The Role of Immigration in a Deep Recession

Ismael Gálvez-Iniesta*

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Abstract

Many economies experienced large immigrant inflows before the Great Recession of 2008 took place. This paper studies the impact of these foreign-born workers on the labor market during a recession. To this end, I develop a random search model of the labor market featuring vacancy persistence, endogenous return migration, and wage rigidity. Consistent with the Spanish data, some immigrants in the model leave the country in the event of a recession, so they free up jobs for natives. Yet, since immigrants and natives differ in their match-quality draws, immigrants also affect firms' job creation decisions. While the return-migration channel has an unambiguously positive effect on native workers, the calibration results for the Spanish economy suggest that the job-creation effect is negative. I find that immigrants attenuate the recession and improve the welfare of natives. During the recession, the native unemployment rate would have been 2 percentage points higher in the absence of the pre-crisis immigration boom. Return migration is the key channel of this difference, since its short- and long-run impacts on the native unemployment rate are, respectively, 10 and 2 times as large as the sum of the impact of all the other channels.

Keywords: Immigration, Labour market, Search, Vacancy persistence, Unemployment
JEL Codes: E24, J61, J63, J64

*Universitat de les Illes Balears, Department of Applied Economics. Email: i.galvez@uib.es. Web: sites.google.com/view/ismaelgalvez. I am indebted to Matthias Kredler for his guidance and advice throughout the project. I also would like to thanks Samuel Bentolila, Juan José Dolado, Andrés Erosa, Jesús Fernández-Huertas, Marcel Jansen, Belén Jerez, Salvatore Lo Bello, Luigi Minale, Evi Pappa, José-Vicente Rodríguez Mora, Hernán Seoane, Jan Stuhler, Cristina Tealdi, Ludo Visschers, Felix Wellschmied and seminar participants at the PhD Student UC3M Workshop, UC3M Macro Reading Group, University of Edinburgh Student Workshop, ENTER Jamboree 2019 (Tilburg), ENTER Seminar (Stockholm School of Economics), XXIV Workshop in Dynamic Macroeconomics 2019 (Vigo), and others for useful comments and suggestions. Financial support from the Spanish Ministry of Education is gratefully acknowledged.

1 Introduction

The increase in the foreign-born population is one of the main socioeconomic changes that has been seen in many developed countries over the last decades. In the United States, the share of foreign-born individuals increased from 9.2% of the population in 1990 to 14.3% in 2010. More striking examples can be found in Europe. In Italy, over the same time span, the share of foreign residents rose from 2.5% to 9.7%, whereas in Spain it increased from 2.1% to 14.4%. In these economies, the Great Recession took place contemporaneous to this context of large immigrant inflows. As a result of rigid labor markets, in Spain and Italy the economic downturn triggered by the Great Recession led to a substantial increase in unemployment, instead of wage reductions. Many papers have tried to estimate the impact of immigration on the labor market outcomes of host countries (some examples include Borjas (2003), Card (2005), Ottaviano and Peri (2012), Chassamboulli and Palivos (2014), Battisti et al. (2017), Dustmann et al. (2017) or Moreno-Galbis and Tritah (2016)).[1] However, most of these papers either abstract from search frictions or focus on stationary environments, and consequently, little is known about how this impact depends on the economic cycle.

The present paper studies the impact that a high share of foreign-born workers has on rigid labor markets during a recession. I document two empirical facts for the Spanish economy. First, I provide evidence that the Great Recession affected job-finding and job-separation rates differently for immigrant and native workers. In particular, I find that the effect of the crisis on the probability of losing one's job was three times as high for immigrants than for natives. Secondly, I document that foreign outflows were very responsive to the Great Recession, as many immigrants left the country. Then, I build a random search model of the labor market featuring vacancy persistence, endogenous return migration,[2] and downward wage rigidity,[3] which capture these empirical facts. I use the model to quantify the amount by which the native unemployment rate would have increased during the Great Recession in the absence of the pre-crisis immigration boom. I also use the framework to understand the underlying channels behind the results.

The first contribution of the paper is its quantification of the impact of immigration on the labor market via the use of a frictional search model, which will be solved out of its steady state. By incorporating the study of immigration in non-stationary environments, I allow its impact to depend on the economic cycle. Two ingredients are key to generating immigration effects on the native unemployment rate during a recession. The first ingredient is vacancy persistence: in the model, if an employed worker leaves the country or is fired, the job will continue to exist and the

[1] See Kerr and Kerr (2011) or Edo (2019) for recent surveys.

[2] Throughout the paper I indistinctly use the terms return migration and foreign outflows to refer to the flow of foreign-born workers leaving the country.

[3] There is substantial evidence of downward wage rigidity in the Spanish labor market. For instance, Font et al. (2015) and De la Roca (2014) find that real wages are weakly pro-cyclical in Spain, especially in recessions. Gálvez-Iniesta (2020) also finds small wage responses during the Great Recession for both immigrants and natives. In Section 6.1 I show that partially relaxing this assumption does not change the main results of the paper.

firm could post it again. The second ingredient is heterogeneity between immigrants and natives, which stems from three sources: (1) representing the large foreign outflows, immigrants can leave the country at any period; (2) immigrants' unemployment flow payments are lower; and (3) immigrants and natives draw their match qualities from different distributions. In the model, production is given by the sum of aggregate productivity and a match-quality component, which is drawn after a firm meets a worker. I allow the distribution of match-quality draws to differ for immigrants and natives in order to pin down both the native wage premium and the job-separation gap between them. With these two ingredients (vacancy persistence and immigrant-native heterogeneity), the model contains three channels through which immigration affects the native unemployment rate during a recession. The first is the *job-creation effect*: as search is random and there is heterogeneity between immigrants and natives, the share of immigrants among those searching for a job affects firms' decisions regarding job creation. The second is the *return-migration effect*: unemployed immigrants leaving the country affect firms' job creation, whereas employed immigrants who leave increase the stock of existing jobs. The third is the *match-destruction effect*: since the impact of the recession on job separation is higher for immigrants than for natives, the share of immigrants among the employed affects the stock of existing jobs. A quantitative exercise in a calibrated model determines the sign and magnitude of each of the channels.

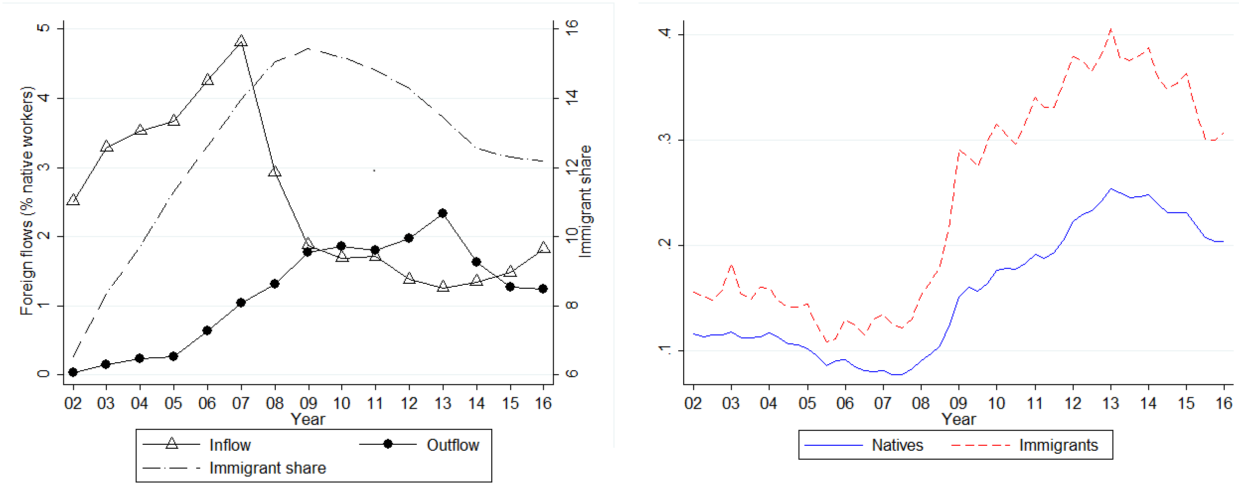
The second contribution of the paper is the introduction of vacancy persistence (Pries and Rogerson (2005)) into a model with endogenous return migration, which turns out to be key for the quantitative results. By incorporating the notion of capital into the model, vacancy persistence allows us to distinguish between worker turnover and job turnover, and it helps the model reproduce the realistic dynamics of the job-finding rate during the Great Recession. These dynamics would not be captured in the standard model with a free-entry condition in which vacancies adjust immediately to a negative shock. Importantly, it makes the effects of immigration long-lasting: the employed immigrants' *return-migration* and *match-destruction* channels would be ignored in the standard model.

Although the methodology could be extended to other economies, I focus my discussion on the Spanish case for three main reasons. On the one hand, as the left-hand panel in Figure 1 shows, Spain experienced large foreign inflows during the expansion, raising the share of the foreign-born population from barely 4% at the end of the 1990s to more than 14% only ten years later.[4] On the other hand, with the economic slowdown foreign inflows dramatically decreased while foreign outflows steadily increased.[5] Finally, Spain experienced sizable employment destruction in the Great Recession that was even more pronounced among the immigrant population (see the right-hand panel of Figure 1). In sum, the emergence of a deep recession in the context of a population

[4]See Izquierdo et al. (2016) for a recent exhaustive description of the historical migration process.

[5]Prieto et al. (2018) already described the immigrants' internal and international migration responses during the Great Recession. They study how different forms of international migration (return migration and re-migration) depend upon the demographic characteristics of the immigrant. However, because of data limitations they abstract from education heterogeneity.

with a large share of immigrants makes the Spanish economy a particularly interesting case of study.



(a) Foreign Flows and Immigrant Share

(b) Unemployment Rate

Figure 1: Trends in the Spanish Immigration Experience. The left-hand panel displays the foreign inflows and outflows along the left axis, and the immigrant share along the right axis. All series are constructed from the National Statistics Institute's migration data. The right-hand panel shows the unemployment rate among natives and immigrants based on the Spanish Labor Force Survey.

I calibrate the model to the low-skilled segment of the Spanish labor market.[6] The focus on this segment is motivated by two facts. First, immigrants are more often low-skilled workers, which implies that the potential effects of immigration would be quantitatively larger in that segment. Secondly, return migration was also higher among the low-skilled during the period under consideration. I show that the model's performance during the Great Recession is consistent with the empirical facts discussed previously, as the model captures (1) the higher increase that immigrants see in their job-separation rates over natives, as well as (2) the drop of the immigrant share by delivering actual immigrant outflows. On top of this, the model reproduces the smooth decrease in job finding observed in the data.

In the first part of the quantitative analysis I use the model to quantify the amount by which the native unemployment rate would have increased during the Great Recession in the absence of the pre-crisis immigration boom. To do this, the model is first completed under two steady states. In the first one, aggregate productivity is high, and wages are Nash-bargained. In the second state, aggregate productivity is lower, and wages cannot be adjusted. I then compute the transition path between steady states for two economies: (1) a baseline economy with the observed pre-crisis immigration boom, and (2) a counterfactual economy with no foreign inflows during the pre-crisis period. In this transition path, again, wages cannot be adjusted.

[6]Following Battisti et al. (2017) and Krusell et al. (2000), high-skilled labor is defined as requiring college completion (or equivalent) or above.

I find that the native unemployment rate would have been substantially higher in this counterfactual scenario without immigration than in the baseline economy. The largest difference is reached three years after the shock, when the unemployment rate of natives is three percentage points higher in the counterfactual economy than in the baseline. The reason for this is that the drop in the job-finding rate is more moderate in the baseline than in the no-immigration economy. The model also predicts that unemployed native workers are the ones who benefit most from the presence of immigrants, as they are more directly affected by the higher job-finding rate.

I also use the framework to disentangle the relative importance of each of the channels by which immigrants affect the labor market during crises. The model suggests that the job-creation effect is negative but small. This is a calibration outcome: in order to pin down the native wage premium and the job-separation gap between immigrants and natives, the calibration implies that draws of match qualities are more concentrated and have a lower mean for immigrants than for natives. Yet, a decomposition analysis reveals that return-migration and match-destruction effects are positive and dominate the job-creation effect, implying overall welfare gains for native workers. Quantitatively, in fact, I find that return migration is the most relevant channel: in the short- and long-run the impact of return migration is, respectively, 10 and 2 times as large as the sum of the impact of the other two channels.

Finally, I conduct some robustness checks. First, I investigate the role of wage rigidity in explaining the results. I show that introducing a certain degree of wage flexibility does not affect the model's performance during the Great Recession. Moreover, the predictions that can be made of the main counterfactual remain unaffected. Secondly, I explore the validity of the results under an alternative calibration strategy. In particular, following Battisti et al. (2017) and Albert (2021), I assume that the native wage premium stems from differences in workers' bargaining power instead of differences in match qualities. I find that in this case the sign of the job-creation effect becomes positive. This is intuitive, as now firms can extract a higher share of the match surplus from immigrant workers. Nevertheless, the magnitude of the job-creation effect is small, and thus, the quantitative results of the main counterfactual experiment still hold.

Literature Review and Contribution

This paper primarily relates to the literature that estimates the impact of immigration on the labor market in a frictional environment. In this context, my contribution is the incorporation of a study on immigration into a frictional model with non-steady-state dynamics. Regarding models with search frictions, Chassamboulli and Palivos (2014) study the effect of a skill-biased immigrant inflows, allowing for heterogeneous effects for low- and high-skilled natives. They find that skill-biased immigration raises the overall net income of natives. Also, while unskilled native workers benefit in terms of both employment and wages, skilled natives benefit in terms of employment, though they may lose in terms of wages. Using a similar framework, Battisti et al. (2017) add a welfare state and analyze the welfare effect of a marginal increase in immigration. They conduct their quantitative analysis on a large set of countries and find welfare gains for both skilled and unskilled native workers in two thirds of the countries. Interestingly, for Spain they find welfare losses for the unskilled native workers when the marginal increase of immigration exclusively involves unskilled immigrants. Other related work, such as Chassamboulli and Peri (2015) or Albert (2021), highlights the importance of the different effects of documented and undocumented immigration. In Chassamboulli and Peri's (2015) model, immigrants (especially illegal ones) have worse outside options than natives, so their wages are lower. Hence, their presence boosts firm job creation. They find that tightening border controls weakens low-skilled labor markets, increasing unemployment among low-skilled native workers. Albert (2021) introduces non-random hiring in his model. This gives rise to a competition effect of immigration, implying that the wage difference between natives and immigrants determines whether immigration is beneficial for natives or not. He finds that documented immigration reduces employment among natives, whereas undocumented immigration leads to gains for native workers in terms of both employment and wages. While all these papers stress the relevance of accounting for labor market frictions when analyzing the effect of immigration, they focus on steady-state comparisons. As stated above, I add to this body of literature by analyzing immigration in the context of a recession. My paper makes further contributions by incorporating wage rigidity into the analysis.

My study is also related to the literature that considers whether immigrant mobility smooths labor market adjustments. Cadena and Kovak (2016) use data on low-skilled Mexican-born immigrants in the United States and leverage the substantial geographic variation in labor demand during the Great Recession to identify migration responses to local shocks. They demonstrate that Mexican-born immigrants' high level of mobility reduces the incidence of local demand shocks on natives. With a similar identification strategy, Basso et al. (2019) use Euro-area data and find that the mobility of foreign workers (which is strongly pro-cyclical) reduces the variation of overall employment rates throughout the business cycle. Using data from Spain, Özgüzel (2020) shows that migrants leaving the province accelerate employment and wage growth among the natives staying in the same province. My contribution is the incorporation of this channel into a general equilibrium model and the quantification of its impact on facilitating labor market adjustments.[7]

Finally, the paper draws upon the literature on vacancy persistence. Fujita and Ramey (2007) emphasize the excessively fast responses of vacancies to productivity shocks in the standard search and matching model with free entry, and they show that the introduction of vacancy persistence improves the dynamics of the standard model.[8] More recently, Acharya and Wee (2018) depart from the free entry assumption to study replacement hiring. I add to this literature by showing

[7]Notice that these papers focus on local labor markets, and therefore, they analyze the role of regional mobility. Since, in the present paper, I model the labor market of the country as a whole, I focus on international mobility. Nevertheless, the intuition and the mechanisms of the channels should be similar. See the Conclusions section for a broader discussion.

[8]See Elsby et al. (2015) for a recent survey on the topic.

that the interaction between vacancy persistence and return migration leads to new implications regarding labor market adjustments during a recession. In particular, I show that due to vacancy persistence, immigrants leaving the labor market when no jobs are being created (e.g., a recession) have a positive effect on the evolution of the job-finding rate.

The rest of the paper is organized as follows. Section 2 documents the labor market and mobility behavior of the immigrant population in Spain during the Great Recession. Section 3 outlines the quantitative model used herein, which is solved and calibrated in Sections 3.7 and 4, respectively. Section 4.1 examines the model's performance, and Sections 5 and 6 describe the counterfactual experiments. Finally, Section 7 concludes.

2 Empirical Evidence

This section reviews the labor market performance and migration patterns of the immigrant population in Spain during the Great Recession. Below, I highlight two important facts, both of which give reason for and guide the quantitative analysis in the next sections:

- Immigrant workers were more affected than natives by the onset of the crisis, mainly due to differences in the evolution of their job-separation rates, namely, the increase in the job-separation rate was higher for immigrants than for natives.
- Migration flows were more responsive among immigrants than natives. Foreign inflows dropped, and foreign return migration increased with the onset of the crisis, whereas natives did not emigrate much.

2.1 The Data

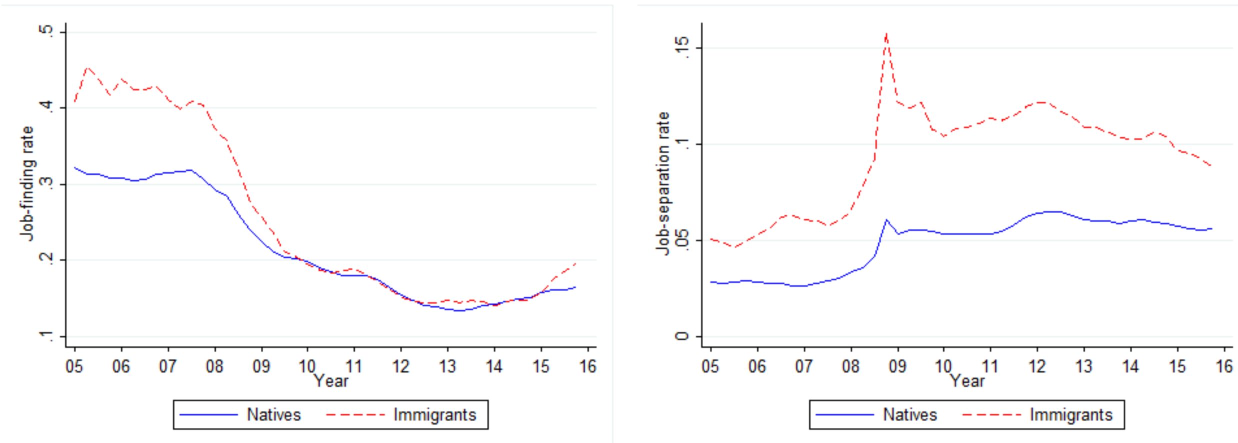
I use data from the Spanish Labor Force Survey-Flows (SLFS-Flows) from 2005Q1 to 2016Q1. The Spanish Labor Force Survey (SFLS) is a quarterly representative survey of about 65,000 households, comprising around 180,000 individuals. The sample is divided into six waves (rotation groups), and every quarter, one wave is replaced by a new one. This allows us to track each individual for five successive quarters (over a period of one and a half years). The survey asks respondents about their labor market status and job characteristics (occupation, sector or type of contract) as well as personal and demographic information (gender, age, education, nationality, marital status, region of residence, etc.).[9] The survey as we know it today began in 2005. Before this time, the longitudinal dimension of the survey did not provide information on nationality.[10]

[9]See Silva and Vázquez-Grenno (2013) for more details on this survey.

[10]The SFLS-Flows is the longitudinal version of the standard cross-section version of the SLFS. That is, the SLFS-Flows is based on the cross-sectional SLFS. While the cross-section version provides information on both country of birth and nationality, the SPLS-Flows only provides nationality.

2.2 Labor Market Transitions by Nationality

We construct job-finding and job-separation rates by nationality,[11] and they are defined as the quarterly probability of transitioning from unemployment to employment and from employment to unemployment, respectively. The left-hand panel of Figure 2 plots the evolution of the job-finding rate for low-skilled workers.[12] We find that before the crisis, the job-finding rate was higher for immigrants than for natives, but both rates quickly converged after 2008.



(a) Job-Finding Rate

(b) Job-Separation Rate

Figure 2: Transition rates of low-skilled workers. The transitions are seasonally adjusted using a four-quarter moving average, constructed from the SLFS-Flows.

The right-hand panel of Figure 2 shows that throughout the period under consideration, the job-separation rate was higher for immigrants than for natives. However, the gap widened after 2008. Together, the two figures suggest that immigrant transition flows were more sensitive to the onset of the crisis. Nonetheless, they should be viewed with caution, as part of these differences might be explained by a composition effect, i.e., immigrants were younger, worked more often as temporary workers, and were more concentrated in the construction sector.[13]

In order to account for this, and to quantify the differential impact of the crisis on the employ-

[11] Computed rates are conditional on staying in the country. That is, if a worker transitions from employment to unemployment and then moves out of the country within the same quarter, that job separation does not add to the job-separation rate. Consequently, the constructed series of immigrant job-separation rates can be seen as lower bounds of the actual job-separation rates.

[12] Following Battisti et al. (2017) and Krusell et al. (2000), low-skilled labor is defined as requiring less than college completion (or equivalent).

[13] See Gálvez-Iniesta (2020) for an overview of the descriptive statistics of natives and immigrants. Using a linear probability model, I estimate the evolution of the job-finding and job-separation rates of immigrants and natives, conditional on observable characteristics. I show that the unconditional patterns are not explained by composition effects.

ment transitions of immigrants and natives, I estimate the following linear probability model:

$$UE_{i,t} = \beta_1 + \beta_1^m imm_i + \beta_1^c crisis_t + \beta_1^{mc} imm_i * crisis_t + \boldsymbol{\delta}_1 \boldsymbol{X}_{i,t}^1 + \varepsilon_{i,t}^1 \quad (1)$$

$$EU_{i,t} = \beta_2 + \beta_2^m imm_i + \beta_2^c crisis_t + \beta_2^{mc} imm_i * crisis_t + \boldsymbol{\delta}_2 \boldsymbol{X}_{i,t}^2 + \varepsilon_{i,t}^2 \quad (2)$$

where $UE_{i,t}$ ($EU_{i,t}$) is a dummy variable defined only for the unemployed (employed), taking a value of 1 if a job is found (lost) at time t and 0 otherwise; imm_i is a dummy variable that takes a value of 1 if the worker is an immigrant and 0 otherwise;[14] $crisis_t$ is a dummy variable that takes a value of 1 for the time interval 2008Q3-2013Q2 and 0 otherwise;[15] $\boldsymbol{X}_{i,t}^1$ is a vector of control variables that includes dummies for education, potential experience, marital status, age, gender, region of residence, occupation, sector of activity,[16] and year dummies; $\boldsymbol{X}_{i,t}^2$ includes all variables in $\boldsymbol{X}_{i,t}^1$ and further adds as controls the type of contract (permanent or temporary), type of job (full- or part-time), and tenure; and $\varepsilon_{i,t}$ is the idiosyncratic error term.

The coefficients of interest are β_1^{mc} and β_2^{mc}, which are associated with the interaction term of the variables imm_i and $crisis_t$. Their signs and magnitudes will be used to quantify the differential impact of the crisis on the probability of finding (or losing) a job between immigrant and native workers. The estimation results of equations (1) and (2) are displayed in Columns (1) and (2), respectively, of Table 1. The estimated value of β_1^{mc} can be interpreted as follows: among comparable workers, during the crisis (2008Q3-2013Q2), the drop in the probability of finding a job was 7.9 pp higher for immigrants than for natives. In other words, *ceteris paribus*, the crisis is associated with a 7.9 pp decrease in the job-finding rate for natives (captured by the coefficient β_1^c), while for immigrants the decrease in the same rate was 15.2 pp (captured by the sum of β_1^c and β_1^{mc}). This suggests that the impact of the crisis on the probability of finding a job was more than twice as large for immigrants than for natives. The left-hand panel in Table 2 displays the estimated predicted job-finding probabilities for each group before and after the crisis and the marginal effect of the crisis dummy for each group. The estimation shows a sizable drop in the job-finding rates during the crisis: by around 44% for immigrants and 18% for natives.

Column (2) in Table 1 shows the results of the estimation of equation (2) (the probability of losing a job, i.e., EU). The estimated β_2^{mc} can be read as follows: for comparable workers, during the crisis (2008Q3-2013Q2), the increased probability of losing a job was 3.7 pp higher for immigrants than for natives. In other words, *ceteris paribus*, the crisis is associated with a 1.5 pp increase in the job-separation rate for natives (captured by β_2^c), while for immigrants that same increase is 5.2 pp ($\beta_2^c + \beta_2^{mc}$). This suggests that the impact of the crisis on the probability of losing a job was

[14] The survey does not provide the worker's country of birth, so we define immigrants as workers with a foreign nationality.

[15] I chose this time span since 2008Q3 and 2013Q2 are the first and last quarters with a negative quarterly growth rate of real GDP (save two quarters in 2010 with slightly positive rates). The results are robust to adjusting the quarter from which the dummy for the crisis starts to take the value 1. Results are also very similar when the dummy crisis takes a value of 1 for all periods after 2008Q3 and 0 otherwise.

[16] In the case of unemployed individuals, the sector of activity and occupation is that in which the worker was last employed.

Table 1: Regression results of EU and UE transitions

	(1) Probability of finding a job (UE)	(2) Probability of leaving a job (EU)
β^m	0.070***	-0.019***
	(0.010)	(0.001)
β^{mc}	-0.073***	0.037***
	(0.011)	(0.001)
β^c	-0.079***	0.015***
	(0.010)	(0.001)
Observations	206346	1559302
R-squared	0.052	0.097

Notes: Regression of a dummy variable for the transition from unemployment to employment (UE, in Column (1)) and from employment to unemployment (EU, in Column (2)) on dummies of migration status, crisis, and the interaction of the last two. Both regressions include controls for education, potential experience, marital status, age, gender, region of residence, occupation, sector of activity, type of job, and the year. The EU regression also includes, as controls, the type of contract (permanent or temporary), type of job (full or part-time), and tenure. Significance levels: $^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Source: Spanish Labor Force Survey-Flows (2005-2015).

more than three times greater for immigrants than for natives. The estimation also reveals that the increase in the probability of losing one's job associated with the crisis was very large for both groups (right-hand panel of Table 2): *ceteris paribus*, it more than tripled for immigrants (from 2.11% to 7.28%) and increased by a factor of 1.5 among natives (from 3.47% to 4.96%).

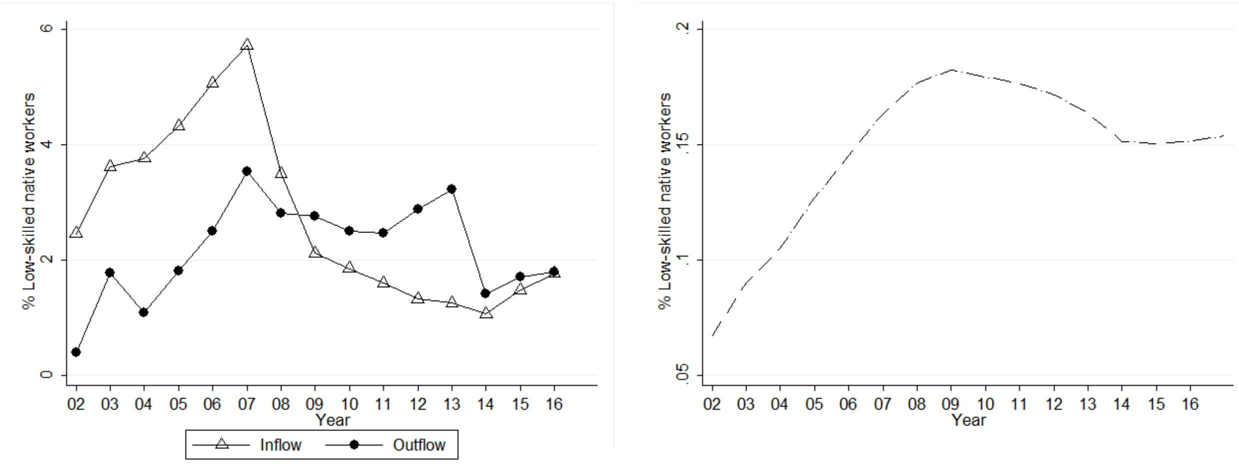
Table 2: Adjusted predictions and marginal effect

	Probability of finding a job (UE)			Probability of leaving a job (EU)		
	Crisis 0	Crisis 1	Marginal Effect	Crisis 0	Crisis 1	Marginal Effect
Native	43.75	35.81	-7.94^{***}	3.47	4.96	1.49^{***}
Immigrant	58.87	33.61	-15.25^{***}	2.11	7.28	5.17^{***}

Notes: Adjusted predicted probabilities and marginal effects were computed with the linear probability model described in equations (1) and (2) and were estimated with all the control variables. The predicted values are evaluated at the mean of the covariates. The left-hand panel (UE) makes use of 206,346 observations and the right-hand panel (EU) 1,559,302 observations. Significance level: $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

2.3 Immigrant Mobility Responses

Using the SLFS and the Spanish Migration Statistic (which is based upon Residential Variation Statistics), I construct the series of inflows and outflows of low- and high-skilled foreign workers from 2002 onward (left-hand panel of Figure 3).[17] We can see that the Great Recession triggered a sudden change in the pre-crisis trend of foreign inflows, as they plummeted dramatically after 2008.



(a) Foreign flows

(b) Immigrant Labor Force Share

Figure 3: Trends in the mobility of low-skilled immigrants. The left-hand panel was constructed using the Spanish Migration Statistic. The right-hand panel was constructed from the Labor Force Survey.

Interestingly, Figure 3 also shows a steady increase in foreign outflows that started slightly before 2008. Specifically, we can see that from 2009 foreign outflows exceed foreign inflows, implying a drop in the share of low-skilled immigrants in the labor force (right-side panel of Figure 3). Immigrant mobility patterns during the crisis contrast with those of natives. As Figure 2 in Online Appendix F shows, native inflows and outflows were minimal, both during the pre-crisis period and after the Great Recession.[18]

The empirical evidence provided in this section leads us to suspect that the presence of foreign-born workers affects the behavior of the labor market during a recession. In a context in which very few jobs are created (during a deep economic crisis such as the Great Recession, for example), immigrants' higher level of mobility may contribute to moderating the drop in natives' job-finding rates,[19] acting as a buffer channel. On the other hand, as immigrants are *ceteris paribus* more likely

[17]The Residential Variation Statistics only provide aggregate data on foreign flows. However, the SLFS asks respondents about their years of residence in Spain. Therefore, by using the SLFS, I can compute the share of newcomers that are high- and low-skilled workers.

[18]The Residential Variation Statistics have some drawbacks regarding their coverage of emigration. As emigrants do not have any incentive to remove themselves from the list of residents, actual native emigration (and hence also native return migration to Spain) may be underestimated. gon (2013) estimates that between 2008 and 2012 official figures on native outflows could represent just one third of actual outflows. Along this line, two observations are worth highlighting: first, even with this estimation, native outflows are still quantitatively small with respect to foreign outflows, and second, as gon (2013) states, although we do not have information on emigrated natives' levels of education, we expect that recent native Spanish emigration is driven mainly by high-skilled workers.

[19]In the simple version of the standard search and matching model of the labor market, the job-finding rate is a

to lose their jobs than natives, it is reasonable to think that there is a certain degree of unobserved heterogeneity between them, implying that immigrants also affect firms' job-creation incentives. Depending on the source and magnitude of the heterogeneity, this channel could be positive or negative for native workers.

3 The Model

I build upon the canonical search and matching model (Mortensen and Pissarides (1994)) but depart by introducing vacancy persistence (Pries and Rogerson (2005) or Fujita and Ramey (2007)), endogenous return migration choices, and downward wage rigidity. The model aims to rationalize the empirical facts presented in the previous section, and it will be used to quantify the amount by which the native unemployment rate would have increased during the Great Recession in the hypothetical absence of the pre-crisis immigration boom.

3.1 The Environment

I consider an infinite horizon model with discrete time $t = 0, 1, 2, \ldots$. The economy may be out of its steady-state equilibrium, and thus, we keep track of calendar time t. There are two types of infinitely lived workers in the model economy, natives and immigrants, indexed by $j = \{N, M\}$. Workers are risk-neutral and have a common discount factor β. The mass of native workers is held constant and normalized to 1.

Every period there is an exogenous inflow m_M of immigrants[20] who enter the labor market as unemployed.[21] Emigration is endogenous,[22] i.e., each period, immigrants (both employed and unemployed) choose between (1) staying in the labor market, or (2) emigrating (leaving the labor market) and obtaining an exogenously fixed lifetime flow utility w_M^A.[23] In order to account for emigration that is not driven by economic factors, a migration-preference shock is introduced: every period workers draw an i.i.d. migration-preference shock ε from a distribution with a c.d.f. denoted by $G(\varepsilon)$.

There is an infinite mass of risk-neutral firms which may be either matched with a worker, unmatched, or inactive. Firms can only be matched with one worker. Matched firms produce $z + x$ units of output, where z is an aggregate productivity component and x is an idiosyncratic

positive function of market tightness (v/u). Suppose that the number of vacancies is fixed (firms are not creating new jobs). Then, a decrease in the number of unemployed workers (e.g., due to higher return migration among unemployed immigrants) will lead to an increase in the job-finding rate (on impact).

[20] There are several reasons for why this assumption is reasonable. Bertoli et al. (2011) argue that the Latin American crisis had a lot to do with the Spanish immigration boom. Similarly, Bertoli and Moraga (2013) show that Spanish migration policies also played an important role. Lastly, the expansion of the European Union into Eastern European can be assumed to be responsible for a large part of immigration flows over this period.

[21] The assumption that immigrants enter the labor market as unemployed is made for computational convenience and plays no role in the quantitative results.

[22] Consequently, in this model the share of immigrants is endogenously determined by the emigration probabilities.

[23] We can interpret this flow as the discounted lifetime wage that immigrants expect to obtain when working abroad.

match-specific component (match quality). The match quality $x \in [0, x^{max}]$ is drawn at the time the firm and the worker meet, and it remains constant for the duration of the match. Immigrants and natives draw x from a different distribution with a c.d.f. denoted by $F_j(x)$.[24]

It is costless for the unemployed to search for work, whereas employed workers cannot search. Unemployed workers also receive a flow payment b_j.

Upon matching, the match quality is unknown, and it takes time for agents to learn it.[25] The learning process is simple: each period, agents discover the actual value of x with probability α. Employed workers earn a wage $w_j^*(x)$ when they are employed in a match with a known quality. I denote the wage paid to employed workers when their match quality is unknown by $\widetilde{w}_j$. Following Pries and Rogerson (2005), I assume that when the match quality is unknown, the expected production of the current period is given by the expected output $z + \bar{x}_j$.[26] This ensures that the match surplus of jobs with unknown qualities is always positive and hence, all meetings lead to match formation.

3.1.1 Wage Setting

In the initial steady state, wages are set according to the Nash-bargaining solution. Formally, wages are given by the following expressions:

$$w_{j,t}^*(x) = arg \max_{w_{j,t}(x)} \left(W_{j,t}^*(x) - U_{j,t}\right)^{\gamma} \left(J_{j,t}^*(x) - V_t^o\right)^{(1-\gamma)} \tag{3}$$

$$\widetilde{w}_{j,t} = arg \max_{\widetilde{w}_{j,t}} \left(\widetilde{W}_{j,t} - U_{j,t}\right)^{\gamma} \left(\widetilde{J}_{j,t} - V_t^o\right)^{(1-\gamma)} \tag{4}$$

where γ denotes the worker's bargaining power.[27] In the above equations, $W_{j,t}^*(x)$ and $\widetilde{W}_{j,t}$ denote the value functions of workers employed in a match with a known quality x or an unknown quality, respectively; $U_{j,t}$ is the worker's value function when unemployed; $J_{j,t}^*(x)$ and $\widetilde{J}_{j,t}^*(s)$ denote the value functions of firms employing a worker in a match with a known quality x or an unknown quality, respectively; and V_t^o is the value of a firm with a previously created, unfilled job.

Final steady state and along the transition

Motivated by the large body of empirical evidence on wage rigidity in Spain during the Great Recession (Font et al. (2015), De la Roca (2014), Gálvez-Iniesta (2020)) , I introduce a simple form

[24] As will be explained in Section 4, the heterogeneity between immigrants and natives in $F_j(x)$ will be identified by the empirical wage gap between the two. In a similar model, Albert (2021) and Chassamboulli and Palivos (2014) take a different approach and assume no productivity differences between immigrants and natives. Instead, to account for the observed wage gap in the model, they introduce heterogeneity in bargaining power or in the unemployment utility flow. In Section 6.2, I follow Albert's (2021) strategy, and I show that the results of the main counterfactual experiment are robust to this model assumption.

[25] This technical assumption is needed to account for endogenous job-destruction in a steady state.

[26] The intuition behind this assumption is simple. Think of a firm with several employers. If a new worker is hired, it will take some time to observe her actual productivity. During that time, it is reasonable to think that the firm will proxy the new worker's productivity as the average of the rest of (observably similar) workers.

[27] Section 6.2 introduces heterogeneity in this parameter so that $\gamma_M < \gamma_N$.

of downward wage rigidity into the model.[28] Specifically, I assume that after a negative shock to aggregate productivity, wages cannot be adjusted, i.e., they are fixed to their initial steady-state values (Hall (2003)).[29] This is equivalent to a stochastic framework with perfectly myopic agents: firms and workers expect to re-bargain wages if needed.[30]

3.1.2 Matching technology

I assume that nationality and match quality (upon discovery) are observable to the firm only after a meeting takes place. This means that the search process is random: firms cannot direct their search towards a specific type of worker, and there is only one labor market where both immigrant and native workers search for jobs. The total number of matches between unemployed workers and posted jobs is determined by a Cobb-Douglas matching function:

$$m(v_t, u_t) = \xi v_t^{\delta} u_t^{1-\delta} \tag{5}$$

where ξ denotes the matching efficiency, u_t is the number of unemployed workers, and v_t is the number of posted (advertised) jobs. For each period, posted jobs are given by:

$$v_t = k_t^n + k_t^{o,p} \tag{6}$$

where k_t^n denotes the number of new jobs created at time t, and $k_t^{o,p}$ are the number jobs that were created before t but went unfilled and are posted at t (see Section 3.1.3). We will refer to k_t^n and $k_t^{o,p}$ as *newly created jobs* and *previously created, unfilled jobs*, respectively. The probability that a worker matches with a firm is $p(\theta_t) = m(v_t, u_t)/u_t = \xi\theta_t^{\delta}$, where $\theta_t = v_t/u_t$ is the labor market tightness. The probability that a firm matches with a worker is $q(\theta_t) = m(v_t, u_t)/u_t = \xi\theta_t^{\delta-1}$.

3.1.3 Vacancy Costs

Following Pries and Rogerson (2005), I assume that there is a constant fixed cost $\bar{K}$ for creating a new job.[31] To post a job, at each time t firms must also pay a flow cost κ in order to fill the position. I incorporate the fixed cost in the model for two reasons. First, it allows us to distinguish between worker and job turnover.[32] Secondly, it is the most simple way of incorporating a notion of capital into the model, as the fixed cost $\bar{K}$ can be interpreted as the capital investment required

[28]Wage rigidity is not exclusive to the Spanish economy. Barattieri et al. (2014) document the existence of wage rigidity in the United States Using a model with search frictions, and Ravn and Sterk (2017) incorporate inflexible wages into the model to account for the lack of decline in real wages in the United States during the Great Recession.

[29]Hall (2003) allows wages to be fixed, but only within a bargaining set in order to improve the dynamics of the model. Our assumption about extreme wage rigidity is more closely related to Shimer (2004).

[30]Firms and workers are forward-looking agents, as they need to form expectations about the future when making decisions (see the value functions in 3.3 and 3.4). They are myopic in the sense of their incapacity to expect that they will not be able to change wages if there is a shock to aggregate productivity z.

[31]See also Acharya and Wee (2018) and Riegler (2019).

[32]Michaels et al. (2017) and Mercan et al. (2019) have stressed the relevance of this distinction given the increasing importance of quit-driven replacement hiring among the posted vacancies. Using German data, Mercan et al. (2019) find that 56% of posted vacancies are associated with old jobs that became unfilled after a worker quit.

to create a job. The implications of the fixed cost are twofold. First, in the model, if an employed worker emigrates or her match is endogenously destroyed, her job will continue to exist.[33] Secondly, as in Riegler (2019), during the transition between steady states, some firms will fill jobs (jobs will be posted) even if they do not create new job positions.

As a consequence of this, we need to distinguish between the stock of unfilled jobs that are available to be posted and the jobs that are posted at each time t. For every period, the first stock is given by the sum of the previously created, unfilled jobs (k_t^o) and newly created jobs (k_t^n). Firms then decide whether or not to post (advertise) their previously created, unfilled job positions k_t^o. I denote the number of previously created, unfilled jobs that are posted at time t as $k_t^{o,p}$. I define an indicator function $\mathbb{I}_{post,t}$ that takes a value of 1 if firms with previously created, unfilled jobs decide to post the job and 0 otherwise. Therefore, at each period the number of posted jobs is given by:

$$v_t = k_t^n + k_t^{o,p} = k_t^n + \mathbb{I}_{post,t} k_t^o \tag{7}$$

3.1.4 Job Separation

Job separation can occur for exogenous or endogenous reasons. I assume that job positions are exogenously destroyed at rate λ, which can be interpreted as job obsolescence: firms cannot rehire another worker following such separations, and consequently, the stock of unfilled jobs that are available to be posted in the economy decreases.

Job separations may also occur endogenously: every period, firms and workers engaged in a match with a known quality jointly decide whether to continue producing or to end the relationship. The match is only preserved if the two of them agree on the decision. At the initial steady state there is no room for disagreement, as wages are Nash-bargained every period. Therefore, the match is preserved as long as the match surplus is positive. This is not the case when wages are fixed: in this scenario, if aggregate productivity z drops, the surplus of some matches may become negative with the new and lower z. In other words, when wages are not Nash-bargained every period, firms and workers will not always agree on maintaining the match. I denote as $\mathbb{I}_j(x)$ the indicator function that takes a value of 1 if both parties agree to maintain the match. If a match is endogenously destroyed, workers become unemployed[34] and the job adds to the stock of previously created, unfilled jobs, as in Pries and Rogerson (2005).

[33] As discussed in Fujita and Ramey (2007), due to the existence of a fixed creation cost and in contrast to the standard DMP model, in this setup, previously created jobs are a predetermined variable and unfilled positions have a positive value in equilibrium.

[34] I assume that workers becoming unemployed at period t cannot search for a job within that period. See Subsection 3.2 and the law of motion for the evolution of unemployment (equation (3) in Online Appendix A.1).

3.2 Timing

At the very beginning of the period, aggregate productivity z is realized. Upon observing z, immigrant workers draw the migration-preference shock ε, decide whether to emigrate or not, and then emigration takes place (or not). After that, endogenous separations take place, exogenous job destruction occurs with probability λ, and agents learn their match quality x with probability α. Next, firms decide whether they want to create new jobs at cost $\bar{K}$. At the same moment, firms with previously created, unfilled jobs decide whether they want to post the jobs. After all these decisions are made, the matching process takes places: firms with unfilled, posted jobs and unemployed workers meet, and matches are formed. Then, for the matches that are maintained, production takes place and wages are paid, while unemployed workers receive b_j. Lastly, immigration occurs.

3.3 The Worker's Problem

As there is no aggregate uncertainty in the model, I formulate workers' and firms' decision problems in recursive form.[35]

Unemployed workers

Every period unemployed workers choose between emigrating or staying in the country unemployed.[36] For type-j workers, the value of staying in the country as unemployed $V_{j,t}^{U,stay}$ can be written as:

$$V_{j,t}^{U,stay} = b_j + \beta \left[p\left(\theta_t\right) \widetilde{W}_{j,t+1} + \left(1 - p(\theta_t)\right) U_{j,t+1} \right] \tag{8}$$

where $\widetilde{W}_{j,t}$ is the value of being employed in a job of unknown quality and $U_{j,t}$ is the value of being unemployed.

The value of staying in the country and remaining unemployed can be decomposed into two terms. The first one is the flow payment b_j, associated with unemployment. The second term is the expected discounted value of the next period: with probability $p\left(\theta_t\right)$ the unemployed worker finds a job of unknown quality.[37] With the complementary probability $1 - p(\theta_t)$, the worker remains unemployed, in which case she obtains the value of being unemployed $U_{j,t+1}$.

The value of emigrating is given by:

$$V_t^{mig} = W_j^A + \varepsilon_t \tag{9}$$

where the first term in (9) is the value of working abroad, which is the discounted sum of the

[35] This notation is convenient since the model is not only solved under steady-state conditions, but during the transition between states.

[36] For the sake of generality, I define all value functions for a generic worker of type $j \in N, M$. However, as explained in 3.1 I abstract from native emigration. Therefore, the decision to emigrate is restricted to immigrants ($j = M$).

[37] As explained in Section 3.1, I assume that when firms and workers first meet, the match quality is unknown.

lifetime flow payment w_j^A:

$$W_j^A = w_j^A + \beta W_j^A \tag{10}$$

and the second term in (9) is the one-time migration utility shock ε_t that workers draw from the distribution $G(\varepsilon)$ each period. After observing the realization of ε_t, the unemployed worker will emigrate if $V_{j,t}^{U,stay} \leq V_t^{mig}$. There exists a threshold value $\varepsilon_{j,t}^{u,*}$ such that $W_j^A + \varepsilon_{j,t}^{u,*} = V_{j,t}^{U,stay}$. In words, $\varepsilon_j^{u,*}$ is the migration-preference shock value that makes an unemployed worker indifferent between staying in the country or emigrating: for any $\varepsilon_t \geq \varepsilon_{j,t}^{u,*}$, the unemployed worker will emigrate and obtain the value of emigrating W_j^A plus the migration-preference shock ε_t.

The value of being unemployed $U_{j,t}$ can then be written as follows:

$$U_{j,t} = G\left(\varepsilon_{j,t}^{u,*}\right) V_{j,t}^{U,stay} + \left(1 - G\left(\varepsilon_{j,t}^{u,*}\right)\right)\left(W_j^A + \mathbb{E}\left[\varepsilon_t | \varepsilon_t \geq \varepsilon_{j,t}^{u,*}\right]\right) \tag{11}$$

where $G\left(\varepsilon_{j,t}^{u,*}\right) = Prob\left(\varepsilon \leq \varepsilon_{j,t}^{u,*}\right)$, the probability that the unemployed worker does not emigrate.[38]

Employed workers

Each period, employed workers decide whether or not to emigrate, with the value of emigrating being the same for all workers regardless their employment status (see equations (9) and (10)).

Workers employed in a match with a known quality

The value for a worker to stay in the country as employed in a match with a known quality is the following:

$$V_{j,t}^{*,stay}(x) = \mathbb{I}_{j,t}(x)\left\{\underbrace{w_{j,t}^*(x) + \beta\left[(1-\lambda) W_{j,t+1}^*(x) + \lambda U_{j,t+1}\right]}_{V_{j,t}^{stay}}\right\} + \left(1 - \mathbb{I}_{j,t}(x)\right) U_{j,t} \tag{12}$$

$$\text{where} \quad \mathbb{I}_{j,t}(x) = \begin{cases} 1 & \text{if} \quad \left(V_{j,t}^{stay}(x) \geq U_{j,t}\right) \wedge \left(J_{j,t}(x) \geq V_t^o\right) \\ 0 & \text{otherwise} \end{cases}$$

where $w_{j,t}^*(x)$ denotes the wage paid to a worker of type j in a job with match quality x. The value function (12) has two terms. The first term stands for the expected discounted value for the worker if she keeps the job. That is, $\mathbb{I}_{j,t}(x) = 1$, which means that for both the worker and the firm, the value of remaining matched is higher than their respective outside options (i.e., the value of unemployment $U_{j,t}$ and the value of a previously created, unfilled job V_t^o). If this is the case, then the worker gets wage $w_{j,t}^*(x)$ today. In the next period, with probability λ, the job is eliminated,

[38] Notice that since ε has an independent and identically-distributed distribution (Fan et al. (2017)) the value functions (8)−(11) do not depend on ε.

in which case the asset value will be given by $U_{j,t+1}$. With probability $1-\lambda$ the job survives, in which case the value is $W^{*}_{j,t+1}(x)$. Lastly, the second term states that in the case of dissolving the match today ($\mathbb{I}_{j,t}(x)=0$), the worker obtains the value of unemployment $U_{j,t}$.

I denote the migration threshold value as $\varepsilon^{*,*}_{j,t}(x)$, such that $W^{A}_{j}+\varepsilon^{*,*}_{j,t}(x)=V^{*,stay}_{j,t}(x)$. Then, the value of being employed in a job with a known quality can be written as:

$$W^{*}_{j,t}(x)=G\left(\varepsilon^{*,*}_{j,t}(x)\right)V^{*,stay}_{j,t}(x)+\left(1-G\left(\varepsilon^{*,*}_{j,t}(x)\right)\right)\left(W^{A}_{j}+\mathbb{E}\left[\varepsilon_t|\varepsilon_t\geq\varepsilon^{*,*}_{j,t}(x)\right]\right) \tag{13}$$

where $G\left(\varepsilon^{*,*}_{j,t}(x)\right)=Prob\left(\varepsilon\leq\varepsilon^{*,*}_{j,t}(x)\right)$, the probability that the worker employed in a job with known quality x does not emigrate.

Workers employed in a match with an unknown quality

The value for a worker to remain in the country and employed in a match of unknown quality can be expressed as follows:

$$\widetilde{V}^{stay}_{j,t}=\widetilde{w}_{j,t}+\beta\left[\lambda U_{j,t+1}+(1-\lambda)\left(\alpha\int_{0}^{x^{max}}W^{*}_{j,t+1}(x')\,dF_j(x')+(1-\alpha)\widetilde{W}_{j,t+1}\right)\right] \tag{14}$$

where $\widetilde{w}_{j,t}$ is the wage paid to workers if the match quality is unknown. If the worker chooses to stay, she receives the wage $\widetilde{w}_{j,t}$. In the next period, with probability λ the worker becomes unemployed and gets U_{t+1}. Otherwise, if the job persists, two events may occur: (1) with probability α the match quality is discovered and the worker makes a draw of x, or (2) the match quality remains unknown and the asset value becomes $\widetilde{W}_{j,t+1}$.

Again, these workers must decide whether to emigrate or not. Let us denote by $\widetilde{\varepsilon}^{*}_{j,t}$ the migration threshold value such that $W^{A}_{j}+\widetilde{\varepsilon}^{*}_{j,t}=\widetilde{V}^{stay}_{j,t}$. Then, the value of being employed in a job of unknown quality can be written as:

$$\widetilde{W}_{j,t}=G\left(\widetilde{\varepsilon}^{*}_{j,t}\right)\widetilde{V}^{stay}_{j,t}+\left(1-G\left(\widetilde{\varepsilon}^{*}_{j,t}\right)\right)\left(W^{A}_{j}+\mathbb{E}\left[\varepsilon_t|\varepsilon_t\geq\widetilde{\varepsilon}^{*}_{j,t}\right]\right) \tag{15}$$

where $G\left(\widetilde{\varepsilon}^{*}_{j,t}\right)=Prob\left(\varepsilon\leq\widetilde{\varepsilon}^{*}_{j,t}\right)$, the probability that a worker employed in a job of unknown quality does not emigrate.

3.4 The Firm's Problem

Firms employing a worker in a match with a known quality

The value function of a firm employing a worker in match of known quality can be written as:

$$\begin{aligned}J^{*}_{j,t}(x)=&G\left(\varepsilon^{*,*}_{j,t}(x)\right)\Big[\mathbb{I}_{j,t}(x)\left\{z+x-w^{*}_{j,t}(x)+\beta\left(1-\lambda\right)J^{*}_{j,t+1}(x)\right\}\\&+(1-\mathbb{I}_{j,t}(x))V^{o}_{t}\Big]+\left(1-G\left(\varepsilon^{*,*}_{j,t}(x)\right)\right)V^{o}_{t}\end{aligned} \tag{16}$$

$$\text{where} \quad \mathbb{I}_{j,t}(x) = \begin{cases} 1 & \text{if} \quad \left(V^{stay}_{j,t}(x) \geq U_{j,t}\right) \wedge \left(J_{j,t}(x) \geq V^o_t\right) \\ 0 & \text{otherwise} \end{cases}$$

First of all, the value to the firm depends on the worker's decision to emigrate or not. With probability $1 - G(\widetilde{\varepsilon}^*_{j,t})$ the worker emigrates, the match is dissolved, and the firm obtains the value of a previously created, unfilled job V^o_t. If the worker stays, she decides whether to preserve the match or not. If the match is maintained, the value to the firm is represented by two terms. The first term is the present profit, given by the difference between production and the wage paid to the worker. The second term consists of expected future discounted profits, which depend on the probability that the job is exogenously destroyed: with probability $1-\lambda$ the job remains productive, in which case the value of expected discount profits will be equal to $J^*_{j,t+1}(x)$; with the remaining probability λ the job is exogenously destroyed and future profits are zero. Lastly, if the match is endogenously dissolved, the firm obtains V^o_t.

Firms employing a worker in a match wtih an unknown quality

The value function of a firm employing a worker in a match of unknown quality is the following:

$$\begin{aligned} \widetilde{J}_{j,t} =& G\left(\widetilde{\varepsilon}^*_{j,t}\right)\left[z + \bar{x}_j - \widetilde{w}_{j,t} + \beta\left[(1-\lambda)\left(\alpha \int_{x^{min}}^{x^{max}} J^*_{j,t+1}(x')dF_j(x')\right.\right.\right. \\ &\left.\left.\left.+ (1-\alpha)\widetilde{J}_{j,t+1}\right)\right]\right] + \left(1 - G\left(\widetilde{\varepsilon}^*_{j,t}\right)\right) V^o_t \end{aligned} \tag{17}$$

Again, the value function depends on the worker's choice to emigrate. The first term stands for the value obtained by the firm if the worker does not emigrate, in which case, during period t the firm obtains the present profit, given by the difference between production and the wage paid to the worker. The next period's value is given by expected future discounted profits, which again depend on the exogenous job-destruction rate. With probability λ the job is destroyed and the firm obtains zero profit. However, if the job survives, one of two events will occur: (1) with probability α the match quality is discovered and the worker makes a draw of x, in which case the firm obtains $J^*_{j,t+1}(x')$; or (2) with probability $1-\alpha$ the match quality is not revealed and subsequently, the firm's asset value is $\widetilde{J}_{j,t+1}$. Finally, the second term is the value the firm receives if the worker emigrates, which is given as the value of a previously created, unfilled job V^o_t.

Firms with previously created, unfilled jobs

The value to a firm, of a previously created, unfilled job position is given by:

$$V_t^o = \max\left\{\underbrace{-\kappa + \beta\left[q\left(\theta_t\right)\left(\phi_t \widetilde{J}_{M,t+1} + (1-\phi_t)\widetilde{J}_{N,t+1}\right) + \left(1 - q\left(\theta_t\right)\right)V_{t+1}^o\right]}_{V_t}, 0\right\} \tag{18}$$

where $\phi_t = \frac{u_{M,t}}{u_t}$ is the share of unemployed immigrants among the total number of unemployed workers.

Every period, firms with a previously created, unfilled job position decide whether or not to post the position. If posted, the value for the firm is given by two terms. The first term, κ, is the flow cost incurred by the firm when posting a job. The second term is the expected future discounted value, which depends on the probability of filling the posted job. So, with probability $q\left(\theta_t\right)$, the posted job is filled. Since search is random, then the firm's option value depends on the probability that the job is filled by a native or immigrant worker, represented by ϕ_t and $1 - \phi_t$, respectively. These probabilities are simply the share of the type of each worker in the total pool of unemployed workers. On the other hand, with probability $1 - q\left(\theta_t\right)$, the posted job remains unfilled and the firm continues to obtain V_{t+1}^o. Finally, if the job is not posted, firms obtain zero value in that period.

New firms

With the presence of a fixed cost, $\bar{K}$, to create a new job, the free entry condition now takes the form:

$$\begin{aligned} V_t = \bar{K} \quad & \text{if} \quad k_t^n > 0 \\ 0 \leq V_t < \bar{K} \quad & \text{if} \quad (k_t^n = 0 \quad \& \quad k_t^{o,p} > 0) \\ 0 > V_t \quad & \text{if} \quad (k_t^n = 0 \quad \& \quad k_t^{o,p} = 0) \end{aligned} \tag{19}$$

Given the timing of the model, a new job created at t can be filled in that same period. Equations (18) and (19) imply that all new jobs created at t will also be posted in that period. Unlike the standard model with free entry, the existence of a fixed cost implies that an unfilled vacancy has a positive value in equilibrium.

3.5 Steady-State Equilibrium

Definition. Given that z, a steady-state equilibrium, is a list $\{w_j^*(x)$, $\widetilde{w}_j$, u_j, k^o, k^n, $\widetilde{e}_j$, e_j^*, $J_j^*(x)$, $\widetilde{J}_j$, U_j, $W_j^*(x)$, $\widetilde{W}_j$, V, V^o, W_j^A, $\mathbb{I}_j(x)$, $\mathbb{I}_{post}$, $\widetilde{\varepsilon}_j^*$, $\varepsilon_j^{*,*}(x)$, and $\varepsilon_j^{u,*}\}$ such that:

1. Agents optimise. Given $w_j^*(x)$, $\widetilde{w}_j$, u_j, k^o, and k^n, the value functions $J_j^*(x)$, $\widetilde{J}_j$, U_j, $W_j^*(x)$, $\widetilde{W}_j$, V, V^o, and W_j^A satisfy equations (8) - (18); the match preservation and job-posting decision rules $\mathbb{I}_j(x)$ and $\mathbb{I}_{post}$ satisfy equations (12) and (18), respectively; and the migration-

preference shock thresholds $\varepsilon_j^{u,*}$, $\varepsilon_j^{*,*}$, and $\widetilde{\varepsilon}_j^*$ satisfy equations (11), (13), and (15), respectively.

2. Job-creation condition. Given $w_j^*(x)$ and $\widetilde{w}_j$, the ratio $\frac{v}{u}$ must be such that $V = \bar{K}$.

3. Bargaining. The wage functions $w_j^*(x)$ and $\widetilde{w}_j$ solve the Nash-bargaining problem in equations (3) and (4).

4. The distributions of workers and jobs are time-invariant according to the laws of motion described in equations (1) - (4) (in Online Appendix A.1).

3.6 Equilibrium Transition Path

Definition. Given a sequence of aggregate productivity $\{z\}_{t=t_0...t_1}$ and a sequence of fixed wages $\left\{\overline{w^*}_j(x), \overline{\widetilde{w}}_j\right\}_{t=t_0...t_1}$, an equilibrium transition path with rigid wages between t_0 and t_1 is a sequence of distributions $\left\{u_{j,t}, k_t^o, k_t^n, \widetilde{e}_{j,t}, e_{j,t}^*\right\}_{t=t_0...t_1}$, a sequence of value functions $\left\{J_{j,t}^*(x), \widetilde{J}_{j,t}, U_{j,t}, W_{j,t}^*(x),\right.$ $\left.\widetilde{W}_{j,t}, V_t, V_t^o, W_j^A\right\}_{t=t_0...t_1}$, a sequence of match preservation decision rules $\{\mathbb{I}_{j,t}(x)\}_{t=t_0...t_1}$, a sequence of job-posting decision rules $\{\mathbb{I}_{post,t}\}_{t=t_0...t_1}$, and a sequence of migration-preference shock thresholds $\left\{\widetilde{\varepsilon}_{j,t}^*, \varepsilon_{j,t}^{*,*}(x), \varepsilon_{j,t}^{u,*}\right\}_{t=t_0...t_1}$ such that:

1. Agents optimise. Given the sequence $\left\{\overline{w^*}_j(x), \overline{\widetilde{w}}_j, u_{j,t}, k_t^o, k_t^n\right\}_{t=t_0...t_1}$, the sequence $\left\{J_{j,t}^*(x), \widetilde{J}_{j,t}, U_{j,t}, W_{j,t}^*(x),\right.$ satisfies equations (8) - (18) in every period t; the sequences of match preservation and job-posting decision rules $\{\mathbb{I}_{j,t}(x)\}_{t=t_0...t_1}$ and $\{\mathbb{I}_{post,t}\}_{t=t_0...t_1}$ satisfy equations (12) and (18), respectively, in every period t; and the sequence of migration-preference shock thresholds $\left\{\varepsilon_{j,t}^{u,*}, \varepsilon_{j,t}^{*,*}(x), \widetilde{\varepsilon}_{j,t}^*\right\}_{t=t_0...t_1}$ satisfy equations (11), (13), and (15), respectively, in every period t.

2. Job-creation condition. Given the sequence $\left\{\overline{w^*}_j(x), \overline{\widetilde{w}}_j, u_{j,t}, k_t^o, k_t^n\right\}_{t=t_0...t_1}$, the ratio $\frac{v_t}{u_t}$ in each period t must be such that $V_t = \bar{K}$ if new jobs are created ($k_t^n > 0$); $0 \leq V_t < \bar{K}$ if no new jobs are created but firms post their previously created, unfilled jobs ($k_t^n = 0$ and $k_t^{o,p} > 0$); or $V_t < 0$ if neither new jobs are created nor previously created, unfilled jobs are posted ($k_t^n = 0$ and $k_t^{o,p} = 0$). That is, equation (19) holds in each period t.

3. Law of motion. The distributions evolve according to the laws of motion described in equations (1) - (4) (in Online Appendix A.1).

3.7 Simulating the Great Recession

The goal of the model is to simulate the performance of the labor market during the Great Recession that took place in 2008Q2.[39] The standard approach would be to solve for the pre-crisis period

[39] The second quarter of 2008 is chosen as the start of the Great Recession as it was the first quarter with a negative quarterly growth rate of real GDP in Spain.

(2008Q2) as an initial steady state, then drop the aggregate productivity and compute the transition path towards a final steady state (in 2016). However, as Figure 1 shows, before the Great Recession, the Spanish labor market was characterized by a combination of low unemployment rates, high foreign inflows, and low foreign outflows. This implies that the share of immigrants was growing, which prevents us from assuming that the environment was stationary.[40] To find a solution, I take the following approach (see also Figure 4):

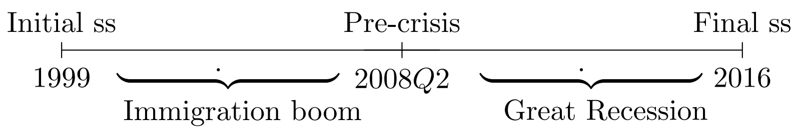


Figure 4: Roadmap

- I first solve the model in an initial steady state at the beginning of 1999, with $z = z^H$. This economy aims to resemble the Spanish economy of the years before the Great Recession. For this reason, the model is calibrated to match empirical moments in the data for Spain in the period 2005Q1-2008Q2.[41] Importantly, I use the immigrant share in 1999 as target. In that year, foreign inflows and outflows were very similar and, therefore, the share of immigrants was stationary.[42]

- The economy is then unexpectedly shocked by the immigration boom: an equilibrium transition path from 2000 to 2008Q2 is solved by introducing the actual inflows of foreign-born workers $\{m_{M,t}\}_{t=2000...2008Q2}$ that are observed in the data for that period.[43] This transition is called the immigration boom. Agents expect the immigration boom to last forever (i.e., firms and workers do not expect that the transition will stop or that aggregate productivity will drop in 2008Q2).

- I solve the model for the final steady state in 2016. Two exogenous changes are introduced with respect to the initial steady state. First, I introduce a permanent and unexpected negative shock to aggregate productivity ($z = z^L < z^H$).[44] Secondly, immigrant inflows,

[40] In particular, assuming that the pre-crisis economy is in a steady state would impose the unrealistic equilibrium condition on the stationarity of the distribution of immigrants, which by definition only holds when foreign inflows equal foreign outflows. Notice that this is not an issue in 2016, i.e., the final steady state.

[41] Ideally, I would like to use data moments for the period 2000-2008. However, the SLFS-Flows (used to compute employment flows) only started to provide information on respondents' nationalities in 2005. Nevertheless, as Figure 1 shows, unemployment rates from 2000 to 2005 did not vary much, so I do not expect that there were big differences in the employment transition rates during that period.

[42] See Fernández-Huertas Moraga and López-Molina (2018) for a detailed description on gross flows of migration in and out of Spain.

[43] Specifically, $\{m_{M,t}\}_{t=2000...2008Q2}$ is the average inflow of foreign-born workers that arrived to Spain between 2000 and 2008Q2.

[44] I do not aim to uncover the underlying causes of the negative shock that triggered the onset of the Great Recession. In the model, the drop in aggregate productivity z could be interpreted as the reduced form of the main global and Spain-specific idiosyncratic causes that set off the crisis: the burst of the real estate bubble, global financial turbulence, the low pre-crisis levels of real productivity growth, the high level of private debt, etc. See

m_M, are dropped to account for the observed foreign inflows in the years following the crisis.

- Lastly, the equilibrium transition path from 2008Q2 to 2016 is computed (the Great Recession). Online Appendix B.2 provides the detailed computation algorithm.[45] Foreign-born worker inflows $\{m_{M,t}\}_{t=2008Q2...2016}$ are set to the actual inflows of the corresponding period.

4 Calibration

I calibrate the model to the Spanish economy during the period 2005Q1-2008Q2. In the calibration I tie some parameters to empirical counterparts or values commonly used in the literature, and jointly calibrate all the rest to relevant moments of the Spanish data.

Functional forms

I assume that the distribution of match-quality draws $F_j(x)$ is log-normal with parameters (μ_j, σ_j).[46] The migration-preference shock $G(\varepsilon)$ is assumed to follow a normal distribution[47] with a zero mean[48] and standard deviation σ_ε. For the quantitative analysis, both distributions are discretized. I use 100 equidistant nodes to approximate the log-normal distribution of match-quality productivity $F_j(x)$ and 200 equidistant nodes for the grid of migration-preference shocks.

Pre-Specified Parameters

There are two types of parameters in the model. Some are directly equated to their empirical counterparts or are taken from the literature. Others are obtained by matching a set of moments in the data. The top panel of Table 3 lists those model parameters that I take from the literature or observe directly in the data. I normalize the mean wage of native workers to be 1 in equilibrium. Aggregate productivity z is set to 0.31. Each period in the model is one month,[49] and therefore, the discount factor β is set to 0.9967 to reflect an annualized real interest rate of 4.1%. I follow most of the search literature in setting the elasticity of the matching function δ equal to 0.5. The

Fernández-Villaverde et al. (2010), Ortega and Peñalosa (2012), or García-Santana et al. (2020) for more details on the roots of the Great Recession in Spain.

[45] See Dolado et al. (2021) for a similar implementation of transitions.

[46] There is no obvious empirical counterpart to match this distribution. The choice of log-normality follows Mortensen and Nagypal (2007), and it is supported by the evidence that wages are log-normally distributed. I depart from the assumption of mean zero log-normality. Instead, I calibrate the parameters of distribution $F_j(x)$ to match the empirical wage mean. See subsection 4 for details on the identification.

[47] Assuming extreme-value type-1 distributions is more common in the migration literature, as they simplify the analysis when the migration choice involves several destinations. Since here the choice is simply to stay or leave the country, assuming normality does not involve technical complications.

[48] From equations (9) and (10) we can see that the mean of the migration-preference shock distribution and the flow payment associated with working abroad, w_j^A, play the same role in the model. Therefore, by assuming that the migration-preference shock distribution has zero mean, we drop one redundant parameter that otherwise would have to be estimated.

[49] For the sake of comparison with the data, I time-aggregate some of the model-generated moments to a quarterly frequency.

bargaining power of workers, γ, is set to 0.8.[50] This is higher than the value usually set in the literature, and it was chosen because of the high rigidities that characterize the Spanish labor market.[51] As in Bils et al. (2011), I give a predominant role to the endogenous match-separation channel over exogenous separations by setting the exogenous monthly separation probability equal to 0.0017 (0.005 quarterly). Lastly, using the estimates in Hall and Milgrom (2008), I fix the flow payment of unemployment b_j to represent 70% of the mean wage of each group, implying $b_N = 0.7$ and $b_M = 0.47$.

Table 3: Calibration Results

Description	Parameter	Value	Target/Source	Data	Model
Calibrated externally					
Discount factor	β	0.9967	From literature		
Matching funct. param.	δ	0.5	From literature		
Worker bargain. power	γ	0.8	From literature		
Job destruction	λ	0.0016	Bils et al. (2011)		
Native unemp. benefit	b_N	0.700	Hall and Milgrom (2008)		
Immig. unemp. benefit	b_M	0.471	Hall and Milgrom (2008)		
Calibrated internally					
Matching efficiency	ξ	0.138	Native JFR	0.310	0.304
Prob. to discover quality	α	0.272	Immigrant SR	0.055	0.056
Flow cost posting a job	κ	0.058	Worker hiring cost	0.420	0.395
Fixed cost creating a job	$\bar{K}$	15.362	Vacancy rate	0.080	0.080
Immigrant wage abroad	w_M^A	0.302	Immigrants LF share	0.021	0.021
Native mean match qual.	μ_N	0.292	Native mean wage	1.000	1.000
Immig. mean match qual.	μ_M	0.076	Imm. mean wage	0.700	0.670
Native match qual. s.t.d.	σ_N	0.456	Native SR	0.027	0.027
Imm. match qual. s.t.d.	σ_M	0.325	Wage s.t.d. N/M ratio	1.618	1.570
Migration shock s.t.d.	σ_ε	239.653	Migration prob. ratio	1.467	1.260

Calibrated Parameters

The remaining 10 parameters are jointly calibrated to ensure that the initial steady state of the model matches a number of relevant empirical moments in the data. I search for the combination of parameters that minimizes the following loss function:

$$\mathbb{L} = \sum_{c=1}^{C} \left| log\left(m_c^M\left(\Theta\right)\right) - log\left(m_c^D\right)\right| \tag{20}$$

where m^D is a C-by-1 vector containing the data moments used as calibration targets and $m^M(\Theta)$ is the C-by-1 vector containing the counterpart model moments, which is a function of the whole

[50] In a model with endogenous separations, Mortensen and Nagypal (2007) also choose a higher-than-standard bargaining power (0.71) for workers, arguing that the role of this parameter differs with respect to the standard version of the model with exogenous separations.

[51] This can be interpreted as a reduced-form way of accounting for the evidence that Spanish labor institutions are less conducive to low levels of unemployment than institutions in similarly developed countries. In particular, as argued by Bentolila and Jimeno (2006), in Spain, the combination of a high incidence of industry-level (collective) bargaining and high levels of union power drive wages up and move them away from worker productivity. See Bentolila and Jimeno (2006) and Bentolila et al. (2012) for more details on the institutional characteristics of the Spanish labor market.

set of parameters to be calibrated Θ. I choose $C = 10$, so the model is exactly identified. The bottom part of Table 3 displays the list of the parameters that are jointly estimated and the data moment that identifies each of them.

The labor market flows (job-finding rates and job-separation rates) and the immigrant share are computed using the SLFS-Flows. For wages I use data from the 2006 Spanish Wage Structure Survey.[52] Online Appendix F.1 provides details on the data. The vacancy rate is computed for the period 2000-2008.[53] I use administrative data from Spanish Social Security registers ("*Muestra Continua de Vidas Laborales*") to approximate the return migration probabilities for employed and unemployed immigrants.

Given the nonlinearity of the model, the value of all the parameters, in principle, affects the whole set of moments used as targets. Nevertheless, it is possible to specify which moment provides information on each particular parameter. The mean of the match-quality distribution μ_j mainly affects the mean wage of each group. The standard deviation of the native match-quality distribution σ_N is set to replicate the native job-separation rate. In turn, the standard deviation of the immigrant match-quality distribution σ_M is calibrated to match the native-immigrant ratio of the standard deviation of wages. The smaller the variance in the immigrant match-quality distribution (σ_M), the more concentrated their draws will be, and hence, the lower the dispersion of their equilibrium wages. The learning parameter α is identified by the immigrant job-separation rate. The intuition for this goes as follows: in a steady state, all the endogenous job separations (the ones that are not driven by the return migration of immigrants) occur when the match quality x is learned, and it turns out that the match surplus for that x is negative.[54] This means that the higher the learning probability α, the faster agents will discover bad quality matches (i.e., matches with an x that is below the threshold x^* that makes the firm indifferent between remaining matched with the worker or dissolving the match), and hence, the more separations will occur in equilibrium.

The fixed cost $\bar{K}$ is set to match the observed vacancy rate: an increase in the cost of creating a job raises the opportunity cost of closing it, which increases the pool of previously created, unfilled jobs.[55] The flow cost κ is chosen so that per-worker hiring costs κ/q equal 14% of quarterly worker compensation, in line with Elsby and Michaels (2013).[56] The matching efficiency parameter ξ equals 0.13 in order to match the native job-finding rate (Bils et al. (2011)). The immigrants' wage

[52] We use this year as representative of the pre-crisis period.

[53] Due to the existence of differences in data sources over different spans of time, analyzing vacancy data is not straightforward. I follow Boscá Mares et al. (2017) to construct a homogeneous time series of the stock of vacancies during the period from 2000-2018, combining three sources: the "Unfilled Job Vacancies" series (OECD), the "Job Vacancy Statistics" (Eurostat), and the "Quarterly Labor Cost Survey" (Eurostat). Online Appendix F.2 provides details on the computation.

[54] This is a consequence of considering that the match quality is constant over the duration of the match. In Mortensen and Pissarides (1994), endogenous separations arise because the match qualities change stochastically.

[55] Alternatively, we may think that the higher $\bar{K}$ is, the further we are from the standard search and matching model with free entry, where the pool of posted jobs are simply the newly created ones.

[56] This target moment has been widely used in the search and matching literature. I use estimates from Silva and Toledo (2009). Notice that their definition of worker-hiring costs does not include any fixed cost. Therefore, the existence of a fixed cost in my model does not prevent me from using it as a target. As the period in the model is a month, and the monthly mean wage is normalized to one, this moment leads to the value 0.42 in Table 3.

abroad w_M^A is calibrated to match the proportion of immigrants in the labor force. Lastly, the standard deviation of the migration-preference shock σ_ε replicates the return-migration probability ratio between employed and unemployed workers. The higher the value of σ_ε, the higher the probability that an immigrant employed in a high quality match will emigrate, and hence the lower the unemployed-employed return-migration probability ratio.

Calibration Results

The model is able to replicate the full extent of the wage gap observed in the data by making the mean of the distribution of the match-quality draw μ_j lower for immigrants than for natives. The dispersion of the distribution is also lower for immigrants. This is revealed in their higher job-separation rate and higher wage dispersion. The job-creation cost $\bar{K}$ is 30 times the job-filling cost, which implies a ratio of aggregate creation costs to output of 2%, in line with its empirical counterpart. The estimated value of α is 0.27, implying that learning is fast: after 3 months, more than 60% of all matches have learned their actual productivity, consistent with the results of Menzio et al. (2016).

4.1 Model Performance

To further explore the implications of the baseline model, I test it along the transition from the pre-crisis period to the final steady state, which is a non-targeted dimension. This transition aims to match the labor market performance of the Spanish economy during the Great Recession. As explained before, what triggers the transition is the unexpected drop in aggregate productivity z. The decrease in z is chosen so that the model generates a realistic change in the job-finding rate and output per capita from 2008 to 2016,[57] which is achieved with a 1.96% decrease. In the Online Appendix we discuss the quantitative properties of the model economy at both the initial and final steady states, and during the pre-crisis period.

As Figure 5 shows, the model does a remarkably good job of matching the decrease in the share of the immigrant labor force. Since foreign inflows are fixed to actual flows (see Section 4), it implies that the model is successful at endogenously generating foreign outflows that are very similar to those observed in the data.

Figure 6 plots the evolution of labor market flows during the Great Recession in the model (top panel) and in the data (bottom panel). The model is successful at generating a smooth decrease in the job-finding rate (left-hand panel), which is achieved by the introduction of a fixed cost for creating a job. As Figure 7 shows, the smooth drop in market tightness cannot be replicated in the standard model with free entry, where vacancies are a jump variable (Fujita and Ramey (2007)): the job-finding rate converges immediately to its final steady-state value.[58] Regarding job-separation

[57] Output per capita drops 5.85% in the model and 5.74% in the data.

[58] To solve the model without a fixed cost of creating a job ($\bar{K} = 0$), I keep all parameters unchanged except the flow cost of posting a vacancy κ, which is set to 0.15. This value is chosen so that the model matches the job-finding

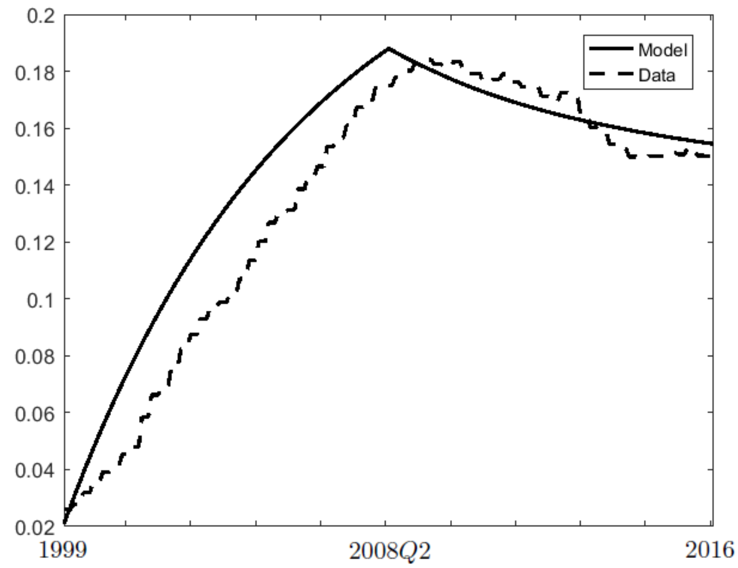


Figure 5: Low-skilled immigrant labor-force share: Model economy vs data.

rates (right-side panel of Figure 6), the model can account for the spike in employment destruction for both types of worker. Furthermore, it is consistent with the empirical fact that immigrants are more sensitive to the cycle. As the top-right panel shows, the increase in the job-separation rate is higher for immigrants than for natives (11 vs 8.6 percentage points) due to the lower dispersion in the match-quality draws of immigrants (i.e., $\sigma_M < \sigma_N$, see Table 3): immigrants are more concentrated in matches with quality x close to the quality threshold below which workers are fired (Figure 3 in Online Appendix F). As a consequence, when the crisis hits (i.e., when aggregate productivity z drops), a higher fraction of them become unproductive and hence a higher share of such workers get endogenously separated. The model overestimates the increase of job-separation rates on impact, mainly because the drop in aggregate productivity z is a one-time shock: the model compresses all the employment adjustment into a single period.[59]

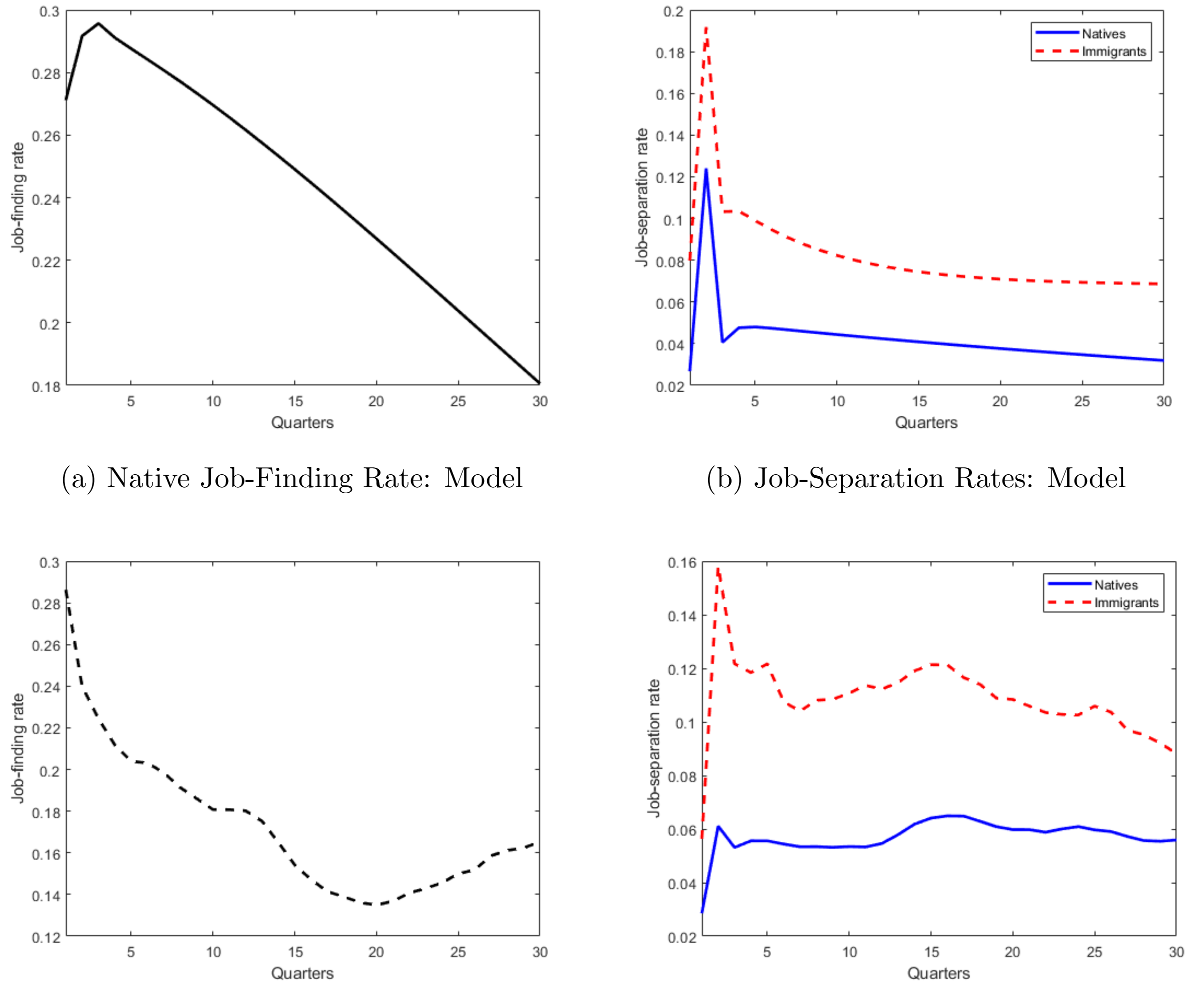
5 Counterfactual Analysis

To assess the effects of immigration during the Great Recession with the calibration that replicates the data, I solve for the recession (i.e., the transition path from the pre-crisis period to the final steady state) in a counterfactual economy without foreign inflows during the expansion.

I refer to this counterfactual as the "no immigration" economy, and it simply consists of an economy transiting from the initial steady state in 2000 to the pre-crisis state in 2008Q2 without immigrants coming into the labor market (i.e., foreign inflows are set to zero: $\{\bar{m}_{M,t}\}_{t=2000...2008Q2} =$

rate at the initial steady state.

[59] I keep the modelling of the negative shock as simple as possible for computational reasons. Nevertheless, the model fit could be improved by adding some frictions in the firing decision or by imposing a smooth drop in z.



(a) Native Job-Finding Rate: Model

(b) Job-Separation Rates: Model

(c) Native Job-Finding Rate: Data

(d) Job-Separation Rates: Data

Figure 6: Model prediction and data during the Great Recession: Labor market flows. Panels (a) and (b) show the native job-finding rate and the job-separation rates (by nationality) from the model. Panels (c) and (d) display the native job-finding rate and job-separation rates (by nationality) seen in the data taken from the SLFS-Flows for the period 2008Q3-2016Q1. The data series are filtered using a four-quarter moving average. The horizontal axes show the number of quarters since the onset of the Great Recession. See text for details.

0).[60] Once the pre-crisis state of the "no immigration" economy is found, I hit the economy with the same drop in aggregate productivity z as in the baseline model and solve for the Great Recession. I compare the labor market outcomes of the "no immigration" counterfactual with those of the baseline economy.

[60]Notice that the initial steady state (2000) is common for the baseline and the "no immigration" economies. On the other hand, in the "no immigration" economy, despite inflows being set to zero, there are immigrant outflows: this is the reason for the slight drop in the immigrant share in the "no immigration" economy from 2000 to 2008Q2 (Figure 4 in Online Appendix F).

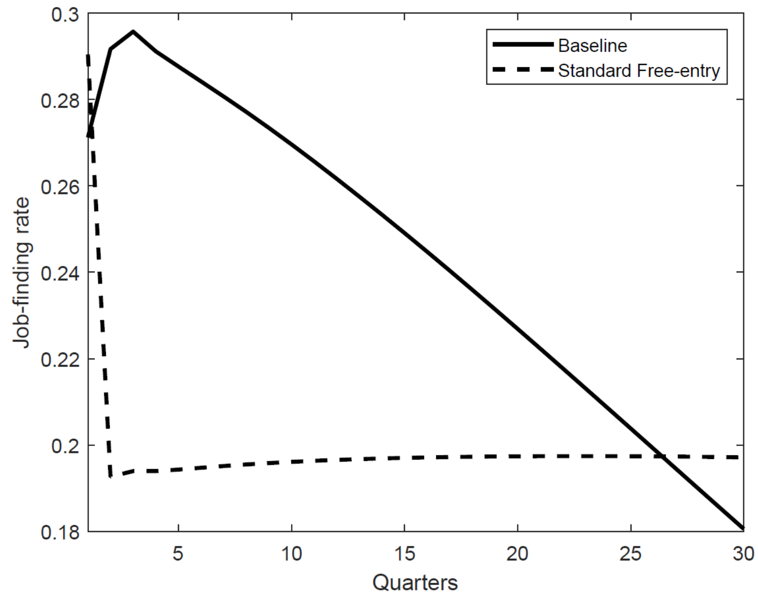


Figure 7: The native job-finding rate: Baseline model vs standard free-entry model

5.1 Model Mechanisms

The model outlined in the previous section features three different channels through which a rise in the immigrant share affects the job-finding rate of natives and therefore, their labor market outcomes during the recession.

The Job-Creation Effect

An increase in foreign inflows changes the composition of the pool of unemployed workers, affecting the decisions firm make regarding job creation (see equation (18)). The sign of this effect depends on how the expected value of a match with an immigrant, ($\widetilde{J}_M$), compares to that of native, ($\widetilde{J}_N$). These values, in turn, are determined by the heterogeneity between immigrants and natives. On the one hand, immigrants may leave the country while employed, which, *ceteris paribus*, makes them less attractive to firms. On the other hand, the immigrant unemployment flow payment b_M is lower than that of natives, implying that firms can extract a higher surplus from immigrants. Lastly, natives and immigrants draw their match qualities from different distributions. The sign of the job-creation effect is therefore ambiguous.

The calibration (Subsection 4) shows that $\widetilde{J}_N > \widetilde{J}_M$, so the job-creation effect is negative: a rise in the share of immigrants among the unemployed, ($\uparrow \phi$), lowers firms' expected surplus from a match. This has two implications: first, the final state with more immigrants features less job creation in equilibrium, and second, during the recession, firms will delay the time at which job creation is reactivated, putting upward pressure on the native unemployment rate.

The Return-Migration Effect

As job creation involves a fixed cost for firms, an employed worker emigrating implies that a job becomes available to be posted again and could be filled by an unemployed worker. If an economy is shocked (e.g., a recession occurs), the relative value of staying in the country as employed lowers, driving up emigration. This, in turn, will increase in the pool of created but vacant positions ($\uparrow k_t^o$), and hence, the job-finding rate will go up. The sign of this channel is unambiguously positive for natives: the more employed immigrants there are before a recession takes place, the stronger this effect.

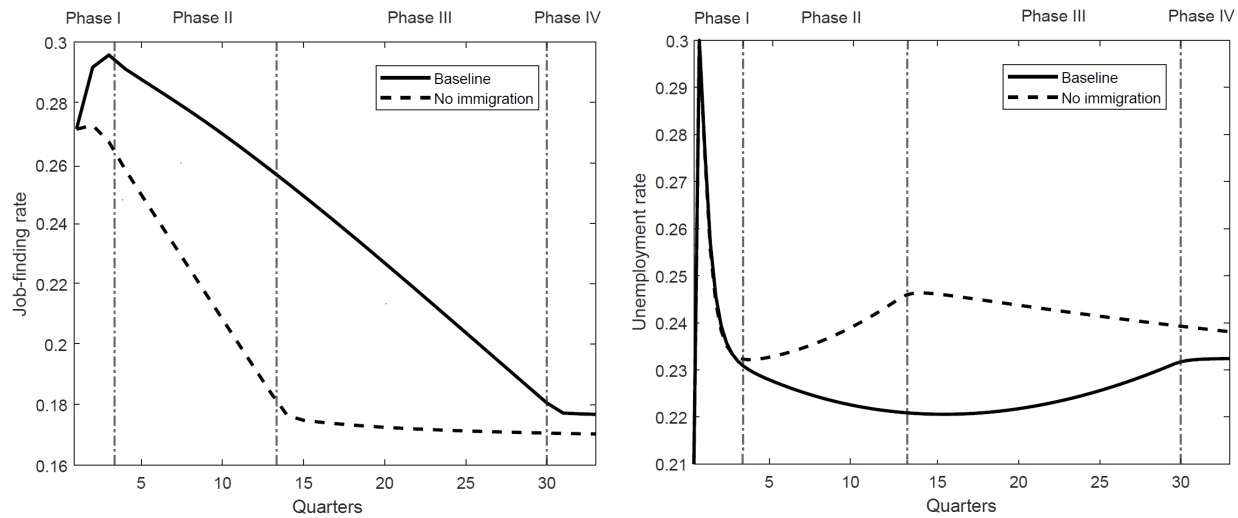
What about the effect of unemployed immigrants emigrating? As discussed above, the job-creation effect of immigration is negative. Therefore, the emigration of unemployed immigrants drives up the expected benefit of creating a job. In other words, accounting for return migration moderates the negative sign of the job-creation channel.

The Match-Destruction Effect

As pointed out in Subsection 3.1.4, following Pries and Rogerson (2005), I assume that after an endogenous separation, the job position is not destroyed but instead enters the pool of previously created, unfilled jobs k^o. This, together with the fact that match destruction is higher for immigrants than for natives (see Figure 6), implies that the higher the share of immigrants, the higher the fraction of workers who will lose their jobs after a crisis hits. Therefore, the increase (on impact) of k^o will be larger, and hence increase the native job-finding rate. This match-destruction effect is unambiguously positive on impact. However, its sign is unclear in the long run: as a larger number of immigrants join the pool of the unemployed, there will also be a worsening of firms' incentives to create jobs (i.e., the job-creation effect), which in turn will delay the creation of new jobs.

5.2 The Effects of Immigration

Figures 8 and 9 illustrate the transition path of the main labor market indicators in the baseline economy (solid line) and in the counterfactual economy without foreign inflows during the expansion (dashed line). These two economies differ in immigrant share (Figure 4 in Online Appendix F), which implies that the starting points of their transitions are different. (By definition, their pre-crisis states are not the same.) For the sake of comparison, the starting point of all figures is normalized to the pre-crisis value of the baseline economy. The model predicts that the increase in the native unemployment rate after the Great Recession is the same in both economies (right-hand panel of Figure 8). However, unemployment rates diverge shortly into the transition. Specifically, the drop is faster in the baseline economy, suggesting that the native unemployment rate would have been higher without immigration: three years after the Great Recession, the native unemployment rate



(a) Native Job-Finding Rate

(b) Native Unemployment Rate

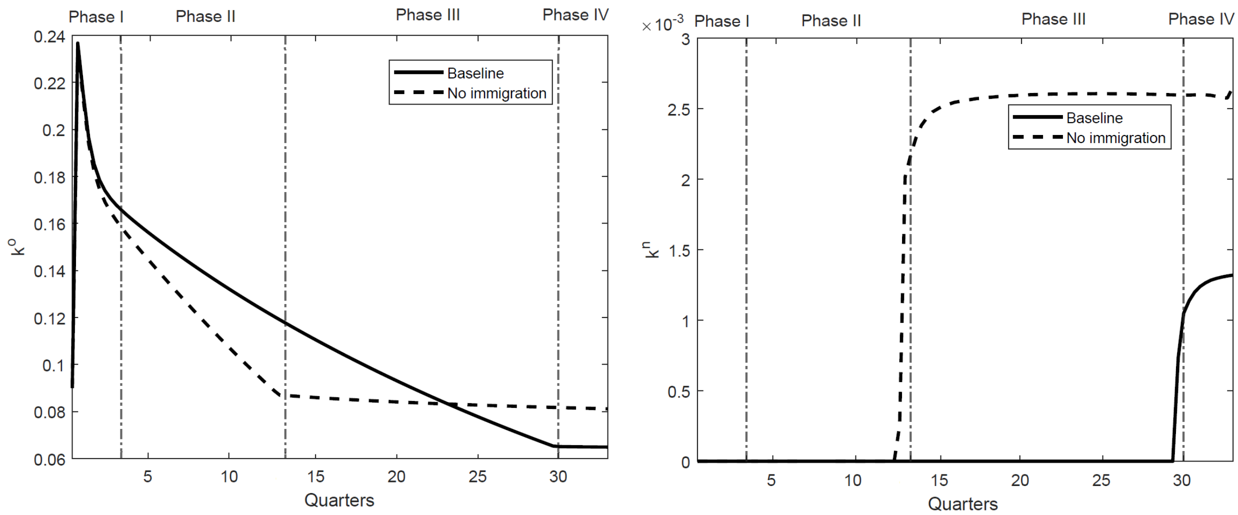
Figure 8: The effect of immigration: Native labor market performance

would have been three percentage points higher (around 260,000 workers[61]) without immigration.

The decline in the job-finding rate is smoother in the baseline economy than in the counterfactual one (left-hand panel of Figure 8), which explains the evolution of the unemployment rate. Since immigrants have a higher job-separation rate than natives, in the baseline economy (with a larger immigrant share) the fraction of matches that are endogenously destroyed on impact is larger. This implies, on impact, a larger increase in the stock of previously created, unfilled jobs (left-hand panel of Figure 9), and hence a higher increase in the native job-finding rate immediately after the shock (i.e., the *match-destruction effect*). The *return-migration effect* plays its role during the transition to the new steady state, explaining the divergence in the job-finding rate of the two economies: during the transition, in the baseline economy, some immigrants leave the country, driving the job-finding rate up. Finally, a higher share of immigrants results in a negative job-creation effect, which implies that it takes more time for firms to start creating new jobs after a crisis hits.

To better understand the diverging transition paths of the native unemployment rate in the two scenarios, I split the Great Recession into four phases. In the first phase, $Q \in [1-3]$, the unemployment rate drops very quickly in the two economies. This occurs (despite no job creation, see the right-hand panel of Figure 9) because the job-finding rate remains high due to the increase in the stock of previously created, unfilled jobs (left-hand panel of Figure 9) following the extensive match destruction generated by the negative shock. Here we can clearly identify the *match-destruction effect*: in the baseline economy, with more immigrants, there are more separations on impact. This explains the higher increase in the stock of jobs, and therefore, the larger increase in the job-finding

[61] To obtain this number I use the following formula: $(e^b_N - e^c_N)e^{data}_N$, where $e^b_N and e^c_N$ are the total number of employed natives in the baseline and counterfactual economies, respectively, and e^{data}_N is the total number of employed natives in 2007Q4.



(a) Previously Created, Unfilled Jobs

(b) New Jobs Created

Figure 9: The effect of immigration: Vacancy dynamics

rate right after the crisis. However, unemployment rates during this phase are very similar in the two economies, suggesting that the magnitude of this effect is small. This result will be confirmed in the next section.

In the second phase, $Q \in (3, 13]$, the creation of new jobs is zero in both economies, implying that the only chance of leaving unemployment is through jobs that were already created (i.e., previously created, unfilled jobs). The quantity of already-created jobs is decreasing in both economies, but the speed is slower in the baseline economy (left-hand panel of Figure 9). This is explained by the *return-migration effect*: in the "no immigration" economy few workers leave the country, and consequently, few jobs open up. This explains the increase in the native unemployment rate in the "no immigration" economy. In contrast, in the baseline economy, more workers leave the country, which slows down the job-finding rate decline (left-hand panel of Figure 8). Ultimately, this helps natives recover employment (right-hand panel of Figure 8).

In the third phase, $Q \in (13, 30]$, the native unemployment rates in the two economies converge. Here the *job-creation effect* becomes relevant. As the right-hand panel of Figure 9 shows, at $Q = 13$ job creation is reactivated in the "no immigration" economy, whereas in the baseline economy, firms do not yet create new jobs. Consequently, the job-finding rate stops dropping in the counterfactual economy, and the unemployment rate decreases, in contrast to the baseline economy. As stated before, job creation recovers faster in the counterfactual economy because the pool of unemployed individuals is "better" than in the baseline economy (i.e., the job-creation effect of immigration is negative). Of course, in the absence of the return migration of unemployed workers, job creation would be delayed even more in the baseline economy.

Lastly, after $Q = 30$, firms start creating new jobs again in the baseline economy, and unemployment among natives falls in both economies.

Welfare effects by employment status

This subsection compares the relative change in the value function from the pre-crisis state to the recession (two years after the shock) in both the baseline economy and the counterfactual economy that has no foreign inflows.[62] Table 4 displays the results for native workers (for immigrant workers, see Table 1 in Online Appendix F). The Great Recession generated welfare losses for all workers regardless their employment status. The model suggests that, for unemployed natives, the welfare drop would have been 0.41 pp higher in the case of no immigration (first column).[63] Welfare losses are also lower for natives employed in a job of unknown quality (0.28 pp, second column) and for those employed in jobs with a known quality x who get fired, in both economies (0.32 pp, third column).The welfare effect of immigration is negligible for workers employed with the highest match qualities (last column). This is expected, as these workers are very unlikely to become unemployed, and the model predicts that most of the impact of immigration manifests through the job-finding rate.

Table 4: Native welfare change (pp) in the baseline economy and the "no immigration" economy

	${\mathbb{W}_{\mathbb{N}}}^U$	$\widetilde{\mathbb{W}}_N$	$\mathbb{W}^*_N(x^*)$	$\mathbb{W}^*_N(x^{max})$
Baseline	-3.50	-3.24	-4.51	-0.32
No immigration	-3.90	-3.52	-4.83	-0.32
Difference	0.41	0.28	0.32	0.00

Notes: The table reports the welfare change (in percentage points) from the pre-crisis period to two years after the negative aggregate shock. The first two rows display the results for the baseline economy and for the counterfactual economy, respectively. The last row shows the results of subtracting the welfare drop obtained in the counterfactual to the one obtained in the baseline model. Welfare changes are reported for different workers: Column ${\mathbb{W}_{\mathbb{N}}}^U$ reports the welfare change for unemployed native workers; Column $\widetilde{\mathbb{W}}_N$ reports the welfare change for workers employed in matches with an unknown match quality; Column $\mathbb{W}^*_N(x^*)$ reports the welfare change for workers employed in matches endogenously destroyed in both the baseline and counterfactual economies; and Column $\mathbb{W}^*_N(x^{max})$ reports the welfare change for workers employed in matches with the highest qualities.

Inequality

I compute the growth of the Gini index (using value functions) from the pre-crisis state to the recession (again, two years after the shock) in both the baseline and the "no immigration" economies.

[62] Value functions are the most appropriate measure of welfare in the model. By risk neutrality, they equal expected discounted wages. We can interpret the change in the value that workers attain in equilibrium as the consumption-equivalent change in the present discounted value of flow utility after the drop in aggregate productivity.

[63] Notice that because of the way I computed the last row of Table 4 (see Notes), a positive difference means that the welfare drop is lower in the baseline than in the counterfactual economy.

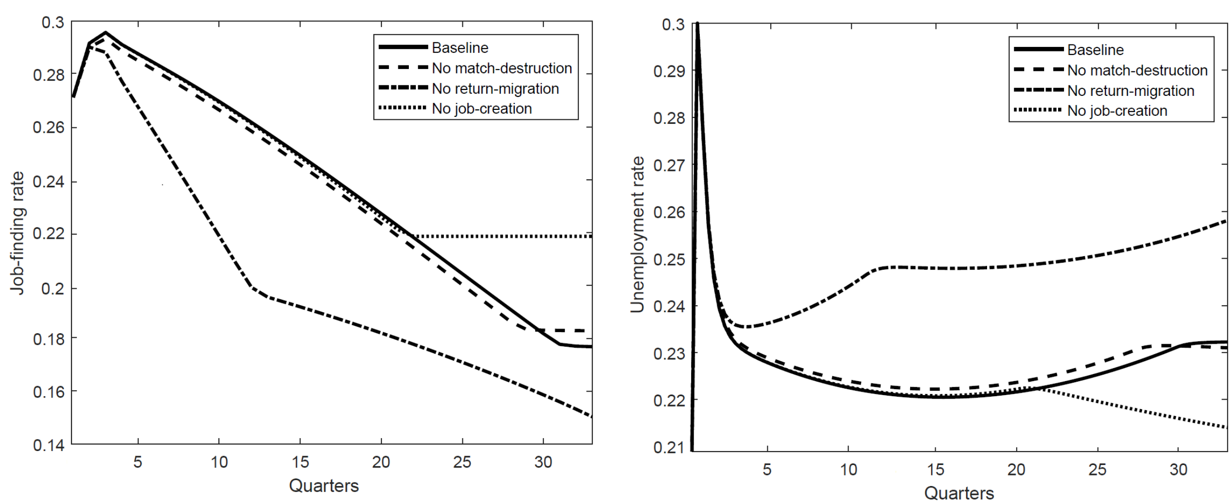
The results suggest that the increase in inequality would have been higher without immigrants (12.30%) than in the baseline economy (11.20%).

5.3 Decomposition Analysis

5.3.1 The contribution of each mechanism

This section quantitatively assesses the contribution of each models' channels (job-creation, return-migration, and match-destruction) to the overall effect of immigration during the Great Recession. To do this, I shut down each of the three channels and compare the main labor market outcomes in each of the three restricted versions of the model compared to the (full) baseline model. Online Appendix D provides details on the decomposition.

Figure 10 displays the evolution of the native job-finding and unemployment rates in each of the restricted versions of the model as well as in the baseline. Let us first focus on the model without job creation. We switch off this channel by artificially lowering the probability that firms expect to be matched with an unemployed immigrant (ϕ). In doing this, firms restart job creation sooner than in the baseline model (right-hand panel of Figure 6 in the Online Appendix). In particular, the creation of new jobs picks up five years after the shock ($Q = 22$), and from that moment on, the job-finding rate diverges from the baseline, and the native employment rate recovers more quickly (Figure 10).[64] As Table 5 shows, in the long run (eight years after the shock), the native unemployment rate is 1.8 percentage points lower in the model without the job-creation channel than in the baseline model, though it has no impact in the short run.



(a) Native Job-Finding Rate (b) Native Unemployment Rate

Figure 10: Decomposition analysis: Native labor market performance

[64]Notice that by exogenously lowering firms' beliefs about immigrants' unemployment share (ϕ), the final steady state changes as well. Therefore, not only does the unemployment rate fall faster in this version of the model, but it is also lower in the steady state.

Table 5: Native unemployment rate difference (pp) between each restricted model and the baseline

Years after the shock	1	2	3	6	8
No match destruction	0.10	0.12	0.10	0.23	-0.10
No return migration	0.62	1.62	2.66	2.57	2.47
No job creation	0.00	0.00	0.00	-0.39	-1.75

Notes: Differences in the native unemployment rate in each of the restricted models with respect to the baseline model. A positive number means that the native unemployment rate is higher in the restricted model than in the baseline.

Quantitatively the match-destruction effect is almost negligible (Figure 10 and the first row of Table 5), both in the short run and the long run. However, it is interesting that the sign of the effect differs depending on the time horizon. In particular, shutting down match destruction has a negative impact on native employment in the short run (two years after the shock, the native unemployment rate is 0.12 percentage points higher than in the baseline), while it has a positive effect in the long run (eight years after the shock, the native unemployment rate is 0.10 percentage points lower). The reason for the negative short-run effect is that right after the crisis hits, the rise in k^o would be lower than in the baseline (left-hand panel of Figure 6 in the Online Appendix). However, job creation picks up earlier and there is less match destruction, as fewer immigrants become unemployed. In other words, switching off match destruction alleviates the negative job-creation effect of immigration.

Return migration is the key channel that explains the smoother drop in the native job-finding rate during the Great Recession. In the economy without return migration, the drop in the job-finding rate is much steeper. Three years after the shock, the native unemployment rate is 2.66 percentage points higher when return migration is not allowed (second row of Table 5). The impact of return migration remains large in the long run: eight years after the shock, the native unemployment rate is 2.47 percentage points higher than in the baseline economy. Overall, return migration is quantitatively the most important channel, both in the short run and in the long run. In the short run (one to six years after the shock), the average impact of return migration on the native unemployment rate is 10 times as large as the sum of the others two channels. In the long run (eight years after the shock), the positive impact of return migration overcomes the negative effect of the other two channels. Its impact is 1.34 times as large as the sum of the (negative) impact of the other two channels.

5.3.2 The Return-Migration Effect

The overall effect of immigrants' return migration stems from the combination of two channels: the return migration of unemployed workers and that of employed workers. Understanding which one is the main driver has important implications for policy design. For instance, if a government aims to promote return migration, the optimal policy should focus on designing the right incentives for the group (employed or unemployed) that has the largest impact, as we might expect that employed and unemployed workers respond differently to economic incentives.[65] In order to disentangle the two effects, this section solves for the Great Recession in two restricted versions of the model in which either employed or unemployed immigrants are not allowed to leave the country.

Table 6: Native unemployment rate difference (pp) between each restricted model and the baseline

Years after the shock	1	2	3	6	8
No employed immigrant return	0.12	0.47	0.89	1.76	1.16
No unemployed immigrant return	0.12	0.31	0.50	1.11	1.24

Notes: Differences in the native unemployment rate in each of the restricted versions of the model with respect to the baseline model. A positive number means that the native unemployment rate is higher in the restricted model than in the baseline.

Restricting the return of either of the two groups (employed or unemployed) raises the native unemployment rate (See Figure 7 in the Online Appendix F). Interestingly, the relative importance of each of them depends on the time horizon that we consider. Table 6 displays differences in the native unemployment rate between the restricted and the baseline models for several years after the negative shock. In the short run (one to six years after the shock), shutting down the return migration of employed immigrants has a higher impact. However, in the long run (eight years after the shock), the main driver is the emigration of unemployed immigrants. This finding is economically intuitive: in the short run, the economy transits through a no-job-creation scenario (first and second phase, as explained in Subsection 5.2), where the only change regarding finding a job comes through jobs becoming available after employed immigrants emigrate. Therefore, if employed immigrants are not allowed to leave, the job-finding rate would drop more than in the baseline economy and the native unemployment rate would be higher. Table 6 shows that six years after the shock, the native unemployment rate would be around 2 pp higher if employed immigrants did not emigrate.

In contrast, the model suggests that, in the long run, the return migration of unemployed workers is more relevant than that of employed workers. The rationale for this goes as follows. In the long run, the job-creation effect becomes more important, since it takes a long time (5 years) for firms to resume job creation. In other words, the composition of the pool of unemployed workers becomes relevant only after some years. If no unemployed immigrants leave, the pool of unemployed workers would not change during the transition. Hence, firms would resume job creation later than in the baseline economy, putting upward pressure on the native unemployment rate. The model suggests that eight years after the shock, the native unemployment rate would be 1.24 pp higher if unemployed immigrants could not emigrate.

[65] A policy in this spirit was implemented by the Spanish government in 2008, with limited impact. See Amuedo-Dorantes and Pozo (2018) for details on the policy's design and effectiveness.

6 Other Counterfactual Experiments

6.1 Relaxing Wage Rigidity

Motivated by the extensive evidence on downward wage rigidity in Spain during the Great Recession, in the model, I assume that wages do not adjust themselves after the drop in aggregate productivity z. From here, two questions arise: (1) Is this assumption crucial for the performance of the model? and (2) Are the model predictions sensitive to allowing some degree of wage flexibility? To answer these questions, I modify the model by introducing an exogenous parameter α_w to govern how much of the gap between rigid and fully flexible (Nash-bargained) wages is closed at every period during the Great Recession.[66] In particular, during the Great Recession, wages at period t are given by the following equation:

$$w_{j,t} = \overline{w}_j - t(\overline{w}_j - w_j^{NB})\alpha_w \tag{21}$$

where $\overline{w}_j$ denotes the rigid wage (i.e., the equilibrium wage, which is Nash-bargained at the initial steady state) and w_j^{NB} denotes the fully flexible wage (i.e., the equilibrium wage at the final steady state under Nash-bargaining).

Model Performance

Wage rigidity matters for the model's performance. Think of a firm right after the drop in aggregate productivity. If, in the next period, the firm were able to lower a worker's wage, the expected future value of staying matched with the worker would increase. Therefore, it may be better for the firm not to dissolve the match today. However, if the firm knows that it will not be possible to lower wages in subsequent periods, its expected future surplus will be lower and more jobs will be endogenously destroyed.

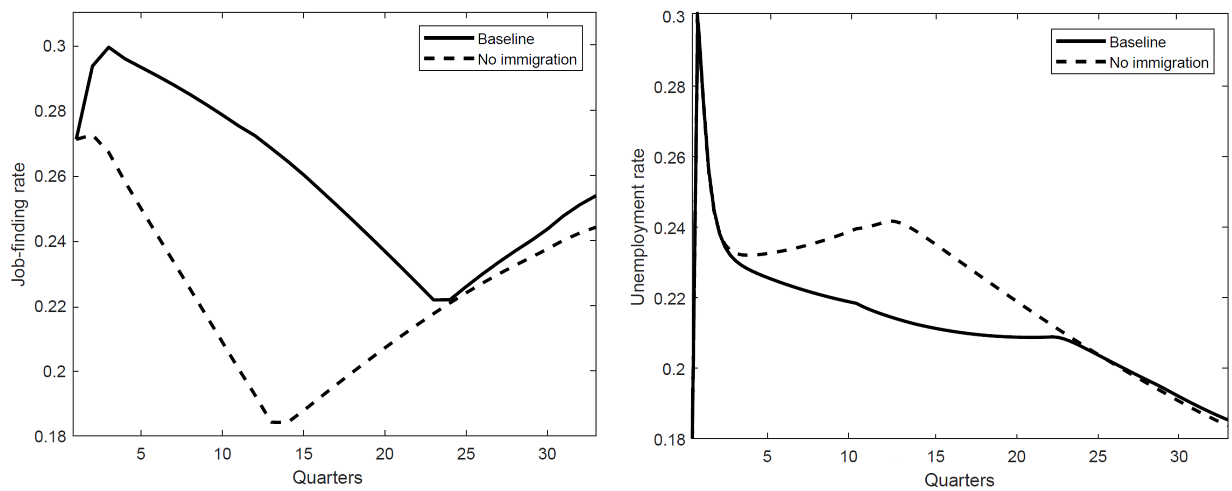
I solve for the Great Recession using different values of α_w and keeping the rest of the parameters constant. The faster the wage adjustment occurs (higher α_w), the lower the increase in the job-separation rate (see the upper panel of Figure 8 in Online Appendix F) because some matches will survive, as firms know that wages will drop soon. In fact, for a big enough α_w, all matches survive, in which case the model is not able to deliver the increase in the unemployment rate that is observed in the data. The model's prediction regarding the higher increase in the job-separation rate for immigrants than for natives is robust to some degree of wage adjustment. As expected, a faster wage adjustment also accelerates the creation of new jobs (Panel C of Figure 8 in Online Appendix F). Yet, for certain values of α_w, the model is successful in delivering a smooth drop in the job-finding rate that is consistent with the data.

[66] This parameter specifies the number of periods that it takes for wages to reach their Nash-bargained values of the final steady state.

The Effects of Immigration during the Great Recession

The previous results confirm that the model performs well when a certain degree of wage flexibility is introduced. Here, I use the same counterfactual as in Section 5, but I set α_w to 0.01, and keep the rest of the parameters constant.[67] This value of α_w implies that it takes four years to close half of the gap between rigid and fully flexible wages.

Figure 11 shows the effect of immigration on the native job-finding and unemployment rates under this new version of the model in which $\alpha_w = 0.01$. As we can observe, the qualitative prediction of the counterfactual is unaffected: the native unemployment rate would have been higher without immigration (Panel (b)). Again, the reason is the smoother drop in the native job-finding rate in the baseline economy (Panel (a)).



(a) Native Job-finding Rate

(b) Native Unemployment Rate

Figure 11: The effect of immigration with wage flexibility ($\alpha_w = 0.01$): Native labor market performance

Quantitatively, the results are similar. Table 7 sheds light on the magnitude of the differences. It shows the average difference in native unemployment rates in the baseline and the "no immigration" economies, for the two versions of the model (wage-rigid and wage-flexible). As we can see, at beginning of the recession (one to four years after the shock), the results are very similar. Over time however, the model with full wage rigidity predicts a larger immigration effect. Interestingly, the experiment suggests that with a certain degree of wage flexibility, immigration has no long-run effect (six to eight years after the shock), whereas in the model with full wage rigidity, the impact of immigration is long-lasting (last column of Table 7).

[67] I choose this value because when $\alpha_w = 0.01$ the model is consistent with the empirical evidence in Section 2 (see Figure 8 in Online Appendix F).

Table 7: Native unemployment rate difference (pp) between the "no immigration" and baseline economies

Years after the shock	1-4	4-6	6-8
Wage-Rigid Model	1.84	2.17	1.09
Wage-Flexible Model	1.80	1.01	0.00

Notes: Differences in the native unemployment rate in the "no immigration" economy with respect to the baseline economy for the models with wage rigidity and wage flexibility. A positive number means that the native unemployment rate is higher in the economy without immigration.

6.2 Shutting Down Mean Match-Quality Heterogeneity

In the baseline calibration, the wage gap between immigrants and natives arises due to the heterogeneity in the mean of the distribution of match-quality draws between the two types of worker. Consequently, the baseline calibration delivers a higher mean match quality for natives than for immigrants ($\mu_N > mu_M = \mu$). The literature has explored alternative calibration strategies in order to pin down the immigrant wage gap. In particular, Battisti et al. (2017) and Albert (2021) assume no productivity differences between immigrants and natives. Instead, they incorporate heterogeneity in the workers' bargaining power to explain differences in observed wages. In this section, I check whether the predictions of the counterfactual are robust to this alternative calibration strategy.

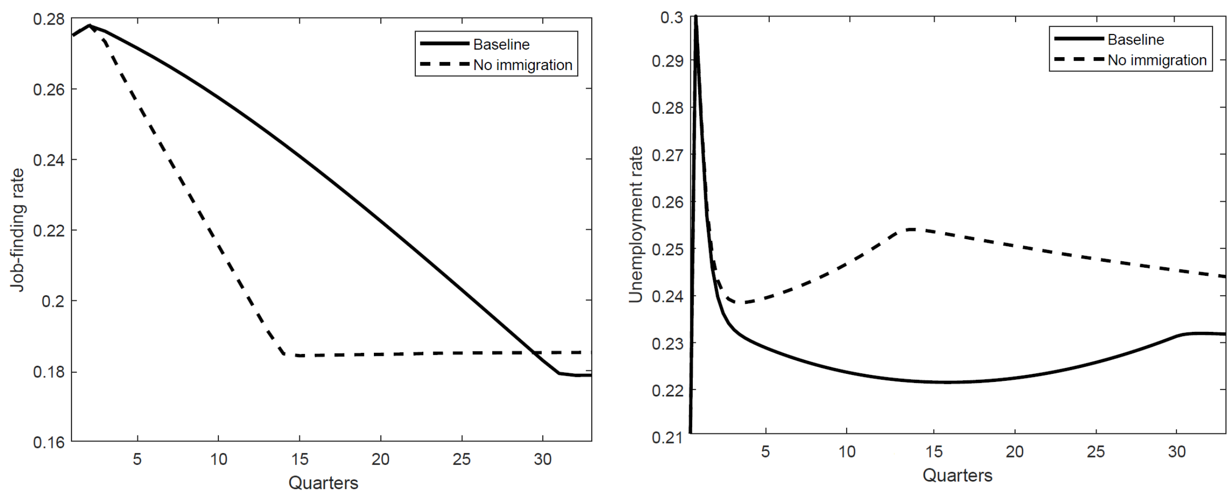
To be more precise, I modify the model as follows. First, I switch off differences in mean match qualities between immigrants and natives by setting $\mu_M = \mu_N = \mu$. Secondly, I introduce heterogeneity in the workers' bargaining power so that $\gamma_N \neq \gamma_M$. I recalibrate the model following the same strategy described in Section 4. The only difference is that now γ_M pins down the immigrants' mean wage.[68] Table 2 in Online Appendix F shows the calibration results. As expected, the bargaining power is lower for immigrants than for natives, since γ_M is estimated to match the fact that immigrants have lower wages. The intuition for this result is simple: the lower γ_M is, the higher the share of the match surplus that firms are able to extract, and hence, the lower the immigrant wage compared to the native wage. Table 10 in Online Appendix F shows that the model fit at the initial steady state is virtually unchanged. Figure 9 in Online Appendix F clearly shows that the model performs very similarly to the baseline model during the Great Recession. We can conclude that the alternative calibration strategy is successful at matching both the initial pre-crisis state of the Spanish economy and the Great Recession.

Then, I repeat the counterfactual experiment and the decomposition analysis of Section 5 with the new calibration. Two main results stand out. First, the calibration delivers $\widetilde{J}_N < \widetilde{J}_M$, implying that now the job-creation effect of immigration is positive. To see why this is happening, think of a firm that is making a decision about creating a job. The firm now knows the following: (1)

[68] The natives' mean wage is still identified by the value of the mean match quality μ, which is equal to μ_N in the baseline calibration.

immigrant and native workers draw their match qualities from a distribution with the same mean, and therefore, they expect to draw a very similar match quality x, and (2) immigrants have less bargaining power than natives. Hence, the firm will be able to extract a higher share of the surplus from them. Altogether, (1) and (2) imply that the firm's expected surplus from a match is higher if filled by an immigrant worker. Consequently, the more immigrants among those searching for a job, the higher the firms' incentives to create jobs will be.

Secondly, the results of the main counterfactual exercise are very similar. Figure 12 displays the evolution of the native job-finding and unemployment rates in the baseline and "no immigration" economies. The native unemployment rate in the counterfactual is higher than in the baseline



(a) Native Job-Finding Rate (b) Native Unemployment Rate

Figure 12: The effect of immigration without mean match-quality heterogeneity: Native labor market performance

economy. Remember that under this calibration the job-creation effect of immigration is positive. The fact that the results of the counterfactual experiment are very similar with respect to the baseline calibration confirms that the job-creation effect is not quantitatively very relevant. The positive sign of the job-creation effect shows up very clearly in Figure 10 in Online Appendix F. The results also suggest when the return-migration channel is switched off, the long-run native unemployment rate is lower than in the baseline. The rationale for this result is as follows: since the job-creation effect of immigration is positive, the fact that unemployed immigrants leave the country negatively affects firms' incentives to create jobs. That is, the more unemployed immigrants that return migrate, the longer firms will delay the creation of new jobs. Therefore, the native unemployment rate would be lower if return migration were not allowed.

7 Conclusions

This paper studies the impact of foreign-born workers on the labor market during a recession. First, using Spanish data, I provide evidence that the impact of the Great Recession on employment was different for immigrant workers and native workers. Secondly, I document that foreign outflows were very responsive to the crisis, as many immigrants left the country. Then, I build a random search model of the labor market with vacancy persistence, endogenous return migration, and downward wage rigidity to capture these empirical findings.

I find that three years after the Great Recession, the unemployment rate of Spanish natives would have been 2.6 percentage points higher in the absence of the pre-crisis immigration boom. A key result of the quantitative analysis is that the job-creation effect of immigration is negative. Yet, the counterfactual exercise predicts that return-migration and match-separation effects are positive and dominate the job-creation effect, implying overall welfare gains for native workers. In fact, a decomposition analysis reveals that the return-migration channel is quantitatively the most relevant channel.

The findings of this paper have important policy implications. Stricter immigration enforcement is predicted to be detrimental, as it would remove one important channel through which labor markets adjust during a recession. Along this line, the adverse effects of such a policy will be especially large for natives if either negative aggregate shocks are frequent or the labor market is particularly rigid. Moreover, given the positive impact of return migration, a policy subsidizing immigrants for a voluntary return (e.g., lump-sum bonuses or higher unemployment benefits than what they are entitled to obtain) will help the labor market adjust during a recession, and hence will enhance the recovery of employment.

This paper leaves out many channels that could potentially be meaningful for the results presented herein, and which stand as relevant topics of research in their own right. First, I take on a national perspective, restricting my attention to the impact of foreign-born worker outflows to other countries. However, data shows that foreign-born workers are also more prone to move across regions (within a country) than natives. In a framework with vacancy persistence, such as the one developed in the present study, the impact of immigration is asymmetric in recessions and economic expansions. In other words, with vacancy persistence, immigrants leaving the labor market in a context of no job creation (recession) have a positive effect on the native job-finding rate. But, immigrants entering a local market where jobs are created in a normal fashion (expansion) would have a very small impact on the job-finding rate (the effect only works through search externalities). Consequently, in this setup I expect that the positive effect of immigration in the regions that were more negatively affected by the crisis (from where immigrants move) would be higher than in the baseline model with an exclusively national labor market. Furthermore, I expect that the impact of immigration in regions barely affected by the crisis (to where immigrants move) would be very small.

Secondly, I abstract from the potential selection of returned immigrants. As immigrants that decide to leave the country may be very different compared to stayers, the composition of the remaining immigrants will be affected. Taking this variation into account in the composition of the pool of immigrants could lead to important implications regarding the impact of immigration on firms' job-creation incentives.

Lastly, this paper ignores the potential fiscal implications of migrants. In theory, the net impact of immigration on the government budget is not obvious. On the one hand, immigrants are younger than natives and therefore can alleviate the pension burden. This channel could be particularly relevant for some European countries where the ageing of the population is becoming a first-order issue. On the other hand, the empirical evidence presented in the current study suggests that immigrants are also more likely than natives to lose jobs in a recession. Therefore, a higher immigrant share could increase government expenses on unemployment benefits. Incorporating this trade-off in a life-cycle framework is a promising avenue for future research.

References

(2013). “La nueva emigración española. Lo que sabemos y lo que no.”

Acharya, Sushant and Shu Lin Wee (2018). “Replacement hiring and the productivity-wage gap.” *FRB of New York Staff Report*, (860).

Albert, Christoph (2021). “The Labor Market Impact of Immigration: Job Creation versus Job Competition.” *American Economic Journal: Macroeconomics*, 13(1), 35–78.

Amuedo-Dorantes, Catalina and Susan Pozo (2018). “Assessing the Effectiveness of Pay-to-Go Policies: Evidence from Spain’s Voluntary Return Program1.” *International Migration Review*, 52(3), 750–779.

Barattieri, Alessandro, Susanto Basu, and Peter Gottschalk (2014). “Some evidence on the importance of sticky wages.” *American Economic Journal: Macroeconomics*, 6(1), 70–101.

Basso, Gaetano, Francesco D’Amuri, and Giovanni Peri (2019). “Immigrants, labor market dynamics and adjustment to shocks in the Euro Area.” *IMF Economic Review*, 67(3), 528–572.

Battisti, Michele, Gabriel Felbermayr, Giovanni Peri, and Panu Poutvaara (2017). “Immigration, search and redistribution: A quantitative assessment of native welfare.” *Journal of the European Economic Association*, 16(4), 1137–1188.

Bentolila, Samuel, Pierre Cahuc, Juan J Dolado, and Thomas Le Barbanchon (2012). “Two-tier labour markets in the great recession: France Versus Spain.” *The Economic Journal*, 122(562), F155–F187.

Bentolila, Samuel and J.F Jimeno (2006). “13 Spanish Unemployment: The End of the Wild Ride?” *Structural unemployment in Western Europe: reasons and remedies*, p. 317.

Bertoli, Simone, Jesús Fernández-Huertas Moraga, and Francesc Ortega (2011). “Immigration policies and the Ecuadorian exodus.” *The World Bank Economic Review*, 25(1), 57–76.

Bertoli, Simone and Jesús Fernández-Huertas Moraga (2013). “Multilateral resistance to migration.” *Journal of Development Economics*, 102, 79–100.

Bils, Mark, Yongsung Chang, and Sun-Bin Kim (2011). “Worker heterogeneity and endogenous separations in a matching model of unemployment fluctuations.” *American Economic Journal: Macroeconomics*, 3(1), 128–54.

Borjas, George J (2003). “The labor demand curve is downward sloping: Reexamining the impact of immigration on the labor market.” *The quarterly journal of economics*, 118(4), 1335–1374.

Boscá Mares, José Emilio, Rafael Doménech Vilariño, Francisco Javier Ferri Carreres, and José Ramón García Martínez (2017). "Shifts in the Beveridge Curve in spain and their macroeconomic effects." *Revista de Economia Aplicada, 2017, vol. XXV, num. 75, p. 5-27.*

Cadena, Brian C and Brian K Kovak (2016). "Immigrants equilibrate local labor markets: Evidence from the Great Recession." *American Economic Journal: Applied Economics*, 8(1), 257–90.

Card, David (2005). "Is the new immigration really so bad?" *The Economic Journal*, 115(507), F300–F323.

Chassamboulli, Andri and Theodore Palivos (2014). "A Search-Equilibrium Approach to the Effects of Immigration on Labor Market Outcomes." *International Economic Review*, 55(1), 111–129.

Chassamboulli, Andri and Giovanni Peri (2015). "The labor market effects of reducing the number of illegal immigrants." *Review of Economic Dynamics*, 18(4), 792–821.

De la Roca, Jorge (2014). "Wage cyclicality: Evidence from Spain using social security data." *SERIEs*, 5(2-3), 173–195.

Dolado, Juan J, Etienne Lalé, and Nawid Siassi (2021). "From dual to unified employment protection: Transition and steady state." *Quantitative Economics*, 12(2), 547–585.

Dustmann, Christian, Uta Schönberg, and Jan Stuhler (2017). "Labor supply shocks, native wages, and the adjustment of local employment." *The Quarterly Journal of Economics*, 132(1), 435–483.

Edo, A (2019). "The impact of immigration on the labor market." Tech. Rep. 3.

Elsby, Michael WL and Ryan Michaels (2013). "Marginal jobs, heterogeneous firms, and unemployment flows." *American Economic Journal: Macroeconomics*, 5(1), 1–48.

Elsby, Michael WL, Ryan Michaels, and David Ratner (2015). "The Beveridge curve: A survey." *Journal of Economic Literature*, 53(3), 571–630.

Fan, Xiaodong, Ananth Seshadri, and Christopher Taber (2017). "Understanding earnings, labor supply, and retirement decisions." *Michigan Retirement Research Center Research Paper*, (2017-367).

Fernández-Huertas Moraga, J and G López-Molina (2018). "Predicting Spanish Emigration and Immigration." Tech. rep., AIReF Working Papers.

Fernández-Villaverde, Jesús, Lee Ohanian, et al. (2010). "The Spanish crisis from a global perspective." *The Crisis of the Spanish Economy, FEDEA.*

Font, Paulino, Mario Izquierdo, and Sergio Puente (2015). "Real wage responsiveness to unemployment in Spain: asymmetries along the business cycle." *IZA Journal of European Labor Studies*, 4(1), 13.

Fujita, Shigeru and Garey Ramey (2007). "Job matching and propagation." *Journal of Economic dynamics and control*, 31(11), 3671–3698.

Gálvez-Iniesta, Ismael (2020). "Natives Responses to Immigration and the Cyclicality of Wages and Labour Market Flows: Immigrants versus Natives." Tech. rep., Discussion paper.

García-Santana, Manuel, Enrique Moral-Benito, Josep Pijoan-Mas, and Roberto Ramos (2020). "Growing like Spain: 1995–2007." *International Economic Review*, 61(1), 383–416.

Hall, Robert E (2003). "Wage determination and employment fluctuations." Tech. rep., National Bureau of Economic Research.

Hall, Robert E and Paul R Milgrom (2008). "The limited influence of unemployment on the wage bargain." *American economic review*, 98(4), 1653–74.

Izquierdo, Mario, Juan F Jimeno, and Aitor Lacuesta (2016). "Spain: from massive immigration to vast emigration?" *IZA Journal of Migration*, 5(1), 1–20.

Kerr, Sari Pekkala and William R Kerr (2011). "Economic impacts of immigration: A survey." Tech. rep., National Bureau of Economic Research.

Krusell, Per, Lee E Ohanian, José-Víctor Ríos-Rull, and Giovanni L Violante (2000). "Capital-skill complementarity and inequality: A macroeconomic analysis." *Econometrica*, 68(5), 1029–1053.

Menzio, Guido, Irina A Telyukova, and Ludo Visschers (2016). "Directed search over the life cycle." *Review of Economic Dynamics*, 19, 38–62.

Mercan, Yusuf, U Melbourne, and Benjamin Schoefer (2019). "Jobs and Matches: Quits, Replacement Hiring, and Vacancy Chains." *American Economic Review: Insights*.

Michaels, Ryan, David Ratner, Michael Elsby, et al. (2017). "Vacancy Chains." In *2017 Meeting Papers*, 888, Society for Economic Dynamics.

Moreno-Galbis, Eva and Ahmed Tritah (2016). "The effects of immigration in frictional labor markets: Theory and empirical evidence from EU countries." *European Economic Review*, 84, 76–98.

Mortensen, Dale and Eva Nagypal (2007). "Labor-market Volatility in Matching Models with Endogenous Separations." *scandinavian Journal of Economics*, 109(4), 645–665.

Mortensen, Dale T and Christopher A Pissarides (1994). "Job creation and job destruction in the theory of unemployment." *The review of economic studies*, 61(3), 397–415.

Ortega, Eloísa and Juan Peñalosa (2012). "The Spanish economic crisis: key factors and growth challenges in the euro area." *Banco de Espana Occasional Paper*, (1201).

Ottaviano, Gianmarco IP and Giovanni Peri (2012). "Rethinking the effect of immigration on wages." *Journal of the European economic association*, 10(1), 152–197.

Özgüzel, Cem (2020). "The Cushioning Effect of Immigrant Mobility: Evidence from the Great Recession in Spain."

Pries, Michael and Richard Rogerson (2005). "Hiring policies, labor market institutions, and labor market flows." *Journal of Political Economy*, 113(4), 811–839.

Prieto, Victoria, Joaquín Recaño, and Doris Cristina Quintero-Lesmes (2018). "Migration responses of immigrants in Spain during the Great Recession." *Demographic Research*, 38, 1885–1932.

Ravn, Morten O and Vincent Sterk (2017). "Job uncertainty and deep recessions." *Journal of Monetary Economics*, 90, 125–141.

Riegler, Markus (2019). "The impact of uncertainty shocks on the job-finding rate and separation rate."

Shimer, Robert (2004). "The consequences of rigid wages in search models." *Journal of the European Economic Association*, 2(2-3), 469–479.

Silva, José I and Javier Vázquez-Grenno (2013). "The ins and outs of unemployment in a two-tier labor market." *Labour Economics*, 24, 161–169.

Silva, José Ignacio and Manuel Toledo (2009). "Labor turnover costs and the cyclical behavior of vacancies and unemployment." *Macroeconomic Dynamics*, 13(S1), 76–96.