (Adão et al., 2019) and the risk of conflating short- and long-run responses (Jaeger et al., 2018).

3 A model of population shocks in local housing markets

3.1 Environment

Local housing markets are indexed by i (a province or municipality). A hat denotes a log change, $\hat{p} = d \ln p$. A market receives an inflow

$$\tilde{m}_i = \frac{M_i}{N_{i,t-1}},$$

arrivals over initial population, which I treat as a push from origin countries rather than a response to local conditions. Section 6.2 shows how to make that assumption hold empirically. $\tilde{m}_i$ is the *potential* shock, the population that would be added if no existing resident responded. The market is described by four relations.

Labour demand. More workers lower the local wage, with labour demand elasticity $\sigma > 0$:

$$\hat{w} = -\frac{1}{\sigma} \hat{N}. \quad (2)$$

Housing demand. Each household demands floor space $h(p)$ with price elasticity $\varepsilon > 0$:

$$\hat{H}^d = \hat{N} - \varepsilon \hat{p}. \quad (3)$$

Housing supply. Construction responds to price with elasticity $\eta \geq 0$. Land, geography, planning and permitting all enter through η :

$$\hat{H}^s = \eta \hat{p}. \quad (4)$$

Population. Population changes with arrivals and with residents relocating when their wage net of housing costs changes. With s the housing budget share and $\kappa \geq 0$ resident mobility:

$$\hat{N} = \tilde{m} + \kappa (\hat{w} - s \hat{p}). \quad (5)$$

$\kappa = 0$ means no resident moves; $\kappa \rightarrow \infty$ is the perfect-mobility limit of Rosen (1979) and Roback (1982).

3.2 Equilibrium

Housing-market clearing, $\hat{H}^d = \hat{H}^s$, gives

$$\hat{p} = \frac{\hat{N}}{\eta + \varepsilon}. \quad (6)$$

Substituting (2) and (6) into the bracket of (5), the change in the wage net of housing costs is

$$\hat{w} - s \hat{p} = -\Phi \hat{N}, \quad \Phi(\eta) \equiv \frac{1}{\sigma} + \frac{s}{\eta + \varepsilon}. \quad (7)$$

Φ measures how much residents' real income falls per 1% of additional population: wages fall and housing costs rise. Equilibrium population and price follow:

$$\hat{N} = \frac{\tilde{m}}{1 + \kappa \Phi}, \quad (8)$$

$$\hat{p} = \beta(\eta) \tilde{m}, \quad \beta(\eta) = \frac{1}{(\eta + \varepsilon)(1 + \kappa \Phi)} = \frac{1}{D(\eta)}, \quad (9)$$

with

$$D(\eta) \equiv (\eta + \varepsilon) \left(1 + \frac{\kappa}{\sigma}\right) + \kappa s. \quad (10)$$

The remaining variables are

$$\hat{H} = \eta \beta(\eta) \tilde{m}, \quad \hat{w} = -\frac{1}{\sigma} \frac{\tilde{m}}{1 + \kappa \Phi}. \quad (11)$$

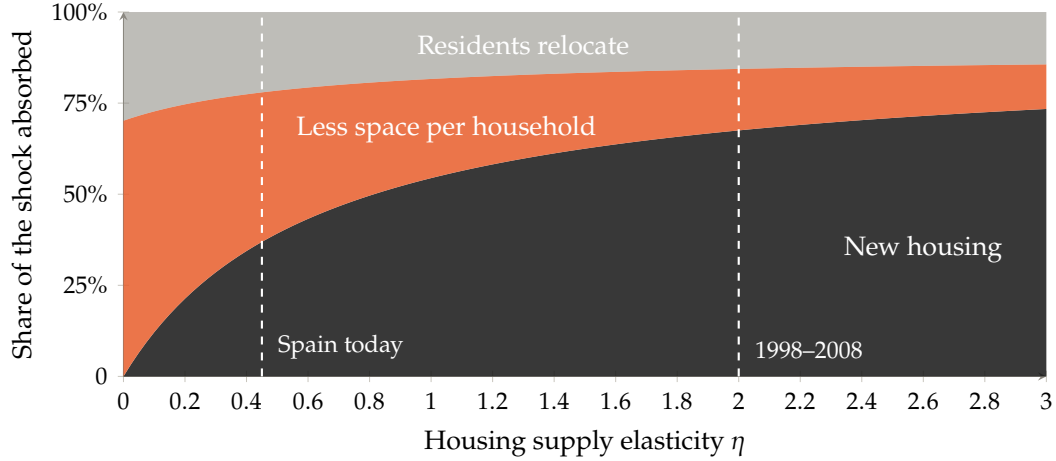


FIGURE 1. The absorption identity. Shares of a population shock absorbed by new construction ($\eta\beta$), lower housing consumption per household ($\varepsilon\beta$) and relocation of existing residents ($\kappa\Phi/(1 + \kappa\Phi)$), as a function of supply elasticity. Calibration: $\varepsilon = 0.5$, $\sigma = 4$, $s = 0.3$, $\kappa = 0.5$.

Proposition 1 (Price incidence). *The price incidence of a population shock, $\beta(\eta) = 1/D(\eta)$, is positive, decreasing and convex in supply elasticity:*

$$\beta'(\eta) = -\frac{1 + \kappa/\sigma}{D(\eta)^2} < 0, \quad \beta''(\eta) = \frac{2(1 + \kappa/\sigma)^2}{D(\eta)^3} > 0.$$

It is also decreasing in mobility κ , and bounded above by $1/\varepsilon$, the response with fully rigid supply and no mobility.

Low η sends a shock mostly into price; high η sends it mostly into construction. Convexity means that a given gain in supply elasticity lowers incidence most where supply is most rigid.

3.3 Where the shock goes: an exact decomposition

A population shock must be absorbed. The model says exactly where.

Proposition 2 (Absorption identity). *Per unit of potential shock $\tilde{m}$, the three quantity margins of adjustment exhaust the shock:*

$$\underbrace{\eta\beta}_{\text{new housing}} + \underbrace{\varepsilon\beta}_{\text{less space per household}} + \underbrace{\frac{\kappa\Phi}{1 + \kappa\Phi}}_{\text{relocation of residents}} = 1. \quad (12)$$

As η rises, the construction share rises and both other shares fall.

The identity clarifies the role of the price. It is not a fourth margin of absorption. It is the signal that activates the three margins that are, and β measures how far it must move to do so. A market that can build needs only a small price rise to absorb a shock. A market that cannot build must raise prices until enough households consume less space or leave. Figure 1 plots the decomposition under the Spanish calibration of Section 5.

Definition 1 (Housing Absorption Index). The Housing Absorption Index of market i is the

share of a population shock absorbed by new housing:

$$HAI_i \equiv \eta_i \beta(\eta_i; \kappa_i, \varepsilon, \sigma, s) \in [0, 1).$$

The index is a summary measure of a market's capacity to accommodate population growth through construction, as opposed to price-induced crowding or displacement. It is bounded above by one, rises with η_i and falls with κ_i , since mobility diverts part of the shock to relocation. Section 6.1 shows how HAI_i can be recovered from estimated price and construction responses.

3.4 Two incidences: price and population

The literature usually reports one number, the price response. The model implies a second, which matters as much.

Proposition 3 (Population absorption). *The share of a potential inflow that materialises as resident population is*

$$A(\eta, \kappa) \equiv \frac{\partial \hat{N}}{\partial \tilde{m}} = \frac{1}{1 + \kappa \Phi(\eta)}.$$

For $\kappa > 0$, A is increasing in η and decreasing in κ . A more elastic supply therefore lowers the price incidence β and raises population absorption A .

The intuition runs through Φ . Where housing can expand, each arrival raises housing costs less, residents' real income falls less, and fewer of them leave. Elastic supply lets a place absorb more people at a lower cost to those already there.

This result must be read carefully. $\tilde{m}$ is the shock that reaches the local market and $\hat{N}$ is the population that remains after prices, wages and mobility have adjusted. The proposition is therefore a statement about *local absorption*, not about the decision to migrate to a country. It says that higher supply elasticity raises the share of a migration shock absorbed through population rather than through housing costs. It does not say that building more attracts more immigration.

3.5 Supply elasticity and mobility

Mobility is the second state variable. With $\kappa = 0$ nobody moves and the whole shock is absorbed locally through price, construction and crowding. As $\kappa \rightarrow \infty$ the market approaches the perfect-mobility benchmark, where residents' real income cannot change and relocation absorbs whatever construction does not.

Proposition 4 (Supply elasticity and mobility are substitutes). *The price gradient in supply elasticity becomes flatter as mobility rises:*

$$\frac{\partial^2 \beta}{\partial \eta \partial \kappa} > 0,$$

so $|\beta'(\eta)|$ is decreasing in κ .

Where residents are mobile, relocation absorbs much of the shock, and the capacity to build matters less for prices. Where residents are immobile, as in Spain where interprovincial

TABLE 1. Incidence of a 1% population shock by supply elasticity and mobility

		Price β	Population absorbed A	New housing HAI
Rigid supply, $\eta = 0.45$	Immobile, $\kappa = 0$	1.05	1.00	0.47
	Spain, $\kappa = 0.5$	0.82	0.78	0.37
	Mobile, $\kappa = 2$	0.49	0.47	0.22
Elastic supply, $\eta = 2$	Immobile, $\kappa = 0$	0.40	1.00	0.80
	Spain, $\kappa = 0.5$	0.34	0.84	0.68
	Mobile, $\kappa = 2$	0.23	0.58	0.46

Notes: Model calibration with $\varepsilon = 0.5$, $\sigma = 4$, $s = 0.3$. $A = 1/(1 + \kappa\Phi)$ and $HAI = \eta\beta$. Moving from $\kappa = 0$ to $\kappa = 2$ lowers the price response by 0.56 points in the rigid market and by 0.17 points in the elastic one (Proposition 4).

mobility is low, supply elasticity is the decisive margin. Markets therefore differ along two dimensions, as Table 1 shows: a market can be easy or hard to build in, and its residents can be more or less likely to move. The same shock produces four different patterns of incidence.

3.6 Prices, rents and capitalisation

The model is written in terms of a single housing price. In practice, price is capitalised rent, $p = r/c$, where c is the user cost of housing: the interest rate net of expected appreciation, plus taxes, depreciation and maintenance (Poterba, 1984; Himmelberg et al., 2005). In log changes,

$$\hat{p} = \hat{r} - \hat{c}. \quad (13)$$

If the user cost varies over time but not across markets, year effects absorb $\hat{c}$ and the same β applies to rents and prices. That assumption fails in booms. Expected appreciation rises most where inflows are largest, so the user cost falls with the shock. Writing $\hat{c}_i = -\chi \tilde{m}_i$ with $\chi \geq 0$,

$$\frac{\partial \hat{p}}{\partial \tilde{m}} = \beta + \chi, \quad \frac{\partial \hat{r}}{\partial \tilde{m}} = \beta. \quad (14)$$

Rents identify the fundamental incidence β . The gap between the price and rent responses identifies a capitalisation or expectations component χ . The paper therefore treats rents and prices as distinct outcomes. This matters for the comparison of the two Spanish waves: without the distinction, a rent-dominated present would be compared with an expectations-dominated past.

4 Institutions, technology and reallocation

4.1 Rent regulation: redistribution and leakage

A rent cap does not remove the pressure of a population shock. It changes where the pressure lands. Consider a regulated municipality in which the rental stock splits into a regulated long-term segment R , a share ω of the stock, and a free segment F (seasonal lets, rooms, uncapped neighbouring municipalities), a share $1 - \omega$. To isolate the mechanism I set $\kappa = 0$ and assume that arrivals rent in F , since R does not expand. Both assumptions are relaxed in the discussion below.

The regulated rent can rise only by a reference index ρ common to all regulated areas, so

$\partial \hat{r}_R / \partial \tilde{m} = 0$. Landlords withdraw units from R as the free rent rises relative to the regulated one, with elasticity η_L :

$$\hat{H}_R = -\eta_L(\hat{r}_F - \hat{r}_R) = -\eta_L \hat{r}_F. \quad (15)$$

Of the withdrawn units, a share $\lambda \in [0, 1]$ leaves residential use (tourist lets, vacancy, sales to non-residents) and $1 - \lambda$ reappears in F . With total demand normalised so that $H_R = \omega$ and $H_F = 1 - \omega$, clearing in F requires

$$\underbrace{\tilde{m} + \eta_L \omega \hat{r}_F}_{\text{arrivals and displaced tenants}} - \varepsilon(1 - \omega)\hat{r}_F = \underbrace{(1 - \lambda)\eta_L \omega \hat{r}_F + \eta(1 - \omega)\hat{r}_F}_{\text{units moving to } F}, \quad (16)$$

so that

$$\hat{r}_F = \frac{\tilde{m}}{(1 - \omega)(\eta + \varepsilon) - \lambda \eta_L \omega}. \quad (17)$$

An equilibrium exists only if the denominator is positive, that is, if $\lambda < (1 - \omega)(\eta + \varepsilon)/(\eta_L \omega)$: the leakage of units cannot exceed the free segment's capacity to absorb demand.

Proposition 5 (Rent regulation redistributes; leakage inflates). *Under regulation, the shock leaves the regulated rent unchanged, raises the free rent by more than the unregulated benchmark $1/(\eta + \varepsilon)$, and shrinks the regulated stock. The stock-weighted average rent responds by*

$$\frac{\partial \bar{r}}{\partial \tilde{m}} = \frac{1 - \omega}{(1 - \omega)(\eta + \varepsilon) - \lambda \eta_L \omega},$$

which equals the unregulated benchmark if and only if $\lambda = 0$, and exceeds it if $\lambda > 0$.

Rent control is therefore purely redistributive on average when no regulated unit leaves residential use, and inflationary when some do. The policy question reduces to measuring λ . The amplification in the free segment rests on the assumption that arrivals cannot enter R . If some arrivals take regulated tenancies through inherited contracts or sharing, the amplification is smaller. Because the block is derived in the no-mobility limit, its benchmark is $1/(\eta + \varepsilon)$ rather than the full $\beta(\eta) = 1/D(\eta)$ that the regression estimates. Extending it to $\kappa > 0$ is part of the work programme, and the empirical design reads β_3 as a shift relative to the uncontrolled benchmark in the same market.

4.2 Remote work: demand without local labour supply

A remote worker who settles in a market demands housing but does not compete in the local labour market, because the wage is earned elsewhere. Let $\tilde{T}_i$ be arrivals of remote workers over initial population, driven by the national expansion of remote work ΔT and by the market's pull θ_i (amenities, connectivity, climate):

$$\tilde{T}_i = \Delta T \cdot \theta_i. \quad (18)$$

Only the locally working population enters labour demand, $\hat{w} = -(\hat{N} - \tilde{T})/\sigma$. Remote workers also typically earn more than local residents and demand more space; let $\psi \geq 1$ be a remote worker's housing demand relative to a local resident's, so that $\hat{H}^d = \hat{N} + (\psi - 1)\tilde{T} - \varepsilon \hat{p}$. Solving as before (Appendix A):

Proposition 6 (Remote work). *The price response to remote-worker arrivals is*

$$\hat{p} = \beta(\eta) \tilde{m} + \beta_4 \tilde{T}, \quad \beta_4 = \psi \beta(\eta) \left(1 + \frac{\kappa}{\sigma}\right),$$

so $\beta_4 > \beta(\eta)$ whenever $\kappa > 0$ or $\psi > 1$.

Two channels multiply. An immigrant lowers the local wage slightly, so some residents leave and free up housing; a remote worker does not (the factor $1 + \kappa/\sigma$). A remote worker also demands more housing per head (the factor ψ). Remote work is best understood not as additional demand but as a *spatial relocation* of demand: it moves housing demand away from where jobs are towards where amenities are. Without this term, part of the price growth on the coast, in the islands and in well-connected mid-sized cities would be wrongly attributed to immigration.

4.3 Endogenous population reallocation

Equation (5) allows residents only to leave in response to a shock. Spanish evidence suggests that natives tend instead to move *towards* immigrant-receiving provinces (Sanchis-Guarner, 2023), plausibly because inflows come with agglomeration benefits or improved amenities. Let the amenity value of a market rise with the inflow, $\hat{A} = a \tilde{m}$ with $a \geq 0$, and enter residents' location choice:

$$\hat{N} = \tilde{m} + \kappa (\hat{w} - s\hat{p} + \hat{A}). \quad (19)$$

Proposition 7 (Reallocation of either sign). *With amenity response a , equilibrium population and price are*

$$\hat{N} = \frac{1 + \kappa a}{1 + \kappa \Phi} \tilde{m}, \quad \hat{p} = \frac{1 + \kappa a}{D(\eta)} \tilde{m},$$

and the response of existing residents is

$$\hat{N} - \tilde{m} = \frac{\kappa(a - \Phi)}{1 + \kappa \Phi} \tilde{m}.$$

Residents flow out if $a < \Phi$, flow in if $a > \Phi$, and do not move if $a = \Phi$.

The paper therefore speaks of *endogenous population reallocation* rather than native displacement. The sign of the residents' response is an empirical question, and it identifies whether amenity gains exceed the real-income loss Φ . Inward reallocation amplifies the price response, because the shock is reinforced rather than partly offset.

4.4 Immigration as construction labour

The model treats supply elasticity as fixed. But immigrants are also workers, and in Spain they are heavily represented in construction. If inflows ease labour shortages in construction, supply elasticity rises over time with the cumulative inflow,

$$\eta_{i,t} = \eta_{i,0} + \zeta \sum_{\tau < t} \tilde{m}_{i\tau}, \quad \zeta \geq 0. \quad (20)$$

A population shock then has two opposing effects on prices. The demand channel raises them on impact through $\beta(\eta)$. The supply channel lowers the incidence of every subsequent shock,

since β is decreasing in η . The long-run price incidence of sustained immigration is lower than the short-run one, and the gap is larger where supply is most rigid, because β is convex. Estimating ζ requires linking inflows to construction employment and is left for future work, but the channel matters for policy: the same population that raises demand can also expand the capacity to meet it.

5 Calibration for Spain

This section calibrates the model to Spanish parameters. Every number here follows from the model and the parameter choices in Table 2; none is an econometric estimate. The calibration states what the model predicts before looking at the data. Section 7 confronts these predictions with estimates.

5.1 Setting

The Spanish data fit the model's low-elasticity regime. All net population growth in the year to July 2026 was foreign-born, so nationally $\tilde{m}$ is approximately population growth, 0.90%. Households grew faster, by 1.22%, because native households are getting smaller, a separate demand driver that the empirical work must control for. Households are being formed at about 2.6 times the rate of completions (240,000 against 92,000 in 2025), and the Banco de España puts the cumulative 2021–2025 gap between completions and net household formation at around 750,000 dwellings, while about 450,000 unsold new homes from the previous boom remain (Banco de España, 2026, pp. 124–126, 145–146). Prices are rising faster than rents (12.2% against 5.6% for asking rents), which, through (13), signals a falling user cost. New rental contracts rose 8.8% in 2024 against 2.8% for existing ones, consistent with pressure landing on whoever is searching. Appendix B lists the sources.

5.2 Parameters

TABLE 2. Calibrated parameters

Parameter	Value	Basis
ε , price elasticity of housing demand	0.5	Standard estimates
$\bar{\eta}$, mean long-run supply elasticity	0.45	Banco de España (2026, p. 146), from long-run macroeconomic models; FUNCAS range 0.3–0.6
s , housing budget share	0.3	Typical renter burden
σ , labour demand elasticity	4	Small wage effects of immigration in Spanish evidence; $\sigma = 1$ would imply a 1% wage fall per 1% of population
κ , resident mobility	0.5	Low interprovincial mobility in Spain; the sign of reallocation is estimated in Section 7.9
ψ , remote worker's relative housing demand	1.0–1.2	Higher incomes times an income elasticity of housing of about 0.7 (illustrative)

5.3 Results

With these parameters, $\Phi = 1/4 + 0.3/0.95 = 0.566$ and $D(\bar{\eta}) = 0.95 \times 1.125 + 0.15 = 1.219$. Table 3 reports the implied responses.

TABLE 3. Calibrated responses to a 1% population shock at mean supply elasticity

Quantity	Expression	Value
Price response, β_1	$1/D(\bar{\eta})$	0.82
New housing (HAI)	$\bar{\eta}\beta_1$	0.37
Lower space per household	$\varepsilon\beta_1$	0.41
Residents relocating	$\kappa\Phi/(1 + \kappa\Phi)$	0.22
Population absorbed, A	$1/(1 + \kappa\Phi)$	0.78
Price gradient in elasticity, β_2	$-(1 + \kappa/\sigma)/D^2$	-0.76
Construction gradient in elasticity	$[\varepsilon(1 + \kappa/\sigma) + \kappa s]/D^2$	+0.48
Remote workers, β_4 , $\psi = 1$	$\beta_1(1 + \kappa/\sigma)$	0.92
Remote workers, β_4 , $\psi = 1.2$	$\psi\beta_1(1 + \kappa/\sigma)$	1.11

Notes: Model calibration, not estimates. The three absorption shares sum to one, and population absorbed equals new housing plus lower space per household (Proposition 2).

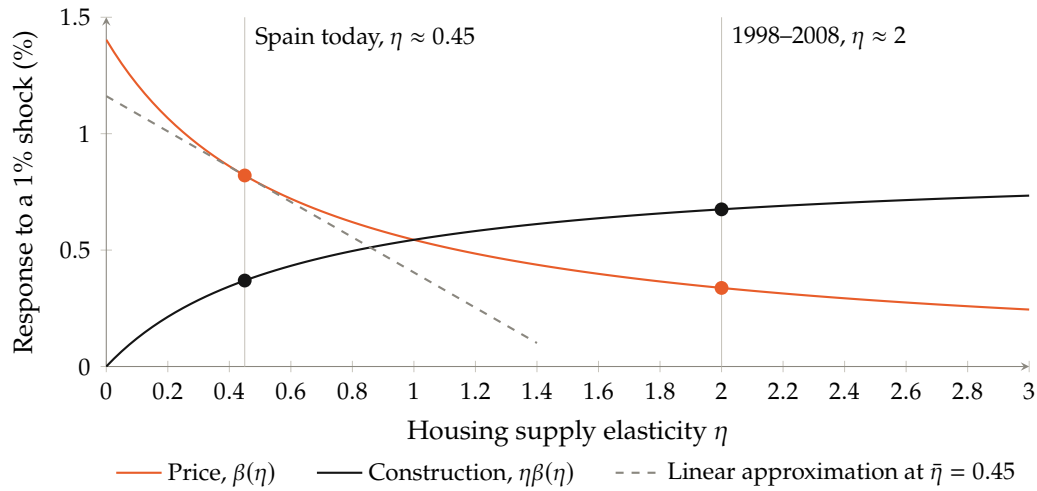


FIGURE 2. Price and construction responses to a 1% population shock. The dashed line is the first-order approximation used in the estimating equation, which understates the price response in the most rigid markets (at $\eta = 0$: 1.16 against 1.40).

At the current inflow of 0.90% a year, the model attributes about 0.74 points of annual price and rent growth to immigration, or 1.0 point if the shock is measured by household growth. That is roughly 13–18% of asking-rent growth and 6–8% of price growth.

Two waves. Figure 2 shows the price and construction responses across supply elasticities. At $\eta = 2$, closer to the 1998–2008 response, $\beta = 0.34$ and the construction response is 0.68. Today's price response is about 2.4 times larger and the construction response about half as large. That is the prediction for the comparison of the two waves (hypothesis H3 in Section 6.3).

Rent regulation. Proposition 5 can be calibrated in the same way. Because the empirical evidence on regulation rests on four treated provinces, that calibration is reported in Appendix C rather than here.

5.4 Sensitivity

TABLE 4. Sensitivity of the price response β_1

Change from baseline	β_1
Baseline	0.82
No resident mobility ($\kappa = 0$)	1.05
Higher mobility ($\kappa = 1$)	0.67
Large wage effects ($\sigma = 1$)	0.63
Rigid supply ($\eta = 0$)	1.40
Higher supply elasticity ($\eta = 1$)	0.54
Elastic supply ($\eta = 2$)	0.34

Across plausible parameters the price response ranges from about 0.6 to 1.05 (Table 4), close to identified estimates of the rent response of about 0.9% for US cities (Saiz, 2007) and 0.8% for Spanish provinces (Sanchis-Guarner, 2023).

5.5 What the model does not explain

The current inflow accounts for about 0.7 of the 12.2 points of annual price growth. The remainder comes from forces outside the model: income growth, a falling user cost, credit conditions and native household formation. The same gap appears historically. González and Ortega (2009)'s 52% price increase from a 17% inflow implies about 3% per point, while the model's ceiling is $1/\varepsilon = 2$ even with fully rigid supply and no mobility. Market-specific expectations, the capitalisation term χ of Section 3.6, are the natural missing channel. This is a further reason to estimate the rent and price responses separately.

6 Empirical strategy

6.1 From the model to an estimating equation

$\beta(\eta)$ is non-linear, but a first-order expansion around mean elasticity $\bar{\eta}$ yields a linear equation whose coefficients have structural meaning:

$$\hat{p}_i \approx \underbrace{\beta(\bar{\eta})}_{\beta_1} \tilde{m}_i + \underbrace{\beta'(\bar{\eta})}_{\beta_2} \tilde{m}_i(\eta_i - \bar{\eta}). \quad (21)$$

β_1 is the price response to a 1% inflow in a market of mean elasticity. β_2 is how much that response falls per additional point of elasticity. η_i is centred on its mean so that β_1 keeps this meaning. Because β is convex (Proposition 1), the linear term understates the response in the most rigid markets: at $\eta = 0$ the approximation gives 1.16 against an exact 1.40. If η_i varies widely, a quadratic term $\tilde{m}_i(\eta_i - \bar{\eta})^2$ with coefficient $\beta''(\bar{\eta})/2$ can be added.

For construction the response is $\eta\beta(\eta)$, whose derivative in η is

$$\frac{d[\eta\beta(\eta)]}{d\eta} = \frac{\varepsilon(1 + \kappa/\sigma) + \kappa s}{D(\eta)^2} > 0. \quad (22)$$

The same interaction should therefore enter with a negative sign for prices and a positive sign

for construction. Opposite signs in the two regressions are the signature of the mechanism.

Collecting the extensions, the estimating equation for market i in year t is

$$\Delta \ln Y_{it} = \alpha_i + \gamma_t + \beta_1 \tilde{m}_{it} + \beta_2 \tilde{m}_{it}(\eta_i - \bar{\eta}) + \beta_3 \tilde{m}_{it} RC_{it} + \beta_4 \tilde{T}_{it} + \delta RC_{it} + X'_{it} \pi + u_{it}, \quad (23)$$

where Y is, in turn, the house price, the rent (regulated and free), the housing stock, the native population or listings. α_i absorbs persistent amenities and level differences. γ_t absorbs the national user cost, the regulated reference index ρ and national policy. RC_{it} indicates rent regulation, with main effect δ capturing level shifts unrelated to inflows. X_{it} contains income, employment growth, native household formation and the share of tourist dwellings. Each coefficient maps to a structural expression:

$$\beta_1 = \beta(\bar{\eta}), \quad \beta_2 = \beta'(\bar{\eta}), \quad \beta_3^F = \frac{1}{(1 - \omega)(\eta + \varepsilon) - \lambda \eta_L \omega} - \frac{1}{\eta + \varepsilon}, \quad \beta_4 = \psi \beta(\bar{\eta}) \left(1 + \frac{\kappa}{\sigma}\right). \quad (24)$$

Recovering supply elasticities and the absorption index. Estimating (23) for prices market by market, or in groups of markets, gives $\hat{\beta}_i$. Estimating it for the housing stock gives $\hat{\theta}_i = \eta_i \hat{\beta}_i$. Their ratio recovers local supply elasticity, and the construction coefficient is itself the absorption index:

$$\hat{\eta}_i = \frac{\hat{\theta}_i}{\hat{\beta}_i}, \quad \widehat{HAI}_i = \hat{\theta}_i. \quad (25)$$

No province-level supply elasticities exist for Spain, so (25) is a contribution in its own right, and it allows a map of absorption capacity across Spanish markets. In practice, provincial coefficients will be noisy. The natural implementation estimates them for groups of provinces defined by predetermined geographic constraints, or shrinks them towards the pooled estimate.

6.2 Identification

Each regressor in (23) is endogenous in its own way and requires its own source of variation.

Inflows: a shift-share instrument. Immigrants choose markets with strong labour demand, which also raises prices, so OLS overstates β_1 . Immigrants also settle where earlier compatriots live (Card, 2001). With n indexing origin countries and settlement shares from the 2001 Census,

$$\lambda_{ni} = \frac{M_{n,i,2001}}{M_{n,2001}}, \quad Z_{it} = \frac{\sum_n \lambda_{ni} \Delta M_{n,t}^{(-i)}}{N_{i,t-1}}, \quad (26)$$

where $\Delta M_{n,t}^{(-i)}$ is the national change in residents born in country n , net of province i 's expected contribution, approximated by $\Delta M_{n,t}(1 - \lambda_{ni})$. Using country of birth rather than nationality avoids the mechanical fall in the foreign population when immigrants naturalise. The instrument covers 55 origin countries and seven regional residual groups. Shares come from the municipal register on 1 January 2001 for the first wave and 1 January 2011 for the second, the last settlement pattern before each wave; 1998 and 2001 shares are used as robustness checks. Spain's inflows are largely origin-driven: the collapse of Venezuela, outflows from Colombia and Peru, the 2022 temporary protection of Ukrainians. This supports

the exogeneity of the shifts (Borusyak et al., 2022). The first stage is

$$\tilde{m}_{it} = \pi_i + \tau_t + \pi_1 Z_{it} + \pi_2 Z_{it}(\eta_i - \bar{\eta}) + \xi_{it}, \quad (27)$$

with the interaction instrumented by $Z_{it}(\eta_i - \bar{\eta})$. Validity checks:

- Shift-share-robust inference (Adão et al., 2019): shocks are origin-by-year national changes, clustered by origin, with the null imposed (AKM0).
- Rotemberg weights to identify which nationalities drive the estimate, and robustness to excluding the dominant ones (Goldsmith-Pinkham et al., 2020).
- Pre-trends: regress 2008–2014 price changes on 2015–2026 instrument values.
- Alternative base years for the shares, and the lagged instrument to separate short- from long-run responses (Jaeger et al., 2018).
- First-stage strength reported throughout.

Supply constraints: geography. η_i must be predetermined. I construct a measure in the spirit of Saiz (2010): the share of land within 25 km of each provincial capital that is sea or has a slope above 15%. For each capital, 150 random points are drawn and their elevation and slope over 100 m are read from the 25-metre European digital elevation model (EU-DEM). The measure ranges from about 1% (Madrid, Sevilla, Salamanca) to over 85% (the two Canary Island provinces), with Gipuzkoa, Málaga, Bizkaia and Barcelona among the most constrained. Current construction outcomes cannot be used, since they respond to prices.

Supply constraints: planning. Topography captures physical constraints, but in Spain the binding constraint is often the classification of land for development. As a regulatory complement I use the Catastro's annual urban statistics, which report for each province the area of urban parcels, built and unbuilt. Unbuilt urban parcels are land that planning has already classified as urban but that is still vacant, the slack in the development pipeline. I measure it in 2014, before the second wave, as the vacant share of urban land; across the 46 provinces it averages 43% and ranges from 30% (the Balearic Islands) to 59% (Guadalajara). By 2026 the average had fallen to 34%. The measure covers 46 provinces, since the Basque Country and Navarre keep separate cadastres.

Rent regulation. Caps are declared where rents are already high, so RC_{it} is endogenous. With provincial rents available until 2024, the only usable variation is Catalonia: the regional cap of Law 11/2020, in force from September 2020 until it was annulled in March 2022, and the stressed-area caps under Law 12/2023 from March 2024. I set $RC_{it} = 1$ for the four Catalan provinces in 2021 and 2024 and estimate β_3 from the interaction with the instrumented inflow. With four treated provinces this test is underpowered. Municipal data and the later adoptions in the Basque Country, Navarre and Galicia, combined with a staggered difference-in-differences (Callaway and Sant'Anna, 2021) or a discontinuity at the Law 12/2023 eligibility thresholds, are the natural extension. INE's index by contract age, available from

2022, approximates the split between the regulated and free segments by existing and new contracts.

Remote work: exposure. The share of residents working from home is contaminated, because it counts residents whose employer is local. Madrid hosts about a quarter of Spain's remote workers against 16% of employment mainly because the jobs are there. I therefore use exposure, $\tilde{T}_{it} = \Delta T_t \cdot \theta_i$. θ_i is the share of dwellings that were second homes in 2001, a predetermined measure of a province's pull for non-local residents. ΔT_t is the national shift to remote work, concentrated in 2020–2021. The exposure is used as a reduced form and as an instrument for inflows of Spain-born adults, with a placebo in 2016–2017 and a province-specific trend in θ_i to absorb the secular growth of second-home markets.

6.3 Hypotheses

TABLE 5. Testable hypotheses

	Hypothesis	Test	Rejected if
H1	Population shocks raise rents and prices	$\beta_1 > 0$	$\beta_1 \leq 0$
H2	Cross-provincial supply constraints moderate incidence	$\beta_2 < 0$ for prices, > 0 for construction	Same sign in both
H3	The construction margin closed between waves	Smaller construction response in 2015–24 than in 2003–08	No difference between periods
H4	Regulation shifts rather than removes pressure	$\beta_3 < 0$ regulated rent, > 0 free rent, < 0 regulated stock	Free-rent $\beta_3 \leq 0$
H5	Remote workers push prices more than immigrants	$\beta_4 > \beta_1$, with $\tilde{T}$ and $\tilde{m}$ in the same units	$\beta_4 \leq \beta_1$
H6	Residents reallocate endogenously	Sign of the Spain-born adult response identifies $\alpha - \Phi$	Two-sided test
H7	Prices capitalise expectations	Price coefficient exceeds rent coefficient, $\chi > 0$	$\chi \leq 0$

H3 is the central test. Because the first-wave instrument fails the pre-trend test for prices and rents are not available before 2011, it is run on quantities: the dwelling stock, households and population. Price and rent responses are interpreted for the second wave only, separately, because the price response includes χ .

6.4 Data

The panel covers 50 provinces (Ceuta and Melilla are excluded) from 2003 to 2024. Population by place of birth on 1 January comes from INE's continuous population statistics (ECP), and the inflow $\tilde{m}_{it}$ is the change in the foreign-born population during year t over total population at its start. Settlement shares by country of birth come from the municipal register (Padrón) for 1998, 2001 and 2011, and national stocks by country of birth from the ECP. House prices are the Ministry of Housing's (MIVAU) quarterly appraised value of free-market housing per square metre, averaged by year; quarters that the Ministry suppresses for too few appraisals, which it reports as zero, are treated as missing, and years with fewer than three valid quarters are dropped. This affects seven small provinces in 2011–2012 and only the pooled 2003–2024 annual panel. Rents are INE's rental price index (IPVA), available by province from 2011 and

by contract age from 2022; it excludes the Basque Country and Navarre, whose tax records are separate. The dwelling stock and the number of principal dwellings, which equals the number of households, are MIVAU's annual estimates from 2001. All outcomes enter as annual log changes in percent. Appendix B documents the sources and the replication code.

7 Results

This section reports the estimates. Table 7 gives annual responses within provinces. Table 8 gives cumulative responses over each wave. Table 10 uses the absorption identity to show where each wave went. Table 12 tests the mechanism, and Table 6 assesses the instrument.

7.1 The instrument

The shift-share is a strong predictor of inflows. In the annual panel a one-point increase in the predicted inflow raises the actual inflow by 0.72 points over 2003–2024 ($F = 42$) and by 0.66 points over 2015–2024 with 2011 shares ($F = 21$). The 2001 shares predict the second wave poorly ($F = 8.5$), because the origin mix changed between waves. Romanians and Moroccans drove the first wave; Colombians, Moroccans and Venezuelans carry the largest Rotemberg weights in the second. The analysis therefore uses the last pre-wave settlement pattern for each wave.

Inference. With a shift-share instrument, provinces exposed to the same origin countries receive the same identifying shocks, so their residuals may be correlated regardless of geography, and province-clustered standard errors can be too small (Adão et al., 2019). I therefore also report shift-share-robust p -values. They treat the origin-by-year shocks as the source of randomness, cluster shocks by origin across years to allow for persistent origin flows, and impose the null when computing residuals (the AKM0 variant, which has better size when a few origins carry much of the variation). The shift-share-robust standard errors are generally of the same order as, and often smaller than, the province-clustered ones. All the main results survive. One secondary result weakens: the geography interaction falls from the 5% to the 10% level. Differences between the two waves are estimated jointly on the same 50 provinces with province-clustered errors; because the two waves' shocks share origin clusters, AKM0 p -values are reported for each wave separately but not for the difference. Province-clustered standard errors are reported in parentheses throughout, and AKM0 p -values in brackets.

For the second wave the instrument passes the pre-trend test (Table 6, panel b). Cumulative predicted inflows over 2015–2024 are unrelated to price growth over 2008–2014, but strongly related to price growth over 2014–2024. For the first wave the test fails. The predicted 2003–2008 inflow is strongly correlated with price growth over 1997–2002, *before* the inflow, and unrelated to price growth during it. Immigrants settled in markets whose booms were already under way. The paper therefore gives a causal interpretation to second-wave price and rent responses only, and reads first-wave quantity responses as descriptive of how that boom was accommodated.

7.2 Rents and prices

Rents rise with population inflows, gradually. Within provinces, the annual rent response to an inflow equal to 1% of the population is 0.35% (Table 7, column 1). Cumulated over the

TABLE 6. Instrument validity and robustness

<i>(a) First stage: annual inflow on instrument</i>		
2003–24, 2001 shares	0.72 (0.11)	$F = 42.3$
2003–08, 2001 shares	1.07 (0.19)	$F = 31.0$
2015–24, 2011 shares	0.66 (0.14)	$F = 21.1$
2015–24, 2001 shares	0.36 (0.12)	$F = 8.5$
<i>(b) Pre-trends: cumulative price change on the wave's cumulative instrument</i>		
	Before the wave	During the wave
Wave 1 (1997–2002 vs 2002–08)	2.31*** (0.58)	0.04 (0.51)
Wave 2 (2008–14 vs 2014–24)	–0.48 (0.35)	2.86*** (0.54)
Wave 2, 2001 shares	0.09 (0.38)	2.17*** (0.68)
<i>(c) Excluding the three origins with the largest Rotemberg weights</i>		
Wave 2, excluding Colombia, Morocco, Venezuela		
rents	0.19 (0.15)	$F = 41.9$
prices	1.47** (0.69)	$F = 40.8$
dwelling stock	0.22* (0.13)	$F = 45.2$
<i>(d) Pooled 2003–24 dwelling-stock response: alternative specifications</i>		
Region×year fixed effects	1.05*** (0.20)	$F = 36.8$
Clustered by region (17)	0.64*** (0.14)	$F = 30.6$
1998 shares	0.74*** (0.23)	$F = 17.8$
Inflow in t and $t - 1$	0.10 and 0.58**	sum 0.68

Notes: Panel (b) uses 46 provinces with price data from 1997 and robust standard errors. In wave 2 the instrument is unrelated to price growth before the wave and strongly related to it during the wave; in wave 1 it predicts price growth that preceded the inflow, so wave-1 price estimates are not given a causal interpretation. Rotemberg weights follow Goldsmith-Pinkham et al. (2020); the largest wave-2 weights are on Colombia, Morocco, Venezuela, and negative weights sum to -0.05. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

second wave, the response is 1.05% (s.e. = 0.21; Table 8). This is close to the model's calibrated $\beta(\bar{\eta}) = 0.82$ and to identified estimates of about 0.9% for US cities (Saiz, 2007) and 0.8% for Spanish provinces over 2001–2012 (Sanchis-Guarner, 2023). The cumulative price response reported below is likewise of the same order as their price estimates of about 3%. Figure 3 shows the reduced form behind it: provinces predicted to receive more immigrants saw larger rent increases.

Prices respond more than rents. The annual price response over 2015–2024 is 1.89% and the cumulative response 3.95% (s.e. = 1.01). Estimating both equations on the same sample, the price response exceeds the rent response by $\chi = 1.65$ (s.e. = 0.81, shift-share-robust $p = 0.002$; Table 12), which rejects the hypothesis that prices and rents move together (H7). In the framework of Section 3.6, part of the price response is capitalised expected growth. Rents therefore measure the fundamental incidence β , and the remainder of the price response is a capitalisation component that the model's static equilibrium does not contain.

7.3 Construction: the collapse of the supply response

The sharpest result concerns construction. Over 2003–2008 each point of cumulative inflow was accompanied by a 0.71% increase in the dwelling stock (s.e. = 0.20). Over 2015–2024 the response is –0.12% (s.e. = 0.12), statistically indistinguishable from zero. The difference, –0.82, is significant at the 1% level when the two waves are estimated jointly on the same provinces (Table 8, column 3), and each wave's estimate survives shift-share-robust inference. Treating

TABLE 7. Annual responses to a 1% population inflow

	Rents	House prices		Housing stock		Population	Spain-born
	2015–24	2015–24	2003–24	2015–24	2003–24	2015–24	2015–24
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IV	0.35*	1.89**	1.15*	0.24	0.64***	0.78***	0.27***
	(0.19)	(0.88)	(0.69)	(0.15)	(0.16)	(0.07)	(0.06)
OLS	0.59***	1.37***	1.23***	−0.04	0.38***	1.15***	0.14***
	(0.12)	(0.41)	(0.34)	(0.05)	(0.08)	(0.04)	(0.03)
AKM0 <i>p</i> -value	[0.036]	[0.005]	[0.124]	[0.040]	[0.049]	[<0.001]	[0.001]
First-stage <i>F</i>	19.7	19.2	36.4	21.1	42.3	21.1	21.1
Observations	460	460	1,001	500	1,100	500	500

Notes: Province-year panel, 50 provinces. Each coefficient is the response, in percent, of the annual log change in the outcome to a foreign-born inflow equal to 1% of the province's population. The inflow is instrumented with the leave-one-out shift-share of equation (26), using 2011 settlement shares for 2015–2024 and 2001 shares for 2003–2024. Province and year fixed effects; standard errors clustered by province in parentheses. AKM0 *p*-values in brackets are shift-share-robust (Adão et al., 2019), treating origin-country shocks as the source of randomness, clustering shocks by origin and imposing the null. Rents: INE rental price index. Prices: MIVAU appraised value of free-market housing. Stock: MIVAU dwelling stock. Spain-born: change in Spain-born residents aged 20–64 over initial population. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

the two cross-sections as independent, as an earlier version did, overstates the standard error of the difference, because the province-level errors of the two waves are positively correlated. Figure 4 shows the change: in the first wave the provinces predicted to receive more immigrants built more, and in the second they did not. In the language of Definition 1, the Housing Absorption Index fell from about 0.7, close to the model's prediction of 0.68 for $\eta = 2$, to about zero.

Two caveats apply. The stock series is a model-based estimate published by the Ministry and may smooth local variation. And because the first-wave price response cannot be given a causal interpretation, a first-wave supply elasticity cannot be recovered as θ/β . For the second wave, the ratio of the construction to the rent response gives $\hat{\eta} = -0.11$, with a 90% interval of $[-0.31, 0.10]$. Even the upper end of this interval is below the Banco de España long-run estimate of 0.45 used in the calibration. In the short and medium run that matters for a decade-long wave, Spanish housing supply has been close to perfectly inelastic.

7.4 Why the construction margin closed: the legacy of the bust

Calling the collapse a fall in η names it; it does not explain it. One candidate is specific to Spain. The 2008 bust left a large stock of finished but unsold new homes, about 513,000 at the end of 2015 by the Ministry's estimate, very unevenly distributed: more than 5% of the dwelling stock in Castellón, Toledo and Almería, below 1.2% in Bizkaia, Huelva, Guadalajara and Málaga. If that overhang was a buffer, inflows should have drawn it down and building should have restarted only once it was exhausted. If instead it marks where the bust destroyed developers and lenders, building should stay switched off where it is large even when demand arrives.

Table 9 separates the two readings with direct measures of construction: the Ministry's administrative counts of starts and completions, which are flows rather than the model-based stock estimate. Over the whole wave, completions respond weakly to inflows (0.09 per

TABLE 8. Cumulative responses by wave: long differences

	Wave 1 2003–2008 (1)	Wave 2 2015–2024 (2)	Difference (2) – (1) (3)
Rents	—	1.05*** (0.21) [<0.001]	—
House prices	–0.64 (0.89) [0.105]	3.95*** (1.01) [0.003]	4.59*** (1.16)
Dwelling stock	0.71*** (0.20) [0.029]	–0.12 (0.12) [0.066]	–0.82*** (0.24)
Principal dwellings (households)	1.65*** (0.17) [0.002]	0.18 (0.29) [0.459]	–1.47*** (0.32)
Population	1.61*** (0.10) [0.006]	2.00*** (0.18) [<0.001]	0.40*** (0.13)
Spain-born, 20–64	0.24*** (0.08) [0.030]	0.63*** (0.16) [0.004]	0.39*** (0.12)
First-stage <i>F</i>	70.5	21.8	
Provinces	50	50	

Notes: Cross-sections of 50 provinces. The cumulative log change in each outcome over the wave (percent) is regressed on the cumulative inflow over the wave, instrumented with the cumulative shift-share (2001 shares for wave 1, 2011 shares for wave 2). Heteroskedasticity-robust standard errors. Brackets: shift-share-robust AKM0 *p*-values (Adão et al., 2019). Column 3 estimates both waves jointly on the same 50 provinces (wave-specific intercepts and slopes) with standard errors clustered by province, so the covariance between the two cross-sections is taken into account; a joint province bootstrap gives the same conclusions. AKM0 *p*-values are not reported for the difference because the two waves' shocks share origin clusters. Rents are available only from 2011. **p* < 0.1, ***p* < 0.05, ****p* < 0.01.

unit, $p = 0.10$). The response is concentrated where little unsold housing was left: 0.22 for completions and 0.33 for starts in provinces below the median overhang, against 0.04 and 0.07 above it. The interaction is negative and significant at 5% for completions (–0.15 per standard deviation of overhang) and at 10% for starts. The buffer reading fails: the unsold stock did not fall faster where more immigrants arrived (0.01, s.e. 0.04). The Banco de España notes that this stock has barely moved since 2018 despite strong demand, which suggests it does not match what households want (Banco de España, 2026, p. 145). Prices rose more in response to inflows where the overhang was larger (2.40 per standard deviation, $p = 0.08$), while rents did not, consistent with expectations recovering fastest where the bust had been deepest.

The evidence therefore points to a legacy rather than a buffer: where the bust was worst, the building response remained switched off, and the homes it left behind were in the wrong places to absorb the new demand. Two caveats apply. The overhang is measured at the end of 2015, one year into the wave, and the Ministry measures it as the increase over 2004, so four provinces with old stock record zero. And the overhang is correlated with everything else the

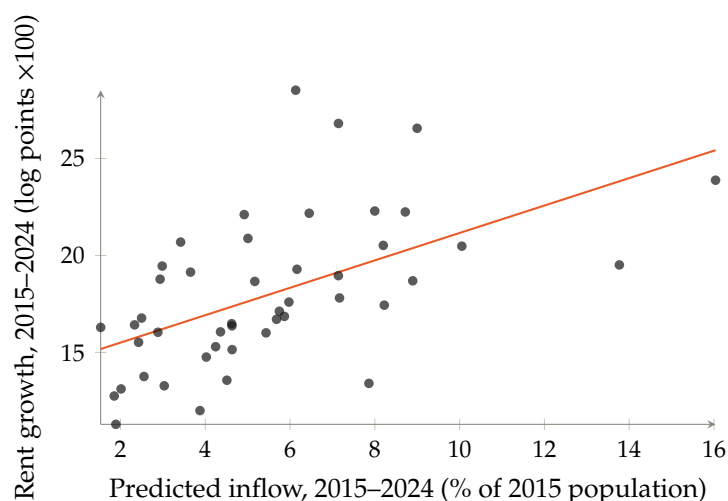


FIGURE 3. Reduced form: predicted inflows and rent growth across provinces, second wave. Each point is a province (46 provinces with rent data; the rental index excludes the Basque Country and Navarre). The line is the least-squares fit.

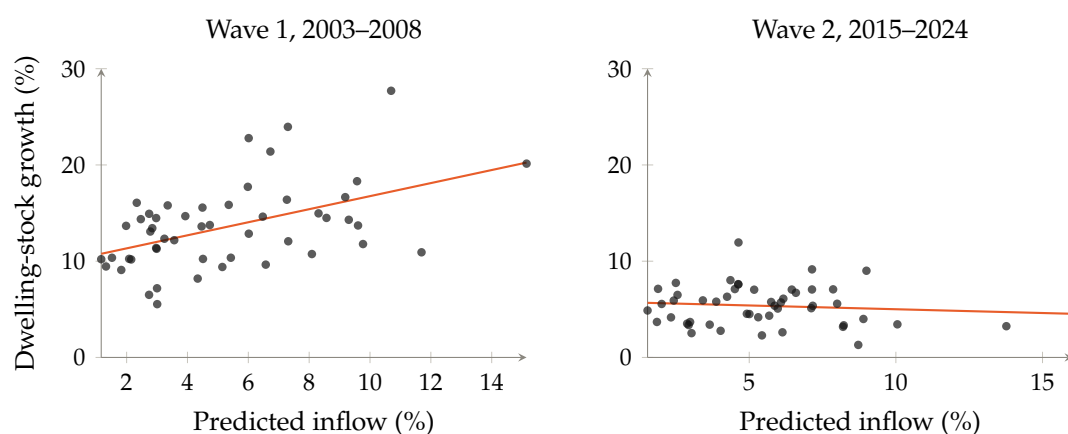


FIGURE 4. Reduced form: predicted inflows and growth of the dwelling stock across provinces. In the first wave, provinces predicted to receive more immigrants expanded their housing stock more; in the second they did not.

bust did to a province, including credit losses and land write-downs, so the table identifies where construction survived, not the single channel that switched it off.

7.5 Where the second wave went

If construction did not absorb the second wave, something else did. Table 10 and Figure 5 apply the absorption identity to the data. Population growth is split into new construction (the stock response), conversion of existing vacant or secondary dwellings into main residences (the response of principal dwellings minus the stock response), more residents per dwelling (the population response minus the principal-dwelling response), and the net movement of other residents.

The contrast is stark. In the first wave, receiving provinces added households roughly one for one with population (1.65 per unit of inflow). The households were housed in new construction and, even more, in converted second homes and vacant dwellings. Crowding

TABLE 9. The legacy of the bust: wave-2 responses by the stock of unsold new housing

	Baseline	Interaction		Split at the median	
	Inflow (1)	Inflow (2)	× overhang (3)	Low (4)	High (5)
Dwelling stock (estimate)	−0.12 (0.12)	−0.12 (0.13)	−0.15 (0.12)	−0.08 (0.18)	−0.12 (0.17)
Completions	0.09 (0.06)	0.11** (0.06)	−0.15** (0.07)	0.22** (0.09)	0.04 (0.06)
Starts	0.15* (0.09)	0.17** (0.09)	−0.21* (0.11)	0.33** (0.13)	0.07 (0.09)
Unsold stock absorbed	0.01 (0.04)	−0.02 (0.05)	−0.05 (0.06)		
House prices	3.95*** (1.01)	4.54*** (1.24)	2.40* (1.37)		
Rents	1.05*** (0.21)	1.10*** (0.25)	0.10 (0.27)		
First-stage F	21.8		29.4	57.8	16.9
Provinces	50		50	25	25

Notes: Wave-2 long differences, 2015–2024, instrumented with the cumulative shift-share (2011 shares). Overhang: MIVAU’s estimate of unsold new dwellings at the end of 2015 as a share of the dwelling stock (mean 2.0%, s.d. 1.3%), standardised in column 3; column 2–3 regressions control for its main effect. Completions and starts are MIVAU’s administrative counts (free-market and protected), cumulated over 2015–2024, as a percentage of the 2014 dwelling stock. Unsold stock absorbed is the fall in the unsold stock between 2015 and 2024, as a percentage of the 2014 dwelling stock. Rents: 46 provinces. MIVAU’s unsold stock is measured as the increase over 1 January 2004, so it is zero in Badajoz, Cáceres, Cantabria and Navarre. Heteroskedasticity-robust standard errors. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

played no role. In the second wave, households barely increased (0.18, not significant) and crowding absorbed the shock, with a share of 1.82 per unit of inflow. The annual fixed-effects panel gives the same picture, with a crowding share of about one in the second wave and a household response indistinguishable from zero. In the model’s terms, today’s shock is absorbed through the ε margin, households consuming less space, rather than through η .

7.6 Crowding measured directly

The crowding share in Table 10 is a residual: population growth minus the Ministry’s estimate of principal dwellings. If that estimate misses household formation, the residual overstates crowding. The population register offers a direct measure. INE’s Atlas of household income reports, for every census section, the number of people registered in each dwelling. Rebuilding provincial households from about 36,000 sections gives an annual series of persons per household from 2016 to 2024.

Table 11 instruments its change with the same shift-share. Each 1% of population arriving raises persons per household by 0.84% over the wave (s.e. 0.05), and by 0.50% within the year in the annual panel. Nationally, household size fell over the period, so the inflow slowed a long decline in household size rather than reversing it. The direct estimate confirms the sign, timing and significance of the residual, but it is smaller: over the same window, population minus principal dwellings gives 1.39. The register records more household formation than

TABLE 10. Where the shock went: absorption accounting by wave

Per unit of inflow	Wave 1, 2003–2008		Wave 2, 2015–2024	
	Estimate	90% interval	Estimate	90% interval
New construction (θ , the HAI)	0.71	[0.35, 1.04]	−0.12	[−0.29, 0.11]
Conversion of existing stock to main residence	0.94	[0.62, 1.29]	0.30	[−0.20, 0.81]
More residents per dwelling	−0.04	[−0.26, 0.17]	1.82	[1.29, 2.34]
Net relocation of other residents ($1 - A$)	−0.61	[−0.79, −0.45]	−1.00	[−1.33, −0.71]
Memo: population response A	1.61	[1.45, 1.79]	2.00	[1.71, 2.33]
Memo: household (principal dwelling) response	1.65	[1.38, 1.96]	0.18	[−0.26, 0.69]
Memo: Spain-born adults	0.24	[0.11, 0.39]	0.63	[0.36, 0.92]
Memo: rent response β	—		1.05	[0.71, 1.40]
Implied supply elasticity θ/β	—		−0.11	[−0.31, 0.10]

Notes: Long-difference IV responses per unit of cumulative inflow. The first four rows sum to one by construction: construction is the dwelling-stock response; conversion is the principal-dwelling response minus the stock response; crowding is the population response minus the principal-dwelling response; relocation is one minus the population response, so a negative value means the inflow attracted additional residents. Intervals from 1,000 province bootstrap replications.

the Ministry's series, 0.84 against 0.53 per unit, and the gap is the conversion and sharing of dwellings that the stock estimate does not see. On either measure, crowding is the largest single margin of the current wave: at least 0.84 of the 1.92 units by which population responds.

7.7 Population reallocation

The model's relocation margin assumes that inflows push some existing residents out. The data reject this. Within provinces, each point of inflow is associated with a 0.27-point *increase* in Spain-born adults over 2015–2024 (Table 7, column 7), and the cumulative estimates are larger. Natives moved towards immigrant-receiving provinces, as Sanchis-Guarner (2023) also found; her estimate of about 35 natives per 100 immigrants over 2001–2012 is of the same order as the first-wave estimate here, 0.24. In terms of Proposition 7, the amenity or agglomeration response exceeds the real-income loss, $a > \Phi$. Relocation therefore amplifies rather than absorbs the shock, and the price response is correspondingly larger.

7.8 Heterogeneity, regulation and remote work

Geography (H2). Over the second wave, the price response is larger where more land around the provincial capital is unavailable. A one-standard-deviation increase in unavailable land raises the cumulative price response by 2.32 points (s.e. = 0.95). As noted above, the coefficient is significant at 5% with clustered errors but only at 10% with shift-share-robust inference ($p = 0.07$). The rent interaction has the predicted sign ($p = 0.09$), and the stock interaction has the predicted sign but is imprecise. In the annual panel the price interaction is close to zero, and the stock interaction has the wrong sign (0.10, $p = 0.04$) and vanishes once region-by-year effects are included. Topography within 25 km is an imperfect proxy for supply constraints in Spain, where the binding constraint is often the classification of land for development rather than slope or water. The regulatory measure does not help. Interacting the inflow with the scarcity of vacant urban land in 2014 yields price and rent interactions that are small, insignificant and of the wrong sign, and a stock interaction of the wrong sign that is significant

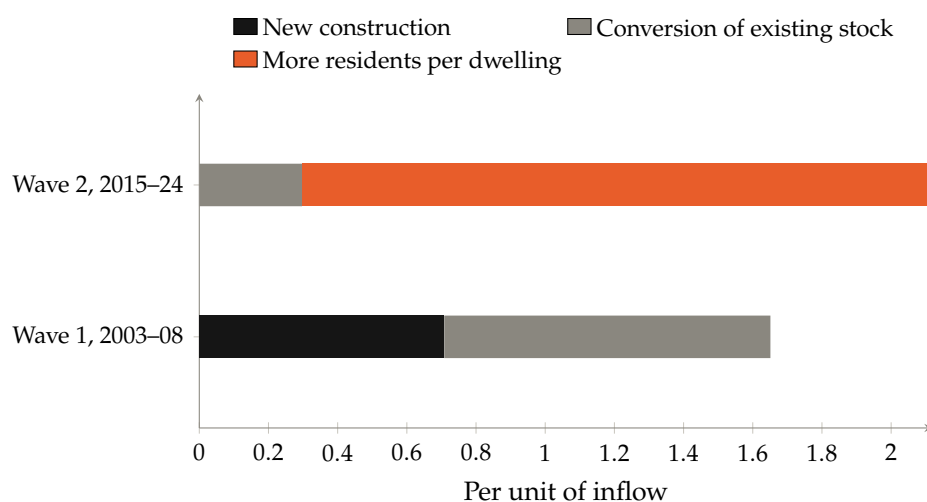


FIGURE 5. Absorption accounting. Shares of each unit of inflow absorbed by new construction, conversion of existing dwellings to main residences, and more residents per dwelling (long-difference IV estimates, Table 10). Point estimates that are negative and statistically indistinguishable from zero (construction in wave 2, crowding in wave 1) are drawn as zero. Not shown: net relocation of other residents, which is negative in both waves because inflows attracted additional residents rather than displacing them.

under shift-share-robust inference ($p = 0.04$; Table 12, rows H2'). The likely reason is that, after the 2008 crash, vacant urban land was concentrated in provinces where the boom had planned more development than demand later justified, such as Guadalajara, Toledo and Murcia. The measure partly records past over-planning in low-demand markets rather than slack where immigrants arrive, and within provinces, vacant land is often far from where demand concentrates. With provincial data, cross-sectional heterogeneity in supply constraints is therefore only weakly identified. The time-series contrast between the two waves is much sharper.

Rent regulation (H4). The evidence is limited by design: four treated provinces and, for the split by contract age, a single treated year. Within those limits, the response of new-contract rents to inflows is higher in regulated Catalan provinces, while the response of existing-contract rents is not. This is the pattern Proposition 5 predicts if new contracts behave like the free segment. It should be read as suggestive.

Remote work (H5). Exposure to remote work, measured by the 2001 share of second homes, strongly predicts inflows of Spain-born adults in 2020–2021, with no effect in a 2016–2017 placebo. The associated rent response is positive but imprecise ($p = 0.12$), and there is no detectable price response. Remote work clearly relocated people; at the provincial level and annual frequency its effect on housing costs cannot be separated from zero.

7.9 Model and data

The estimates confirm the model's central prediction and reject two of its assumptions. As predicted, the construction share of absorption collapsed between waves while the rent and price responses of the current wave are large. But the relocation margin works in the opposite

TABLE 11. Crowding measured directly: household size in the population register

	Long difference 2016–2024	Annual panel 2016–2023
Persons per household (register)	0.84*** (0.05)	0.50*** (0.09)
Households (register)	0.84*** (0.15)	
<i>Same window, accounting measures</i>		
Population (ECP)	1.92*** (0.16)	
Principal dwellings (MIVAU)	0.53** (0.27)	
Implied crowding (difference)	1.39	
First-stage F	28.7	34.3
Observations	50	400

Notes: Persons per household from INE's Atlas de Distribución de Renta de los Hogares, which counts the residents registered at each dwelling in the population register. INE publishes the indicator by census section rounded to one decimal; provincial households are rebuilt as the sum over about 36,000 sections of population divided by household size. Atlas year t refers to the register of 1 January $t + 1$. Outcomes in log points $\times 100$ per unit of instrumented inflow (cumulative over 2016–2023 in column 1). Column 1: robust standard errors; column 2: province and year fixed effects, standard errors clustered by province. National persons per household fell from 2.576 to 2.518 over the window. $*p < 0.1$, $**p < 0.05$, $***p < 0.01$.

direction to the one assumed, and the margin that absorbed today's shock is crowding rather than construction.

The benchmark calibration of Section 5 assumes residents move out ($a = 0$). Table 13 replaces that assumption with the estimated sign. Matching the amenity response a of Proposition 7 to the Spain-born adult response raises the model's rent response from 0.82 to 1.71; matching it to the full population response raises it to 2.11. With inward reallocation and the standard demand elasticity $\varepsilon = 0.5$, the model therefore over-predicts the rent response of about 1.05 instead of under-predicting it. The only way to reconcile the model with all three moments, rents, construction and population, is a much larger ε : about 1.9, four times the standard value. That is the crowding result in the model's own language. When supply cannot respond and arrivals pull natives in rather than pushing them out, the market clears because households accept less space at modest rent increases.

7.10 Who pays

The title of the paper promises incidence in the distributional sense as well. Table 14 combines the estimated responses with the tenure structure. A rent response of about 1% per 1% of population falls on market renters, who make up 31% of people in the bottom income decile and 8% in the top. Because renters in the bottom deciles also spend a larger share of income on rent, the average cost of a 1% inflow is 13 basis points of income in the bottom decile and 2 in the top. By age, half of households headed by someone under 30 and a third of those

TABLE 12. Tests of the mechanism

	Coefficient	s.e.	AKM0 p	Predicted sign
<i>H2. Inflow $\times$ unavailable land (per s.d.)</i>				
Prices, wave 2 long difference	2.32**	(0.95)	[0.070]	+
Rents, wave 2 long difference	0.28	(0.17)	[0.092]	+
Dwelling stock, wave 2 long difference	-0.16	(0.12)	[0.223]	-
Prices, annual panel 2003–24	-0.10	(0.27)	—	+
Dwelling stock, annual panel 2003–24	0.10**	(0.05)	—	-
<i>H2'. Inflow $\times$ scarcity of vacant urban land, 2014 (per s.d.)</i>				
Prices, wave 2 long difference	-0.89	(1.47)	[0.404]	+
Rents, wave 2 long difference	-0.21	(0.26)	[0.166]	+
Dwelling stock, wave 2 long difference	0.31	(0.21)	[0.035]	-
<i>H4. Inflow $\times$ rent regulation (Catalonia)</i>				
Rents, all contracts (2015–24)	-0.22	(0.29)	—	≈ 0
Rents, new contracts (2022–24)	2.10***	(0.61)	—	+
Rents, existing contracts (2022–24)	0.36	(0.31)	—	-
<i>H5. Remote-work exposure: second-home share $\times$ 2020–21</i>				
Spain-born adult inflow	0.11***	(0.02)	—	+
Placebo: same exposure $\times$ 2016–17	0.00	(0.01)	—	0
Rents	0.11	(0.07)	—	+
Prices	-0.11	(0.21)	—	+
<i>H7. Capitalisation, 2015–24 annual panel</i>				
Rent response β	0.34*	(0.20)	—	
Price minus rent response χ	1.65**	(0.81)	[0.002]	+

Notes: Each row is from a separate regression. H2: inflow interacted with the standardised share of unavailable land within 25 km of the provincial capital, instrumented with the shift-share interacted with the same measure; long differences control for the main effect of unavailable land. H2': inflow interacted with minus the standardised share of urban-classified land that was vacant in 2014 (Catastro), 46 provinces; the Basque Country and Navarre keep separate cadastres. H4: four treated provinces; regulated years are 2021 (Catalan Law 11/2020) and 2024 (stressed-area caps under Law 12/2023); new- and existing-contract indices are available only for 2022–2024, so these rows rest on a single treated year and standard errors are unreliable. H5: reduced form controlling for the inflow and a province-specific trend in exposure. H7: price and rent equations stacked on the same sample. Province and year fixed effects and province-clustered standard errors unless stated. AKM0: shift-share-robust p -value (Adão et al., 2019), reported where the design is a shift-share IV. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

aged 30–44 rent at market prices, against 5% of those over 65, 82% of whom own outright. The 4% price response is a transfer in the opposite direction: an unrealised gain concentrated among older and richer households. The crowding margin adds a non-monetary cost on the same side of the ledger, since it falls on those searching for housing. These are first-order calculations that ignore changes in tenure and location, but the direction is unambiguous: the current wave's housing incidence is regressive in income and runs from young to old.

TABLE 13. The model recalibrated with the estimated direction of reallocation

	Amenity response a	Rent β	New housing	Less space per household	Population $\hat{N}/\tilde{m}$
Benchmark, $a = 0$, $\eta = 0.45$, $\varepsilon = 0.5$	0.00	0.82	0.37	0.41	0.78
a matched to Spain-born adults	2.18	1.71	0.77	0.86	1.63
a matched to population	3.14	2.11	0.95	1.05	2.00
Also $\eta = 0$, $\varepsilon = 1.9$ implied	2.82	1.05	0.00	2.00	2.00
Estimates, wave 2		1.05	-0.12	2.12	2.00

Notes: Proposition 7 with $\sigma = 4$, $s = 0.3$, $\kappa = 0.5$. The amenity response a is set so that the model's population response equals the estimated one: one plus the Spain-born adult response (0.63) in the second row, the full population response (2.00) in the third. The last model row also sets supply elasticity to its estimate (the construction response is not distinguishable from zero) and backs out ε from market clearing, $\hat{N} = (\eta + \varepsilon)\hat{p}$; with three parameters chosen to match three moments, its rent response matches the estimate by construction, so that row is a consistency check, not a test. "Less space per household" in the estimates row is conversion plus crowding (Table 10).

TABLE 14. Who pays and who gains: tenure, income and age

(a) Persons by income decile, 2024				
Decile	Market renters (%)	Owners (%)	Rent / income of tenants (%)	Cost of a 1% inflow (basis points of income)
1	31	50	39	13
2	26	61	39	11
3	21	69	21	5
4	21	69	21	5
5	21	70	21	5
6	13	80	21	3
7	14	81	21	3
8	12	83	21	3
9	9	86	21	2
10	8	88	21	2
(b) Households by age of the reference person, 2024				
	Market renters (%)	Owners (%)	Outright owners (%)	
16–29	51	27	13	
30–44	33	53	16	
45–64	15	76	43	
65 and over	5	89	82	

Notes: Panel (a): INE, Encuesta de Condiciones de Vida (table 59953, distribution of each tenure group across income deciles per consumption unit), converted to shares within each decile with Eurostat's national tenure shares (ilc_lvho02). Rent over disposable income of tenants is Eurostat's ilc_mdcd02, 38.8% below 60% of the median income and 20.6% above it; deciles 1–2 are assigned the first value. The last column is the cumulative rent response to a 1% inflow (1.05%, Table 10) times the rent burden times the share of market renters, in basis points of the decile's income: an average across renters and non-renters, so the cost to a renting household is 41 basis points in the bottom deciles and 22 above. Panel (b): INE, ECV table 9994. Every owner gains from the 3.9% cumulative price response; the gain is realised only on sale or as collateral.

8 Which margin should absorb the next shock?

The framework turns a question usually posed as “how do we reduce demand?” into a different one: *which margin do we want to absorb the next unit of population growth?* The estimates give the question urgency. In the current wave the construction margin is closed and crowding has taken its place. Table 15 subjects the same potential shock, a 1% inflow, to alternative policies under the Spanish calibration.

Public housing. To add public construction, let the authority build a fraction g of the shock directly, so that supply becomes $\hat{H}^s = \eta\hat{p} + g\tilde{m}$. Solving as before (Appendix A),

$$\hat{N} = \frac{1 + \kappa s g / (\eta + \varepsilon)}{1 + \kappa \Phi} \tilde{m}, \quad \hat{p} = \frac{\hat{N} - g\tilde{m}}{\eta + \varepsilon}. \quad (28)$$

Public building lowers the price response, but it partly crowds out private construction because it lowers the price signal that private supply responds to. With $g = 0.25$, private construction falls from 0.37 to 0.27, a crowding-out of about 42%.

TABLE 15. The same 1% population shock under alternative policies

Scenario	Price response	Private construction	Public housing	Population absorbed	Residents relocating
Baseline ($\eta = 0.45$)	0.82	0.37	—	0.78	0.22
Higher supply elasticity ($\eta = 1$)	0.54	0.54	—	0.82	0.18
Half the inflow ($\tilde{m} = 0.5$)	0.41	0.18	—	0.39	0.11
Public housing ($g = 0.25$)	0.59	0.27	0.25	0.81	0.19
Same shock as remote workers ($\psi = 1.2$)	1.11	0.50	—	0.85	0.15

Notes: Responses in percent to a potential shock of 1% of the population, except in the half-inflow scenario. Calibration with $\varepsilon = 0.5$, $\sigma = 4$, $s = 0.3$, $\kappa = 0.5$. Rent regulation is treated separately in Table 18, because it splits the market into two segments with different prices.

Four lessons follow.

1. *Raising supply elasticity is the only policy that lowers the price response while raising both private construction and population absorption.* Public housing also raises total construction and absorption, but it does so partly by displacing private building (lesson 3). Raising mean elasticity from 0.45 to 1 cuts the price response by a third, from 0.82 to 0.54, and lowers the incidence of every future shock, not just the current one. Since the estimated short-run elasticity is close to zero rather than 0.45, the potential gain is larger than the calibration suggests.
2. *Reducing the inflow lowers prices one-for-one with population.* Because the model is linear in $\tilde{m}$, halving the inflow halves the price response, but it also halves the population absorbed. It lowers prices by forgoing the population growth itself, not by absorbing it better.
3. *Public housing works, at a discount.* It lowers prices and raises population absorption, but part of it displaces private construction that would otherwise have occurred.
4. *Rent regulation changes who bears the shock, not its size.* At best ($\lambda = 0$) it shifts the incidence

from regulated tenants to searchers in the free segment. At worst ($\lambda > 0$) it raises the average rent and shrinks the regulated stock.

The overhang evidence of Section 7.4 adds a fifth lesson. *A stock of empty homes is not the same as supply.* Spain carried about half a million unsold new homes through the current wave, and inflows did not draw them down, because they were not where the new demand arrived. Counting vacant or unsold dwellings overstates the capacity of a market to absorb a shock; what matters is the elasticity of supply where people want to live.

Remote work is not a policy lever in the same sense, but the last row shows why its geography matters. Per head, it raises local prices about a third more than immigration, and it does so where amenities rather than jobs are located.

9 Conclusion

A population shock is never simply “absorbed by the housing market”. It is absorbed by new construction, by conversion of the existing stock, by households consuming less space and by the movement of other residents, and prices move until these margins exhaust it. This paper has shown that the decomposition is exact in a standard spatial-equilibrium model, and has measured each margin for Spain’s two immigration waves.

In 2003–2008 receiving provinces built and converted housing roughly in step with their population. Since 2015 the construction margin has been closed. Starts and completions still respond to inflows where the 2008 bust left little unsold housing, and not where it left most; the unsold homes themselves were not absorbed by the new demand. The current wave has instead been absorbed by squeezing: the population register records more people per dwelling in the provinces that received more immigrants. Each 1% of population arriving raises rents by about 1% and prices by about 4% cumulatively. Natives do not leave receiving provinces; they move towards them, which reinforces the pressure. The rent burden falls mainly on low-income households and on the young, the price gain on older owners.

The broader point is general. The same population shock does not have the same incidence everywhere or at every time, because the margin that absorbs it depends on how readily each margin can move. When the construction margin closes, growth is accommodated by crowding rather than by building, and the cost falls on whoever is searching for housing.

Limitations. The first-wave instrument fails the pre-trend test, so first-wave price responses are not interpreted causally, and the comparison of construction responses between waves is descriptive for the first wave. The dwelling-stock and household series are the Ministry’s model-based estimates; the direct measures of construction (starts and completions) and of crowding (register household size) are available only for the second wave. The paper identifies the collapse of the construction response, not its cause: neither topography nor vacant urban land predicts provincial differences, and the unsold-stock evidence is consistent with a legacy of the bust but is correlated with everything else the bust did. Provinces are large units and within-province spillovers are not captured. Rent-regulation and remote-work effects rest on few treated units or years. The distributional calculation is first order and uses national tenure shares.

Next steps. Three extensions would sharpen the cause of the collapse. A planning measure built from land classification in the Sistema de Información Urbana (urban, developable and non-developable land by municipality) or from the lag between building visas and municipal licences would give the first province-level supply constraint for Spain built from planning rather than slope. Developer and lender balance sheets by province would separate the credit channel from the overhang. Municipal data would capture spillovers within provinces. The provincial panel, the shift-share instrument and the code are released with the paper so that others can extend them.

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A Proofs and derivations

Throughout, $D(\eta) = (\eta + \varepsilon)(1 + \kappa/\sigma) + \kappa s$ and $\Phi(\eta) = 1/\sigma + s/(\eta + \varepsilon)$, so that $D = (\eta + \varepsilon)(1 + \kappa\Phi)$.

Equivalence of the two forms of β . $(\eta + \varepsilon)(1 + \kappa\Phi) = (\eta + \varepsilon) + \kappa(\eta + \varepsilon)/\sigma + \kappa s$, which is $D(\eta)$.

Proposition 1. D is linear in η with $D' = 1 + \kappa/\sigma > 0$, so $\beta' = -D'/D^2 < 0$ and $\beta'' = 2D'/D^3 > 0$. In κ , $\partial D/\partial \kappa = (\eta + \varepsilon)/\sigma + s > 0$, so β is decreasing in κ . Since D is increasing in both η and κ , β is maximised at $\eta = \kappa = 0$, where $D = \varepsilon$ and $\beta = 1/\varepsilon$.

Proposition 2. From (6), $(\eta + \varepsilon)\hat{p} = \hat{N}$, so $\eta\beta + \varepsilon\beta = \hat{N}/\tilde{m} = 1/(1 + \kappa\Phi)$. Residents relocating per unit of shock are $1 - \hat{N}/\tilde{m} = \kappa\Phi/(1 + \kappa\Phi)$. Adding the two gives one. For monotonicity, $d(\eta\beta)/d\eta = \beta + \eta\beta' = [D - \eta(1 + \kappa/\sigma)]/D^2 = [\varepsilon(1 + \kappa/\sigma) + \kappa s]/D^2 > 0$. $d(\varepsilon\beta)/d\eta = \varepsilon\beta' < 0$. $\Phi'(\eta) = -s/(\eta + \varepsilon)^2 < 0$, and $x/(1 + x)$ is increasing in x , so the relocation share is decreasing in η for $\kappa > 0$.

Proposition 3. $A = 1/(1 + \kappa\Phi)$. Then $\partial A/\partial \eta = -\kappa\Phi'/(1 + \kappa\Phi)^2 = \kappa s/[(\eta + \varepsilon)^2(1 + \kappa\Phi)^2] > 0$ for $\kappa > 0$, and $\partial A/\partial \kappa = -\Phi/(1 + \kappa\Phi)^2 < 0$.

Proposition 4. Write $D_\kappa = \partial D/\partial \kappa = (\eta + \varepsilon)/\sigma + s$. Differentiating $\beta' = -(1 + \kappa/\sigma)/D^2$ with respect to κ :

$$\frac{\partial \beta'}{\partial \kappa} = \frac{2(1 + \kappa/\sigma)D_\kappa - D/\sigma}{D^3}.$$

The numerator equals

$$2\left(1 + \frac{\kappa}{\sigma}\right)\left(\frac{\eta + \varepsilon}{\sigma} + s\right) - \frac{1}{\sigma}\left[(\eta + \varepsilon)\left(1 + \frac{\kappa}{\sigma}\right) + \kappa s\right] = \left(1 + \frac{\kappa}{\sigma}\right)\frac{\eta + \varepsilon}{\sigma} + 2s + \frac{\kappa s}{\sigma} > 0.$$

Since $\beta' < 0$, a positive derivative means $|\beta'|$ falls as κ rises.

Proposition 5. From (17), the free rent exceeds $1/(\eta + \varepsilon)$ whenever $\omega > 0$, since $(1 - \omega)(\eta + \varepsilon) - \lambda\eta_L\omega < \eta + \varepsilon$. The regulated stock responds by $-\eta_L\hat{r}_F < 0$. The regulated rent responds by zero, so the stock-weighted average is $(1 - \omega)\hat{r}_F$. With $\lambda = 0$ this equals $(1 - \omega)\tilde{m}/[(1 - \omega)(\eta + \varepsilon)] = \tilde{m}/(\eta + \varepsilon)$. The denominator of $\hat{r}_F$ is strictly decreasing in λ , so the average exceeds the benchmark for any $\lambda > 0$ satisfying the existence condition.

Proposition 6. With remote arrivals $\tilde{T}$, labour demand is $\hat{w} = -(\hat{N} - \tilde{T})/\sigma$, population is $\hat{N} = \tilde{m} + \tilde{T} + \kappa(\hat{w} - s\hat{p})$, and clearing gives $\hat{p} = [\hat{N} + (\psi - 1)\tilde{T}]/(\eta + \varepsilon)$. Substituting,

$$\hat{N}(1 + \kappa\Phi) = \tilde{m} + \tilde{T}\left(1 + \frac{\kappa}{\sigma} - \frac{\kappa s(\psi - 1)}{\eta + \varepsilon}\right).$$

The coefficient on $\tilde{T}$ in $\hat{p}$ is therefore

$$\frac{1}{D}\left[1 + \frac{\kappa}{\sigma} - \frac{\kappa s(\psi - 1)}{\eta + \varepsilon} + (\psi - 1)(1 + \kappa\Phi)\right] = \frac{\psi(1 + \kappa/\sigma)}{D},$$

using $(\psi - 1)(1 + \kappa\Phi) = (\psi - 1)(1 + \kappa/\sigma) + (\psi - 1)\kappa s/(\eta + \varepsilon)$. With $\psi = 1$, $\beta_4 = \beta(1 + \kappa/\sigma)$.

Proposition 7. With $\hat{N} = \tilde{m} + \kappa(\hat{w} - s\hat{p} + a\tilde{m})$, the same substitution gives $\hat{N}(1 + \kappa\Phi) = (1 + \kappa a)\tilde{m}$. The price follows from (6). The residents' response is $\hat{N} - \tilde{m} = \tilde{m}[(1 + \kappa a) - (1 + \kappa\Phi)]/(1 + \kappa\Phi)$.

Public housing, equation (28). With $\hat{H}^s = \eta\hat{p} + g\tilde{m}$, clearing gives $\hat{p} = (\hat{N} - g\tilde{m})/(\eta + \varepsilon)$. Substituting into the population equation, $\hat{N}[1 + \kappa/\sigma + \kappa s/(\eta + \varepsilon)] = \tilde{m}[1 + \kappa s g/(\eta + \varepsilon)]$. Private construction is $\eta\hat{p}$. The absorption identity becomes $\eta\beta_g + \varepsilon\beta_g + g + (1 - \hat{N}/\tilde{m}) = 1$, where $\beta_g = \hat{p}/\tilde{m}$.

B Data and sources

TABLE 16. Spain: descriptive facts used in the paper

Indicator	Value	Source
<i>Demand</i>		
Population, 1 July 2026	49,801,559 (+0.90%, +444,205)	INE, ECP Q2 2026
Foreign nationals	7,437,543 (+4.86%)	INE, ECP Q2 2026
Foreign-born population	Over 10 million	INE, ECP 2026
Households	19,874,860 (+1.22%)	INE, ECP Q2 2026
Main origin nationalities	Colombian, Venezuelan, Moroccan	INE, ECP
<i>Supply</i>		
Net household formation, 2025	≈240,000	Banco de España (2026, p. 126)
Completions, 2025	92,000 (−9%)	Banco de España (2026, p. 124)
Completions minus household formation, 2021–2025	≈ −750,000 dwellings	Banco de España (2026, p. 146)
Unsold new dwellings, end 2015 → 2024	513,848 → 455,280	MIVAU, stock de vivienda nueva
Long-run supply elasticity	≈0.45; range 0.3–0.6	Banco de España (2026, p. 146); FUNCAS
Vacant share of urban land, 2014 → 2026	43% → 34% (46 provinces)	Catastro, urban statistics
<i>Prices and rents</i>		
House prices, Q2 2026	+12.2% y/y	INE, IPV
Asking rents, September 2026	15.1 €/m ² , +5.6% y/y	idealista
Rents, all contracts, 2024	+3.5%; new +8.8%, existing +2.8%	INE, IPVA
Asking rents, Catalonia vs. Madrid, 2024Q1–2025Q4	+5.7% vs. +8.5%	Fedea (2026)
Rental listings, same period	−20.5% vs. +3.9%	Fedea (2026)

Notes: INE household and migration figures are provisional. Portal rents are asking prices. Banco de España figures are from its Annual Report 2025, chapter 2 (English edition, page numbers as cited).

Additional sources used in Sections 7.4–7.10. Unsold new housing by province: Ministerio de Vivienda y Agenda Urbana, *Informe sobre el stock de vivienda nueva*, editions 2016–2024, each

TABLE 17. Replicating the 2001–2012 design on this panel

	This panel, 2002–2011	Sanchis-Guarner (2023)
House prices	1.62*** (0.61)	about 3
Dwelling stock	0.58*** (0.14)	—
Population	1.15*** (0.04)	—
Spain-born adults (natives per immigrant)	0.10*** (0.03)	about 0.35
First-stage F	81	

Notes: Annual flows from 1 January 2002 to 1 January 2012, province and year fixed effects, 2001 settlement shares, standard errors clustered by province. Her rent estimate (about 0.8) cannot be replicated because the provincial rent index starts in 2011. The design differs in the population measure (country of birth here) and in the house-price series. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

reporting the stock at the end of the year and of the previous year. Starts and completions: MIVAU, province by month, 2008–2025. Household size: INE, Atlas de Distribución de Renta de los Hogares, demographic indicators by census section, 2015–2023. Tenure by income decile and by age: INE, Encuesta de Condiciones de Vida, tables 59953 and 9994; Eurostat ilc_lvho02 and ilc_mdmd02. All are downloaded and processed by the script code/09_extension_data.py.

Replication of the 2001–2012 design. Table 17 runs the annual design of Sanchis-Guarner (2023) on this panel. The price response has the same sign and is significant but is about half her estimate; the native co-location response is positive but smaller. Differences in the population measure (country of birth rather than nationality) and in the price series are the likely reasons. Recovering her estimates exactly would require her data; the comparison shows that the qualitative patterns the paper builds on, rising prices and native co-location, are present in the earlier period on this panel too.

C Rent regulation: a calibration

This appendix applies Proposition 5. Every number is a model calculation with assumed parameters, not an estimate. The empirical counterpart in Section 7 rests on four treated provinces and, for the split between new and existing contracts, a single treated year, so it cannot discipline these numbers.

Table 18 applies Proposition 5 with $\omega = 0.6$, $\eta_L = 1$ and $\kappa = 0$, so the unregulated benchmark is $1/(\eta + \varepsilon) = 1.05$. Equilibrium requires $\lambda < 0.63$. With $\lambda = 0.3$ the model's average rent response doubles; this is an illustration of how much the leakage parameter matters, not a prediction for any Spanish market. Measuring λ matters more than any other parameter in this block.

Descriptive evidence is consistent with this direction but cannot test it. Between the first quarter of 2024 and the end of 2025, asking rents rose 5.7% in Catalonia, which capped rents in stressed areas in March 2024, against 8.5% in Madrid, while rental listings fell 20.5% in Catalonia and rose 3.9% in Madrid. The comparison is descriptive and does not separate the regulated and free segments. Listings are also a flow of new offers rather than the regulated

TABLE 18. Rent regulation: model responses to a 1% population shock (calibration, not estimates)

	No control	$\lambda = 0$	$\lambda = 0.15$	$\lambda = 0.3$
Regulated rent	1.05	0	0	0
Free rent	1.05	2.63	3.45	5.00
Average rent	1.05	1.05	1.38	2.00
Regulated stock	—	-2.63	-3.45	-5.00

Notes: Percent changes. $\eta = 0.45$, $\varepsilon = 0.5$, $\omega = 0.6$, $\eta_L = 1$, $\kappa = 0$. Calibration.

stock, so they overstate its response.