Immigration and Monopsony: Evidence Across the Distribution of Firms

[Preliminary and incomplete]

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Abstract

We argue that immigration can strengthen the monopsony power of firms. If migrants have low reservation wages, immigration will encourage firms to decrease wage offers at the bottom of the wage distribution. This allows them to profit from cheaper migrant labor, but at the cost of foregoing native employment (due to natives' higher wage demands). This monopsonistic trade-off can generate large negative effects on native employment, which greatly exceed those in competitive models. We validate these predictions using firm-level evidence from a large immigration wave in Germany, and we corroborate our findings using more aggregated data from the US. These adverse labor market effects are not inevitable, and may be ameliorated through policies which constrain monopsony power.

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1 Introduction

The labor market impact of immigration is traditionally interpreted in a competitive framework, where workers earn their marginal product. In these models, the effects depend on how immigration shifts the relative supply (and hence prices) of different factors of production, whether skill labor inputs or capital. However, if firms have monopsony power, the impact of immigration will depend additionally on the reservation wages of migrants. In this paper, we explore the implications for pay and employment across the distribution of firms, both theoretically and empirically. These implications are crucial for designing effective immigration policy, and can help to reconcile conflicting results in the empirical literature.

Our basic insight is simple. Consider a distribution of firms offering different wages to productively identical workers, as in Albrecht and Axell (1984) or Burdett and Mortensen (1998). If migrants have low reservation wages, immigration will encourage firms to drop to and decrease wages at the bottom of the offer distribution. This action is not costless: if firms cannot perfectly wage discriminate, they will have to forego potential native hires who demand higher wages; but the trade-off becomes increasingly profitable as the migrant population expands. If migrants' reservation wages are sufficiently low, such firms may even profit by reducing their employment overall.

More generally though, this model admits the possibility of large negative effects on native employment which greatly exceed those in competitive models. Intuitively, under perfect competition, any adverse wage effect must be accompanied by an *expansion* of total employment, as firms move down their labor demand curves: the crowding-out of native workers is at most partial. But under monopsony, wage cuts may alternatively reflect movement down firms' *supply* curves, as they forego native employment to exploit cheaper migrant labor. These effects are amplified if migrants' low reservations facilitate the entry of unproductive firms and the creation of "bad jobs" (in the language of Acemoglu, 2001).

To test these predictions, we study a large and sudden influx of predominantly young and low-educated migrants from Eastern Bloc countries to Germany beginning in the late 1980s, following the collapse of the Iron Curtain. We are not the first labor economists to study this event (see e.g. Angrist and Kugler, 2003*b*, D'Amuri, Ottaviano and Peri, 2010, Brücker and Jahn, 2011, Dustmann and Glitz, 2015 and Bruns and Priesack, 2019), but we pose different questions and rely on different variation. The setting offers a number of advantages that aid causal identification, including the sudden onset of the migration influx, its large size, and its dependence on external "push factors".

Moreover, the influx was accompanied by a fierce political debate on firms' alleged ex-

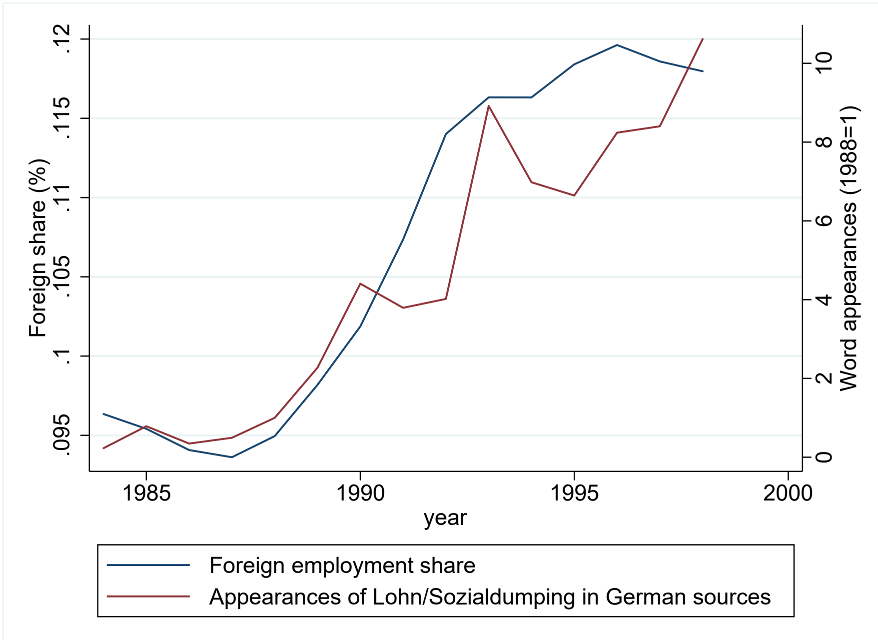


Figure 1: References to *Lohndumping* or *Sozialdumping* in printed German sources

Notes: Foreign employment share computed using the Sample of Integrated Labour Market Biographies (SIAB): see below for data description. Word appearances taken from Google Ngram: these are counts in German printed sources, expressed as a share of total words in the database (and then indexed to 1 in 1988). *Lohndumping* is typically translated as "wage dumping", and *Sozialdumping* as "social dumping".

ploitation of migrant labor at excessively low wages. Indeed, new words were popularized to desribe the phenomenon: *Lohndumping* ("wage dumping" in English) and *Sozialdumping* ("social dumping").[1] As Figure 1 shows, references to *Lohndumping* and *Sozialdumping* in printed German sources took off at precisely the time of the immigration wave we study. This setting therefore appears well suited to study how access to "cheap" migrant labor affects firm behavior and labor markets.

To estimate the impact of the shock, we exploit spatial variation in migrant inflows across local labor markets in West Germany, identified by pre-existing migrant enclaves (as in Altonji and Card, 1991; Card, 2001). The availability of detailed administrative registers for both workers and establishments allow us to address selection and other potential threats to identification, such as the coincident inflow of ethnic (repatriate) and East Germans. As the model predicts, the new migrants disproportionately concentrate in small low-paying

[1] The *Lohndumping* neologism appears to be based on a misunderstanding of the English term "price dumping", a form of predatory behavior in which products are "dumped" en masse into a market to increase market share or to drive out competition. The term "wage dumping" however sounds peculiar to native English speakers, since wages cannot be "dumped" in a figurative sense as products can (see also Sewell, 2010, https://translationpost.com/2010/02/11/lohndumping/).

firms. Firms respond by concentrating at the bottom of the wage distribution, and shedding native workers. On average, total firm employment contracts. These findings are difficult to rationalize in a competitive labor market, but are broadly consistent with a monopsonistic environment where migrants have low wage demands. In the final part of the paper, using (publicly accessible) local-area data, we show that immigration has similar negative effects on firm size in the US.

One *cannot* conclude from these results that immigration is generally harmful for native workers. Instead, our model suggests that the impact of immigration depends heavily on migrants' reservation wages and the institutional context (and not just on migrants' skill mix, as in competitive models). This may also help explain why different studies reach different conclusions. A growing number of studies find remarkably large negative employment effects, in settings with low-paid immigrants: see e.g. Dustmann, Schoenberg and Stuhler (2017) and Bruns and Priesack (2019) on Germany, Muñoz (2021) on France, and Delgado-Prieto (2021) on Colombia. In particular, Muñoz finds that low-paid "posted workers" (temporary foreign labor from low-income countries) displace French workers one-for-one.

Moreover, since the wage cuts are driven by firms' monopsony power, the policy implications are very different from competitive models. The potentially harmful effects of immigration may be mitigated through policies which target monopsony power directly (rather than by restricting immigration itself), such as a minimum wage[2] (see e.g. Edo and Rapoport, 2019) or a regularization policy (e.g. Monras, Vázquez-Grenno and Elias, 2020; Amior and Manning, 2020). These considerations are especially important for European governments, as they seek to absorb a large number of refugees into the labor market over the coming years.

Our paper is closely related to Amior and Manning (2020), who also study the impact of immigration in a monopsonistic framework. But the focus here is different. While Amior and Manning consider the *aggregate-level* effects of immigration on wages (across the skill distribution), we consider the impact across the distribution of *firms* (using regional variations). This focus on firms allows us to draw new insights for the impact on *employment*, and not just on wages (in contrast to Amior and Manning); and we offer an equilibrium model which clarifies how these effects materialize.

Our hypothesis rests on the claim that migrants have low reservation wages. On this point, we draw on a large and growing literature. Several papers show (like us) that migrants

[2]When a minimum wage was finally introduced in German in 2015, Dustmann et al. (2020) find that low-wage workers benefited partly by moving to larger higher-paying firms (at no cost to total employment).

concentrate in smaller and/or lower-paying firms (Aydemir and Skuterud, 2008; De Matos, 2017; Dustmann, Ku and Surovtseva, 2019; Arellano-Bover and San, 2020; Dostie et al., 2020), consistent with lower reservations. Others offer evidence that firms impose larger mark-downs on migrants' wages (Nanos and Schluter, 2014; Hirsch and Jahn, 2015; Caldwell and Danieli, 2018; Amior and Manning, 2020). Low reservations may be rationalized in different ways. Migrants may face greater liquidity constraints and less access to welfare benefits; their reference point may relate to their country of origin (Constant et al., 2017; Akay, Bargain and Zimmermann, 2017), whether for psychological reasons or because of remittances (Albert and Monras, 2018; Dustmann, Ku and Surovtseva, 2019); or they may discount their time in the host country more heavily, because they intend to return (Amior, 2017; Adda, Dustmann and Görlach, forthcoming), binding visa time limits, or deportation risk.

Our paper also contributes to a growing literature on the firm-level effects of immigration: see e.g. Dustmann and Glitz, 2015; Kerr, Kerr and Lincoln, 2015; Mitaritonna, Orefice and Peri, 2017; Beerli et al., 2021. In particular, Malchow-Moller, Munch and Skaksen (2012) find that migrant employees depress native wages within Danish firms; and they argue that one possible explanation is their low reservations. Taking a more theroretical approach, Chassamboulli and Palivos (2013; 2014), Chassamboulli and Peri (2015), Battisti et al. (2017) and Albert (forthcoming) explore how migrants' reservations can affect wage bargains and job creation. And Naidu, Nyarko and Wang (2016) show how a UAE reform which relaxed restrictions on job mobility boosted the wages of incumbent migrant employees and improved firm retention.

Our findings are also pertinent to the broader question of the distributional effects of immigration. In particular, Dustmann, Frattini and Preston (2012) study the local effects of immigration along the native wage distribution; and Card (2009) and Gould (2019) estimate effects on residual inequality. In our paper, we highlight the role of firms in shaping distributional effects, independently of changes in worker productivity. This focus is in line with recent work by Card, Heining and Kline (2013) and Song et al. (2019) on firm effects in earnings inequality.

In the next section, we set out our theoretical model. Section 3 describes the labor market experience of early 1990s immigrants in Germany, and describes the identification of regional immigration shocks. Section 4 tests the predictions of the model, using this regional variation. Finally, in Section 5, we turn to the US evidence, based on local-area aggregates.

2 Model

Our key theoretical arguments can be derived from standard wage-posting models of the labor market. Following the framework of Albrecht and Axell (1984), we set out a frictional labor market model with monopsonistic wage posting and heterogeneous reservation wages in this section. In Appendix B we demonstrate that similar implications can be derived based on the framework by Burdett and Mortensen (1998), which incorporates on-the-job search, *job ladders*, and equilibrium wage dispersion. The models we consider are not new: our contribution is to apply them to the question of immigration, and explore the associated comparative statics. We begin with the minimal ingredients required to describe our basic hypothesis, and we explore a range of extensions afterwards. We do not seek to estimate or calibrate the model: instead, we derive *qualitative* predictions, which we test with German and US data.

Suppose there are n workers and k firms. Firms produce a homogeneous output good whose price is normalized to 1, and labor is the sole factor of production. In the baseline model, we assume the marginal product of labor is fixed at p in all firms (following the exposition of Rogerson, Shimer and Wright, 2005). Each firm chooses its wage w to maximize profit, trading off profit per worker with labor force size.

For now, we assume only the unemployed search for work: they randomly meet firms at rate λ, and accept a wage offer if it exceeds their reservation. At rate δ, workers leave employment through random separations to unemployment. Workers are risk neutral and discount the future at rate r.

A fraction μ of the labor force are migrants. Natives and migrants are productively identical, but differ in their unemployment utility flow: natives receive b_N when unemployed, and migrants b_M, where $b_N > b_M$. One might motivate this assumption by various distinct mechanisms highlighted by the existing literature (see above), and we also present context-specific evidence below.

2.1 Equilibrium in baseline model

For a given distribution F of wage offers, unemployed migrants will have some reservation wage which represents the minimum acceptable offer: we denote this as w_0. And unemployed natives will have their own reservation, which we denote w_1, where $w_1 > w_0$. In equilibrium, no firm will offer a wage other than w_0 and w_1. Intuitively, firms which offer a wage below both reservations recruit no workers; and those which offer above either reservation can benefit by cutting their wage (profit per worker increases, at no cost to employment). The offer distribution can then be summarized by the triple (w_0, w_1, ϕ), where ϕ is the "low-pay sector share", i.e. the share of firms which offer w_0.

Let U_N and U_M denote the present discounted values of unemployed natives and migrants. In equilibrium, these can be expressed in recursive form as:

$$rU_N = b_N + (1-\phi)\lambda\left[E_N(w_1) - U_N\right] \tag{1}$$

$$rU_M = b_M + (1-\phi)\lambda\left[E_M(w_1) - U_M\right] + \phi\lambda\left[E_M(w_0) - U_M\right] \tag{2}$$

where r is the discount rate, and hence rU_N and rU_M are the unemployment flow values for natives and migrants (assuming they have infinite lives). These consist of a basic utility flow (b_N and b_M), plus the expected asset gain associated with job finding. $E_N(w)$ and $E_M(w)$ are the employment values in jobs paying w, for natives and migrants respectively; so these gains are given by $E_X(w) - U_X$, for $X = \{N, M\}$. Workers receive high-wage offers w_1 at rate $(1-\phi)\lambda$, and low-wage offers w_0 at rate $\phi\lambda$. However, only migrants accept w_0 offers, and hence the additional term in (2). The employment values are given by:

$$rE_X(w) = w + \delta\left[U_X - E_X(w)\right] \tag{3}$$

for $X = \{N, M\}$. The flow utility of employed workers consists of their wage w, plus the expected loss associated with job loss, which occurs at rate δ.

Since w_1 is the native reservation, we have $E_N(w_1) = U_N$. Looking at (1), this means that natives enjoy no surplus from finding work, and no loss from an exogenous separation. Using (1) and (3), this implies the native reservation is equal to:

$$w_1 = b_N \tag{4}$$

where b_N is the native unemployment utility flow. Similarly, since w_0 is the migrant reservation, we have $E_M(w_0) = U_M$. Using this, (2) and (3), we can solve for w_0:

$$w_0 = \frac{(r+\delta)\,b_M + (1-\phi)\lambda b_N}{r+\delta+(1-\phi)\lambda} \tag{5}$$

which is a weighted average of the native and migrant unemployment utility flows, i.e. b_N

and b_M. The steady-state native and migrant unemployment rates are given by:

$$u_N = \frac{\delta}{\delta + (1-\phi)\lambda} \tag{6}$$

and

$$u_M = \frac{\delta}{\delta + \lambda} \tag{7}$$

respectively, where ϕ is the share of firms in the low-pay sector (i.e. the share which offer w_0). Native unemployment u_N exceeds migrant unemployment u_M if some firms offer w_0: i.e. if $\phi > 0$.

It remains to solve for ϕ. To this end, we turn to the firm's problem. Consider a firm which offers w_0. This firm will face a labor inflow of $\frac{\lambda}{k} u_M \mu n$ and outflow of $\delta l(w_0)$, where $l(w_0)$ is the firm's steady-state labor force. Equating the two, and using (2), we have: $l(w_0) = \frac{n}{k} \cdot \frac{\lambda\mu}{\delta+\lambda}$. The associated profit is then:

$$\begin{aligned} \pi(w_0) &= (p - w_0)\, l(w_0) \\ &= \frac{n}{k} \cdot \frac{\mu\lambda}{\delta+\lambda} \cdot \frac{(r+\delta)(p-b_M) + (1-\phi)\lambda(p-b_N)}{r+\delta+(1-\phi)\lambda} \end{aligned} \tag{8}$$

Similarly, consider a firm which offers w_1. The firm will have inflow $\frac{\lambda}{k}[u_M\mu + u_N(1-\mu)]n$ and outflow $\delta l(w_1)$. Equating the two, and using (1) and (2), the steady-state labor force is: $l(w_1) = \frac{n}{k}\left[\frac{\mu\lambda}{\delta+\lambda} + \frac{(1-\mu)\lambda}{\delta+(1-\phi)\lambda}\right]$. So the associated profit is:

$$\begin{aligned} \pi(w_1) &= (p - w_1)\, l(w_1) \\ &= \frac{n}{k}\left[\frac{\mu\lambda}{\delta+\lambda} + \frac{(1-\mu)\lambda}{\delta+(1-\phi)\lambda}\right](p-b_N) \end{aligned} \tag{9}$$

As Rogerson, Shimer and Wright (2005) show, there is a unique equilibrium which can take one of three forms:

1. $\pi(w_1) = \pi(w_0)$, and firms offer different wages (i.e. $0 < \phi < 1$)

2. $\pi(w_1) > \pi(w_0)$ and all firms offer w_1 (i.e. $\phi = 0$)

3. $\pi(w_1) < \pi(w_0)$ and all firms offer w_0 (i.e. $\phi = 1$)

The equilibrium form depends on the parameter values. As we show in Appendix A, the low-pay sector share ϕ is determined in the following way:

$$\phi = \begin{cases} 0 & \text{if } \tilde{\mu} \leq \frac{r+\delta+\lambda}{r+\delta} \\ \frac{\delta+\lambda}{\lambda}\left[1 - \frac{r}{(r+\delta)\tilde{\mu}-(\delta+\lambda)}\right] & \text{if } \tilde{\mu} \in \left(\frac{r+\delta+\lambda}{r+\delta}, \frac{\delta+\lambda}{\delta}\right) \\ 1 & \text{if } \tilde{\mu} \geq \frac{\delta+\lambda}{\delta} \end{cases} \tag{10}$$

where

$$\tilde{\mu} = \frac{\mu}{1-\mu} \cdot \frac{b_N - b_M}{p - b_N} \tag{11}$$

(10) shows that ϕ is weakly increasing in the $\tilde{\mu}$ parameter. Intuitively, firms are more likely to offer w_0 if (i) there are many migrants (μ large) and (ii) if the migrant reservation b_M is small relative to b_N. Both these conditions ensure it is profitable to price out native labor.

In the absence of immigrants ($\mu = 0$), the $\tilde{\mu}$ parameter in (11) will equal zero; and (10) shows that no firms will offer the low wage ($\phi = 0$). A small increase in μ makes no difference. But for sufficiently large μ, $\tilde{\mu}$ will exceed $\frac{r+\delta+\lambda}{r+\delta}$, and some firms will begin offering w_0 (i.e. $\phi > 0$). In the region $\phi \in (0, 1)$, i.e. away from the corner conditions, the low-pay sector share ϕ is strictly increasing in $\tilde{\mu}$. And for $\tilde{\mu}$ sufficiently large, all firms will offer the low wage (i.e. $\phi = 1$).

2.2 Comparative statics

We now consider the impact of immigration on a range of outcomes. Though we rely on the Albrecht and Axell (1984) framework, these results are new. Note that, all else equal, equilibrium wages and employment rates are invariant to $\frac{n}{k}$, the ratio of workers to firms. Our strategy is to study changes in the migrant share μ, holding the ratio $\frac{n}{k}$ fixed. In practice, one might expect $\frac{n}{k}$ to change in response to immigration; and we consider this possibility in an extension below.

Proposition 1. *Migrants concentrate in low-paying firms.*

Since migrants have a low unemployment utility flow ($b_M < b_N$), their reservation wage w_0 is lower than the native reservation w_1: see (5). Therefore, as long as some firms offer w_0 (i.e. if $\phi > 0$), only migrants will accept these low offers.

Proposition 2. *A larger migrant share μ induces firms to reduce offers at the bottom of the distribution. This effect is increasing in the $\frac{b_N - b_M}{p - b_N}$ ratio.*

A larger μ increases the $\tilde{\mu}$ parameter in (11); and based on (10), the low-pay sector share ϕ must then expand (away from the corner conditions). Looking at (11), the effect of migrant share μ is increasing in $\frac{b_N - b_M}{p - b_N}$. Intuitively, immigration is more likely to induce firms to price out native labor if migrant labor can be purchased more cheaply (i.e. if $\frac{b_N - b_M}{p - b_N}$ is large). A larger ϕ also reduces the migrant reservation w_0 (see (5)), since migrants are now less likely to receive w_1. However, the native reservation w_1 remains fixed at b_N; so as long as $\phi < 1$, high-wage firms continue to offer (and employed natives continue to earn) w_1. As we show below, native wages may contract under different assumptions; but more generally, it remains true that immigration will reduce wage *offers* more than natives' *realized* wages. Note this distinction between offered and realized wages (for workers of given productivity) does not exist in a competitive model.

Proposition 3. *A larger migrant share μ induces firms to shed native labor at the bottom of the distribution. This effect is increasing in the $\frac{b_N - b_M}{p - b_N}$ ratio.*

Equation (6) shows that native unemployment u_N is increasing in ϕ. And therefore, given Proposition 2, it must be (weakly) increasing in the migrant share μ; and this effect is increasing in $\frac{b_N - b_M}{p - b_N}$. Intuitively, since native labor is elastically supplied at $w_1 = b_N$, native workers exit employment rather than accepting the lower wages on offer. Note there is no effect on native employment in firms which continue to offer w_1, since they do not drop below the native reservation b_N.

Proposition 4. *A larger migrant share μ may induce firms to reduce their employment overall, and with certainty if the initial μ is sufficiently small.*

Average firm employment can be expressed as $\frac{(1-\bar{u})n}{k}$, where $\bar{u} = \mu u_M + (1 - \mu) u_N$ is the average unemployment rate (across all workers), and u_N and u_M are the native and migrant unemployment rates respectively. Taking the worker-firm ratio $\frac{n}{k}$ as given, the elasticity of firm employment is therefore equal to the elasticity of $1 - \bar{u}$, which can be expressed as:

$$\frac{d \log (1 - \bar{u})}{d\mu} = \underbrace{\frac{u_N - u_M}{1 - \bar{u}}}_{\text{Composition effect}} \underbrace{- (1 - \mu) \cdot \frac{u_N}{1 - \bar{u}} \cdot \frac{d \log u_N}{d\mu}}_{\text{Wage-setting effect}} \tag{12}$$

The sign of this elasticity is ambiguous: it depends on the relative size of two countervailing effects. The first is a positive "composition effect": for a given wage offer distribution, a larger migrant share μ increases firm employment, because migrants (with low reservations) accept more offers than natives.

The second is a negative "wage-setting effect": a larger μ induces firms to drop into the low-pay sector (i.e. cut their offers from w_1 to w_0), which reduces native employment and hence employment overall (all else equal). This effect arises from the wage-employment trade-off, which is the essential feature of monopsony. For the marginal firm which drops from w_1 to w_0, the larger profit per worker they gain by cutting wages must be offset by an employment loss. Since the wage-setting effect is particular to monopsony, an overall reduction of firm employment must be attributed to monopsony power.

The wage-setting effect will dominate (and firm size will contract on average) if the initial migrant share μ is sufficiently small. This ensures ϕ is close to 0 (few firms offer w_0), so native unemployment u_N is close to migrant unemployment u_M, and the composition effect is close to zero: see equation (12).

2.3 Theoretical extensions

The model we present above clarifies our main theoretical points, but it is very stylized. We now consider a number of theoretical extensions. Some of these amplify the effects we describe above, and some diminish them.

(i) Heterogeneous native reservations. The baseline model rules out any impact on realized native wages. This is because natives supply labor perfectly elastically at w_1 (which is fixed at their reservation, b_N). But this need not bear out under more general assumptions. For example, suppose some fraction of natives share the same unemployment utility flow as migrants, i.e. b_M. Then, the impact of immigration on native employment will be smaller (some natives will accept w_0 offers), and their wages will also contract on average (for the same reason). Having said that, there may be significant institutional constraints on wage-setting in certain labor markets (see e.g. Dustmann et al., 2014, on Germany), which limit the flexibility of native wages. If these constraints are not properly enforced for migrant labor (see e.g. Angrist and Kugler, 2003*b*; Cyrus and Helias, 1993), then the basic model with all natives demanding b_N (and migrants $b_M < b_N$) may offer a reasonable fit.

(ii) On-the-job search. In the baseline model, we rule out on-the-job search. But as we show in Appendix B, we can account for this by applying the framework of Burdett and Mortensen (1998). Rather than a single low wage w_0, the low-pay sector will now consist of a continuous distribution of wage offers (between b_M and b_N), as firms compete directly with one another for employees. Similarly, the high-pay sector will consist of a continuous distribution of offers exceeding b_N. The basic propositions above are unaffected. However, we do now see a native wage effect, even in the basic case with perfectly differentiated reservations (i.e. with all migrants receiving b_M in unemployment, and all natives b_N): when firms drop into the low-pay sector (following an immigration shock), this increases monopsony power in the high-wage sector, so firms are able to extract greater rents from natives (whose wages converge towards b_N).

(iii) Differential discount rates r. Above, we assume that natives and migrants share the same discount rate, r. However, one might expect migrants to discount their time in the host country more heavily: for example, they may intend to return to their country of origin, or face some deportation risk (if they are undocumented). This amplifies the effects on wage offers (Proposition 2) and native employment (Proposition 3), since the migrant reservation w_0 will now be lower: for $b_M < b_N$, (5) shows that w_0 is decreasing in r.

(iv) Differential contact rates λ. Above, we have assumed that natives and migrants differ only in their reservations. But they may also might meet firms at different rates λ. For example, Caldwell and Danieli (2018) find that migrants in Germany have fewer outside job options than natives. If migrants have a lower λ (e.g. because of language difficulties or poor integration into the labor market), they are less likely to meet high-wage firms; and if $b_M < b_N$, their reservation w_0 will therefore be lower: see equation (5). However, a low migrant contact rate λ also makes it harder for firms to access them, which will diminish competition between natives and migrants.

(v) Downward-sloping labor demand. In the baseline model, we assume the marginal product of labor is fixed at p. But suppose instead there are diminishing returns to labor, perhaps because of a rigid capital stock. Any growth in firm employment (as in Proposition 4) will then be accompanied by downward pressure on wages, and vice versa. In a competitive model (where there is no wage-setting effect), any contraction in wages must then be accompanied by an expansion of firm employment.

(vi) Endogenous $\frac{n}{k}$ and contact rate λ. In the baseline model, we take the ratio of workers n to firms k as given. But there are reasons to believe this ratio might change. First, $\frac{n}{k}$ may contract if the stock of firms k is rigid, and immigration causes the labor force n to expand: all else equal, this will contribute to a mechanical expansion of firm size. On the other hand, if firms are free enter, the growth of monopsony rents may cause k to expand in equilibrium relative to n; and this may also shift the contact rate λ (if it is endogenous to market tightness). We explore this possibility more formally in Appendix C. We show the introduction of free entry (and endogenous contact rates λ) makes no difference to the impact of immigration in the basic model above. Once we account for on-the-job search however, an elastic supply of firms does moderate the adverse effects of immigration, though

Propositions 1-4 are qualitatively unaffected.

(vii) Heterogeneous firms. In the baseline model, we assume all firms have identical productivity p. But suppose instead that firms vary in their productivity. As we show in Appendix D, the impact of immigration on wages and employment are qualitatively unchanged, but the effects are amplified. As in Albrecht and Axell (1984), less productive firms will offer lower wages in equilibrium: this is because they maximize profit at lower levels of employment; and lower wages are sufficient to achieve this. This also means they will will drop into the low-pay sector (from w_1 to w_0) much more readily, in response to immigration; and this amplifies any impact on wages offers and native employment. In an environment with free entry, immigration may also induce Melitz-type (2003) selective entry of low-quality firms, which would be unable to operate without low-reservation labor.[3] This selective entry will amplify the wage and employment effects still further; and since the new entrants are less productive (and hence smaller), any negative impact on mean firm size will also be amplified.

(viii) Native exit. In parallel to selective entry of firms, we might also expect selective exit of workers. The baseline model predicts that native labor suffers a contraction of employment. In response, natives may exit the labor force (e.g. early retirement) or relocate elsewhere (if the immigration shock is spatially concentrated). This reduces the share of high-reservation workers in the labor force, and the migrant share μ expands further. This encourages more firms to drop into the low-pay sector, so even more natives exit, and so on: the labor market becomes ever less competitive, and empties out its workforce. These effects may be reinforced further by selective entry of low-quality firms. See also Manning (2010), who attributes the concentration of low-quality firms in smaller cities to local monopsony power.

(ix) Wage discrimination and efficiency. Until now, we have assumed individual firms are unable to pay different wages to natives and migrants (doing identical work). This is a source of inefficiency: firms forego native employment (in response to immigration), even though natives are willing to work at a wage below their marginal product p. But to the extent that firms *can* wage discriminate, any impact on wage offers and native employment is diminished; and in the case of perfect discrimination, the effects are entirely eliminated (see Amior and Manning, 2020). In a monopsony model like ours, this would involve firms recruiting migrants at w_0, while retaining their native employees (doing identical work to

[3] See Dustmann et al. (2020) for evidence on how a larger minimum wage forces low-quality firms out of the market.

the new migrant hires) at w_1. Alternatively, perfect discrimination may arise implicitly in random matching frameworks where wages are bargained ex post (after contact occurs) between individual firms and workers (as in e.g. Chassamboulli and Palivos, 2013; 2014, Chassamboulli and Peri, 2015, and Battisti et al., 2017): in standard expositions, this form of bargaining protects natives from any direct competition with migrant labor; though see Albert (forthcoming) for a more complex bargaining model which does account for direct competition. In practice, our estimates suggest that new immigrants in our German application were paid similarly to natives within firm-occupation cells: this suggests there was no substantial pay discrimination, at least in this context.

3 German immigration shock

In this section, we provide a detailed account of the immigration shock that affected the German labor market in the late 1980s and early 1990s. We first describe national trends in the composition of the workforce and compare the characteristics of recent immigrant arrivals to earlier migrants and native workers. We then describe the spatial distribution of migrants and discuss potential confounders of our empirical strategy, which exploits variation in immigrant arrivals across local labor markets.

3.1 Data

Our two main data sources are the Sample of Integrated Labour Market Biographies (SIAB) and the Establishment History Panel (BHP), both provided by the Institute for Employment Research (IAB) in Nuremberg. We use weakly anonymized versions of these data sets, which can be accessed during on-site stays at a Research Data Center of the IAB or via remote data execution. We augment our analysis with aggregate, complete-count information on the distribution of foreign nationals across German districts provided by the Federal Employment Agency's statistical service (*Bundesagentur für Arbeit Statistik*) as well as information on internal population flows provided by the Federal Statistical Office of Germany. For our main analysis, we aggregate all data sources to 204 local labor markets (BBSR, 2015). For robustness tests, we also repeat our analysis on the finer *district* level (*Landkreise* and *kreisfreie Staedte*), with similar results.

3.1.1 Sample of Integrated Labour Market Biographies (SIAB)

To study the individual characteristics of migrant and native workers, we use the Sample of Integrated Labour Market Biographies (SIAB 7510), a 2% subsample of the universe of all dependent employees subject to social security contributions (Vom Berge, Burghardt and Trenkle, 2014). The data are representative for more than 80% of the German workforce, but exclude civil servants, the self-employed, full-time students, and the military.[4] The SIAB integrates information from different administrative sources to provide complete labor market biographies of sampled workers, starting in 1975. This panel information is a key advantage compared to cross-sectional data sources.[5]

We restrict our sample to individuals aged 16-65 in West Germany (excluding West Berlin). For the analysis of employment we consider both full- and part-time employed. Our employment variables refer to an individual's employment status on June 30 of the respective year. Locations are defined based on place of work rather than place of residence. Wages are identified by the average gross daily wage in the employment spell that contains this reference date. We restrict the analysis of wages to full-time workers, including trainees. Wages are right-censored at the social security contribution ceiling (less than 6 percent of all observations). Following Dustmann, Ludsteck and Schönberg (2009), we impute censored wages under the assumption that the error term is normally distributed, while allowing for a different residual variance by gender and year. We further impute missing educational information, implementing a procedure developed by Fitzenberger, Osikominu and Völter (2005).

The data contain nationality rather than place of birth. To account for naturalizations, we identify foreign workers based on the first observed working spell of each worker.[6] Following Brücker and Jahn (2011) and Bruns and Priesack (2019), we identify Ethnic Germans based on information contained in the SIAB on the receipt of special language courses and other integration programs. As East Germans migrating from East to West Germany cannot be reliably identified in the SIAB, we augment our analysis using information on internal

[4]The exclusion of these groups is not a major concern for our analysis. The self-employment rate of natives has remained fairly stable in our analysis period, and immigrant arrivals are unlikely to displace civil servants as of legal restrictions (Brücker and Jahn, 2011).

[5]Most importantly, we can control for individual fixed effects to address compositional changes that bias wage estimates from repeated cross-sections (Bratsberg and Raaum 2012, Dustmann, Schoenberg and Stuhler 2017, Ortega and Verdugo 2021, Borjas and Edo, 2021*a*). The ability to track workers further allows us to distinguish and compare recent arrivals from previous migrants.

[6]Naturalizations were infrequent in our analysis period, and the group of recently arrived foreign nationals corresponds closely to the group of foreign born (Angrist and Kugler, 2003*a*). Due to legislative changes naturalizations became more frequent after 1998 .

population flows between districts (*Kreiswanderungsmatrix*) from the German Federal Statistical Office. The quality of these statistics is high since both residents and landlords were required by law to (de-)register with the local population registration office during our analysis period.

3.1.2 Establishment History Panel (BHP)

To study the impact of migration across the distribution of firms, we use the Establishment History Panel), which covers half of the universe of establishments subject to social security. We use two different versions of the BHP. We use the BHP-v7510 (Gruhl, Schmucker and Seth, 2012) to construct the regional immigrant shares and instrument, as this version is the last to report employment structure in the establishment by nationality. We use the BHP-v7519 for all other parts of our analysis, as this version contains mored detailed wage information as well as pre-compiled AKM worker and firm fixed effects (as estimated by Bellmann et al., 2020, following Card, Heining and Kline 2013).[7] For each establishment and year, the BHP contains detailed information on employment and the composition of the workforce in terms of skill, demographics and nationality, and the distribution of wages within each establishment. For presentational purposes, we use the terms establishments and firms interchangeably. Compared to the SIAB, the BHP offers two key advantages. First, our focus is on establishment-level outcomes, and the BHP contains complete information on an establishment's entire workforce while the SIAB only contains information on sampled workers.[8] Second, the SIAB only covers 2% of employees, while the BHP contains 50% of all establishments, and therefore enables more precise analysis of the regional evolution of wages and employment.

3.2 National trends in immigration

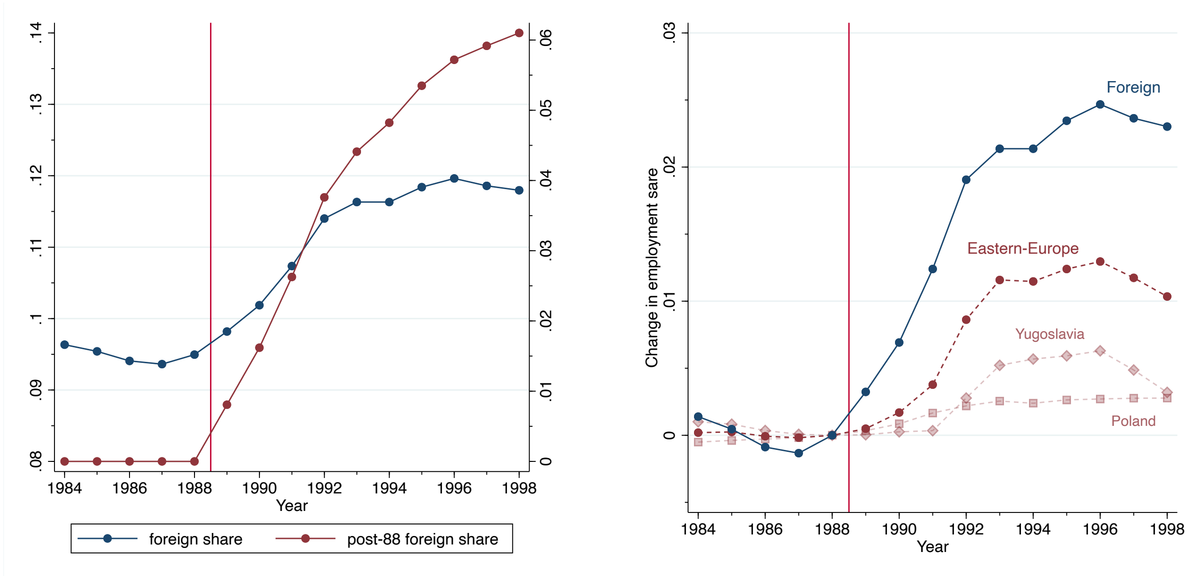
Germany experienced a sharp and large immigration wave during the early 1990s, triggered by the fall of the Iron Curtain as well as other political developments in Europe. As shown in Figure 2a, between 1988 and 1993 the share of foreign nationals in regular employment

[7]Because each version of the BHP contains a separate 50% draw of the full population of establishment a comparison is informative about the robustness of our results. The results from the BHP-v7510 are similar and available upon requests.

[8]However, it is possible to merge establishment characteristics from the BHP to individual records in the SIAB (*BHP Additional Variables*). This allows us to merge the establishment median wages to construct comparable definitions of the firm wage distribution for both SIAB and BHP, and to merge (AKM) establishment fixed effects as estimated on the universe of employment records by Card, Heining and Kline (2013).

Figure 2: Foreign share in employment

(a) Foreign share (b) Change relative to 1988



Notes: SIAB, change in employment shares of different nationalities.

increased from 9.5 to 12 percent (blue line). By 1995, over 5% of the West-German workforce consisted of foreigners who entered after 1988 (red line), corresponding to about 1 million workers. While other European countries also experienced an upturn in migration around this time, the inflow was largest and sharpest in Germany (Angrist and Kugler, 2003*a*). In addition, Germany experienced an inflow of "posted workers" from abroad and other forms of irregular employment not covered by social security, in particular in the construction sector (Werner, 1996). Figure 2b illustrates that a large share of the overall inflow is due to migration from Eastern Europe, in particular from Yugoslavia and Poland.[9] Other important source countries include Turkey, Greece and Romania. As in quasi-experimental settings such as Card (1990) or Dustmann, Schoenberg and Stuhler (2017) these inflows were triggered by external political events or "push factors" (Llull, 2017) that were unrelated to *local* economic conditions in Germany, such as the fall of the Iron Curtain, the Yugoslavian war or the Kurdish-Turkish conflict. However, because the location choice of immigrants within Germany could be affected by local economic trends, we instrument for those location choices based on past settlements (see Section 3.3).[10]

[9] See also Bruns and Priesack (2019), who provide a comprehensive account of these immigrant inflows.

[10] Other studies that combine external push factors with the past settlement instrument include Aydemir and Kirdar (2017), Edo (2020) and Delgado-Prieto (2021).

As shown in Table 1, recent migrants had less education than natives, and were much younger than natives or previous migrants: two thirds were below age 30. They also tended to work in smaller firms: their average establishment size is little more than half of natives'. The contrast is even more striking when comparing recent to previous migrants (which includes the guest worker generation), who often worked in large establishments in manufacturing or other tradable industries.

On average, the wage of recent migrants were 42 log points lower than for natives. Controlling for age and gender more than halves this gap, reflecting the young age of recent arrivals. Further controlling for education and occupation we still observe a wage gap of 9 log points: foreign workers receive lower wages than natives even conditional on their qualifications and occupational position. Conditioning additionally on firm-fixed effects effects, however, nearly eliminates the foreign wage penalty. That is, native and new foreign workers doing similar jobs in the same firm are paid similarly on average: the foreign wage penalty stems primarily from differences in wage setting between firms rather *within*-firm pay discrimination, consistent with the wage-setting mechanism in our theoretical model.

Wage gaps were larger for older workers, who in contrast to young immigrants also experienced sizable within-firm penalties: foreign arrivals aged 30-49 experienced a 9.3 log points penalty (conditional on firm FEs), while the penalty increases to 18.5 log points for workers aged 50 and older.[11] This age pattern could be due to the institutional regulations that restrict pay for young workers (e.g., wage regulations for trainee workers) or reflect the limited transferability of work experience from origin to destination country for older workers. Our estimates refer to foreign workers in regular jobs subject to social security: contemporaneous reports suggest that wages were even lower among foreign nationals not covered by social security, such as "posted" workers (Cyrus and Helias, 1993).[12]

Indeed, as Figure 1 shows, concerns about excessively low pay among foreign workers fueled a public and political debate on *Lohndumping* ("wage dumping"). Ultimately, this debate led to the tightening of immigration restrictions and, in 1997, to the introduction of a minimum wage in the construction sector.

The increase in foreign employment shares was heavily concentrated in certain industries, as shown in Appendix Table A1. The foreign share increased by more than 14 percentage

[11] This observation also explains why Dustmann, Schoenberg and Stuhler (2017) find larger wage penalties for Czech commuters; while foreign arrivals were strongly overrepresented among young workers in our setting (see Table 1), Czech commuters were instead overrepresented among middle-aged workers.

[12] See also Muñoz (2021) on the heavy pay penalties suffered by posted workers in France, following the accession of new EU member states.

Table 1: Characteristics of immigrants

	Natives	Migrants	
		previous	recent
	(1)	(2)	(3)
Female	0.417	0.297	0.357
Education			
low	0.106	0.418	0.379
medium	0.802	0.530	0.562
high	0.093	0.052	0.059
Age			
below 30	0.311	0.170	0.641
30-49	0.469	0.602	0.331
50 and above	0.219	0.228	0.028
Establishment size	1423.7	2346.8	806.0
Wage			
level	4.200	4.246	3.780
gap, raw	–	0.046	-0.420
gap, net of dem	–	-0.074	-0.188
gap, net of dem/edu/occ	–	0.004	-0.088
gap, +establishment FE	–	-0.013	-0.020

Notes: SIAB, mean values for years 1988-95. We define "previous" migrants as those who entered employment before 1988, "recent" migrants entered in or after 1988.

points (by more than 50%) in hotels or restaurants in the hospitality sector, and also increased strongly in agriculture, household and business-related services, and construction.[13] Few migrants entered the public sector or heavily contracting industries, such as mining. Non-tradable industries received a higher share of migrants than tradables, in contrast to earlier migrant cohorts, which were overrepresented in mining, manufacturing and other heavy industries. As shown in Appendix Table A2, migrants earn less than natives in every industry, even after controlling for demographic characteristics and education.

3.3 Regional variation in the immigration shock

As described in Section 4.2, our empirical strategy exploits variation in immigrant arrivals across regions, using the spatial distribution of past immigrant settlements as a predictor

[13] The observed increase of the foreign share in construction was 4.7 percentage points, which is surprisingly low in light of media reports from the time. The likely explanation is that social security and many other data sources exclude subcontracted "posted workers" from foreign firms. Their number was around 90,000 in 1993, with approximately two thirds of the total working in construction (Werner, 1996).

for regional distribution of more recent arrivals.[14] Our aim is to exclude local variation in labor demand shocks. Specifically, we predict the local change in foreign shares based on the distribution of foreign nationals at baseline (following Altonji and Card, 1991; Card, 2001):

$$\Delta m_{r93} = \frac{\sum_o s_{or80} \left(n_{o93} - n_{o88}\right)}{n_{r88}}, \tag{13}$$

where $n_{o93} - n_{o88}$ is the change between 1988 and 1993 in the number of migrant workers of nationality o at the national level, $s_{or80} = \frac{n_{or80}}{n_{o80}}$ is the share of migrants of nationality o located in region r in 1980, and the denominator n_{r88} is employment in region r in the base year 1988.[15] As with all shift-share instruments, identification may be motivated by exogeneity of the initial local nationality shares to omitted shocks (Goldsmith-Pinkham, Sorkin and Swift, 2020), or by exogenous aggregate-level (nationality-specific) migrant inflows (Borusyak, Hull and Jaravel, 2022).

Based on the BHP, Figure 3 plots the distribution of both the predicted change in the foreign share Δm_{r93} and the actual change across 204 local labor market regions in Germany. Sub-figure (a) shows that immigrant arrivals are predicted to be concentrated in and around the largest cities (*Hamburg*, *Cologne*, *Frankfurt, Munich* and *Stuttgart*), but also in some other, less densely populated areas. The correlation between the past settlement instrument and other local characteristics, such as demographic structure or density, is a potential issue for our empirical strategy, which we discuss in the next section.[16] Sub-figure (b) plots the actual change in foreign share. The actual and predicted change are highly correlated, as illustrated in sub-figure (a) of Figure 4; and this correlation is not merely driven by large cities.

As shown in Figure 4(b), this "first-stage" relation is even more pronounced when using the SIAB to construct immigrant arrival *rates* to capture the share of recently arrived immigrant workers rather than the change in migrant stocks. From the perspective of our model, these recent arrivals are likely to play a crucial role in any adverse wage-setting effects: based on the observable wage differentials in Table 1, they may have significantly lower

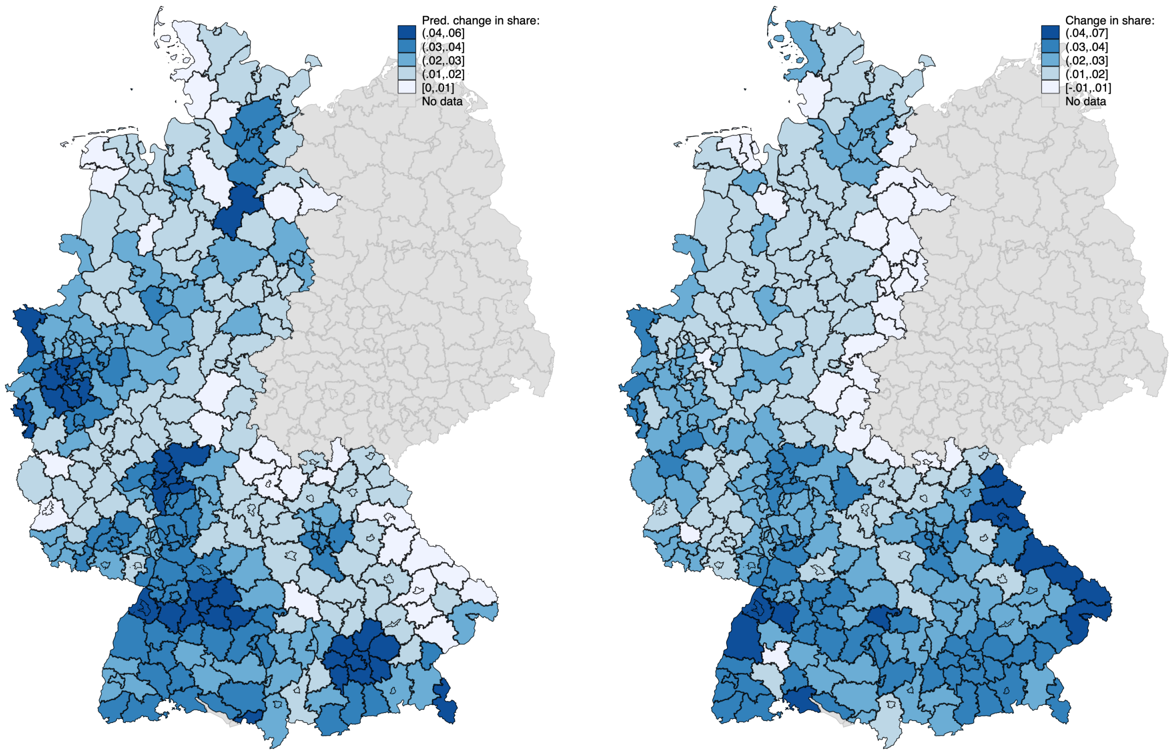
[14]Our identification strategy differs therefore from the strategy chosen in an earlier study of the same immigration wave by Bruns and Priesack (2019), who use distance to the south and east German borders as instruments.

[15]The use of past immigrant shares in 1980 reduces potential bias from serial correlation in demand shocks, but the results remain similar when measuring the local shares s_o in other pre-treatment years or when using external statistics based on full-count employment data to construct the local shares (the latter addressing the potential influence of sampling error; see Aydemir and Borjas, 2011).

[16]Similar issues apply to most other migration studies. For example, metropolitan areas in the US have experienced much greater migrant inflows than rural areas (Albert and Monras, 2018).

Figure 3: Change in foreign share (1988-93)

(a) Predicted (b) Actual



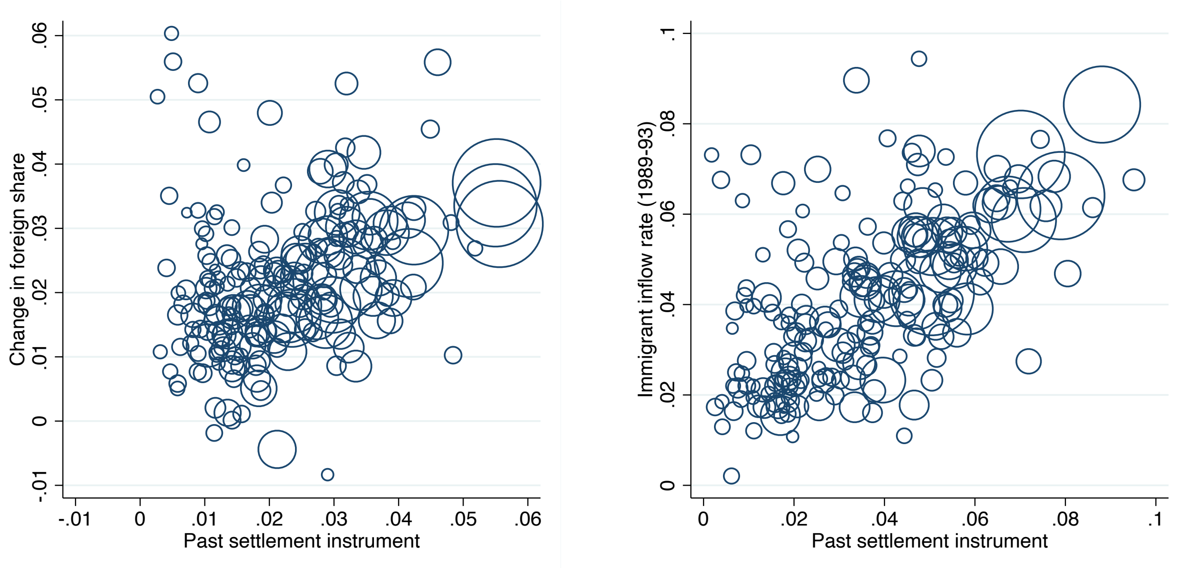
Notes: Establishment History Panel (BHP). Sub-figure (a) plots the predicted change in foreign share between 1988 and 1993 as defined in (13) across 204 local labor markets in West Germany. Sub-figure (b) plots the actual change in foreign share.

reservation wages than natives or previous migrants. However, the change in stocks can be observed in both SIAB and BHP, while recent migrants can be identified only in the SIAB. We therefore use the predicted change in foreign share Δm_{r93} as our instrument (and as our main explanatory variable, as we focus on reduced form estimates in this draft).

While the actual and predicted changes are highly correlated, two major exceptions are visible from a comparison of the two maps (Figure 3). First, the foreign share increases strongly close to the Czech border (in the South-East), in sharp contrast to the predictions based on the past settlement instrument. As described in Moritz (2011) and Dustmann, Schoenberg and Stuhler (2017), this strong inflow was caused by a special commuting policy applying to Germany's border regions, which allowed Czech workers to commute into the German labor market (but not to live in Germany). This pattern is illustrated further in Figure 5(a), which plots the prediction errors from the first stage regression against the past settlement instrument. The most extreme under-predictions are in regions close to the German-Czech border, which are marked red and labelled by their distance from the border

Figure 4: First Stage

(a) Change in foreign share (BHP) (b) Foreign arrival rate (SIAB)



Notes: Sub-figure (a) plots the change in foreign share in each local labor market between 1988 and 1993 against the predicted share defined in 13 in the Establishment History Panel (BHP). Sub-figure (b) plots the foreign arrival rate between 1989-1993 against the corresponding predicted arrival rate in the Sample of Integrated Labour Market Biographies (SIAB). The size of each circle is proportional to total employment in 1988.

(in km).

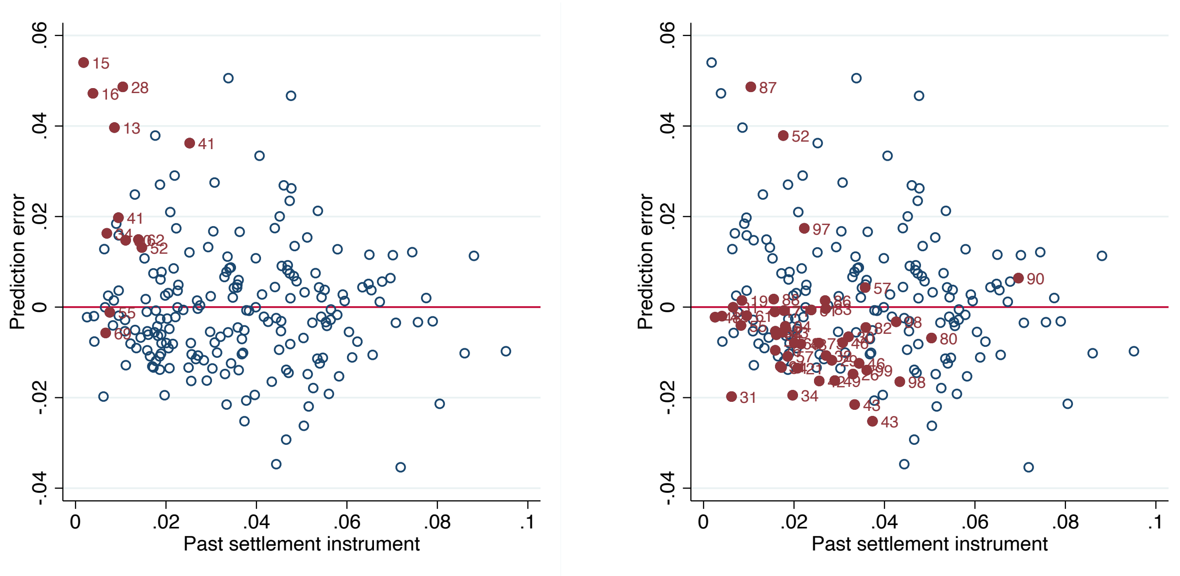
Second, very few foreign workers settle close to the inner German border (i.e. separating East from West Germany): while the past settlement instrument predicts an increase in the foreign share of about 2 percentage points, the actual increase is close to zero. This pattern is illustrated further in sub-figure (b) of Figure 5, in which West German labor markets close to the inner German border are marked with their distance to that border: the change in foreign share is underpredicted in most of these regions. The likely cause is large labor inflows (both migrants and commuters) from East Germany to the West following reunification in 1990: we believe new foreign arrivals avoided these border regions to escape labor market competition with East German arrivals. We provide further evidence on this interpretation in the next section.

3.4 Potential confounders

Our setting offers important advantages: the external determinants of immigrant inflows (triggered by external events), their large size and spatial dispersion, their sharp onset, the stable pre-period in which foreign shares remained steady (allowing for a clean distinction

Figure 5: Prediction Error in First Stage

(a) vs. Czech border (b) vs. East German border



Notes: Sample of Integrated Labour Market Biographies (SIAB). Both sub-figures plot the prediction error from a regression of the foreign arrival rate in each local labor market between 1989 and 1993 against the predicted arrival rate. In sub-figure (a), local labor markets in the German-Czech border region are marked in red and labelled with their distance to the German-Czech border (in km). In sub-figure (b), local labor markets close to the inner German border are labelled with their distance to the inner German border (in km).

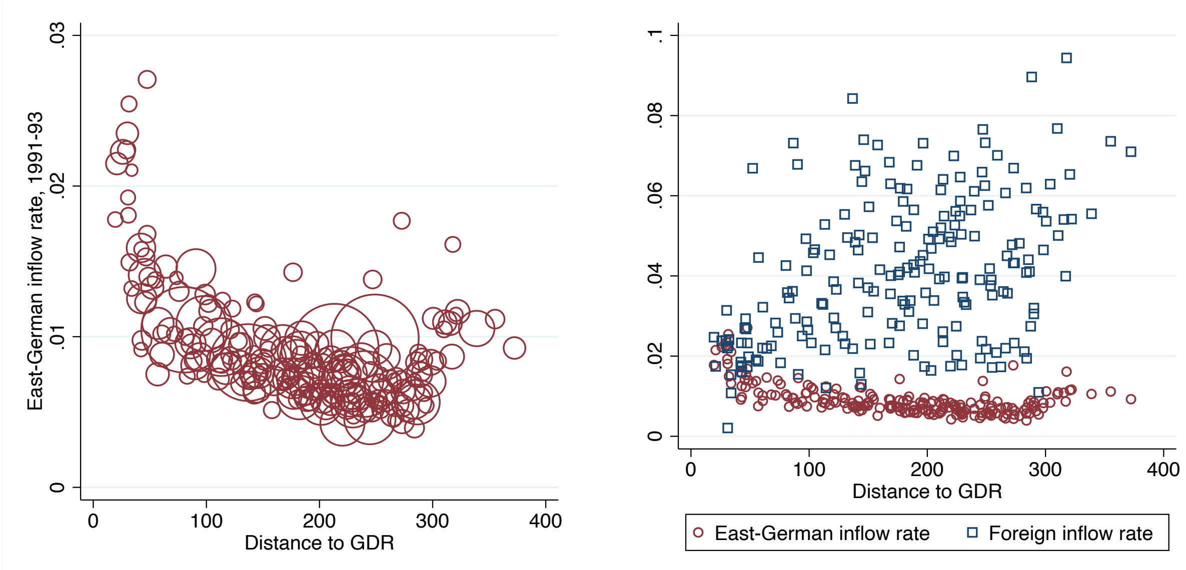
into pre- and post-treatment periods), and the availability of high-quality panel data on both individual workers and establishments. However, Germany was subject to three other major events in our analysis period, which may confound our estimates: (i) German reunification and the accompanying inflow of East Germans into the Western labor market, (ii) the repatriation of ethnic Germans from territories of the former Soviet Union (Glitz, 2012), and (iii) the recession of 1993. Both East and Ethnic Germans had German citizenship, making it harder to identify these groups in our data. The recession may be a concern as it falls in the middle of our analysis period, and may have affected local labor markets differently depending on local industry and demographic structures. We discuss each of these issues in turn.

3.4.1 Reunification and inflows from East Germany

German reunification led to a substantial inflow of East Germans to West German labor markets. While East Germans are not reliably identified in the SIAB, we augment our employment data with information on internal population movements provided by the German Federal Statistical Office. These data contain detailed information on movements between

Figure 6: Comparing East German and Foreign Inflows

(a) East German Inflows (b) East German and Foreign Inflows



Notes: Sample of Integrated Labour Market Biographies (SIAB). Sub-figure (a) plots the inflow rate of East Germans between 1991 and 1993 across local labor markets in West Germany against the distance to the inner German border. Sub-figure (b) plots the the inflow rate of East Germans together with the inflow rate of foreign arrivals between 1989 and 1993.

districts in Germany for each year between 1991 and 1995, making it possible to identify East German population flows for each West German district or local labor market. Figure 6(a) plots these inflows as a share of population in 1988 against the local labor market's distance to the former inner German border. The figure illustrates that distance is the primary determinant of the location choice of East German arrivals, with a correlation between their inflow rate and log distance of -0.67.[17]

Figure 6(b) compares the size of East German and foreign inflows across local labor markets. Two observations stand out. First, foreign inflows are much more variable across regions than East German inflows. While the latter are a relatively smooth function of the distance to the inner German border, foreign inflows are highly variable and not very correlated with distance to that border. Foreign inflows are particularly low along a narrow corridor right at the former border, which was exposed to very large inflows, including commuting flows, from East Germany. Table 2 provides additional evidence. As shown

[17]This result is in line with a similar analysis in Bruns and Priesack (2019), who show that distance to the *Eastern* German border (vs. *inner* German border) predicts the change in the share of East German immigrants in West German regions in the SIAB (as well as in the German *Mikrozensus*). Figure 6 shows that East German inflows are particularly high within an 80km strip from the former inner German border, which is the range that Bruns and Priesack (2019) drop to confirm robustness of their main results.

Table 2: East German vs. Foreign Inflows

	East-German population inflows 1991-93			
	(1)	(2)	(3)	(4)
Δ foreign share 1988-93				
actual	-0.041	0.013		
	(0.021)	(0.018)		
predicted			-0.049*	0.023
			(0.025)	(0.022)
Distance E./W.		-0.004***		-0.004***
		(0.000)		(0.000)
Constant	0.010***	0.028***	0.010***	0.028***
	(0.001)	(0.002)	(0.001)	(0.002)
r2	0.024	0.460	0.032	0.464
N	204	204	204	204

* p<0.10, ** p<0.05, *** p<0.01

Notes: Sample of Integrated Labour Market Biographies (SIAB), regression estimates across 204 local labor markets. The predicted change in foreign share is defined in 13. Distance E./W. is the log distance to the inner German border.

in Columns (1)-(2), the East German inflow rate is negatively correlated with the actual change in foreign shares across local labor markets – consistent with the pattern observed in Figure 6b. However, this correlation is small, and becomes negligible when controlling for distance to the inner German border. Columns (3) and (4) confirm a similar pattern when considering the *predicted* change in the foreign share, as defined in (13), rather than the actual change. Moreover, we find a similar pattern when measuring employment rather than population inflows in the SIAB.[18]

To address the small negative correlation between East German and foreign inflows, we control for the log distance to the inner German border in all regressions. This control will also capture other distance-related consequences of German reunification, such as those related to trade or structural changes in the spatial distribution of economic activity (due to market access or policy changes).

3.4.2 Repatriation of ethnic Germans

A second potential issue relates to the repatriation of ethnic Germans during our analysis period. After the end of World War II, about 15 million Germans fled from former territories

[18] In a robustness test, we identify as East German those workers whose first employment spell in the SIAB was located in an East German district. This definition is not very reliable, since the SIAB covers East German employment only from 1992 onwards. We nevertheless find that this employment-based definition of East German inflows is highly correlated with population inflows from external sources.

Table 3: Ethnic German (Aussiedler) vs. Foreign Inflows

	Change in *Aussiedler* share 1988-93			
	(1)	(2)	(3)	(4)
Δ foreign share 1988-93				
actual	-0.116	-0.125		
	(0.076)	(0.076)		
predicted			-0.155	-0.177*
			(0.079)	(0.081)
Distance E./W.		0.001		0.001
		(0.001)		(0.001)
Constant	0.021***	0.017**	0.022***	0.016**
	(0.002)	(0.006)	(0.002)	(0.006)
r2	0.025	0.026	0.041	0.046
N	204	204	204	204

* p<0.10, ** p<0.05, *** p<0.01

Notes: Sample of Integrated Labour Market Biographies (SIAB), regression estimates across 204 local labor markets. The predicted change in foreign share is defined in 13. Distance E./W. is the log distance to the inner German border.

of the German Reich. While most moved to Germany in the immediate postwar years, some remained in various regions outside Germany that subsequently became part of the Eastern Bloc. With the lifting of travel restrictions after the end of the Cold War, many of these ethnic Germans and their descendants returned to Germany. In 1990, nearly 400,000 individuals, mainly from the former Soviet Union, Poland, and Romania, arrived in Germany, reducing to 225,000 per year over the following years (Glitz, 2012).

The concern is that the spatial distribution of these newly arrived ethnic Germans (*Spätaussiedler*) might correlate with the distribution of foreign nationals as captured by our analysis. Though the government aimed to ensure an equal distribution of ethnic Germans across the country (relative to local population), these efforts were largely ineffective until 1996 when restrictions were tightened (Glitz, 2012). To study their distribution, we follow Brücker and Jahn (2011) and Bruns and Priesack (2019) in exploiting administrative information contained in SIAB on the receipt of special language courses and other integration subsidies that were specially reserved for ethnic Germans.[19] Using this information, we construct the change in the share of ethnic Germans between 1988 and 1993 for each local labor market, and relate this change to the corresponding change in the foreign share. Table 3 reports the results, following the same structure as Table 2. We find that the inflow rate of Ethnic Germans is negatively correlated with both the actual change (columns 1-2) and the

[19] Attendance in these courses correspond to specific values in the variables *Leistungsart* contained in SIAB; see Brücker and Jahn (2011) and Bruns and Priesack (2019) for details.

predicted change in foreign shares (columns 3-4), irrespective of whether we control for the distance to the inner German border. However, this relationship is weak, with less than 5% of the spatial variation in ethnic shares explained by foreign shares, and negligible in size compared to the displacement effects on native workers that we document below. Moreover, this negative relation can be interpreted as part of the overall impact we aim to capture, as ethnic Germans (like the native-born population) had an incentive to avoid those local labor markets that were more heavily exposed to foreign inflows (and vice versa).

3.4.3 Other demand and supply shocks

Local labor markets are subject to local demand and other supply shocks, which could be correlated with the past settlement instrument. On the supply side, differences in the demographic structure of high-immigration cities might correlate with differential trends in population and employment levels. To address this concern, we include the share of young workers below 30 as in our baseline specification. On the demand side, a concern is the recession of 1993, which led to large employment losses in manufacturing and which occurred shortly after the immigrant inflow reached its peak in 1991. To address this concern our baseline specification includes "Bartik shocks" (Bartik, 1991), which control for industry-specific demand shocks by interacting the pre-treatment industrial composition of each local labor market with industry-specific trends in employment on the national level. Our results are generally insensitive to this control, suggesting that distributional effects related to the 1993 recession do not affect the internal validity of our estimates.

4 Estimation results

In this section, we estimate the labor market impact of migration across the firm distribution, exploiting spatial and temporal variation in immigrant shares. Our aim is to test Propositions 1-4 in Section 2.2. As described in Section 3.1, we use two main data sources. When feasible we present results from the Establishment History Panel (BHP), which covers half of the universe of all establishments subject to social security contributions. We augment those results with estimates from Integrated Labour Market Biographies (SIAB), which allows us to distinguish more specific worker types and to track individual workers over time.

4.1 Empirical strategy

Our empirical strategy exploits variation in immigrant arrivals across regions (*spatial approach*). Our baseline evidence is based on 204 local labor market regions (*Arbeitsmarktregion*) in West Germany. As an alternative specification, we consider finer variation across 326 districts (*Landkreise* and *kreisfreie Städte*), with similar results. We implement a generalized difference-in-differences model allowing for dynamic treatment effects, estimating separately for each year $t \in \{1984, ..., 1998\}$:

$$\Delta y_{rgt} = \alpha_{gt} + \beta_{gt}\Delta m_{r93} + \gamma_{gt}X_{rt} + \varepsilon_{rgt} \tag{14}$$

where $\Delta y_{rgt} = y_{rgt} - y_{rg88}$ is the change in regional outcome such as wages or employment in region r for group g between year t and base year 1988, X_{rt} is a vector of region r controls, and Δm_{r93} is the *predicted* change in the foreign share between 1988 (just before migrant share begins to expand) and 1993 (when it stabilizes) as defined in equation (13) (see also Figure 2).[20] Observations are weighted by employment in the base year. We use Δm_{r93} as our main explanatory variable rather than as instrumental variable, such that the coefficients β_{gt} represent reduced-form rather than two-stage least square estimates.

As equation (14) is expressed in differences, we implicitly control for pre-treatment differences in the level of outcome y across regions (region fixed effects). To control for East-West migration flows related to German reunification, all regressions include region's log distance to the inner German border as a control in the X_{rt} vector (see Section 3.4.1). As described in Section 3.4.3, our baseline specification controls further for industry-driven demand shocks (as in Bartik, 1991) to exclude possible confounding variation in labor demand, as well as age shares in 1980 that predict local trends in population and labor supply.

We estimate equation (14) separately for each year t. For the post-treatment years $t > 1988$, the coefficients β_t represent the dynamic reduced-form impact of the predicted change in migration shares on outcome y in year t. For the pre-treatment years $t < 1988$, the coefficients β_t represent falsification tests on the existence of pre-trends and the validity of our research design. These tests are informative in our setting, as the sudden and unexpected onset of the migration shock allows for a sharp distinction between pre- and post-treatment periods. The sharp increase in migration flows further implies that our esti-

[20] We always use the same regressor Δm_{r93} irrespectively of whether the outcome Δy_{rgt} is defined over the entire local labor market r or over a particular sub-group g. By using "pure" spatial variation we avoid potential issues with the misclassification of immigrants across groups and can identify total rather than just relative effects between groups (Dustmann, Schoenberg and Stuhler, 2016).

Table 4: Descriptive Statistics by Firm Wage Quartile (in 1988)

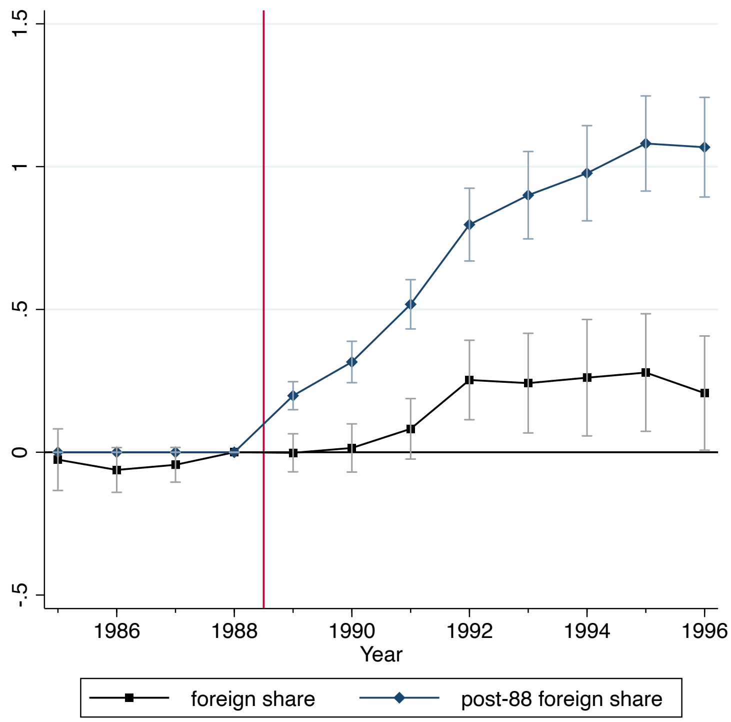
	Q1	Q2	Q3	Q4
Establishments (#)	162,604	162,804	162,724	162,830
Median wage (log)	3.00	3.61	3.89	4.19
Employment	478,111	1,199,234	2,710,077	5,458,870
in quartile	0.048	0.120	0.272	0.548
Skill shares				
Low skilled	0.301	0.296	0.292	0.218
Medium skilled	0.567	0.613	0.626	0.661
High skilled	0.009	0.013	0.025	0.080
Establishment size				
mean (firm-weighted)	2.9	7.4	16.7	33.5
mean (worker-weighted)	16.1	75.1	391.5	2141.0
share small (emp<5)	0.852	0.646	0.466	0.415
share medium	0.147	0.347	0.508	0.530
share large (emp>=100)	0.000	0.008	0.025	0.054
Share foreigners	0.089	0.072	0.079	0.068

Notes: Establishment History Panel in 1988, by quartiles of the median establishment wage (within local labor market and year). Skill shares are worker-weighted.

mates are not subject to dynamic spillovers from earlier migration shocks, which complicate the interpretation of spatial estimates in other settings (Amior and Manning, 2018; Jaeger, Ruist and Stuhler, 2018).

Apart from considering the effect of migration on local labor markets overall, we also assess its impact across the distribution of firms. Specifically, we split establishments into four quartiles according to their median wage, separately for each region and year. Table 4 provides summary statistics for the year 1988 (pre-treatment), based on the Establishment History Panel (BHP). Wage levels differ substantially across quartiles: establishments in the bottom quartile pay 61 log points less than those in the second quartile, and 119 less than those at the top. Moreover, low-paying establishments tend to be smaller: the mean establishment size is just 2.9 workers in the bottom quartile compared to 33.5 workers at the top. Accordingly, the top quartile accounts for 55% of all employment. This difference in firm size is consistent with standard monopsony models: firms which offer higher wages recruit more workers. Low-paying firms employ relatively more low skilled workers and fewer foreigners, but the differences are not very pronounced. The exception is the share of high-skilled workers, which is below 1% in low-pay compared to 8% in high-pay establishments.

Figure 7: Impact on foreign share



Notes: Sample of Integrated Labour Market Biographies (SIAB). Regression estimates based on equation (14) across 204 local labor markets. The dependent variable is the share of post-1988 foreigners in employment (blue line) or the change in the overall foreign share relative to 1988 (black).

4.2 Changes in foreign share

We begin by studying the variation in immigration across the distribution of firms. Figures (7) and (8) plot estimates of β_{gt} based on equation (14), regressing the change in the regional foreign share on the past settlement instrument, as defined in (13). We distinguish two outcomes: (i) the share of post-1988 foreigners in employment (blue line, which is zero by construction before 1988) and (ii) changes in the overall foreign shares relative to 1988 (black line). The instrument does not predict the change in the local foreign share in the pre-treatment years between 1984 and 1988. Starting from 1989, the post-1988 foreign share in exposed local labor markets starts rising until 1995, when the coefficient estimates stabilize at just over 1.[21] The effect on the overall foreign share peaks at 0.3 in the same year: the difference between the lines indicates that pre-1988 foreigners are exiting the labor market over the treatment period (as already implied by Figure 2a).

We next estimate the impact of the settlement instrument on foreign shares separately

[21]This evidence corresponds to the first stage of an instrumental variable estimator. We present reduced-form estimates below.

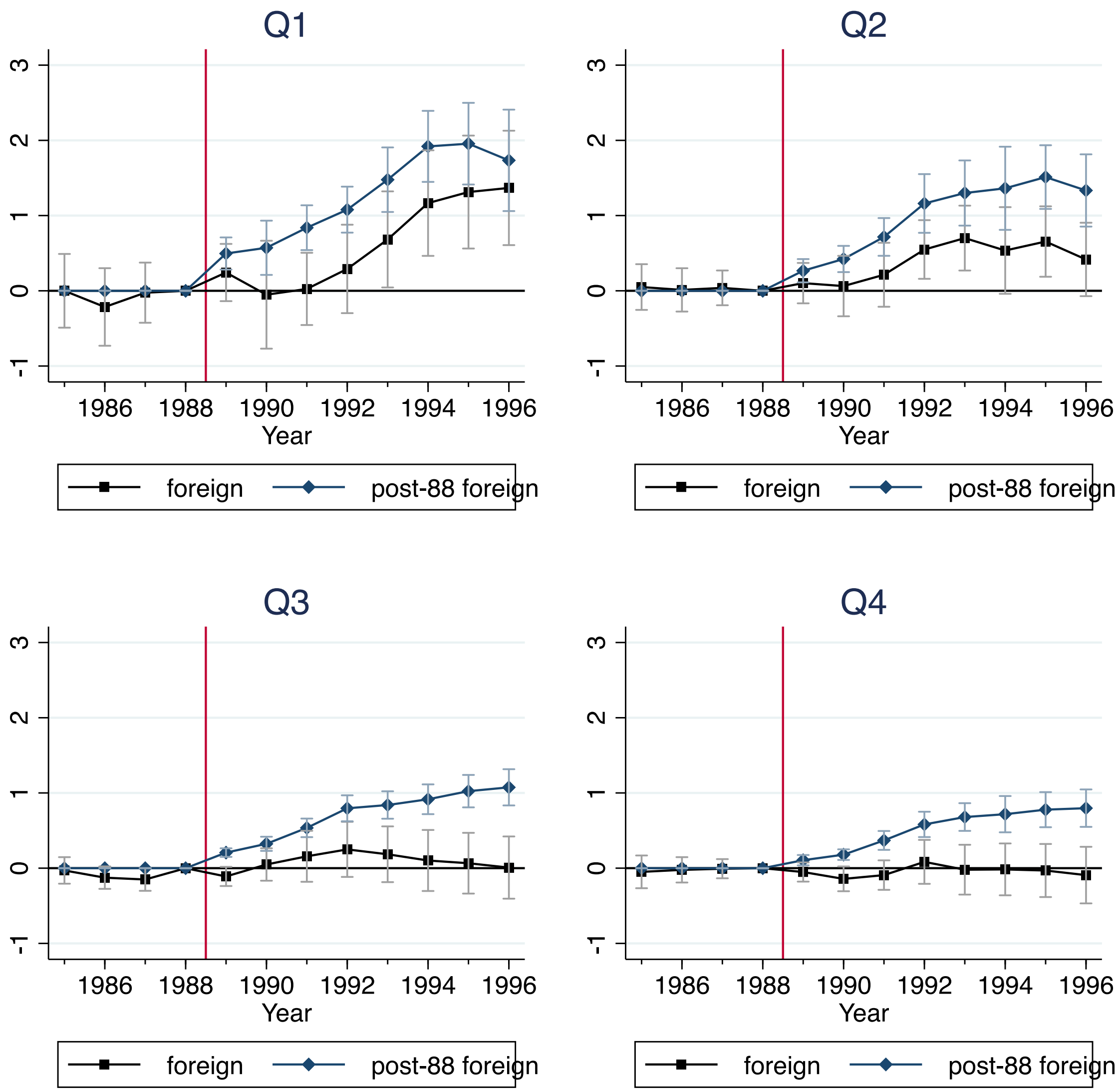
for each quartile of the firm-wage distribution (corresponding to groups g) using equation (14). As shown in Figure (8), the post-1988 foreign share increases in all quartiles, but much more in low-wage firms. The overall foreign share (in black) is similarly concentrated at the bottom; but in this case, there is no change in Q3 and Q4. This finding is consistent with Proposition 1: *migrants concentrate in low-paying firms*. It is also consistent with existing studies which show that a large part of native-migrant wage disparities can be explained by firm fixed effects (see e.g. Aydemir and Skuterud, 2008; Dustmann, Ku and Surovtseva, 2019; Arellano-Bover and San, 2020; Dostie et al., 2020), as well as Table 1 above. Our model rationalizes this result by migrants having low reservation wages. This is key to understanding the wage-setting response of firms and the implications for native employment.

4.3 Effect on firm wages

We next estimate the impact of migration on wages across the firm distribution, using equation (14). Specifically, our outcome y_{rgt} is the average of log mean establishment wages in area r and quartile g. As already mentioned, we report reduced-form rather than 2SLS estimates. Figure (9) plots the results. We observe a large contraction of firms' wages in the bottom quartile of the firm wage distribution (where the new immigrants are most heavily concentrated), and a milder effect in the second quartile; but there is no effect on *average* wage levels in high-wage firms. The effects are very similar for the overall establishment wage (i.e. across all workers: black line) and for the native wage (blue): this indicates the effects are not merely driven by changes in firm-level migrant composition. The effects are precisely estimated and consistent with Proposition 2: *A larger migrant share induces firms to reduce offers at the bottom of the distribution.*

To assess the size of these reduced-form estimates, we can scale them by the first-stage relation. Focusing on the bottom quartile, the reduced-form wage effect reaches -2 by 1995, which compares to a 1.1 increase in the post-88 foreign share (Figure 7): i.e. a 1 pp. expansion of local migrant share decreases the median wage in low-wage firms by about 1.8%. The post-88 foreign share increased by more than 5 pp. on average (see Figure 2), which implies the immigration shock induced a wage contraction of 9% in low-wage firms on average (and an even larger contraction in high-migration regions). Distributional effects on local wages have previously been identified by Card (2009), Dustmann, Frattini and Preston (2012) and Gould (2018); our contribution is to highlight the role of firms in generating these effects.

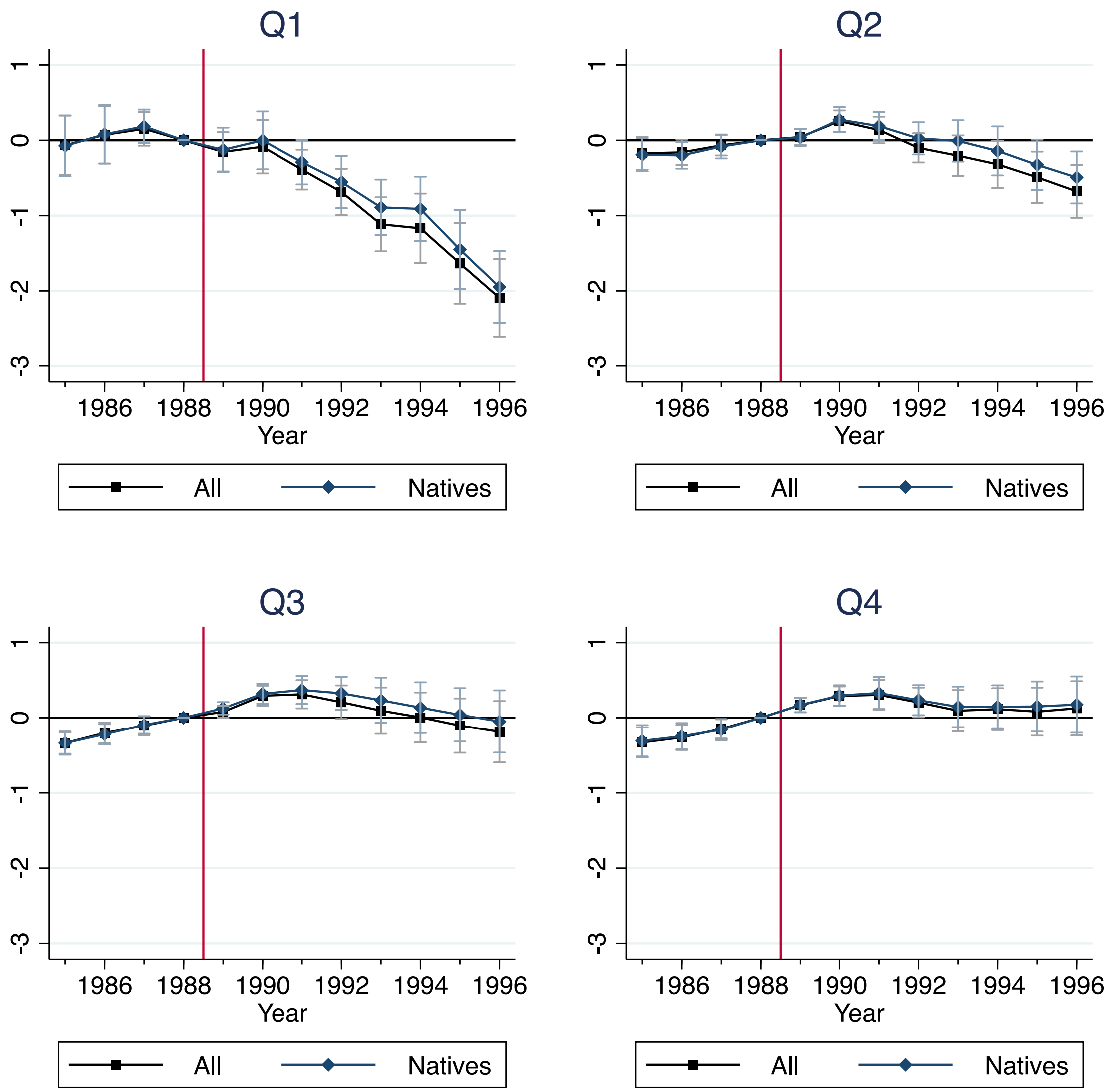
Figure 8: Impact on foreign share by firm wage quartile



Notes: Sample of Integrated Labour Market Biographies (SIAB). Regression estimates based on equation (14) across 204 local labor markets. The dependent variable is the share of post-1988 foreigners in employment (blue line) or the change in the overall foreign share relative to 1988 (black). Quartiles of median establishment wages by region and year.

Table (5) describes the estimated wage effects in greater detail. The top panel reports firm-weighted estimates from the BHP, while the bottom panel reports worker-weighted estimates from the SIAB. The first two rows report the quartile-specific estimates of Figure 9 (for all workers and natives only), but also the overall firm-level wage effect (i.e. across all quartiles). This overall effect is strongly negative for the full worker sample, with a coefficient of -0.5. But for natives, the overall effect is much smaller (and statistically insignificant),

Figure 9: Firm wage effects by quartile



Notes: Establishment History Panel, regression estimates based on equation (14) across 204 local labor markets. The dependent variable is the average change of log mean establishment wages between period t and the base year 1988. We present estimates for both the overall establishment wage (i.e. across all workers: black line) and for the native wage (blue).

despite the similarity *within* quartiles. This is partly due to natives being more heavily concentrated in the upper quartiles, where wage effects are estimated to be small. Wage effects are slightly more negative for low skilled workers than medium/high skilled (though note these effects account for both natives and migrants); and they look similar when restricting the sample to incumbent firms (which existed in both 1988, our base year, and 1995).

In the bottom panel of Table 5, we study the effect on the worker-weighted native wage

Table 5: Wage effects (1988-95)

	Overall	Q1	Q2	Q3	Q4
	(1)	(2)	(3)	(4)	(5)
Firm wage (BHP)					
all	-0.517**	-1.635***	-0.491***	-0.104	0.082
	(0.177)	(0.273)	(0.174)	(0.184)	(0.163)
natives	-0.158	-1.451***	-0.326	0.039	0.150
	(0.201)	(0.268)	(0.171)	(0.181)	(0.170)
low skilled	-0.797*	-1.632***	-0.859**	-0.761*	0.788*
	(0.358)	(0.307)	(0.291)	(0.363)	(0.327)
medium/high skilled	-0.413*	-1.558***	-0.462**	-0.050	0.009
	(0.162)	(0.266)	(0.162)	(0.200)	(0.182)
incumbent firms	-0.611***	-1.391***	-0.539**	-0.079	-0.109
	(0.160)	(0.213)	(0.167)	(0.189)	(0.149)
Individual wage (SIAB)					
natives, raw	0.046	-1.871	-0.944	-1.048	0.179
	(0.298)	(1.017)	(0.750)	(0.676)	(0.341)
natives, controls	-0.128	-2.069	-0.708	-0.761	0.013
	(0.215)	(1.106)	(0.610)	(0.401)	(0.255)
natives, w/ FEs	-0.820**	-2.426**	-1.247***	-0.823***	-0.659**
	(0.234)	(0.716)	(0.372)	(0.212)	(0.247)

Notes: BHP and SIAB, regression estimates based on equation (14) across local labor markets. Top panel: Dependent variable is the firm-weighted mean change of establishment mean log wages in the region between 1988 and 1995. Bottom panel: Dependent variable is the mean change in individual log wages in the region between 1988 and 1995 (raw wages or net of individual fixed effects).

using data from the individual-level SIAB (in the respective quartiles of the firm wage distribution).[22] In the first row, we report changes in mean native wages overall and by firm quartile: the coefficient estimates are similar to the corresponding coefficients from the BHP (second row), but the standard errors are larger (unsurprisingly, given the SIAB only offers a 2% sample). In the next row, we residualize individual wages by observable characteristics (age, education, gender) before collapsing to the region $\times$ year level; but this makes little difference. Importantly, as the SIAB tracks workers over time, we can also condition on unobservable skill differences, by residualizing wages against individual fixed effects before collapsing. We find a substantially more negative wage effect after purging individual fixed effects, consistent with evidence that naive comparisons of means in cross-sectional data un-

[22] As described in Section 3.1, we merge firm wages from the BHP to individual records in the SIAB to construct (firm-weighted) quartiles of the establishment wage distribution. The definition of quartiles are therefore comparable in the top and bottom panel of Table 5.

Table 6: Firm wage premia (1988-95)

	Overall	Q1	Q2	Q3	Q4
	(1)	(2)	(3)	(4)	(5)
$AKM^{post}_{r,1995} - AKM^{pre}_{r,1988}$	-0.649***	-1.138***	-0.562***	-0.604***	-0.487***
	(0.139)	(0.239)	(0.142)	(0.160)	(0.109)
$AKM^{post}_{r,1995} - AKM^{post}_{r,1988}$ (entries)	-0.119***	-0.813***	0.147	-0.073	0.078
	(0.039)	(0.181)	(0.126)	(0.109)	(0.041)
$AKM^{pre}_{r,1995} - AKM^{pre}_{r,1988}$ (exits)	0.080	0.230	0.064	0.045	0.166**
	(0.068)	(0.172)	(0.099)	(0.064)	(0.058)

Notes: Regression estimates based on equation (14) across 204 local labor markets. First row: Dependent variable is the mean change in AKM firm FEs ("wage premia") in the region between 1988 and 1995. Firm FEs are based on separate estimations of two-way worker-firm FE models by Bellmann et al. (2020) for the periods 1985-92 (AKM^{pre}) and 1993-99 (AKM^{post}). Second row: Dependent variable is the change in the mean "post" firm FEs in the region due to compositional changes (firm entries). Third row: Dependent variable is the change in the mean "pre" firm FEs in the region (due to firm exits).

derstate the wage impact of migration because of selective employment responses along the wage distribution (Bratsberg and Raaum 2012, Dustmann, Schoenberg and Stuhler 2017, Ortega and Verdugo 2021, Borjas and Edo, 2021*a*); and see below for estimates of those employment effects. The wage effects are still largest in the lower quartiles; but notably, we now estimate negative even at the top of the firm distribution.

Consistent with the model, the estimates show the wage effects are concentrated at the bottom of the firm distribution. But it does not necessarily follow that these effects are driven by the firm *themselves*, as the model implies. For example, it may be that low-paying firm employ low skilled workers who compete more heavily with the new migrants; and the wage effects simply reflect a reduction in their marginal products (as a competitive model would predict). To isolate an effect on mark-downs (as opposed to marginal products), we study changes in "AKM" firm fixed effects, in the spirit of Abowd, Kramarz and Margolis (1999). These effects are often interpreted as a proxy for firm productivity; but here, we are seeking to identify changes in firms' wage policies (for given productivity).

We present our estimates in Table 6. We rely on AKM firm effect estimates from Bellmann et al. (2020), which have been attached to our BHP data. Bellmann et al. estimate these firm effects in two distinct periods: 1985-92 and 1993-99 (which we treat as our "pre" and "post" periods). For each period, they estimate firm effects in a model for log wages, conditional on observable (time-varying) worker characteristics, worker fixed effects, and time fixed effects. For the sample of firms which present in area r at time t, let $AKM^{pre}_{r,t}$ denote the mean pre-period AKM effect (i.e. the firm effect estimated in the 1985-92 sample); and let $AKM^{post}_{r,t}$ denote the mean post-period AKM effect (i.e. the firm effect estimated in the 1993-99 sample). Note that $AKM_{r,t}^{pre}$ and $AKM_{r,t}^{post}$ still vary with year t due to firm entry and exit in region r.

In the top row of Table 6, we estimate the impact of the immigration shock on the difference between the post-shock AKM (among firms present in 1995) and the pre-shock AKM (among firms present in 1988). Overall, we find a large negative effect of -0.65. The effect is largest in Q1 (reaching over -1), but we also find negative effects in Q4. [23] In principle, this change in firm effects may be driven by (i) wage cuts among incumbent firms or (ii) a shift in firm composition towards lower-paying firms. The incumbent effect can be motivated by our baseline model; and the compositional effect follows from the "heterogeneous firm" extension: a labor market with low-reservation workers can sustain lower-quality firms. We now disentangle these two mechanisms empirically. To study the contribution of new firm entrants, we estimate the shock's impact on differences in the mean *post-period* AKM among the 1995 and 1988 firm samples. Since we do not observe the post-period AKM for firms exiting before the start of the post period (in 1993), this difference identifies the contribution of new entrants (which only appeared after 1988) to the overall AKM change. Comparing the first and second rows, new entrants contribute of the 20% of the overall negative wage effect (column 1). It turns out that the impact of new entrants falls entirely on Q1: that is, much of the reduction in Q1 wages is driven by low-quality entrants (rather than existing firms).

In the final row, we study the contribution of selective firm exists. To this end, we estimate the impact on differences in the mean *pre-period* AKM among the 1995 and 1988 firm samples. Since we do not observe a pre-period AKM for firms entering after the end of the pre period (in 1992), this difference identifies the contribution of exiters (which exited before 1995) to the overall AKM change. Overall, exiters make no significant contribution (column 1).

To summarize, Table 6 identifies large wage reductions which are attributable to changes in *firm* effects, rather than worker effects. These firm effects are mostly driven by wage cuts within incumbent firms (present both before and after the migration shock). But about 20% of the firm effects are driven by the entry of new low-paying firms, which is facilitated by the growing stock of low-reservation migrants.

[23] These estimates are quantitatively comparable to the SIAB estimates in the bottom row of Table 5, which also purge worker fixed effects. One major difference is that the AKM estimates allow for the individual fixed effects to be different in the pre- and post-period while they were time-constant in our anlaysis in SIAB.

4.4 Effect on native and total employment

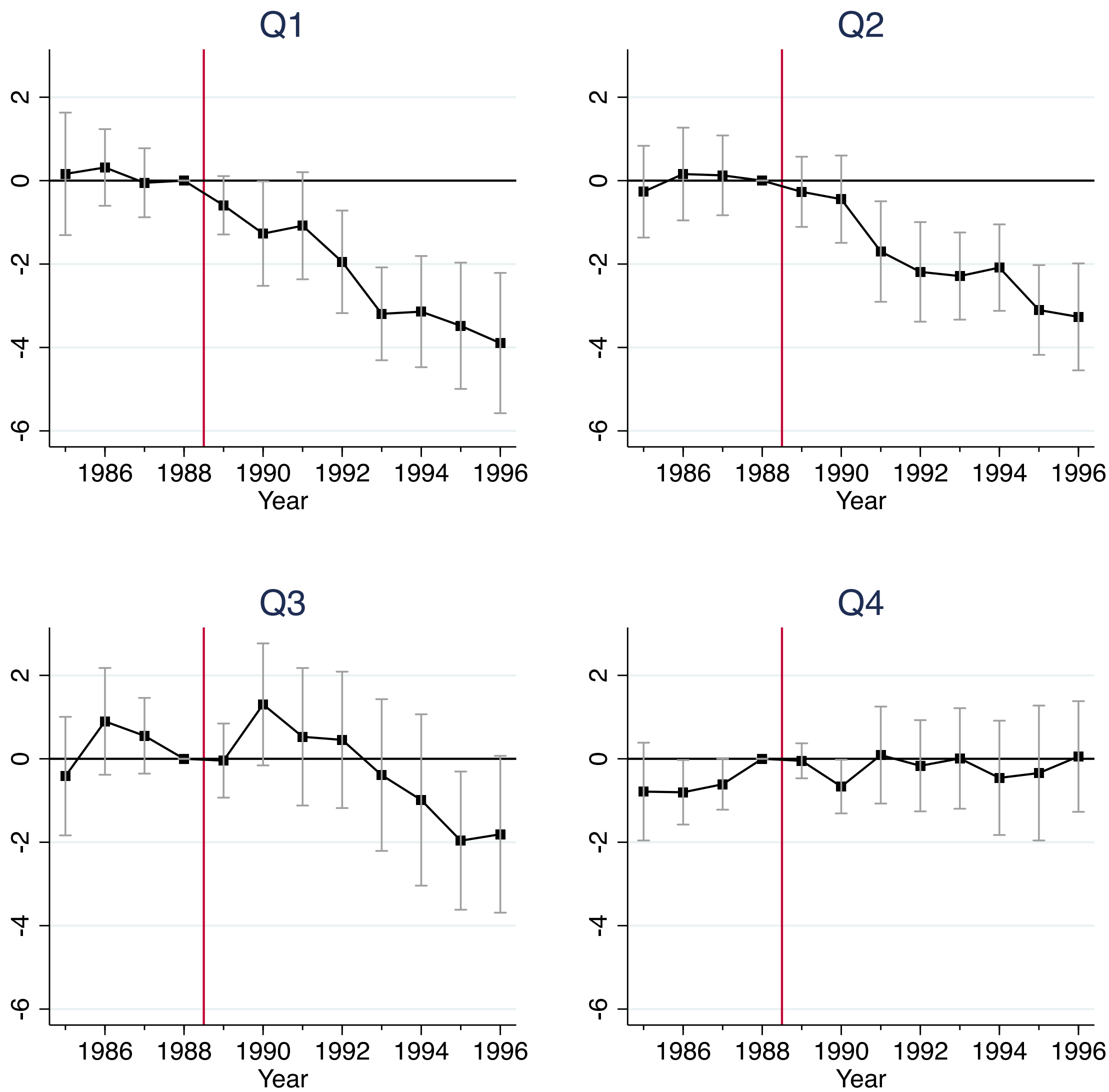
How did migration affect the employment of native workers and their allocation across firms? To address this question, we estimate equation (14) using the change in log native employment as the dependent variable. Figure (10) plots our estimates across quartiles of the establishment wage distribution. We find a large and rapid reduction in native employment in low-wage firms, with a predicted 1 pp. increase in the regional post-88 foreign share reducing native employment by about 2% after three years, and further reductions in subsequent years. We observe similarly large native employment losses in the second quartile, mild employment losses in the third, and no employment losses in the top quartile. These observations are in line with Proposition 3: *A larger migrant share induces firms to shed native employment at the bottom of the distribution.* Crucially, the wage and employment effects are *both* largest in the bottom quartiles. This is consistent with firms moving down their supply curves, *off* their demand curves: intuitively, firms willingly forego native labor to secure migrant employment at low wages. These results are difficult to rationalize in a competitive model.

Interestingly, the reduction in native employment in Q2 and Q3 seems to manifest after the effects in Q1. This can be rationalized by the "native exit" extension in Section 2.3. Intuitively, the reduction of wage offers (at the bottom of the distribution) induces natives to exit the labor force or relocate elsewhere; and this progressively causes the supply of natives to dry up further up the firm distribution.

We next assess the net effect of migration on *total* employment: this is a function of both the sharp increase in foreign employment (Figure 8) and the reduction in native employment (Figure (10)). According to Proposition 4, the latter "wage-setting effect" may in principle dominate: *a larger migrant share may induce firms to reduce their employment overall.* Figure 11 reports our estimates, using the SIAB to distinguish the contribution of different groups. As it turns out, the total employment effect is close to zero (top left quadrant): the local inflow of new immigrants (top right) displaces employment from natives and pre-88 immigrants (bottom two quadrants).

This result is difficult to reconcile with the standard competitive model, where a reduction in firm wages should be accompanied an *expansion* of total employment (as the reduction in wages reflects a reduction in labor's marginal product). The magnitude of employment displacement in this setting is unusual in the literature. However, it is not unique: Dustmann, Schoenberg and Stuhler (2017) find that Czech commuters working in Germany (in the

Figure 10: Impact on native employment by quartile



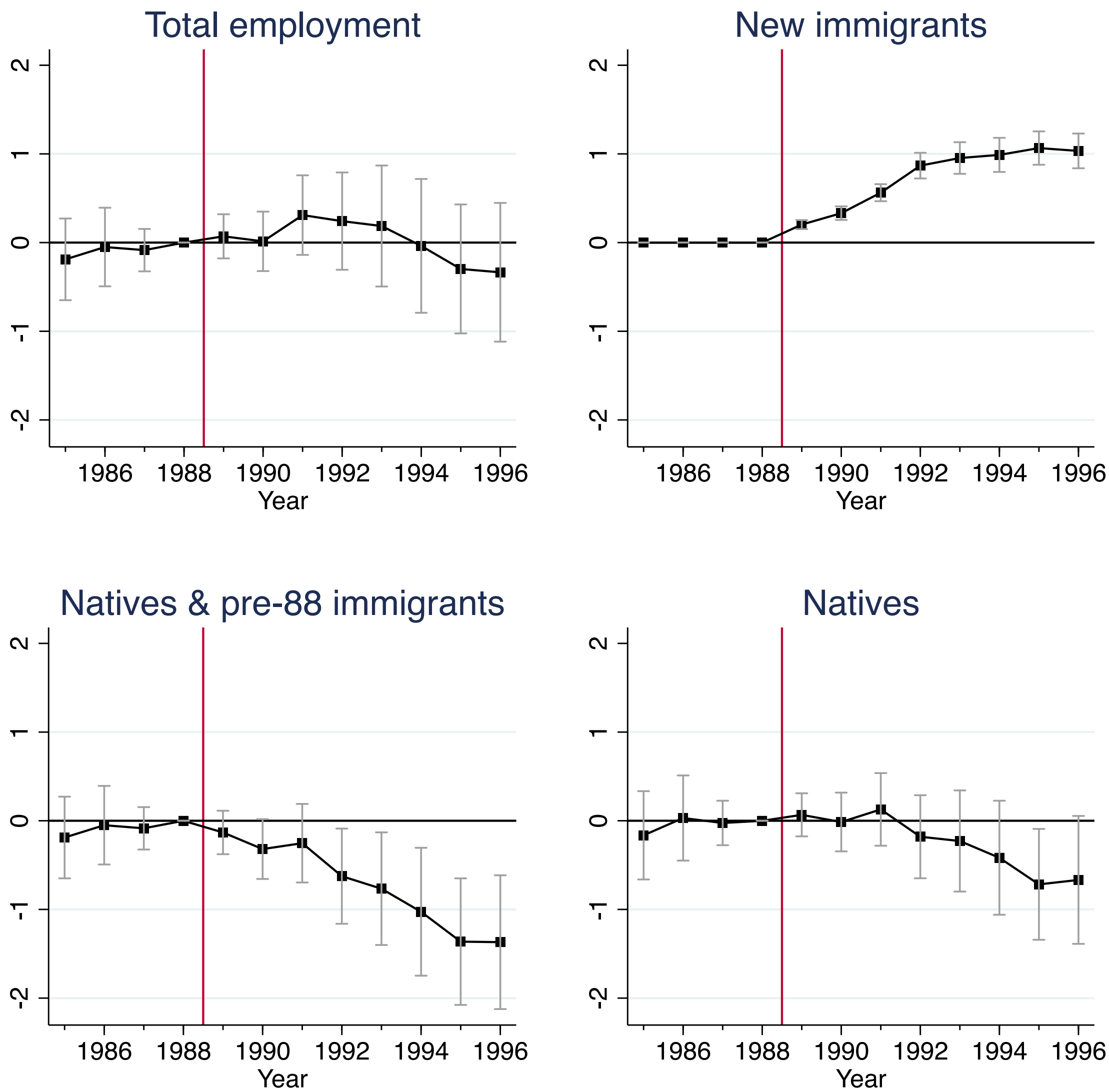
Notes: Establishment History Panel, regression estimates based on equation (14) across 204 local labor markets. The dependent variable is the mean change of log native employment between period t and the base year 1988.

same period) also induce a large displacement effect[24]; see Muñoz (2021) on the impact of posted workers in France, and Delgado-Prieto (2021) on Venezuelan regufees in Colombia, for other examples. Our model predicts that such effects ultimately depend on how migrants' reservation wages compare to natives'; and this will vary substantially by context.

Table (7) provides more details on the employment and population effects, using the

[24]Though the Czech commuters contributed to the German social security system, they did not enjoy its benefits; and this can account for their low reservation wages.

Figure 11: Impact on total employment



Notes: SIAB, regression estimates based on equation (14) across 204 local labor markets. The dependent variable is the contribution in the indicated category to total employment growth between period t and the base year 1988.

BHP. Total employment contracts (column 2), but the effect is statistically insignificant (the coefficient here is slightly different to Figure 11: this is because we are now using the BHP rather than the SIAB). Interestingly, the employment effect is much larger for women (column 3): this is consistent with French evidence from Borjas and Edo (2021*b*). Column 4 shows the employment contraction is entirely driven by "regular" employees (column 4), as opposed to "trainees" (column 5). Intuitively, the new migrants are very young, and many firms are hiring them at low trainee wages while reducing the number of regular (non-trainee)

Table 7: Employment and population effects (1988-95)

	Employment (log):				
	Native	Total	Female	Regular	Trainees
	(1)	(2)	(3)	(4)	(5)
Δ foreign share	-1.084**	-0.594	-1.215***	-1.084**	3.279*
(predicted)	(0.353)	(0.354)	(0.325)	(0.352)	(1.407)
	Other (log):				
	Population	Emp/Pop rate	# of firms	Mean firm size	
	(6)	(7)	(8)	(9)	
Δ foreign share	0.174	-0.767**	0.242	-0.958***	
(predicted)	(0.185)	(0.293)	(0.232)	(0.173)	

Notes: Establishment History Panel, regression estimates based on equation (14) across 204 local labor markets.

native employees.

4.5 Scale and firm size effects

In Table 7, we also estimate the impact of the immigration shock on other "scale" variables of interest. Column 6 shows the working-age population does grow, but not significantly. And column 8 shows the number of firms expands somewhat; but again, not significantly.

It is noteworthy that the effects on "scale" variables (i.e. total employment, population and number of firms) are less precisely estimated than other outcomes. This is perhaps to be expected, if there are unobserved trends in local population. Conditional on population though, all the other outcomes of interest are fully determined by the model - with constant returns to scale. The firm entry extension (in Appendix C) determines the ratio of the firm stock k to population n, independently of the population level. And for a given $\frac{k}{n}$ ratio, the model also pins down the employment rate (i.e. the ratio of employment to population). This can explain why the impact on *ratios* of the scale variables are more robust and precisely estimated: see the significant negative effects on the log employment rate (column 7) and the log mean firm size (column 9).

As a reduction in overall regional employment, the reduction in firm size is difficult to rationalize in a competitive model: moving down a labor demand curve, a decrease in firms' wages (as estimated in Section 4.3) should be accompanied by an *expansion* of employment. But it can be rationalized by monopsonistic firms trading off native employees for cheaper migrant labor. Table 8 offers additional detail on the firm size effects. In regions more heavily exposed to migration, we find a strong increase in the share of small establishments

Table 8: Establishment size (1988-95)

	Δ Log share of firms with # employees:			
	1-4	5-19	20-99	100+
	(1)	(2)	(3)	(4)
Δ foreign share	0.488***	-0.624**	-1.908***	-0.290
(predicted)	(0.106)	(0.226)	(0.276)	(0.603)
N	204	204	204	204
R-sq	0.286	0.227	0.173	0.075

Notes: Establishment History Panel, regression estimates based on equation (14) across 204 local labor markets. The dependent variable is the 1988-95 change in the log share of establishments of the indicated size.

(below five workers) and a decrease in the share of larger firms.

5 US evidence

Above, we have shown the German immigration shock causes a reduction in firm size. This is consistent with a monopsonistic framework where migrants have low reservation wages, but it is difficult to reconcile with a competitive model. We now show these effects are not confined to this particular setting, but rather have broader relevance. To this end, we study spatial variation in immigration across the US between 1980 and 2010. Unlike in the German case, we do not study a one-off immigration event, but instead rely on decadal changes identified by an enclave instrument. There is of course a long-standing literature which exploits this variation to estimate effects on native wage and employment rates: these are mostly (but not universally) found to be small and negative; see e.g. Jaeger, Ruist and Stuhler (2018) for recent evidence and a survey of the literature. Rather than relitigating these debates, we focus here on the impact on firm size: just as in Germany, we show that local increases in migrant share trigger a reduction in mean firm size.

5.1 Empirical specification and data

Similar to equation (14) above, we rely on a "reduced form" specification:

$$\Delta y_{rt} = \alpha_t + \beta \Delta m_{rt}^{US} + \gamma_t X_{rt} + \varepsilon_{rt} \tag{15}$$

where Δy_{rt} is the change in some outcome of interest in area r, between time $t-1$ and t. Time observations are each a decade apart: 1980, 1990, 2000 and 2010. Δm_{rt}^{US} is an enclave

Table 9: US establishment size effects

	Δ Migrant population share					Δ Log mean firm size				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Enclave	0.294***	0.278***	0.263***	0.396***	0.573***	-0.156***	-0.227***	-0.307***	-0.425***	-0.426***
	(0.032)	(0.031)	(0.032)	(0.079)	(0.048)	(0.055)	(0.047)	(0.037)	(0.113)	(0.086)
Enclave: Lagged					-0.397***					0.244**
					(0.039)					(0.108)
Bartik			0.168***	0.171**	0.035			0.895***	1.682***	1.282***
			(0.037)	(0.081)	(0.026)			(0.127)	(0.160)	(0.123)
Bartik: Lagged					0.204***					-0.678***
					(0.031)					(0.114)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Amenity controls	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
CZ fixed effects	No	No	No	Yes	No	No	No	No	Yes	No
Observations	2,166	2,166	2,166	2,166	2,166	2,166	2,166	2,166	2,166	2,166

*** p<0.01, ** p<0.05, * p<0.1.

instrument:

$$\Delta m_{rt}^{US} = \frac{\sum_o s_{ort-1} \left(n_{ot} - n_{ot-1}\right)}{n_{rt-1}} \tag{16}$$

which predicts changes in migrant share between $t-1$ and t, based on local shares s_{ort-1} of origin groups o at $t-1$, similar to equation (13). X_{rt} is a vector of local controls, which includes Bartik industry shift-shares and range of observable fixed amenities[25] interacted with time effects (identical to those used by Amior and Manning, 2020). The enclave and Bartik shift-shares are constructed using US census extracts and American Community Survey samples (Ruggles et al., 2017). Areas r correspond to 722 commuting zones (CZs) in the Continental US. See Appendix E for further details on data construction.

To identify firm size, we rely on publicly accessible data from County Business Patterns (CBP). The CBP is based on the Business Register, which contains a record for each known establishment with paid employees, outside of agricultural production, railroad, public administration and household employment. Based on this information, the CBP reports employee and establishment counts within industry-county cells (which we aggregate further to CZ-level).

5.2 US estimates

We present our basic estimates of (15) in Table 9. In columns 1-5, we study the effect of the enclave shock Δm_{rt}^{US} on the migrant population share (constructed using US census and ACS data): this can be interpreted as a "first stage". In column 1, which conditions on year effects only, the coefficient on Δm_{rt}^{US} is about 0.3 (with a standard error of just 0.03); and this is little affected by the inclusion of observable amenities (column 2) and a Bartik shift-share (column 3). In column 4, we control for local fixed effects: since (15) is already expressed in first differences, this removes area-specific linear *trends* in amenities or labor demand. Despite this being a demanding specification for such a short panel, we continue to see a precisely estimated positive effect. Unlike our German setting (where we study a one-off immigration event), migrant inflows in US CZs are heavily serially correlated (Jaeger, Ruist and Stuhler, 2018). This may bias our estimates if there are dynamics in migrant share responds dynamically. To address this possibility, we control for a lagged enclave shock Δm_{rt-1}^{US} in column 4: the coefficient on the contemporaneous shock now increases to 0.57, offset by a (smaller) negative coefficient on Δm_{rt-1}^{US} (-0.40). Intuitively, local expansions in migrant share are diffused through the country in the period following the shock: see Amior (2021).

In columns 6-10, we estimate the same specifications for changes in log mean firm size (i.e. a "reduced form" specification). Firm size responds negatively in column 6 (year effects only), and including the amenity and Bartik controls only strengthens the effect: the coefficient in column 8 is -0.31, with a standard error of just 0.04. This is even true of local fixed effects in column 9. And in the dynamic specification (column 10), we see a mean reverting effect which perfectly reflects changes in migrant share in column 5: the initial local shock reduces firm size (with a coefficient of -0.43), but this effect is partly offset (0.24) in the subsequent decade as the immigration shock diffuses nationally.

From the perspective of our model, the robust negative firm size effects are consistent with a negative "wage-setting" effect, as firms choose to impose larger mark-downs (and price our native labor). These findings are consistent with Amior and Manning (2020), who offer evidence for adverse mark-down effects in the US (though using aggregate-level variation across skill groups, rather than spatial variation). In terms of magnitude, the (positive) effects on migrant share are similar to the (negative) effects on log mean firm size. This suggests a 1 pp increase in migrant share triggers a 1% contraction in firm size.

[25] Presence of coastline, climate (maximum January/July temperatures, mean July relative humidity), log population density in 1900, and an index of CZ isolation (log distance to closest CZ).

Table 10: US establishment size effects by industry and size category

	Δ Log mean firm size				Δ Log share of firms with [...] employees:			
	Overall	W/i industry	Tradable	Non-trad	1-4	5-19	20-99	100+
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Enclave	-0.307***	-0.263***	-0.528***	-0.334***	0.136***	-0.130***	-0.318***	-0.408***
	(0.037)	(0.038)	(0.104)	(0.056)	(0.032)	(0.042)	(0.053)	(0.063)
Bartik	0.895***	0.283***	1.183***	0.025	0.145*	-0.402***	0.114	1.202***
	(0.127)	(0.129)	(0.261)	(0.124)	(0.080)	(0.087)	(0.133)	(0.171)
Amenity controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,166	2,166	2,073	2,166	2,166	2,166	2,150	2,000

*** p<0.01, ** p<0.05, * p<0.1.

Though qualitatively similar, these effects are smaller than what we see in our German case study: e.g. the first stage effect is about 0.3 (Table **??**), but the response of log mean firm size (bottom row of Table **??**) ranges from -0.7 to -1.8. Based on our model, this would suggest the "wage-setting" effect is substantially larger in Germany, a consequence perhaps of substantially lower migrant reservation wages.

In Table 10, we offer additional evidence on the nature of the firm size effect in the US. As our point of departure, we take column 8 of Table 9 (ignoring dynamics for simplicity). We begin by reproducing these estimates in column 1 of Table 10. In column 2, we re-estimate this specification after residualizing firm size changes by industry: the estimates change little, which suggests the bulk of the effect materializes within industries (similar to Germany); and columns 3 and 4 show the effects are similar in traded and non-traded industries. Columns 5-8 estimate effects on log shares of firms in various size categories: the share of small firms (fewer then 5 employees) grows, and the remaining categories contract (with larger responses for the larger size categories).

6 Conclusion

In this paper, we offer new evidence that immigration can strengthen the monopsony power of firms. Based on German immigration in the early 1990s, we show that firms respond to an immigration shock by cutting wage offers. We interpret this as a movement down their labor supply curves, as they forego native employment to exploit cheaper migrant labor. The wage cuts are concentrated at the bottom of the firm distribution, where new migrants disproportionately concentrate. Overall, firm size contracts; and we find a similar negative impact on firm size in the US. These adverse labor market effects are *not* inevitable, and may be ameliorated through policies which constrain monopsony power (such as minimum wages, properly enforced, or regularizations). In terms of the broader literature, our hypothesis can help account for conflicting results on the labor market effects of immigration: these effects will depend on migrants' reservation wages (which are likely to vary substantially by context), and not just on their skill mix.

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Appendices

A Derivation of equilibrium wage distribution

In this appendix, we derive the equilibrium ϕ (i.e. the share of firms offering the native reservation w_0) in the baseline model, as summarized by equations (10) and (11). As Rogerson, Shimer and Wright (2005) show, there is a unique equilibrium which can take one of three forms:

1. $\pi(w_1) = \pi(w_0)$, and firms offer different wages (i.e. $0 < \phi < 1$)

2. $\pi(w_1) > \pi(w_0)$ and all firms offer w_1 (i.e. $\phi = 0$)

3. $\pi(w_1) < \pi(w_0)$ and all firms offer w_0 (i.e. $\phi = 1$)

To derive (10) and (11), we consider each case in turn.

Case 1: $\pi(w_1) = \pi(w_0)$ **and** $0 < \phi < 1$

Using equations (8) and (9), $\pi(w_1) = \pi(w_0)$ implies:

$$\frac{n}{k}\left[\frac{\mu\lambda}{\delta+\lambda} + \frac{(1-\mu)\lambda}{\delta+(1-\phi)\lambda}\right](p-b_N) = \frac{n}{k}\cdot\frac{\mu\lambda}{\delta+\lambda}\cdot\frac{(r+\delta)(p-b_M)+(1-\phi)\lambda(p-b_N)}{r+\delta+(1-\phi)\lambda} \quad \text{(A1)}$$

After rearranging, we have:

$$\phi = \frac{\delta+\lambda}{\lambda}\left[1 - \frac{r}{(r+\delta)\tilde{\mu}-(\delta+\lambda)}\right] \quad \text{(A2)}$$

with $\tilde{\mu}$ defined by (11). Since ϕ lies between 0 and 1, it follows that:

$$0 < \frac{\delta+\lambda}{\lambda}\left[1 - \frac{r}{(r+\delta)\tilde{\mu}-(\delta+\lambda)}\right] < 1 \quad \text{(A3)}$$

which implies that $\tilde{\mu} \in \left(\frac{r+\delta+\lambda}{r+\delta}, \frac{\delta+\lambda}{\delta}\right)$. This is the $\phi \in (0,1)$ case of equation (10).

Case 2: $\pi(w_1) > \pi(w_0)$ **and** $\phi = 0$

Using equations (8) and (9), and imposing $\phi = 0$, $\pi(w_1) > \pi(w_0)$ implies:

$$\frac{n}{k}\left[\frac{\lambda\mu}{\delta+\lambda} + \frac{\lambda(1-\mu)}{\delta+\lambda}\right](p-b_N) > \frac{n}{k}\cdot\frac{\lambda\mu}{\delta+\lambda}\cdot\frac{(r+\delta)(p-b_M)+\lambda(p-b_N)}{r+\delta+\lambda} \quad \text{(A4)}$$

After rearranging:

$$\tilde{\mu} < \frac{r+\delta+\lambda}{r+\delta} \quad \text{(A5)}$$

with $\tilde{\mu}$ defined by (11). This is the $\phi = 0$ case of equation (10).

Case 3: $\pi(w_1) < \pi(w_0)$ **and** $\phi = 1$

Using equations (8) and (9), and imposing $\phi = 1$, $\pi(w_1) < \pi(w_0)$ implies:

$$\frac{n}{k}\left[\frac{\lambda\mu}{\delta+\lambda} + \frac{\lambda(1-\mu)}{\delta}\right](p-b_N) < \frac{n}{k}\cdot\frac{\lambda\mu}{\delta+\lambda}(p-b_M) \quad \text{(A6)}$$

After rearranging:

$$\tilde{\mu} > \frac{\delta+\lambda}{\delta} \quad \text{(A7)}$$

with $\tilde{\mu}$ defined by (11). This is the $\phi = 1$ case of equation (10).

B Model with on-the-job search

In this appendix, we set out an alternative model with on-the-job search, as in Burdett and Mortensen (1998). All the model's assumptions are identical, except all workers now draw offers at rate λ (and not just the unemployed). Rather than a single low wage w_0, the low-pay sector will now consist of a continuous distribution of wage offers (between b_M and b_N), as firms compete directly with one another for employees. Similarly, the high-pay sector will consist of a continuous distribution of offers exceeding b_N. The basic propositions in the main text are unaffected.

In what follows, we first derive the equilibrium wage distribution G across workers, and then the equilibrium offer distribution F across firms. And we conclude by revisiting the four propositions from the main text.

B.1 Wage distributions for native and migrant workers

Assuming all workers draw offers at rate λ, accepting an offer does not limit a worker's ability to continue searching, so workers optimally accept *any* offer which improves on their current utility flow. That is, employed workers accept any offer which exceeds their current wage, and the unemployed accept any offer which exceeds b_N (for natives) or b_M (for migrants): i.e. unlike in the baseline model, the bs are now reservation wages for *all* unemployed workers.

Clearly, no firm will offer a wage below b_M (the migrant reservation, since no worker will accept such an offer) or above p (labor productivity). Let $F(w)$ be the distribution of wage offers across firms. In equilibrium, we must therefore have: $F(b_M) = 0$. However, firms may choose to set wages below the native reservation b_N in equilibrium, so $F(b_N)$ may exceed zero. For the purposes of this appendix, let ϕ denote the share of firms offering less than b_N (as opposed to the share of firms offering w_0, as in the main text): i.e. $\phi \equiv F(b_N)$.

Now, let $G_N(w)$ be the distribution of wages across employed natives, and $G_M(w)$ the distribution across employed migrants. In steady-state, G_N and G_M will of course depend on the offer distribution $F(w)$. In particular, consider the group of firms paying wages less than w. The inflow of workers to this group must equal the outflow in equilibrium. For natives, this gives:

$$u_N \lambda [F(w) - F(b_N)](1-\mu) n = \delta (1-u_N) G_N(w)(1-\mu) n + \lambda (1-F(w))(1-u_N) G_N(w)(1-\mu) n \tag{A8}$$

where $(1-\mu) n$ is the stock of natives (where μ is the migrant population share), and u_N

is their unemployment rate. The native inflow to this group of firms is composed entirely of the unemployed. So, the left-hand side is the flow of unemployed natives who meet firms offering between b_N and w. And the outflow is composed of two components: (i) the flow of natives employed at wages below w who are separated to unemployment (at rate δ); and (ii) the flow of natives employed at wages below w who meet firms offering wages exceeding w. The parallel expression for migrants is:

$$u_M \lambda F(w) \mu n = \delta (1 - u_M) G_M(w) \mu n + \lambda (1 - F(w)) (1 - u_M) G_M(w) \mu n \tag{A9}$$

where we have imposed: $F(b_M) = 0$. The steady-state native and migrant unemployment rates are

$$u_N = \frac{\delta}{\delta + (1 - \phi) \lambda} \tag{A10}$$

and

$$u_M = \frac{\delta}{\delta + \lambda} \tag{A11}$$

Substituting (A10) and (A11) into (A8) and (A9) respectively, we can solve for G_N and G_M in terms of the offer distribution F:

$$G_N(w) = \frac{1}{\phi} \cdot \frac{\delta [F(w) - \phi]}{\delta + \lambda [1 - F(w)]} \tag{A12}$$

$$G_M(w) = \frac{\delta F(w)}{\delta + \lambda [1 - F(w)]} \tag{A13}$$

B.2 Firms' employment

We now derive $l(w)$, the equilibrium employment of a firm paying wage w. This also comes out of a steady-state condition. Let $R(w)$ be the flow of type b workers recruited to such a firm, and let $S(w|)$ be the flow of workers who are separated from this firm. A steady-state equilibrium requires: $R(w) = S(w)$. Notice that $S(w)$ is simply equal to:

$$S(w) = [\delta + \lambda (1 - F(w))] l(w) \tag{A14}$$

i.e. workers can leave a firm through separation to unemployment or by meeting a firm offering a wage exceeding w. For firms offering $w \geq b_M$ (as all firms must in equilibrium), the recruitment flow is given by:

$$R(w) = I[w \geq b_N] \cdot \left\{ \frac{\lambda}{k} u_N + \frac{\lambda}{k} (1 - u_N) G_N(w) \right\} (1 - \mu) n + \left\{ \frac{\lambda}{k} u_M + \frac{\lambda}{k} (1 - u_M) G_M(w) \right\} \mu n \tag{A15}$$

The first term on the right-hand side describes the native inflow, and the second term the migrant inflow. I is an indicator function taking 1 if $w \geq b_N$: firms only recruit natives if their offer exceeds b_N. The $\frac{\lambda}{k} u_N$ and $\frac{\lambda}{k} u_M$ terms are the flows of workers from unemployment, and the $\frac{\lambda}{k}(1 - u_N) G_N(w)$ and $\frac{\lambda}{k}(1 - u_M) G_M(w)$ terms are the flows from firms paying less than w. Using (A10), (A11), (A12) and (A13), this expression can be simplified to:

$$R(w) = \frac{n}{k} \cdot \frac{\delta \lambda \{(1 - \mu) I[w \geq b_N] + \mu\}}{\delta + \lambda (1 - F(w))} \tag{A16}$$

Imposing the steady-state condition $R(w) = S(w)$ then yields:

$$l(w) = \frac{n}{k} \cdot \frac{\delta \lambda \{(1 - \mu) I[w \geq b_N] + \mu\}}{[\delta + \lambda (1 - F(w))]^2} \tag{A17}$$

B.3 Equilibrium size of low-pay sector

As Burdett and Mortensen (1998) famously show, the combination of wage posting and on-the-job search yields a non-degenerate continuous distribution of wage offers. Intuitively, if there is a mass point in the wage offer distribution, a firm can profit by offering epsilon more than that mass point: the cost in wages is negligible, but the firm recruits a discretely larger workforce.

In equilibrium, firms can either locate in the "high-pay sector" (offering $w \geq b_N$) or "low-pay sector" (offering $w < b_N$). If the high-pay sector exists (i.e. $\phi < 1$), the lowest offer in that sector must be b_N: otherwise, the lowest-paying firm (in that sector) would increase their profit by cutting their offer to b_N (with no employment loss). Similarly, if the low-pay sector exists (i.e. $\phi > 0$), the lowest offer in that sector must be b_M. Just as in the baseline model in the main text, the equilibrium offer distribution can take one of three forms:

1. $\pi(b_N) = \pi(b_M)$, and firms locate in both sectors (i.e. $0 < \phi < 1$)
2. $\pi(b_N) > \pi(b_M)$ and all firms locate in the high-pay sector (i.e. $\phi = 0$)
3. $\pi(b_N) < \pi(b_M)$ and all firms locate in the low-pay sector (i.e. $\phi = 1$)

Using (A17), the equilibrium profit from offering b_N and b_M can be written as:

$$\pi(b_N) = (p - b_N)\, l(b_N) = \frac{n}{k} \cdot \frac{\delta\lambda (p - b_N)}{[\delta + (1-\phi)\lambda]^2} \tag{A18}$$

and

$$\pi(b_M) = (p - b_M)\, l(b_M) = \frac{n}{k} \cdot \frac{\mu\delta\lambda (p - b_M)}{(\delta + \lambda)^2} \tag{A19}$$

The equilibrium ϕ can be derived by inserting (A18) and (A19) into the three cases listed above. Just as in the baseline model, the equilibrium ϕ can be expressed as:

$$\phi = \begin{cases} 0 & \text{if } \tilde{\mu} \leq 1 \\ \frac{\delta+\lambda}{\lambda}\left(1 - \frac{1}{\tilde{\mu}}\right) & \text{if } \tilde{\mu} \in \left(1, \frac{\delta+\lambda}{\delta}\right) \\ 1 & \text{if } \tilde{\mu} \geq \frac{\delta+\lambda}{\delta} \end{cases} \tag{A20}$$

where $\tilde{\mu}$ is now defined as:

$$\tilde{\mu} = \left[\mu\left(1 + \frac{b_N - b_M}{p - b_N}\right)\right]^{\frac{1}{2}} \tag{A21}$$

So, ϕ is increasing in $\left[\mu\left(1 + \frac{b_N - b_M}{p - b_N}\right)\right]^{\frac{1}{2}}$, away from the corner conditions. Just as in the baseline model, firms are more likely to make a low-wage offer (i.e. below b_N) if (i) there are many migrants (μ large) and (ii) if the migrant reservation b_M is small relative to b_N.

B.4 Equilibrium offers within high and low-pay sectors

Equations (A20) and (A21) describe the equilibrium share of firms ϕ which locate in the low-pay sector (i.e. offer wages $w < b_N$). Conditional on this equilibrium ϕ, we now solve for the offer distribution *within* the high and/or low-pay sectors. Since firms are identical, we can solve for the equilibrium offer distribution by imposing that all firms earn the same profits. In the high-pay sector (assuming it exists: i.e. if $\phi < 1$), the lowest-paying firm offers b_N, so this requires:

$$\pi(w) = \pi(b_N) \tag{A22}$$

for $w \geq b_N$. Replacing the profit functions with (A17) and rearranging, the share of offers between b_N and any given $w \geq b_N$ can be expressed as:

$$F(w) - \phi = \left(1 - \phi + \frac{\delta}{\lambda}\right)\left[1 - \left(\frac{p-w}{p-b_N}\right)^{\frac{1}{2}}\right] \tag{A23}$$

We now apply the same logic to the low-pay sector. Conditional on this sector existing (i.e. if $\phi > 0$), the lowest-paying firm offers b_M. Given all firms earn identical profits, it must be that:

$$\pi(w) = \pi(b_M) \tag{A24}$$

for $w \geq b_M$. Applying (A17) and rearranging, conditional on $\phi < 1$, the share of offers below any given $w < b_N$ can be expressed as:

$$F(w) = \frac{\delta + \lambda}{\lambda}\left[1 - \left(\frac{p-w}{p-b_M}\right)^{\frac{1}{2}}\right] \tag{A25}$$

Putting together (A23) and (A25), we therefore have:

$$F(w) = \begin{cases} I[\phi > 0] \cdot \frac{\delta+\lambda}{\lambda}\left[1 - \left(\frac{p-w}{p-b_M}\right)^{\frac{1}{2}}\right] & \text{if } w \in [b_M, b_N) \\ I[\phi < 1] \cdot \left\{\phi + \left(1 - \phi + \frac{\delta}{\lambda}\right)\left[1 - \left(\frac{p-w}{p-b_N}\right)^{\frac{1}{2}}\right]\right\} & \text{if } w \in [b_N, p) \end{cases} \tag{A26}$$

B.5 Implications for Propositions 1-4

We now revisit Propositions 1-4 from Section 2.2 in the main text:

1. Proposition 1 states that migrants concentrate in low-paying firms. This continues to be true: only migrants will accept wage offers below b_N.

2. Proposition 2 states that a larger migrant μ induces firms to reduce offers at the bottom of the distribution. The continues to be true: the low-pay sector share ϕ is increasing in μ (away from the corner conditions), and this effect is increasing in the $\frac{b_N - b_M}{p - b_N}$ ratio: see equations (A20) and (A21).

3. Proposition 3 states that a larger migrant μ induces firms to shed native employment at the bottom of the distribution. This continues to be true: as μ increases, firms drop into the low-pay sector (ϕ increases), and native unemployment u_N expands: see equation (A10).

4. Proposition 4 states that a larger migrant μ may induce firms to reduce their employment overall. Equation (A17) reveals that μ has a positive "composition effect" on firms' employment in the low-pay sector: holding wage offers fixed, only migrants accept low-wage offers. But (A17) also shows that μ has a negative "wage-setting effect": as more firms drop into the low-pay sector, they lose access to native employment. And just as in the baseline model, without knowledge of the parameter values, we cannot know ex ante which effect will dominate on average.

Though the four propositions are robust to the introduction of on-the-job search, there is one difference worthy of comment. Unlike in the baseline model, a larger μ does now generate a negative effect on natives' *realized* wages. As firms drop into the low-pay sector (i.e. as ϕ increases) in response, this increases monopsony power in the high-pay sector, so firms are able to extract greater rents from natives. This is visible in equation (A12): at any given wage $w \geq b_N$, the share of native workers on wages below w, i.e. $G_N(w)$, expands as ϕ increases.

C Model with endogenous contact rate

C.1 Free entry condition and equilibrium

In the baseline model, we have assumed a fixed number of firms (k) and hence a fixed contact rate λ. In this appendix, we consider an environment (with homogeneous firms) where these are endogenous. If firms are free to enter and produce, monopsonistic power must be maintained by some barrier to entry or hiring. We impose a fixed cost c which each firm must pay to produce any quantity of output. Of course, there are alternative means of sustaining market power in equilibrium, but the specific modeling decision is immaterial for the theoretical results.

Suppose the total flow of worker-firm meetings is determined by a Cobb-Douglas matching function $m(\bar{u}n, k) = \lambda_0 (\bar{u}n)^{\alpha} k^{1-\alpha}$, where:

$$\bar{u} = \mu u_M + (1-\mu) u_N \tag{A27}$$

is the mean unemployment rate (so $\bar{u}n$ is the stock of unemployed workers), and k the (now endogenous) stock of firms. An important parameter is the labor market tightness, defined by $\theta \equiv \frac{k}{\bar{u}n}$. The contact rate for workers λ is now equal to:

$$\lambda = \lambda_0 \theta^{1-\alpha} \tag{A28}$$

and the contact rate for firms is $\lambda_0 \theta^{1-\alpha} \cdot \frac{\bar{u}n}{k} = \lambda_0 \theta^{-\alpha}$.

The free entry condition requires that:

$$\pi(w) = c \tag{A29}$$

in equilibrium, for any wage offer w (since firms are identical). Suppose at least some firms offer the high wage w_1 (i.e. $\phi < 1$): this must be true if at least some natives are employed. Replacing profit with $\pi(w_1)$ from equation (9), the free entry condition can then be expressed as:

$$\frac{n}{k}\left[\frac{\mu\lambda}{\delta+\lambda} + \frac{(1-\mu)\lambda}{\delta+(1-\phi)\lambda}\right](p - b_N) = c$$

Using (A27), (A28), and the definition of θ, this can be rewritten as:

$$\frac{\lambda_0}{\delta}(p - b_N) = c\theta^{\alpha} \tag{A30}$$

Equation (A30) shows that market tightness θ is fully determined by $\frac{\lambda_0}{\delta}$, $p - b_N$ and the operating cost c. Intuitively, profits are increasing in $\frac{\lambda_0}{\delta}$ (which ensures hires are larger relative to separations) and $p - b_N$ (i.e. greater profits per hire), and decreasing in c. To ensure that profits are equal to the operating cost c in equilibrium, each of these must be offset by larger market tightness θ, which increases competition over workers (and hence diminishes profits).

Crucially though, market tightness θ is independent of the migrant share μ. This is because native wages are fixed at their reservation b_N. Consequently, the migrant share does not affect the profits of *individual* firms offering w_1; and since all firms must earn the same profit in equilibrium (firms are identical), μ does not enter equation (A30). Since μ does not affect market tightness θ, it does not affect the contact rate λ; so the implications for wage offers (Proposition 2) and native employment (Proposition 3) are identical to the baseline case (with fixed stock of firms k) in the main text.[26]

The implications for firm size (Proposition 4) are also unaffected. Recall mean firm size

[26]Though θ is immune to migrant share μ, the stock of firms k may of course change (if the total unemployment stock $\bar{u}n$ does), since $k = \theta\bar{u}n$. But in this model, it is the market tightness θ which is crucial to wages offers and employment rates.

can be expressed as $\frac{(1-\bar{u})n}{k}$. In the baseline model, we take $\frac{n}{k}$ is taken as given; so mean firm size is fully determined by the mean unemployment rate $\bar{u}$. But the same is true in this extension. Notice that mean firm size can also be written as $\theta\left(\frac{1}{\bar{u}}-1\right)$. Since market tightness θ is immune to migrant share μ, any effect on mean firm size can only come through $\bar{u}$ - just as in the baseline model.

C.2 Alternative version with on-the-job search

Above, we have shown that market tightness θ is unaffected by migrant share μ. But alternative assumptions do yield different results. In particular, θ does respond positively to μ if workers can search on-the-job. The reason is that, in this framework, native wages contract in response to μ (see Appendix B): all else equal, this would expand profit per worker; so θ must increase in equilibrium (to ensure profits remain fixed at the operating cost c).

To show this formally, we need to redefine the matching function (since both employed and unemployed workers now search): $m(n,k)=\lambda_0 n^{\alpha}k^{1-\alpha}$. Market tightness θ is now equal to $\frac{k}{n}$. The free entry condition for this model can be derived by imposing $\pi(b_N)=c$ in equation (A18). Combining this with (A10), this yields:

$$\frac{\lambda_0}{\delta}(p-b_N)\,u_N^2=c\theta^{\alpha} \tag{A31}$$

This is identical to equation (A30), except we now have the native unemployment rate u_N on the left-hand side. Equation (A31) describes a *positive* relationship between θ and u_N: larger native unemployment increases the recruitment pool for firms, so equilibrium requires a larger θ (which increases competition over workers) to keep profit fixed.

Using (10), we can also derive a downward sloping "wage-setting curve". Assuming for simplicity that $0<\phi<1$ (i.e. firms operate in both the high and low-pay sectors), equations (10) and (A10) imply:

$$u_N=\frac{\delta}{\delta+\lambda_0\theta^{1-\alpha}}\left[\mu\left(1+\frac{b_N-b_M}{p-b_N}\right)\right]^{\frac{1}{2}} \tag{A32}$$

which is a *negative* relationship between θ and u_N. Intuitively, a larger θ implies a larger contact rate λ, which dries up the migrant unemployment pool. Holding native unemployment u_N fixed, this makes the low-pay sector relatively less attractive to firms. To ensure firms are optimizing in wage offers, this larger λ must be offset in equilibrium by a smaller

u_N (which makes the high-pay sector less attractive).

Together, the free entry condition (A31) and wage-setting curve (A32) imply a unique equilibrium in market tightness θ and native unemployment u_N. What is the impact of immigration? A larger migrant share μ shifts the wage-setting curve (A32): native unemployment u_N increases for every θ. But migrant share does not enter the free entry condition (A31). Consequently, a larger μ will increase both θ and u_N in equilibrium. The firm entry response does limit the impact on u_N: larger θ and hence λ dries up the migrant unemployment pool, and discourages firms from dropping into the low-pay sector. However, it cannot *reverse* the impact on u_N: the firm entry response only materializes in the first place because of a contraction of native employment and wages.

Finally, what are the implications for the firm size effect? Recall that average firm size is equal to: $\frac{(1-\bar{u})n}{k} = \frac{1-\bar{u}}{\theta}$, where $\bar{u}$ is the mean unemployment rate. For fixed $\theta \equiv \frac{k}{n}$ (as in baseline model), firm size is fully identified by (and decreasing in) $\bar{u}$. But in this extension (with both free entry and on-the-job search), we also expect an increase in θ, so firm size will respond more negatively (or less positively).

D Model with heterogeneous firms

In the baseline model, we assume all firms have identical productivity p. We now consider an alternative scenario where firms vary in their productivity, akin to Albrecht and Axell (1984). Let H denote this productivity distribution, so $H(p)$ is the share of firms with productivity below p. Firms may either be active (if they can operate at a profit) or inactive (if not). All (and only those) firms with productivity p above the migrant reservation wage w_0 will be active: so the active stock of firms (k in the baseline model) is equal to $1 - H(w_0)$. This set-up implies a limited stock of high-quality firms (which may be justified by a constrained supply of entrepreneurial talent), similar in spirit to Melitz (2003). We assume for simplicity that the contact rate λ is exogenous of the active stock of firms: this is equivalent to assuming $\alpha = 1$ in equation (A28) in Appendix C; but see Appendix C on the implications of relaxing this assumption. For the purposes of this analysis, we restrict attention to equilibria with equilibrium wage dispersion: i.e. at least some firms offer w_1 and others offer w_0 ($0 < \phi < 1$).

D.1 Equilibrium

We now solve for equilibrium in this framework. Let p^* denote the productivity of the marginal firm (endogenous in the model) which is indifferent between offering w_1 and w_0.

That is, p^* must satisfy:

$$\pi\left(w_0|p^*\right)=\pi\left(w_1|p^*\right) \tag{A33}$$

where $\pi\left(w|p\right)$ is the profit earned by a productivity p firm offering wage w. Just as in the baseline model, employment in low-wage firms is $l\left(w_0\right)=\frac{n}{k}\cdot\frac{\mu\lambda}{\delta+\lambda}$; and employment in high-wage firms is $l\left(w_1\right)=\frac{n}{k}\left[\frac{\mu\lambda}{\delta+\lambda}+\frac{(1-\mu)\lambda}{\delta+(1-\phi)\lambda}\right]$, where ϕ is the share of *active* firms which offer w_0. Equation (A33) can then be rewritten as:

$$\phi=\frac{\delta+\lambda}{\lambda}\left[1-\frac{r}{\left(r+\delta\right)\frac{\mu}{1-\mu}\cdot\frac{b_N-b_M}{p^*-b_N}-\left(\delta+\lambda\right)}\right] \tag{A34}$$

We call this the "wage-setting equation". Note it is identical to (10) in the main text, except productivity p has now been replaced by p^*: since firms are no longer identical, this wage-setting equation must only be satisfied by the marginal firm. Equation (A34) describes a *negative* equilibrium relationship between ϕ and p^*. Intuitively, if the marginal firm is more productive (i.e. p^* larger), that firm will care relatively more about employment (compared to profit per worker). All else equal, this will incline such a firm to offering w_1 instead of w_0. To ensure indifference, ϕ must therefore be smaller in equilibrium: this ensures a smaller native unemployment pool, which makes recruitment harder for high-wage firms.

To solve for equilibrium, we require one more equation. This comes from the definition of ϕ (the share of active firms which offer w_0):

$$\phi=\frac{H\left(p^*\right)-H\left(w_0\right)}{1-H\left(w_0\right)} \tag{A35}$$

We call this the "active firm condition". Holding the migrant reservation w_0 fixed, (A35) describes a *positive* relationship between ϕ and p^*: if the marginal firm which offers w_1 is more productive (i.e. p^* larger), the share of active firms offering w_0 (i.e. ϕ) must mechanically be larger. However, this relationship is amplified through changes in the active stock of firms. Based on (5), the migrant reservation w_0 is decreasing in ϕ, since a larger ϕ reduces access to high-wage firms. If so, a larger p^* implies a smaller w_0: this causes $H\left(w_0\right)$ to contract (there are more active firms, offering w_0); so ϕ in (A35) increases even more.

Putting equations (A34) and (A35) together, we therefore have a unique equilibrium in ϕ and p^*.

D.2 Impact of immigration

A larger migrant share μ shifts the wage-setting equation (A34): the low-wage share ϕ of active firms expands for any p^*. But migrant share does not enter the active firm condition (A31). Consequently, a larger μ will reduce θ and increase p^* in equilibrium. Since ϕ expands, the migrant reservation w_0 and native employment will also contract; so the effects of immigration are qualitatively unchanged from the baseline model in the main text.

Crucially though, the effects of immigration are amplified in this model. First, the impact of migrant share μ on ϕ will be larger if the productivity p^* of the marginal firm is smaller (see equation (A34)): this is because lower-quality firms care relatively more about profit per worker (compared to employment), so they drop more readily from w_1 to w_0.

Second, the impact on ϕ is amplified by the activation of low-quality firms. Intuitively, a larger supply of migrants with low reservations sustains the existence of low-quality firms (offering w_0), which would otherwise be unable to operate profitably. These firms account for a growing share of offers to the labor force, amplifying any adverse effects on the migrant reservation w_0 and native employment. To see how this manifests formally, consider the active firm condition (A35). If all firms have productivity above w_0 (as in the baseline model), the denominator of (A35) will collapse to 1. This turns off the amplification mechanism via w_0 in that denominator (described above). The positive relationship between ϕ and p^* in (A35) then becomes shallower, and the overall (positive) impact of migrant share μ on ϕ is therefore smaller.

Finally, consider the implications for the firm size effect. Proposition 4 states that average firm size will contract in response to a larger migrant share μ if the negative "wage-setting effect" dominates the positive "composition effect". The endogenous activation of low-quality firms amplifies the former (since wage offers and native employment contract further), so the negative "wage-setting effect" becomes larger and is more likely to dominate.

E Additional details on US data

Our US analysis is based on the Census Bureau's County Business Patterns (CBP). The CBP is an annual dataset, based on the Business Register, which offers detailed information on the distribution of establishments and employees across counties and industries. The CBP covers all industries except agricultural production, railroad, public administration and household employment. For every county-industry cell, the CBP reports total employment and total establishments (both overall and by size bucket).

The CBP presents two technical challenges. Employment counts in some county-industry cells are suppressed to preserve confidentiality (amounting to about 1-3% of total employment each year), and industry classifications change periodically. To create stable panels, we rely on the files created by Eckert et al. (2020). They impute suppressed employment counts in a linear program, which exploit the constraints implied by geographical and industrial hierarchies; and they use official industry crosswalks to produce stable series based on the NAICS 12 classification.

F Additional empirical evidence

Table A1: Change in foreign share by industry (1988-95)

Industry	pp. change
[21] Hospitality	14.1%
[1] Agriculture and forestry	6.9%
[26] Household services	6.4%
[17] Construction	4.7%
[23] Business-related services	4.0%
[16] Food and tobacco	3.8%
[5] Plastics	3.5%
[6] Pit and quarry	3.4%
[15] Leather and textile	3.3%
[8] Metal production and processing	3.0%
[13] Wood and wood products	2.9%
[12] Musical instruments, jewelry, toys	2.8%
[7] Ceramic and glass	2.6%
[18] Trading	2.5%
[19] Transportation and communications	2.4%
[22] Healthcare and welfare	2.3%
[10] Vehicle manufacturing	2.2%
[14] Printing and paper processing	2.2%
[27] Social services	2.1%
[25] Recreational services	2.1%
[24] Educational services	2.0%
[11] IT, electronics, optics	1.9%
[9] Manufacturing	1.4%
[4] Chemical industry	1.2%
[3] Mining	0.9%
[28] Public administration	0.7%
[20] Credit and insurance	0.7%
[2] Energy	0.4%
Tradable industries	1.5%
Nontradable industries	3.3%

Notes: SIAB, change in foreign share by industry in percentage points between 1988-95.

Table A2: Wage levels by industry

	Natives	Migrants		Wage gap	
		previous	recent	raw	adj.
	(1)	(2)	(3)	(3)-(1)	(3)-(1)
[1] Agriculture and forestry	3.79	4.01	3.73	-0.06	0.04
[2] Energy	4.56	4.48	3.59	-0.97	-0.38
[3] Mining	4.40	4.33	3.74	-0.66	-0.07
[4] Chemical industry	4.54	4.45	4.00	-0.54	-0.18
[5] Plastics	4.26	4.23	3.99	-0.27	0.05
[6] Pit and quarry	4.39	4.38	4.16	-0.23	0.00
[7] Ceramic and glass	4.22	4.21	3.98	-0.24	0.07
[8] Metal production and processing	4.32	4.32	3.91	-0.41	-0.06
[9] Manufacturing	4.40	4.39	3.84	-0.56	-0.20
[10] Vehicle manufacturing	4.32	4.41	3.59	-0.73	-0.34
[11] IT, electronics, optics	4.35	4.28	3.93	-0.42	-0.05
[12] Musical instruments, jewelry, toys	4.00	4.06	3.64	-0.36	-0.02
[13] Wood and wood products	4.13	4.24	3.94	-0.19	0.05
[14] Printing and paper processing	4.33	4.29	4.02	-0.31	0.01
[15] Leather and textile	4.01	4.06	3.77	-0.24	0.07
[16] Food and tobacco	4.01	4.11	3.79	-0.22	0.04
[17] Construction	4.21	4.30	3.91	-0.30	-0.09
[18] Trading	4.10	4.15	3.70	-0.40	-0.11
[19] Transportation, communication	4.22	4.26	3.83	-0.39	-0.13
[20] Credit and insurance	4.45	4.49	4.04	-0.41	-0.14
[21] Hospitality	3.64	3.66	3.47	-0.17	-0.04
[22] Healthcare and welfare	4.08	4.22	3.70	-0.38	-0.12
[23] Business-related services	4.20	4.17	3.77	-0.43	-0.18
[24] Educational services	4.25	4.43	3.66	-0.59	-0.32
[25] Recreational services	4.38	4.37	3.92	-0.46	-0.26
[26] Household services	3.39	3.52	2.93	-0.46	-0.14
[27] Social services	4.29	4.26	3.63	-0.66	-0.32
[28] Public administration	4.28	4.28	3.80	-0.48	-0.17