How do regional labor markets adjust to immigration? A dynamic analysis for post-war Germany *

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Abstract

This paper provides a comprehensive analysis of the dynamic labor market effects of one of the largest forced population movements in history, the mass inflow of eight million German expellees into West Germany after World War II. The expellee inflow was distributed very asymmetrically across two West German regions. We develop a dynamic equilibrium model that closely fits two decades of historical data on the regional unemployment differential and the regional migration rate. Both variables increase dramatically after the expellee inflow and decline only gradually over the next decade. The long-lasting adjustment process implies losses in the lifetime labor income of native workers that are not covered by conventional steady state analyses. Regional migration serves as an important adjustment margin for native workers to insure against local labor supply shocks.

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1 Introduction

This paper studies how regional labor markets in West Germany adjusted to one of the largest forced population movements in history, the mass inflow of German expellees after World War II. The eight million expellees who had arrived in West Germany by the end of 1949–most of whom from the territories that Germany relinquished after the war–were distributed very unevenly across the country. The share of expellees in the population ranged from 3.1% in the federal state of Rhineland-Palatinate to 33.3% in Schleswig-Holstein. We exploit this large, unexpected, and highly uneven inflow of expellees to study how quickly and by what margins regional labor markets adjusted to the inflow.

Our paper contributes to an extensive literature that analyzes labor market adjustments to immigration.[1] Over the past two decades, interest in the issue has been fueled by sharply rising numbers of international migrants and public concern about the consequences of immigration. The recent surge in forced migration and the growing inflow of refugees into Europe have only added to these concerns. Despite strong public interest, the burgeoning literature on immigration has hardly addressed two major aspects of the adjustment process (Borjas 2014): the length of the adjustment process and the relative importance of different adjustment margins along the adjustment process.[2] Our paper addresses these two aspects.

We start our analysis by presenting novel empirical facts on how regional labor markets in West Germany adjusted to the inflow of expellees, drawing on administrative data from 1939-70. We derive these facts by contrasting the economic development of two stylized regions: a high-inflow region H that consists of what were known as the "refugee states" of Bavaria, Lower Saxony, and Schleswig-Holstein, and a low-inflow region L that consists of the remaining West German states. The two regions had similar unemployment and population growth rates before World War II. However, during and after the war, much more expellees fled or were transferred to region H than to region L, largely because region H is located much closer to the homelands of expellees than region L. We compare economic developments in the two regions before the inflow

[1] Okkerse (2008), Longhi, Nijkamp, and Poot (2010), Kerr and Kerr (2011), Dustmann, Schönberg, and Stuhler (2016), and Peri (2016) provide comprehensive reviews, meta-analyses, and critiques of the existing literature.

[2] In fact, the existing literature focuses mainly on changes in wages as the key margin through which labor markets adjust to immigration (see, e.g., Aydemir and Borjas (2011), Manacorda, Manning, and Wadsworth (2012) or Dustmann, Frattini, and Preston (2013)). Moreover, the literature typically analyzes the labor market effects of immigration in a static framework (see, e.g., Card (2001), Boustan, Fishback, and Kantor (2010) or Braun and Mahmoud (2014)). In contrast, remarkably little is known about the labor market effects of immigration along the adjustment path and about the time that it takes the labor market to digest an immigration-induced labor supply shock (Jaeger, Ruist, and Stuhler 2018). We discuss related work on the dynamic labor market effects of immigration below.

and document their subsequent relative development until 1970. We argue that this comparison is informative about the adjustment path because regional differences in initial inflow rates were large and exogenous to local labor market conditions.

Our empirical facts reveal that by 1950, the unemployment rate in region H was as high as 16.7% and exceeded the unemployment rate in region L by a factor of two and a half. Regional unemployment rates then gradually converged during the 1950s and eventually fell to around 1% by the early 1960s. The decrease and convergence in regional unemployment was accompanied by large regional migration flows. In 1950 alone, net migration from region H to L amounted to 1.9% of the population in region H.

These large migration flows diffused the labor market effect of the expellee inflow from region H to region L and re-equilibrated local regional labor markets. Consequently, a direct comparison of labor market outcomes between the two regions will underestimate, except on impact, the true causal effect of receiving high rather than low expellee inflows even if the initial distribution of expellees was exogenous to local labor market conditions. After all, such comparison would show little or no differences because, over time, the high inflow of expellees into region H affected not only region H itself but also region L.[3]

To interpret the empirical pattern, and isolate the causal effect of the expellee inflow along the adjustment path, we develop a parsimonious dynamic equilibrium model that accounts for regional migration and its effect on regional labor markets. The backbone of this model is a two-region search and matching model of unemployment where workers take recurrent and forward-looking migration decision between the two regional labor markets. In each region, a representative firm employs many workers and accumulates capital to produce output. The firm faces costs when it adjusts its workforce or capital stock.

To calibrate the model to historical data, we exploit both the cross-section and time dimension of the data. We show that the calibrated model's adjustment dynamics after the asymmetric historical expellee inflow closely fit our empirical facts. Using the calibrated model, we find that it takes regional labor markets about a decade to absorb the expellee inflow. Regional migration

[3]Internal migration is but one general equilibrium effect that could create spillovers from the high- to the low-inflow region. Other mechanisms include capital flows between regions (Borjas 1999) or trade linkages (Hanson and Slaughter 2002, Lewis 2004, Peters 2019). Unfortunately, to the best of our knowledge, data on inter-regional capital or trade flows are not available for the period under consideration. However, our analysis of shifts in regional production structures in Section 3.2 tentatively suggests that at least Rybczynski-type general equilibrium effects have played no role in our context. Our focus on internal migration as the main channel through which local immigrant inflows are diffused through the aggregate economy is shared by much of the literature on the labor market effects of immigration (Borjas 2003, Monras 2020b).

played a crucial role in the adjustment process. By 1965, more than one-third of the initial increase in region H's population was absorbed through migration to the low-inflow region L. The model also suggests that migration was more important than capital accumulation in narrowing the gap between regional capital-population ratios, created by the asymmetric expellee inflow.

The adjustment process of the native population differs strongly from the process of the population as a whole. The employment probability of native workers decreases in the first few quarters of the adjustment process, whereas the employment probability of the average worker increases monotonically throughout. The negative effect of the expellee inflow on native employment is largest ten quarters after the arrival of the expellees. When measured at that time, native employment decreases by 4.33 workers for every ten expellees who arrive in region H. Of those 4.33 native workers, 1.30 leave the labor force, 2.42 enter the unemployment pool, and 0.61 leave region H for region L.

Our calibrated model also allows us to make inference on income losses of natives, for which, unfortunately, we have no data. We find that the expellee inflow decreased the expected discounted lifetime labor income of the average native worker in West Germany by 1.51%. The short-term decline, measured by per-period labor income, is much larger and reaches 5.91% nine quarters after the shock. Regional migration is an important adjustment margin for native workers to ensure against income losses arising from local expellee inflows. The short-run wage elasticities, which in our calibrated model are between -0.17 and -0.25, are in line with empirical estimates that we produce based on a large-scale survey of employees' earnings in trade and industry. All these results survive a battery of checks, in which we check for the–potentially confounding–influence of pre-existing differences between regional labor markets.

Related literature. Our finding of prolonged adjustment processes after the expellee inflow complements a nascent literature that studies the dynamic wage effects of immigration. Cohen-Goldner and Paserman (2011) analyze the impact of the inflow of more than one million Soviet Jews into Israel after the collapse of the Soviet Union. The authors show that the initially negative wage effect of the inflow dies out after five to seven years. Edo (2019) studies the sudden inflow of repatriates from Algeria to France in 1962. He finds that wages fell between 1962 and 1968 and then returned to their pre-shock level in 1976. Cohen-Goldner and Paserman (2011) and Edo (2019) exploit variation in the migrant share across labor market segments, assuming that these segments are isolated from each other. In contrast, our structural approach directly accounts for movements between regional labor market segments and therefore allows us to quantify the role of regional migration as an adjustment margin.

In recent work, Colas (2018) considers a dynamic equilibrium model of local US labor markets to study dynamic wage and income effects of immigration. He finds that the wage effect of immigration is cut in half ten years after the shock, as natives move away from high inflow locations. In a related setting, Monras (2020a) studies local labor market adjustments in the US, including internal migration and its effect on life-time income, induced by the Great Recession.[4] When treating this event as a permanent change in local productivity, he finds that adjustments in most locations are completed within a decade. An important difference between our paper and both Colas (2018) and Monras (2020a) is the calibration strategy. While Colas (2018) and Monras (2020a) calibrate their models to moments of the distribution of workers obtained from cross-sectional or panel data, we calibrate the model directly to the adjustment dynamics following the expellee inflow. We also consider a natural experiment involving a one-time inflow of exceptional size.

Braun and Mahmoud (2014) is, to the best of our knowledge, the only other study that analyzes the labor market effects of our specific episode of forced migration.[5] The authors demonstrate that expellees had a substantially negative effect on native employment in 1950. In contrast to our paper, Braun and Mahmoud (2014) focus on the short-term effect of the expellee inflow and do not quantify the relative importance of different margins through which the West German economy adjusted over time to the expellee inflow.

Another related literature studies the link between immigration and subsequent internal migration of native workers. Some studies find that native workers indeed respond to immigration by moving out to other areas (see, for example, Filer (1992), Borjas (2006) or Boustan, Fishback, and Kantor (2010)), while other studies find no such effect (see, for example, Card and DiNardo

[4] Monras (2020b) analyzes the short- and long-term effects of Mexican immigration into the US on the wages of low-skilled natives. He finds that Mexican-US immigration has large negative wage effects in the short run, and that regional migration quickly dissipates local labor supply shocks. Monras (2020b) uses a dynamic structural model to obtain the evolution of wages in a counterfactual no-migration scenario. In contrast to our paper, however, he focuses on wage effects only – and hence abstracts from the unemployment and labor force participation margins.

[5] Additional work has studied the economic integration of expellees in post-war West Germany (Bauer, Braun, and Kvasnicka 2013, Braun and Dwenger 2020, Falck, Heblich, and Link 2012), and the effect of the expellee inflow on sectoral change and output growth in 1939-50 (Braun and Kvasnicka 2014), on productivity and regional economic development (Peters 2019), the spatial equilibrium of population (Braun, Kramer, Kvasnicka, and Meier 2020, Schumann 2014, Wyrwich 2020), and public policy setting (Chevalier, Elsner, Lichter, and Pestel 2018). Burda (2006) analyzes the reallocation of production factors after German reunification in 1990, and shows that the integration process involves significant migration from East to West Germany. Grossmann, Schäfer, Steger, and Fuchs (2017) consider the dynamic effects of labor market integration on migration flows, capital formation, and house prices following German reunification.

(2000), Card (2001) or Kritz and Gurak (2001)). However, this literature generally abstracts from adjustment dynamics.

Our paper also contributes to an emerging literature that studies the effect of immigration within search and matching models. Ortega (2000) studies a two-country model, in which unemployed workers decide where to search for a job. Chassamboulli and Palivos (2014) analyze the effects of US skill-biased immigration, while Liu (2010) and Chassamboulli and Peri (2015) focus on *illegal* immigration into the US. Battisti, Felbermayr, Peri, and Poutvaara (2018) analyze the welfare effects of immigration on low-skilled and high-skilled natives in 20 countries. Our work differs from these papers in three main respects. First, we focus on the adjustment dynamics triggered by immigration rather than on the steady-state effects of immigration. Second, we study the role of regional migration within a country as an adjustment margin to immigration. Third, we calibrate key model parameters using data from a natural experiment.

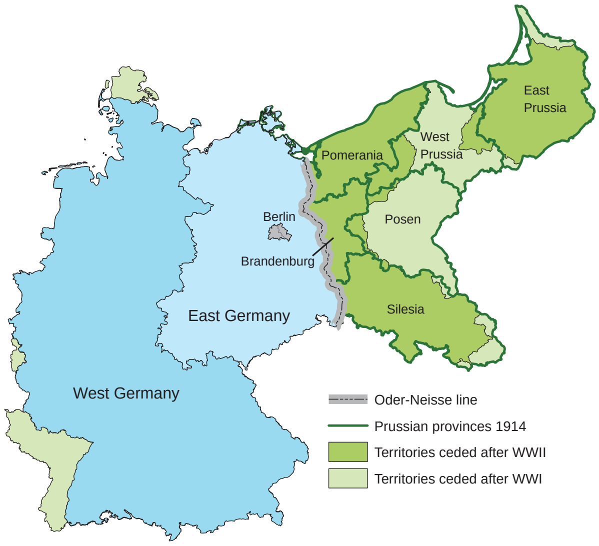
This paper proceeds as follows. Section 2 provides background on our historical setting, and Section 3 derives empirical facts on how regional labor markets in West Germany adjusted to the expellee inflow. Section 4 develops the dynamic equilibrium model that we use to analyze the historical data. Section 5 explains the calibration of model parameters and assesses the model fit. Section 6 contains our main results on the channels through which regional labor markets adjusted to the expellee inflow and the associated income effects for native workers. Finally, Section 7 concludes.

2 Historical background and nature of the expellee inflow

Below, we shall refer to those territories east of the present-day eastern border of Germany that were part of the German Reich before World War I as eastern territories (see Figure 1 for an overview of Germany's territorial losses between 1919 and 1945). We shall refer to the Federal Republic of Germany as West Germany and to the German Democratic Republic as East Germany (again, see Figure 1).

Three phases of displacement. The displacement of Germans from Central and Eastern Europe took place between 1944 and 1950 and occurred in three phases. The first phase took place during the final stages of the war, the second phase occurred between the end of the war in May 1945 and the Potsdam Agreement in August 1945, and the third phase after the conclusion of the Potsdam Agreement.

Figure 1: German territorial losses in World War I and II



Base maps: MPIDR and CGG (2011).

The first phase of the displacement took place as the Red Army advanced westwards in the final stages of World War II. As a result, hundreds of thousands of Germans from the eastern territories of the German Reich fled further inland. Most of these refugees planned to return home after the end of the war, and therefore fled to regions close to their former homelands.

The second phase of the displacement took place in the months immediately following the end of the war. Polish authorities first prevented refugees from returning to their former homelands and then started to expel the remaining German population. These "wild" expulsions had not yet been sanctioned by an international treaty. The Czechoslovakian authorities soon followed the Polish example and began to drive the German population out of the country.

The third phase of the displacement began after the Soviet Union, the United Kingdom, and the United States concluded the Potsdam Agreement of August 1945. The Agreement authorized the expulsion of Germans from Central and Eastern Europe and shifted the German-Polish border westwards to the Oder-Neisse line. The eastern territories that Germany lost after World War II were placed under Polish or Russian control (see Figure 1). Germans remaining east of the new border were brought to post-war Germany in compulsory and organized transfers.

The Potsdam Agreement also divided post-war Germany into British, French, American, and Soviet zones of occupation. The three western zones were merged into West Germany in 1949. The Soviet zone became East Germany in 1950. Below, we characterize the expellee inflow to West Germany, which is the focus of our analysis.

Regional distribution of expellees. The expellee inflow prompted a dramatic increase in the population of West Germany. Despite heavy war losses, the West German population grew from 39 million in 1939 to 48 million in 1949. By the end of 1949, 7.7 million expellees had arrived in West Germany, accounting for 16.3% of the West German population.

More than half of the expellees came from the eastern territories that Germany had ceded after World War II, such as East Prussia and Silesia. Another quarter had lived in Czechoslovakia before the war, most of them in the mainly German-speaking Sudentenland, which Nazi Germany annexed in 1938. The remaining expellees came mostly from the eastern territories that Germany had already ceded after its defeat in World War I, such as Posen and West Prussia.

The share of expellees in the population differed greatly across West German states, and ranged at the end of 1949 from 3.1% in the state of Rhineland-Palatinate to 33.3% in Schleswig-Holstein. There are three main reasons for the very uneven regional distribution of expellees in West Germany. First, German refugees who fled the approaching Red Army during the final stages of the war (first phase of displacement) mainly sought shelter in regions close to their former homelands. The "wild" expulsions (second phase of displacement) only added to the uneven regional distribution, as Polish and Czechoslovakian authorities often just drove Germans across the border into post-war Germany.

Second, the French refusal to admit any of the organized expellee transfers (third phase of displacement) to their zone of occupation led to a very uneven distribution of expellees between West German occupation zones. As they had not been invited to the Potsdam Conference, the French did not feel bound by the Potsdam Agreement. Therefore, expellees to West Germany were initially transferred only to the American and British zones of occupation.

Third, expellees were more likely to be placed in areas where housing was available. Since the Allied bombing campaigns had destroyed much of the housing stock in major West German cities, the expellees often had to be transferred to rural regions that had been less devastated by the war (Connor 2007, Burchardi and Hassan 2013).

Unlike in most other immigration episodes, the initial regional distribution of expellees in West Germany was not driven by local labor market conditions (Braun and Kvasnicka 2014, Braun and Mahmoud 2014).[6] This was because in all three phases of the displacement, expellees were generally unable to choose their initial destination in West Germany based on local eco-

[6]The regional distribution of expellees remained largely unchanged until the end of 1949 because the occupying powers severely restricted relocations in the immediate post-war period (Müller and Simon 1959, Ziemer 1973). In fact, the state-level expellee shares in 1946 and 1949 are highly correlated, with a correlation coefficient of 0.996.

nomic conditions. As mentioned before, expellees fled to the most accessible regions west of the front line in the first phase of the displacement, and were brought to West Germany in compulsory expellee transfers in the second and third phase. Local authorities then distributed expellees based on the availability of housing, not jobs (Nellner 1959). Regions that received many expellees thus differed little in their pre-inflow economic conditions from regions that received only few expellees, a point that we will back up in Section 3.

Socio-demographic characteristics of expellees. Expellees were relatively close substitutes to native West Germans on the German labor market. They were all German native speakers and had been educated in German schools. In addition, expellees and native inhabitants had, in most cases, been living in the same country for decades (the eastern territories, home to most expellees, had been part of the German Reich since it was founded in 1871). Moreover, expellees were not a selected sub-group of their home regions, as virtually all Germans living east of the new German-Polish border were forced to migrate. This contrasts with most other migration episodes, in which immigrants are a selected group of the population from the countries of origin (Borjas 1987, Chiquiar and Hanson 2005).

Table A1 in Appendix A.1 shows that expellees and native West Germans were indeed very similar in their pre-war socio-demographic characteristics. There were more women than men among both expellees and non-expellees, a legacy of the two world wars. Expellees were slightly younger than natives and, therefore, also less likely to be married. Moreover, expellees had almost identical years of schooling to natives, a similar probability of having completed vocational training, and a slightly higher probability of having graduated from university.

Appendix Section A.2 shows in detail that as a result of these similarities, the expellee supply shock differed little across skill groups. We thus expect skill-specific wage and employment effects of immigration to differ little from average wage effects (see, for example, Borjas (2013) and Dustmann, Schönberg, and Stuhler (2016)). For this reason, and because labor market data by skill level is generally not available for the period of analysis, we will largely abstract from the distributional consequences of immigration by skill level.[7]

[7] Wage and employment responses may still differ across skill groups if their labor supply elasticities are not the same (Dustmann, Schönberg, and Stuhler 2016). In particular, higher labor supply elasticities will amplify employment responses but dampen wage responses. In our context, it is unclear whether labor supply elasticities increase or decrease with worker skills (if they vary at all). While Appendix A.6 shows that high-skilled workers might have responded more elastically along the migration margin, we may expect high-skilled workers to respond less elastically along the unemployment and non-employment margin (Bargain, Orsini, and Peichl 2014, Dustmann, Schönberg, and Stuhler 2016).

Despite the similarities, expellees were significantly less likely to work in agriculture after the war (see again Table A1). This may be because expellees were more mobile between sectors than natives (Braun and Kvasnicka 2014), because there was not enough farmland available for them to become farmers (Connor 2007), or because they had a comparative advantage in industry within the rural labor markets they were sent to (Peters 2019).

3 Empirical facts on regional development

We now present novel empirical facts on how regional labor markets in West Germany adjusted to the large and asymmetric inflow of expellees. We derive these facts by comparing the demographic and economic developments of two stylized regions, a high-inflow region H and a low-inflow region L, between 1939 and 1970. We thus only exploit the variation in the expellee inflow across regions, in line with recent recommendations in Dustmann, Schönberg, and Stuhler (2016).[8] Our key labor market variables are regional unemployment rates and the West German labor force participation rate. We further describe the evolution of regional population and the underlying migration flows between the two regions. Finally, we use regional GDP per worker as a measure of regional productivity differences.

3.1 Regional classification and pre-war differences

Table 1 shows how we classified the West German federal states (*Bundesländer*) into a high- and a low-inflow region. It also provides an overview of expellee inflows into these regions, of economic characteristics before the war and of the regional degree of war damage.

The high-inflow region H consists of Bavaria, Lower Saxony, and Schleswig-Holstein. These three states were called "refugee states" (*Flüchtlingsländer*) in contemporary publications. Although the refugee states accounted for only a third of West Germany's pre-war population, they hosted more than 60% of all expellees by the end of 1949. The population share of expellees in region H was 25.1% (see column (3) of Table 1). The low-inflow region L consists of the remaining West German states. The population share of expellees in region L was 10.5% at

[8] Dustmann, Schönberg, and Stuhler (2016) classify empirical studies that estimate the wage effects of immigration into three groups. The first group exploits variation in immigrant inflows across education-experience cells, the second uses variation in inflows across regions, and the third exploits variation across both regions and education. Dustmann, Schönberg, and Stuhler (2016) argue that only the second approach estimates the total wage effect of immigration, whereas the other two approaches estimate different relative wage effects. They then show that only estimates of total wage effects retain a clear interpretation when allowing for heterogeneous labor supply elasticities and "downgrading" of immigrants. Downgrading occurs if upon arrival, immigrants start at a lower occupational position than natives with similar observable skills.

the end of 1949, and thus less than half of the population share in region H.

The states in region H hosted considerably more expellees than those in region L for all three reasons discussed in Section 2. First, all three states in region H were relatively easily accessible for refugees who were fleeing the approaching Red Army during the final stages of the war.[9] Second, all three states were not located in the French occupation zone that was initially sealed for expellees. Third, all three states retained a relatively intact housing stock during the war.

Pre-existing regional differences between region H and L might provide an alternative explanation, other than the asymmetric expellee inflow, for observed differences in economic development after the inflow. Columns (4) to (7) of Table 1 thus report pre-war data on regional population growth, unemployment, agricultural employment, and national income per capita, and column (8) shows the percentage of housing destroyed in the war.

Before the war, population growth rates were very similar in the two regions. The population in region H grew by 10.7% between 1925 and 1939, only 0.7 percentage points more than the population in region L. Likewise, unemployment rates were very similar before the war, reaching 1.6% in region H and 2.0% in region L in 1938 (see column (4)).[10]

However, Table 1 also shows that region H was more agrarian than region L. In 1939, 36.5% of the labor force in region H, but just 21.8% in region L, worked in agriculture (see column (6)). Since the agricultural sector was less productive than the non-agricultural sector (Eichengreen and Ritschl 2009), region H was also somewhat poorer than region L. In fact, national income per capita was around 8% lower in H than in L in 1936 (see column (7)). Moreover, the more rural region H suffered less from war damage than region L, since the Allied bombing campaign primarily targeted German cities. Around 12% of all dwellings in region H were destroyed during the war, considerably less than the West German average of 20.3% (see column (8)).

[9] Bavaria was the prime destination for refugees from neighboring Sudetenland, and Schleswig-Holstein was the prime destination for refugees from East-Prussia arriving via the Baltic Sea. Lower Saxony received an over-proportional number of refugees because of its general proximity to the eastern territories.

[10] In the wake of the massive rearmament policy undertaken by Nazi Germany, full employment existed in 1938. Therefore, unemployment figures for 1938 might be uninformative about structural differences in unemployment rates between the two regions. Prior to 1938, unemployment tended to be somewhat lower in region H than in region L. In fact, the unemployment rate in 1936 was 6.3% in region H and 9.2% in region L. Importantly, there is no evidence that unemployment was higher in region H before the war, as we observe it for the post-war period.

Table 1: Expellee inflows, pre-war differences and war damage in West German states

	Expellee[1] inflows			Pre-war differences				War damage
	1949 population (in 1,000s)	1949 expellee population (in 1,000s)	% expellees in 1949 population	Population change, 1925-39 (%)	1938 unemployment rate (%)[2]	Share of 1939 labor force in agriculture (%)	1936 national income per capita (RM)[3]	Share of destroyed dwellings (%)[4]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bavaria	9,158	1,938	21.1	9.9		38.0		12.5
+ Lower Saxony	6,790	1,851	27.3	13.1		36.6		12.0
+ Schleswig-Holstein	2,649	882	33.3	8.1		28.9		10.5
Region H	18,597	4,671	25.1	10.7	1.6	36.5	898	12.1
Baden-Württemberg	6,318	792	12.5	10.3		31.5		10.4
+ Hesse	4,280	703	16.4	9.3		27.8		13.7
+ Rhineland-Palatinate	2,908	91	3.1	8.1		38.1		16.3
Region L'	13,506	1,586	11.7	9.4	1.6	32.1		12.8
+ North Rhine-Westphalia	12,988	1,267	9.8	8.8		14.1		30.0
+ Bremen	544	44	8.1	37.0		3.9		41.0
+ Hamburg	1,558	103	6.6	15.4		2.1		49.1
Region L	28,596	3,000	10.5	10.0	2.0	21.8	974	24.2
Federal Republic	47,194	7,671	16.3	10.3	1.9	27.0	955	20.3

Data sources: Data on expellees in 1949 come from Statistisches Bundesamt (1955c). Data on the population and the agricultural employment share in 1939 are from Statistisches Bundesamt (1954a). Data on the expellee share in 1946 come from Statistisches Bundesamt (1952b), and data on the population in 1925 from Hohls and Kaelble (1989). Data on national income and on 1938 unemployment rates come from Länderrat des Amerikanischen Besatzungsgebiets (1949), and data on the share of destroyed dwellings in 1946 from Deutscher Städtetag (1949).

Notes: [1] Expellees are defined as German nationals or ethnic Germans who on 1 September 1939 lived (i) in the former German territories east of the Oder-Neisse line, (ii) in Saarland or (iii) abroad. [2] The unemployment rate is expressed as a percentage of the dependent labor force. Pre-war unemployment data is not available for the West German states in their post-war borders. The unemployment rate of region H is approximated by the labor-force-weighted average of the unemployment rates in the employment agency districts of Bavaria, Lower Saxony, Nordmark. The unemployment rate of region L is approximated by the average of the unemployment rates in Hesse, Southwest Germany, Rhineland and Westphalia. [3] Pre-war national income data are not available for the West German states in their post-war borders. National income of region H is approximated as the population-weighted average of national income in Bavaria, Hannover, and Schleswig-Holstein. National income of region L is approximated as the average income of Baden, Württemberg, Hesse, and Hesse-Nassau, the Rhine Province and Westphalia. [4] The share of destroyed dwellings is calculated as the share of dwellings that were completely destroyed as a percentage of the housing stock in mid-1943.

Our analysis accounts for these pre-existing differences in two ways. First, we account for them directly in our model. In particular, we allow for region-specific exogenous productivity trends. Differential trends may capture, for instance, productivity gains from the reallocation of labor away from agriculture. These gains were arguably more important for the agrarian region H.[11] In additional robustness checks, we also allow for regional differences in the degree of war damage. Second, we use an alternative classification of federal states that levels out pre-existing differences in the degree of industrialization and war damage (see Appendix A.10). We then show that our quantitative results in the structural model are robust to the use of this alternative classification.

3.2 Empirical facts

We compare the demographic and economic developments of regions H and L in 1939, i.e., before the flight and expulsion, and between 1950 and 1970, i.e., in the first two decades after the expellee inflow was complete.

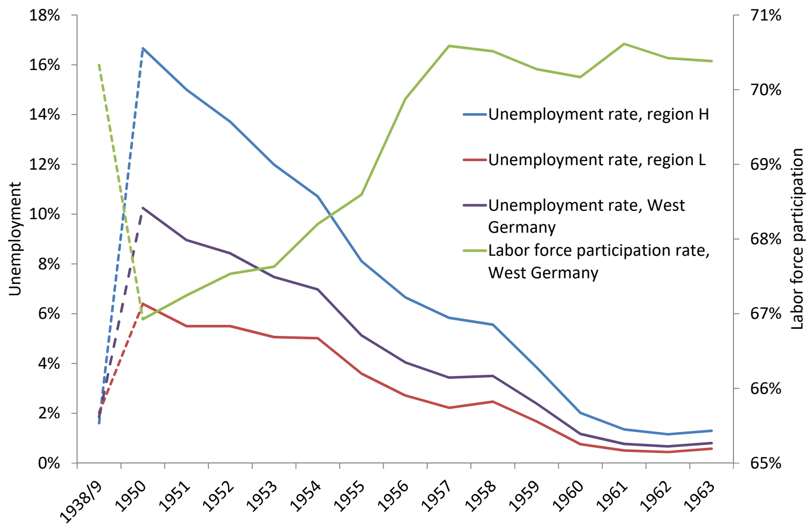
Unemployment and labor force participation. Figure 2 shows unemployment rates in regions H and L before the war and between 1950 and 1963 (our data series ends in 1963, as time-consistent regional employment data is not available after then). Both regions had almost full employment before the war. Unemployment then increased dramatically in both regions in the immediate post-war period. However, the situation was much more severe in the high-inflow region H, where the unemployment rate was 16.7% in 1950, than in the low-inflow region L, where it was 6.4%. Expellees were much more likely to be unemployed than native workers at that time: every third unemployed person in West Germany was an expellee in 1950.[12] Regional unemployment rates in both regions then gradually decreased in the 1950s. By the early 1960s, both regions were back at what was basically full employment.

We augment the unemployment data with data on labor force participation because the unemployment data only cover persons who were officially registered as unemployed. In contrast, persons who would generally like to work but have withdrawn from the labor market, say because they consider their chances of finding a job to be small, are not officially registered as unemployed.

[11] Between 1950 and 1970, the agricultural employment share fell by 18.8 percentage points in region H but by 'only' 14.1 percentage points in region L.

[12] Expellees then benefited dis-proportionally from the fall in unemployment in the 1950s. By 1958, their share among the unemployed had fallen to 22.0%. Unfortunately, we cannot calculate separate unemployment rates for expellees and non-expellees, as our data on employment does not distinguish between the two groups.

Figure 2: Unemployment and labor force participation rates, 1938-63



Data sources: The unemployment data come from Länderrat des Amerikanischen Besatzungsgebiets (1949) (for 1938) and from the German employment agency (for 1950-63). Data on economically active persons, used to calculate the labor force participation rate, are taken from Sensch (2004), Table B3.1. Data on the total population aged 16-65 come from the Statistisches Bundesamt.
Notes: The unemployment rate is expressed as a percentage of the dependent labor force. The unemployment rate of region H in 1938 is approximated by the (labor force-weighted) average of the 1938 unemployment rates of Bavaria, Lower Saxony, Nordmark, the unemployment rate of region L by the average of the unemployment rates of Hesse, Southwest Germany, Rhineland and Westphalia. The labor force participation rate is the ratio of all economically active persons to the population aged 15-65.

Therefore, an increase in the number of discouraged workers does not show up as an increase in unemployment, but rather as a fall in labor force participation.

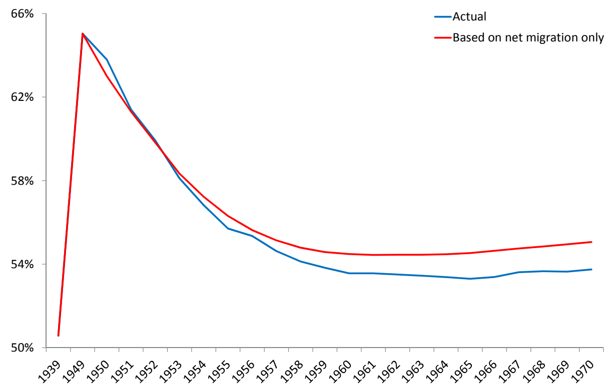
Figure 2 shows that the decline in regional unemployment in the 1950s coincided with an increase in the West German labor force participation rate from 66.9% in 1950 to 70.6% in 1957 (unfortunately, participation rates are not available at a regional level for 1950-63). Labor force participation was, therefore, low in 1950, presumably because labor market prospects were dire. As the labor market recovered, and the probability of finding a job grew, formerly discouraged workers might have increasingly chosen to re-join the labor force.[13]

Population and internal migration. The red line in Figure 3 shows that the population size of region H relative to region L soared from 50.6% in 1939 to 65.0% at the end of 1949. The expellee inflow, therefore, changed the relative size of the two regions dramatically.[14] Relative population then gradually came down again and reached 53.7% in 1970.

The blue line in Figure 3 shows that regional migration from H to L was by far the most im-

[13] Appendix A.3 provides evidence against the alternative hypothesis that the increase in labor force participation in the 1950s reflect secular trends, such as increasing female labor force participation.
[14] Appendix A.4 shows that factors other than the expellee inflow were only of minor importance for the increase in relative population.

Figure 3: Population in region H over population in region L, 1939-70



Data sources: Statistisches Bundesamt, Institut für Raumforschung.
Note: Population is measured at the end of each year. The population series that is based on migration only is calculated by adding to the actual population figure of the H and L region on 31 December 1949 (cumulated) net migration between the two regions.

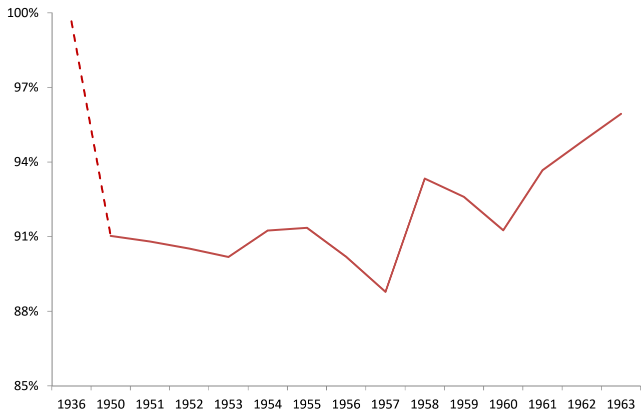
portant factor in moving the relative population size of the two regions back towards its pre-war level. The line shows how the relative population size of the two regions would have evolved if the only reason for changes in the relative population size had been migration between region H and region L. The migration-based population series thus abstracts from other potential influences, such as differences in fertility rates or migration from abroad, on the relative population size of the two regions. It declines from 65.0% in 1949 to 54.5% in 1960.

Appendix A.5 shows that net migration from region H to L was substantial for both expellees and natives, but that the former were more likely to migrate internally than the latter. In addition, Appendix A.6 provides tentative evidence that high-skilled individuals were more likely to migrate from region H to L. However, skill-selective migration appears to have had little effect on regional differences in skill levels.

GDP per worker. Figure 4 shows GDP per worker of region H relative to region L between 1950 and 1963. In 1950, GDP per worker of region H reached just 91.0% of region L's level. The gap remained largely unchanged until the mid-1950s. It then narrowed considerably in the late 1950s and early 1960s, and relative GDP per worker stood at 95.9% in 1963 (when the data series on employment ends). Appendix A.7 shows that the mid- and late-1960s saw no further improvement in region H's relative GDP *per capita*.

How did relative GDP change between 1939 and 1950? Unfortunately, there are no pre-war GDP data for German regions that are comparable to the post-war data. Instead, we use two proxies for regional GDP differences before the war (Appendix A.8 discusses these proxies in

Figure 4: GDP per worker in region H relative to region L, 1950-63



Data sources: National income data for 1936 are from Länderrat des Amerikanischen Besatzungsgebiets (1949), GDP data for 1950-63 are from Statistisches Bundesamt, data on the number of workers in 1939-63, as reported in Statistisches Bundesamt (1959) and Statistisches Bundesamt (1964), are from the employment agencies. *Notes*: The data point for 1936 refers to the (approximated) national income per worker of region H relative to region L (see Appendix A.8 for details). We normalize this proxy for national income by the number of workers in 1939. All other data points give GDP per worker of region H relative to region L. The term 'worker' refers to all dependent employees.

detail). The first proxy uses national income data from 1936. Region H's national income per worker reached 99.7% of region L's value in 1936. Judged by this proxy, region H suffered a marked decline in relative GDP following the expellee inflow (Figure 4 shows the 1936 value of relative national income along with data for relative GDP for 1950-63). The second proxy uses firm sales as a proxy for production, as suggested by Vonyó (2012). Relative sales per worker in region H fell from 75.1% of region L's value in 1935 to 69.8% in 1950.

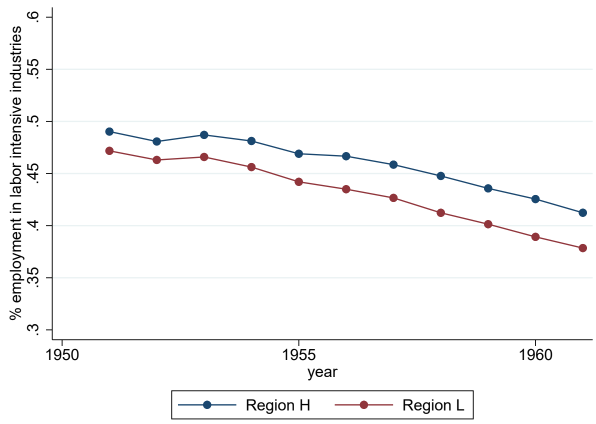
Overall, therefore, both proxies suggest that relative GDP per worker decreased significantly in region H between 1939 and 1950. Relative GDP per worker then bounced back in the late 1950s and early 1960s. Since we do not have comparable GDP data from before the war, we cannot be certain whether relative GDP per worker returned to its pre-inflow level.

Shifts in production. Regions that are highly interconnected by trade may also adjust to immigration by changing their production structure, as predicted by the Rybczynski theorem in Heckscher–Ohlin trade models. In our context, we would expect expellee inflows to increase labor-intensive production and decrease capital-intensive production. The associated shift in labor demand may then allow regions to absorb the expellee inflow without changes in wages.[15]

Figure 5 provides suggestive evidence that shifts in production structure, while plausible a

[15] The evidence for this mechanism is mixed. Hanson and Slaughter (2002) and Lafortune, Tessada, and González-Velosa (2015) find that local US economies indeed responded to immigration in the late and early 20th century, respectively, through changes in the output mix. Lewis (2004) and González and Ortega (2011), in contrast, find no such evidence.

Figure 5: Regional employment shares in labor-intensive industry production



Data source: *Industrieberichterstattung* of Statistisches Bundesamt
Notes: The figure shows the share of employment in labor-intensive industries among 21 mining and manufacturing industries in regions H and L. The city states of Bremen and Hamburg are excluded, as we lack data for many industries in these states. The classification as labor-intensive is based on industry capital-labor ratios in 1939. See Appendix A.9 for details and further robustness checks.

priori, appear not to have been an important adjustment channel in our context. The figure depicts, separately for regions H and L, the share of industry employment in labor-intensive mining and manufacturing industries for 1951 to 1961. Industries are classified as labor intensive based on their capital-labor ratios in 1939 (see Appendix A.9 for details on data sources). For both regions, we observe a steady decline in the employment share of labor-intensive industries in the 1950s (by 7.8 and 9.3 percentage points in region H and L, respectively). This observation is not consistent with the predictions of the Rybczynski theorem. Appendix A.9 shows that we reach similar conclusions if we consider sectors outside industry and alternative regional classifications.

Summary of empirical facts. To sum up, we have established four key empirical facts.

1. Unemployment increased dramatically between 1938 and 1950 in both regions. The 1950 unemployment rate was two and half times larger in region H than in region L. Unemployment then gradually declined during the 1950s, and both regions recorded full employment in the early 1960s. Expellees were much more likely to be unemployed than natives.

2. The labor force participation rate in West Germany increased strongly between 1950 and 1957, and remained constant thereafter.

3. The relative population size of region H went up from 50.6% in 1939 to 65.0% at the end of 1949, and then gradually decreased in the 1950s. Migration from region H to L was the

decisive factor in moving relative population back towards its pre-war level in the 1950s.

4. Relative GDP per worker of region H declined between 1939 and 1950. Region H then experienced faster economic growth than region L in the late 1950s and early 1960s.

To quantify to what extent these empirical facts can indeed be understood as a consequence of the expellee inflow, we now derive a dynamic two-region search and matching model of unemployment. The model allows us to quantify and interpret the regional adjustment processes after the inflow shock also over the medium and long run because it offers three important advantages over a reduced-form regression model. First, the model accounts for the effect of regional migration on local labor markets. Since, over time, regional migration flows will diffuse the labor market effect of the expellee inflow from region H to region L, a simple comparison of labor market outcomes between the two regions will underestimate the causal effect of receiving high rather than low expellee inflows on native labor market outcomes (Borjas and Monras 2017). After all, such comparison would show little or no differences, simply because the high inflow of expellees into region H will–through migration–also affect region L over time.

Second, the dynamic search and matching model allows us to assess the effect of the expellee inflow on variables that we do not directly observe in the data, such as regional employment of native workers and expellees, regional labor force participation of native workers and expellees, or regional wages. This allows us to decompose the expellee inflow into a comprehensive set of adjustment margins, and to make inference on income losses of natives. Finally, the model allows us to run counterfactual exercises, in which we can disentangle the importance of different variables, such as the regional distribution of the expellee inflow, in shaping adjustment dynamics and the effect on native income.

4 A dynamic model of regional labor markets

The backbone of our model is the textbook Diamond-Mortensen-Pissarides search and matching model of unemployment. We depart from a version of this model with endogenous labor force participation and extend it in two directions that are motivated by the particular historical episode that we study.[16]

[16] A salient feature of the historical episode that we do not directly consider is the growth spurt of the West German economy as a whole in the 1950s. Economist have advanced three explanations for this growth spurt (see Eichengreen and Ritschl (2009) for a review): neoclassical convergence, structural change, and a shock to total factor productivity (TFP) with subsequent recovery. Our model accounts for the first of the three explanation

Our first extension is regional migration. We consider two regional labor markets–one in region H and another in region L–that interact via migration. Workers who search for a job make a forward-looking choice of whether to search in region H or L.[17] Our second extension incorporates regional expellee inflows into the model. We model them as an exogenous increase in the number of non-employed workers, i.e., as a labor supply shock, and calibrate the regional distribution of this shock from the historical data.

In each region, a representative firm employs many workers and accumulates capital to produce output. Output is homogenous across regions and serves as numeraire. Adjusting employment or the capital stock is subject to costs. Furthermore, we consider a competitive equilibrium, in which firms and workers bargain over the wage. Our description of the model focuses on region H with the understanding that region L is formulated symmetrically to region H. Variables that pertain to region L are superscripted by a star.

4.1 Labor market stocks and flows

The working-age population P_t in region H at time t comprises employed workers N_t, unemployed workers U_t, and non-participating workers R_t, and hence $P_t = N_t + U_t + R_t$. Regional population evolves over time, because X_t expellees enter the labor market in region H exogenously and non-employed workers move endogenously between regions. This yields

$$P_t \quad = \quad P_{t-1} + X_t + G_t^\star - G_t \ , \qquad (1)$$

where $G_t^\star - G_t$ denotes net migration to region H.

We assume that all expellees are non-employed upon arrival, because they were forced to emigrate to a new environment and, hence, gave up previous employment. Despite initial non-employment, however, some expellees in the model are employed by the end of the first period, because a worker can pass through several labor market states within a period.

We also assume that expellees are homogenous to native workers in our model. The homogeneity assumption reflects the fact that expellees and natives were close substitutes on the

(as we allow for capital deepening during the adjustment process) and for the third explanation, to the extent that the TFP shock was asymmetric across regions. While Eichengreen and Ritschl (2009) largely dismiss the structural change explanation, they provide strong evidence for the TFP explanation. However, Eichengreen and Ritschl (2009) are interested in the aggregate growth performance of the West German economy. In contrast, we focus on regional differences in economic performance–and are thus most concerned with regional differences in productivity growth. We allow for these differences when calibrating our model to the data, see Section 5.3.

[17] Ortega (2000) and Chassamboulli and Peri (2015) also assume that only workers who search for a job, but not workers who are employed, decide whether to migrate.

West German labor market (see Section 2). Burda (2006) and Grossmann, Schäfer, Steger, and Fuchs (2017) adopt a similar homogeneity assumption in their analyses of regional economic integration between East and West Germany after German reunification.

At the beginning of period t, non-employed workers in region H, both expellees and natives, discretely choose one of three alternatives, namely not participating in the labor market, participating in the labor market in region H, or participating in region L. We denote the non-participation probability with $1-\pi_t$ and the migration probability, that is participating in region L, with γ_t. The workers' non-participation probability then determines the size of the reserve pool R_t of workers who are out of the labor force:

$$R_t = (1-\pi_t)[P_{t-1} + X_t - (1-\lambda)N_{t-1}] \ . \tag{2}$$

Square brackets in this equation contain the number of non-employed workers at time t, and $0 < \lambda < 1$ denotes the exogenous job separation rate. Furthermore, the workers' migration probability determines the size of H to L migration flows:

$$G_t = \gamma_t[P_{t-1} + X_t - (1-\lambda)N_{t-1}] \ . \tag{3}$$

Production in region H takes place once the participating workers who stay in region H have moved into either unemployment or employment. Employment, which evolves according to

$$N_t = (1-\lambda)N_{t-1} + M_t, \tag{4}$$

corresponds to new jobs, denoted by M_t, plus workers with ongoing jobs. The sum of employed and unemployed workers equals the labor force, i.e., $L_t = N_t + U_t$. In Appendix C.1, we show that equations (1) to (4) determine population, employment, and the labor force in region H given initial conditions P_{-1} and N_{-1}, population and employment in region L, expellee inflow X_t, and transition probabilities π_t and γ_t.

4.2 Labor market states and their values

In each period, a worker occupies one out of six labor market states. These states are employment, unemployment, and non-participation in either region H or L. Each state is accompanied by a value function that determines a worker's value of being in this state. The value of an employed worker in region H at date t is denoted by W_t and recursively computed as

$$W_t \quad = \quad w_t + (1-\lambda)\beta W_{t+1} + \lambda\beta E_\mu(\mathcal{U}_{t+1}). \tag{5}$$

The employed worker receives wage w_t (in units of the numeraire) at date t and the expected continuation value, discounted at $0 < \beta < 1$, at date $t+1$. This value has two parts. The first part occurs with likelihood $1-\lambda$ and is the value W_{t+1} of a worker who remains employed in the next period. The second part occurs with likelihood λ and is the value of a worker who loses his or her job at the end of period t. It is given by

$$\begin{aligned}\mathcal{U}_{t+1} \quad \equiv \quad & \max\{H_{t+1} + \bar{\mu}_{Ot+1}, \\ & \max[\phi_{t+1}W_{t+1} + (1-\phi_{t+1})Q_{t+1} + \bar{\mu}_{Ht+1},\ \phi^\star_{t+1}W^\star_{t+1} + (1-\phi^\star_{t+1})Q^\star_{t+1} + \bar{\mu}_{Lt+1}] + \hat{\bar{\mu}}_{It+1}\}.\end{aligned} \tag{6}$$

Value $\mathcal{U}_{t+1}$ depends on two nested decisions, each indicated by a max operator, that the worker takes at the beginning of period $t+1$. The worker decides to participate in the labor market if the value of non-participation, denoted by H_{t+1}, is smaller than the value of participation (captured by $\max[\dots] + \hat{\bar{\mu}}_{It+1}$ in equation (6)) after accounting for idiosyncratic preference shocks $\bar{\mu}_{Ot+1}$ and $\hat{\bar{\mu}}_{It+1}$. Shock $\bar{\mu}_{Ot+1}$ is distributed extreme-value Gumbel with location parameter $\sigma_h \ln h$, $0 < h < 1$, and scale σ_h^{-1}. Increasing the value of the location parameter makes non-participation permanently more attractive, and increasing scale puts greater weight on economic motives in workers' choice of non-participation. Thus, we interpret σ_h^{-1} as workers' propensity to participate in the labor market. We specify the distribution of $\hat{\bar{\mu}}_{It+1}$ in Appendix C.2.

Furthermore, in equation (6), the worker decides to migrate to region L if the value of searching for a job in region H is smaller than the value of searching for a job in region L, after accounting for preference shocks $\bar{\mu}_{Ht+1}$ and $\bar{\mu}_{Lt+1}$. The value of searching for a job in region H, $\phi_{t+1}W_{t+1}+(1-\phi_{t+1})Q_{t+1}$, depends on the job-finding rate ϕ_{t+1}, the value of an employed worker W_{t+1}, and the value of an unemployed worker Q_{t+1}. Shock $\bar{\mu}_{Ht+1}$ is distributed extreme-value Gumbel with location parameter $\sigma_f \ln f$, $0 < f < 1$, and scale σ_f^{-1}. Shock $\bar{\mu}_{Lt+1}$ follows the same distribution with location parameter $\sigma_f \ln(1-f)$ and scale σ_f^{-1}.[18] Accordingly, we interpret σ_f^{-1} as workers' propensity to migrate. Workers draw preference shocks at the beginning of a period. All preference shocks are mutually independent of each other.[19]

[18] Regional preferences (or "home bias") arising from location parameters of preference shocks imply that native workers favor their current region of residence and expellees favor their arrival region. Thus, conditional on not being employed, migration probabilities for native workers and expellees are the same.

[19] Monras (2020a) uses a similar nested discrete-choice problem to model multi-region migration.

The value of an unemployed worker in region H is recursively computed according to

$$Q_t = b_q + \beta E_\mu(\mathcal{U}_{t+1}) \ . \tag{7}$$

The unemployed worker receives unemployment benefits $b_q > 0$ and the expected discounted value $\mathcal{U}_{t+1}$ given in equation (6). Finally, the value of a worker who does not participate in the labor market corresponds to

$$H_t = b_h - b_q + Q_t \ , \tag{8}$$

where $b_h > b_q$ denotes home benefits. The parsimonious formulation of H_t emerges because we model participation as a decision about the current period only. Thus, the continuation values of the unemployed worker and the non-participating worker coincide. A main motivation for introducing the participation margin into the model is the lack of regional data on labor force participation. Without such data, we cannot attribute non-participants to the respective regional unemployment pool. Therefore, we use the model with participation margin to decompose aggregate participation data into their regional contributions.

4.3 Migration and participation probabilities

The probability to migrate from region H to region L is equal to the probability to migrate from H to L, conditional on participating in the labor market, multiplied by the participation probability: $\gamma_t = \gamma_t^{cond} \times \pi_t$. The conditional migration probability is the likelihood that the labor market is more attractive in region L than in region H,

$$\gamma_t^{cond} = \text{Prob}[\ \phi_t W_t + (1-\phi_t)Q_t + \bar{\mu}_{Ht} \leq \phi_t^\star W_t^\star + (1-\phi_t^\star)Q_t^\star + \bar{\mu}_{Lt}\ ] \ . \tag{9}$$

Furthermore, the participation probability is the likelihood that in a given period, non-participation in region H is less attractive than labor-market participation,

$$\pi_t = \text{Prob}[\ H_t + \bar{\mu}_{Ot} \leq \max[\phi_t W_t + (1-\phi_t)Q_t + \bar{\mu}_{Ht},\ \phi_t^\star W_t^\star + (1-\phi_t^\star)Q_t^\star + \bar{\mu}_{Lt}] + \hat{\bar{\mu}}_{It}\ ] \ . \tag{10}$$

In Appendix C.2, we solve for the maximum operators in value functions (5), (6) and (7) and express these functions in terms of transition probabilities which are endogenously determined in equilibrium. In Appendix C.3, we derive solutions for probabilities γ_t and π_t.

4.4 Firm behavior, wage bargaining, and labor market matching

Firms in region H use their workforce and capital stock to produce output, which is homogenous across regions and serves as numeraire. The representative firm maximizes the discounted sum of period profits,

$$\sum_{t=0}^{\infty} \beta^t \left[F(K_t, N_t) - w_t N_t - I_t - \overline{\kappa}_v V_t - \frac{\kappa_\eta}{2} \left(\frac{q_t V_t - q\widetilde{V}_t}{N_{t-1}} \right)^2 N_{t-1} - \frac{b}{2} \left(\frac{I_t - \tilde{I}_t}{K_{t-1}} \right)^2 K_{t-1} \right]. \tag{11}$$

The firm produces output with technology $F(N_t, K_t) = a_t K_t^{1-\chi} N_t^{\chi}$, where productivity a_t follows a deterministic, exogenous process (see equation (62) in Appendix C.8) and $\chi \in (0, 1)$. Profits are sales minus the wage bill $w_t N_t$, investment I_t, and employment and capital adjustment costs. The cost of posting vacancies are linear in vacancies V_t as in the textbook Diamond-Mortensen-Pissarides model. We also assume convex costs of hiring $q_t V_t$, where q_t denotes the job-filling rate (defined below), to capture the increasing costs for training and integrating new workers into the workforce, which seems an especially important cost component in our historical setting. We refer to the parameter κ_η, which governs the magnitude of convex hiring costs, as firms' propensity to not adjust employment.

The firm takes as given the number of hires exempted from costly adjustment, $q\widetilde{V}_t$, which evolve as $q\widetilde{V}_t = (\lambda \bar{N}_t)^{\lambda} (q\widetilde{V}_{t-1})^{1-\lambda}$ and where $\bar{N}_t$ denotes employment in region H in a steady state with aggregate population equal to $P_t + P_t^{\star}$. Thus, even with infinite hiring costs, $\kappa_\eta \to \infty$, hiring gradually adjusts to its new steady state such that the economy scales with population. The firm's workforce evolves as shown in equation (4), with $M_t = q_t V_t$.

The firm's capital stock accumulates according to $K_t = (1-\rho)K_{t-1} + I_t$, where $\rho \geq 0$ denotes the depreciation rate. Capital adjustment is subject to costs governed by parameter $b \geq 0$. We interpret this parameter as firms' propensity to not adjust capital. The firm takes as given the level of investment exempted from costly adjustment, $\tilde{I}_t = (\rho \bar{K}_t)^{\rho} (\tilde{I}_{t-1})^{1-\rho}$, where $\bar{K}_t$ denotes the level of capital in region H in steady state with aggregate population equal to $P_t + P_t^{\star}$. Solving the firm problem yields conventional optimality conditions (see Appendix C.4).

The wage rate is determined by Nash bargaining and thus maximizes the weighted product $(W_t - Q_t)^{\alpha} J_t^{1-\alpha}$, which comprises a worker's net surplus from work $W_t - Q_t$ and the firm's net surplus from one extra worker J_t. The bargaining process yields the surplus sharing rule $W_t - Q_t = \frac{\alpha}{1-\alpha} J_t$, where $0 < \alpha < 1$ denotes a worker's share of the total surplus from the job.

Non-employed workers who participate in the labor market in region H are matched to firms in this region through the regional matching function $M(S_t, V_t) = a_{mt} S_t^{\xi} V_t^{1-\xi}$, with $\xi \in (0, 1)$. Matching efficiency a_{mt} follows a deterministic, exogenous process (see equation (64) in Appendix C.8) and the number of job searchers is denoted by $S_t = U_t + M_t$. We postulate two regional matching functions instead of one aggregate matching function, as we have assumed that regional labor markets are segregated.[20] For later use, we define the job-filling rate as matched workers over aggregate vacancies, $q_t = M(S_t, V_t)/V_t$. Appendix C.5 describes the model solution.

5 Model fit and capital versus migration as adjustment margins

We choose the parameters of the model in three steps. In the parametrization step, we set initial conditions and expellee inflow rates to historical values and a first set of parameters to values conventional in the literature. In the second step, we calibrate a second set of parameters by targeting steady-state values of endogenous variables. In the third step, we calibrate the remaining eight parameters by minimizing the distance between the model's adjustment dynamics after the expellee inflow and the historical time series described in Section 3. We discuss the model fit for plausible alternative parameter calibrations in Appendix D.

5.1 Parametrization

We set initial conditions and expellee inflow rates to the historical values shown in the upper panel of Table 2. Relative regional population before the expellee inflow, $P_{-1}/P^{\star}_{-1}$, equals 54.4% in historical data, after adjusting this data for population changes between 1939 and 1950 that are unrelated to the expellee inflow (we describe the adjustment in Appendix A.4). Moreover, initial regional capital stocks per capita, $K_{-1}/(P_{-1} + P^{\star}_{-1})$ and $K^{\star}_{-1}/(P_{-1} + P^{\star}_{-1})$, start from below their steady-state values to account for war-related capital damage. According to Krengel (1958), 19% of the West German industrial capital stock was destroyed in the war. Regional expellee inflows are equal to the regional expellee population on 31 December 1949, as shown in column (2) of Table 1, after expressing the regional expellee population relative to the West German population. No expellees arrive after period $t = 0$ in the model, as the inflow was basically complete by the end of 1949 (see Section 2).

[20] The assumption of segmented labor markets is common in the literature (see, for example, Epifani and Gancia (2005) and Lkhagvasuren (2012)), and also describes the German labor market in the 1950s well. Communication was still costly at that time, and the average household did not own a car or a telephone. Furthermore, we consider two large regional labor markets, so that the average distance between two arbitrary locations within these labor markets is large as well. Therefore, workers would have had to travel relatively great distances to reach the other labor market.

Table 2: Parametrization

Parameter	Description	Value
$P_{-1}/P^{\star}_{-1}$	Relative regional population	54.4%
k_{-1}/k	War-related damage of K_{-1}	81%
$X_0/(P_0 + P^{\star}_0)$	Expellee inflow in region H	9.9%
$X^{\star}_0/(P_0 + P^{\star}_0)$	Expellee inflow in region L	6.4%
β	Discount rate	0.99
δ	Depreciation rate	0.025
χ	Labor income share	2/3
α	Worker's bargaining power	0.5
$1 - \xi$	Weight on vacancies in $M(\cdot)$	0.5
λ	Separation rate	0.054

Notes: Initial condition $k_{-1} = K_{-1}/(P_{-1} + P^{\star}_{-1})$ denotes the capital stock per capita before the expellee inflow and k denotes the steady-state level of the capital stock per capita. See Section 5 for further explanation.

We set the parameters in the lower panel of Table 2 to values that are either conventional in the literature or taken from historical data. A period corresponds to one quarter and hence the value of the discount factor β implies a 4% annual interest rate. The value of the depreciation rate δ implies a 10% annual capital depreciation rate. The values of workers' bargaining power α and the elasticity of matches to vacancies $1 - \xi$ are taken from Gertler and Trigari (2009). The value of the separation rate λ yields the average monthly separation rate of 1.8% that we observe in historical data on West Germany for 1950-1963.[21]

5.2 Targeting steady-state values

We calibrate a second set of parameters, summarized in Table 3, by targeting steady-state values of endogenous variables. We consider a steady state with region-specific population, zero net migration from region H to L, and zero exogenous worker inflow. Otherwise, the steady state is symmetric in both regions (Appendix C.6 contains the steady-state solution). Therefore, parameters in Table 3 apply to either region.

To calibrate unemployment benefit $\tilde{b}_q$ in Table 3, we equate the unemployment rate in steady state to its historical value in West Germany in 1963 and solve for $\tilde{b}_q$. We treat the 1963 value as steady state, because the West German unemployment rate was as low as 0.8% in 1963 and stayed almost constant until the early 1970s. To calibrate parameter h, which determines the

[21]We calculate the rate by dividing the number of persons who became newly unemployed in a given month by the number of employed persons in the previous months. Data come from the German employment agency and are available once per quarter (i.e., we use monthly data that we observe only once per quarter). From September 1955 onwards, the employment agency records inflows into the pool of job seekers instead of inflows into unemployment. Employment data are no longer available for 1964-70.

Table 3: Parameters calibrated by targeting steady-state variables

Variable (1)	Description (2)	Target (3)	Parameter (4)	Description (5)	Value (6)
U/L	Unemployment rate	0.8%	$\tilde{b}_q$	Unemployment benefit	0.0342
L/P	Participation rate	96.8%	$1-h$	Participation probability	0.6506
$\tilde{b}_q/w$	Replacement ratio	51%	$\bar{\kappa}_v$	Vacancy posting costs	0.0255
H	Non-participation value	$\phi W + (1-\phi)Q$	$\tilde{b}_h$	Home benefit	0.0668
q	Job-filling rate	68%	a_m	Matching efficiency	0.7692
K/N	Capital-labor ratio	1	a	Productivity	0.1043

Notes: Columns (1) and (3) list endogenous variables along with their steady-state values that we target. The parameters in columns (4) and (6) follow from these targets. Parameter values in region L coincide with the parameter values in region H reported in the table. See Section 5 and Appendix C.6 for further explanation.

participation probability in steady state, we equate the labor force participation rate to its historical value for prime-aged men (aged 25-54) in 1963, which is equal to 96.8%. We set the probability of migrating from region H to L in steady state to match gross migration flows from region H to L in 1963, which yields $0.345\% = 1 - f$. The probability of migrating from L to H in steady state then follows from the condition that net migration flows are zero in steady state. This yields $0.187\% = 1 - f^{\star}$.[22]

To calibrate firms' cost to post a vacancy $\bar{\kappa}_v$, we set the replacement ratio $\tilde{b}_q/w$ to 51%. This value corresponds to the average earnings replacement ratio between 1950 and 1970 of a single unemployed beneficiary (Flora 1986). The calibration implies that expected costs to hire a new worker equal 56% of the quarterly wage, which aligns well with existing estimates.[23] To calibrate the home benefit parameter $\tilde{b}_h$, we set the value of non-participation equal to a weighted average of the values of employment and unemployment. To calibrate the value of the matching efficiency a_m in Table 3, we target the quarterly job-filling rate in West Germany between 1950 and 1970 (see Appendix C.7). Finally, we normalize the capital-labor ratio to unity and derive regional productivity a from this normalization.

5.3 Targeting adjustment dynamics

We calibrate the remaining eight parameters by targeting the historical time series described in Section 3. Four parameters are "propensity parameters" that do affect the model's adjustment dynamics to the expellee inflow but do not affect the model's steady state. They are workers'

[22] Migration flows between H and L were indeed balanced in 1963. The higher probability of migration from H to L is a consequence of H being less populated than L.

[23] Using US data, Silva and Toledo (2009) report average costs per newly hired worker of close to 60% of the quarterly wage in 1980. Using German data, Yaman (2011) estimates these costs at EUR 4,000 in the year 2000. Relating this estimate to a gross monthly wage of EUR 2,551 in Germany in the year 2000 yields a cost estimate of about 52% (computed as $4000/(3 \times 2551)$), which again is close to our calibration.

propensity to participate in the labor market $1/\sigma_h$, their propensity to migrate $1/\sigma_f$, and firms' propensity not to adjust employment κ_η or capital b. The other four parameters determine initial conditions $a_{-1}/a^{\star}_{-1}$ and $a_{m,-1}/a^{\star}_{m,-1}$ and persistence ρ_a and ρ_m of the exogenous processes of productivity and matching efficiency. We assume that initial conditions deviate from steady state in opposite directions in each region (see Appendix C.8). This provides the model with alternative mechanisms to explain regional asymmetry in historical data other than asymmetric regional expellee inflows.

We calibrate the eight parameters by minimizing the distance between the model's simulated adjustment path after the expellee inflow and the historical time series (see Redding and Sturm (2008) for a similar calibration approach). We measure distance as $D = \Psi' W \Psi$. The vector Ψ is $n \times 1$, and each of its elements Ψ_j denotes the mean absolute difference between a variable in the model and the historical data,

$$\Psi_j = \left(\frac{100}{T - t_0}\right) \sum_{t=t_0}^{T} \text{abs}(y_t - y_t^{data}) \ , \tag{12}$$

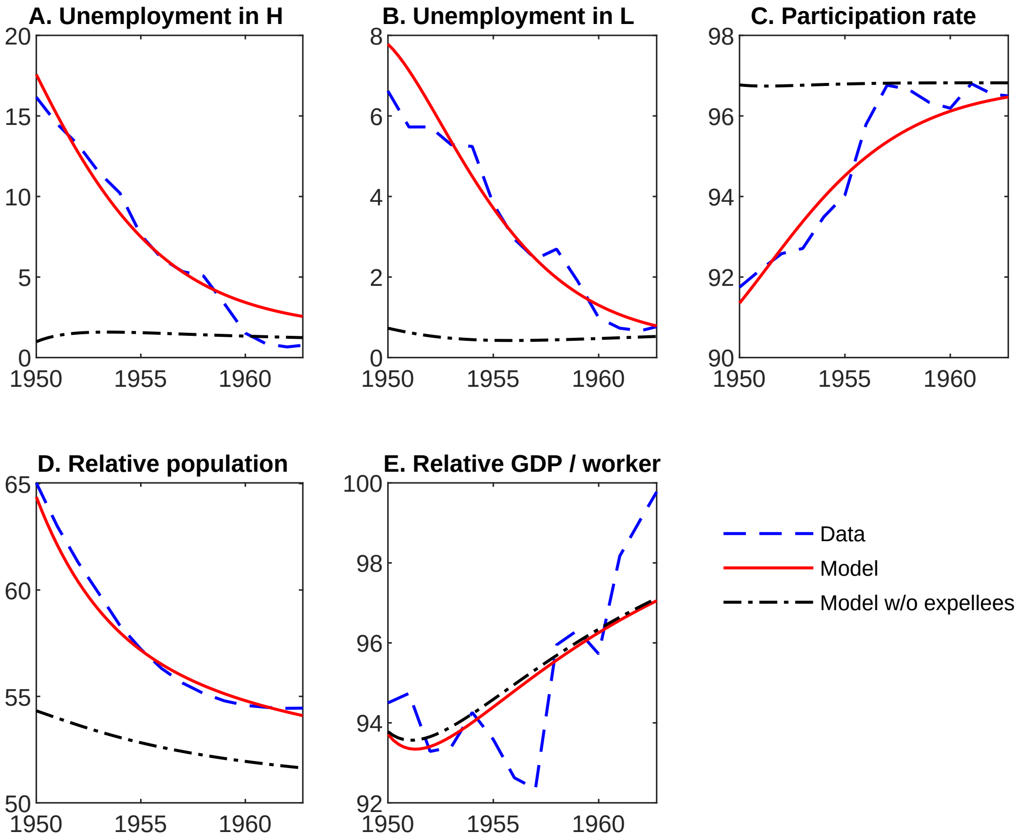
using y_t to denote a generic variable. We use data on $n = 5$ variables, namely relative population $P_t/P_t^{\star}$, regional unemployment rates U_t/L_t and $U_t^{\star}/L_t^{\star}$, average labor force participation $(L_t + L_t^{\star})/(P_t + P_t^{\star})$ and relative GDP per worker $Y_t N_t^{\star}/(Y_t^{\star} N_t)$, for the period $t_0 = 1950.Q1$ to $T = 1962.Q4$. The contribution of each variable to D is governed by the diagonal matrix W. We set W such that each regional unemployment rate contributes 12.5% and each other variable contributes 25%.

The relative population series abstracts from influences other than regional migration (see Section 3.2), since our model also abstracts from such influences. We also transform regional unemployment rates to equal 0.8% in 1963 for these time series to be consistent with the regional symmetry of the model's steady state. We normalize the historical data on relative GDP per worker by its 1963 value. Thus, like the unemployment rates, we treat the 1963 value as steady state.[24] We normalize labor force participation by its 1961 value, the maximum participation rate in our data, and linearly interpolate all historical data from annual to quarterly frequency.

Appendix Table A8 reports the parameter values that minimize distance D and shows that

[24] Two observations suggest that relative GDP per worker had reached its steady-state value by 1963 (when the data series ends). First, relative GDP per *capita* remained fairly constant throughout the 1960s (see Appendix A.7). Second, despite lower GDP per capita in region H than L, net migration was zero at the time. Moreover, participation was arguably in steady state in 1963, because there was basically full employment at that time and the participation rate had hardly changed since 1957 (see Figure 2).

Figure 6: Model fit of historical data



Notes: The figure compares the historical data (blue dashed line) to the adjustment paths predicted by our calibrated model with exogenous expellee inflow (red solid line) and without expellee inflow (black dashed-dotted line). See Section 5.4 for further explanation.

they are robust to plausible changes in our baseline calibration. We now discuss model fit and the parameter values on which the model fit depends.

5.4 Model fit of historical data

Figure 6 compares the historical data, which we target to calibrate the parameters governing model dynamics, to the adjustment paths implied by the calibrated model. The figure shows that the calibrated model fits the historical data remarkably well, both qualitatively and quantitatively. The figure also shows the model-implied adjustment paths without the regional expellee inflow (to which we turn below).

Panels A and B of Figure 6 show that the model fits the initial magnitudes and persistent decline of the historical regional unemployment rates. Regional unemployment increases because expellees arrive in either region without a job, and unemployment remains persistently high because expellees and unemployed native workers only gradually move into employment. The persistence of unemployment implied by the model depends, in particular, on firms' propensity not to adjust employment κ_η.

The model also fits the large discouraged worker effect (Panel C), which reduces the historical labor force participation rate by almost 5 percentage points below its equilibrium rate. Labor force participation is slightly less persistent than the unemployment rates, again in line with the historical data. The evolution of labor market participation in the model depends to a large degree on workers' propensity to participate $1/\sigma_h$.

Furthermore, the model captures the gradual decline in relative population of region H to L after the expellee inflow (Panel D). Relative population declines because non-employed workers, motivated by lower unemployment rates, higher wages and higher job-finding rates in region L, migrate from region H to L. Ongoing migration along with faster capital accumulation in region H first attenuates regional differences in wages and job-finding rates, and eventually eliminates above-steady-state migration incentives altogether.

The model also fits the dynamics in relative GDP per worker (Panel E). However, the catch-up in GDP per worker in the model does not arise because of the expellee inflow but is almost entirely driven by the exogenous productivity process. This is evident from the fact that the model-implied adjustment paths are very similar with and without the expellee inflow. Our calibration suggests that the pre-inflow regional productivity gap was 6%, which is broadly consistent with estimates reported in Waidlein (2013).[25] The productivity gap then narrows over time. This catch-up may reflect productivity gains from the reallocation of labor away from agriculture, which were arguably more important in the initially more agrarian region H (see our discussion of pre-existing regional differences in Section 3.1).

While the regional productivity gap is essential to replicate historical data on relative GDP per worker, it plays a negligible role in explaining unemployment, employment, and participation dynamics. The productivity gap induces some migration from the more to the less productive region but the contribution to overall migration flows is relatively small.

Our calibration also suggests that matching efficiency was higher in region H than in L, which generates persistent, but small regional unemployment differentials. This allows the model to extend adjustment dynamics in regional unemployment rates beyond the end of our calibration

[25] Waidlein (2013) reports state-level estimates on two measures of total factor productivity, which she infers under strong assumptions, as reliable regional productivity data are unavailable for the historical time period. We aggregate the estimates to the level of our regions H and L, using population as weights, and take the average of the two measures. Reassuringly, in her data, the gap in total factor productivity between region H and L in 1950, normalized by the corresponding 1963 value, is equal to is 5.2% and hence very close to our calibration.

sample and thereby improves model fit. Appendix D shows that our results do not hinge in any way on the presence of regional differences in matching efficiency.

5.5 Capital versus migration as adjustment margins

Workers and firms respond to the economic incentives created by the expellee inflow. Workers migrate from the high- to the low-inflow region in search of higher wages and better job prospects. Firms expand their capital stock, incentivized by increases in the return to capital. These incentives are stronger in the high-inflow region H. Both types of adjustment–migration from region H to L and differential capital accumulation–narrow the gap between regional capital-population ratios, created by the asymmetric expellee inflow, and spur economic convergence between labor markets. This subsection explores the relative importance of migration and differential capital accumulation in the convergence process, before the next section explores the relative importance of the different labor flows as adjustment margins.

We decompose log differences in regional capital-population ratios into log differences in regional capital stocks and population:

$$\ln\left(\frac{K_t}{P_t}\right) - \ln\left(\frac{K_t^\star}{P_t^\star}\right) = (\ln K_t - \ln K_t^\star) - (\ln P_t - \ln P_t^\star)\,. \tag{13}$$

Differential capital accumulation changes the gap in regional capital stocks (first term in brackets on the right-hand side), whereas migration changes the gap in population (second term). By subtracting from both sides of equation (13) log differences in regional employment-to-population ratios, we obtain:

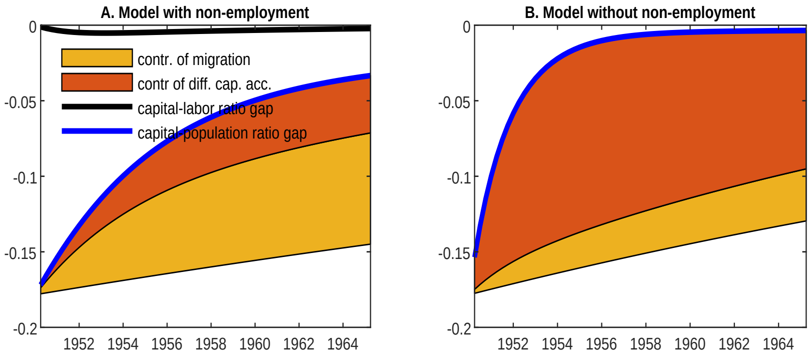
$$\ln\left(\frac{K_t}{N_t}\right) - \ln\left(\frac{K_t^\star}{N_t^\star}\right) = (\ln K_t - \ln K_t^\star) - (\ln P_t - \ln P_t^\star) - \left[\ln\left(\frac{N_t}{P_t}\right) - \ln\left(\frac{N_t^\star}{P_t^\star}\right)\right]. \tag{14}$$

Comparing equations (13) and (14) shows that differences in regional employment-to-population ratios drive a wedge between the gaps in capital-to-labor and capital-to-population ratios.

To obtain the relative importance of differential capital accumulation and migration as adjustment margins, we subtract from (13) the corresponding decomposition in a 'no-adjustment scenario' with prohibitively high employment adjustment cost and migration rates at steady state.[26] We then decompose the difference in capital-population ratio gaps between the histori-

[26]Steady state migration very slowly redistributes the inflow from the high- to the low-inflow region because of the inherent locational preferences of workers. Steady state migration is thus the only channel through which the gap in capital-population ratios vanishes over time in the no-adjustment scenario. The rate of capital accumulation, in contrast, is imposed to be identical in the two regions (see Appendix C.9 for details).

Figure 7: Differential capital versus migration as adjustment margins



Notes: The figure shows the paths of the capital-population and capital-labor ratio gaps in our model (Panel A) and in a simplified model without non-employment (Panel B). We calibrate parameters and the inflow shock in both models to the values in our baseline calibration (see Sections 5.1-5.3). Furthermore, the figure shows the corresponding decompositions of the capital-to-population gap into differential capital accumulation (orange area) and migration (yellow area) (see equation (13)), after subtracting from this decomposition the decomposition in a no-adjustment scenario. See the main text for further details.

cal and no-adjustment scenarios into its two components, the contribution of differential capital accumulation and migration.

Panel A of Figure 7 depicts these contributions along with the model-implied paths of both the capital-population and capital-labor ratio gaps between regions H and L.[27] The gap in capital-population ratios (blue line) plummets on impact. This is because the expellee inflow adds considerably more population to region H than to region L. Both differential capital accumulation (the orange area in the figure) and migration (the yellow area) close the gap over time. Of the two adjustment margins, migration is the more important one. By 1965, migration accounts for 65.8% of the difference in capital-population ratio gaps between the factual and no-adjustment scenario, whereas differential capital accumulation accounts for only 34.2%.

The gap in capital-labor ratios (black line in Panel A), in contrast, does not plummet on impact. This is because expellees initially only add to the unemployment pool. Region H's lower employment-to-population rate thus counterbalances its lower capital-population ratio (see equation (14)). Over time, the gap in employment rates narrows again, as expellees are integrated into the labor market. Relatively higher employment growth in region H lowers the capital-labor ratio gap, whereas migration from region H to L and differential capital accumulation increase

[27]Unfortunately, capital stock data for German states is only available from 1970 onwards. We can thus not compare the model-implied capital-population ratio gap to the data. The data for 1970 show that the capital-population ratio was almost identical in region H (62903 EUR in 2000 prices) and region L (62081 EUR). The gap was thus close to zero in 1970, consistent with the model. At the same time, we know from Section 3.2 that regional migration did not bring region H's relative population all the way back to its initial level by 1970 (relative population soared from 50.6% in 1939 to 65.0% at the end of 1949 and then came down to 53.7% in 1970). Together, these facts tentatively suggest that differential capital accumulation has played some role in equalizing regional capital-population ratios after the asymmetric expellee inflow.

the gap. The former effect initially outweighs the latter effects, so that the capital-labor ratio gap decreases in the first few years after the shock before slowly converging back to zero.

The non-employment margin in our model thus smooths the adjustment path of the capital-labor ratio. This, in turn, significantly affects the incentives of firms to accumulate capital and of workers to migrate. To clarify this point, Panel B. repeats our decomposition in a model with full employment (see Appendix C.9 for details). Capital-labor and capital-population ratios are now identical, as the employment-to-population rate is always one. The gap in capital-labor ratios now plummets with immigration, as expellees immediately enter employment. Both higher capital accumulation in region H and migration from region H to L narrows the gap again. However, capital accumulation is now much more important than migration, especially at the beginning of the adjustment process. By 1965, differential capital accumulation still accounts for 72.9% of the difference in the capital-labor ratio gaps between the historical and no-adjustment scenario. The dominant role of capital accumulation follows from the sharp decrease in capital-labor ratios, which creates ample incentives for capital accumulation.

The two models also differ in their predictions regarding wages (see Figure A11 in Appendix C.10). On impact, wage losses are considerably less severe in our model with non-employment than in the model with full employment. This is because the marginal productivity of workers declines less strongly than in the full employment model, in which the capital-labor ratio plummets on impact. However, wage losses are also more persistent because immigration has a persistent negative effect on job finding probabilities–and thus on the outside option of workers in the wage bargain.

6 Main results on the labor market effects of the expellee inflow

We have shown that our parsimonious model explains the empirical facts surprisingly well. In this section, we hence use this model to address our key research questions. Subsection 6.1 discusses how quickly and by what labor margins regions H and L adjust to the expellee inflow, and Subsection 6.2 quantifies the effect of the inflow on native labor income. Appendix D shows that our main results are robust to various changes in the model calibration. In particular, the robustness checks allow for asymmetric initial capital stocks, consider alternative definitions of the high- and low-inflow region, and restrict matching efficiency to be the same in both regions.

6.1 Margins of labor market adjustment

This subsection shows that 15 years after the inflow, more than a third of the initial increase of the population in the high-inflow region H is absorbed through migration to the low-inflow region L. We also show that the adjustment processes of native inhabitants and expellees differ strongly from each other because the two groups start from different labor market states.

Employment, unemployment, non-participation, and regional net migration are the adjustment margins in the labor market and we measure the relative contribution of a margin by tracing out how the expellee inflow affects this margin in the course of time. Appendix E derives the model-implied decomposition

$$X_0 \quad = \quad N_T - N_{-1} + U_T - U_{-1} + R_T - R_{-1} + \sum_{t=0}^{T} (G_t - G_t^{\star}) \ ,$$

which expresses the cumulative change in region H employment, unemployment, non-participation, and net migration between the time period before the inflow and period T. Considering this decomposition relative to the counterfactual situation and normalizing it by the size of the expellee inflow yields

$$1 \quad = \quad \frac{N_T - \widetilde{N}_T}{X_0} + \frac{U_T - \widetilde{U}_T}{X_0} + \frac{R_T - \widetilde{R}_T}{X_0} + \frac{\sum_{t=0}^{T} [(G_t - G_t^{\star}) - (\widetilde{G}_t - \widetilde{G}_t^{\star})]}{X_0} \ , \qquad (15)$$

where $\widetilde{N}_T$, for instance, denotes counterfactual employment in region H as implied by the estimated model but without the expellee inflow.

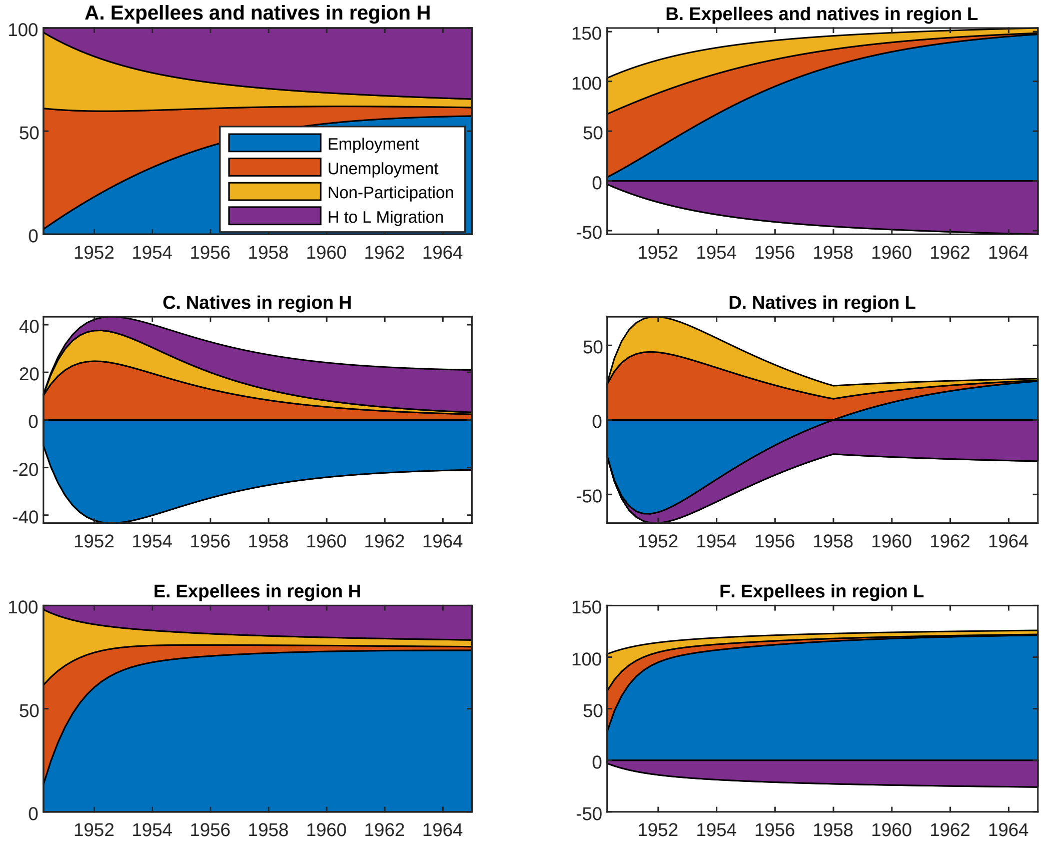
We can learn more about the economic adjustment mechanisms by splitting decomposition (15) into one decomposition for the native population and another decomposition for expellees. Computing the decomposition for the native population yields (see Appendix E):

$$0 \quad = \quad \frac{N_{NT} - \widetilde{N}_{NT}}{X_0} + \frac{U_{NT} - \widetilde{U}_{NT}}{X_0} + \frac{R_{NT} - \widetilde{R}_{NT}}{X_0} + \frac{\sum_{t=0}^{T} [(G_{Nt} - G_{Nt}^{\star}) - (\widetilde{G}_{Nt} - \widetilde{G}_{Nt}^{\star})]}{X_0} \ , \qquad (16)$$

where N_{NT}, for instance, denotes native employment at time T. Since the native population experiences no exogenous inflow, the four adjustment margins on the right-hand side of equation (16) add up to zero. We obtain the decomposition for expellees by subtracting the decomposition for the native population (16) from decomposition (15) (see Appendix E).

Both data limitations and the difficulty to separate the effect of the expellee inflow from other developments in the economy prevent us from computing decompositions (15) and (16) directly

Figure 8: Cumulative contribution of adjustment margins over time, regions, and worker types



Notes: The figure shows, separately for region H and L, the relative contribution of each adjustment margin for the overall population (Panels A and B), for the native population (Panels C and D) and for expellees (Panels E and F). Each decomposition is expressed relative to the corresponding decomposition in a counterfactual scenario, in which we set the expellee inflow to zero. See Section 6.1 for further explanation.

in the raw data. In particular, we are missing data on native and expellee employment and on regional labor force participation. The model-implied counterfactual accounts for adjustment dynamics that are not due to the expellee inflow but instead due to war-related damage of capital stocks and differential regional trends in total factor productivity and matching efficiency.

Figure 8 shows, separately for region H and L, the relative contribution of each adjustment margin in the overall population (Panels A and B), the native population (Panels C and D), and the expellee population (Panels E and F). Relative contributions are shown for each time horizon T from the time of the expellee inflow until 1965.

Three main findings emerge from the decompositions. First, the unemployment and non-participation margins dominate the adjustment process for the overall population in the early years after the shock, whereas the employment and migration margins dominate this process in later years. This is true for both regions (see Panel A for region H and Panel B for region

L). In later years, the contribution of the migration margin is sizable. By 1965, migration has contributed more than one-third to the cumulative labor market adjustment of region H.

Second, it takes regional labor markets about a decade to absorb the expellee inflow shock. In particular, it takes 13 years in region H and 9.25 years in region L to close 90% of the gap between unemployment at the time of the inflow and unemployment in the terminal steady state. Monras (2020a) also finds that it took about a decade before the labor reallocation across US Metropolitan areas triggered by the Great Recession was completed.

Third, the adjustment process of native workers differs strongly from the process of expellees (compare Panels C and E for region H and Panels D and F for region L). The reason for the markedly different adjustment processes of native workers and expellees is that both groups start from very different initial labor market states. While most native workers are initially employed, all expellees are initially non-employed. Our results show that the different initial conditions shape the labor market experiences of the two groups in the wake of the shock.

In particular, native employment decreases in each region at the beginning of the adjustment process, with job separations of native workers outnumbering new matches in the first few quarters after the shock (see Panels C and D). Native employment in region H reaches a minimum ten quarters after the shock. When measured at that time, native employment decreases by 4.33 native workers for any ten expellees who arrive in region H. This minimum employment effect is robust to various modifications in our model calibration (see Appendix D). Of the 4.33 native workers who are out of employment, 1.30 leave the labor force, 2.42 enter the unemployment pool, and 0.61 leave region H for region L.[28] The unemployment rate of native workers equals 10.78%. The large negative employment effect that we find is broadly consistent with evidence in Glitz (2012). He studies the immigration of ethnic Germans from Eastern Europe and the former Soviet Union to Germany after the fall of the Berlin Wall and finds that in the short run, 3.1 native workers lose their jobs for every ten immigrants that find employment.

Furthermore, 3.75 years after the expellee inflow, migration accounts for one-third of the

[28] Native workers in our model adjust to the expellee inflow in a way that closely resembles the adjustment predicted by the literature on (negative) local labor demand shocks (see, for example, Blanchard and Katz (1992), Decressin and Fatas (1995), Lkhagvasuren (2012), Dao, Furceri, and Loungani (2017), Beyer and Smets (2015), Basso, D'Amuri, and Peri (2019)). The literature on labor demand shocks focuses on region-specific shocks. Our historical shock, in contrast, hits both regions, although to a very different degree, and thus convolutes aggregate and region-specific components (see, for example, Furlanetto and Ørjan Robstad (2019) for responses to aggregate immigration shocks). We thus decomposed the historical shock in a common and a region-specific component and quantified the relative contribution of the adjustment margins for the region-specific component. The decomposition supported our conclusion: Native workers adjust to the region-specific component of the expellee inflow in a way that closely resembles the labor market adjustments after a negative labor demand shock.

decrease in region H's native employment, and after 15 years, it accounts for basically the entire decrease. By 1965, 1.78 native workers have left region H for any ten expellees who arrive. These internal native migrants expand the labor market in region L (see Panel D). Since native migrants arrive without a job, they initially add to the unemployment and non-participation pools. Over time, however, native migrants find jobs and eventually increase native employment in region L, whereas native employment in region H falls permanently.

In contrast to the native population, expellees are gradually absorbed into employment, with their inflows into employment exceeding their outflows from employment over the entire adjustment path (see Panels E and F). This process is faster in region L than in region H because the job-finding rate remains higher in the low-inflow region L. Two years after the shock, expellee employment already stands at 95% in region L but at only 60% in region H (relative to the initial regional expellee inflow).

6.2 The effects of the expellee inflow on native labor income

We have shown that native workers experience an increased probability of non-participation and unemployment along the adjustment path, and respond to the expellee inflow by moving from region H to L. These adjustment processes affect natives' expected lifetime labor income. This subsection quantifies this income effect, for which we have no direct evidence in the data.[29] We caution, however, that our model does not capture the potentially important effect of job loss on future wages (Jarosch 2015), because previous unemployment spells have no effect on wages conditional on being re-employed. In our model, immigration decreases wages by temporarily lowering the capital-labor ratio, and thus the marginal productivity of workers, and by temporarily deteriorating the outside option of workers in the wage bargain.

We find that the expellee inflow reduces expected discounted lifetime income of native workers by 1.51%, reflecting the large and long-lasting adjustment processes described in Section 6.1. Per-period income effects in the first years after the expellee inflow are up to four times larger than the overall effect on lifetime income, reflecting mainly the negative wage effects of immigration on impact. Income losses are largest for native workers who are non-employed in region H at the time of the expellee inflow.

[29] In our partial equilibrium model, we implicitly divide a household into workers, consumers and shareholders and focus our analysis on workers, but not on consumers or shareholders. Accordingly, our analysis is silent about who owns what share of the economy-wide capital stock and, hence, about the effects of the expellee inflow on capital income.

6.2.1 Overall treatment effect on expected discounted lifetime income

Table 4 reports the treatment effects of the expellee inflow on the expected discounted lifetime income (EDI) of native workers. The treatment effect, $\mathcal{T}_0$, is the percentage difference between a worker's EDI in the historical scenario, $\mathcal{Z}_0$, and her EDI in a counterfactual scenario without expellee inflow, $\widetilde{\mathcal{Z}}_0$, at the time of the shock:

$$\mathcal{T}_0 \quad = \quad 100(\mathcal{Z}_0 - \widetilde{\mathcal{Z}}_0)/\widetilde{\mathcal{Z}}_0 \ . \tag{17}$$

Since a worker can be in one of six different states (employed, unemployed, or non-participating in region H or region L) at the time of the inflow, we compute six worker-specific treatment effects in Table 4. We augment the worker-specific treatment effects by the treatment effects for the average native worker in region H, the average native worker in region L, and the average native worker in both regions (Appendix F.1 explains how we calculate these average treatment effects).

The first main result in Table 4 is that the expellee inflow reduces the EDI of the average native worker by 1.51%. This value is robust to various modifications in our model calibration (see Appendix D). The decline of native income in our model arises only from the adjustment dynamics toward the new steady state. Once this steady state is reached, the expellee inflow no longer affects native income. In contrast, Battisti, Felbermayr, Peri, and Poutvaara (2018) quantify the steady-state income effect of exogenously given immigration rates in models with labor market frictions, fiscal redistribution and skill complementarities, but without internal migration. For Germany, they find that in a steady state with a migrant share of 15.3%, native income is 0.31% higher than in a no-migration steady state. While their income measure is more comprehensive than ours as it also includes fiscal and capital income, our results suggests that adjustment dynamics matter for the overall income effects of immigration.

The second main result in Table 4 is that income losses vary significantly with a worker's initial location and labor market status. For the average native worker, losses are 63.7% larger in region H than region L (2.03% compared with 1.24%). In both regions, losses are significantly higher for workers who are unemployed at the time of the shock rather than employed. This is because the expellee inflow decreases job-finding rates and hence the re-employment probability of unemployed native workers. In contrast, employed natives only suffer from lower job-finding rates if they lose their jobs in later periods. Overall, therefore, a worker's initial state has a

Table 4: Treatment effect on expected discounted lifetime income of native workers

	Region H		Region L	
Worker type	Income	Treatment effect (in %)	Income	Treatment effect (in %)
Average	Z_N	−2.03	$Z_N^\star$	−1.24
Employed	W	−1.97	$W^\star$	−1.20
Unemployed	Q	−2.46	$Q^\star$	−1.58
Non-participant	H	−2.45	$H^\star$	−1.57
Average in both regions, $\overline{Z}_N$		−1.51		

Notes: The treatment effect is defined in equation (17) and described in Section 6.2.1. We distinguish native workers by their labor market status and their location at the time of the shock.

marked impact on her income losses.

6.2.2 Per-period and cumulative treatment effect

We analyze how income losses evolve over time by decomposing the overall treatment effect in the EDI of the average native worker in both regions, $\overline{Z}_{Nt}$, in two ways. The first decomposition is the per-period treatment effect and shows in which period the treatment effect is largest; the second decomposition is the cumulative treatment effect and shows how long it takes for the overall treatment effect to be realized.

We denote the per-period treatment effect in period t by $\mathcal{PT}_t$ and define it as the difference between period t income in the historical scenario, $\mathcal{Z}_t - \beta\mathcal{Z}_{t+1}$, and period t income in the counterfactual scenario, $\widetilde{\mathcal{Z}}_t - \beta\widetilde{\mathcal{Z}}_{t+1}$, expressed in terms of the average counterfactual income:

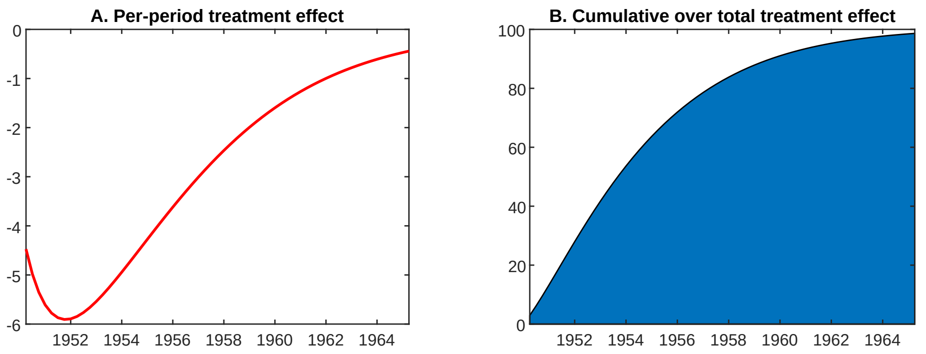
$$\mathcal{PT}_t \quad = \quad 100\left(\frac{[\mathcal{Z}_t - \beta\mathcal{Z}_{t+1}] - [\widetilde{\mathcal{Z}}_t - \beta\widetilde{\mathcal{Z}}_{t+1}]}{(1-\beta)\widetilde{\mathcal{Z}}_0}\right).$$

Panel A in Figure 9 shows that the per-period treatment effect in $\overline{Z}_{Nt}$ evolves non-monotonically over time. On impact, the expellee inflow reduces the per-period income of the average native worker in both regions by 4.47% relative to counterfactual income. As more and more native workers become unemployed or leave the labor force over time (see Section 6.1), the per-period treatment effect declines even further, reaching a minimum value of −5.91% nine quarters after the shock, and slowly dissolves thereafter.[30]

Borjas (2017)'s re-analysis of the Mariel Boatlift–in which around 125,000 Cuban refugees arrived in Florida between April and October 1980–also suggests that the adverse wage effects of

[30]The large (in absolute terms) per-period treatment effects in the early years after the expellee inflow are consistent with the considerably smaller overall treatment effect, since the latter averages the discounted per-period effects over a worker's lifetime, i.e., $\mathcal{T}_0 = (1-\beta)(\mathcal{PT}_0 + \beta\mathcal{PT}_1 + \beta^2\mathcal{PT}_2 + \dots)$. We re-iterate that the overall treatment effects does not account for potential adverse effects of job loss on wages later in life.

Figure 9: Treatment effects over time



Notes: The figure depicts the per-period treatment effect (Panel A) and the cumulative overall treatment effect in expected discounted lifetime income (Panel B) of the average native worker. See Section 6.2.2 for further explanation.

immigration initially increase over time.[31] The hump-shaped income loss dynamics we obtain are also predominantly governed by wage income. Two factors determine these dynamics. First, the (unconditional) employment probability of native workers declines gradually but also recovers only gradually (see Panel C in Figure 8). Natives losing their jobs find themselves in a massively expanded unemployment pool and hence face lower job finding rates along the adjustment path.[32] Second, firms accumulate capital to absorb the expellee inflow into employment. However, since firms face capital adjustment costs, employment rises faster than capital in the initial years thereby putting further downward pressure on wages (see also Section 5.5).

Since it takes more than a decade for per-period treatment effects to vanish, it also takes a long time for the overall treatment effect to be realized fully. We summarize this speed of adjustment in a cumulative treatment effect for the average native worker in both regions. This cumulative treatment effect corresponds to the overall treatment effect truncated at date t,

$$\mathcal{CT}_t \;=\; 100\left([\mathcal{Z}_0 - \beta^{t+1}\mathcal{Z}_{t+1}] - [\widetilde{\mathcal{Z}}_0 - \beta^{t+1}\widetilde{\mathcal{Z}}_{t+1}]\right)/\widetilde{\mathcal{Z}}_0 \;.$$

Truncation implies that historical and counterfactual income are compared up to date t only and that $\mathcal{CT}_t$ approaches the overall treatment effect $\mathcal{T}_0$ as t becomes large. The ratio of cumulative to overall treatment effect, $\mathcal{CT}_t/\mathcal{T}_0$, then yields the fraction of the overall treatment effect that is realized over a certain time horizon of the adjustment process, say within the first five years.

Panel B in Figure 9 plots $\mathcal{CT}_t/\mathcal{T}_0$ for the income of the average native worker, and shows

[31] The labor market effects of the Mariel Boatlift are still subject of academic debates. Peri and Yasenov (2018), for instance, find no wage and employment effects on low-skilled workers.

[32] This effect also persists because initially discouraged workers re-enter the unemployment pool over time.

that the overall treatment effect builds up only gradually over time. Five years after the expellee inflow, the cumulative treatment effect still amounts to less than two-thirds of the overall treatment effect, and it takes another ten years for the remaining effect to be fully realized. This result shows that per-period income has to be analyzed over a long period of time in order to obtain a full picture of the overall income effect of the expellee inflow.

6.2.3 Wage elasticity of immigration

Most papers on the labor market effects of immigration focus on the wage elasticity of immigration in the short run. This subsection calculates the model-implied wage elasticity of immigration and compares it to existing empirical estimates.

When measured at the time of the shock, the wage elasticity in our model, computed as $(d\log(w_t) - d\log(\widetilde{w}_t))/d\log(P_t)$, equals -0.17 and -0.25 in region H and L, respectively. We can think of this elasticity as the short-run or partial equilibrium wage effect of immigration before (the bulk of) adjustment takes place. Much of the empirical immigration literature uses spatial variation in immigrant inflows to estimate this short-run effect (Jaeger, Ruist, and Stuhler 2018).

Our short-run wage elasticities are slightly lower than most estimates in the literature and thus imply larger wage effects of immigration. In fact, Friedberg and Hunt (1995) and Kerr and Kerr (2011) report that most studies find wage elasticities of -0.1 or higher. However, estimates vary widely (Dustmann, Schönberg, and Stuhler 2016). Recent spatial correlation studies that find sizeable negative wage effects of immigration include Dustmann, Schönberg, and Stuhler (2017) for Germany and Jaeger, Ruist, and Stuhler (2018) for the US.

Appendix B shows that the short-run wage elasticities in our model are within the range of empirical estimates that we obtain from a large scale survey of West German employees' earnings in trade and industry in 1951. Depending on the exact regression specification, we find wage elasticities of between -0.134 and -0.288 (with an average elasticity of -0.191), which lends credibility to the predictions of our structural model.

6.3 Counterfactual immigration experiments

We conduct three counterfactual experiments, which explore the predictions of our structural model under different parameter calibrations. We verbally summarize the key insights from the experiments here and relegate details to Appendix G.

The first experiment varies the initial regional distribution of expellees, holding the size of the inflow constant. We find that an unequal distribution of expellees actually reduces income losses of the average native worker.[33] This perhaps surprising result is due to the fact that with a preference for the current region of residence, native inhabitants in region L are partly shielded from the expellee inflow to region H. Distributing all expellees to region H, in which there are relatively few natives, maximizes the number of natives shielded from heightened labor market competition. In contrast, expellee workers lose out in this experiment, as they all start in the congested labor market of region H with a small probability of finding a job quickly.

The second experiment varies the timing of the expellee inflow and spreads it over time. We find that a more gradual inflow of expellees would have significantly reduced native income losses, kept unemployment down, and dampened adjustment dynamics in regional labor markets.

The third experiment explores the effects of strong preferences for the home region, hindering inter-regional migration. We find that moving from strong home bias to our baseline calibration markedly reduces the regional asymmetry in native income losses. Regional migration thus plays an important role for workers to insure against local shocks, in line with recent evidence for the US (Monras 2020a).

7 Discussion and conclusion

This paper has analyzed how regional labor markets in West Germany adjusted to the inflow of eight million expellees after World War II. Three key findings emerge. First, it took regional labor markets more than one decade to absorb the expellee inflow. Second, the adjustment process was characterized by large differences in regional unemployment rates and strong migration from the high- to the low-inflow region. Third, the large and long-lasting adjustment dynamics in regional labor markets decreased the expected discounted lifetime labor income of the average native worker in West Germany by 1.51%. Per-period losses in native labor income are much larger and reach up to 5.91% in the short run. These economic adjustment costs are not covered by conventional steady state analyses.

We have derived our results in the context of an episode of internal mass migration, in which natives and immigrants are very similar in many respects. This feature has allowed our analysis

[33] Clearly, our analysis abstracts from a number of channels through which the regional distribution of expellees might affect native income. The extreme initial distribution of expellees, for instance, decreases the employment probability of expellees and hence increases their dependency on unemployment benefits. In general equilibrium, native workers will have to finance the benefits of unemployed expellees and thus have an interest in high expellee employment. Such interest is absent in our framework.

to abstract from skill differences between native workers and immigrants. In contrast, today's migration flows are often concentrated in specific parts of the skill distribution. Skill differences then become an essential model ingredient. The external validity of our findings is thus limited when it comes to the *distributional* consequences of immigration. Our key finding of prolonged adjustment processes after immigration, in contrast, is unlikely to be specific to our historical setting. In fact, recent evidence for the US (Borjas 2017, Colas 2018) and Israel (Cohen-Goldner and Paserman 2011) also point to prolonged adjustment process in response to *international* immigration.

Our results provide relevant insights for the burgeoning–and largely static–empirical literature on the labor market effects of immigration. First, the time elapsed since immigration matters greatly for the results of empirical studies on the labor market effects of immigration. Not only do short-run effects of immigration differ greatly from longer-run effects. The effects can also evolve non-monotonically over time. Therefore, estimated short-run effects of immigration do not generally establish a bound on longer-run effects and vice versa.

Second, prolonged adjustment processes, as documented in our analysis, can bias existing estimates of the short-term wage effects of immigration. A large body of empirical work address the endogeneity of immigrant location with a "shift-share" instrument that combines the composition of current immigrant inflows at the national level with settlement patterns of immigrants in the past (Card 2001). However, Jaeger, Ruist, and Stuhler (2018) have recently shown that in the presence of dynamic adjustment processes, estimates using this "shift-share" instrument are likely to conflate the short-term wage effect of recent immigrant arrivals with the longer run adjustment processes to previous inflows.

Third, our dynamic analysis–and the large differences between lifetime and per-period income effects that we find–reminds us of the simple fact that any static analysis will necessarily provide only an incomplete snapshot of the overall benefits and costs of immigration. A deeper understanding of the dynamic effects of immigration is, therefore, essential for informing the policy debate on immigration.

Future research in this area might address several caveats of our analysis. First, our analysis assumes that there are no long-run effects of immigration on wages and productivity, as we use a "standard" constant returns to scale production technology. Clearly, the long-run effects of immigration, and thus transitional dynamics, may differ under either increasing or decreasing returns to scale. Economies of scale might, for instance, arise from high-skilled migration fostering firm innovation and productivity (Kerr, Kerr, and Lincoln 2014).

Second, and related to the previous point, our framework abstracts from potential positive effects of immigration for native workers. Such positive effects can arise if, say, natives and immigrants differ in their skills or in their search costs (see, for instance, Chassamboulli and Palivos (2014)). While our goal in this paper was to build the most parsimonious model that can explain the historical data, and our specific historical episode allows us to abstract from many differences between immigrants and native workers, some of the simplifications may not be warranted in other settings.

Third, regions in our analysis are linked through internal migration but not through trade. Such trade linkages may be another reason for why immigrant inflows might have consequences for initially non-treated regions (Peters 2019).

Fourth, our analysis has abstracted from the entry and exit of firms in response to immigrant inflows. Dustmann and Glitz (2015) have recently highlighted the importance of this adjustment channel in a static framework, and it would be valuable to explore its dynamic implications.

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Online appendix – not meant for publication

A Data appendix

A.1 Socio-demographic characteristics of expellees and non-expellees

Table A1: Socio-demographic characteristics of expellees and non-expellees in West Germany, September 1950

	Expellees[a]	Rest of the population[b]
% females	52.9	53.2
Age structure		
% aged 0-17	29.7	27.7
% aged 18-24	11.3	10.1
% aged 25-44	30.0	27.9
% aged 45-59	17.9	19.9
% aged 60 and above	11.1	14.3
Marital status (aged 18 and above)		
% single	25.7	23.4
% married	60.4	64.0
% widowed or divorced	14.0	12.5
Education (born 1885-1925)[c]		
Years of schooling[d]	8.5	8.3
Years of education[e]	9.9	9.8
% vocational training	36.2	36.3
% university degree	3.5	2.8
Sector of employment		
% agriculture	13.8	26,0
% manufacturing and mining	38.9	34.5
% Construction	11.8	7.2
% Trade and finance	7.7	10.7
% Transport	5.1	5.8
% Private and public services	22.4	15.8

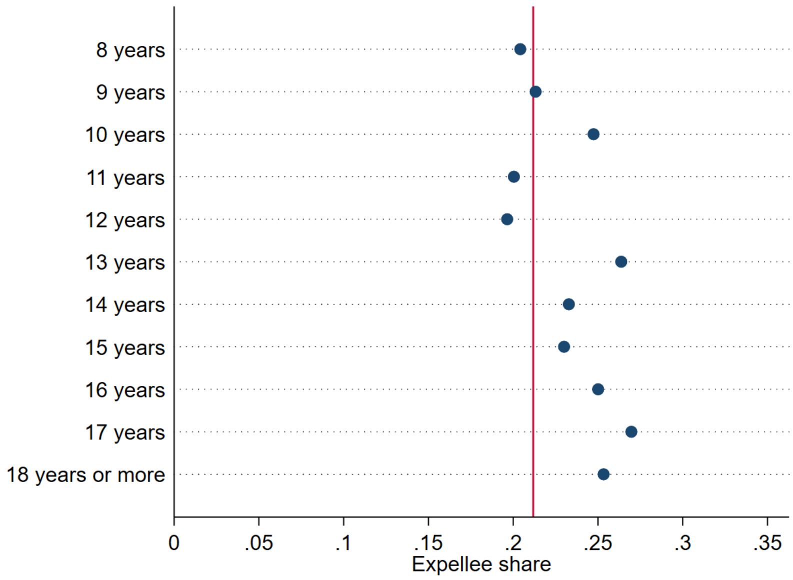
Data sources: All data except for educational attainment are from the census of 13 September 1950, as published in Statistisches Bundesamt (1952b) and Statistisches Bundesamt (1953). Figures on education are from our own calculations based on a 10% sample of the census of 27 May 1970 (FDZ der Statistischen Ämter des Bundes und der Länder 2008). The table is largely reproduced from Braun and Kvasnicka (2014), except for the data on sectoral employment.

Notes: [a] Expellees are defined as German nationals or ethnic Germans who on 1 September 1939 lived (i) in the former German territories east of the Oder-Neisse line, (ii) in Saarland or (iii) abroad, but only if their mother tongue was German. [b] The education statistics distinguish between expellees and native West Germans (excluding non-German foreigners). All other statistics distinguish between expellees and the rest of the population. [c] The education statistics are for those who were born between 1885 and 1925 (aged 25 to 65 in 1950). The overwhelming majority of these persons should have completed their education by 1950. [d] Years of schooling are inferred from the minimum years of schooling required to obtain a particular degree. [e] Years of education adds years spent at university and in vocational training to years of schooling.

A.2 Expellee inflows differed little by skill level

This subsection shows that expellee inflows differed little by skill group. Figure A1 depicts the population share of expellees by years of education, which include schooling, vocational training and tertiary education. Data come from a 10% sample of the population census of 27 May 1970 (FDZ der Statistischen Ämter des Bundes und der Länder 2008), the first post-war census that recorded the level of education.[34] We restrict the analysis to cohorts born in 1885-1925, which were 25-65 old in 1950. The population-wide expellee share for these cohorts in 1970 is 21.2% (illustrated by the red line in the figure). The figure shows that across education cells, expellee shares cluster relatively tightly around this population mean.[35] Expellees are somewhat over-represented among the high skilled, and somewhat under-represented among the low skilled, consistent with the evidence in Table A1. This is partly because expellees are slightly younger than non-expellees.

Figure A1: Expellee share by years of education



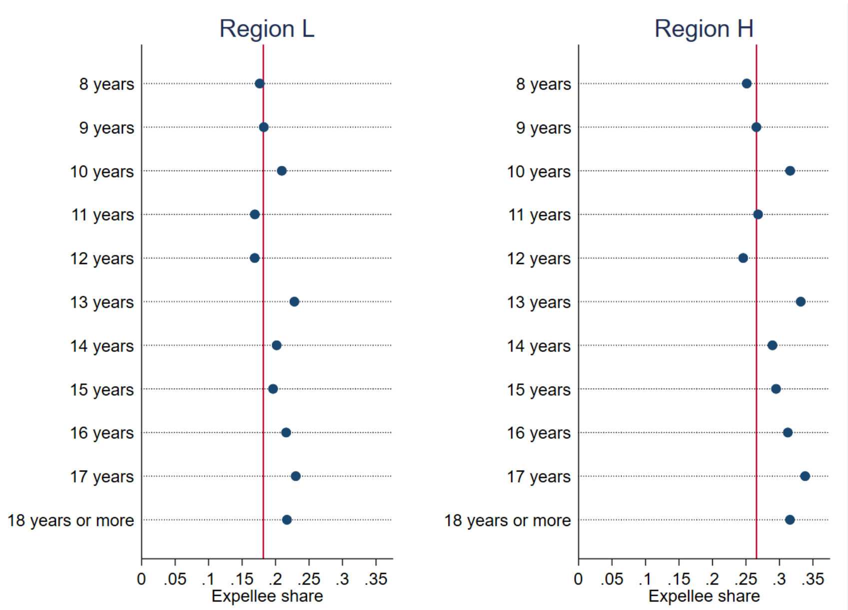
Data source: Own calculation based on a 10% sample of the census of 27 May 1970 (FDZ der Statistischen Ämter des Bundes und der Länder 2008).
Note: The figure shows the expellee share by years of education. The red line shows the expellee share in the population as a whole. Statistics are for West German residents (excluding the Saarland and West Berlin) who were born between 1885 and 1925. The overwhelming majority of these persons should have completed their education by 1950. Residents without German citizenship are excluded.

[34] The census is representative for the West German population in 1970, and does therefore not record data on individuals that died between 1950 and 1970. We exclude foreign nationals from the sample and people living in the Saarland and West-Berlin (which were not part of West Germany in 1950). Expellees are defined as German nationals or ethnic Germans who on 1 September 1939 lived (i) in the former German territories east of the Oder-Neisse line, (ii) in Saarland or (iii) abroad, but only if their mother tongue was German.

[35] More than half of the population born 1885-1925 (55.3%) has only eight years of education, so that the mean expellee share is dominated by the relatively low expellee share in the lowest education cell.

While the expellee supply shock did not vary strongly across education cells for West Germany as a whole, regional skill differences might have been more important. Unfortunately, the census of 1970 does not record the place of residence in 1950. We can thus not quantify skill differences in the initial expellee shock by region. However, the census does record residence in 1970. Based on this information, Figure A2 depicts the share of expellees in 1970 by years of education, separately for region H and region L. The figure shows a similar pattern for both regions H and L: Expellees are somewhat over-represented among the high-skilled and somewhat under-represented among the low-skilled. However, differences in skill-specific expellee shares are relatively small for both regions. The main difference between the two regions is that in 1970, expellee shares are still somewhat higher in region H than in L.

Figure A2: Expellee share by years of education, region H vs L



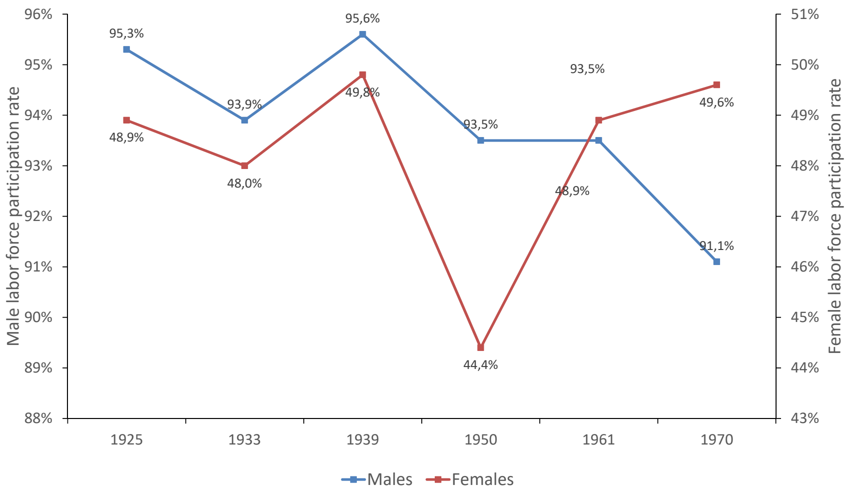
Data source: Own calculation based on a 10% sample of the census of 27 May 1970 (FDZ der Statistischen Ämter des Bundes und der Länder 2008).
Note: The figure shows the expellee share by years of education, separately for region L (left panel) and region H (right panel). The red line shows the expellee share in the population as a whole. Statistics are for West German residents (excluding the Saarland and West Berlin) who were born between 1885 and 1925. The overwhelming majority of these persons should have completed their education by 1950. Residents without German citizenship are excluded.

A.3 Increasing labor force participation rates in the 1950s do not reflect secular trends

Figure 2 in the main text shows that labor force participation rates increased in the 1950s. We have interpreted this increase as an improvement in labor market prospects. Alternatively, the increase could reflect secular trends, unrelated to labor market conditions. This sub-section presents evidence that neither increases in female labor force participation nor shifts from non-market to market work can explain the observed increase in labor force participation.

Figure A3 shows the labor force participation rates of females and males for the census years 1925, 1933, 1939, 1950, 1960 and 1970. Two facts stand out: First, the decline in labor force participation between 1939 and 1950 and the subsequent recovery in the 1950s is driven by female participation. This is consistent with the empirical observation that labor supply elasticities are considerably larger for women than for men (Evers, Mooij, and Vuuren 2008). Second, there is no secular increase in female labor force participation in 1925-70. Instead, participation rates hover around 50%. Only in 1950 does the rate plummet to 44%. Studies of long-run trends in female employment conjecture that many women left the labor market and identified them as housewives in the 1950 census, as they were discouraged by high unemployment rates (Müller, Willms, and Handl 1983, Berger 1986).

Figure A3: Labor force participation rates by gender, 1925-1970



Data source: Müller, Willms, and Handl (1983), Table 1.
Notes: The labor force participation rate is the share of economically active persons in the population aged 15-59 (for 1925-39) or aged 16-59 (for 1950-70). Participation rates refer to the German Reich until 1939 and to West Germany thereafter. The 1939 labor force participation rates were slightly higher in West Germany than in the German Reich as a whole (Statistisches Bundesamt 1954a), so that the decrease from 1939 to 1950 was even slightly greater than depicted.

The secular decline in agriculture decreased the number of working family members in the sector from 2.733 to 2.219 million in 1950-57 (Statistisches Bundesamt 1964). The relative importance of market work thus increased after World War II, especially for women (Müller, Willms, and Handl 1983). However, this trend cannot explain the increase in labor force participation rate in the 1950s, as working family members are counted as economically active.

A.4 Other drivers of Region H's relative population increase

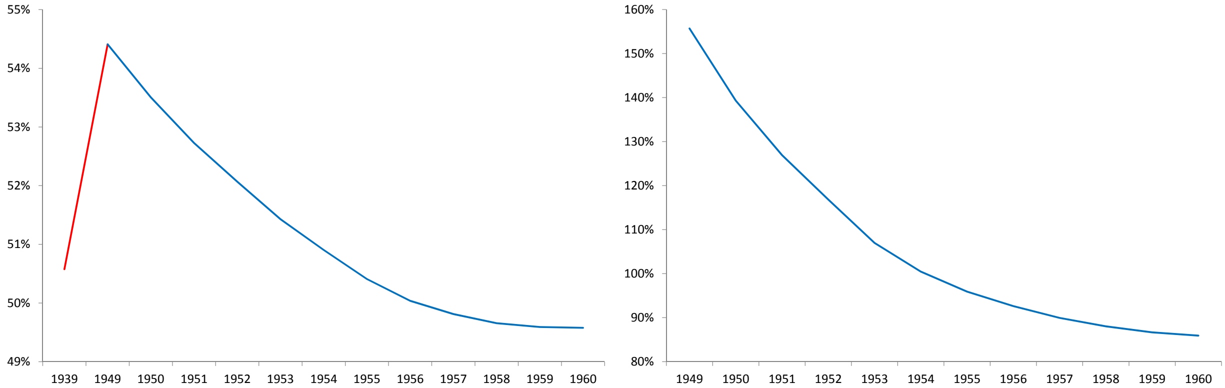
The inflow of expellees was by far the most important driver of this dramatic increase in relative population (see Braun and Mahmoud (2014) for a comprehensive overview of regional population changes in West Germany between 1939 and 1950). However, it was not the only one. Even without the inflow of expellees, region H's population would have grown by more than 713,000 (or 5.4%) between 1939 and 1949. Region L's population, in contrast, would have decreased by 2.0%. There are two main reasons for this difference. First, the states of Lower Saxony and Schleswig-Holstein, both part of region H, bordered the Soviet zone of occupation, and, therefore, also received a disproportionately large share of migrants from what was to become the German Democratic Republic. Second, the number of civilian casualties was lower in rural areas than in urban areas, and therefore many city dwellers, especially from Bremen and Hamburg, were evacuated to rural areas during the war.

Since we consider only the expellee inflow and endogenous regional migration as sources of population change, we calibrate the model to an adjusted relative population of the two regions in 1939. The adjustment adds to the 1939 population of each region the residual population change between 1939 and 1950 that cannot be accounted for by the expellee inflow. We calculate the residual as the difference between the historical population change between 1939 and 1950 and the inflow of expellees. The adjusted relative population of region H is 54.4%.

A.5 Expellees were more likely to migrate internally than natives

Figure A4 plots the migration-based population series separately for native inhabitants and expellees, and shows that regional migration markedly reduced the relative population of both groups in the 1950s. Through migration alone, the relative native population fell from 54.4% in 1949 to 49.6% in 1960 and that of expellees fell from 155.7% to 85.9%. The strong decline in the relative expellee population also suggests that expellees were more likely to leave region H for region L than natives. In fact, the migration rate of expellees stood at a stunning 4.4% in 1950 – and was thus four times higher than the migration rate of natives (1.1%). It fell in tandem with the overall regional migration rate but still exceeded it in 1958.

Figure A4: Population in region H over population in region L for either natives or expellees, based on net migration, 1939-70



(a) Natives (b) Expellees

Data sources: Statistisches Bundesamt, Institut für Raumforschung.
Notes: Population is measured at the end of each year. The population series is calculated by adding to the actual native (expellee) population figure of the H and L region on 31 December 1949 (cumulated) net migration of native workers (expellees) between the two regions.

A.6 High-skilled workers were more likely to migrate internally

This sub-section presents tentative evidence that high-skilled individuals were more likely to migrate between region H and L. Our finding is in line with prior evidence that high-skilled workers are more likely to move in response to local shocks (Dustmann, Schönberg, and Stuhler 2016, Notowidigdo 2020, Wozniak 2010). Since migration statistics are, unfortunately, not available by skill level, we instead draw on individual-level data for one specific birth cohort from the first wave of the German Life History Study (Deutsche Lebensverlaufsstudie, LVS).

The LVS is a retrospective survey that collects life history data from German citizens living in West Germany or West Berlin at the time of the interview. The first wave, conducted in 1985-88, surveyed 1412 Germans born in 1919-21.[36] Importantly for our purposes, the LVS records the complete residential history of respondents. This allows us to identify movers as individuals whose region of residence (region H or L) in 1970 differs from their residence in 1950.

Table A2 shows the share of movers by expellee status and years of schooling. We define expellees as individuals who on 1 September 1939 lived in the Eastern territories of the German Reich or in Eastern Europe. On average, 8.6% of individuals in our sample are movers. This share is much higher among expellees (15.0%) than among non-expellees (6.8%), in line with official migration statistics (see Section A.5). Importantly, the share of movers increases with

[36] Later waves focused on birth cohorts born in 1929-31, 1939-41, 1949-51, 1964 and 1971. Most of these cohorts were too young to be in the labor force in 1950, and the 1929-31 cohort did not complete its education before the displacement.

years of schooling, especially for non-expellees. While the share of movers is only 5.4% among non-expellees with 8 years of schooling, the share more than doubles to 11.9% for non-expellees with 13 years of schooling. We observe similar results when we restrict attention to those moving from region H to L (see columns (4)-(6)).

Table A2: Share of mover by expellee status and years of schooling, birth cohort 1919-21

	Migration b/w H and L			Migration from H to L		
	Expellees	Non-Expellees	All	Expellees	Non-Expellees	All
	(1)	(2)	(3)	(4)	(5)	(6)
Years of schooling						
8 years	0.138	0.054	0.070	0.114	0.035	0.050
	[167]	[707]	[874]	[167]	[707]	[874]
10 years	0.169	0.106	0.123	0.154	0.071	0.094
	[65]	[170]	[235]	[65]	[170]	[235]
13 years	0.190	0.119	0.136	0.190	0.104	0.125
	[21]	[67]	[88]	[21]	[67]	[88]
	0.150	0.068	0.085	0.130	0.047	0.064
	[254]	[945]	[1199]	[254]	[945]	[1199]

Data source: Own calculations based on the German Life History Study.
Notes: The tables shows the share of movers by expellee status and years of schooling. In columns (1)-(3), movers are defined as individuals who either resided in region H in 1950 but had moved to region L by 1970 or resided in region L in 1950 but had moved to region H by 1970. In columns (4)-(6), movers are only those who resided in region H in 1950 but had moved to region L by 1970. The number of observations in each cell is shown in brackets. Expellees are defined as German nationals or ethnic Germans who on 1 September 1939 lived. Years of schooling are inferred from the minimum years of schooling required to obtain a particular degree.

Table A3 estimates differences in migration probability by socio-economic characteristics in a multivariate regression. The dependent variable indicates whether an individual's region of residence in 1970 differs from her residence in 1950. Explanatory variables include expellee status, sex, and dummies for years of schooling. Column (1) shows that expellees have a 7.8 percentage points higher probability of having moved between regions than non-expellees. Individuals with 10 and 13 years of schooling have a 4.8 and 6.2 percentage points, respectively, higher probability of moving than individuals with 8 years of schooling. Columns (2) and (3) show that the positive effects of higher schooling are also visible when we restrict the sample to non-expellees and expellees, respectively. However, the coefficients estimates for expellees are not statistically significantly differently from zero, which is not surprising given the small sample sizes.

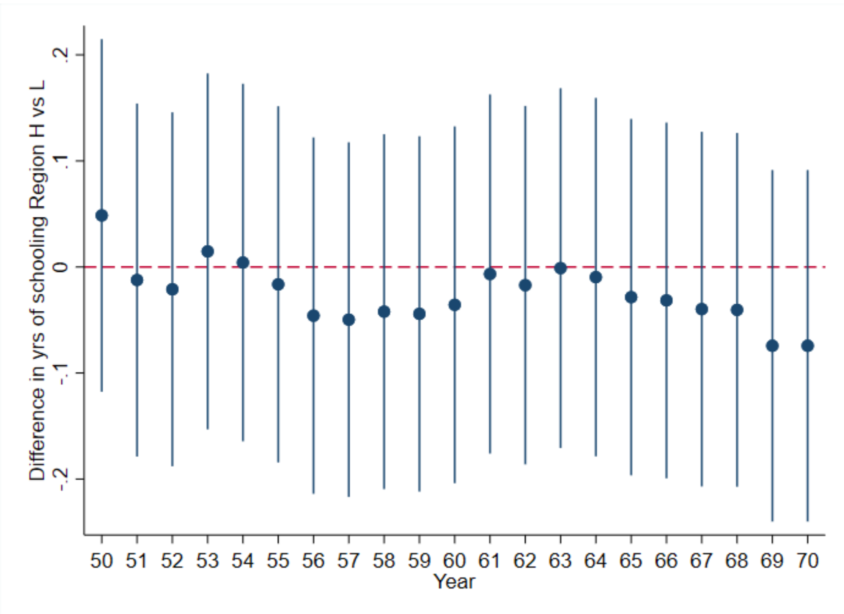
While at least for the 1919-21 birth cohort, migration rates were thus higher for high-skilled individuals, skill-specific migration is unlikely to have markedly changed the regional skill distribution. Figure A5 plots annual differences in average years of schooling between region H and L in 1950-70. Year-to-year changes in the LVS sample are due only to selective migration between

Table A3: Socio-economic determinants of migration probabilities, birth cohort 1919-21

	Migration b/w H and L			Migration from H to L		
	All	Non-Expellees	Expellees	All	Non-Expellees	Expellees
	(1)	(2)	(3)	(4)	(5)	(6)
Expellee	0.078***	–	–	0.080***	–	–
	(0.024)			(0.022)		
Female	-0.009	0.010	-0.079	-0.015	-0.002	-0.064
	(0.017)	(0.017)	(0.048)	(0.015)	(0.015)	(0.045)
10 yrs of schooling	0.048**	0.051**	0.031	0.038*	0.035*	0.040
	(0.023)	(0.025)	(0.054)	(0.020)	(0.021)	(0.051)
13 yrs of schooling	0.062*	0.067	0.063	0.070*	0.069*	0.085
	(0.038)	(0.041)	(0.089)	(0.036)	(0.038)	(0.089)
Baseline probability	0.045	0.045	0.188	0.034	0.034	0.145
R-squared	0.022	0.010	0.014	0.028	0.010	0.014
Observations	1197	944	253	1197	944	253

Notes: The dependent variable in columns (1) to (3) is a dummy variable indicating whether an individual's region of residence in 1970 differs from her residence in 1950. The dependent variable in columns (4) to (6) is a dummy variable indicating whether an individual resided in region H in 1950 but had moved to region L by 1970. Columns (1) and (4) report results for all individuals, columns (2) and (5) restrict the sample to non-expellees, and columns (3) and (6) restrict the sample to expellees. The baseline group are male non-expellees with 8 years of schooling (Columns (1), (2), (4), (5)) or male expellees with 8 years of schooling (Columns (3) and (6)). ***, ** and * denote statistical significance at the 1%-, 5%- and 10%-level, respectively. Robust standard errors are in parentheses.

Figure A5: Regional differences in years of schooling, birth cohort 1919-21



Data source: Own calculations based on the German Life History Study.
Note: The figure plots differences in average years of schooling between region H and L, as estimated in a regionression of years of schooling on a dummy for living in region H (rather than region L). Point estimates are marked by a dot. The vertical bands indicate the 95 percent confidence interval of each estimate.

the two regions.[37] The figure shows that regional differences in years of schooling decline only modestly over the period. None of the differences is statistically significant (which is not sur-

[37] All individuals in the sample had completed their schooling by 1950s. Furthermore, we only consider individuals who lived in either region H or L over the sample period.

prising, given the small sample size). Table A4 draws on census data to show that also for the population at large, regional differences in average years of schooling were small in 1970. The same holds for average years of education (which add years spent at university and in vocational training to years of schooling).

Table A4: Educational attainment in regions H and L, May 1970

	Region H	Region L
Years of schooling[a]	8.4	8.4
Years of education[b]	9.7	9.8
% vocational training	33.7	37.7
% university degree	3.0	2.9

Data source: Own calculations based on a 10% sample of the census of 27 May 1970 (FDZ der Statistischen Ämter des Bundes und der Länder 2008).
Notes: Statistics are for those who were born between 1885 and 1925 (aged 25 to 65 in 1950). The overwhelming majority of these persons should have completed their education by 1950. [a] Years of schooling are inferred from the minimum years of schooling required to obtain a particular degree. [b] Years of education adds years spent at university and in vocational training to years of schooling.

A.7 The regional GDP gap did not narrow further in the mid- and late 1960s

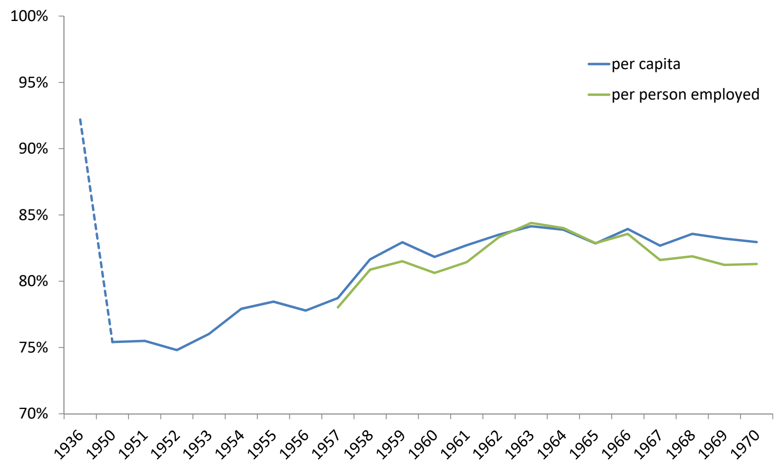
We have shown in Section 3.2 that the gap in GDP per employee between regions H and L remained unchanged until the mid-1950s and then narrowed considerably in the late 1950s and early 1960s. Since the data series on employees stops in 1963, we could not observe whether further convergence takes place in the mid- and late-1960s.

Figure A6 instead plots relative GDP per *capita* in 1950-70. The gap in GDP per capita already narrows in the early 1950s, presumably because of the declining unemployment gaps between region H and L. Convergence continues until the early 1960s. The mid- and late-1960s saw no further improvement in region H's relative GDP per capita. If anything, the gap in comparison with region L widened again. We see similar patterns when we plot GDP per person employed, which is available for 1957 onwards. We thus conclude that no further convergence took place in the mid- and late-1960s.

A.8 Proxies for pre-war regional differences in GDP per employee

We use two proxies for regional differences in GDP per employee before the war. The first proxy, which we also report in Table 1, uses national income data from 1936, but is subject to the

Figure A6: GDP per capita in region H relative to region L, 1950-70



Data sources: Data for 1936 are from Länderrat des Amerikanischen Besatzungsgebiets (1949), data for GDP per capita 1950-70 are from the Statistisches Bundesamt. The number of employed person is based on the German microcensus, as reported in Statistisches Bundesamt (1971).
Notes: The data point for 1936 is the (approximated) national income of region H relative to region L. We calculate the 1936 national income in region H as the population-weighted average of income in Bavaria, Hanover, and Schleswig-Holstein. We then use the average national income in the rest of West Germany (excluding Hamburg and Bremen, Oldenburg, Braunschweig, Lippe, Schaumburg-Lippe) as a proxy for national income in region L. See the text for further explanation. All other data points give GDP per person employed of region H relative to region L.

limitation that the states of the German Reich, for which the income data is available, do not correspond to the later West German states. We therefore had to approximate the values for the H and L regions. We approximate 1936 national income in region H as the population-weighted average of income in Bavaria, Hanover, and Schleswig-Holstein. We then use the average national income in the rest of West Germany (excluding Hamburg and Bremen, Oldenburg, Braunschweig, Lippe, Schaumburg-Lippe) as a proxy for national income in region L. We discard the data for Bremen, Oldenburg, Braunschweig, Lippe, and Schaumburg-Lippe, as data for these regions are only reported as an aggregate figure. We divide national income by the number of dependent employees in 1939.

The second proxy uses data on firm sales that come from published sales tax statistics (Statistisches Bundesamt 1955a, Statistisches Bundesamt 1955b). Total sales are defined as domestic deliveries and other services of a business for money and own consumption of the business. The sales data have two advantages over the national income data. First, comparable data on firm sales exist for both the pre- and the post-war periods (although, unfortunately, only until 1955). Second, sales data are available at district level and can thus be precisely aggregated to the federal state level (and thus also to the level of our two regions). On the downside, sales are not a direct measure of production value, and certain exemptions for businesses with low revenues apply. However, firm sales correlate strongly with national income.[38] The pre- to post-war *changes* in relative sales per employee between the two regions gives at least an indication of the *change* in relative GDP per employee. As sales statistics are not available for 1939, we use data for 1935, along with data on employees for 1939.

A.9 Expellee inflows did not increase labor-intensive production

This section provides further details on our finding from Section 3.2 that the expellee inflow did not disproportionally increase labor-intensive production. In particular, we describe the data underlying Figure 5 in the main text and discuss additional robustness checks.

Manufacturing and mining industries. We digitized annual state-level employment data on 30 mining and manufacturing industries in 1951-1961 from various volumes of the industry report (*Industrieberichterstattung*), published by the German Federal Statistical Office. Employment is recorded for all firms with at least 10 employees and refers to the end of August of a given year. We classify industries into labor- and capital-intensive sectors based on their (German-wide) capital-labor ratio in 1939, which we calculate from capital and employment data reported in Vonyó (2014). Table A5 shows the classification.

State-level employment data are missing for industries with very few firms for reasons of data protection. This problem is particularly pronounced for the city states of Bremen and Hamburg, which we thus drop from our analysis. To maximize industry coverage, we linearly inter- and extrapolate industry employment if the data are missing for at most four years.[39] This leaves us with a panel of 21 industries. These industries are marked by an asterisks in Table A5.

Section 3.2 shows that employment shares in labor-intensive industries declined both in regions H and L in the 1950s. Figure A7 shows that the same holds if we compare regions H and L', which are more comparable in their pre-war economic structure than regions H and L (see Section 3.1).

Major economic sectors. One drawback of the analysis in Figure 5 is that the data begin only in 1951 and cover just a part of the economy. As a robustness check, we use annual state-level employment data on eight broad sectors covering all parts of the economy. We digitized the

[38]The correlation coefficient between sales per capita in 1935 and national income per capita in 1936 is 0.92 for the 19 regions of the German Reich, for which both types of data are available. And for 1950, the correlation coefficient between sales and GDP of the nine West German states is 0.99.

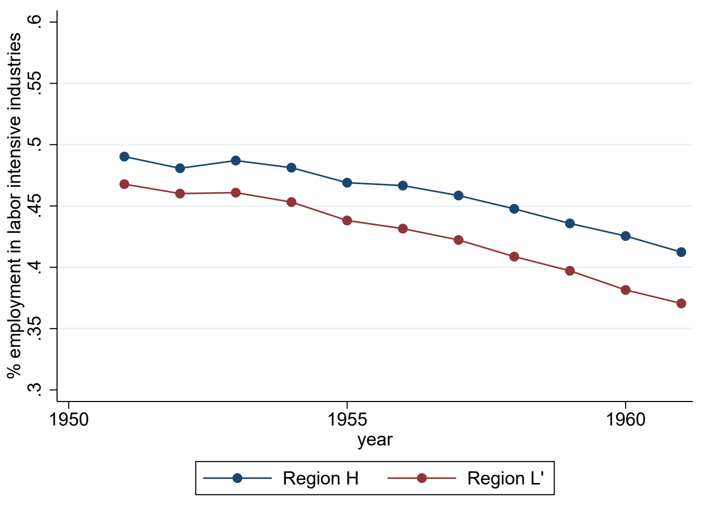
[39]Results are qualitatively unchanged if we decrease this threshold or do not inter- and extrapolate at all.

Table A5: Classification into capital- and labor-intensive industries

Capital-intensive	**Labor-intensive**
Crude oil and gas	Textile industry *
Salt mining	Shipbuilding*
Fuel Industry	Entertainment instruments*
Chemical industry*	Construction materials*
Non-ferrous metals*	Metallic ores
Paper and pulp	Plastic products*
Coal mining	China and earthenware*
Food and tobacco*	Optical and precision engineering*
Transport vehicles*	Steel constructions*
Electrical engineering*	Timber industry*
Rubber and asbestos*	Leather industry
Printing and publishing*	Woodworking*
Glass industry*	Fabricated metal products
Machine tools*	Paper and board*
Iron and steel	Clothing industry*

Data source: Own classification based on data reported in Vonyó (2014).
Note: The classification of mining and manufacturing industries is based on the capital-labor ratios of industries in 1939. The gross capital stock includes machinery, equipment and structures. The listing of industries within columns is from the sector with the highest capital-labor ratio to that with the lowest. * marks industries for which we have complete employment information for all states in region H and L in 1951-61 (excluding Bremen and Hamburg).

Figure A7: Regional employment shares in labor-intensive industries, region H vs L'



Data sources: Statistisches Bundesamt
Notes: The figure shows the share of employment in labor-intensive industries among 21 mining and manufacturing industries in regions H and L'. The classification as labor-intensive is based on industry capital-labor ratios in 1939 and shown in Table A5.

data from Statistisches Bundesamt (1959) (for 1951-1955) and Statistisches Bundesamt (1962) (for 1938, 1950, 1956-1961). We distinguish between labor- and capital-intensive sectors based on their capital-labor ratio in 1950[40], which we calculate from capital stock and employment

[40]Unfortunately, no capital stock data exist for earlier years, so that we cannot calculate pre-war capital-labor ratios.

Table A6: Classification of capital- and labor-intensive sectors

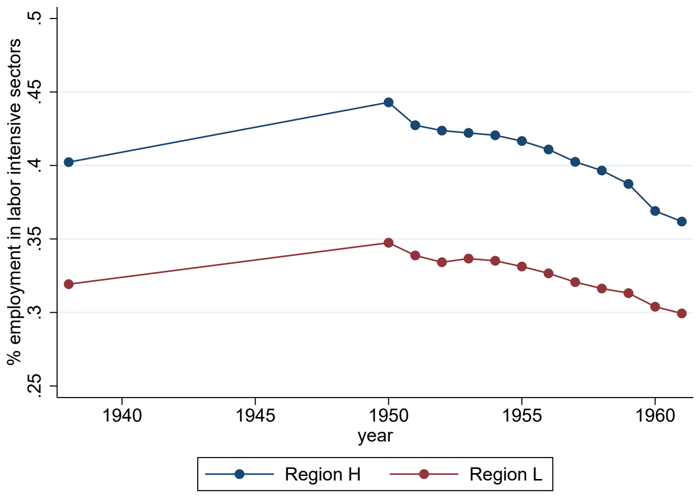
Capital-intensive	**Labor-intensive**
Mining and quarrying, energy, iron and steel production	Agriculture, forestry and fishing
Chemical industry (incl. production of plastic parts and goods)	Food and clothing industry
Iron, steel and metal products; machine tools, transport vehicles; electrical engineering; optical and precision engineering	Other manufacturing
Trade, banking and insurance, private and public services	Construction

Data source: Own classification based on Kirner (1968) and Schwanse (1965).
Note: The classification is based on the capital-labor ratios of sectors in 1950.

data reported in Kirner (1968) and Schwanse (1965). Table A6 lists the eight sectors we use, along with their classification into capital- and labor-intensive sectors. One advantage of the sectoral employment data is that it does not suffer from missing values.

Figure A8 shows that the employment share in labor-intensive sectors is considerably larger in region H than in region L. However, the difference dates back to before the expellee inflow and is largely due to the greater importance of agriculture in Region H. The employment share of labor-intensive sectors, after increasing somewhat between 1938 and 1950, declines in both regions in the 1950s. If anything, the decline is more pronounced in region H, in contrast to the Rybczynski theorem.

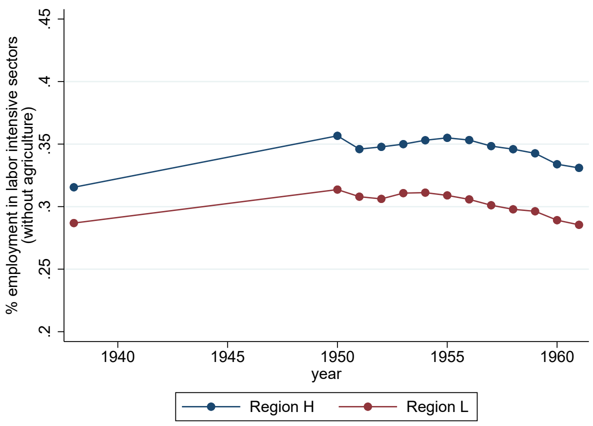
Figure A8: Regional employment shares in labor-intensive sectors



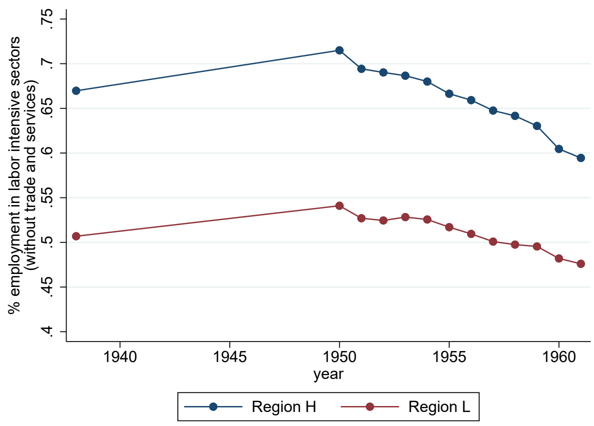
Data source: Statistisches Bundesamt.
Notes: The figure shows the share of employment in labor-intensive sectors among eight broad economic sectors in regions H and L. The classification as labor-intensive is based on capital-labor ratios in 1950 (see Table A6) and the discussion in the text for details.

Figure A9 illustrates that this conclusion is robust to the choice of sectors and regions. Panel (a) excludes the agricultural sector from the analysis and Panel (b) the mainly non-tradable trade, banking, and service sector. Panel (c) compares region H to region L', dropping Bremen, Hamburg, and North Rhine-Westphalia, so as to make the economic structure of regions more comparable. Panel (d) again compares region H and L' but also drops the trade, banking, and service sector. While the regional differences in labor-intensive employment shares vary across panels, the trend is always the same. Labor-intensive sectors decline in both the high- and low-inflow region in the 1950s. If anything, the decline is more pronounced in the high-inflow region.

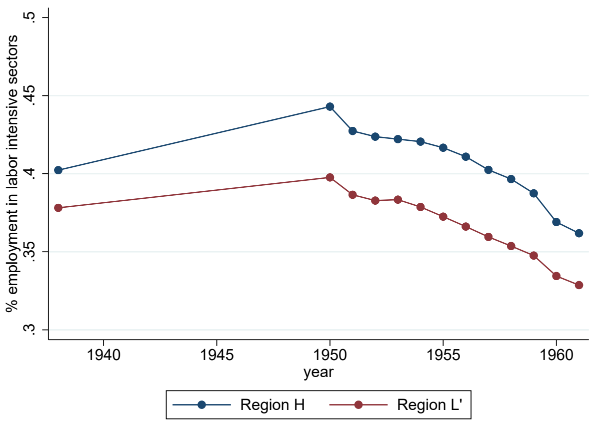
Figure A9: Regional employment shares in labor-intensive sectors



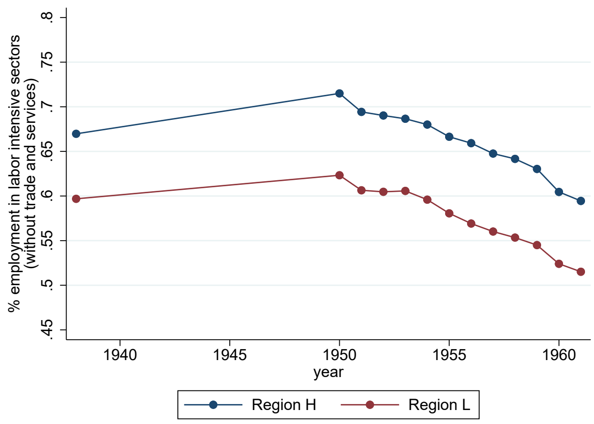
(a) Region H vs L, w/o agriculture



(b) Region H vs. L, w/o tradea/services



(c) Region H vs L'



(d) Region H vs L', w/o trade

Data source: Statistisches Bundesamt.
Notes: The figure shows the share of employment in labor-intensive sectors among eight broad sectors. The classification as labor-intensive is based on sector capital-labor ratios in 1950 (see Table A6). Panel (a) and (b) compare regions H and L, panels (c) and (d) regions H and L'. Panel (a) drops agriculture from the list of sectors, panels (b) and (d) drop trade, banking and insurance, private and public services.

A.10 Alternative regional data classification

This section shows that the empirical facts on labor flows are generally robust to the use of an alternative classification of federal states that levels out pre-existing differences between the high- and the low-inflow region. The alternative classification excludes Bremen, Hamburg, and North Rhine-Westphalia from region L, as these three states are responsible for the differences in agricultural employment and the degree of war damage that we observe for regions H and L (see Table 1).[41] In what follows, we will refer to the resulting geographical entity, which consists of Baden-Württemberg, Hesse, and Rhineland-Palatinate, as region L'. We will refer to the excluded states of Bremen, Hamburg, and North Rhine Westphalia as region (L-L').[42]

Table 1 illustrates that regions H and L' are very similar not only in terms of pre-war population growth and unemployment but also in terms of agricultural employment and war damage. The agricultural employment share in region L' was only slightly lower than in region H in 1939 (32.1% vs. 36.5%). Likewise, the share of destroyed flats, our measure of wartime damage, was virtually identical in the two regions (12.1% and 12.8%). While regions H and L' were thus similar in their pre-war economic structure and their degree of war damage, region L' experienced a much smaller expellee inflow than region H (12.6% vs. 25.0%). The main problem with using the alternative classification is that it excludes almost one-third of the West German population.

Figure A10 shows that the empirical facts presented in Section 3 also prevail, at least qualitatively, when we compare the demographic and economic development of the H region to the L' region rather than to the L region. As before, we consider relative population, relative GDP per worker, and unemployment rates.

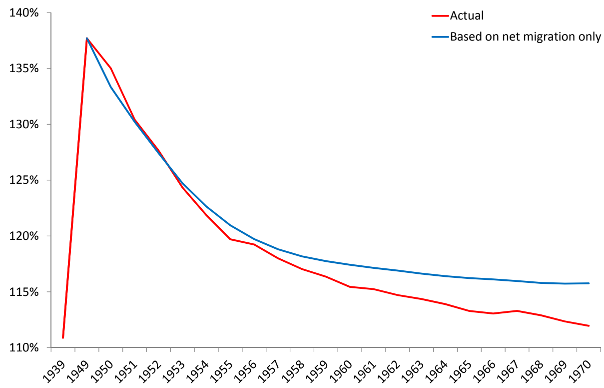
Panel (a) shows the population size of region H relative to region L' from 1939 to 1970 (red line). The graph also shows how the relative population size of the two regions would have evolved if the only reason for changes in the relative population size was regional migration within Germany (blue line). The relative population of H to L' increased markedly from 110.8%

[41] North Rhine-Westphalia comprises the Ruhr region, Germany's pre-war industrial center. Therefore, only 14.1% of North Rhine-Westphalia's labor force was in agriculture before the war (compared to a national average of 27.0%). North Rhine-Westphalia is not only highly industrialized but also highly urbanized and thus suffered over-proportionally from war damage. The same is true for the city states of Bremen and Hamburg, which comprise only urban areas, and had almost no agriculture in 1939.

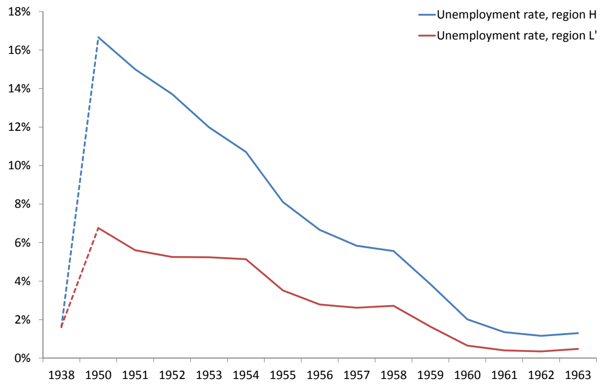
[42] This alternative classification thus divides West Germany into three regions. In our two-region model, we treat migration between regions H and L' as endogenous. To account for net migration flows between region H and (L-L'), however, we treat them as exogenous and subsume them into X_t. Thus, X_t takes non-zero values also after the expellee inflow in $t = 0$. Likewise, we subsume flows between regions L' and (L-L') into $X_t^{\star}$.

in 1939 to 137.7% at the end of 1949. It then gradually came down again and almost, but not completely, reached its pre-inflow value in 1970. Most of the fall in relative population took place in the early- to mid-1950s. The blue line shows that inner-German migration is responsible for most of the change in relative population in the 1950s (but not thereafter).

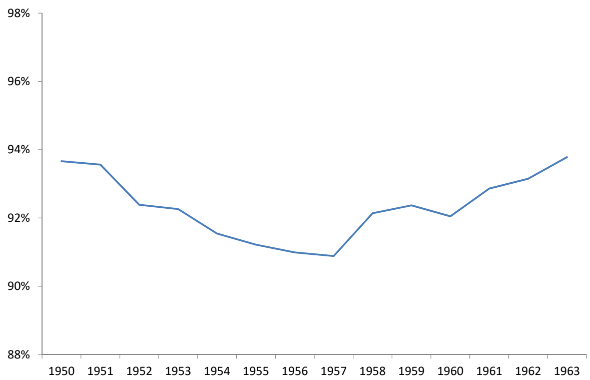
Figure A10: Empirical facts for region H and region L’



(a) Relative population H over L’, 1939-70



(b) Unemployment rate in H and L’, 1938-63



(c) Relative GDP per worker H over L’, 1950-70

Sources: Institut für Raumforschung, Statistisches Bundesamt, Länderrat des Amerikanischen Besatzungsgebiets (1949), Bundesanstalt für Arbeitsvermittlung und Arbeitslosenversicherung. See the notes on the corresponding Figures in Section 3 for details.
Notes: The population series in Panel (a), which is based on migration only, is calculated by adding to the actual population figure of the H and L’ region on 31 December 1949 (cumulated) net migration between the two regions. The unemployment rate in Panel (b) is expressed as a percentage of the dependent labor force. The unemployment rate of region H in 1938 is approximated by the (labor force-weighted) average of the 1938 unemployment rates of Bavaria, Lower Saxony, and the Nordmark. The unemployment rate of region L’ is approximated by the average of the unemployment rates of Hesse and Southwest Germany.

Panel (b) gives the unemployment rates of regions H and L’ in 1938 and between 1950 and 1963. At 1.6%, unemployment rates of the two regions were identical before the war. Both regions then experienced a drastic increase in unemployment, which, however, was much more pronounced in H than in L’. In 1950, the unemployment rate was 16.7% in region H but only 6.8% in region L’. Unemployment then gradually decreased during the 1950s and regional unemployment rates were nearly identical by the beginning of the 1960s.

Panel (c) shows GDP per worker of region H relative to region L' between 1950 and 1963. The gap in GDP per worker is smaller between region H and L' than between H and L and shows no clear trend. Since the employment structure of region H and L' was similar to begin with, the magnitude of sectoral reallocation away from agriculture was comparable as well. The agricultural employment shares in region H and L' fell by 18.8 and 20.6 percentage points, respectively, between 1950 and 1970. This may explain why we observe little evidence for differential productivity trends for region H and L', whereas we do see such evidence when comparing region H to L. Agricultural employment in the more industrialized region L fell by 'only' 14.1 percentage points, so that the associated productivity gains were presumably larger in H and L'.

Overall, comparing the demographic and economic development of regions H and L' yields empirical facts that are similar to those obtained by comparing region H and L. Nevertheless, two differences stand out. First, the population of H continues to fall in the 1960s relative to L' but not relative to L. The decline is, however, relatively modest compared to the decline in the 1950s and due to factors other than inner-German migration. Second, and more importantly, there is no clear trend in GDP per worker of region H when measured relative to region L'. This might be because both regions H and L' benefited to a similar degree from the productivity gains that come with sectoral allocation away from agriculture.

B Empirical evidence on the short-run wage effect of expellees

The short-run wage elasticities in our calibrated model are between -0.17 and -0.25. These elasticities are somewhat smaller–or the adverse wage effects of immigration somewhat larger–than most estimates in the literature. In fact, many studies, but by no means all, find wage effects of immigration close to zero. This section shows that the short-run wage elasticities in our calibrated model are broadly consistent with empirical evidence on the short-run effects of the expellee inflow.

Unfortunately, we do not know of any time series data on regional wage income in West Germany for the period of our analysis. Therefore, we cannot present empirical evidence on the evolution of regional wages in 1939-70 (akin to the other empirical facts in Section 3.2). Instead, we provide descriptive evidence on the short-run effects of the expellee inflow on wage earnings. We use data on weekly earnings of male blue- and white-collar workers in trade and industry from a large-scale survey conducted by the German Statistical Office in 1951 (Statistisches Bundesamt 1954b, Statistisches Bundesamt 1954c).[43] Based on employees' tasks and level of responsibility, the data groups white-collar workers into five performance groups and blue-collar workers into three performance groups. The data is further stratified by sector and federal state.

Let w_{ijkl} denote average weekly earnings of male employees in a labor market cell defined by occupational category i (either blue- or white-collar), performance group j, sector k, and federal state l. We stack the data across all labor market cells and estimate variants of the following regression model:

$$log(w_{ijkl}) = \beta m_{ikl} + \gamma_i + \delta_j + (\gamma_i \times \delta_j) + \upsilon_k + \phi_l \eta + \varepsilon_{ijkl}, \tag{18}$$

where m_{ikl} is the share of expellees among all male employees in cell (i,k,l) in September 1950 (as published in Statistisches Bundesamt (1952a)), γ_i is a dummy for blue-collar workers, δ_j is a vector of performance group dummies, υ_k is a vector of sector dummies, ϕ_l is a vector of state-specific control variables, and ε_{ijkl} is the error term.

Following Braun and Mahmoud (2014), state-specific controls include the share of housing units destroyed in the war, the 1939 share of agricultural workers, and a dummy for the city states Bremen and Hamburg. The share of destroyed housing captures war-related capital destruction and the availability of housing, which, in turn, affected the regional distribution of expellees (see Section 2). The 1939 share of workers in agriculture measures the importance of agriculture for a state and should correlate with pre-war economic development. Finally, a dummy variable captures the specific circumstances of the city states Bremen and Hamburg, which were both largely destroyed in the war and hosted relatively few expellees. In an alternative specification, we replace state-specific controls by a full set of state dummies to remove all (observed and unobserved) heterogeneity between states.

The linear fixed effects for blue-collar worker, performance groups, and sectors control for systematic wage differences across occupational categories, performance groups, and sectors. The interaction between blue-collar workers and performance groups allows for the possibility that wage differences across performance groups are not the same for blue- and white-collar workers. We run both unweighted and weighted regressions (where the sample sizes used to construct the average wage in a labor market cell serve as weights).

[43] The data surveyed 318,851 white-collar employees and 928,652 blue-collar employees. The data did not survey employees in agriculture and in the public sector.

The results are in Panel A of Table A7. The result of the unweighted regression with state-specific controls in column (1) implies that a one percentage point increase in the expellee share in a labor market cell decreases wages in the same cell by 0.191%. This coefficient can be converted to a wage elasticity, defined as the percent change in wages associated with a 1% immigration-induced change in labor supply, by multiplying the coefficient estimate by $(1 - m_{ikl})^2$ (as shown by Borjas (2003)). Since the share of expellees in the male labor force was 16.1% in 1950, the elasticity implied by the regression result in column (1) is about -0.134 ($= -0.191(1 - 0.161)^2$). The estimated wage elasticity decreases to -0.214 ($= -0.304(1 - 0.161)^2$) when we add a vector of state dummies to the regression. This is remarkably close to the short-run wage elasticities in our model. The coefficient estimates obtained in the weighted regression in columns (3) and (4) are generally slightly smaller than those obtained in the unweighted regressions.

Table A7: Short-run wage effects of expellees

	Dependent variable: Log weekly earnings			
	Panel A: Stacked performance groups			
	(1)	(2)	(3)	(4)
Expellee Share	-0.191***	-0.304**	-0.293**	-0.344**
	(0.073)	(0.129)	(0.124)	(0.164)
State controls	yes	-	yes	-
State fixed effects	no	yes	no	yes
Weighted regression	no	no	yes	yes
N	381	381	381	381
R2	0.929	0.931	0.858	0.866
	Panel B: Averaged across performance groups			
	(1)	(2)	(3)	(4)
Expellee Share	-0.240**	-0.409**	-0.213***	-0.200
	(0.0945)	(0.187)	(0.0763)	(0.191)
State controls	yes	-	yes	-
State fixed effects	no	yes	no	yes
Weighted regression	no	no	yes	yes
N	99	99	99	99
R2	0.888	0.896	0.936	0.942

Notes: All regressions include a dummy for blue-collar workers and a vector of sector dummies. Regressions in Panel A include a vector of performance group dummies and interactions between the blue-collar dummy and the performance group dummies. Regressions in Panel B include a set of control variables that indicate the labor market cell's share of workers in the different performance groups. Regressions in (3) and (4) are weighted by the sample sizes used to construct the average wage in a labor market cell. ***,** denote statistical significance at the 1%- and 5%-level, respectively. Robust standard errors are in parentheses.

In an additional robustness check, we consider average weekly earnings of male employees in a occupational category-sector-state cell across all performance groups as the dependent variable, rather than stratifying wages also by performance groups. Unlike in equation (18), average wages and expellee shares are then measured at the same level of aggregation (we do not have data on the share of expellees by performance group). We then estimate the following regression:

$$log(w_{ikl}) = \beta m_{ikl} + s_{ikl}\psi + \gamma_i + \upsilon_k + \phi_l \eta + \varepsilon_{ijkl}, \quad (19)$$

where s_{ikl} is a vector of control variables indicating the share of workers in labor market cell (i,k,l) belonging to the different performance groups.

The results of estimating equation (19) are in Panel B of Table A7. Again, we do find strong evidence for a negative effect of the expellee inflow on wages. The coefficient estimates are somewhat smaller than those reported in Panel A in the unweighted regressions but somewhat larger in the weighted regressions. Overall, however, the differences between the two sets of regressions in Panel A and B are small.

Across all eight specifications in Panel A and B, we do find an average wage elasticity of -0.191 (with estimates ranging from -0.134 to -0.288). The wage elasticities in our model are thus within the range of our empirical estimates.

C Model derivation and calibration

C.1 Labor market stocks and flows

Equations (1) to (4) can be condensed by substituting out for R_t, M_t, G_t and $G_t^\star$. Rearranging labor force as $L_t = N_t + U_t = P_t - R_t$ and substituting for R_t using equation (2) yields

$$L_t \quad = \quad P_t - (1-\pi_t)[P_{t-1} + X_t - (1-\lambda)N_{t-1}] \; . \quad (20)$$

To substitute for M_t in equation (4), we use the job-finding rate $\phi_t = M_t/(M_t + U_t)$ and the identity $P_t = N_t + U_t + R_t$. This yields $N_t = (1-\lambda)N_{t-1} + \phi_t(M_t + P_t - N_t - R_t)$. Substituting for R_t using equation (2) and for $M_t - N_t$ using equation (4) yields

$$N_t \quad = \quad (1-\lambda)(1-\pi_t\phi_t)N_{t-1} + \phi_t[P_t - (1-\pi_t)(P_{t-1} + X_t)] \; . \quad (21)$$

To condense equation (1), we substitute G_t using equation (3) and the corresponding equation for region L, which yields

$$P_t = (1-\lambda)N_{t-1} + (1-\gamma_t)[P_{t-1} - (1-\lambda)N_{t-1} + X_t] + \gamma_t^\star[P_{t-1}^\star - (1-\lambda)N_{t-1}^\star + X_t^\star].$$

Using the corresponding equation for region L (not shown) to substitute for the last term yields

$$(1-\gamma_t^\star)[P_t - (1-\lambda)N_{t-1}] = (1-\gamma_t-\gamma_t^\star)[P_{t-1} - (1-\lambda)N_{t-1} + X_t] + \gamma_t^\star\left[P_t^\star - (1-\lambda)N_{t-1}^\star\right]. \quad (22)$$

Finally, adding equation (1) and the corresponding equation for region L (not shown) yields

$$P_t + P_t^\star = P_{t-1} + P_{t-1}^\star + X_t + X_t^\star. \quad (23)$$

Equations (20), (21), (22), (23) and $L_t = N_t + U_t$ jointly determine P_t, L_t, N_t, U_t and $P_t^\star$ given $N_{t-1}^\star$, initial conditions, exogenous expellee inflows X_t and $X_t^\star$, and transition probabilities. Equations for region L, which correspond to equations (20) and (21), can be derived analogously.

Variables P_t, L_t, N_t, U_t and $P_t^\star$ evolve in a potentially non-stationary way. To solve the model, we transform these variables so that they evolve in a stationary way. Transformations are $rp_t = P_t/(P_t + P_t^\star)$, $n_t = N_t/(P_t + P_t^\star)$, $\ell_t = L_t/(P_t + P_t^\star)$ and $u_t = U_t/L_t$. We denote aggregate population growth as $p_t = (P_t + P_t^\star)/(P_{t-1} + P_{t-1}^\star)$, and transform regional expellee inflows according to $x_t = \frac{X_t}{P_t+P_t^\star}$, $x_t^\star = \frac{X_t^\star}{P_t+P_t^\star}$. With transformed variables, equations (20), (21), (22), (23) and $L_t = N_t + U_t$ read:

$$n_t = (1-u_t)\ell_t, \quad (24)$$

$$\ell_t = rp_t - (1-\pi_t)[rp_{t-1}/p_t - (1-\lambda)n_{t-1}/p_t + x_t], \quad (25)$$

$$n_t = (1-\lambda)(1-\phi_t\pi_t)n_{t-1}/p_t + \phi_t\{rp_t - (1-\pi_t)[(rp_{t-1}/p_t + x_t)]\}, \quad (26)$$

$$(1-\gamma_t^\star)[rp_t - (1-\lambda)n_{t-1}/p_t] - \gamma_t^\star\left[(1-rp_t) - (1-\lambda)n_{t-1}^\star/p_t\right] \quad (27)$$

$$= (1-\gamma_t-\gamma_t^\star)[(rp_{t-1}/p_t - (1-\lambda)n_{t-1}/p_t + x_t],$$

$$1 = p_t(1-x_t-x_t^\star). \quad (28)$$

The corresponding equations for $n_t^\star, \ell_t^\star$, and $u_t^\star$ in region L complete this system.

C.2 Value functions

In a first step, we solve workers discrete-choice problem. In a second step, we use this solution to derive operational expressions for workers value functions.

Workers discrete-choice problem: To solve equation (6), we restate it as nested discrete-choice problem and transform preference shocks such that their location parameters are equal to zero. Dropping time subscripts, this yields

$$\mathcal{U}_I \equiv \max\{\phi W + (1-\phi)Q + \sigma_f \ln f + \mu_H,\ \phi^\star W^\star + (1-\phi^\star)Q^\star + \sigma_f \ln(1-f) + \mu_L\}, \quad (29)$$

$$\mathcal{U} \equiv \max\{H + \sigma_h \ln h + \mu_O,\ \mathcal{U}_I + \sigma_h \ln(1-h) + \hat{\mu}_I\}, \quad (30)$$

with shocks $\mu_H, \mu_L \sim \text{Gumbel}(0, \sigma_f^{-1})$, $\mu_O \sim \text{Gumbel}(0, \sigma_h^{-1})$, and $\hat{\hat{\mu}}_I = \sigma_h \ln(1-h) + \hat{\mu}_I$.

We use standard results for the maximum of two Gumbel-distributed random variables with the same scale parameter (see Ben-Akiva and Lerman (1985)) to solve for the maximum operator in equation (29). This yields

$$\mathcal{U}_I = V_I + \tilde{\mu}_I, \quad (31)$$

$$\tilde{\mu}_I \sim \text{Gumbel}(0, \sigma_f^{-1}), \quad (32)$$

$$V_I = \sigma_f \ln\{f \exp((\phi W + (1-\phi)Q)/\sigma_f) + (1-f)\exp((\phi^\star W^\star + (1-\phi^\star)Q^\star)/\sigma_f)\}. \quad (33)$$

Thus, $\mathcal{U}_I$ is equal to the combined value V_I plus a new preference shock $\tilde{\mu}_I$ with location parameter equal to zero and the same scale parameter as μ_H and μ_L. To solve for the maximum operator in equation (30), we substitute equation (31) into equation (30), which yields

$$\mathcal{U} = \max\{H + \sigma_h \ln h + \mu_O,\ V_I + \sigma_h \ln(1-h) + \tilde{\mu}_I + \hat{\mu}_I\}, \quad (34)$$

and assume that the combined preference shock $\mu_I = \tilde{\mu}_I + \hat{\mu}_I$ is distributed extreme-value Gumbel with location parameter equal to zero and the same scale as μ_O. Also, we impose the condition $\sigma_h \geq \sigma_f$, i.e., the variance of the combined shock μ_I cannot be smaller than the variance of one of its components. With these assumptions, we obtain from equation (34) that

$$
\begin{aligned}
\mathcal{U} &= V + \mu, && (35)\\
\mu &\sim \text{Gumbel}(0, \sigma_h^{-1}), && (36)\\
V &= \sigma_h \ln\{h \exp(H/\sigma_h) + (1-h)\exp(V_I/\sigma_h)\}. && (37)
\end{aligned}
$$

Furthermore, we obtain from equations (35) and (36) that

$$
E_\mu(\mathcal{U}) = V + \sigma_h \bar{e}, \tag{38}
$$

where $\bar{e}$ is Euler's constant. We now express V as function of the value differentials $\Upsilon = W - W^\star$, $\Omega = W - Q$, and $\Omega^\star = W^\star - Q^\star$, by substituting for V_I in equation (37) using (33) and rearranging the resulting equation. This yields

$$
\begin{aligned}
E_\mu(\mathcal{U}) &= W - (1-\phi)\Omega + \sigma_h \ln\Big\{ h \exp(\sigma_h^{-1}[b_h - b_q - \phi\Omega]) \\
&+ (1-h)\big\{f + (1-f)\exp(\sigma_f^{-1}[(1-\phi)\Omega - (1-\phi^\star)\Omega^\star - \Upsilon])\big\}^{\frac{\sigma_f}{\sigma_h}} \Big\} + \sigma_h \bar{e}.
\end{aligned} \tag{39}
$$

Workers value functions: We now express value functions (5) and (7) in terms of value differentials Υ_t, Ω_t, and $\Omega_t^\star$. Substituting for $\beta E_\mu(\mathcal{U}_{t+1})$ in equation (5) using (7) yields

$$
W_t = w_t + (1-\lambda)\beta W_{t+1} + \lambda[Q_t - b_q], \tag{40}
$$

and subtracting from this equation the corresponding equation for region L yields

$$
(1-\lambda)\Upsilon_t = w_t - w_t^\star + (1-\lambda)\beta\Upsilon_{t+1} + \lambda\left[\Omega_t^\star - \Omega_t\right]. \tag{41}
$$

This equation describes the evolution of Υ_t. To obtain an equation describing the evolution of Ω_t, we subtract equation (7) from (5) and substitute for $E_\mu(\mathcal{U}_{t+1})$ using equation (39). This yields

$$
\begin{aligned}
\Omega_t &= w_t - \tilde{b}_q + (1-\lambda)\beta\big[(1-\phi_{t+1})\Omega_{t+1} - \sigma_h \ln\big\{h \exp(\sigma_h^{-1}[b_h - b_q - \phi_{t+1}\Omega_{t+1}]) \\
&+ (1-h)\big\{f + (1-f)\exp(\sigma_f^{-1}\Delta_{t+1})\big\}^{\frac{\sigma_f}{\sigma_h}}\big\}\big],
\end{aligned} \tag{42}
$$

with

$$\Delta_t \equiv (1-\phi_t)\Omega_t - (1-\phi_t^\star)\Omega_t^\star - \Upsilon_t \tag{43}$$

and $\tilde{b}_q = b_q - (1-\lambda)\beta\sigma_h\bar{e}$. Analogous steps for region L yield

$$\begin{aligned}\Omega_t^\star &= w_t^\star - \tilde{b}_q + (1-\lambda)\beta\big[(1-\phi_{t+1}^\star)\Omega_{t+1}^\star - \sigma_h \ln\big\{h\exp(\sigma_h^{-1}[b_h - b_q - \phi_{t+1}^\star\Omega_{t+1}^\star]) \\ &+ (1-h)\big\{f^\star + (1-f^\star)\exp(-\sigma_f^{-1}\Delta_{t+1})\big\}^{\frac{\sigma_f}{\sigma_h}}\big\}\big],\end{aligned} \tag{44}$$

where we assume $h^\star = h$. To summarize, equations (41), (42), (43), and (44) determine the net values $\Upsilon_t, \Omega_t, \Omega_t^\star$ and Δ_t given job finding probabilities and wages.

C.3 Choice probabilities

Participation probability: Using equations (29) and (31), we substitute for the maximum operator in the participation probability in equation (10), which yields

$$\begin{aligned}\pi_t &= \text{Prob}[\ H_t + \sigma_h \ln h + \mu_{Ot} \leq V_{It} + \sigma_h \ln(1-h) + \mu_{It}\ ], \\ &= \text{Prob}[\ (H_t + \sigma_h \ln h + \mu_{Ot}) - (V_{It} + \sigma_h \ln(1-h) + \mu_{It}) \leq 0\ ],\end{aligned}$$

where we also use $\mu_{It} = \tilde{\mu}_{It} + \hat{\mu}_{It}$. Since μ_{Ot} and μ_{It} are distributed with the same scale parameter, standard results for the difference of two Gumbel-distributed random variables apply (see Ben-Akiva and Lerman (1985)). Using these, the previous equation can be rearranged to obtain

$$\pi_t = \frac{(1-h)\exp\{V_{It}/\sigma_h\}}{h\exp\{H_t/\sigma_h\} + (1-h)\exp\{V_{It}/\sigma_h\}}.$$

Substituting for V_{It} using equation (33) yields

$$\pi_t = \frac{(1-h)\big\{f + (1-f)\exp[\sigma_f^{-1}\Delta_t]\big\}^{\frac{\sigma_f}{\sigma_h}}}{h\exp[\sigma_h^{-1}(b_h - b_q - \phi_t\Omega_t)] + (1-h)\big\{f + (1-f)\exp[\sigma_f^{-1}\Delta_t]\big\}^{\frac{\sigma_f}{\sigma_h}}}, \tag{45}$$

where (43) determines Δ_t. Analogous steps yield the participation probability in region L,

$$\pi_t^\star = \frac{(1-h)\big\{f^\star + (1-f^\star)\exp[-\sigma_f^{-1}\Delta_t]\big\}^{\frac{\sigma_f}{\sigma_h}}}{h\exp[\sigma_h^{-1}(b_h - b_q - \phi_t^\star\Omega_t^\star)] + (1-h)\big\{f^\star + (1-f^\star)\exp[-\sigma_f^{-1}\Delta_t]\big\}^{\frac{\sigma_f}{\sigma_h}}}. \tag{46}$$

Migration probability: We transform preference shocks in the conditional migration probability in equation (9) such that they have location parameter equal to zero. This yields

$$\gamma_t^{cond} = \text{Prob}[\ (\phi_t W_t + (1-\phi_t)Q_t + \sigma_f \ln f + \mu_{Ht}) - (\phi_t^\star W_t^\star + (1-\phi_t^\star)Q_t^\star + \sigma_f \ln(1-f) + \mu_{Lt}) \leq 0\ ].$$

In this equation, shocks μ_{Ht} and μ_{Lt} have the same scale parameter such that standard results for the difference of two Gumbel-distributed random variables apply again. This yields

$$\gamma_t^{cond} = \frac{(1-f)\exp\{\sigma_f^{-1}\Delta_t\}}{f + (1-f)\exp\{\sigma_f^{-1}\Delta_t\}}.$$

Thus, we obtain for the unconditional migration probability that

$$\gamma_t = \frac{(1-f)\exp\{\sigma_f^{-1}\Delta_t\}}{f + (1-f)\exp\{\sigma_f^{-1}\Delta_t\}} \times \pi_t. \tag{47}$$

Analogous steps for region L yield

$$\gamma_t^\star = \frac{(1-f^\star)\exp\{-\sigma_f^{-1}\Delta_t\}}{f^\star + (1-f^\star)\exp\{-\sigma_f^{-1}\Delta_t\}} \times \pi_t^\star. \tag{48}$$

Equations (45), (46), (47) and (48) determine participation and migration probabilities.

C.4 Firms first-order optimality conditions

The firm maximizes discounted profit in (11) subject to (4) and the capital accumulation equation. The first order conditions regarding employment N_t and vacancies V_t yield, respectively,

$$J_t = (1-\lambda)\beta J_{t+1} + F_N(k_t, n_t) - w_t + \beta\frac{\kappa_\eta}{2}\eta_{t+1}^2, \tag{49}$$

$$J_t = \overline{\kappa}_v / q_t + \kappa_\eta \eta_t, \tag{50}$$

where J_t denotes the value of one extra worker and $F_N(k_t, n_t)$ denotes the marginal product of labor expressed in transformed variables with $n_t = N_t/(P_t + P_t^\star)$ and $k_t = K_t/(P_t + P_t^\star)$. Furthermore, η_t denotes the quasi-growth rate of employment (net of $q\tilde{V}_t/N_{t-1}$),

$$\eta_t = \frac{q_t V_t - q\widetilde{V}_t}{N_{t-1}}.$$

In this equation, we substitute for $q_t V_t$ using (4) and express the resulting equation in terms of transformed variables by dividing it by $P_t + P_t^{\star}$. This yields

$$\eta_t = (n_t - a_{vt})p_t/n_{t-1} - (1-\lambda), \tag{51}$$

where the exogenous variable $a_{vt} = q\widetilde{V}_t/(P_t + P_t^{\star})$ evolves as

$$a_{vt} = (\lambda n)^{\lambda} (a_{vt-1}/p_t)^{1-\lambda}, \tag{52}$$

which follows from dividing $q\widetilde{V}_t = (\lambda \bar{N}_t)^{\lambda}(q\widetilde{V}_{t-1})^{1-\lambda}$ by $P_t + P_t^{\star}$.

To solve the firm problem, we also derive the first order conditions for capital K_t and investment I_t and substitute for the Lagrange multiplier on the capital accumulation equation. This yields

$$b\kappa_t = (1-\rho)\beta b\kappa_{t+1} + [F_K(k_t, n_t) - 1 + (1-\rho)\beta] + \beta\frac{b}{2}(\kappa_{t+1})^2 d, \tag{53}$$

where we also denote the quasi-growth rate of capital (net of $\tilde{I}_t/K_{t-1}$) by

$$\kappa_t = \frac{I_t - \tilde{I}_t}{K_{t-1}}.$$

In this equation, we substitute for investment using capital accumulation and express the resulting equation in terms of stationary variables by dividing it by $P_t + P_t^{\star}$. This yields

$$\kappa_t = (k_t - a_{It})\, p_t/k_{t-1} - (1-\rho), \tag{54}$$

where the exogenous variable $a_{It} = \widetilde{I}_t/(P_t + P_t^{\star})$ evolves as

$$a_{It} = (\rho k)^{\rho} (a_{It-1}/p_t)^{1-\rho}, \tag{55}$$

which follows from dividing $\tilde{I}_t = (\rho \bar{K}_t)^{\rho}(\tilde{I}_{t-1})^{1-\rho}$ by $P_t + P_t^{\star}$.

C.5 Model solution

We solve the model numerically using the deterministic extended path algorithm of Fair and Taylor (1983), as implemented in Adjemian, Bastani, Karamé, Juillard, Maih, Mihoubi, Perendia, Ratto, and Villemot (2018). This algorithm assumes perfect foresight and accounts for permanent shifts in variables and nonlinearities in the model. For convenience, we reference here the core equations of the model:

- Equations (41), (42), (43), and (44) describe value differentials.
- Equations (45), (46), (47) and (48) describe participation and migration probabilities.
- Equations (24) to (28) and three corresponding equations for region L describe labor-market stocks and flows.
- Equations (49) to (52) and (53) to (55) and the corresponding equations for region L describe firms first-order optimality conditions.
- Equation $\phi_t = a_{mt}^{1/\xi} q_t^{1-1/\xi}$ and the corresponding equation for region L describe labor-market matching.

C.6 Model steady state

In Section 5.2, we calibrate variables $rp, \ell + \ell^\star, u$, and q to their values in the data. To solve for the steady state, we also assume participation to population ratios to be equal in both regions, which yields $\ell + \ell^\star = \ell/rp = \ell^\star/(1 - rp)$. Thus, our standard labor market relationships yield

$$\begin{aligned}
\ell &= (\ell + \ell^\star)\, rp, \\
\ell^\star &= \left(\tfrac{1-rp}{rp}\right) \ell, \\
n &= (1-u)\,(\ell/rp)\, rp, \\
n^\star &= \left(\tfrac{1-rp}{rp}\right) n.
\end{aligned}$$

Without expellee inflow in steady state, $x = x^\star = 0$, equation (28) yields $p = 1$, and equation (27) yields $\gamma^\star[(1 - rp) - (1 - \lambda)n^\star] = \gamma[rp - (1 - \lambda)n]$. Substituting in this equation that $n^\star = n(1 - rp)/rp$ and simplifying yields

$$\gamma^\star(1 - rp) \quad = \quad \gamma rp, \tag{56}$$

which shows that net migration between region H and L is equal to zero. Using regional symmetry in steady state, $w = w^\star$ and $\phi = \phi^\star$, we solve equations (41), (42), (43), and (44) for workers value differentials, which yields

$$\Delta = 0,$$

$$\Upsilon = 0,$$

$$\Omega = \Omega^\star = \frac{w - \tilde{b}_q}{1-(1-\lambda)(1-\phi)\beta}, \tag{57}$$

where we also use our assumption $H = \phi W + (1-\phi)Q$ from Section 5.2 and take the wage rate as given but solve for it below. Workers choice probabilities are determined by equations (45), (46), (47) and (48),

$$\pi = \pi^\star = 1 - h,$$

$$\gamma = (1-f)(1-h),$$

$$\gamma^\star = (1-f^\star)(1-h).$$

We obtain the job finding rate

$$\phi = \frac{1}{\pi}\left(\frac{\lambda n/rp}{1-(1-\lambda)n/rp}\right)$$

by solving equation (26), and the job filling rate

$$q \quad = \quad a_m^{1/(1-\xi)}\phi^{-\xi/(1-\xi)}$$

by solving the matching function. Equation (54) yields $\kappa = 0$ in steady state, and hence equation (53) determines the capital labor ratio

$$\frac{k}{n} \quad = \quad \left(\frac{1-\beta(1-\rho)}{a(1-\chi)}\right)^{-\frac{1}{\chi}}.$$

Equation (51) yields $\eta = 0$ in steady state. Hence, equations (49) and (50) yield

$$w - F_N \quad = \quad -[1-(1-\lambda)\beta]\overline{\kappa}_v/q \tag{58}$$

and, after substituting for J using the surplus sharing rule $\Omega = \frac{\alpha}{1-\alpha}J$,

$$\frac{1-\alpha}{\alpha}\Omega = \overline{\kappa}_v/q.$$

To solve for wages, we substitute for Ω in the previous equation using (57) to obtain

$$[1-(1-\lambda)\beta]\overline{\kappa}_v/q \quad = \quad \frac{1-\alpha}{\alpha}(w-\tilde{b}_q)-(1-\lambda)\beta\phi\overline{\kappa}_v/q.$$

We substitute this equation for the right hand side of equation (58) (times -1) and obtain

$$w \quad = \quad (1-\alpha)\tilde{b}_q+\alpha\{\chi a(k/n)^{1-\chi}+(1-\lambda)\beta\overline{\kappa}_v\phi/q\},$$

which concludes the steady state solution for core variables.

C.7 Calibrating job-filling rates

The job-filling rate equals the ratio of job-finding rate over labor market tightness, i.e., $q(\theta_t) = \phi_t/\theta_t$. As data on gross worker flows is not available for the historical time period, we follow Shimer (2005) and infer the job-finding rate from aggregate data on employment, unemployment and short-term unemployment. Let u_t be the number of workers unemployed at the end of month t (in contrast to the rest of the paper, t refers to a month rather than to a quarter in this appendix), and let u_t^N be the number of workers unemployed for less than one month at the end of the same month. Finally, let ϕ_t denote the probability of an unemployed worker finding a job during month t. If we further assume that no unemployed worker exits the labor force, the unemployment rate evolves according to

$$u_{t+1} = (1-f_{t+1})u_t + u_{t+1}^N. \tag{59}$$

The job-finding probability ϕ_t is given by

$$f_{t+1} = 1-\frac{u_{t+1}-u_{t+1}^N}{u_t}. \tag{60}$$

Unfortunately, the German Federal Employment Agency does not provide data on short-term unemployment for the historical period. However, it does provide data on total inflows into unemployment during a month, I_t. When a worker enters the unemployment pool, she has, on average, half a month to leave the unemployment pool before she is recorded as short-term unemployed at the end of the month. The number of short-term unemployed at the end of month t can then be approximated by $(1-0.5\phi_t)I_t$, and the job-finding probability can be expressed as:

$$\phi_{t+1} = \frac{u_t + I_{t+1} - u_{t+1}}{u_t + 0.5 I_{t+1}}. \tag{61}$$

We use monthly West German data from July 1950 to December 1970 to calculate the job-finding probability for every month. Data is taken from various issues of the German Federal Employment Agency's *Amtliche Nachrichten*. Note that from September 1955 onwards, the employment agency records inflows into the pool of job seekers instead of inflows into unemployment. Therefore, we use data on job seekers to calculate the job-finding probability for this period. The data indicate that the average monthly job-finding probability was 0.50.

Moreover, data from the German employment agency also indicates that between 1950 and 1970, the average monthly vacancy-unemployment rate in West Germany was 2.20. We thus approximate the quarterly job-filling rate as $(3 \times 0.50)/2.20 \approx 0.68$.

C.8 Exogenous processes and their estimation

Exogenous processes for regional productivity and matching efficiency evolve according to

$$a_t = a^{1-(\rho_a+\rho_{a1})+\rho_a\rho_{a1}} \times (a_{t-1})^{\rho_a+\rho_{a1}} \times (a_{t-2})^{-\rho_a\rho_{a1}} \tag{62}$$

$$a_t^{\star} = a^{1-(\rho_a+\rho_{a1})+\rho_a\rho_{a1}} \times (a_{t-1}^{\star})^{\rho_a+\rho_{a1}} \times (a_{t-2}^{\star})^{-\rho_a\rho_{a1}} \tag{63}$$

$$a_{mt} = a_m^{1-\rho_m} a_{mt-1}^{\rho_m} \tag{64}$$

$$a_{mt}^{\star} = a_m^{1-\rho_m} (a_{mt-1}^{\star})^{\rho_m},$$

with persistence parameters ρ_a, ρ_{a1} and ρ_m restricted to the unit interval. We assume that initial conditions in relative productivity are evenly distributed between regions, that is $a_{-1} = a(1-s_a)$ and $a_{-1}^{\star} = a(1+s_a)$, where a denotes the steady-state level of regional productivity and $2s_a$ is equal to the regional productivity spread before the expellee inflow. We treat the initial conditions for the matching efficiency process correspondingly.

For our benchmark calibration, we impose $\rho_{a1} = 0$ in equations (62) and (63) and optimize over ρ_a, ρ_m, s_a and s_m (in addition to the propensity parameters). For our robustness check with the alternative data classification (see Appendix D), we optimize over the same parameters but instead impose $\rho_{a1} = \rho_a$ in equations (62) and (63). In addition, we set the initial conditions a_{-2} and $a_{-2}^{\star}$ equal to the level of steady state productivity a. This allows us to keep the same number of parameters in the benchmark calibration and the robustness check.

C.9 Model with full employment

This subsection sketches the model with full employment to which we compare the full-fledged model in Section 5.5. We sketch workers locational choice, population dynamics, wage determination and firms capital and investment choice. Furthermore, we derive the economic dynamics in the 'no-adjustment scenario' for the model with full employment and the model with non-employment.

With a single labor market state in region H, the value of a worker in this region evolves according to $W_t = w_t + \beta E_\mu \max\{\mu_{Ht+1} + W_{t+1},\ \mu_{Lt+1} + W^\star_{t+1}\}$, with preference shocks $\mu_H, \mu_L \sim$ Gumbel$(0, \sigma_f^{-1})$. Specifying the corresponding value for a worker in region L and going through derivations similar to those in Appendices C.2 and C.3 shows that the regional value differential $v_t \equiv W_t - W^\star_t$ evolves according to

$$v_t = w_t - w^\star_t + \beta v_{t+1} + \beta\sigma_f \ln\left\{\frac{f + (1-f)\exp(-\frac{1}{\sigma_f}v_{t+1})}{f^\star + (1-f^\star)\exp(\frac{1}{\sigma_f}v_{t+1})}\right\}, \tag{65}$$

and that migration probabilities are given by

$$\gamma_t = \frac{1-f}{1-f+f\exp(\frac{1}{\sigma_f}v_t)}, \tag{66}$$

$$\gamma^\star_t = \frac{1-f^\star}{1-f^\star+f^\star\exp(-\frac{1}{\sigma_f}v_t)}. \tag{67}$$

Relative population in region H evolves according to

$$rp_t = \gamma^\star_t + (1-\gamma_t-\gamma^\star_t)\{(1-x_t-x^\star_t)rp_{t-1} + x_t\}, \tag{68}$$

which follows from setting $\lambda = 1$ in equation (27) and substituting for p_t using equation (28). Regional wages are equal to their regional marginal products of labor,

$$w_t = \chi a_t\left(\frac{k_t}{rp_t}\right)^{1-\chi},$$

$$w^\star_t = \chi a^\star_t\left(\frac{k^\star_t}{1-rp_t}\right)^{1-\chi}.$$

With full employment, firms merely choose capital and investment such that firms first-order optimality conditions are given by equations (53) to (55) and the corresponding equations for firms in region L.

The 'no-adjustment scenario' in the model with full employment: Dynamics in the 'no-adjustment scenario' considered in Section 5.5 emerge in the limit $\sigma_f, b \to \infty$. In the limit $\sigma_f \to \infty$, equations (66) and (67) imply that migration rates are constant and equal to their steady-state values, $\gamma = 1 - f$ and $\gamma^\star = 1 - f^\star$. Thus, from equation (68), population then evolves as $rp_{\infty,t} = 1 - f^\star + (f + f^\star - 1)\{(1 - x_t - x_t^\star) rp_{\infty,t-1} + x_t\}$. The limit $b \to \infty$ implies $\kappa_t = 0$ such that by equation (53), the capital-labor ratio is equal to its steady-state value. The path of capital follows from (54), $k_{\infty,t} = (1 - \rho)k_{\infty,t-1}/p_t + a_{It}$.

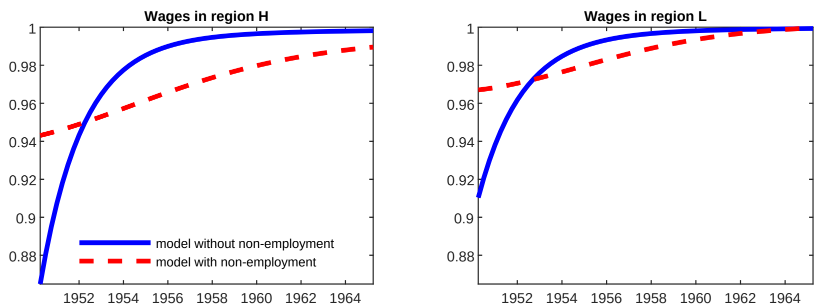
The 'no-adjustment scenario' in the model with non-employment: In the model allowing for non-employment, we consider the 'no-adjustment scenario' as the limit $\sigma_f, \sigma_h, \kappa_\eta, b \to \infty$. With $\sigma_f, \sigma_h \to \infty$, it follows from equations (45), (46), (47) and (48) that migration and participation probabilities are equal to their steady-state values. With $\kappa_\eta, \to \infty$, it follows that $\eta_t = 0$ such that equation (51) implies $n_{\infty,t} = (1 - \lambda)n_{\infty,t-1}/p_t + a_{vt}$. With this, equation (27) implies

$$
\begin{aligned}
& (1 - \gamma^\star)[rp_{\infty,t} - (1 - \lambda)n_{\infty,t-1}/p_t] - \gamma^\star \left[(1 - rp_{\infty,t}) - (1 - \lambda)n^\star_{\infty,t-1}/p_t\right] \\
= \quad & (1 - \gamma - \gamma^\star)[(rp_{\infty,t-1}/p_t - (1 - \lambda)n_{\infty,t-1}/p_t + x_t].
\end{aligned}
$$

The limit $b \to \infty$ has the same consequences as in the model with full employment.

C.10 Wage responses with and without non-employment margin

Figure A11: Wage responses



Notes: The plots depicts wages in region H (Panel A) and region L (Panel B) in our model with non-employment (red dashed line) and in a simplified model without non-employment (blue solid line). Wages are normalized by their respective steady-state values. We calibrate parameters and the inflow shock in both models to the values in our baseline calibration (see Sections 5.1-5.3).

D Robustness checks

This section shows that our main results on the effects of the expellee inflow on native income and employment are robust to plausible changes in our baseline calibration. The robustness checks focus, in particular, on pre-existing differences between regions H and L. We conduct four robustness checks and report for each check our distance measure of model fit, the calibrated parameters, the treatment effect on native income (in %), and the minimum effect on native employment in region H along the adjustment path (for any ten expellees who arrive in region H). All statistics are in Table A8, along with the initial conditions on regional capital stocks, productivity and matching efficiency (the first panel presents the corresponding results for the baseline calibration).

A. Asymmetric initial capital stocks. Our baseline calibration abstracts from regional differences in war-related damage to the capital stock. However, such differences might provide an alternative explanation, other than asymmetric expellee inflows, for the regional adjustment dynamics observed historically. Therefore, robustness check A. accounts for regional differences in war damage, and sets initial regional capital stocks in region H and L to 88% and 77% of their steady-state values, respectively.[44] Asymmetric initial capital stocks slightly improve model fit. Importantly, the model-implied income and employment losses of the expellee inflow decrease only slightly.

B. No matching efficiency shock. The estimated matching efficiency shock is very persistent and thus helps the model to generate persistent regional differences in the unemployment rate, as we observe them in the data. Robustness check B. shows that the model's main predictions do not hinge on the presence of matching efficiency shocks. While the model fit deteriorates somewhat when we restrict matching efficiency to be the same in both regions, the employment and income losses of the expellee inflow increase only slightly in magnitude (see Panel B. of Table A8).

[44] We calculate these initial regional capital stocks by using the fact that damage d of the nationwide capital stock is a weighted sum of damage of regional capital stocks, i.e., $d(K + K^{\star}) = d_H K_{-1} + d_L K^{\star}_{-1}$. We transform this equation into per capita terms and solve it for d_H using the observation that $d_L = 2d_H$, which follows from the historical data on regional war damage in Table 1. This yields $d_H = d(1 + P_{-1}/P^{\star}_{-1})/(2 + P_{-1}/P^{\star}_{-1})$. Our calibration implies $d = 0.19$ and $P_{-1}/P^{\star}_{-1} = 0.544$.

C. Alternative data classification. Robustness check C. uses an alternative data classification of federal states that levels out pre-existing differences in both the degree of industrialization and in war damage. It excludes Bremen, Hamburg and North Rhine-Westphalia from region L, as these three states are responsible for the observed pre-existing differences between regions H and L (see Table 1).[45] The model fit improves considerably if we use the alternative classification of regions (see Panel C. of Table A8). As expected, the exogenous productivity process that the model prefers for this data classification indicates considerably smaller productivity differences between regions. Nevertheless, the income effect remains virtually unchanged. This is despite the fact that significantly fewer native workers migrate endogenously from the high- to the low-inflow region than in the baseline classification (see Appendix A.10 for the details). As fewer natives migrate, the minimum effect on native employment in region H increases somewhat (from −4.33 in baseline to −3.59).

D. Initial capital stock at steady state. Our baseline calibration sets initial regional capital stocks 19% below their steady-state values to account for war-related damage of the capital stock. However, the Nazi era also witnessed massive investment in industrial capacity that partly made up for later war damage. In fact, the magnitudes of investment and war damage – and the degree to which the former out-weighted the latter – is still debated among economic historians (Eichengreen and Ritschl 2009, Vonyó 2012). Robustness check D., therefore, initializes capital stocks at their steady-state values rather than below them. This change in calibration has again little effect on the model-implied income and employment effects of the expellee inflow (see Panel D. of Table A8).

[45] Appendix A.10 documents the empirical facts for the alternative classification and shows that they are qualitatively similar to the facts for the baseline classification, except for GDP per worker.

Table A8: Robustness checks

	Initial conditions of capital[1]		Initial conditions and persistence of exog. processes[2]				Calibrated propensity parameters[3]				Model fit[4]	Model predictions[5]	
	k_{-1}/k	$k^\star_{-1}/k^\star$	$1-s_a$	ρ_a	$1-s_{a_m}$	ρ_m	κ_η	b	σ_f	σ_h	D	$\mathcal{T}_{N0}$ (in %)	$\min N_N$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Baseline calibration	0.81	0.81	0.97	0.98	0.75	0.99	9.62	1.42	0.11	0.23	0.48	−1.51	−4.33
A. Asymmetric initial capital stocks	0.88	0.77	0.96	0.97	0.50	0.97	8.52	2.12	0.09	0.14	0.42	−1.48	−3.80
B. No matching efficiency shock	0.81	0.81	0.97	0.98	1	.	10.20	1.28	0.09	0.31	0.61	−1.56	−4.68
C. Alternative data classification	0.81	0.81	0.999	0.96	0.52	0.97	6.83	2.23	0.08	0.11	0.34	−1.59	−3.59
D. Initial capital stock at steady state	1	1	0.97	0.98	0.50	0.97	9.45	0.84	0.10	0.14	0.49	−1.48	−3.88

Notes: The table shows the effects of various changes in the baseline calibration on model fit and calibrated parameters. The table also shows the effects of the expellee inflow on native income and employment. Each robustness check changes the baseline calibration in one dimension, keeping all other parameters at the baseline values discussed in Section 5. [1] Initial condition k_{-1} denotes the capital stock per capita before the expellee inflow, and $k^\star$ denotes the steady-state level of the capital stock per capita. [2] Processes for productivity and matching efficiency in region H are $a_t = a^{1-\rho_a}(a_{t-1})^{\rho_a}$ and $a_{mt} = a_m^{1-\rho_m} a_{mt-1}^{\rho_m}$. We optimize over ρ_a, ρ_m and initial conditions $a_{-1} = a(1-s_a)$ and $a_{m,-1} = a_m(1-s_m)$. Processes in region L have initial conditions $a^\star_{-1} = a(1+s_a)$ and $a^\star_{m,-1} = a_m(1+s_m)$. In exercise C., we assume that productivity a_t follows the process $a_t = a^{1-2\rho_a+\rho_a^2} \times a_{t-1}^{2\rho_a} \times a_{t-2}^{-\rho_a^2}$ and that $a^\star_t$ follows the corresponding process with the same persistence coefficient ρ_a. We optimize over ρ_a and initial condition a_{-1} and fix $a_{-2} = a$ at steady state. Thus, in exercise C., we estimate the same number of parameters as for the baseline specification. See Appendix C.8 for details. [3] Propensity parameters are firms' reluctance to adjust employment κ_η or capital b and workers' propensity to migrate σ_f and participate in the labor market σ_h. [4] The distance of targeted moments D compares the model's simulated adjustment path in response to the expellee inflow to the historical time series on relative population, regional unemployment rates, average labor force participation, and relative GDP per worker (see Section 5). [5] Treatment effect $\mathcal{T}_{N0}$ denotes the percentage change in the expected discounted income of the average native worker as a result of the expellee inflow (see Section 6.2.1). $\min N_N$ denotes the minimum effect of the expellee inflow along the adjustment path on native employment in region H (for any ten expellees who arrive in region H).

E Labor market decompositions for native workers and expellees

Labor market experience of native workers versus expellees. To compute decompositions for native workers and expellees separately, we track each group over time through its own stock flow system. The stock flow system of native workers in region H resembles the stock flow system of the overall population in region H (equations (20), (21), (22) and (23)), but is not subject to exogenous worker inflow. Native populations in region H and L evolve according to

$$\begin{aligned}(1-\gamma_t^\star)[P_{Nt}-(1-\lambda)N_{Nt-1}] &= (1-\gamma_t-\gamma_t^\star)[P_{Nt-1}-(1-\lambda)N_{Nt-1}]+\gamma_t^\star\left[P_{Nt}^\star-(1-\lambda)N_{Nt-1}^\star\right], \\ P_{Nt}+P_{Nt}^\star &= P_{Nt-1}+P_{Nt-1}^\star.\end{aligned}$$

The remaining variables in region H evolve according to

$$\begin{aligned}N_{Nt} &= (1-\lambda)(1-\phi_t\pi_t)N_{Nt-1}+\phi_t\{P_{Nt}-(1-\pi_t)P_{Nt-1}\} \\ L_{Nt} &= P_{Nt}-(1-\pi_t)[P_{Nt-1}-(1-\lambda)N_{Nt-1}]\ , \\ U_{Nt} &= L_{Nt}-N_{Nt}\ .\end{aligned}$$

These equations have initial conditions $P_{N,-1}=P_{-1}$ and $N_{N,-1}=N_{-1}$, which follow from the assumption that there are no expellees in the initial steady state. Stationary transformations of the variables in the stock flow system for native workers and in the corresponding system for expellees (see below) are, with $i=N,X$: $rp_{it}=P_{it}/(P_t+P_t^\star),\ n_{it}=N_{it}/(P_t+P_t^\star),\ \ell_{it}=L_{it}/(P_t+P_t^\star),\ u_{it}=U_{it}/L_{it}$. Thus, the transformed stock flow system of native workers in region H reads

$$\begin{aligned}(1-\gamma_t^\star)[rp_{Nt}-(1-\lambda)n_{Nt-1}/p_t] &= (1-\gamma_t-\gamma_t^\star)(rp_{Nt-1}-(1-\lambda)n_{Nt-1})/p_t \\ &\quad +\gamma_t^\star\left[rp_{Nt}^\star-(1-\lambda)n_{Nt-1}^\star/p_t\right], \\ rp_{Nt}+rp_{Nt}^\star &= rp_{Nt-1}+rp_{Nt-1}^\star)/p_t, \\ n_{Nt} &= (1-\lambda)(1-\phi_t\pi_t)n_{Nt-1}/p_t+\phi_t\{rp_{Nt}-(1-\pi_t)rp_{Nt-1}/p_t\} \\ \ell_{Nt} &= rp_{Nt}-(1-\pi_t)(rp_{Nt-1}-(1-\lambda)n_{Nt-1})/p_t\ , \\ u_{Nt} &= 1-n_{Nt}/\ell_{Nt}\ ,\end{aligned}$$

with initial conditions $rp_{N,-1} = rp$ and $n_{N,-1} = n$. To compute expellees' distribution over labor market states, we exploit the fact that in a particular state, expellees and native workers amount to a region's population, e.g. $U_t = U_{Nt} + U_{Xt}$. This yields

$$
\begin{aligned}
rp_t &= rp_{Nt} + rp_{Xt} \\
n_t &= n_{Nt} + n_{Xt} \ , \\
\ell_t &= \ell_{Nt} + \ell_{Xt} \ , \\
u_t \ell_t &= u_{Nt}\ell_{Nt} + u_{Xt}\ell_{Xt} \ .
\end{aligned}
$$

We derive the stock flow system for native workers and expellees in region L using analogous steps.

Decomposition for native and expellee workers jointly. Recall that population in region H evolves as $P_t = P_{t-1} + X_t + G^\star_t - G_t$. Combining this equation with the identity $P_t = N_t + U_t + R_t$ and taking first differences yields

$$X_t = \Delta N_t + \Delta U_t + \Delta R_t + G_t - G^\star_t \ , \tag{69}$$

where Δ denotes the difference operator, i.e., $\Delta N_t = N_t - N_{t-1}$. Equation (69) shows that the expellee inflow X_t into region H can be decomposed into changes in employment N_t of both native workers and expellees, unemployment U_t, non-participation R_t, and into net migration $G_t - G^\star_t$. Cumulating equation (69) over the time horizon T yields $\sum_{t=0}^{T} X_t = \sum_{t=0}^{T}(\Delta N_t + \Delta U_t + \Delta R_t + G_t - G^\star_t)$ and simplifying the new equation yields

$$\sum_{t=0}^{T} X_t = N_T - N_{-1} + U_T - U_{-1} + R_T - R_{-1} + \sum_{t=0}^{T}(G_t - G^\star_t) \ , \tag{70}$$

where N_T, for instance, denotes region H employment at time T. Subtracting from this equation the corresponding equation in the counterfactual situation yields

$$\sum_{t=0}^{T} X_t = N_T - \widetilde{N}_T + U_T - \widetilde{U}_T + R_T - \widetilde{R}_T + \sum_{t=0}^{T}[(G_t - G^\star_t) - (\widetilde{G}_t - \widetilde{G}^\star_t)] \ , \tag{71}$$

using that initial conditions are the same in the historical and counterfactual situation and that expellee inflow is zero in the counterfactual. After dividing this equation by the cumulative expellee inflow (which reduces to X_0 as long as expellees enter only in period zero), we obtain equation (15) in the main text.

Decomposition for native workers and expellee workers separately. Recall that native population obeys the identity $P_{Nt} = N_{Nt} + U_{Nt} + R_{Nt}$ and evolves as $P_{Nt} = P_{Nt-1} + G^{\star}_{Nt} - G_{Nt}$. Combining both equations yields that $\Delta N_{Nt} + \Delta U_{Nt} + \Delta R_{Nt} + (G_{Nt} - G^{\star}_{Nt}) = 0$, because the native population in region H changes only as native workers move. We subtract from this equation the corresponding equation in the counterfactual situation, cumulate the resulting equation over the time horizon T and divide it by the cumulative expellee inflow. This yields the native decomposition (16). Finally, subtracting the decomposition for native workers (16) from the decomposition for native workers and expellees (15) yields the decomposition for expellee workers.

F Expected discounted lifetime labor income

F.1 Expected discounted lifetime income of the average worker

The EDI of the average native worker in region H, denoted by Z_{Nt}, weighs the value of working by the (regional) share of natives who are employed, $(L_{Nt} - U_{Nt})/P_{Nt}$; the value of unemployment by the share of natives who are unemployed, U_{Nt}/P_{Nt}; and the value of non-participation by the share of native workers who are non-participating, $(1 - L_{Nt}/P_{Nt})$:[46]

$$Z_{Nt} = \frac{L_{Nt}}{P_{Nt}} \left[\left(1 - \frac{U_{Nt}}{L_{Nt}}\right) W_t + \frac{U_{Nt}}{L_{Nt}} Q_t \right] + \left(1 - \frac{L_{Nt}}{P_{Nt}}\right) H_t \ . \tag{72}$$

We compute a corresponding measure, $Z^{\star}_{Nt}$, for the average native worker in region L. The EDI of the average native worker in both regions weighs Z_{Nt} and $Z^{\star}_{Nt}$ by their population shares:

$$\overline{Z}_{Nt} \ = \ (P_{Nt} Z_{Nt} + P^{\star}_{Nt} Z^{\star}_{Nt})/(P_{Nt} + P^{\star}_{Nt}) \ . \tag{73}$$

[46] To recover value W_t from value differentials, we use the equation

$$(1-\lambda) W_t \ = \ w_t + (1-\lambda)\beta W_{t+1} - \lambda \Omega_t.$$

which maps the differential Ω_t into W_t given wages. This equation follows from subtracting λW_t from both sides of equation (40) and using a linear transformation for W_t to absorb the constant term. Values $Q_t, W^{\star}_t$, and Q_t then follow from the definitions of value differentials.

F.2 Expellee labor income

Akin to native labor income in equation (72), expellee labor income in region H is defined as

$$Z_{Xt} = \frac{L_{Xt}}{P_{Xt}} \left[\left(1 - \frac{U_{Xt}}{L_{Xt}}\right) W_t + \frac{U_{Xt}}{L_{Xt}}\, Q_t \right] + \left(1 - \frac{L_{Xt}}{P_{Xt}}\right) H_t \ .$$

We compute a corresponding measure, $Z^{\star}_{Xt}$, for the average expellee worker in region L. The EDI of the average expellee worker in both regions weighs region-specific expellee labor incomes by their population shares, $\overline{Z}_{Xt} = (P_{Xt}Z_{Xt} + P^{\star}_{Xt}Z^{\star}_{Xt})/(P_{Xt} + P^{\star}_{Xt})$.

G Counterfactual immigration experiments

This section provides further details on the three counterfactual experiments we conducted.

A. Counterfactual initial regional distribution of expellees. Counterfactual experiment A. either distributes all expellees into Region H, or distribute expellees so that regional inflow rates, X_0/P_{-1} and $X^{\star}_0/P^{\star}_{-1}$,[47] are identical.[48] Identical inflow rates imply that $X_0/(X_0 + X^{\star}_0)$ equals $P_{-1}/(P_{-1} + P^{\star}_{-1})$ and thus 0.35. In our model, the distribution with equal inflow rates mimics today's policy of distributing refugees across German states according to local population size. Similar distribution quotas are also the subject of animated debate within the European Union.

The results in Panel A. of Table A9 suggest that sending all expellees to region H reduces the income loss of the average native worker, as measured by the overall treatment effect on the EDI, from 1.51% in the historical scenario to 1.24% (see column (1); the first panel in the table replicates the results of the historical scenario). This perhaps surprising result is due to the fact that with a preference for the current region of residence, native inhabitants in region L are partly shielded from the expellee inflow to region H. Distributing all expellees to region H, in which there are relatively few native inhabitants, maximizes the number of natives shielded from the negative effects of immigration. In contrast, the income loss of the average expellee, as measured by the percentage difference between the EDI of the average expellee (defined in Appendix F.2) and the EDI of the average native in the case without any expellees, increases

[47] We denominate regional inflow rates by P_{-1} and $P^{\star}_{-1}$ rather than P_0 and $P^{\star}_0$ to ensure that they are exogenous.

[48] Recently, Braun and Dwenger (2020) have used empirical reduced-form estimates to simulate the regional distribution of expellees that maximizes their participation in the labor force. In contrast to our work, Braun and Dwenger (2020) focus on expellee outcomes only and abstract from adjustment dynamics.

from 2.83% to 4.43% when all expellees are distributed to region H (column (4)). This is because all expellees then start in the congested labor market of region H with a small probability of finding a job quickly.

The income loss of the average native worker in both regions increases (to 1.66%) when expellees are distributed in proportion to the initial native population in each region. The proportional distribution of expellees is thus worse than the historical distribution from the perspective of the average native worker in our model.[49] The income loss of expellees, in contrast, is considerably smaller (at 2.18%) in that case. Our results also show that a proportional distribution levels out regional differences in unemployment (columns (8) and (9)).

Panel A. of Table A9 also shows that we observe the longest duration of adjustment when all expellees are distributed to region H, and the shortest duration when expellees are distributed proportionally (column (5)). The duration of adjustment is measured by the number of quarters that it takes for 90% of the overall treatment effect to be realized. Distributing all expellees to the less populous region H maximizes internal migration incentives, and thus increases the magnitude and persistence of regional migration flows. By 1965, more than half of the initial increase in the population of region H is absorbed through migration to region L if all expellees are distributed to region H (column (10)).

B. Gradual inflow of expellees over time. Instead of considering a one-off inflow, Counterfactual B. distributes the expellee inflow over either three or ten years, assuming that quarterly inflow rates, $X_t/(P_t + P_t^\star)$ and $X_t^\star/(P_t + P_t^\star)$, are constant over this period. Gradual intakes of refugees are common practice in many countries today. In 2015, for instance, the UK agreed to take in 20,000 Syrian refugees over a five-year period.

The results in Panel B. of Table A9 suggest that a more gradual inflow of expellees markedly reduces the income loss of native workers. The income loss decreases by 13% when the expellee inflow is distributed over three years, and by almost 30% when the expellee inflow is distributed over ten years (see column (1)). The counterfactual also shows that a more gradual inflow increases the minimum per-period treatment effect and keeps average unemployment rates down. Distributing the expellee inflow over ten years reduces the average unemployment rate in the

[49]Clearly, our analysis abstracts from a number of channels through which the regional distribution of expellees might affect native income. The extreme initial distribution of expellees, for instance, decreases the employment probability of expellees and hence increases their dependency on unemployment benefits. In general equilibrium, native workers will have to finance the benefits of unemployed expellees and thus have an interest in high expellee employment. Such interest is absent in our framework.

first ten years of adjustment from 8.71% to 5.72% in region H and from 4.14% to 2.71% in region L (columns (8) and (9)).

Overall, the counterfactual suggests that a more gradual inflow of immigrants can limit the negative effects of immigration. Of course, our model does not account for the–potentially large–costs of delayed entry for immigrants themselves.

C. Counterfactual locational preferences. Counterfactual C. explores the effects of strong preferences for the home region, hindering inter-regional migration. These preferences are determined by σ_f, i.e., the inverse propensity of workers to migrate. Modifying the strength of these preferences allows us to discern the role of labor mobility in insuring native inhabitants against asymmetric inflow shocks.

The results in Panel C. of Table A9 show that strong home bias shields workers in region L from the negative income effects of regional migration from region H to L. Therefore, the income loss for the average native worker in region L decreases from 1.24% in the historical scenario to 0.24% (column (3)). Conversely, natives in region H suffer in the scenario with strong home bias, as workers are no longer able to evade the poor labor market conditions in region H by moving to region L. Consequently, the income loss for the average native worker in region H increases from 2.03% to 3.45% (column (2)).

Table A9: Counterfactual immigration experiments

	Overall treatment effect on EDI (in %) of native in			Income of avg. expellee[1] (in %)	Duration of adjustment[2] (# quarter)	Minimum per-period treatment effect[3] (in %) of average native in		Avg. unemployment rate 1950.Q1 to 1959.Q4 (in %)		Migration as adjustment margin[4]
	Both regions	Region H	Region L			Region H	Region L	Region H	Region L	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Historical scenario	−1.51	−2.03	−1.24	−2.83	38	−6.64	−5.14	8.71	4.14	34.45
A. Initial regional distribution of expellees										
$\frac{X_0}{X_0+X_0^\star} = 0.352$	−1.66	−1.34	−1.83	−2.18	41	−5.49	−6.77	5.84	5.73	5.79
$\frac{X_0}{X_0+X_0^\star} = 1$	−1.24	−2.40	−0.64	−4.43	35	−7.13	−3.19	11.46	2.58	55.80
B. Gradual expellee inflow over time										
Over three years	−1.31	−1.88	−1.02	−2.31	44	−6.53	−4.95	8.04	3.75	32.83
Over ten years	−1.07	−1.61	−0.79	−1.97	61	−5.25	−3.46	5.72	2.71	28.06
C. Locational preferences										
High ($\sigma_f = 10000$)	−1.34	−3.45	−0.24	−3.61	32	−7.11	−4.96	11.73	2.37	5.76

Notes: The table shows the effects on various outcome variables of varying the initial regional distribution of the expellee inflow (Panel A.), the timing of the expellee inflow (Panel B.) and locational preferences for the home region of residence (Panel C.). Each counterfactual varies only one parameter at a time, keeping all other parameters at the values described in Section 5. [1] The income of the average expellee is the percentage difference between the average expellee's EDI upon arrival and the EDI of the average native in the case without any expellee inflow. [2] The duration of adjustment is the number of quarters that it takes for 90% of the treatment effect in column (1) to be realized. [3] The minimum per-period treatment effect is the minimum of the per-period treatment effect on native income (as described in Section 6.2.2) over the adjustment path. [4] Migration as an adjustment margin is computed as cumulative net migration over the total expellee inflow into region H by 1965.

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