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ISSN: 2365-9793

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ABSTRACT

Immigration, Monopsony and the Distribution of Firm Pay*

We argue that the arrival of immigrants with low reservation wages can strengthen the monopsony power of firms. Firms can exploit "cheap" migrant labor by offering lower wages, though at the cost of forgoing potential native hires who demand higher wages. This monopsonistic trade-off can lead to large negative effects on native employment, which exceed those in competitive models, and which are concentrated among low-paying firms. To validate these predictions, we study changes in wage premia and employment across the firm pay distribution, during a large immigration wave in Germany. These adverse effects are not inevitable, and may be ameliorated through policies which constrain firms' monopsony power over migrants.

JEL Classification: J31, J42, J61, J64, J11
Keywords: immigration, monopsony, firms

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* We are grateful for feedback from seminars at Tel Aviv, UCL, Stuttgart-Hohenheim, "Migration and the Macroeconomy" workshop (Bocconi), MIT, IZA Migration Meeting (Boston), Warwick, Berkeley, CEPR Bank of Italy Workshop, Arizona State, Davis, UCLA, UBC, UT Austin, Javeriana, DICE, RWI-Cream workshop in Essen, University of Glasgow, EUI, ETH Zurich, Uppsala University, LISER, PSE and LMU Munich. Funding from the Israel Science Foundation under "The Labor Market Impact of Migration Under Monopsony" (grant no. 1548/18) and from the Comunidad de Madrid and MICIU (RYC2019-027614-I, AM-EPUC3M11 and H2019/HUM-5891) is gratefully acknowledged. Matan Kolerman provided excellent research assistance. This paper was previously circulated as "Immigration and Monopsony: Evidence Across the Distribution of Firms", and it subsumes parts of an earlier unpublished paper: "The Impact of Migration in a Monopsonistic Labor Market: Theoretical Insights" (Amior, 2017).

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 entirely on how immigration shifts the relative supply (and hence prices) of different factors of production, whether labor inputs or capital. However, if firms have monopsony power (i.e. the ability to set wages below marginal products), 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 the frictional wage-posting models of Albrecht and Axell (1984) or Burdett and Mortensen (1998). In this environment, an influx of migrants with low reservation wages will allow some firms to reduce their wage offers in equilibrium, even if marginal products remain unchanged. If firms cannot wage discriminate, this low-pay strategy forces them to forgo potential native hires who demand higher wages. But this monopsonistic trade-off becomes profitable for more firms as immigration increases.

The character of these wage and employment effects differs markedly from the canonical competitive model. Under perfect competition, any distributional effects are tied to the marginal products of heterogeneous *workers* (e.g. Borjas, 1999). But in our framework, the focus shifts to the distribution of *firms*. As more firms adjust their pay strategy, a low-pay sector emerges which disproportionately employs migrant labor. Notably, this workplace segregation does not preclude but rather *reflects* labor market competition between natives and migrants.

Our framework also permits large negative effects on native employment, which greatly exceed those in competitive models. By adopting a low-pay strategy, firms are implicitly rejecting native labor in favor of cheaper migrants. This amounts to a movement *away* from their labor demand curves, which the competitive model rules out. In principle, if migrants have sufficiently low reservation wages, firms may even profit by reducing their employment overall. While this implication may seem surprising, it mirrors the well-known insight that, under monopsony, a minimum wage may *increase* employment.

The essential role of small and low-paying firms in this story may appear counterintuitive, as "monopsony power" is commonly associated with large dominant firms, sustained by barriers to entry. But in our model, the increase in market power is driven by changes on the *other side* of the market (i.e. in labor force composition[1]), and this has very different implications. The emergence of a low-pay sector may also be amplified by selective firm entry, as immigration allows small unproductive firms to operate profitably (facilitating the creation of "bad jobs", in the language of Acemoglu, 2001).[2]

To test these predictions, we study a large and sudden influx of predominantly young and low-educated migrants from Eastern Bloc countries to Germany, triggered by the collapse of the Iron Curtain. We are not the first to study this event (see e.g. Angrist and Kugler, 2003, 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 appears well-suited to studying the implications of low reservation wages; indeed, the influx was accompanied by a fierce political debate on firms' alleged exploitation of migrant labor at low wages. New words were popularized to describe the phenomenon: as Figure 1 shows, a surge of references to *Lohndumping* ("wage dumping") and *Sozialdumping* ("social dumping") coincided precisely with the immigration wave.

We begin by providing evidence on wage-setting in our German context. Conditional on observable characteristics, new immigrants were paid 10% less than comparable natives. As our model predicts, this wage penalty is mostly a consequence of migrants sorting into low-paying firms: this is indicative of low reservation wages and an inability of firms to (perfectly) wage discriminate. Indeed, we find that natives and migrants benefited similarly from working in high-paying firms (see also Arellano-Bover and San, 2020, on Israel; Dostie et al., 2020, on Canada; and Aslund et al., 2021, on Sweden).[3] This opens the door to the monopsonistic trade-off at the heart of the model: firms can seek to secure migrant labor at low wages, but only at the cost of forgoing native hires.

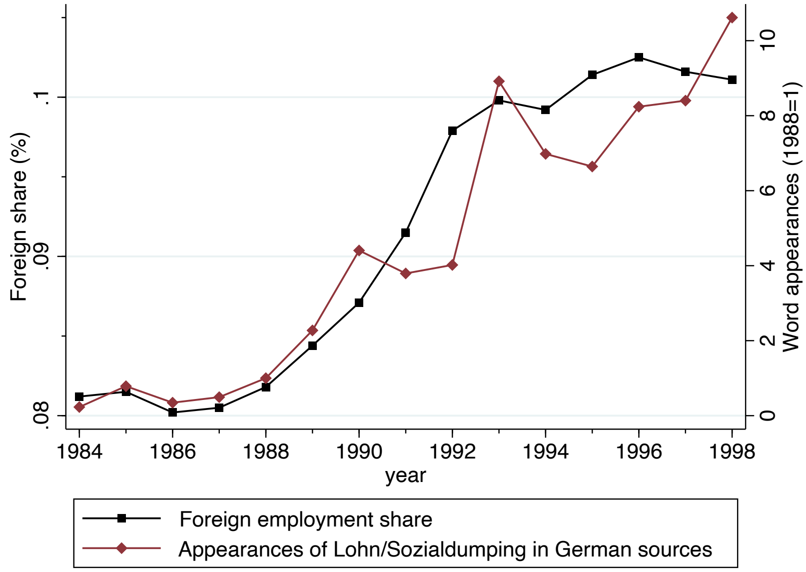
To estimate the impact of the shock, we exploit spatial variation in migrant inflows across local labor markets in West Germany, identified by pre-existing migrant enclaves (as in Altonji and Card, 1991; Card, 2001). The availability of detailed administrative registers for both workers and establishments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

[1]Firm size is ultimately an outcome, and its relationship with market power (whether positive or negative) will depend on the model and source of variation (Syverson, 2019; Manning, 2021).

[2]These insights also speak to Hsieh and Klenow (2009), who argue that labor and other inputs in developing countries are inefficiently concentrated in a long tail of low-quality firms. In our framework, such a tail is sustained by migrants with low reservation wages.

[3]More broadly, wage offers are often not tailored to individual workers, especially among the low-paid: see e.g. Caldwell and Harmon (2019), Lachowska et al. (2022) and Di Addario et al. (2023).

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 in German printed sources from Google Ngram, expressed as a share of total annual words in the database (and then indexed to 1 in 1988). *Lohndumping* is typically translated as "wage dumping", and *Sozialdumping* as "social dumping".

As the model predicts, the new immigrants disproportionately concentrated in small low-paying firms. In response, we see reductions in both wages *and* native employment at the bottom of the firm distribution. The crowd-out of native employment is so large that firm size contracted on average.[4] These findings are difficult to rationalize in a competitive labor market: one might expect the reduction in wage premia to encourage *more* hiring, as firms move down their labor demand curves. Instead, we interpret these effects as a movement *away* from firms' demand curves, as some firms shed native labor to exploit cheaper migrants.

Crucially, the wage effects at the bottom of the firm pay distribution are not driven by compositional changes in firms' employment. Rather, they reflect genuine reductions in wage premia (as identified by "AKM" firm fixed effects, as in Abowd, Kramarz and Margolis, 1999) for workers of fixed characteristics. Consistent with our model, these reductions were driven by both changes in pay among existing firms and the entry of new low-paying firms.

One *cannot* conclude from these results that immigration is generally harmful for native workers. Instead, our model suggests that its impact depends heavily on migrants' reservation wages and the institutional context (and not just on migrants' skill mix, as in

[4] In Appendix H, using (publicly accessible) local-area data, we show that immigration had similar negative effects on firm size in the US.

competitive models), which vary significantly across empirical settings. This may also help explain why some studies find large negative employment effects in settings with low-paid immigrants: see e.g. Angrist and Kugler (2003) on Western Europe; Dustmann, Schoenberg and Stuhler (2017) and Bruns and Priesack (2019) on Germany; Abramitzky et al. (2019), Amior (2020), Burstein et al. (2020), Monras (2020) and Doran, Gelber and Isen (2022) on the US; Muñoz (2021) on France and Belgium; and Delgado-Prieto (2021) on Colombia.

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 firms' monopsony power over migrants (rather than by restricting immigration itself), such as a minimum wage[5] (see e.g. Edo and Rapoport, 2019), a regularization policy (e.g. Amior and Manning, 2020; Monras, Vázquez-Grenno and Elias, 2020), or other interventions which improve the integration of migrants (Brell, Dustmann and Preston, 2020; Foged, Hasager and Yasenov, 2022).

Related literature

This paper subsumes parts of an earlier unpublished paper (Amior, 2017), which developed the theoretical argument. It is also closely related to Amior and Manning (2020), who consider the aggregate-level effects of immigration on monopsonistic wage mark-downs, using US skill cell variation. Relative to Amior and Manning, our contributions are both conceptual and empirical. First, we explore an equilibrium framework with multiple wage-posting firms: this allows us to draw new insights on the *distribution of firm pay*, and to assess the implications for *employment* (and not just wages). Second, we test our model's predictions using matched administrative data, exploiting a well-defined natural experiment.

Our hypothesis rests on new migrants having low reservation wages, a claim supported by a large and growing literature.[6] Several papers show (like us) that they concentrate in small and/or low-paying firms (Aydemir and Skuterud, 2008; De Matos, 2017; Dustmann, Ku and Surovtseva, 2019; Arellano-Bover and San, 2020; Dostie et al., 2020; Aslund et al., 2021): we offer a story for this phenomenon, based on non-discriminating firms. More broadly, this story can help account for workplace segregation of migrants, as documented by Hellerstein, Neumark and McInerney (2008) and Glitz (2014). Others offer evidence that firms (have the power to) extract larger rents from migrant labor (Winter-Ebmer and Zweimüller,

[5] When a minimum wage was introduced in Germany 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).

[6] This may also manifest in acceptance of worse workplace amenities: e.g. migrants are more likely to work at night or on weekends (Edo, 2015) or in jobs with higher injury risk (Orrenius and Zavodny, 2009).

1996; Nanos and Schluter, 2014; Hirsch and Jahn, 2015; Caldwell and Danieli, 2018; Amior and Manning, 2020; Biblarsh and De-Shalit, 2021; Costas-Fernandez and Lodato, 2023). The literature has rationalized low reservations in many different ways, though the precise mechanism is not important for our argument.[7]

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); Beerli et al. (2021); Egger, Auer and Kunz (2021); Mahajan (2022). Some of this work focuses on the technological implications of high-skilled immigration: in particular, Mitaritonna, Orefice and Peri (2017) explore productivity effects across heterogeneous firms. Others study how immigration affects the sorting or reallocation of workers across firms (Orefice and Peri, 2020; Brinatti and Morales, 2021; Gyetvay and Keita, 2023). Closer to our story, Malchow-Moller, Munch and Skaksen (2012) find that migrant employees depress native wages within Danish firms, and attribute this to migrants' low reservation wages; Edo (2015) makes a similar argument using skill cell variation. Using calibrated job search models, Chassamboulli and Palivos (2013; 2014), Chassamboulli and Peri (2015), Battisti et al. (2017) and Albert (2021) explore how migrants' reservations can affect wage bargaining and job creation. And like us, Delgado-Prieto (2023) finds that the effects of immigration in Colombia are concentrated in small firms, though the mechanisms are different.[8]

Our findings are also pertinent to the broader question of the distributional effects of immigration. Dustmann, Frattini and Preston (2012) study the effects of immigration along the native wage distribution, and Card (2009) and Gould (2019) estimate effects on residual inequality. Consistent with these studies, we find that the adverse effects of immigration are concentrated among low-earning natives. However, we highlight the important role of firms in shaping these distributional effects, independently of changes in worker productivity.

[7] 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 (Dustmann, Ku and Surovtseva, 2019; Albert and Monras, 2022). Poor information or undocumented status may inhibit job search (Hotchkiss and Quispe-Agnoli, 2013; Albert, 2021), and may also cause migrants to underestimate their outside options (as in Jäger et al., 2022). Migrants may discount their time in the host country more heavily, due to return intentions (Amior, 2017; Adda, Dustmann and Görlach, 2022), visa time limits, or deportation risk. Finally, several studies consider the implications of visa-related job mobility restrictions for firms' market power: see Matloff (2003); Depew, Norlander and Sørensen (2017); Gibbons et al. (2019); Hunt and Xie (2019); Wang (2021); Doran, Gelber and Isen (2022). For example, Naidu, Nyarko and Wang (2016) show that relaxing job mobility restrictions in the UAE boosted the wages of migrant employees (and improved retention).

[8] In our setting, this is an equilibrium outcome which arises from the wage-setting process (firms adopting a low-pay strategy, which exploits cheap migrant labor but excludes native hires). But in Delgado-Prieto, it reflects technological constraints particular to low-income countries (only small firms hire informal labor).

Our focus on the contribution of firm effects to wage inequality builds on the agenda of Card, Heining and Kline (2013) and Song et al. (2019). Like these studies, we rely on firm wage premia (for fixed individuals) estimated by the AKM method, which exploits job-movers for identification. In line with our model, we interpret these premia as reflecting firms' wage policies, determined in equilibrium. And we show empirically that these firm premia are malleable to economic shocks, just as our model predicts. This is not a trivial finding: as Lachowska et al. (2023) show, firm wage premia are very persistent over time. We also find that half the reduction in the wage premia is driven by the entry of new low-paying firms; similarly, Card, Heining and Kline (2013) show that entrants contribute substantially to growing pay dispersion at the *aggregate* level.

Building on Moretti (2004), Roca and Puga (2017) and Card, Rothstein and Yi (2021), we also use a similar AKM-style approach to identify regional wage premia (for fixed individuals), this time exploiting regional migrants for identification. This approach controls for compositional changes of the workforce, which have been found to bias the wage effects of immigration in earlier work (Bratsberg and Raaum 2012, Borjas and Edo 2021 and Dustmann et al. 2023). These regional premia can be interpreted as regional averages of the AKM premia of local firms; indeed, both respond similarly to the immigration shock.

In the next section, we set out our theoretical model. Section 3 then describes our natural experiment, and Section 4 explores the role of firms in wage-setting for natives and migrants. In Section 5, we describe our empirical strategy, which exploits spatial variation in the intensity of the shock. We estimate aggregate region-level labor market effects in Section 6, and then effects across the firm distribution in Section 7. In Section 8, we tackle the challenge of composition bias in our wage effect estimates, by tracking job-movers. Though our model guides us to focus on the *firm* distribution, we conclude in Section 9 by estimating more traditional sources of heterogeneity across the native *worker* distribution.

2 Model

Our key theoretical propositions can be derived from standard wage-posting models. In our main exposition, we rely on the framework of Albrecht and Axell (1984), which includes the minimal ingredients required for our argument: search frictions, monopsonistic wage-posting, and heterogeneous reservation wages. The model we consider is not new: our contributions are to apply it to the question of immigration, and to explore the associated comparative statics. The model is highly stylized, and we do not seek to estimate it: instead, we derive qualitative predictions, which we test empirically.

Suppose there are n workers and k firms. Firms produce a homogeneous output good whose price is normalized to 1, with labor 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). By fixing marginal products, we eliminate any labor market effects which materialize through the traditional competitive channels, allowing us to focus on the specific implications of our model.[9] Each firm pays a single wage w to all employees: in choosing this wage, firms trade off profit per worker with labor force size.

In our baseline model, only the unemployed search for work: they randomly meet firms at rate λ, and accept offers which exceed their reservations. At rate δ, workers are exogenously separated 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 reservation wages. In the baseline model, we attribute these differences to unemployment utility flows: natives receive b_N when unemployed, and migrants receive $b_M < b_N$. In practice, high discount rates r or low meeting rates λ may also contribute to migrants' low reservations, but we do not take a stance on this question: our focus is not the origin of low reservations, but rather their implications.

After presenting the heavily stylized baseline model, we explore a number of pertinent theoretical extensions. In particular, we consider the implications of heterogeneity in native reservation wages, on-the-job search (using the framework of Burdett and Mortensen, 1998), an endogenous offer rate λ, heterogeneous firms, a labor force participation margin, wage discrimination, heterogeneous skills, and co-ethnic networks.

2.1 Equilibrium in baseline model

Let w_0 denote the reservation wage of unemployed migrants (i.e. the minimum acceptable offer), and w_1 the reservation of natives. These reservations will of course depend partly on the distribution of wage offers, which is itself endogenously determined.

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

[9] In practice, we expect the labor market effects to be shaped by shifts in *both* monopsony power (as in our model here) *and* factor proportions (as in the canonical competitive model). Our point is not that the latter are unimportant: rather, they are not the *only* channel through which immigration affects labor markets.

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, so rU_N and rU_M are the native and migrant flow values. These consist of a basic utility flow (b_N or b_M), plus the expected asset gains from job finding, i.e. the $E-U$ terms, where $E_N(w)$ and $E_M(w)$ are the employment values in jobs paying w. 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 from random separations, which occur at rate δ.

Since w_1 is the native reservation, we have $E_N(w_1) = U_N$. Using (1) and (3), it follows that the native reservation is simply equal to their unemployment utility flow:

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

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. Intuitively, the migrant reservation wage w_0 exceeds their utility flow b_M, due to the opportunity cost of forgoing a high-wage offer w_1 (which arrives at rate $(1-\phi)\lambda$).

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

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

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

where ϕ is the share of firms in the low-pay sector (i.e. the share which offer w_0).

To close the model and solve for the low-pay sector share ϕ, we now specify the firm's problem. Each firm chooses a single wage w (either w_0 or w_1, as explained above) to maximize profit:

$$\max_{w \in \{w_0, w_1\}} \pi(w) = (p - w)\, l(w) \tag{8}$$

where $l(w)$ is the labor supply to the firm, comprised of both natives and migrants. Since firms cannot wage discriminate, there is a trade-off here: a lower offer w_1 increases profit per worker $(p - w)$, but reduces labor supply (as natives only accept w_1 offers).

As Rogerson, Shimer and Wright (2005) show, this model has a unique equilibrium. The equilibrium will take one of three forms, depending on the parameter values:

1. $\pi(w_1) > \pi(w_0)$ and all firms offer w_1 (i.e. the low-pay sector share $\phi = 0$)

2. $\pi(w_1) = \pi(w_0)$, and firms offer different wages[10] (i.e. $0 < \phi < 1$)

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

Corresponding to these three cases, the equilibrium low-pay sector share ϕ is:

$$\phi = \begin{cases} 0 & \text{if } \tilde{\mu} \leq \frac{r+\delta+\lambda}{r+\delta} \\ \frac{\delta+\lambda}{\lambda}\left[1 - \frac{r}{(r+\delta)\tilde{\mu} - (\delta+\lambda)}\right] & \text{if } \tilde{\mu} \in \left(\frac{r+\delta+\lambda}{r+\delta}, \frac{\delta+\lambda}{\delta}\right) \\ 1 & \text{if } \tilde{\mu} \geq \frac{\delta+\lambda}{\delta} \end{cases} \tag{9}$$

where

$$\tilde{\mu} = \frac{\mu}{1-\mu} \cdot \frac{b_N - b_M}{p - b_N} \tag{10}$$

See Appendix A for a derivation. Equation (9) shows that the equilibrium low-pay sector share ϕ is a continuous increasing function of the exogenous $\tilde{\mu}$ parameter. Intuitively, more firms will offer w_0 if (i) there are many migrants[11] (μ large) and (ii) if the migrant reservation b_M is small relative to b_N.

[10] Note that $\pi(w_1) = \pi(w_0)$ is not a knife-edge case: it arises for a discrete range of parameter values, as the low-pay sector share ϕ serves to equalize profits in equilibrium.

[11] If there are sufficiently few migrants (such that $\tilde{\mu} \leq \frac{r+\delta+\lambda}{r+\delta}$), a w_0 offer is never profitable (so $\phi = 0$). Conversely, if there are sufficiently many migrants (such that $\tilde{\mu} \geq \frac{\delta+\lambda}{\delta}$), all firms will offer w_0 (so $\phi = 1$).

2.2 Comparative statics

We now consider the impact of immigration on the labor market. Though we rely on the Albrecht and Axell (1984) framework, these comparative statics are new. 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: this allows us to abstract from scale effects, and focus entirely on the implications of labor force *composition*. Of course, one might expect $\frac{n}{k}$ to change in response to immigration, and we consider this possibility in an extension below. In practice though, it turns out that the $\frac{n}{k}$ ratio is little affected in our empirical application.

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

This result follows from the assumption that firms cannot tailor offers to individual workers: firms which adopt a low-pay strategy (i.e. w_0 in our stylized model) cannot recruit high-reservation workers (i.e. natives). In this way, workplace segregation (between natives and migrants) arises *endogenously* from firms' wage policies, even in the absence of homophily or ethnic networks.

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

To reduce its wage, a non-discriminating monopsonist must forgo employment of high-reservation workers (i.e. natives). But as the share of low-reservation migrants increases, the associated employment loss becomes smaller (i.e. labor supply becomes less elastic and monopsony power increases) at the bottom of the offer distribution. In response, firms optimally reduce their wage offers at this part of the distribution.

In our stylized model, this manifests through an expansion of the low-pay sector share ϕ: see equation (9). This wage effect is further amplified by a reduction in migrants' reservation wage w_0 (see equation (5)): intuitively, a larger ϕ causes migrants' outside options to deteriorate, so low-wage firms can now recruit them at even lower pay.

Looking at equation (10), the effect of migrant share μ becomes more negative as $\frac{b_N - b_M}{p - b_N}$ increases. Intuitively, immigration is more likely to induce firms to undercut native labor if migrant labor can be purchased more cheaply (i.e. if b_M is small relative to b_N).[12]

[12] Moreover, this effect is amplified if productivity p is low relative to the native reservation b_N: this limits the rents from employing natives, so a low-pay strategy becomes more attractive. This insight matters also for our empirical application, as Germany experienced a recession in the latter half of the period we study.

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

As firms reduce offers at the bottom of the pay distribution (as in Proposition 2), they must necessarily forgo employment of high-reservation workers (i.e. natives). At the aggregate level, the expansion of the low-pay sector share ϕ reduces native employment: see equation (6). As with the wage effect, this employment effect becomes more negative as $\frac{b_N - b_M}{p - b_N}$ increases. Among natives who remain employed, there is an implicit reallocation towards those (fewer) firms which continue to offer w_1.

Proposition 4. *A larger migrant share μ may induce firms to reduce their employment overall.*

Average firm size can be expressed as $\bar{l} = \phi l(w_0) + (1 - \phi) l(w_1)$, where ϕ is the share of firms offering w_0. As Appendix A.3 shows, taking the worker-firm ratio $\frac{n}{k}$ as given, the effect of migrant share μ on $\bar{l}$ is:

$$\frac{d\bar{l}}{d\mu} = \underbrace{\frac{n}{k}\left[\frac{\lambda}{\delta + \lambda} - \frac{\lambda(1-\phi)}{\delta + \lambda(1-\phi)}\right]}_{\text{Composition effect}} - \underbrace{\frac{n}{k} \cdot \frac{(1-\mu)\lambda\delta}{[\delta + \lambda(1-\phi)]^2} \cdot \frac{d\phi}{d\mu}}_{\text{Wage-setting effect}} \tag{11}$$

The sign of $\frac{d\bar{l}}{d\mu}$ 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 the size of low-pay firms, because only migrants accept their offers.

The second is a negative "wage-setting effect": a larger μ induces more firms to adopt a low-pay strategy (i.e. cut their offers from w_1 to w_0), which reduces native employment. Depending on the parameter values, either effect may dominate.[13]

2.3 What is new here?

These results differ markedly from the standard competitive framework, in two ways: (i) a shift in focus to the distribution of firms, and (ii) the potential size of employment effects. Both insights are new to the broader literature (even in nascent work tying monopsony to immigration), and are crucial to effective policy design. We discuss each in turn.

First, the impact of immigration varies along the distribution of *firms*, even among workers with identical skill. As the migrant share μ expands, more firms adopt a low-pay strategy

[13] For example, the wage-setting effect will dominate if the initial migrant share μ is sufficiently small. This ensures ϕ is close to 0 (few firms offer w_0), so the composition effect in (11) is close to zero.

and shed native labor. From the perspective of workers, high-wage jobs become increasingly scarce; and those who do not secure these jobs must either accept low offers or remain unemployed. This contrasts with more conventional models, where the effects of immigration vary only across the *skill* distribution, driven by differential changes in marginal products. Of course, we do not rule out the latter channel. But our model draws attention to important distributional effects which empirical research might otherwise miss.

Second, our model opens the door to potentially large negative employment effects, which are otherwise difficult to rationalize. In a competitive framework, since workers are paid their marginal product p, we are restricted to movements along the labor demand curve. Therefore, any reduction in wages (driven by changes in p) must be accompanied by an expansion of total employment n; and quantitatively, this expansion ought to be substantial.[14]

In contrast, in our model, immigration can generate a shift *away* from the labor demand curve (for any given marginal product p), as firms increasingly adopt low-pay strategies. As Proposition 4 shows, under these conditions, even a contraction of total employment becomes feasible (i.e. crowd-out exceeding one-for-one). This message is reminiscent of the theoretical discussion in the minimum wage literature. There, it is well known that a higher minimum wage need not generate employment losses if firms have market power. Similarly, in our context, a wage reduction need not be associated with an expansion of total employment.

These insights are crucial to the policy discussion: in our model, any negative wage or employment effects can be eliminated by policies which constrain firms' market power over migrants. These include regularization or integration policies (which can increase migrants' reservation wages) or a minimum wage set at b_N. These policies would have no such effect in a competitive model, where workers earn their marginal product p.

2.4 Theoretical extensions

The model above clarifies our basic story, but it is very stylized. We now consider various theoretical extensions: some amplify the effects we describe above, and others diminish them.

(i) Heterogeneous native reservations. In the baseline model, the wage and welfare effects fall entirely on migrants: this is because natives receive no surplus in equilibrium (they are paid their reservation wage), so they have nothing to lose from exiting employment. But this will not bear out under more general (and plausible) assumptions. For example, suppose

[14] Consider a pessimistic case for native labor, where native and migrant workers are perfect substitutes, in a two-factor model with labor and capital. Even here, assuming Cobb-Douglas technology (with a $\frac{2}{3}$ labor share), a 1% reduction in wages (driven by immigration) would generate a 3% increase in total employment (with capital fixed). And if capital is elastic, employment growth will be even larger.

some limited fraction of natives share the same unemployment utility flow as migrants, i.e. b_M. Then, natives' *realized* wages will also contract, and not just the *offers* they receive.

(ii) On-the-job search. In Appendix B, we introduce on-the-job search, in the style of Burdett and Mortensen (1998). Rather than a single wage w_0, the low-pay sector now consists of a continuous distribution of wage offers (between b_M and b_N), as firms compete directly for employees. Similarly, the high-pay sector contains a distribution of offers exceeding b_N. The basic propositions above are unaffected. But since natives now receive a surplus in equilibrium, we do now see a native wage effect even if all natives have equally large reservations (equal to b_N). Intuitively, when firms drop into the low-pay sector (following an immigration shock), this reduces competition in the high-pay sector; so firms can extract greater rents from natives (whose wages converge towards b_N). Also, this setting implies some interesting transitory dynamics: on arrival, migrants will begin at the bottom of the jobs ladder, and they will gradually work their way up. Indeed, job mobility is known to make an important contribution to migrant wage assimilation: see e.g. Lehmer and Ludsteck (2015), Dustmann, Ku and Surovtseva (2019) and Arellano-Bover and San (2020).

(iii) Other reservation wage stories. In the baseline model, we attribute differences in native and migrant reservations entirely to out-of-work utility, b_N and b_M. But in principle, these differences may be amplified by high migrant discount rates r or low contact rates λ.[15]

(iv) 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. Alternatively, if firms are free to 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. In Appendix C, we show the wage and employment effects (in Propositions 2-4) are preserved. Intuitively, firms will only enter in equilibrium if they can offer lower wages.

(v) Heterogeneous firms. The baseline model predicts differential wage and employment effects across the firm distribution, even though firms are identical. In Appendix D, we show that introducing heterogenous firms (which differ in productivity p) amplifies these wage and employment effects. As in Albrecht and Axell (1984), low-p firms offer lower wages in equilibrium, because they maximize profit at lower levels of employment. This also means

[15] For example, migrants might discount their time in the host country more heavily (lower r in the model), if they intend to return to their country of origin or face some deportation risk (Amior, 2017; Adda, Dustmann and Görlach, 2022). Alternatively, Caldwell and Danieli (2018) find that migrants in Germany have fewer outside job options than natives, akin to a lower λ in our model. As equation (5) shows, if $b_M < b_N$, a low r or low λ will reduce the migrant reservation wage w_0 further.

they drop into the low-pay sector (from w_1 to w_0) much more readily in response to immigration. Under 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.[16]

(vi) Native exit. In parallel to selective entry of firms, we might also expect selective exit of workers. If natives suffer a reduction in welfare, as in the on-the-job search extension, some may choose to exit the labor force (e.g. early retirement) or relocate elsewhere (if the shock is spatially concentrated). This causes the migrant share μ to expand further, encouraging more firms to adopt low-pay strategies, so even more natives exit, and so on. This process makes the labor market become ever less competitive.

(vii) Wage discrimination. We have assumed that firms cannot pay different wages to natives and migrants (doing identical work). This is a source of inefficiency: firms forego native employees who are willing to accept wages below their marginal product p. If instead firms can *perfectly* wage discriminate (i.e. the opposite extreme), they would recruit migrants at wage b_M and natives at b_N, and the migrant share μ would have no effect. Note that perfect discrimination arises 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; Battisti et al., 2017): this form of bargaining protects natives from any direct competition with migrant labor.[17] An intermediate scenario with *partial* discrimination (e.g. some firms can discriminate, others cannot) would preserve our model's predictions qualitatively, but diminish them quantitatively. In practice, in our German setting, we find little evidence of wage discrimination against migrants within firms.

(viii) Heterogeneous skills. For simplicity, we have assumed that natives and migrants share the same productivity, and compete in the same labor market. Suppose instead that natives and migrants are distributed across multiple skill types j, as in Amior and Manning (2020). The model above can then be interpreted as the labor market for a particular skill type j, whose constituent natives and migrants are productively identical. Wages in market j will depend on both p_j (the skill-specific marginal product) and firms' wage-setting choices. If migrants are distributed differently to natives across skill types j, this would partially shelter natives from direct labor market competition. If there is no skill overlap at all, wage undercutting effects would be fully eliminated. As Amior and Manning (2020) show, the

[16] This is analogous to Dustmann et al. (2020), who show how a larger minimum wage forces low-quality firms out of the market. And see also Manning (2010), who attributes the concentration of low-quality firms in smaller cities to weaker labor market competition.

[17] Though see Albert (2021) for a more complex bargaining model which does allow for direct competition.

implications of skill segregation are then analogous to wage discrimination: in both cases, natives are sheltered from direct labor market competition with migrants.

(ix) Co-ethnic networks. Gyetvay and Keita (2023) highlight the importance of firm-level co-ethnic networks: if migrants concentrate in different firms due to ethnic preferences or networks, this will moderate any labor market competition with natives.

Note that these "exogenous" forms of segregation (i.e. segregation which is determined outside the model, whether due to heterogeneous skills or preferences) have very different implications to segregation which arises *endogenously* through firms' wage policies (as in Proposition 1). While exogenous segregation *precludes* labor market competition between natives and migrants, endogenous segregation is an *outcome* of this same competition.

3 Data and German immigration shock

In this section, we characterize the German immigration shock of the late 1980s and early 1990s. After describing our data sources, we report national trends in migrant shares, and compare the characteristics of the new arrivals to natives and previous migrant cohorts.

3.1 Data sources

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). We use weakly anonymized versions, accessible by remote data execution. We augment our analysis with district-level population counts and bilateral flows from the Federal Statistical Office of Germany (*Statistisches Bundesamt*), the Federal Office for Building and Regional Planning (BBSR) and the 1987 Census (GESIS Data Archive, ZA2472). For our main analysis, we aggregate all data sources to 204 local labor markets (BBSR, 2014) in the SIAB, or 203 local labor markets in the BHP (which uses a more recent territorial definition, merging two districts). In this data, locations are defined based on place of work rather than residence, and we identify "migrants" by nationality rather than place of birth.[18]

Sample of Integrated Labour Market Biographies (SIAB) For our worker-level analysis, we use the SIAB-v7510 (Vom Berge, Burghardt and Trenkle, 2014), a 2% panel of all dependent employees subject to social security contributions. The data are representative for more than 80% of the workforce, but exclude civil servants, the self-employed,

[18]Naturalizations were infrequent in our analysis period, but became more frequent after 1998.

full-time students, and the military.[19] We restrict our sample to individuals aged 16-65 in West Germany (excluding West Berlin). For the employment analysis, we consider both full- and part-time workers, and construct an annual panel using employment records from June 30 of each year. Wages correspond to the average gross daily wage in the employment spell containing this reference date. We restrict the wage analysis to full-time workers. Wages are right-censored at the social security contribution ceiling (less than 6% of all observations): following Dustmann, Ludsteck and Schönberg (2009), we impute censored wages under the assumption that errors are normally distributed, while allowing for different residual variance by gender and year. We also impute missing educational information, following Fitzenberger, Osikominu and Völter (2006). The IAB allows users to attach establishment-level characteristics to worker records in the SIAB: among other outcomes, we merged the AKM firm fixed effects estimated by Card, Heining and Kline (2013) on the universe of employment records.

Establishment History Panel (BHP) To study effects across the firm pay distribution, we use the BHP-v7510 and BHP-v7519[20] (Gruhl, Schmucker and Seth, 2012), which covers half of all establishments subject to social security. For each establishment and year, the BHP contains detailed information on employment and wages. For presentational purposes, we use the terms "establishments" and "firms" interchangeably. Compared to the SIAB, the BHP offers two key advantages: it contains information on an establishment's entire workforce (while the SIAB only contains sampled workers), and it covers 50% of all establishments (the SIAB only covers 2% of employees).

3.2 National trends in immigration

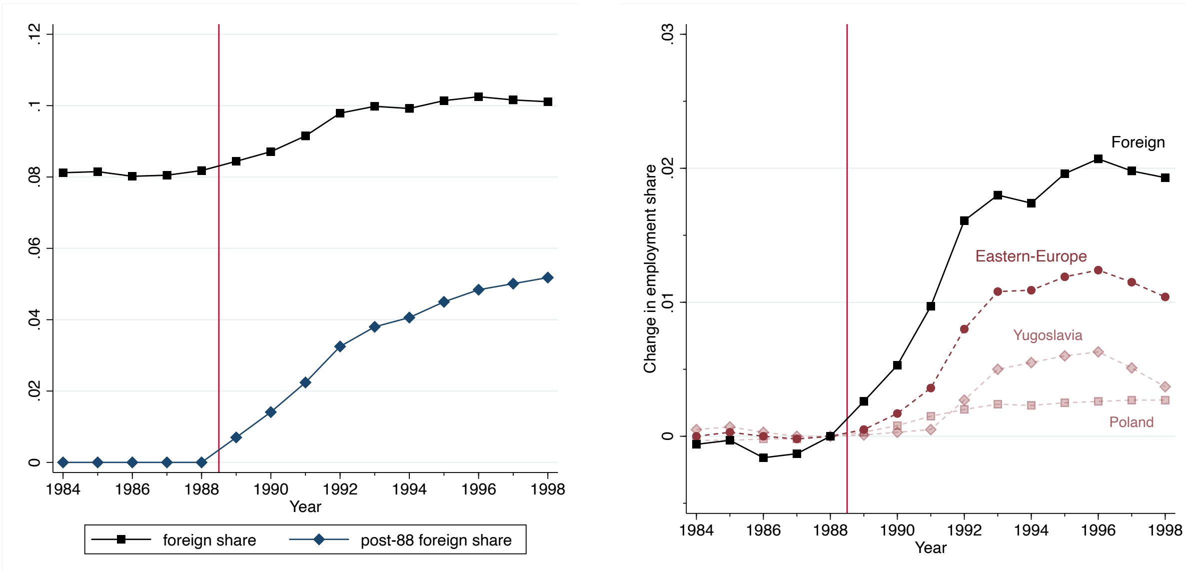
Germany experienced a large and sudden immigration wave during the early 1990s, triggered by the fall of the Iron Curtain and the Yugoslav War. As shown in Figure 2a, between 1988 and 1993, the share of foreign nationals in regular employment increased from 8 to 10% (black line). By 1997, over 5% of the West German workforce consisted of foreigners who entered after 1988 (blue line), corresponding to about 1 million workers. Figure 2b shows

[19] 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 due to legal restrictions (Brücker and Jahn, 2011).

[20] These are two different versions of the BHP. We use the BHP-v7510 to construct the regional immigrant shares and enclave instrument, as this version is the last to report employment structure of establishments by nationality. We use the BHP-v7519 for all other parts of our analysis: this version contains more detailed wage information, as well as AKM firm fixed effects estimated by Bellmann et al. (2020) on the universe of employment records, updating earlier estimates by Card, Heining and Kline (2013).

Figure 2: Foreign share in employment

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



Notes: SIAB, foreign share in employment (panel a) and change in employment shares of selected nationalities (panel b).

that much of the shock originated from Eastern Europe, especially Yugoslavia and Poland. While other European countries also experienced an upturn in migration at this time, the inflow was largest and sharpest in Germany (Angrist and Kugler, 2003). In addition, there was an influx of subcontracted "posted workers" from foreign firms: these numbered about 90,000 in 1993, most of whom were employed in construction (Werner, 1996).

3.3 Observable characteristics of new migrants

Table 1 shows that the new migrants (entering after 1988) had less education than natives, and were also much younger: more than 60% were under 30. They also tended to work in smaller firms: their average establishment size is half that of natives'. The contrast is even more striking when comparing new to previous migrants (which includes the so-called "guest worker" generation), who often worked in large establishments in manufacturing or other tradable industries (Brinatti and Morales, 2021).

The immigration shock was heavily concentrated in certain industries, as shown in Appendix Table A1. The foreign share increased by nearly 11 pp in the hospitality sector, and also grew strongly in agriculture, food manufacturing, household and business-related services, and construction. Few migrants entered the public sector or industries that were contracting at the time, such as mining. While earlier migrant cohorts were overrepresented

Table 1: Characteristics of natives and migrants

	Female	Education shares			Age shares			Estab.	Tradable
	share	Low	Mid	High	16-29	30-49	50-65	size (∅)	share
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Natives	0.420	0.164	0.754	0.082	0.294	0.487	0.219	1,336	0.378
Previous migrants	0.303	0.462	0.492	0.046	0.160	0.599	0.241	2,204	0.540
New migrants	0.354	0.620	0.340	0.040	0.625	0.347	0.028	718	0.349

Notes: SIAB, mean values for years 1990-96, among individuals aged 16-65. We define "previous" migrants as those who entered employment before 1989, "new" migrants entered in or after 1989. "Mid" education indicates upper secondary or vocational degree, and "high" indicates university or technical college. Sample size in millions is 2.064 for natives, 0.161 for previous migrants, and 0.073 for new migrants.

in tradable industries (a legacy of Germany's guest worker program, which filled jobs in mining, manufacturing and other heavy industries), new arrivals had a similar concentration in tradables to natives (column 9).

4 Validation of wage-setting assumptions

Our theoretical results are underpinned by the assumption that wage offers (to productively identical workers) can differ *between* firms, but not *within* them. Before estimating the effects of the immigration shock, we begin by assessing the validity of this assumption.

First, in Section 4.1, we show that new immigrants were paid 10% less than comparable natives. This wage penalty can be rationalized by low migrant reservation wages in many non-competitive frameworks, and not just in ours. But we show empirically that it is mostly a consequence of migrants *sorting into* low-paying firms, and not wage discrimination *within* firms – just as our model predicts (see Proposition 1). In Section 4.2, we then show further that natives and migrants benefit similarly from working in high-paying firms. These results are consistent with our particular assumptions on wage-setting, and open the door to the monopsonistic trade-off at the heart of the model.

4.1 Migrant wage penalties and firm effects

In Table 2, we use simple Mincer equations (for log wages) to estimate mean wage differentials between natives and migrants. On average, previous migrants earned slightly more than natives (4%), but new migrants earned 44% less (column 1). Though much of this differential can be statistically explained by age, education, gender and occupation (12-group

Table 2: Average migrant wage penalties

	Basic sample			Firms with natives and migrants		
	(1)	(2)	(3)	(4)	(5)	(6)
Previous migrants	0.041***	-0.005*	0.021***	-0.010***	-0.006***	-0.005**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
New migrants	-0.440***	-0.085***	-0.098***	-0.120***	-0.037***	-0.026***
	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)
Year fixed effects	Y	Y	Y	Y	Y	Y
Edu × age × sex FEs		Y	Y	Y	Y	Y
Edu × age × sex × occ FEs			Y	Y	Y	Y
Firm FEs					Y	Y
Firm × occ FEs						Y
Observations (mil.)	2.583	2.583	2.583	1.022	1.022	1.022
R^2	0.023	0.512	0.583	0.629	0.755	0.805

Notes: SIAB, mean values for years 1990-96, among individuals aged 16-65. We define "previous" migrants as those who entered employment before 1989, "new" migrants entered in or after 1989. Standard errors clustered at the establishment level, * p<0.10, ** p<0.05, *** p<0.01.

classification) in columns 2-3, new migrants still faced a 10% wage penalty conditional on these characteristics.[21]

We next study to what extent this residual wage penalty is driven by sorting *across* (as opposed to wage discrimination *within*) firms. To this end, we restrict our sample to firms which contain both natives and migrants. Though the sample is now 60% smaller, the wage differentials remain broadly similar (cf. columns 3 and 4), with a wage penalty for new migrants of 12%. In column 5, we now introduce firm fixed effects: remarkably, this eliminates most of the penalty, which contracts to under 4%. Conditioning on interacted firm-occupation effects (column 5) reduces the gap still further.

To summarize, the residual wage penalty in our data can mostly be attributed to sorting across firms, consistent with the wage-setting mechanism in our model. In Appendix E.5, we present more direct evidence that new immigrants are heavily concentrated in low-paying firms (with low median wages and low AKM premia).[22] This pay differentiation between firms is consistent with the German model of industrial relations: though there is collec-

[21]These large wage gaps are specific to the immigration episode that we study. In Appendix E.2, we show that after controlling for age, education, gender and occupation, there is little remaining wage gap between natives and new migrants in the early 1980s.

[22]These findings are in line with Aydemir and Skuterud (2008), Dustmann, Ku and Surovtseva (2019), Arellano-Bover and San (2020) and Dostie et al. (2020), who show that firm effects contribute significantly to migrant wage penalties in other contexts. Like Arellano-Bover and San (2020), we also show that in the years after arrival, migrants gradually sort to higher-paying firms. This phenomenon may be rationalized by an on-the-job search extension to our model: see Section 2.4.

tive bargaining at the industry-region level, individual employers can choose to opt out of collective agreements (Card, Heining and Kline, 2013; Jäger, Noy and Schoefer, 2022).[23]

While Table 1 reports average wage gaps, the gaps differ across groups. Migrant penalties were much larger for older workers, who also experienced sizable within-firm differentials (unlike the younger migrants who dominate our sample): new arrivals aged 45-64 experienced a 13% penalty conditional on firm fixed effects.[24] This pattern could reflect the institutional regulations that restrict pay for young workers (e.g., wage regulations for trainees) or the limited transferability of work experience from origin to destination country.[25]

4.2 Rent sharing across firm distribution

The analysis above suggests that the *average* migrant wage penalty (conditional on observable characteristics) is mostly driven by sorting across firms, rather than discrimination within them. This claim can be further buttressed by exploring rent sharing across the *firm distribution*. Specifically, we study to what extent natives and migrants benefit from working in higher-paying firms, applying a similar methodology to Card, Cardoso and Kline (2016), Goldschmidt and Schmieder (2017), Arellano-Bover and San (2020), Dostie et al. (2020), Gerard et al. (2021), Muñoz (2021) and Drenik et al. (2023).

We begin by estimating firm premia, separately for natives, new migrants and previous migrants. For each group, we estimate Mincer equations using the 1990-6 sample, conditional on year effects, interacted education-age-gender effects, and firm effects (which we save). We then regress the estimated firm premia for migrants (new and previous separately) on those of natives. Note that only those (typically larger) firms which contain both natives and migrants (in our 2% sample) will contribute to these regressions (around 10,000 firms).

We present our estimates in Table 3. The OLS coefficients in columns 1 and 4 are about 0.5 or 0.6. This suggests that a firm which pays natives 10% more (conditional on their observable characteristics) will typically pay migrants 5 to 6% more (relative to lower-paying firms): i.e. migrants do benefit from firm-specific rents, but not as much as natives.

[23] Notably, new immigrants are over-represented in small firms (see Table 1), which are less likely to be covered by sectoral agreements.

[24] This observation also explains why Dustmann, Schoenberg and Stuhler (2017) find larger wage penalties for Czech commuters in German firms: while foreign arrivals were comparatively young in our setting (see Table 1), Czech commuters were instead over-represented among middle-aged workers.

[25] Moreover, our estimates refer to regular jobs subject to social security, while wages were even lower among foreign nationals not covered by social security, such as "posted" workers (see *Frankfurter Allgemeine Zeitung*, 20/08/1993, "Streit um die Werkverträge"). Cyrus and Helias (1993) report that Polish posted workers received less than half the typical going rate. Though these practices were forbidden, firms found means of bypassing the rules. See also Muñoz (2021) on the pay penalties of posted workers in France.

Table 3: Differential rent sharing

	Previous migrant premium			New migrant premium			AKM premium
	OLS	IV	EB	OLS	IV	EB	EB
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Native firm premium	0.549***	1.005***	0.969***	0.586***	0.969***	1.011***	0.766***
	(0.014)	(0.037)	(0.020)	(0.018)	(0.045)	(0.032)	(0.006)
Observations	10,810	8,176	10,810	7,648	5,450	7,648	94,589

Notes: Firm-level regressions, based on SIAB data over 1990-96. "Previous" migrants entered employment before 1989, "new" migrants entered in or after 1989. The dependent variable in column 7 are AKM firm fixed effects as estimated by Card, Heining and Kline (2013). Standard errors clustered at the establishment level, * p<0.10, ** p<0.05, *** p<0.01.

We plot these relationships in Appendix Figure A1: they appear strongly linear.

However, these coefficients are likely to be attenuated by measurement error in the native firm premia. One way to address this concern is a "split-sample" IV strategy, as in Goldschmidt and Schmieder (2017) and Drenik et al. (2023): see Appendix E.3 for further details. We begin by splitting our native worker sample into two random groups, and we estimate native firm premia separately for each group ("group 1" and "group 2"). In columns 2 and 5, we then regress the migrant firm premia on the native premia from "group 1", using the "group 2" native premia as an instrument. The estimated coefficients on the native premia are close to 1, for both new and previous migrants.

One disadvantage of split-sample IV is that we lose firms that do not show up in both sub-samples. In columns 3 and 6, we apply an alternative empirical Bayes (EB) procedure described by Angrist, Hull and Walters (2022): as explained in Appendix E.3, this shrinks the variance of the firm premia, under the assumption that they are normally distributed. This yields very similar estimates to split-sample IV.

To summarize, our estimates suggest that on average, migrants benefit *equally* to natives from working for higher-paying firms. That is, even though new migrants are more likely to accept employment at lower-paying firms (Table 2), higher-paying firms appear to be unable or unwilling to discriminate against them. This is consistent with our wage-posting model, where firms offer a single wage to (productively identical) natives and migrants.[26] Dostie et al. (2020) find similar results in Canada; in Israel, Arellano-Bover and San (2020) estimate that migrants receive 85% of the wage rents of natives in high-paying firms in Israel (i.e.

[26]These observations are also in line with evidence from Caldwell and Harmon (2019), Lachowska et al. (2022) and Di Addario et al. (2023), suggesting that the labor market for low-wage workers is more typically characterized by wage-posting rather than individual bargaining.

there is some discrimination, but limited); and in Sweden, Aslund et al. (2021) find that migrants benefit somewhat *more* than natives from working in high-productivity firms.[27]

Unfortunately, without access to full count data, we do not have sufficient variation to estimate the firm premia conditional on worker fixed effects (as in the standard AKM routine in Goldschmidt and Schmieder, 2017; Drenik et al., 2023; Muñoz, 2021). Consequently, the estimates in Table 3 may in principle also reflect unobserved heterogeneity among native and migrant employees, across firms. However, we do have access to the AKM firm premia estimates of Card, Heining and Kline (2013) for the same 1990-96 period: while these are not estimated separately for natives and migrants, we are able to check whether they are correlated with our own premia estimates. In column 7, we replace the dependent variable with the AKM premia, while still using our (shrunk) native premia as a regressor. This delivers a substantial coefficient of 0.77, suggesting that our estimates are indeed good proxies for traditional AKM effects. Moreover, following a strategy similar to Aslund et al. (2021), we also show in Appendix E.4 that natives and migrants (both recent and longer-term) who *transition* from low to high-AKM firms benefit from very similar wage increases.

5 Empirical strategy

In this section, we describe our empirical strategy, which exploits variation in immigrant arrivals across regions (see Section 5.1) using a past-settlement instrument (Section 5.2). We also discuss potential confounders related to German reunification, the arrival of ethnic Germans and sectoral shifts (Section 5.3).

5.1 Regional variation and estimating equation

We exploit variation in immigrant arrivals across local labor market regions (*Arbeitsmarktregionen*) in West Germany. Specifically, we implement a generalized difference-in-differences model allowing for dynamic treatment effects, estimating separately for each year $t \in \{1985, ..., 1996\}$:

$$\Delta y_{rt} = \alpha_t + \beta_t \Delta m_r + \gamma_t X_{rt} + \varepsilon_{rt} \tag{12}$$

[27] Interestingly, the pattern appears very different for other, non-regular forms of labor: Drenik et al. (2023) find that *temp workers* (outsourced workers in temp agency work arrangements) only enjoy 49% of the firm pay premium as regular workers, while Muñoz (2021) finds that *posted workers* (foreign nationals not covered by social security) only receive 10% of the regular pay premium.

where $\Delta y_{rt} = y_{rt} - y_{r88}$ is the change in some regional outcome (such as wages or employment) in region r between the base year 1988 and year t, Δm_r is a measure of the aggregate regional immigration shock between 1988 (just before the migrant share began expand) and 1993 (when it stabilized), and X_{rt} is a vector of region r controls. We describe the shock variable and controls in greater detail below. Observations are weighted by employment in the base year. As equation (12) is expressed in differences, we are implicitly controlling for pre-treatment differences in the level of outcome y across regions (i.e. region fixed effects).

We estimate (12) separately for each year t. For post-treatment years $t > 1988$, the coefficients β_t represent the dynamic (reduced-form) impact of the immigration shock Δm_r on outcome y in year t. For pre-treatment years $t < 1988$, the β_t represent falsification tests on the existence of pre-trends (which can support 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. Moreover, our estimates are not subject to dynamic spillovers from earlier migration shocks, which can be sizable in other settings (Amior and Manning, 2018; Jaeger, Ruist and Stuhler, 2018).

We use the same immigration shock Δm_r in (12) for every year t, and irrespective of whether the outcome Δy_{rt} is defined over the entire local labor market r or for a particular subgroup of firms or workers. By using "pure" spatial variation, we avoid potential issues with the misclassification of migrants across groups; and our β_t estimates will identify total rather than just relative effects between groups (Dustmann, Schoenberg and Stuhler, 2016).

5.2 Identifying the immigration shock

We identify regional immigration shocks Δm_r with the enclave instrument of Altonji and Card (1991) and Card (2001): see Jaeger, Ruist and Stuhler (2018) for a recent survey.[28] This instrument predicts local changes in foreign shares based on the distribution of foreign nationals at baseline, motivated by migrants' preference to settle in large enclaves. The aim is to isolate variation which is orthogonal to omitted demand shocks. Formally:

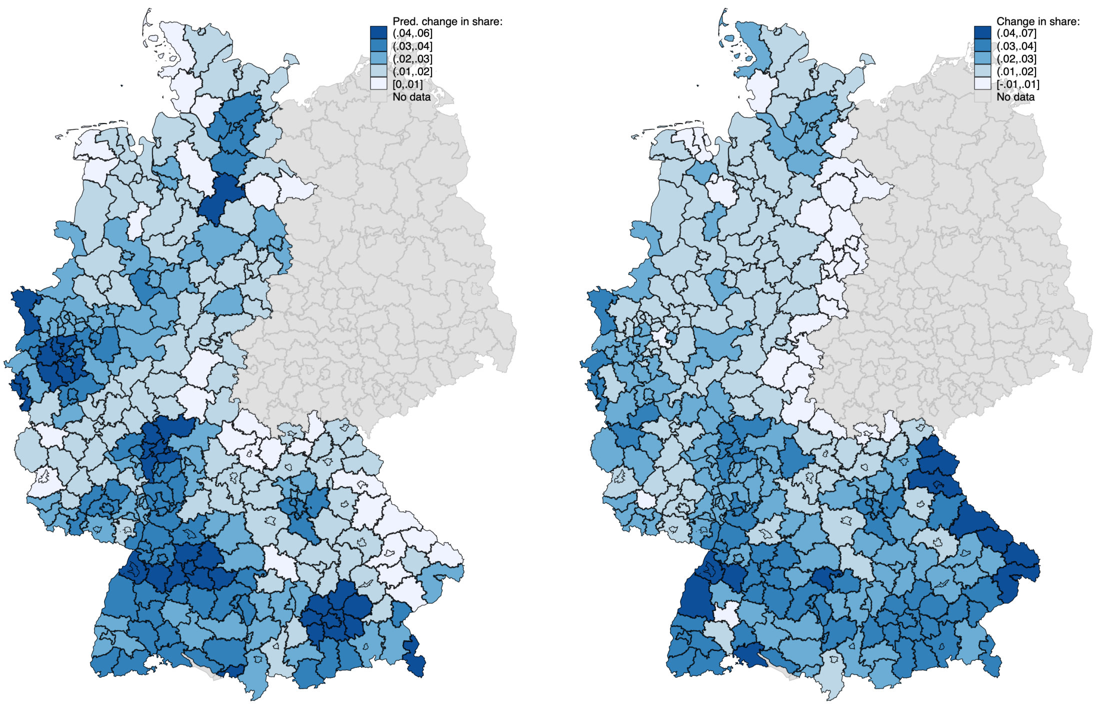
$$\Delta m_r = \frac{\sum_o s_{or80} \left(n_{o93} - n_{o88} \right)}{n_{r80}} \tag{13}$$

where $n_{o93} - n_{o88}$ is the 1988-93 national-level change in the number of origin o migrant workers, $s_{or80} = \frac{n_{or80}}{n_{o80}}$ is the share of origin o migrants located in region r in 1980, and the

[28] Our identification strategy differs from Bruns and Priesack (2019), who study the same immigration wave: they instead use distance to the south and east German borders as instruments.

Figure 3: Changes in foreign employment share (1988-93)

(a) Predicted: enclave shock Δm_r (b) Actual



Notes: BHP. Panel a plots the predicted change in foreign share between 1988 and 1993 (i.e. the enclave shock Δm_r, defined in (13)), across local labor markets in West Germany. Panel b plots the actual change in foreign employment share.

denominator n_{r80} is total employment in region r in 1980.[29]

Contrary to most applications, we use the enclave shock Δm_r as an explanatory variable, and not as an instrument for realized foreign inflows. In this sense, the coefficients β_t in (12) can be interpreted as "reduced form" effects of Δm_r. As with all shift-share instruments, identification may be motivated by the exogeneity of the initial local origin shares to omitted shocks (Goldsmith-Pinkham, Sorkin and Swift, 2020) or by exogenous aggregate-level (origin-specific) migrant inflows (Borusyak, Hull and Jaravel, 2022).[30]

Figure 3 maps the spatial distribution of both the enclave shock Δm_r (Panel a) and realized changes in foreign employment share (Panel b) between 1988 and 1993. Visually, the enclave shock does appear to predict immigration well: both are clustered in similar regions, including some of the larger cities (such as *Frankfurt, Munich* or *Stuttgart*) but also

[29] 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_{or} in other pre-treatment years or when using full-count employment data (from external sources) to construct the local shares (the latter addressing the potential influence of sampling error; see Aydemir and Borjas, 2011).

[30] As the immigration shocks in our analysis were triggered by external political events (see Section 3.2), our setting arguably satisfies the "exogeneity of shocks" assumption of Borusyak, Hull and Jaravel (2022).

in other lower-density regions. In Appendix Figure A3, we plot the two variables against one another: they are highly correlated, across both high and low-population regions.

There are some regions however where the enclave shock Δm_r lacks predictive power. We explore this in greater detail in Appendix F.2, but offer a brief summary here. First, the foreign share grew strongly close to the Czech border (in the South East), in sharp contrast to the predictions from the enclave shock. This reflects a special cross-border commuting policy (analyzed in Dustmann, Schoenberg and Stuhler, 2017) that permitted Czech workers to commute into Germany. Second, very few foreign arrivals worked close to the East-West German border: while Δm_r predicts an increase in foreign share of 2 pp, the actual increase is close to zero. This is likely a consequence of reunification in 1990: new foreign arrivals may have avoided regions close to the inner German border, to escape labor market competition with East Germans (who were migrating and commuting to the West in large numbers).

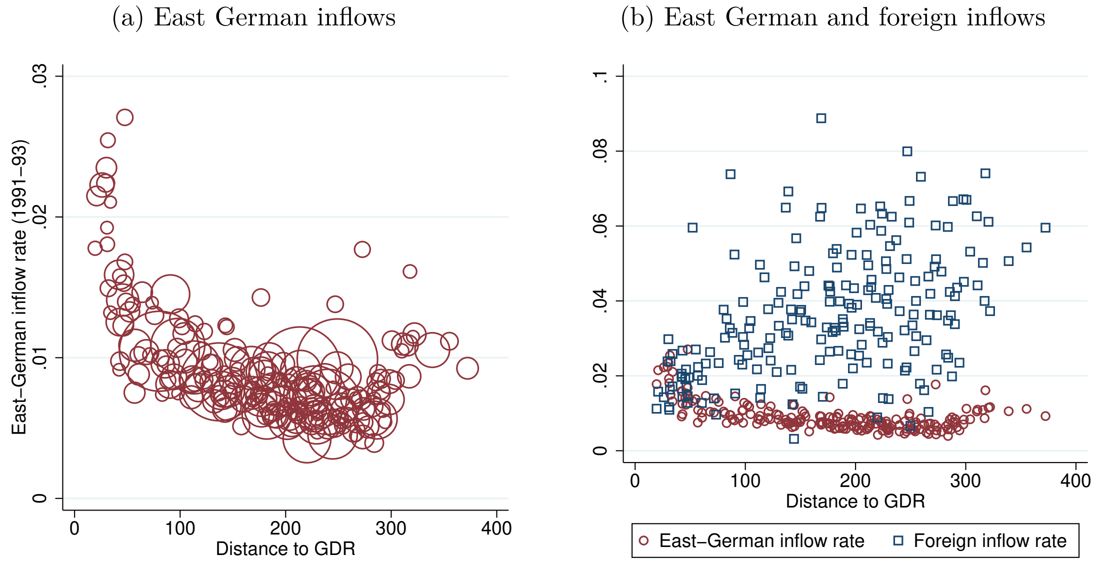
5.3 Potential confounders and controls

Our setting offers important advantages: external triggers of immigrant inflows ("push factors"), their large size and spatial dispersion, their sharp and unexpected onset after a period of steady foreign shares (allowing for a clean distinction between pre- and post-treatment periods), and high-quality panel data on both workers and firms. 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 West, (ii) the repatriation of ethnic Germans from territories of the former Soviet Union, and (iii) sectoral shifts related to the 1993 recession. We discuss each in turn.

(i) Reunification and inflows from East Germany. Reunification led to a large inflow of East Germans to the West. While East Germans are not reliably identified in the SIAB, we do have information on internal population movements between districts from the German Federal Statistical Office (*Kreiswanderungsmatrix*, from 1991). As Figure 4a shows (see also Bruns and Priesack, 2019), inflow rates of East Germans are very closely correlated with distance to the inner German border: the correlation with log distance is -0.67.

Figure 4b compares East German and foreign inflows. Two observations stand out. First, while East German inflows are a smooth function of distance to the inner German border, foreign inflows are highly variable and mostly uncorrelated with distance. The exception is those regions closest to the border, where foreign inflows are very low (as discussed above). However, after controlling for log distance to the border, actual and predicted changes in foreign share are uncorrelated with East German inflows (see Appendix F.3). We therefore

Figure 4: Comparing East German and foreign inflows



Notes: SIAB. Panel a plots the inflow rate of East Germans between 1991 and 1993 in West German labor markets, against the distance to the inner German border. Panel b compares East German inflows with foreign arrivals between 1989 and 1993.

control for log distance in all regressions. Note this control also captures other distance-related consequences of reunification, such as changes in the spatial distribution of trade.

(ii) Repatriation of ethnic Germans. After World War II, about 15 million Germans fled from former territories of the German Reich. While most moved to Germany in the postwar years, some remained in regions that 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 Appendix F.4, we show that ethnic German and foreign inflows are negatively correlated spatially, but the relationship is weak.[31] The repatriation of ethnic Germans is therefore not a concern for our analysis.

(iii) Other demand and supply shocks. As in most studies of immigration, foreign shares are spatially correlated with sectoral and demographic structure. This is a concern if these regional attributes are predictive of future wage or employment growth. In particular, the recession of 1993 led to large employment losses in manufacturing, shortly after the foreign inflow rate peaked in 1991.[32] To address this challenge, we control for two Bartik-type shift-shares in our empirical specification, which predict local employment and wage

[31] Moreover, this negative relation would be part of the overall impact we aim to capture, if ethnic Germans (like the native-born) avoided those local labor markets that were more heavily exposed to foreign inflows.

[32] Note the recession is only a *confounder* if its intensity covaries spatially with the immigration shock. At the *aggregate* level however, it may also amplify the genuine wage-setting effects we seek to identify. As we show in Section 2.2, these effects become more acute in a labor market with low productivity p.

growth (respectively) based on each region's 1980 industrial composition.[33] Turning to the supply side, a potential concern is the sharp decline in fertility in West Germany in the 1960s and 1970s, which generated large regional heterogeneity in population growth in subsequent decades.[34] To exclude this variation, we project working-age population growth (age 18-59) forwards using regional population pyramids from the 1987 census (aging each local cohort year-by-year); and we control for these projections in all empirical specifications.

6 Aggregate region-level effects

We begin in this section by studying the aggregate effects of immigration on local labor markets, following the example of much of the literature. Our estimates point to large crowd-out of native employment. We have shown above how such a result can be rationalized in a monopsonistic labor market model with non-discriminating firms. In Section 7, we will test this interpretation by exploring wage and employment effects across the firm pay distribution.

6.1 Changes in regional foreign share

In Figure 5a, we plot the effects of the enclave shock Δm_r on the foreign employment share, as estimated by equation (12). The black line shows the overall foreign share, relative to 1988: there is no pre-trend, and the β_t coefficient peaks at about 0.3 in 1993. The blue line traces the effect on the share of post-1988 foreigners: this is zero by construction before 1988, and expands to about 1 by 1995. This coefficient will be useful for interpreting the effects which follow: a 1-point effect of Δm_r corresponds to a 1 pp foreign inflow. From the perspective of our model, it is the post-1988 arrivals who matter, as the evidence suggests they accept lower wage offers (see Section 4). In Appendix G.2, we show that this response is robust to different sets of controls and regression weights.

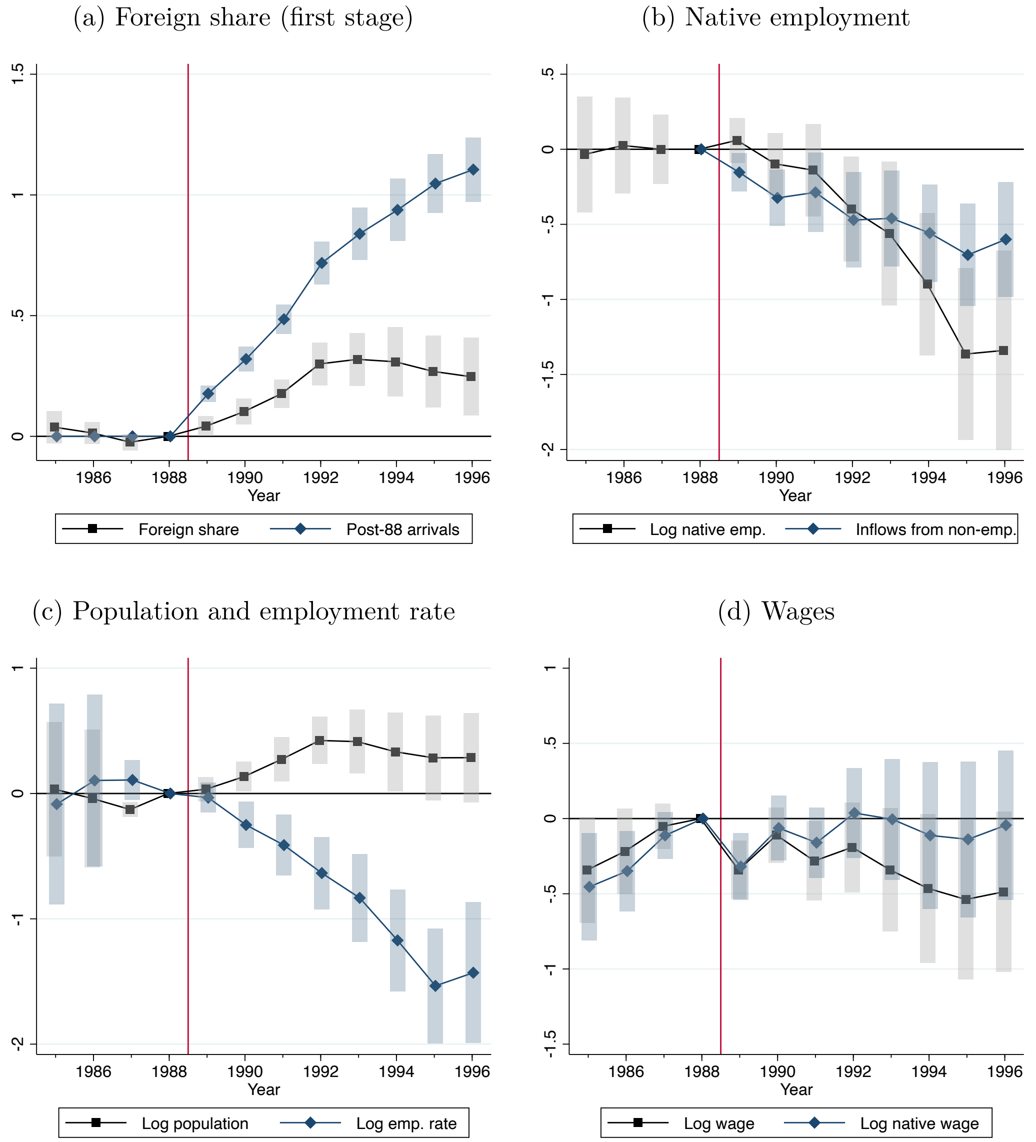
6.2 Impact on regional employment and wages

We next assess the aggregate labor market impact. Figure 5b shows the effect on log native employment *levels* (again, relative to 1988), using equation (12). We find large negative

[33] The "employment Bartik" weights national-level industry employment trends with initial industrial composition, as in Bartik (1991). The "wage Bartik" (which builds on Beaudry, Green and Sand, 2012) applies these weights to national-level wage trends. We use a two-digit industry classification, with 94 codes.

[34] This decline had an important spatial dimension: it was most acute in regions where fertility was initially highest (Basten, Huinink and Klüsener, 2011).

Figure 5: Regional impacts



Notes: SIAB, regression estimates based on equation (12) across 204 local labor markets, with 95% CIs. The dependent variable is the regional change in a given outcome between 1988 and year t. Panel a focuses on the foreign employment and post-1988 arrival shares, Panel b on log native employment and the contribution of inflows from non-employment, Panel c on log population and employment-to-population rate, and Panel d on the mean log wage of all full-time workers and native workers.

effects, reaching -1.3 by 1995 for a 1 pp immigration shock. This estimate varies somewhat with different sets of controls and regression weights, but is always below -1 (Appendix G.2). In the same figure, we show it is partially driven by a reduction in native *inflows* from non-employment into employment, especially in the first years after treatment.[35]

[35] To estimate the inflow response, we control for inflow rates in the pre-treatment period, as these differ between regions more and less exposed to immigration. We explain this exercise further in Appendix G.1.

The crowd-out effect in this setting is large compared to other studies in the literature, but it is not unique: Dustmann, Schoenberg and Stuhler (2017) find that Czech commuters in Germany (in the same period) also induce large displacement; and see Muñoz (2021) on posted workers in France, and Delgado-Prieto (2021) on Venezuelan refugees in Colombia, for other recent examples. Our model predicts that the size of the employment effect depends on how migrants' reservation wages compare to natives', and this will vary substantially by context. In Appendix G.4, we explore this idea by comparing the effect of immigration shocks from different origin countries. The negative employment effects in 5b are driven by origin groups which typically sort into lower-paying firms (which reflects lower reservation wages), just as our model would predict.[36] In Appendix G.5, we show that crowding-out occurs in all sectors, but is largest in tradable industries.

Figure 5c shows a moderate increase in the population of 15-65s (based on Federal Statistical Office data): this follows a similar trajectory to the foreign employment share in Figure 5a. At the same time, the blue line shows a large reduction in the employment-to-population rate, which contracts by 1.5% by 1995 for a 1 pp immigration shock. This effect is robust to different sets of controls and regression weights (Appendix G.2).

Finally, Figure 5d shows that the average *regional* wage across all workers declines (black line), reflecting the arrival of low-paid migrants; but it remains stable for native workers (blue line). This might appear surprising, given the large reduction in the employment rate. However, we will show below that these wage effects are contaminated by compositional shifts in the native employment stock: similar to Bratsberg and Raaum (2012), Borjas and Edo (2021) and Dustmann et al. (2023), the crowd-out of native employment is disproportionately driven by low-paid workers (see Section 9); and this masks the causal effect of immigration on individual wages. We address these compositional changes in Section 8 using a "movers" design, which reveals a substantially negative impact on regional wage premia.

7 Effects across the firm pay distribution

To test the claims of our model more explicitly (and specifically Propositions 1-4 in Section 2.2), we next study the impact of regional immigration shocks across the firm pay distribution. For this analysis, we rely primarily on the Establishment History Panel (BHP), as described in Section 3.1. While providing less details than the individual-level SIAB, the

[36] For this exercise, our empirical approach is to disaggregate the enclave shock Δm_r into origin components, similar to Amior (2020). And see also Costas-Fernandez and Lodato (2023), who explore differences in the effect of immigration (in the UK) from countries with high/low reservation wages.

Table 4: Number of firms and firm size (1988-1995)

	Log number of firms	Log mean firm size		Δ Log share of firms with # employees			
		All firms	Incumbents	1-4	5-19	20-99	100+
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Enclave shock Δm_r	0.277	-1.020***	-0.798**	0.329***	-0.473**	-1.364***	0.188
	(0.218)	(0.287)	(0.321)	(0.103)	(0.232)	(0.289)	(0.605)

Notes: BHP, regression estimates based on equation (12) across 203 local labor markets. Incumbent firms are those present in both 1988 and 1995. The dependent variable in columns 4-7 is the regional change in the log share of firms of the indicated size between 1988 and 1995. * p<0.10, ** p<0.05, *** p<0.01.

BHP covers half of all establishments subject to social security contributions, allowing us to track how different parts of the firm pay distribution respond.

7.1 Number of firms and firm size

To interpret the distributional effects, it is useful to first document what happens to the *number* of firms (k in the model).[37] Column 1 of Table 4 shows this expands somewhat, but not significantly. The growth in the working-age population (i.e. n) in Figure 5c is in fact very similar, implying that the $\frac{n}{k}$ ratio is unaffected, as we assume in the baseline model.

However, we do see a large reduction in mean firm size in column 2. This finding is robust to specification (Appendix G.2), and is driven by an increase in the share of small firms (below five workers), and a decrease in the share of medium-sized firms (columns 4-7). It is not merely a consequence of entry and exit: column 3 shows the firm size reduction is similar among "incumbent" firms (present in both 1988 and 1995). This indicates that the contraction of local employment (Figure 5c) is occurring partly *within* firms. This may appear surprising: one might expect firms to expand their employment as more labor becomes available. But as Proposition 4 shows, it can be rationalized by monopsonistic firms trading off native employees for cheaper migrant labor. To explore whether this is a plausible interpretation, we next study the impact of the shock across the firm distribution.

Though firm size is an unusual outcome in the immigration literature, it is a natural focus of our model – and simple to measure in many contexts. For comparison, we offer evidence on firm size effects in the US in Appendix H, exploiting spatial variation in enclave shocks between 1980 and 2020 (expanding the analysis of Amior, 2020). As in our German setting, we find negative effects on firm size, though the US effects are smaller in magnitude.[38]

[37] We use the terms "establishments" and "firms" interchangeably.

[38] A natural interpretation is that the "wage-setting" effect (in Proposition 4 of the model) is more dominant

Table 5: Descriptive statistics by firm wage quartile (in 1988)

	Q1	Q2	Q3	Q4
Establishments (#)	162,313	162,484	162,455	162,606
Mean wage (log)	3.023	3.622	3.899	4.217
Employment	474,204	1,180,779	2,668,530	5,477,851
Shares in each quartile	0.048	0.119	0.269	0.552
Skill shares				
Low skilled	0.293	0.266	0.248	0.186
Medium skilled	0.672	0.702	0.707	0.707
High skilled	0.016	0.021	0.035	0.096
Establishment size				
mean (firm-weighted)	2.9	7.3	16.4	33.6
mean (worker-weighted)	16.8	72.8	401.0	1873.6
share small (emp<5)	0.845	0.645	0.466	0.417
share large (emp>=100)	0.001	0.007	0.026	0.053
Tradable industry share	0.189	0.306	0.357	0.475
Share foreigners	0.093	0.073	0.075	0.067
Destination shares of job movers (rows sum to 1)				
Movers originating from Q1	0.291	0.306	0.219	0.185
Movers originating from Q2	0.101	0.374	0.295	0.230
Movers originating from Q3	0.032	0.148	0.419	0.403
Movers originating from Q4	0.020	0.065	0.209	0.705

Notes: All data except for final panel based on Establishment History Panel (BHP) in 1988, by quartiles of the median establishment wage (within local labor market and year). Shares of job movers computed using SIAB, 1985-1988. Skill, industry and foreign shares are worker-weighted.

7.2 Firm quartile definitions

Our model makes predictions on how immigration affects the distribution of firm pay and migrant/native employment across this distribution. To test these predictions, we split firms into four quartiles according to their median wage, separately for each region and year. This will allow us to track quartiles of the firm pay distribution (within regions) over time. Our approach here is analogous to labor analyses which track percentiles of the *worker* distribution (as in e.g. Acemoglu and Autor, 2011; Dustmann, Frattini and Preston, 2012), except we are doing so for firms.[39] Note that tracking quartiles (rather than percentiles) makes it simple to explore employment effects across the firm distribution.

in our German setting, due to lower migrant reservation wages.

[39] The identity of firms within these quartiles is liable to change, but this is by intent. We do not track *individual* firms, as our model has nothing to say about how individual firms respond. Additionally, tracking individual firms is empirically challenging given the vast churn in the firm population: 38% of firms in 1995 were not present in 1988 (our baseline year). Nevertheless, in sensitivity tests below, we show what happens if we restrict the sample to incumbent firms (which are present in both years).

Table 5 provides summary statistics by quartile for the year 1988 (pre-treatment). Firms in the bottom quartile pay 60 log points less than those in Q2, and 120 less than those at the top. Low-paying firms also tend to be smaller: the mean firm has just 2.9 workers in Q1, compared to 33.6 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 also employ more low-skilled and foreign workers (at baseline), but these differences are less pronounced.

In the model, we assume that firms participate in a single labor market, with pay disparities sustained in equilibrium by search frictions. To support this interpretation, the final panel of Table 5 describes worker mobility across the four quartiles (using annual job transitions in the SIAB, 1985-1988). Job movers frequently switch between quartiles, with upward mobility from low- to high-pay firms significantly more common than downward mobility. This is indicative of a "jobs ladder", a natural consequence of search frictions: see Burdett and Mortensen (1998) or the on-the-job search extension in Appendix B. The firm quartiles thus appear to be part of an integrated labor market, not distinct labor market segments.

7.3 Changes in foreign share by firm quartile

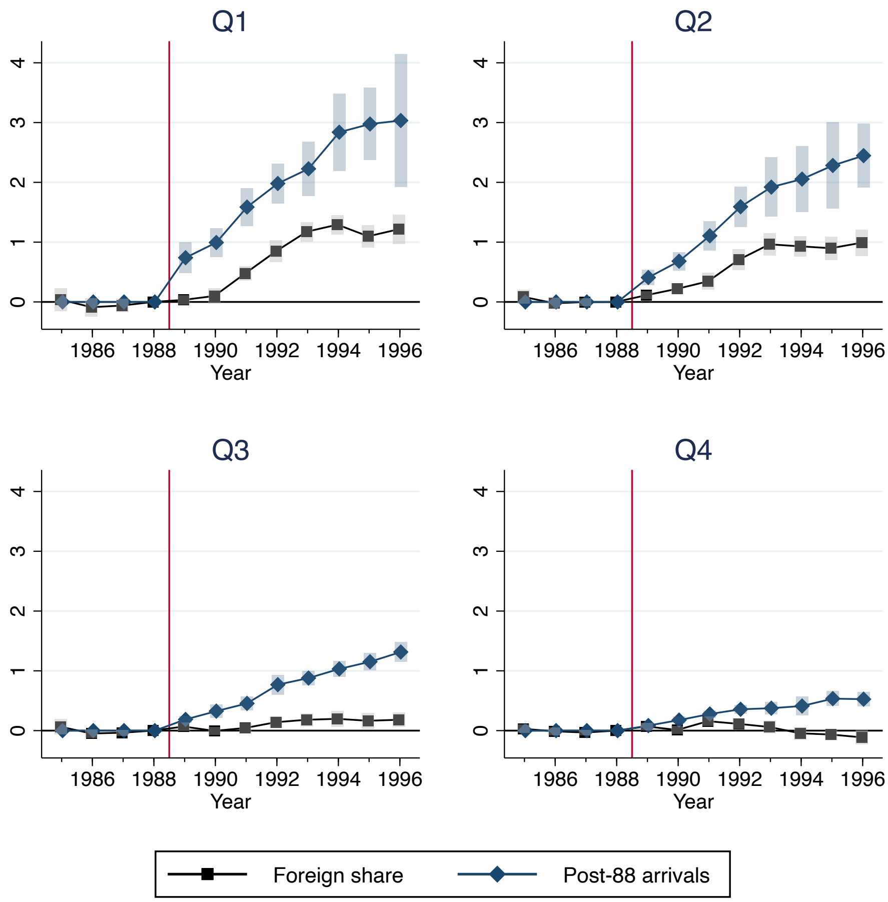
Figure 6 estimates the allocation of (new) immigrants across the distribution of firms. Using equation (12), for each firm quartile, we regress changes in (i) the foreign share and (ii) the post-1988 foreign share on the enclave shock Δm_r. The post-1988 share (blue line) increases in all quartiles, but much more in low-wage firms: the expansion (in pp) is six times larger in Q1 than Q4. The increase in the overall foreign share (black) is even more concentrated at the bottom: the share does not change in Q3 and Q4. This finding is consistent with Proposition 1: *migrants concentrate in low-paying firms*. Our model suggests that this sorting effect is key to understanding firms' wage-setting response and the impact on native employment.

7.4 Wage and employment effects by firm quartile

In Figure 7, we trace the impact on mean log wages and native employment, separately by firm quartile. The blue line shows a large wage reduction in Q1 (where the new immigrants are most heavily concentrated), a milder effect in Q2, and no significant effect in high-wage firms. As Table 6 shows, the wage effects are similar for natives and migrants: this indicates that they are not merely driven by changes in firm-level migrant composition.[40] The effects

[40] We study the relative contribution of firm entrants and incumbent firms in the next section.

Figure 6: Impact on foreign share by firm wage quartile



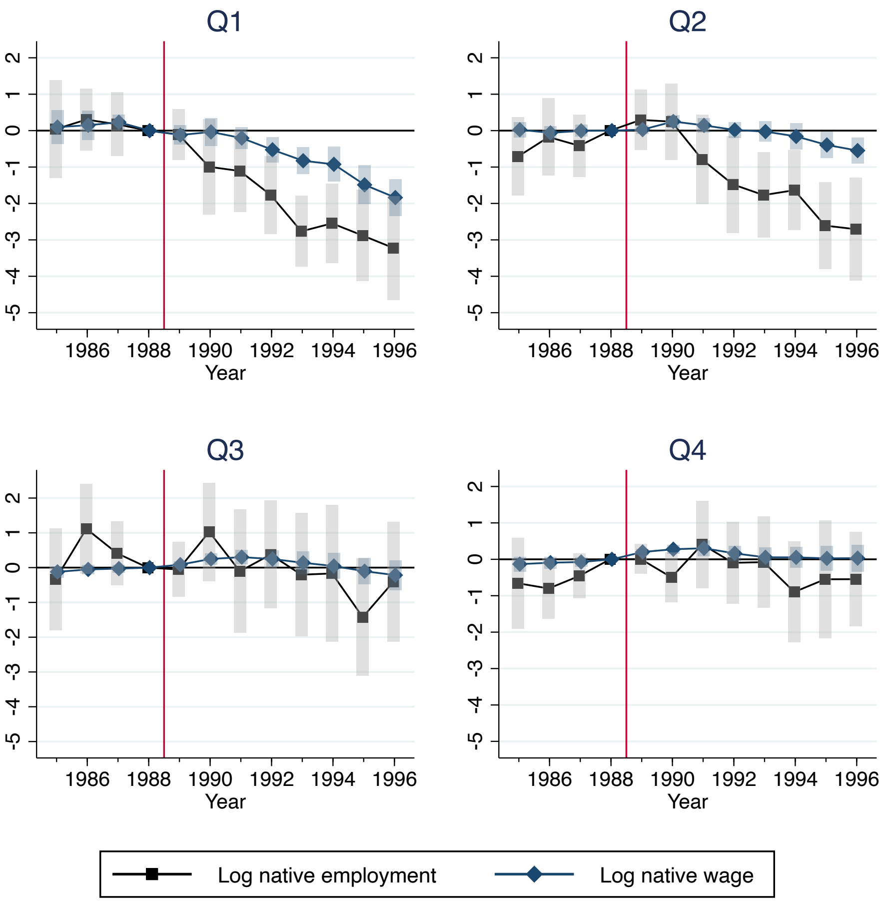
Notes: Regression estimates based on equation (12) across 203 local labor markets with 95% CIs. The dependent variable is the regional change in the foreign employment share (black line, measured in the BHP) or post-1988 arrivals shares (blue line, SIAB) in the respective quartile of the firm wage distribution, between the base year 1988 and the indicated year.

are precisely estimated and consistent with Proposition 2: *A larger migrant share induces firms to reduce wage offers at the bottom of the pay distribution.*

In terms of magnitude, a predicted 1 pp immigration shock reduces the Q1 native wage by 1.5% by 1995. The national-level inflow was nearly 5% by 1995 (Figure 2), implying a 7.5% average reduction in Q1 across all regions. This is a large effect, but Q1 firms only account for about 5% of employment (Table 5). The wage effects are therefore heavily concentrated in a small corner of the labor market. Distributional effects on local wages have previously been identified by Card (2009), Dustmann, Frattini and Preston (2012) and Gould (2019); our estimates highlight the role of firms in generating these effects.

An alternative way to present these effects is to estimate changes in firm pay by percentile (rather than by quartile), and we do so in Appendix G.3 for the 1988-95 period. We also

Figure 7: Wage and employment and effects by firm wage quartile



Notes: BHP, regression estimates based on equation (12) across 203 local labor markets with 95% CIs. The dependent variable is the regional change in log native employment (black line) or the mean log establishment wage (blue line) in the respective quartile of the firm wage distribution, between the base year 1988 and the indicated year.

show in the same appendix that restricting the sample to incumbent firms (present in both 1988 and 1995) does not affect the basic patterns. Among other implications, this indicates that the wage effects are not merely driven by shifts in industrial composition.

We next turn to native employment. Proposition 3 predicts: *A larger migrant share induces firms to shed native employment at the bottom of the pay distribution.* Consistent with the proposition, Figure 7 shows a large and rapid reduction in native employment in Q1: a predicted 1 pp immigration shock reduces native employment in 1995 by 2.9%. We observe similarly large native employment losses in Q2, mild losses in Q3, and no significant effect in Q4.[41] As a result, while new migrants concentrate heavily at the bottom of the firm

[41] Interestingly, the reduction in native employment in Q2 manifests slightly later than the effects in Q1. This can be rationalized by the "native exit" extension in Section 2.4. Intuitively, the reduction of wage

Table 6: Wage and employment effects by firm quartile (1988-95)

	By firm wage quartile			
	Q1	Q2	Q3	Q4
	(1)	(2)	(3)	(4)
Panel A: Firm log wage effects				
all	-1.675***	-0.569***	-0.239	-0.040
	(0.278)	(0.187)	(0.195)	(0.161)
natives	-1.488***	-0.393**	-0.104	0.026
	(0.273)	(0.184)	(0.193)	(0.172)
foreign	-2.193***	-0.417	0.089	1.026***
	(0.444)	(0.302)	(0.287)	(0.259)
Panel B: Log employment effects				
natives	-2.882***	-2.608***	-1.423*	-0.548
	(0.639)	(0.607)	(0.861)	(0.827)
total	-0.851	-1.122*	-1.160	-0.458
	(0.725)	(0.665)	(0.761)	(0.840)

Notes: BHP, regression estimates based on equation (12) across 203 local labor markets. Top panel: Dependent variable is the regional change in the mean log establishment wage in the indicated firm quartile between 1988 and 1995. Bottom panel: Dependent variable is the regional change in log native or total employment in the quartile.

distribution (Figure 6), native employment becomes increasingly concentrated at the top.

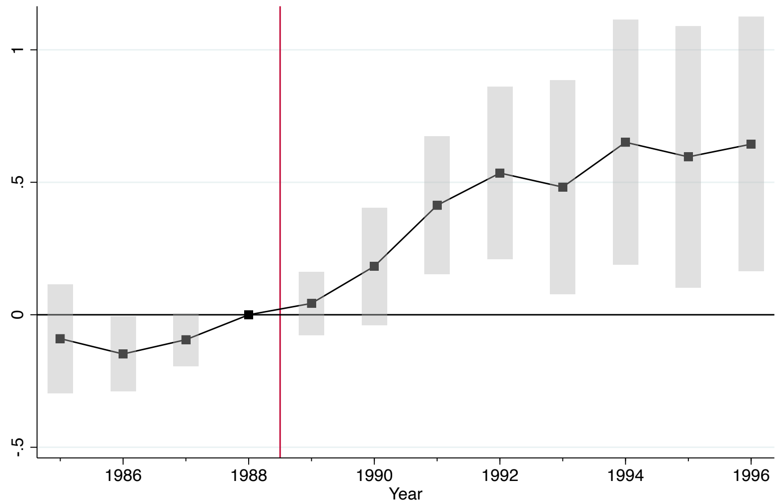
The reduction in native employment in Q1 is so large that even *total* employment contracts (Table 6, Panel B), despite the heavy concentration of new immigrants in these firms. These results are difficult to rationalize in a competitive model: one might expect the large wage reduction in Q1 to encourage *more* hiring, as firms move down their labor demand curves. However, the results are consistent with monopsonistic firms moving *away* from their demand curves, as they attempt to secure cheap migrant labor while forgoing native hires. This possibility is highlighted by Proposition 4: *A larger migrant share may induce firms to reduce their employment overall.*

7.5 Impact on workplace segregation

As firms forgo native labor and hire migrants, workplace segregation is bound to increase. Figure 8 shows the impact of immigration on the index of dissimilarity, a popular measure

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.

Figure 8: Impact on workplace segregation



Notes: BHP, regression estimates based on equation (12) across 203 local labor markets with 95% CIs. The dependent variable is the regional change in the index of dissimilarity between 1988 and the indicated year.

of segregation:

$$ID_r = \frac{1}{2} \sum_{i \in r} \left| \frac{\text{Migrants}_i}{\sum_{i \in r} \text{Migrants}_i} - \frac{\text{Natives}_i}{\sum_{i \in r} \text{Natives}_i} \right| \tag{14}$$

where i denotes establishments in region r. This index compares the shares of the migrant and native workforce (within region r) employed in each establishment, and varies from 0 (no segregation) to 1 (perfect segregation). Segregation grew strongly in affected regions in the early 1990s, reflecting both the concentration of new immigrants in low-pay firms (Figure 6) and the crowding-out of native workers from those same firms (Figure 7).

A common interpretation of workplace segregation is that natives and migrants do not compete for the same jobs. But our model shows how such segregation can arise endogenously precisely because firms prefer to hire cheaper migrant labor while forgoing native hires. Workplace segregation may then not mitigate, but *reflect* labor market competition between natives and migrants. By limiting the scope of migrants' coworker networks, such (endogenous) segregation may in turn impede the long-run integration of immigrants into the host economy (Hellerstein, Neumark and McInerney, 2008; Glitz, 2014; Willis, 2022).

8 Impact on regional and firm wage premia

Above, we show evidence of large native employment effects. If these effects are selective, regional wage changes may partly reflect shifts in worker *composition*, rather than the impact on any particular worker: see e.g. Bratsberg and Raaum (2012), Dustmann, Schoenberg and Stuhler (2017), Ortega and Verdugo (2022) and Borjas and Edo (2021). To address this "selectivity bias", we now identify wage effects from *movers*, i.e. workers who move between firms or regions, based on two-way fixed effect models. Unlike most studies adopting this strategy, we do not use it to decompose wage differentials in the *cross-section*, but rather to identify *changes* in (regional or firm) wage premia following a shock.

We begin in Section 8.1 by exploiting movers between local labor markets to identify *regional* wage premia, similar in spirit to Moretti (2004), Roca and Puga (2017) or Card, Rothstein and Yi (2021). In Section 8.2, we then consider *firm-level* ("AKM") premia, as in Abowd, Kramarz and Margolis (1999). We estimate the regional premia ourselves using worker-level panel data from the 2% SIAB sample. For the firm premia, we rely on AKM effects estimated by others researchers on the universe of employment records (and attached to our BHP data): though this deprives us of flexibility in picking subgroups or time intervals, it does impose discipline in specification. While both regional and firm premia can be used to study region-level wage effects (and yield similar results, as we show below), the latter also allow us to track impacts across the firm pay distribution.

8.1 Regional wage premia

To identify the regional wage premia, we estimate the following equation separately for different three-year intervals[42] (1983-85, 1986-88, and so on):

$$y_{it} = \alpha_t + \eta_{r(i,t)} + \theta_i + \gamma X_{it} + \varepsilon_{it} \tag{15}$$

where y_{it} is the log wage of worker i at year t, α_t are year fixed effects, $\eta_{r(i,t)}$ are region fixed effects (for the region r in which individual i worked in year t), θ_i are individual fixed effects (which account for time-invariant productivity differentials), and the vector X_{it} includes full interactions between gender, education and a cubic in age (centered at age 40). Since we control for individual fixed effects, the regional premia η_r are identified from workers who move between regions. We then use the *change* in premia relative to the pre-treatment period (e.g., $\hat{\eta}_{r,1991-94} - \hat{\eta}_{r,1986-88}$) as the dependent variable in our regional regression (12).[43]

[42] In choosing these intervals, we face a trade-off between improving the precision of the estimated premia (by using longer intervals) and the granularity at which we can identify changes in premia over time (by using shorter intervals). Using three-year intervals provides a good balance between these two objectives.

[43] This approach is different from purging time-constant individual fixed effects, as in e.g. Dustmann, Schoenberg and Stuhler (2017). While such designs capture wage changes among *incumbent* workers, iden-

Table 7: Mean changes in regional wage premia

	Movers			Raw wage	Residualized
	1983-85 v 1986-88 (1)	1991-93 v 1986-88 (2)	1994-96 v 1986-88 (3)	1994-96 v 1986-88 (4)	1994-96 v 1986-88 (5)
All workers	-0.110	-0.326	-0.827***	-0.360	0.186
	(0.334)	(0.220)	(0.220)	(0.301)	(0.230)
Natives only	-0.060	-0.301	-0.944***	0.121	0.264
	(0.340)	(0.209)	(0.241)	(0.284)	(0.219)

Notes: SIAB, regression estimates based on equation (12) across 204 local labor markets. Columns 1-3 report the estimated effect on (mover-identified) regional wage premia η_r, as detailed in Section 8.1. Columns 4-5 report the effect on raw wages or residualized wages (controlling for age-education-gender interactions, but not individual fixed effects). * p<0.10, ** p<0.05, *** p<0.01.

To identify the regional premia η_r in (15), we require an "exogenous mobility" assumption: the sequence of ε_{it} innovations must be orthogonal to the sequence of worker i's location choices (see Card, Rothstein and Yi, 2021, for a detailed discussion). In support of this claim, Appendix G.6 shows that the wage trends of workers moving between low- and high-premia regions are parallel before the move, consistent with the assumption that such location changes are uncorrelated with other individual determinants of wage growth.

In Table 7, we estimate effects of the enclave shock Δm_r on changes in the regional wage premia η_r, separately for different worker samples (rows) and periods (columns). In column 1, we show that there are no differential pre-trends in the estimated wage premia for all workers (row 1) or native workers (row 2), with regional premia developing similarly in more and less exposed areas before the shock materialized.

Column 2 shows that the wage effect in the 1991-93 period is negative, but not statistically significant. However, the point estimates become more negative and significant by 1994-96, with a 1 pp immigration shock decreasing wages by about 0.9%. This suggests that immigration did reduce wages for individuals of fixed characteristics; but this effect is concealed by compositional changes in standard regressions (such as in Figure 5d), as low-wage native workers were crowded out.[44]

To illustrate this problem more explicitly, column 4 shows what happens if we use simple regional means of log wages as our dependent variable (instead of mover-identified wage

tification in our exercise stems entirely from *movers*. By estimating (15) separately for each period, we implicitly allow for worker fixed effects to differ between the pre- and post-periods.

[44] We provide direct evidence on these compositional changes in Section 9 below.

Table 8: Mean changes in firm wage premia

	Mean AKM (1)	Contributions: firm incumbents (2)	firm entrants (3)	firm exiters (4)
$\overline{AKM}_{r,1} - \overline{AKM}_{r,0}$	-0.723***	-0.376***	-0.405***	0.058
	(0.134)	(0.037)	(0.042)	(0.097)

Notes: BHP, regression estimates based on equation (12) across 203 local labor markets. Firm "AKM" premia are estimated by Bellmann et al. (2020) on the universe of employment records, for the periods 1985-92 ($\overline{AKM}_{r,0}$) and 1993-99 ($\overline{AKM}_{r,1}$). * p<0.10, ** p<0.05, *** p<0.01.

premia). And in column 5, we residualize wages against the observable education-gender-age interactions in the X_{it} vector, a common strategy in studies which rely on cross-sectional data. As the results show, these “naive” specifications do not capture the negative wage effects: it appears that they do not control sufficiently for compositional shifts.

In Appendix G.4, we compare how regional wage premia respond to immigration from different origin countries. Consistent with our model’s predictions, the negative effects are driven by origin groups which typically sort into lower-paying firms (indicative of lower reservation wages). In Appendix G.5, we also show the wage premia decrease in all sectors.

8.2 Firm wage premia

We showed in Section 7 that 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 wage-setting choices of the firms *themselves*, as the model implies. For example, it may be that low-paying firms employ low skilled workers who compete more heavily with the new migrants; and the wage effects simply reflect a reduction in the price of low skilled labor in the local labor market (as a competitive model would predict). To isolate a shift in wage policies (as opposed to marginal products), we study changes in AKM firm wage premia.

As explained above, we rely on firm premia estimated by Bellmann et al. (2020) (updating earlier estimates by Card, Heining and Kline 2013), which have been attached to our BHP data. Bellmann et al. estimate these premia in two distinct periods: 1985-92 and 1993-99 (which we treat as our “pre” and “post” periods). For each period, they extract the premia from a model for log wages, conditional on observable (time-varying) worker characteristics, worker fixed effects, and time fixed effects.

Before exploring the distributional effects, we first highlight the connection with the regional premia above: these are simply averages of the premia of their constituent firms. With this in mind, Table 8 estimates the impact of immigration on the *average* firm premium. Let $\overline{AKM}_{r,0}$ denote the mean AKM effect in area r in the pre-period (i.e. "0"), and let $\overline{AKM}_{r,1}$ denote the mean post-period AKM effect (i.e. "1"). Column 1 shows that the change, i.e. $\overline{AKM}_{r,1} - \overline{AKM}_{r,0}$, contracts by about 0.72 in response to a 1 pp immigration shock. As one would expect, this is similar to the effect on the *regional* premia in Table 7 (column 3).[45] This estimate is also robust to different sets of controls and regression weights (Appendix G.2).

In principle, this change in firm premia may be driven by (i) wage cuts by incumbent firms (i.e. those present in both the pre- and post-period) or (ii) a shift in firm composition towards lower-paying firms due to selective entry or exit. The incumbent effect can be motivated by our baseline model, and the compositional effect by the "heterogeneous firm" extension in Section 2.4: a labor market with low-reservation workers can sustain lower-paying (and possibly less productive) firms. In Appendix G.7, we show how the contributions of incumbents, entrants and exiters can be decomposed empirically. Column 2 shows that incumbent firms account for about half the overall effect, and column 3 shows the remainder is driven by the entry of new low-paying firms (exiters make no significant contribution).

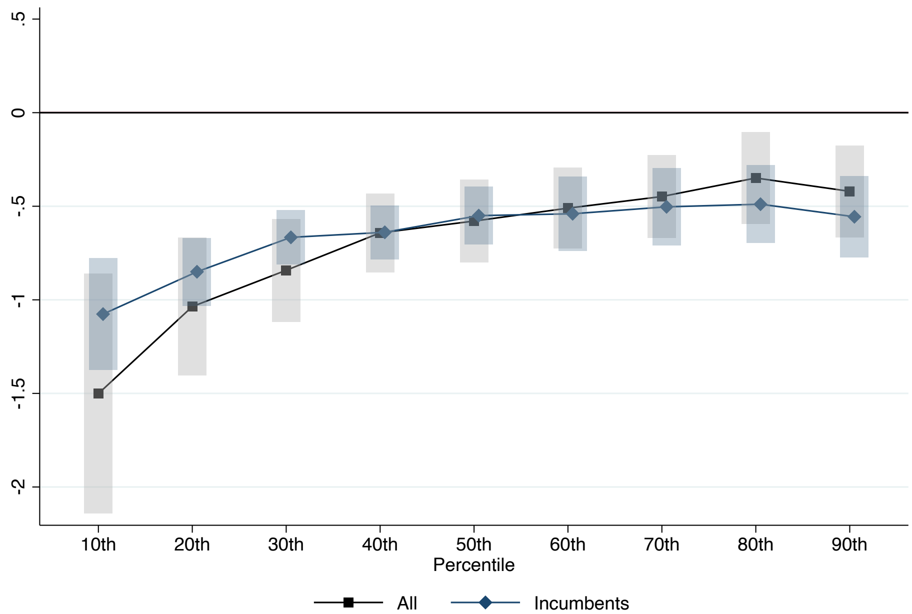
In Figure 9, we assess the impact on the *distribution* of firm premia (i.e. percentiles of the AKM firm fixed effects) within regions. Consistent with Table 6, the effects are largest at the bottom of the distribution. For a 1 pp immigration shock, the 10th percentile AKM contracts by 1.5%, while the 90th percentile contracts by only 0.4%. The blue line shows effects for incumbent firms only, i.e. those present in both the pre- and post-period. The patterns are qualitatively similar, though the decline in wage premia is moderated at the lower percentiles: this reflects the exclusion of new low-wage entrants from the sample (as identified by column 4 of Table 8).[46]

This exercise builds on the agenda of Card, Heining and Kline (2013) and Song et al. (2019), who explore changing dispersion in firm premia at the *aggregate* level. In contrast, Figure 9 does so at the regional level, in response to an *identifiable shock*; and importantly, this response is predictable by economic theory. Interestingly, Card, Heining and Kline (2013) find that much of the aggregate-level increase in firm pay dispersion in Germany can

[45]The estimates are even more similar if we estimate the regional premia in the SIAB using the same "pre-" and "post-" periods as we use in Table 8 (i.e. 1993-99 v 1985-92). This yields a coefficient of -0.739 (with a 0.138 standard error), which is very close to the column 1 estimate in Table 8.

[46]In Appendix G.3, we show equivalent percentile plots for the distribution of median wages (rather than AKM premia) across firms. The results are qualitatively similar, though wage effects are smaller across the full distribution: this reflects the influence of shifts in worker composition.

Figure 9: Changes in AKM firm wage premia by percentile



Notes: BHP, regression estimates based on equation (12) across 203 local labor markets.

be attributed to new entrants: we find the same in response to the immigration shock.

To summarize, this section identifies large wage reductions at the bottom of the firm pay distribution, which are attributable to changes in *firm premia* and not to worker composition. These effects are driven by both incumbent firms (present both before and after the shock) and by the entry of new low-paying firms. These results are consistent with the model's predictions, and can be attributed to the arrival of migrants with low reservation wages.

9 Effects across the native worker distribution

Guided by our model, we have focused above on effects across the distribution of *firms*. In this section, we offer estimates across different *worker* types, more in line with the existing literature. In standard competitive models, this kind of heterogeneity can be attributed to differential changes in workers' marginal products. Though our model takes marginal products as given, we do not discount the possibility of such effects – and hence this analysis.

We present our estimates in Table 9. Each column reports wage and employment effects for different groups of workers. We focus on (i) changes in regional native wage premia, using the "movers" design described in Section 8.1, and comparing the periods 1994-96

Table 9: Native wage and employment effects across worker distribution

	Full	Gender		Age		
	sample	Men	Women	16-29	30-49	50-65
	(1)	(2)	(3)	(4)	(5)	(6)
Δlog native wage (movers)	-0.944***	-0.991***	-0.742	-1.237***	-0.250	-0.079
1994-96 v 1986-88	(0.241)	(0.265)	(0.468)	(0.420)	(0.293)	(0.794)
Δlog native employment	-1.364***	-0.808**	-2.225***	-1.530***	-2.607***	0.229
1995 v 1988	(0.292)	(0.346)	(0.292)	(0.366)	(0.371)	(0.940)
	Education		Worker wage FE			
	Low	Mid/high	Q1	Q2	Q3	Q4
	(7)	(8)	(9)	(10)	(11)	(12)
Δlog native wage (movers)	-2.397*	-0.659**	-1.655***	-0.988**	-0.677**	-0.621
1994-96 v 1986-88	(1.292)	(0.264)	(0.558)	(0.475)	(0.296)	(0.417)
Δlog native employment	-1.907***	-1.905***	-2.279***	-0.903**	-0.273	-0.338
1995 v 1988	(0.455)	(0.347)	(0.589)	(0.419)	(0.386)	(0.701)

Notes: SIAB, regression estimates based on equation (12) across 204 local labor markets. The dependent variable in row 1 is the change in regional wage premia between the periods 1986-88 (pre-treatment) and 1994-96 (post-treatment) estimated using a "movers" design (as in Section 8.1). Row 2 shows log native employment changes between 1988 and 1995.* p<0.10, ** p<0.05, *** p<0.01.

(post-treatment) and 1986-1988 (pre-treatment), and (ii) changes in log native employment between 1988 and 1995.

As a benchmark, column 1 shows effects for the full sample: the wage effect is identical to Table 7 (column 3), while the native employment effect replicates Figure 5b. As already discussed, we see large negative coefficients in each case.

Columns 2-3 decompose these effects by gender. The wage effects are slightly more negative for men, but also more precisely estimated. The reduction in native employment is much more pronounced for women, consistent with French evidence from Borjas and Edo (2021), and the notion that they have more elastic labor supply.

Column 4-6 shows the wage effects are largest for very young workers (under 30), among whom the new migrants are heavily concentrated (see Table 1); but the employment effects are most negative for middle-aged natives (30-49). A natural interpretation is that the 30-49s have higher reservation wages, so are less willing to accept the reduced wage offers.[47] The wage and employment effects for older workers (aged 50+) are close to zero, but these are

[47] A similar pattern – with wage and employment effects showing inverse patterns across age groups – is reported by Dustmann, Schoenberg and Stuhler (2017).

estimated with vast standard errors, so should be interpreted with caution.[48]

Turning to columns 7-8, the wage effects are more negative for low-educated workers, but employment effects are similar across education groups.[49] Whether migrants compete with low or highly educated natives is not obvious in our setting, due to the young age of the immigrant arrivals and the important role of vocational training in the German labor market: while most migrants have "low" education at arrival (see Table 1), many enter trainee positions that lead to a vocational qualification corresponding to "mid/high" education.

Until now, we have focused on workers' observable characteristics. But in columns 9-12, we split the native worker sample into four quartiles ordered by individual fixed effects[50]: in practice, these fixed effects will identify a mixture of unobserved skill and the firms in which these workers happen to be employed. The estimated wage effects are monotonically decreasing, from a peak of -1.7 in the bottom quartile to -0.6 at the top. We also find very large native employment effects at the bottom (reaching -2.3 in column 9). Both the wage and employment effects are statistically insignificant in the top quartile.

To summarize, the wage effects fall mostly on young and low-paid natives, and the low-paid also face the largest employment losses. These results are broadly consistent with the canonical factor proportions model, which predicts that the adverse effects of immigration are concentrated among "similar" natives. But interestingly, the differences are most pronounced when classifying workers by their *wage* rather than education or age.[51] Unsurprisingly then, we also find an increase in aggregate wage inequality in exposed labor markets: a 10 pp immigration shock increases the standard deviation of native log wages by 0.061 (s.e. 0.015).

10 Conclusion

In this paper, we argue that the arrival of immigrants with low reservation wages strengthens the monopsony power of firms. Firms can exploit "cheap" migrant labor by cutting wage

[48]Moreover, we observe a positive pre-trend in employment for this age group which (if extended to our analysis period) would imply the estimated employment effect is biased positively.

[49]Our definition of "mid/high" education here encompasses both the medium and high education categories reported in Table 1, containing more than 80% of native employment. We do not report separate estimates for the high education category, as it only contains 8% of native workers.

[50]Specifically, we regress log wages of between 1980 and 2000 on regional fixed effects, individual fixed effects and full interactions between gender, education and a quartic in age (relative to age 40). We then classify workers based on the quartiles of their individual fixed effects.

[51]This distributional pattern is similar to Dustmann, Frattini and Preston (2012), but our wage estimates are considerably more negative on average. This gap could reflect differences in the setting, or our use of panel data to eliminate the influence of compositional changes.

offers; but in doing so, they must forgo potential native hires who demand higher wages. Using the search framework of Albrecht and Axell (1984), we derive four propositions that characterize the labor market response along the distribution of firm pay. We then test these predictions using spatial variation from the 1990s immigration wave in Germany.

First, we confirm empirically that the new arrivals sorted heavily into low-paying firms, consistent with low reservation wages and non-discriminating firms (Proposition 1). In support of this interpretation, we also show that natives and migrants benefited similarly from working in higher-paying firms. This inability (or unwillingness) to wage discriminate opens the door to the monopsonistic trade-off at the heart of the model: to secure migrant labor at low wages, firms must forgo native employees. But this trade-off becomes profitable to more firms as the migrant workforce grows.

Indeed, we find large reductions in wages at the bottom of the firm pay distribution (Proposition 2). We also find a decline in average wages, but this only becomes apparent once we eliminate composition bias, by tracking job movers across regions and firms (using the AKM method). By studying changes in AKM firm premia, we are also able to attribute the distributional effects to the *wage policies* of low-paying firms, as opposed to changes in the market prices of their particular employees.

In response to these wage cuts, we see large native employment losses among low-paying firms (Proposition 3). This crowding-out effect is so large that firm size declines overall. This is difficult to reconcile with a competitive model, in which wage cuts should encourage firms to hire *more* workers (as they move down their labor demand curves). But it is consistent with firms moving *away* from their demand curves (Proposition 4).

The sorting of new immigrants into low-pay firms, coupled with native crowd-out from such firms, generates a large increase in workplace segregation between natives and migrants. Crucially, this segregation arises endogenously from firms' wage policies: it does not preclude but rather *reflects* labor market competition between natives and migrants.

These adverse labor market effects are *not* inevitable, and may be ameliorated through policies which constrain monopsony power (such as minimum wages, regularizations, or other policies encouraging labor market integration), rather than by restricting immigration itself. Our hypothesis can also help account for conflicting results on the labor market effects of immigration in the broader literature: these effects will depend not just on the migrants' skill mix, but also on their reservation wages (which are likely to vary substantially by context) and on labor market institutions that affect monopsony power.

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Appendices: For Online Publication

A Equilibrium in baseline model

In this appendix, we derive the equilibrium ϕ (i.e. the share of firms offering the migrant reservation w_0) in the baseline model, as summarized by equations (9) and (10). We begin by deriving the profit for firms which offer w_0 and w_1, and we then solve for equilibrium. We also offer a derivation for equation (11), which underpins Proposition 4.

A.1 Profit function

As explained in Section 2.1, firms will only offer one of two wages: the migrant reservation w_0 or the native reservation w_1.

If a firm offers w_0, it will face a labor inflow of $\frac{\lambda}{k}u_M\mu n$ and outflow of $\delta l\left(w_0\right)$, where $l\left(w\right)$ is the firm's steady-state labor force. Equating the two, and using (7), we have: $l\left(w_0\right) = \frac{n}{k}\cdot\frac{\lambda\mu}{\delta+\lambda}$. The associated profit is then:

$$\pi\left(w_0\right) = \left(p - w_0\right) l\left(w_0\right) = \frac{n}{k}\cdot\frac{\mu\lambda}{\delta+\lambda}\cdot\frac{\left(r+\delta\right)\left(p-b_M\right)+\left(1-\phi\right)\lambda\left(p-b_N\right)}{r+\delta+\left(1-\phi\right)\lambda} \tag{A1}$$

Similarly, if a firm offers w_1, it will have inflow $\frac{\lambda}{k}\left[u_M\mu + u_N\left(1-\mu\right)\right]n$ and outflow $\delta l\left(w_1\right)$. Equating the two, and using (6) and (7), the steady-state labor force is: $l\left(w_1\right) = \frac{n}{k}\left[\frac{\mu\lambda}{\delta+\lambda} + \frac{\left(1-\mu\right)\lambda}{\delta+\left(1-\phi\right)\lambda}\right]$. So the associated profit is:

$$\pi\left(w_1\right) = \left(p - w_1\right) l\left(w_1\right) = \frac{n}{k}\left[\frac{\mu\lambda}{\delta+\lambda} + \frac{\left(1-\mu\right)\lambda}{\delta+\left(1-\phi\right)\lambda}\right]\left(p-b_N\right) \tag{A2}$$

A.2 Equilibrium

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

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

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

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

To derive (9) and (10), we consider each case in turn.

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

Using equations (A1) and (A2), and imposing $\phi = 0$, $\pi(w_1) > \pi(w_0)$ implies:

$$\frac{n}{k}\left[\frac{\lambda\mu}{\delta+\lambda} + \frac{\lambda(1-\mu)}{\delta+\lambda}\right](p - b_N) > \frac{n}{k}\cdot\frac{\lambda\mu}{\delta+\lambda}\cdot\frac{(r+\delta)(p-b_M) + \lambda(p-b_N)}{r+\delta+\lambda} \tag{A3}$$

After rearranging, we have:

$$\tilde{\mu} < \frac{r+\delta+\lambda}{r+\delta} \tag{A4}$$

with $\tilde{\mu}$ defined by (10). This is the $\phi = 0$ case of equation (9).

Case 2: $\pi(w_1) = \pi(w_0)$ **and** $0 < \phi < 1$

Using equations (A1) and (A2), $\pi(w_1) = \pi(w_0)$ implies:

$$\frac{n}{k}\left[\frac{\mu\lambda}{\delta+\lambda} + \frac{(1-\mu)\lambda}{\delta+(1-\phi)\lambda}\right](p - b_N) = \frac{n}{k}\cdot\frac{\mu\lambda}{\delta+\lambda}\cdot\frac{(r+\delta)(p-b_M) + (1-\phi)\lambda(p-b_N)}{r+\delta+(1-\phi)\lambda} \tag{A5}$$

After rearranging:

$$\phi = \frac{\delta+\lambda}{\lambda}\left[1 - \frac{r}{(r+\delta)\tilde{\mu} - (\delta+\lambda)}\right] \tag{A6}$$

with $\tilde{\mu}$ defined by (10). Since ϕ lies between 0 and 1, it follows that:

$$0 < \frac{\delta+\lambda}{\lambda}\left[1 - \frac{r}{(r+\delta)\tilde{\mu} - (\delta+\lambda)}\right] < 1 \tag{A7}$$

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 (9).

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

Using equations (A1) and (A2), and imposing $\phi = 1$, $\pi(w_1) < \pi(w_0)$ implies:

$$\frac{n}{k}\left[\frac{\lambda\mu}{\delta+\lambda} + \frac{\lambda(1-\mu)}{\delta}\right](p - b_N) < \frac{n}{k}\cdot\frac{\lambda\mu}{\delta+\lambda}(p - b_M) \tag{A8}$$

After rearranging:

$$\tilde{\mu} > \frac{\delta+\lambda}{\delta} \tag{A9}$$

with $\tilde{\mu}$ defined by (10). This is the $\phi = 1$ case of equation (9).

A.3 Derivation of equation (11)

Using the expressions for $l(w_0)$ and $l(w_1)$ from Section A.1, average firm size can be written as:

$$\begin{aligned}\bar{l} &= \phi l(w_0) + (1-\phi) l(w_1) \\ &= \phi \frac{n}{k} \cdot \frac{\lambda\mu}{\delta+\lambda} + (1-\phi) \frac{n}{k}\left[\frac{\lambda\mu}{\delta+\lambda} + \frac{\lambda(1-\mu)}{\delta+\lambda(1-\phi)}\right] \\ &= \frac{n}{k}\left[\mu\frac{\lambda}{\delta+\lambda} + (1-\mu)\frac{\lambda(1-\phi)}{\delta+\lambda(1-\phi)}\right]\end{aligned} \tag{A10}$$

Differentiating with respect to migrant share μ, taking the worker-firm ratio $\frac{n}{k}$ as given, we have:

$$\frac{d\bar{l}}{d\mu} = \frac{n}{k}\left[\frac{\lambda}{\delta+\lambda} - \frac{\lambda(1-\phi)}{\delta+\lambda(1-\phi)} - \frac{(1-\mu)\lambda\delta}{[\delta+\lambda(1-\phi)]^2} \cdot \frac{d\phi}{d\mu}\right] \tag{A11}$$

which is equation (11) from the main text.

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).

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 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 implies:

$$\begin{aligned} u_N \lambda \left[F(w) - F(b_N)\right](1-\mu) n = {} & \delta (1-u_N) G_N(w) (1-\mu) n \\ & + \lambda (1-F(w)) (1-u_N) G_N(w) (1-\mu) n \end{aligned} \tag{A12}$$

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. The outflow on the right-hand side 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:

$$u_M \lambda F(w) \mu n = \delta (1-u_M) G_M(w) \mu n + \lambda (1-F(w)) (1-u_M) G_M(w) \mu n \tag{A13}$$

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

$$u_N = \frac{\delta}{\delta + (1-\phi)\lambda} \tag{A14}$$

$$u_M = \frac{\delta}{\delta + \lambda} \tag{A15}$$

Substituting (A14) and (A15) into (A12) and (A13) respectively, we can solve for G_N and

G_M in terms of the offer distribution F:

$$G_N(w) = \frac{1}{\phi} \cdot \frac{\delta [F(w) - \phi]}{\delta + \lambda [1 - F(w)]} \tag{A16}$$

$$G_M(w) = \frac{\delta F(w)}{\delta + \lambda [1 - F(w)]} \tag{A17}$$

B.2 Firms' employment

We now derive $l(w)$, the equilibrium employment of a firm paying wage w. 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 equal to:

$$S(w) = [\delta + \lambda (1 - F(w))] \, l(w) \tag{A18}$$

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:

$$R(w) = I[w \geq b_N] \cdot \left\{ \frac{\lambda}{k} u_N + \frac{\lambda}{k}(1 - u_N) G_N(w) \right\} (1 - \mu) n + \left\{ \frac{\lambda}{k} u_M + \frac{\lambda}{k}(1 - u_M) G_M(w) \right\} \mu n \tag{A19}$$

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 (A14), (A15), (A16) and (A17), this expression can be simplified to:

$$R(w) = \frac{n}{k} \cdot \frac{\delta\lambda \{(1 - \mu) I[w \geq b_N] + \mu\}}{\delta + \lambda (1 - F(w))} \tag{A20}$$

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

$$l(w) = \frac{n}{k} \cdot \frac{\delta\lambda \{(1 - \mu) I[w \geq b_N] + \mu\}}{[\delta + \lambda (1 - F(w))]^2} \tag{A21}$$

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. By contradiction, 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. As a result, such a mass point cannot exist in equilibrium.

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

Using (A21), the equilibrium profit from offering b_N and b_M can be written as:

$$\pi(b_N) = (p - b_N)\, l(b_N) = \frac{n}{k} \cdot \frac{\delta\lambda (p - b_N)}{[\delta + (1-\phi)\lambda]^2} \tag{A22}$$

and

$$\pi(b_M) = (p - b_M)\, l(b_M) = \frac{n}{k} \cdot \frac{\mu\delta\lambda (p - b_M)}{(\delta + \lambda)^2} \tag{A23}$$

The equilibrium ϕ can be derived by inserting (A22) and (A23) into the three cases listed above. Just as in the baseline model, the equilibrium ϕ can then be expressed as:

$$\phi = \begin{cases} 0 & \text{if } \tilde{\mu} \leq 1 \\ \frac{\delta+\lambda}{\lambda}\left(1 - \frac{1}{\tilde{\mu}}\right) & \text{if } \tilde{\mu} \in \left(1, \frac{\delta+\lambda}{\delta}\right) \\ 1 & \text{if } \tilde{\mu} \geq \frac{\delta+\lambda}{\delta} \end{cases} \tag{A24}$$

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

$$\tilde{\mu} = \left[\mu\left(1 + \frac{b_N - b_M}{p - b_N}\right)\right]^{\frac{1}{2}} \tag{A25}$$

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 (A24) and (A25) 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 implies:

$$\pi(w) = \pi(b_N) \tag{A26}$$

for all $w \geq b_N$ in the support of F. Replacing the profit functions with (A21) and rearranging, the share of offers between b_N and any given $w \geq b_N$ can be expressed as:

$$F(w) - \phi = \left(1 - \phi + \frac{\delta}{\lambda}\right)\left[1 - \left(\frac{p-w}{p-b_N}\right)^{\frac{1}{2}}\right] \tag{A27}$$

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:

$$\pi(w) = \pi(b_M) \tag{A28}$$

for all $w \geq b_M$ in the support of F. Applying (A21) and rearranging, conditional on $\phi < 1$, the share of offers below any given $w < b_N$ can be expressed as:

$$F(w) = \frac{\delta+\lambda}{\lambda}\left[1 - \left(\frac{p-w}{p-b_M}\right)^{\frac{1}{2}}\right] \tag{A29}$$

Putting together (A27) and (A29), we therefore have:

$$F(w) = \begin{cases} I[\phi > 0] \cdot \frac{\delta+\lambda}{\lambda}\left[1 - \left(\frac{p-w}{p-b_M}\right)^{\frac{1}{2}}\right] & \text{if } w \in [b_M, b_N) \\ I[\phi < 1] \cdot \left\{\phi + \left(1 - \phi + \frac{\delta}{\lambda}\right)\left[1 - \left(\frac{p-w}{p-b_N}\right)^{\frac{1}{2}}\right]\right\} & \text{if } w \in [b_N, p) \end{cases} \tag{A30}$$

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 share μ induces firms to reduce offers at the bottom of the pay 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 (A24) and (A25).

3. Proposition 3 states that a larger migrant share μ induces firms to shed native employment at the bottom of the pay 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 (A14).

4. Proposition 4 states that a larger migrant share μ may induce firms to reduce their employment overall. Equation (A21) 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 (A21) also shows that μ has a negative "wage-setting effect": as more firms drop into the low-pay sector, they lose access to native labor. And just as in the baseline model, without knowledge of the parameter values, we cannot know ex ante which effect will dominate on average.

The four propositions are therefore robust to the introduction of on-the-job search. However, unlike in the baseline model, a larger migrant share μ now also generates a negative effect on natives' *realized* wages. As firms drop into the low-pay sector (i.e. as ϕ increases), this reduces competition in the high-pay sector, so firms are able to extract greater rents from natives. This is visible in equation (A16): at any given wage $w \geq b_N$, the share of native workers earning wages below w (i.e. $G_N(w)$) is increasing in ϕ.

C Model with endogenous contact rate

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 where both are endogenous. If firms are free to enter and produce, monopsonistic power must be maintained by some barrier to entry or hiring. For simplicity, we impose a fixed cost c which each firm must pay to produce any quantity of output.

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:

$$\bar{u} = \mu u_M + (1-\mu) u_N \tag{A31}$$

is the mean unemployment rate across natives and migrants (so $\bar{u}n$ is the total stock of unemployed workers), and k the (now endogenous) stock of firms. It is useful to define labor market tightness as $\theta \equiv \frac{k}{\bar{u}n}$. Using the matching function, the contact rate for workers λ can then be written as:

$$\lambda = \lambda_0 \theta^{1-\alpha} \tag{A32}$$

and the contact rate for firms is $\lambda_0 \theta^{-\alpha}$.

The free entry condition requires that:

$$\pi(w) = c \tag{A33}$$

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 (A2), 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 (A31), (A32), and the definition of θ, this can be rewritten as:

$$\frac{\lambda_0}{\delta}(p - b_N) = c\theta^{\alpha} \tag{A34}$$

Equation (A34) 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 $\frac{\lambda_0}{\delta}$ (i.e. more hires relative to separations) and $p - b_N$ (i.e. greater profits per hire). 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).

Notice however that 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 (A34). 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.

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 limited supply of entrepreneurial talent), similar in spirit to Melitz (2003). For the purposes of this analysis, we restrict attention to equilibria with wage dispersion: i.e. at least some firms offer w_1 and others offer w_0 ($0 < \phi < 1$).

D.1 Equilibrium

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:

$$\pi(w_0|p^*) = \pi(w_1|p^*) \tag{A35}$$

where $\pi(w|p)$ is the profit earned by a productivity p firm offering wage w. Just as in the baseline model, employment in low-wage firms is $l(w_0) = \frac{n}{k} \cdot \frac{\mu\lambda}{\delta+\lambda}$; and employment in high-wage firms is $l(w_1) = \frac{n}{k}\left[\frac{\mu\lambda}{\delta+\lambda} + \frac{(1-\mu)\lambda}{\delta+(1-\phi)\lambda}\right]$, where ϕ is the share of *active* firms which offer w_0. In equilibrium, all firms with $p > p^*$ will offer the high wage w_1, and all firms with $p < p^*$ will offer w_0. This follows from the fact that $\frac{\partial\pi(w_1|p)}{\partial p} > \frac{\partial\pi(w_0|p)}{\partial p}$. Intuitively, high-$p$ firms benefit disproportionately from offering higher wages, because they profit more from larger employment.

Inserting the profit functions (A1) and (A2), equation (A35) implies:

$$\phi = \frac{\delta + \lambda}{\lambda} \left[1 - \frac{r}{(r+\delta)\frac{\mu}{1-\mu} \cdot \frac{b_N - b_M}{p^* - b_N} - (\delta + \lambda)} \right] \tag{A36}$$

We call this the "wage-setting equation". Note it is identical to (9) in the main text, except productivity p has now been replaced by p^*: since firms are no longer identical, this equation must only be satisfied by the marginal firm. Equation (A36) 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 offer 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):

$$\phi = \frac{H(p^*) - H(w_0)}{1 - H(w_0)} \tag{A37}$$

We call this the "active firm condition". Holding the migrant reservation w_0 fixed, (A37) describes a *positive* relationship between ϕ and p^*: if the marginal firm 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 $H(w_0)$ to contract (there are more active firms, offering w_0); so ϕ in (A37) increases even more.

To summarize, the wage-setting equation (A36) describes a negative relationship between ϕ and p^*, and the active firm condition (A37) describes a positive relationship. Putting these 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 (A36): the low-pay sector share ϕ expands for any p^*. But migrant share does not enter the active firm condition (A34). 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.

Quantitatively though, the effects of immigration are amplified in this model 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 wage offers to the labor force, and this reinforces the effect on ϕ.[52]

E Additional evidence on migrants' labor market integration

E.1 The distribution of migrants across industries

In Table A1, we explore the distribution of migrants across industrial sectors. Column 1 reports the share of employment in each of 28 industries in 1988, and column 2 reports foreign shares within these industries. Immigrants were concentrated in mining, plastics, metal, ceramic and glass, leather and textile production and processing, as well as as vehicle manufacturing, construction and hospitality.

Column 3 reports the foreign share by industry in 1995, and column 4 the change in share between 1988 and 1995. The foreign share increased by 10.7 pp in the hospitality sector, reaching more than 30% in 1995, and also grew strongly in agriculture and household services. The expansion in construction in our data was 3.3 pp, which is surprisingly low in light of media reports from the time. But as shown in column 5, the share of post-1988 immigrants arrivals in construction was larger (7.7% in 1995), implying that the employment of previous immigrants decreased substantially in this sector. Moreover, social security and other data sources exclude subcontracted "posted workers" from foreign firms. Their number was around 90,000 in 1993, of whom approximately two thirds were employed in construction (Werner, 1996). The share of new immigrant arrivals was also high in many light manufacturing industries. As the distribution of immigrants across industries is potentially endogenous to demand, we do not use this variation for identification.

[52] To see how this manifests formally, consider the active firm condition (A37). In the baseline model, all firms have productivity above w_0, so the denominator of (A37) collapses to 1. The positive relationship between ϕ and p^* in (A37) then becomes shallower, and the overall (positive) impact of migrant share μ on ϕ is therefore smaller in the baseline model.

Table A1: Employment and immigrant shares by industry

Industry	Share of employment in 1988 (%)	Foreign share within industry		Change in foreign share 1988-95 (pp)	Post-1988 foreign share in 1995 (%)
		in 1988 (%)	in 1995 (%)		
	(1)	(2)	(3)	(4)	(5)
[1] Agriculture and forestry	0.9	7.6	14.6	7.0	10.1
[2] Energy	1.2	1.7	2.3	0.6	0.6
[3] Mining	1.0	14.2	14.3	0.0	1.8
[4] Chemical industry	3.0	8.0	8.7	0.8	2.4
[5] Plastics	1.8	16.1	16.8	0.7	5.6
[6] Pit and quarry	0.9	9.7	11.6	1.9	5.2
[7] Ceramic and glass	0.6	11.8	14.8	3.0	4.9
[8] Metal production and processing	3.8	15.5	17.1	1.6	5.5
[9] Manufacturing	4.9	9.1	9.8	0.7	2.5
[10] Vehicle manufacturing	6.4	12.3	12.4	0.1	3.8
[11] IT, electronics, optics	8.0	10.7	11.7	1.0	3.4
[12] Musical instruments, jewelry, toys	0.2	7.8	9.8	2.1	4.6
[13] Wood and wood products	1.9	7.4	9.4	2.0	4.4
[14] Printing and paper processing	1.8	10.3	11.8	1.5	3.5
[15] Leather and textile	2.6	12.8	14.4	1.6	4.8
[16] Food and tobacco	3.3	7.0	11.7	4.6	5.9
[17] Construction	6.7	11.0	14.4	3.3	7.7
[18] Trading	13.6	4.6	7.3	2.7	4.0
[19] Transportation, communication	4.7	7.4	9.9	2.4	4.0
[20] Credit and insurance	4.1	1.9	2.9	1.0	1.2
[21] Hospitality	2.2	21.7	32.4	10.7	21.8
[22] Healthcare and welfare	7.0	5.7	7.9	2.2	3.7
[23] Business-related services	5.0	6.9	10.5	3.6	6.1
[24] Educational services	3.0	5.4	6.4	1.0	2.9
[25] Recreational services	1.2	6.5	7.7	1.2	3.3
[26] Household services	1.2	9.3	14.8	5.5	9.6
[27] Social services	2.4	5.0	6.6	1.6	3.0
[28] Public administration	6.7	3.3	3.7	0.4	1.1

Notes: Shares computed using SIAB. Post-1988 migrants entered in or after 1989.

E.2 Migrant wage penalties: 1980s placebo

In Section 4.1, we documented a large wage gap (about 10%) between natives and new migrants in the early 1990s, which remained even after accounting for age, education, gender and occupation. In Table A2, we show that this conditional wage gap was much smaller for new migrants in the early 1980s. The table follows the same structure as Table 2 in the main text, except we now restrict the sample to 1980-6 (instead of 1990-6), and new migrants are defined as arriving since 1978 (rather than since 1988). On average, previous migrants earned slightly more than natives (12%), and new migrants earned 25% less (column 1). However, this differential can be entirely explained by differences in age, education, gender

Table A2: Migrant wage differentials: 1980s placebo

	Basic sample			Firms with natives and migrants		
	(1)	(2)	(3)	(4)	(5)	(6)
Previous migrants	0.120***	-0.013***	0.019***	-0.021***	-0.015***	-0.015***
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
New migrants	-0.252***	0.073***	0.008**	-0.048***	0.018***	0.029***
	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)
Year fixed effects	Y	Y	Y	Y	Y	Y
Edu × age × sex FEs		Y	Y	Y	Y	Y
Edu × age × sex × occ FEs			Y	Y	Y	Y
Firm FEs					Y	Y
Firm × occ FEs						Y
Observations (mil.)	2.472	2.386	2.344	0.995	0.955	0.955
R^2	0.662	0.868	0.900	0.674	0.767	0.814

Notes: SIAB, mean values for years 1980-86, among individuals aged 16-65. In this table, we define "previous" migrants as those who entered employment before 1979; "new" migrants entered in or after 1979. Standard errors clustered at the establishment level, * p<0.10, ** p<0.05, *** p<0.01.

and occupation (columns 2 and 3). If we restrict our sample to firms which contain both natives and migrants, we do find a small penalty for new migrants (column 4). As in our main analysis, this gap is explained (in this case, entirely) by differential sorting between firms, rather than wage gaps within firms (columns 5 and 6).

These findings suggest that migrants' reservation wages differ across settings. Such heterogeneity can help reconcile tensions between different studies in the migration literature. According to our model, one would *not* expect the adverse effects we estimate in the 1990s wave to be replicated in other settings, where migrants' reservation wages are closer to those of natives.

E.3 Correcting firm wage premia for measurement error

In Section 4.2, we study firm-specific wage premia for natives and migrants. However, our estimates of these premia are subject to measurement error due to the limited number of workers observed in each firm. This noise may lead to a downward bias in the estimates reported in Table 3. To correct for this measurement error, we follow two approaches: (i) split-sample IV and (ii) empirical Bayes.

(i) Split-sample IV. Our approach is similar to Goldschmidt and Schmieder (2017) or Drenik et al. (2023). We begin by splitting our *native* worker sample into two random groups ("group 1" and "group 2") to separately estimate firm fixed effects for the two samples: we denote these as $\psi_{j,1}$ and $\psi_{j,2}$ for firm j. We then regress the estimates of $\psi_{j,2}$ on those of $\psi_{j,1}$. If there is no sampling variability, we would expect a coefficient of one for this regression. Conversely, if the dispersion of premia only reflects noise, we would expect a coefficient of zero. In fact, we find a coefficient of 0.50 (with a standard error of 0.02). This confirms that our firm premia estimates are indeed noisy.

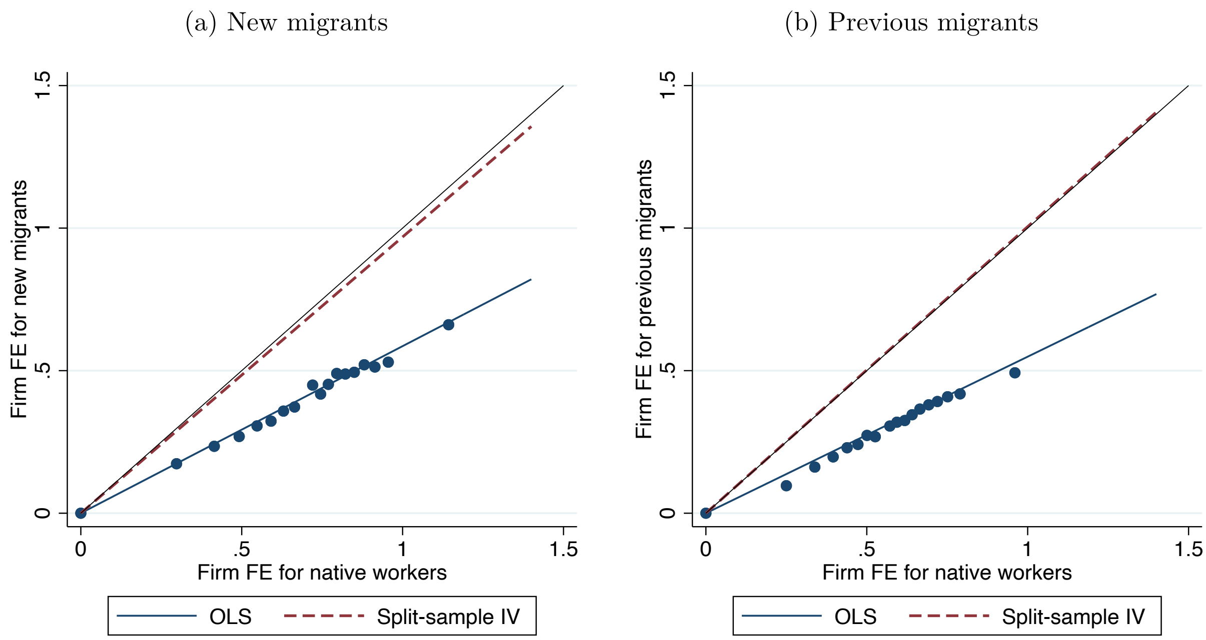
To correct for the influence of this measurement error, we regress the migrant firm premia on the native premia $\psi_{j,1}$ from "group 1", using the estimated "group 2" premia $\psi_{j,2}$ as an instrument. Figure A1 illustrates the results. The blue dots show the mean firm premium for new migrants (panel a) or previous migrants (panel b) across ventiles of the firm premium for native workers, with the solid lines corresponding to linear fits ($\hat{\beta}_{new} = 0.586$ and $\hat{\beta}_{previous} = 0.549$: see Table 3). The dashed red lines correspond to the split-sample IV estimates that adjust for measurement error in the estimated firm premia ($\hat{\beta}_{new} = 0.969$ and $\hat{\beta}_{previous} = 1.005$). We therefore conclude that the distribution of firm wage premia is very similar for migrants and natives, once measurement error is accounted for.

(ii) Empirical Bayes. A more efficient approach is to shrink the variance of the native firm premia, using the empirical Bayes procedure described by Angrist, Hull and Walters (2022). This allows us to preserve the full sample, but it does require that we assume the native firm premia are normally distributed: $\psi_j \sim N\left(\mu_\psi, \sigma_\psi^2\right)$. Given this restriction, a posterior mean for the firm j premium is:

$$\psi_j^* = \frac{\sigma_\psi^2}{\sigma_\psi^2 + s_j^2}\hat{\psi}_j + \frac{s_j^2}{\sigma_\psi^2 + s_j^2}\mu_\psi \tag{A38}$$

This is a weighted average, which shrinks the premium estimate $\hat{\psi}_j$ towards the mean μ_ψ. The weights depend on the relative size of σ_ψ^2 (the variance of the firm premium distribution) and s_j^2 (the variance of the $\hat{\psi}_j$ estimate). The expected premium μ_ψ can be estimated as $\hat{\mu}_\psi = \frac{1}{J}\sum_j \hat{\psi}_j$, and its variance can be estimated as $\hat{\sigma}_\psi^2 = \frac{1}{J}\sum_j \left[\left(\hat{\psi}_j - \hat{\mu}_\psi\right)^2 - s_j^2\right]$. Plugging these into (A38), we can compute a posterior mean ψ_j^* for every firm j. We can then regress the estimated migrant firm premia on the (shrunk) native posteriors. As we show in columns 3 and 6 of Table 3, this yields a coefficient close to 1, just like the split-sample IV estimator.

Figure A1: Firm-level pay premia for natives and immigrants



Notes: SIAB, years 1990-96. The blue dots correspond to the mean firm premium for new migrants (panel a) or previous migrants (panel b) across ventiles of the firm premium for native workers, with the solid lines corresponding to linear fits ($\hat{\beta}_{new} = 0.586$ and $\hat{\beta}_{previous} = 0.549$: see Table 3). The dashed red lines correspond to the split-sample IV estimates that adjust for measurement error in the estimated firm premia ($\hat{\beta}_{new} = 0.969$ and $\hat{\beta}_{previous} = 1.005$). To aid interpretation, we also show a 45 degree line (in black). We define "previous" migrants as those who entered employment before 1989, "new" migrants entered in or after 1989.

E.4 Rent sharing estimates: Longitudinal evidence

An important limitation of the analysis in Table 3 is that we cannot condition on worker fixed effects (as in the standard AKM routine) when estimating the native and migrant firm wage premia. This is because we do not have access to full count data. Consequently, the estimates in Table 3 may in principle be driven by correlations in unobserved heterogeneity between native and migrant employees, across firms.

To address this concern, following a strategy akin to Aslund et al. (2021), we now study what happens to the wages of *individual* workers (separately for natives and migrants) as they transition between low and high-paying firms (as proxied by the AKM firm premia estimates of Card, Heining and Kline, 2013). That is, we estimate simple models for log wages of individuals i in firm j at time t, of the form:

$$\log w_{ijt} = AKM_j \cdot Migrant_i + X_{it}\beta + \beta_t + \beta_i + \varepsilon_{it} \qquad \text{(A39)}$$

Table A3: Worker-level wage effects of AKM

	Basic estimates		Worker fixed effects	
	(1)	(2)	(3)	(4)
AKM	1.038***	1.043***	0.905***	0.897***
	(0.006)	(0.006)	(0.004)	(0.004)
AKM × Previous migrant		-0.047***		0.105***
		(0.007)		(0.012)
AKM × New migrant		-0.020**		0.020
		(0.008)		(0.015)
Year fixed effects	Y	Y	Y	Y
Edu × age × sex FEs	Y	Y	Y	Y
New/previous migrant FEs	Y	Y		
Worker FEs			Y	Y
Observations (mil.)	2.312	2.312	2.260	2.260
R^2	0.601	0.601	0.901	0.901

Notes: SIAB, years 1990-96, among individuals aged 16-65. We define "previous" migrants as those who entered employment before 1989, "new" migrants entered in or after 1989. AKM firm fixed effects are estimated by Card, Heining and Kline (2013), using universe of employment records. Standard errors clustered at establishment level, * p<0.10, ** p<0.05, *** p<0.01.

where AKM_j is the firm-level AKM premium, and $Migrant_i$ is an indicator taking 1 if worker i is a migrant. In the X_{it} vector, we control for interactions between education, sex and age (as in Table 2). We rely on data between 1990 and 1996, the period for which our (time-invariant) AKM_j premia are estimated.

We present our estimates in Table A3. In the first two columns, we do not control for worker fixed effects β_i, and instead include indicators for new (post-1988) and previous migrants. The coefficient on the AKM_j premium in the first column is simply 1, which is perhaps unsurprising (as the AKM premia are estimated with the same wage data). Of greater note, column 2 shows that the AKM slopes are very similar across native and migrant groups: i.e. natives and previous/new migrants benefit similarly from working in higher-AKM firms (consistent with Table 3). But as explained above, since these columns exploit cross-sectional variation, there is a legitimate concern about selection.

In columns 3 and 4, we now control for worker fixed effects β_i. That is, we study how individual wages change as workers *transition* from low to high-AKM firms. Column 4 shows that both natives and previous/new migrants benefit similarly from these transitions; and if anything, migrants benefit slightly more. This analysis strengthens the basic message of Table 3 in the main text: these estimates are not driven by selection.

E.5 Distribution of migrants over firm pay distribution

In this section, we describe the distribution of migrants in the firm wage distribution at the national level. Pooling the years 1990-1996 in the SIAB, Figure A2 plots the density of new (post-1988) and previous migrants across the firm pay distribution, relative to natives. In Panel a, we rank firms by their median wage. Firms are weighted by native employment, so the density of natives in their own firm distribution is 1 by construction (solid black line). In comparison, new migrants are heavily over-represented in low-wage firms, while previous migrants are similarly distributed to natives.

Panel b repeats this exercise, but ordering firms by their AKM wage premia (as estimated by Card, Heining and Kline, 2013). By netting out individual fixed effects, this specification abstracts from compositional differences between firms. New migrants are again over-represented at the bottom of the distribution, though the pattern is less pronounced than for median firm wages. This is perhaps to be expected, as the AKM premia are measured with substantial error (especially in low-paying firms, which are typically small); and this will moderate any genuine distributional differences. Interestingly, previous migrants are now over-represented in high-premium firms, possibly because earlier "guest worker" cohorts were concentrated in large manufacturing firms that tend to be characterized by high premia.

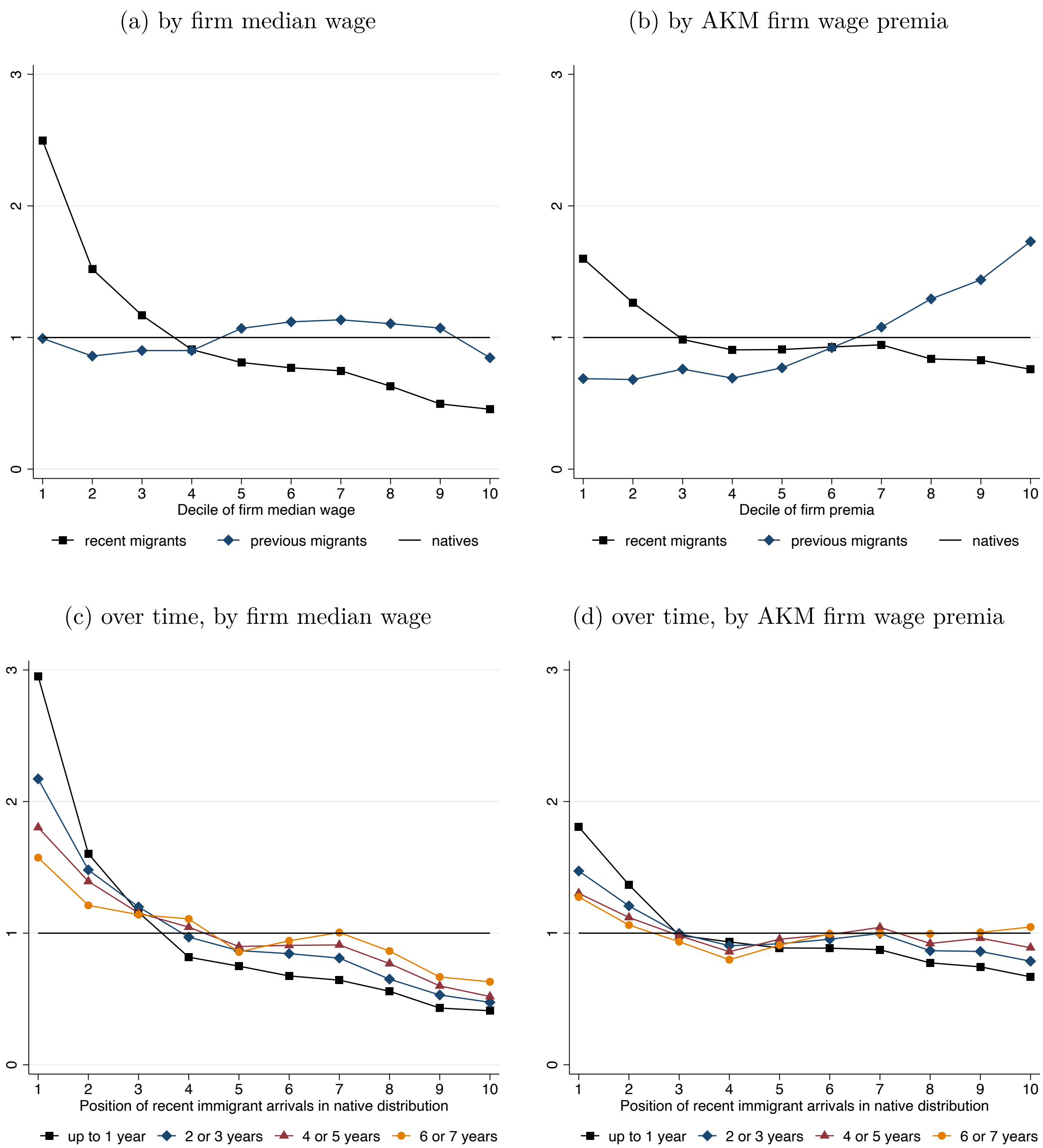
Panels c and d illustrate how the distribution of immigrant arrivals changes with time spent in Germany. Based on the on-the-job search extension to our model (see Section 2.4), we would expect new migrants to gradually work their way up the firm distribution. We distinguish between four categories: 1 year or less in Germany, 2-3 years, 4-5 years, or 6-7 years since their first employment spell. While new arrivals are heavily concentrated in low-pay firms, migrants increasingly transition to better-paying firms over time. By the 6th year, much of the gap with natives is eliminated. These patterns are in line with evidence by Lehmer and Ludsteck (2015), Dustmann, Ku and Surovtseva (2019) and Arellano-Bover and San (2020), showing that a large part of the wage assimilation of migrants can be explained by migrants moving to higher-paying firms.

F First stage estimates and potential confounders

F.1 First stage scatter relation

The maps in Figure 3 illustrate the predictive power of the enclave shock Δm_r for changes in regional foreign employment share. In Figure A3a, we show this relationship in a scatter

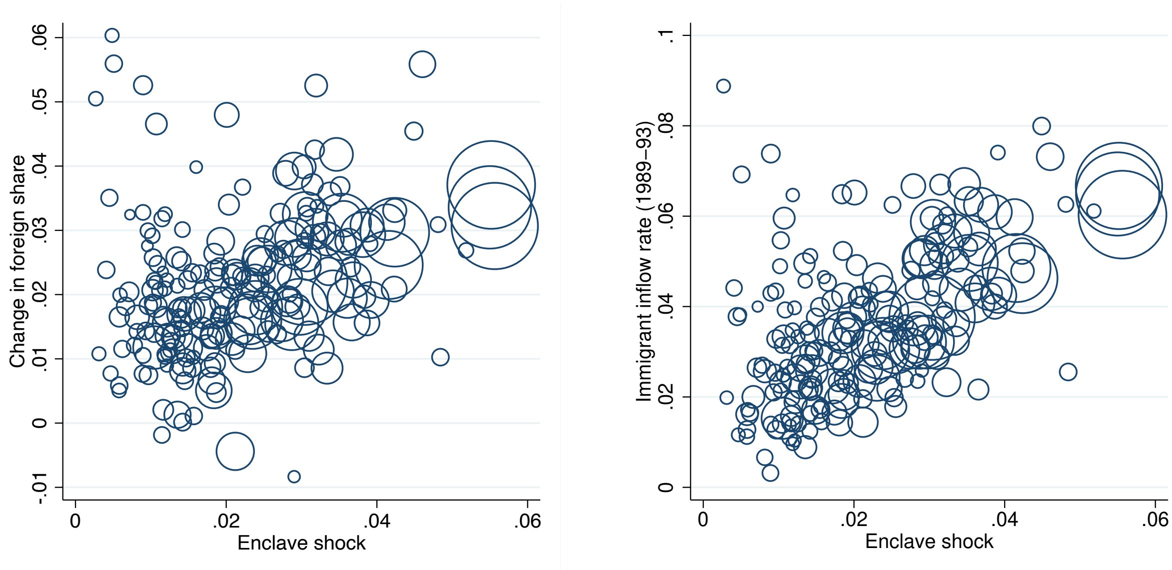
Figure A2: Distribution of migrants over firm pay distribution



Notes: SIAB, years 1990-96, among individuals aged 16-65. We define “previous” migrants as those who entered employment on or before 1988, “new” migrants entered after 1988.

Figure A3: First Stage

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



Notes: Panel 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). Panel 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.

plot. In Figure A3b, we show that this "first-stage" relation is even more pronounced when the outcome is the migrant arrival *rate*[53] (i.e. the number of new foreign workers in 1993, relative to total regional employment in 1988), rather than changes in overall foreign shares. The difference between the two reflects the exit of previous migrant cohorts from the regional employment stock, whether due to reduced employment rates, out-migration, or retirement.

From the perspective of our model, the recent arrivals play a crucial role in any potential adverse wage-setting effects, as they appear to have significantly lower reservation wages than natives or previous migrants (see Section 4).

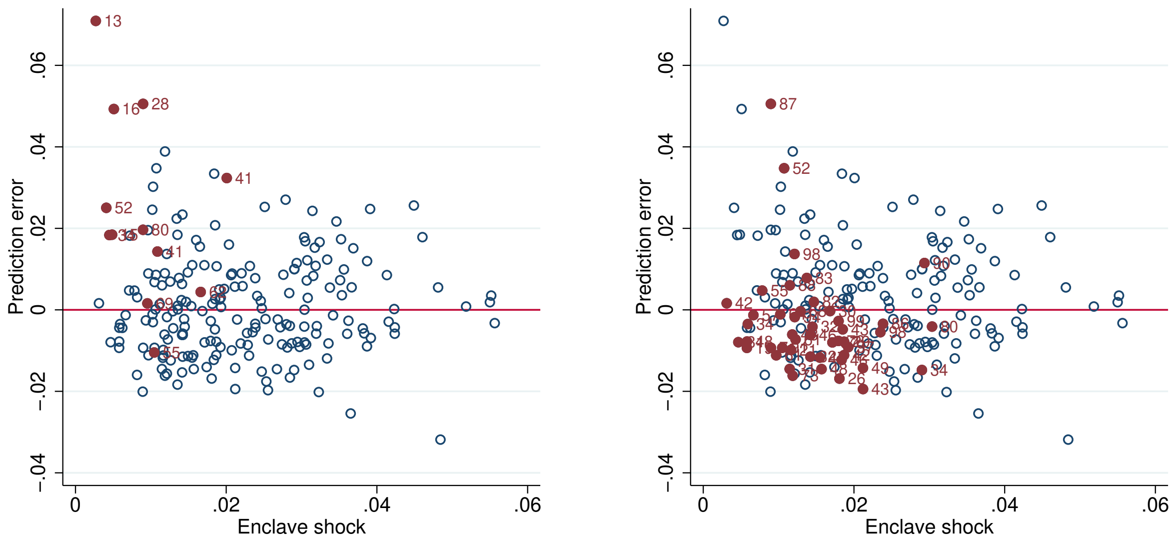
F.2 Prediction errors in first stage

As Figure A3 shows, the enclave shock Δm_r predicts well the distribution of migrants across regions. To explore this further, Figure A4 plots the prediction errors from the first stage regression of the migrant arrival rate against the enclave shock. As panel a shows, the most extreme under-predictions are in regions close to the German-Czech border, which are

[53] Note we can only observe migrants' year of arrival (and hence arrival rates) in the SIAB worker panel, and not in the BHP establishment panel.

Figure A4: Prediction error in first stage

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



Notes: SIAB. Both panels plot prediction errors from a regression of the foreign arrival rate (over 1989 and 1993) on the enclave shock Δm_r, across local labor markets r. In panel a, local labor markets in the German-Czech border region are marked in red and labeled with their distance to the German-Czech border (in km). In panel b, local labor markets close to the inner German border are labeled with their distance to the inner German border (in km).

marked red and labeled by their distance from the border (in km). This was a consequence of a special cross-border policy that allowed Czech workers to commute to (but not to live in) Germany, as studied in Dustmann, Schoenberg and Stuhler (2017). We abstract from this local source of variation in this paper, and focus instead on immigrant arrivals in all of West Germany, as predicted by the enclave shock.

Panel b shows that the enclave shock also overpredicts immigrant inflows in the former East-West German border region. As discussed in Section 5.2, new immigrants likely avoided this region to escape labor market competition with East German commuters and migrants. To partial out this effect, we control for the log distance to the former border in our empirical specification.

F.3 Reunification and inflows from East Germany

In Section 5.2 (and Appendix F.2), we highlight the empirical challenge of reunification. A key concern is that we might be conflating the effect of international migration with that of East German inflows. Our proposed solution is to control in all regressions for log distance to the former inner German border, which predicts these inflows very well (see Figure 4).

Table A4: East German vs. changes in foreign shares

	East German population inflows 1991-93			
	(1)	(2)	(3)	(4)
△foreign share 1988-93				
actual	-0.044*	0.011		
	(0.021)	(0.017)		
predicted (enclave shock)			-0.031	0.031
			(0.025)	(0.022)
Distance E/W border (log)		-0.004***		-0.004***
		(0.000)		(0.000)
Constant	0.010***	0.028***	0.010***	0.029***
	(0.001)	(0.002)	(0.001)	(0.002)
R^2	0.029	0.463	0.019	0.478
N	204	204	204	204

Notes: SIAB, regression estimates across 204 local labor markets. The enclave shock is defined in (13). Distance E/W is the log distance to the inner German border. * p<0.10, ** p<0.05, *** p<0.01.

In Table A4, we provide additional evidence in support of this strategy. In each column, the dependent variable is the population inflow from East-Germany between 1991 and 1993 (provided by the German Federal Statistical Office), expressed as a share of population in 1988. As residents have to register by law, these statistics are reliable measures of true population flows. As shown in Column 1, 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 Figures 3 and 4. 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 (i.e. the enclave shock Δm_r), as defined in (13). In estimates not reported here, we also find similar results when using East German employment (rather than population) inflows as the dependent variable.[54]

To summarize, Table A4 suggests that the log distance control can successfully partial out the small negative correlation between East German and foreign inflows. Note 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).

[54]For this exercise, 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. Nevertheless, this employment-based definition of East German inflows is highly correlated with population inflows from external sources.

F.4 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 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, and 225,000 annually in subsequent years (Glitz, 2012).

The concern is that the spatial distribution of these newly arrived ethnic Germans, who are coded as German nationals in our data, might correlate with the distribution of foreign nationals. 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).

Following Brücker and Jahn (2011) and Bruns and Priesack (2019), we identify recently arrived ethnic Germans by exploiting administrative information contained in the SIAB on the receipt of special language courses and other integration subsidies targeted at this group.[55] Using this information, we construct the change in the employment 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 A5 reports the results, following the same structure as Table A4. The inflow rate of Ethnic Germans (the dependent variable) is negatively correlated with the actual change in the foreign share (columns 1-2), but the relationship is weak and not statistically significant, irrespective of whether we control for the distance to the inner German border. The effect of the enclave shock is slightly more pronounced (columns 3-4), but it still explains less than 5% of the spatial variation in the employment share of ethnic Germans.

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

Table A5: Ethnic German (*Aussiedler*) vs. changes in foreign shares

	Change in *Aussiedler* share (1988-93)			
	(1)	(2)	(3)	(4)
$\triangle$foreign share 1988-93				
actual	-0.111	-0.120		
	(0.074)	(0.074)		
predicted (enclave shock)			-0.173***	-0.200**
			(0.065)	(0.065)
Distance E/W border (log)		0.001		0.002
		(0.001)		(0.001)
Constant	0.021***	0.017***	0.023***	0.015***
	(0.002)	(0.006)	(0.002)	(0.005)
R^2	0.023	0.025	0.078	0.089
N	204	204	204	204

Notes: SIAB, regression estimates across 204 local labor markets. The enclave shock is defined in (13). Distance E/W is the log distance to the inner German border. * p<0.10, ** p<0.05, *** p<0.01.

G Additional evidence on impact of enclave shock

G.1 Contribution of entrants to native crowd-out

A negative effect of the enclave shock on native employment may reflect outflows of incumbent workers, but also reduced inflows of natives into jobs in the region. To illustrate one important adjustment margin, we consider the contribution of *entrants from non-employment*: i.e. natives who were employed in region r in year t, but not employed in any region in 1988. Specifically, we use the number of native entrants in year t (relative to native employment in 1988) as the dependent variable in equation (12). Though more exposed regions show similar pre-trends in total native employment (see Figure 5b), inflow rates do differ before treatment. To address this challenge, we control for the average inflow rate in the pre-period between 1985 and 1988, in addition to our usual set of control variables.

The estimated coefficients in Figure 5b show that the inflow rate in high-immigration regions decreased (relative to the pre-treatment pattern), and this effect explains most of the reduction in native employment in the first years of the immigration wave. A weakness of our analysis here (and of other analysis of regional employment responses) is that we cannot determine what happened to these “missing inflows”: while it is straightforward to track the labor market outcomes of incumbent workers affected by immigration, we do not know which individuals were crowded out from employment in exposed regions (so we cannot track them over time).

Table A6: Robustness of regional employment, firm size and wage effects

		Robustness to controls			Sample and weighting	
		No controls	+ Log distance to E/W border	+ Bartiks and projected pop	Excl. top 3 regions	Unweighted estimates
		(1)	(2)	(3)	(4)	(5)
A.	Post-1988 foreign share (1995)	1.073***	0.970***	1.023***	0.952***	0.846***
		(0.056)	(0.061)	(0.063)	(0.086)	(0.109)
B.	Change in log native emp (1995 v 1988)	-2.234***	-1.946***	-1.377***	-1.253***	-1.101***
		(0.299)	(0.311)	(0.292)	(0.374)	(0.353)
C.	Change in log emp rate (1995 v 1988)	-1.424***	-1.311***	-1.535***	-1.402***	-1.317***
		(0.217)	(0.224)	(0.234)	(0.396)	(0.324)
D.	Change in log firm size (1995 v 1988)	-1.292***	-1.287***	-1.020***	-1.411***	-1.351***
		(0.362)	(0.390)	(0.287)	(0.464)	(0.437)
E.	Change in mean AKM (1993-99 v 1985-92)	-0.625***	-0.764***	-0.723***	-0.703***	-0.654***
		(0.085)	(0.115)	(0.134)	(0.112)	(0.121)

Notes: This table explores the robustness of estimated effects of the enclave shock Δm_r, for various outcomes of interest (along the table rows). In column 1, we show estimates with no controls, and column 2 includes only the log distance to the inner German border. Column 3 shows our baseline estimates, after including all remaining controls (the employment and wage Bartiks, and projected population growth). In column 4, we use the full set of controls, but exclude the regions with the three largest enclave shocks (Frankfurt, Munich and Stuttgart). And in column 5, we estimate our basic specification without weighting observations by employment. * p<0.10, ** p<0.05, *** p<0.01.

G.2 Robustness of regional employment and wage effects

In Table A6, we explore the robustness of estimated effects of the enclave shock Δm_r, for various outcomes of interest. These outcomes are displayed along the rows of the table: the new (post-1988) migrant share in 1995 (from Figure 5a), the change in log native employment between 1988 and 1995 (from Figure 5b), the change in the log native employment rate between 1988 and 1995 (from 5c), the change in log mean firm size between 1988 and 1995 (from column 2, Table 4), and the change in the mean regional AKM firm wage premia (from column 1, Table 8). For the latter outcome, we rely on pre-compiled AKM premia from Bellmann et al. (2020).

For each outcome, the table columns estimate the enclave shock effect using various empirical specifications. In column 1, we show estimates with no controls, and column 2 includes only the log distance to the inner German border. Column 3 shows our baseline estimates, after including all remaining controls (the employment and wage Bartiks, and projected population growth). In column 4, we use the full set of controls, but exclude the regions with the three largest enclave shocks Δm_r (Frankfurt, Munich and Stuttgart). And in column 5, we estimate our basic specification without weighting observations by employment.

In general, the estimates are robust to these different specification choices. In particular, controlling for distance to the inner German border (column 2) makes little difference, which shows that the influx of East Germans is not driving the effects. It is also reassuring that the unweighted estimates (column 5) look similar: this confirms that the effects are not merely driven by a small number of high-employment regions.

Interestingly, log native employment in row B does show some sensitivity. The inclusion of the column 3 controls reduces the coefficient on the enclave shock Δm_r from -1.95 to -1.38. This is mainly due to the population projection control, which predicts local population growth using regional variation in pre-treatment population pyramids (from the 1987 census). This control is strongly predictive of local employment growth, but it happens to correlate negatively with the enclave shock Δm_r. As we explain in Section 5.3, there are good *conceptual* reasons to include this control (arising from the fertility transition). But it appears that it matters more for "scale" variables such as *total* native employment: the employment *rate* in row C (which scales employment by population) is less sensitive.

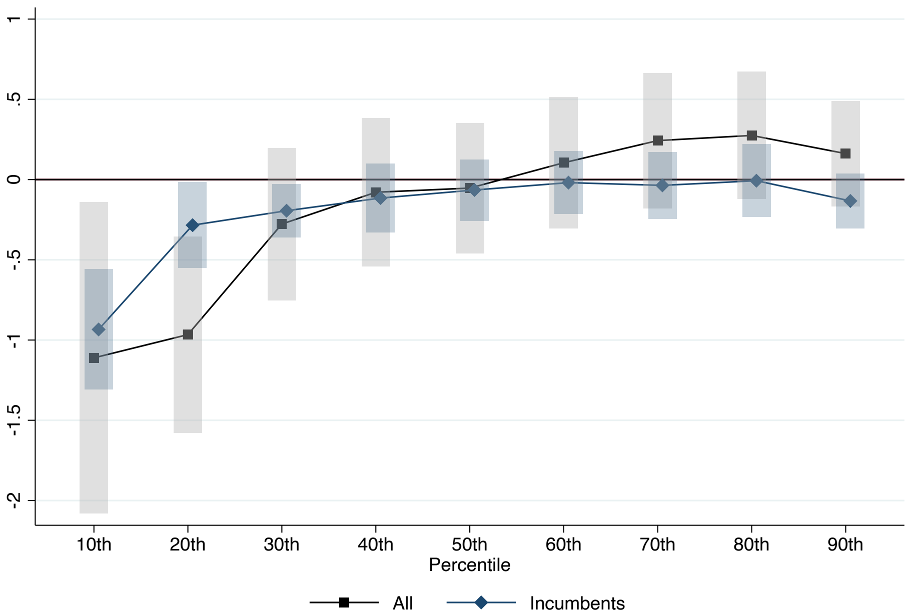
G.3 Firm wage effects by percentile

In Figure 9, we studied the impact of the immigration shock on the distribution of wage premia (i.e. percentiles of the AKM firm fixed effects) within regions. In Figure A5, we show the corresponding analysis for firm median wages (instead of AKM premia), for the 1988-95 interval. The pattern is similar, but the effects are generally smaller in size – consistent with the idea that these estimates are conflated with changes in worker composition (i.e. crowding-out of low-wage natives) which the AKM firm premia abstract from. Nevertheless, we again find that the negative wage effects are concentrated at the bottom of the firm wage distribution, both for the full firm sample and among incumbent firms (i.e. those which are present in both 1988 and 1995).

G.4 Origin-specific immigration shocks

According to our model, migrants' low reservation wages are responsible for the adverse labor market effects. But of course, migrants from different origins are likely to differ in their

Figure A5: Changes in firm median wage (by percentile)



Notes: BHP, regression estimates for 1988-95 interval, based on (12), across 203 local labor markets.

reservation wages (as in e.g. Dustmann, Ku and Surovtseva, 2019); and this heterogeneity can be exploited to test our hypothesis.

Our approach is to divide migrant origins o into two groups (of equal size), according to the mean AKM premia (as computed by Card, Heining and Kline, 2013) of their employers. The idea is that migrants with lower reservation wages are more likely to accept jobs from low-premium firms. For this exercise, we focus on new (post-1988) migrants in the SIAB worker-level data between 1990 and 1996. The low-premia group (i.e. low-AKM firms) consists of the Americas (excluding US and Canada), Asia, Czechoslovakia, Greece, Italy, Poland, Romania, Russia and Yugoslavia. The high-premia group consists of Africa, Spain/Portugal, US/Canada/Australia, other EU, and other non-EU.

We then construct new enclave shocks, which predict migrant inflows from high-AKM origins ($o \in H$) and low-AKM origins ($o \in L$) respectively. Using the notation from Section 5.2, these are:

$$\Delta m_{Hr} = \frac{\sum_{o \in H} s_{or80} \left(n_{o93} - n_{o88} \right)}{n_{r80}} \tag{A40}$$

$$\Delta m_{Lr} = \frac{\sum_{o \in L} s_{or80} \left(n_{o93} - n_{o88} \right)}{n_{r80}} \tag{A41}$$

Table A7: Impact of origin-specific immigration shocks, 1988-95

	Post-1988 migrant shares		Change in log	Change in mean
	High-AKM	Low-AKM	native emp	AKM premia
	(1)	(2)	(3)	(4)
Immigration shock:	1.295***	-0.189	0.147	-0.232
High-AKM origins	(0.116)	(0.126)	(0.628)	(0.206)
Immigration shock:	0.056	0.941***	-1.864***	-0.887***
Low-AKM origins	(0.047)	(0.076)	(0.342)	(0.148)
R^2	0.778	0.659	0.623	0.459
N	204	204	204	203

Notes: Regression estimates in columns 1-3 use SIAB data (for 204 local labor markets), column 4 uses BHP data (203 markets). Columns 1 and 2 report effects on post-1988 migrant shares in 1995, by origin group. Column 3 reports effects on log native employment growth between 1988 and 1995. Column 4 reports effects on changes in mean AKM firm wage premia (as computed by Bellman et al., 2020) between the periods 1985-92 and 1993-99. * p<0.10, ** p<0.05, *** p<0.01.

Note that these instruments sum to the basic enclave shock in equation (13): i.e. $\Delta m_r = \Delta m_{Hr} + \Delta m_{Lr}$.

We then replace the aggregate shock Δm_r with the two origin-specific shocks in our empirical specification:

$$\Delta y_r = \alpha + \beta_H \Delta m_{Hr} + \beta_L \Delta m_{Lr} + \gamma X_r + \varepsilon_r \tag{A42}$$

where Δy_r is the change in some area r outcome between 1988 and 1995, and X_r is our standard set of controls. The approach here is similar to Amior (2020), who disaggregates an enclave shock into Latin American and non-Latin components, using US data.

We present our estimates in Table A7. Columns 1 and 2 show the impact on shares of post-1988 migrants (measured in 1995) from high and low-AKM origins, respectively. The enclave shocks offer sufficient power to disentangle the inflows from each origin group: the high-AKM shock only elicits inflows from high-AKM origins (conditional on the low-AKM shock), and the low-AKM shock only from low-AKM origins. These results offer strong validation for the identification strategy.

In columns 3 and 4, we estimate the impact of these shocks on (i) log native employment and (ii) mean AKM firm premia (as computed by Bellmann et al., 2020). In the main text (in Figure 5b and Table 8), we showed that both outcomes respond negatively to the aggregate

Table A8: Employment and wage effects by industry

		Post-1988 migrant share (1)	Change in log native emp (2)	Change in mean AKM premia (3)
A.	Tradables	0.720***	-2.390***	-0.827***
		(0.084)	(0.351)	(0.226)
B.	Construction	2.453***	-1.580*	-1.079***
		(0.303)	(0.902)	(0.123)
C.	Trade, transport, finance	1.039***	-1.080**	-0.741***
		(0.063)	(0.416)	(0.191)
D.	Other services	1.154***	-0.432***	-0.474***
		(0.076)	(0.357)	(0.115)

Notes: This table estimates effects of the enclave shock Δm_r on wage and employment outcomes (along the table columns), for different industry groups (table rows). Column 1 reports effects on post-1988 migrant share. Column 2 shows effects on log native employment changes between 1988 and 1995. Column 3 shows effects on changes in mean AKM firm wage premia (as computed by Bellman et al., 2020) between the periods 1985-92 and 1993-99. * p<0.10, ** p<0.05, *** p<0.01.

enclave shock Δm_r. But Table A7 shows that the low-AKM origins are mostly responsible for the negative effects in each case. This is consistent with our claim that migrants with low reservation wages drive the adverse labor market effects. However, it is worth stressing that the (statistically insignificant) effect of the high-AKM origins does have a large standard error in column 3.

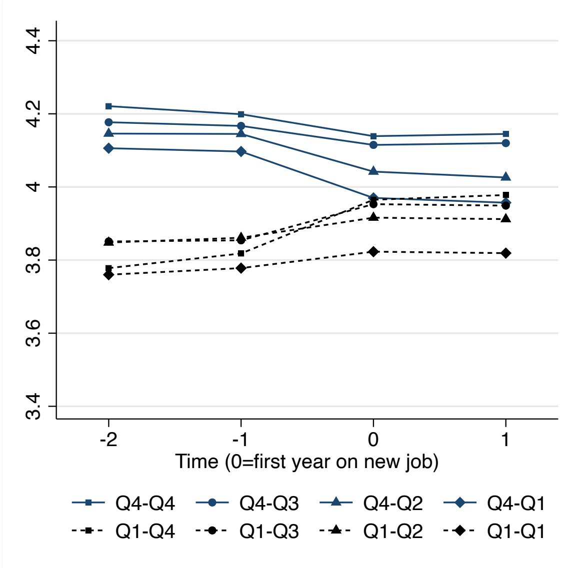
G.5 Employment and wage effects by industry

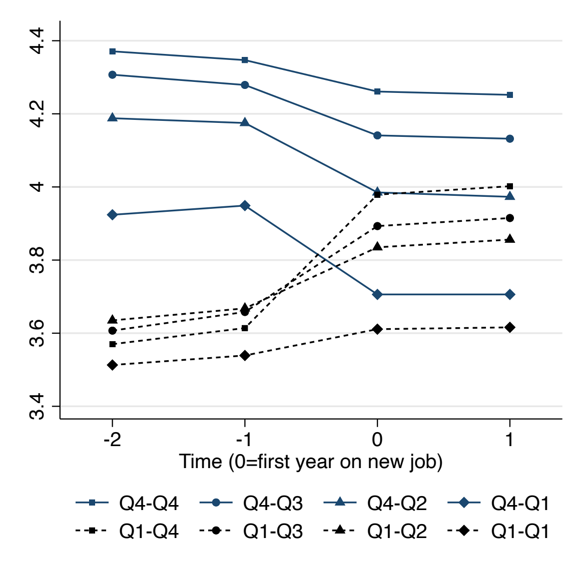
In Table A8, we study sectoral variation in employment and wage effects of the enclave shock Δm_r. We focus on three outcomes: the new (post-1988) migrant share in 1995 (as in Figure 5a), the change in log native employment between 1988 and 1995 (as in Figure 5b), and the change in the mean AKM firm wage premia (as in column 1, Table 8). For the latter outcome, we rely on pre-compiled AKM premia from Bellmann et al. (2020). Along the table rows, we show effects for each outcome in four broad sectors. The "tradables" category in row A includes agriculture, energy, mining and manufacturing (industries 1-16 in Table A1), row B shows construction (industry 17), row C comprises industries 18-20, and row D comprises industries 21-28.

Figure A6: Validation of region and firm wage premia

(a) Regions

(b) Firms





Notes: SIAB, mean wages of workers who change region (panel a) or firm (panel b) during the 1986-88 interval, and who do not change region (or firm) in the previous or subsequent year. Each job is classified into quartiles based on the estimated fixed effects for regions or firms, respectively.

Column 1 shows that the post-1988 migrants are well-represented across all these sectors, and especially in construction. The native employment effects are consistently negative, but largest in tradables. The effects on wage premia are also consistently negative, though somewhat smaller in the "other services" category.

G.6 Validation of regional and firm AKM wage premia

To identify wage premia for regions and firms, we use a "movers design" akin to Abowd, Kramarz and Margolis (1999). Underpinning this approach is an "exogenous mobility" assumption, which requires that the sequence of wage innovations (the ε_{it} in equation (15)) is orthogonal to worker i's location choices. In this appendix, we offer evidence in support of this assumption. Following Card, Heining and Kline (2013) and Card, Rothstein and Yi (2021), we group regions/firms into four quartiles, according to their estimated wage premia. And in Figure A6, we show that workers moving between low- and high-premium regions/firms have similar pre-trends before the move. This exercise is akin to a test for pre-trends in a difference-in-differences design: the results support the assumption that wage changes associated with a move capture regional or firm wage premia, rather than individual differences in wage trajectories.

G.7 Decomposing the change in AKM wage premia

In this section, we show how the mean change in AKM wage premia (at the region level) can be decomposed into contributions from incumbent firms, entrants and exiters. We denote the pre- and post-treatment periods with the subscripts $0, 1$, and define:

- $\overline{AKM}_{r,1}$: mean post-period AKM in area r, among firms active in post-period
- $\overline{AKM}_{r,0}$: mean pre-period AKM in area r, among firms active in pre-period
- $\overline{AKM}_{r,1inc}$: mean post-period AKM, among "incumbent" firms (active in both periods)
- $\overline{AKM}_{r,0inc}$: mean pre-period AKM, among "incumbent" firms (active in both periods)
- $\overline{AKM}_{r,1ent}$: mean post-period AKM, among entrant firms (active only in post-period)
- $\overline{AKM}_{r,0ex}$: mean pre-period AKM, among exiting firms (active only in pre-period)
- $N_{r,1}$: no. firms in area r active in post-period
- $N_{r,0}$: no. firms in area r active in pre-period
- $N_{r,inc}$: no. firms in area r active in both periods

Using this notation, we can write the mean pre-treatment wage premia as:

$$\begin{aligned} \overline{AKM}_{r,0} &= \frac{N_{r,inc}}{N_{r,0}}\overline{AKM}_{r,0inc} + \left(1 - \frac{N_{r,inc}}{N_{r,0}}\right)\overline{AKM}_{r,0ex} \\ &= \overline{AKM}_{r,0inc} + \left(1 - \frac{N_{r,inc}}{N_{r,0}}\right)\left(\overline{AKM}_{r,0ex} - \overline{AKM}_{r,0inc}\right) \end{aligned} \tag{A43}$$

and the post-treatment wage premia as:

$$\overline{AKM}_{r,1} = \left[\frac{N_{r,inc}}{N_{r,1}}\overline{AKM}_{r,1inc} + \left(1 - \frac{N_{r,inc}}{N_{r,1}}\right)\overline{AKM}_{r,1ent}\right] \tag{A44}$$

Using these expressions, we can then decompose the change in mean premia into contributions from incumbents, entrants and exiters:

$$\begin{aligned}\overline{AKM}_{r,1} - \overline{AKM}_{r,0} \;=\; & \underbrace{\frac{N_{r,inc}}{N_{r1}} \left(\overline{AKM}_{r,1inc} - \overline{AKM}_{r,0inc}\right)}_{\text{Incumbents}} \\ & + \underbrace{\left(1 - \frac{N_{r,inc}}{N_{r1}}\right) \left(\overline{AKM}_{r,1ent} - \overline{AKM}_{r,0inc}\right)}_{\text{Entrants}} \\ & - \underbrace{\left(1 - \frac{N_{r,inc}}{N_{r0}}\right) \left(\overline{AKM}_{r,0ex} - \overline{AKM}_{r,0inc}\right)}_{\text{Exiters}}\end{aligned} \tag{A45}$$

For the decomposition in Table 8, we estimate the response of each component of (A45) to the enclave shock Δm_r.

H US evidence on firm size effects

In this appendix, we offer evidence from the US on the impact of immigration on mean firm size. Though firm size is an unusual outcome in the immigration literature, it is a natural focus of our model (see Proposition 4 in Section 2.2); and it is simple to measure in many contexts. We provide these US estimates as a point of comparison for our analysis in the main text.

For this exercise, we rely on spatial variation in immigration between 1980 and 2020, expanding the analysis of Amior (2020). Unlike our German setting, this analysis does not exploit a one-off immigration event, but instead relies on decadal changes identified by an enclave shock. Amior (2020) find large crowd-out in population across commuting zones, and even more in employment, such that local employment rates contract. In what follows, we keep the same data structure as Amior (2020), but replace the dependent variable with changes in mean firm size (sourced from the County Business Patterns data). Just as in our German setting, we find negative effects on firm size; but the US effects are smaller in magnitude.

H.1 Empirical specification

Similar to equation (12) in the main text, we rely on a "reduced form" specification:

$$\Delta y_{rt} = \alpha_t + \beta \Delta m_{rt}^{US} + \gamma_t X_{rt} + \varepsilon_{rt} \tag{A46}$$

where Δy_{rt} is the change in some outcome of interest in area r corresponding to 722 commuting zones (CZs) between time $t-1$ and t. Time observations are each a decade apart (1980, 1990, 2000 and 2010), and Δm_{rt}^{US} is an enclave shock:

$$\Delta m_{rt}^{US} = \frac{\sum_o s_{ort-1} \left(n_{ot} - n_{ot-1}\right)}{n_{rt-1}} \tag{A47}$$

which predicts changes in migrant share between $t-1$ and t, based on local shares s_{ort-1} of 77 origin groups o at $t-1$, similar to equation (13). X_{rt} is a vector of local controls, which includes current and once-lagged Bartik industry shift-shares, as well as a range of observable fixed amenities[56] 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).

H.2 Data description

We borrow the enclave shock Δm_{rt}^{US}, the X_{rt} variables, and migrant share by CZ and year from Amior (2020). The new addition here is our establishment size outcome. To measure firm size by CZ, we rely on publicly accessible data from 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.

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 by exploiting the constraints implied by geographical and industrial hierarchies, and they use

[56] 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 A9: US establishment size effects

	Δ Migrant population share				Δ Log mean firm size			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Decadal enclave shock	0.292***	0.233***	0.388***	0.574***	-0.154***	-0.213***	-0.404***	-0.414***
	(0.031)	(0.034)	(0.060)	(0.047)	(0.054)	(0.037)	(0.113)	(0.091)
Enclave shock: Lag				-0.400***				0.235**
				(0.039)				(0.111)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bartik, amenity controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
CZ fixed effects	No	No	Yes	No	No	No	Yes	No
Observations	2,166	2,166	2,166	2,166	2,166	2,166	2,166	2,166

This table presents estimates of equation (A46), for three decadal observations (from 1980 to 2010) across 722 CZs in the US. In columns 1-4, the dependent variable is the decadal change in the migrant (foreign-born) population share; and in columns 5-8, it is the change in log mean firm size. Robust standard errors, clustered by state, are in parentheses. Observations are weighted by lagged local population share. *** p<0.01, ** p<0.05, * p<0.1.

official industry crosswalks to produce consistent series.

H.3 Empirical estimates

We present our basic estimates of (A46) in Table A9. In columns 1-4, we study the effect of the enclave shock Δm_{rt}^{US} on the migrant (foreign-born) population share: 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 and Bartik shift-shares (column 2). In column 3, we control for area fixed effects: since (A46) 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), and this may bias our estimates if migrant share responds dynamically. To address this concern, 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, as in e.g. Card and Lewis (2007).

In columns 5-8, we estimate the same specifications for changes in log mean firm size (i.e. a "reduced form" specification). Firm size responds negatively in column 5 (year effects only), and including the amenity and Bartik controls only strengthens the effect: the coefficient in column 6 is -0.21, with a standard error of just 0.04. Area fixed effects in column 7 increase the impact still further. And in the dynamic specification (column 8), we see a mean reverting effect which perfectly reflects changes in migrant share in column 4: the initial local shock reduces firm size (with a coefficient of -0.41), but this effect is partly offset (0.24) in the subsequent decade as the immigration shock diffuses nationally.

Though qualitatively similar, these firm size effects are smaller in magnitude than in our German setting. On the one hand, the response of the migrant share to the enclave shock is similar: compare Table A9 to Figure 5a (black line) in the main text. However, the response of firm size in Table A9 is clearly smaller than in Germany: for comparison, we have a coefficient of -1 in Table 4. A natural interpretation is that the "wage-setting" effect (in Proposition 4 of the model) is more dominant in our German setting, due to lower migrant reservation wages. With public data alone, we are unfortunately unable to provide a detailed analysis of wage and employment effects across the firm distribution, as we do in our German analysis.