# Immigration, Monopsony and the Distribution of Firm Pay

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**Abstract**

We argue that the arrival of migrants 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 mitigated through policies which constrain firms' monopsony power over migrants.

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# 1 Introduction

The labor market impact of immigration is traditionally interpreted in a competitive framework, where workers earn their marginal product. In these models, the effects depend 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, in violation of the competitive model. In principle, if migrants have sufficiently low reservation wages, firms may even profit by reducing their employment overall. This seemingly counterintuitive implication 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 surprising, 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 growth 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 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; Bruns and Priesack, 2019), but we pose new questions, study new outcomes (informed by our model), and rely on different empirical variation. The setting appears well-suited to exploring the implications of low reservation wages: the influx was accompanied by 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, references to *Lohndumping* ("wage dumping") and *Sozialdumping* ("social dumping") surged at precisely the time of the immigration wave.

We begin by providing evidence on wage-setting in this period. New immigrants were paid 10% less than observably similar natives, and this wage gap was mostly due to migrants sorting into low-paying firms. As our model shows, this is consistent with 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). Detailed administrative data on both firms and workers allow us to address selection, compositional changes and other potential threats to identification, such as the coincident inflows of ethnic (repatriate) and East Germans.

As the model predicts, the new immigrants disproportionately concentrated in small low-paying firms. At the same time, we see reductions in both wages *and* native employment at

[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, the evidence shows that wage offers are often not tailored to individual workers, especially among the low-paid (e.g. Caldwell and Harmon, 2019; Lachowska et al., 2022; Di Addario et al., 2023).

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




Notes: Foreign employment share is based on Sample of Integrated Labour Market Biographies: 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 indexed to 1 in 1988). *Lohndumping* is typically translated as "wage dumping", and *Sozialdumping* as "social dumping".

the bottom of the firm pay distribution. Crowd-out of native employment was so large that firm size contracted on average (we also corroborate these firm size effects in US data, in Appendix H). 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 they shed native labor to exploit cheaper migrants.

Crucially, the wage effects among low-paying firms are not driven by compositional changes in firms' employment, which would threaten identification (Bratsberg and Raaum, 2012; Ortega and Verdugo, 2022; Borjas and Edo, 2021; Dustmann et al., 2023). Nor do they merely reflect the concentration of particular skill types (with larger exposure to the migration shock) in these firms. Rather, they reflect genuine reductions in firm-specific wage premia (as identified by "AKM" firm fixed effects, as in Abowd, Kramarz and Margolis, 1999) independently of worker type. Consistent with our model, these reductions were driven by both pay cuts among existing firms and the entry of new low-paying firms.

The simple mechanism emphasized here – non-discriminating monopsony – is therefore consistent with a range of empirical findings, some shared with other work (e.g., large reductions in native employment) and some that are novel (e.g., reductions in both pay *and*

average firm size, and the concentration of the employment and wage effects among low-paying firms). Our focus on the firm pay distribution is not arbitrary: it is guided by a simple and foundational model, whose key assumption of imperfect wage discrimination is well-substantiated in both our data and the modern wage-setting literature. We do not claim this model offers the only possible explanation for *each* of our findings. Instead, our point is that it provides a particularly simple and plausible explanation for the *full set* of results;[4] and more generally, that one of the workhorse models of labor economics has important and previously unexplored implications regarding the impact of immigration.

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 competitive models), which vary significantly across empirical settings. This may 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; Amior (2020), Burstein et al. (2020), Monras (2020) and Doran, Gelber and Isen (2022) on the US[5]; Muñoz (2023) on France and Belgium; and Delgado-Prieto (2021) on Colombia.

Moreover, since the wage cuts are driven by 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 (see e.g. Edo and Rapoport, 2019), a regularization policy (e.g. Amior and Manning, 2020; Monras, Vázquez-Grenno and Elias, 2020; Borjas and Edo, 2023), or other interventions which improve the integration of migrants (Brell, Dustmann and Preston, 2020; Foged, Hasager and Yasenov, 2022).

## Related literature

This study subsumes parts of an earlier unpublished paper (Amior, 2017), which explored theoretically how non-discriminating monopsonistic firms can shape the impact of immigration. It is also closely related to Amior and Manning (2020), who consider the salience of this

[4]It seems difficult to find an equally simple model to motivate our key findings. For example, a competitive model with heterogenous firms and workers (and productive complementarities between them) may explain why migrants sort to (and crowd out natives from) low-paying firms. However, such a model would not explain the coincidental reduction of both firm size *and* pay, nor why AKM wage premia (i.e. *conditional* on worker type) decline at the bottom of the firm pay distribution.

[5]Also relevant is a study by Abramitzky et al. (2023) on US border closures in the 1920s (i.e. an emigration shock). In urban areas, they find that the lost foreign labor was fully replaced by internal population inflows.

mechanism in wage effects across US skill cells. Building on these papers, our contributions are both conceptual and empirical. First, we explore an equilibrium framework with multiple 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] These low reservations have been rationalized in different ways, though the precise mechanism is not important for our argument.[7] They are consistent with firms having greater market power over migrant labor, as found in several studies (Winter-Ebmer and Zweimüller, 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). And low reservations can help explain why migrants often concentrate in small and/or low-paying firms (as in 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 e.g. Hellerstein, Neumark and McInerney (2008), Glitz (2014), Ansala, Åslund and Sarvimäki (2021) or Willis (2022).

Our paper also contributes to a growing literature on the firm-level effects of immigration: e.g. Dustmann and Glitz (2015); Kerr, Kerr and Lincoln (2015); Beerli et al. (2021); Egger, Auer and Kunz (2021); Mahajan (2022). Some 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 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

[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).

[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; Borjas and Edo, 2023), 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).

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; and Dodini, Løken and Willén (2022) show that an inflow of Swedish commuters with comparatively low reservations decreased labor costs in Norwegian firms. 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. Finally, Delgado-Prieto (2023) finds that the effects of immigration in Colombia are concentrated in small firms, though the mechanism here is a technological constraint (only small firms hire informal labor).

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.

Our focus on firms' contribution 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 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 that these premia are malleable to economic shocks, just as our model predicts. This is not a trivial finding: as Lachowska et al. (2023) show, firm premia are very persistent over time. We 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.

In the next section, we set out our theoretical model. Section 3 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 immigration. We estimate aggregate labor market effects in Section 6, and effects across the firm distribution in Section 7. In Section 8, we address composition bias in our wage estimates, by tracking job-movers. Though our model guides us to focus on the *firm* distribution, we study more traditional sources of heterogeneity across the *worker* distribution in Section 9.

# 2 Model

Our key propositions can be derived from standard wage-posting models. In our main exposition, we rely on the framework of Albrecht and Axell (1984), which has the minimum ingredients we require: search frictions, monopsonistic wage-posting, and heterogeneous reservation wages. The model we consider is not new: our contribution is to explore its implications for the impact of immigration. 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.[8] 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 $\lambda$, and accept offers which exceed their reservations. At rate $\delta$, workers are exogenously separated to unemployment. Workers are risk neutral and discount the future at rate $r$.

A fraction $\mu$ 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 $\lambda$ 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 some pertinent theoretical extensions: heterogeneity in native reservation wages, on-the-job search (as in Burdett and Mortensen, 1998), an endogenous offer rate $\lambda$, 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

[8] 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.

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 $(w_0, w_1, \phi)$, where $\phi$ 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:

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

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

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 (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 $\phi\lambda$. Only migrants accept $w_0$ offers, and hence the additional term in (2). The employment values are given by:

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

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 $\delta$.

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:

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

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

To close the model and solve for the low-pay sector share $\phi$, 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 low offer $w_0$ 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[9] (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 $\phi$ 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 the equilibrium low-pay sector share $\phi$ is increasing in the exogenous $\tilde{\mu}$ parameter. Intuitively, more firms will offer $w_0$ if (i) there are many migrants[10] ($\mu$ large) and (ii) if the migrant reservation $b_M$ is small relative to $b_N$.

[9] 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 $\phi$ serves to equalize profits in equilibrium.

[10] 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. Our strategy is to study changes in the migrant share $\mu$, holding $\frac{n}{k}$ (the ratio of workers to firms) 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, the $\frac{n}{k}$ ratio is little affected in our empirical application.

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

This follows from the assumption that firms cannot tailor offers to individual workers: firms which offer low wages ($w_0$ 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 without homophily or ethnic networks.

**Proposition 2.** *A larger migrant share $\mu$ induces firms to reduce offers at the bottom of the pay distribution. In our stylized model, this manifests through an increase in the low-pay sector share $\phi$ and a reduction in $w_0$. These effects are increasing in the $\frac{b_N - b_M}{p - b_N}$ ratio.*

Intuitively, to reduce its wage, a non-discriminating monopsonist must forgo employment of high-reservation workers (i.e. natives). But as the migrant share $\mu$ increases, this trade-off becomes more attractive: labor supply becomes less elastic (and monopsony power increases) at the bottom of the offer distribution, where migrants' reservations are concentrated. In response, firms optimally reduce their wage offers at this part of the distribution.

In our stylized model, these wage effects manifest in two ways. First, as equation (9) shows, a larger migrant share $\mu$ causes an expansion of the low-pay sector share $\phi$: i.e. more firms offer the low wage $w_0$. Second, as equation (5) shows, the larger $\phi$ causes the low wage $w_0$ itself to decrease. Intuitively, the larger $\phi$ reduces the quality of migrants' outside options and hence their reservation wage; so firms can now recruit them at even lower pay.

Looking at equation (10), these effects of migrant share $\mu$ become stronger 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 $b_N$).[11]

**Proposition 3.** *As more firms adopt the low-pay strategy (in response to a larger migrant share $\mu$), native employment decreases at the bottom of the pay distribution. This effect is increasing in the $\frac{b_N - b_M}{p - b_N}$ ratio.*

[11] 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.

This result follows immediately from Proposition 2. As the low-pay sector share $\phi$ increases, those firms which switch from a high- to low-pay strategy (i.e. from $w_1$ to $w_0$, in our stylized model) must necessarily forgo employment of high-reservation workers (i.e. natives).

At the aggregate level, this expansion of the low-pay sector share $\phi$ reduces native employment: as equation (6) shows, $u_N$ is increasing in $\phi$. As with the wage effect, this employment effect becomes stronger 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 $\mu$ may cause a reduction in average firm size.*

Average firm size can be expressed as $\bar{l} = \phi l(w_0) + (1-\phi) l(w_1)$, where $\phi$ 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 $\mu$ 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 $\mu$ increases the size of low-pay firms, because only migrants accept their offers.

The second is a negative "wage-setting effect": a larger $\mu$ 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.[12]

Finally, depending on how the number of firms $k$ changes (see Section 2.4 below), not only average firm size but also *total employment* may decrease.

## 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. 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 $\mu$ expands, more firms adopt a low-pay strategy

[12] For example, if the initial low-pay sector share $\phi$ is positive but sufficiently close to zero, the composition effect in (11) will also be close to zero; and the wage-setting effect will dominate.

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, due to 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.[13]

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 case, a wage reduction need not be associated with an expansion of total employment.

These insights are important for policy: 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

[13] 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, as in Burdett and Mortensen (1998). Rather than a single wage $w_0$, the low-pay sector now contains a distribution of offers (between $b_M$ and $b_N$), as firms compete directly for employees. Similarly, the high-pay sector has a distribution of offers exceeding $b_N$. The propositions above are unaffected. But since natives now receive a surplus in equilibrium, we do see a native wage effect. Intuitively, when firms drop into the low-pay sector, this reduces competition in the high-pay sector; so native wages converge towards $b_N$. Also, this extension implies some interesting transitory dynamics: on arrival, migrants begin at the bottom of the jobs ladder, and gradually work their way up. Empirically, job mobility is known to be crucial to migrant wage assimilation (see Lehmer and Ludsteck, 2015; Dustmann, Ku and Surovtseva, 2019; 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 $\lambda$.[14]

**(iv) Endogenous $\frac{n}{k}$ and contact rate $\lambda$.** 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 $\lambda$. 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 they drop into the low-pay sector (from $w_1$ to $w_0$) more readily in response to immigration. Under free entry, immigration may also induce Melitz-type (2003) selective entry of

[14]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 $\lambda$ in our model. As equation (5) shows, if $b_M < b_N$, a low $r$ or low $\lambda$ will reduce the migrant reservation wage $w_0$ further.

low-quality firms, which would be unable to operate without low-reservation labor.[15]

**(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, as in our empirical application). This causes the migrant share $\mu$ 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 wage discriminate against migrants (doing identical work). This is a source of inefficiency, as low-pay firms must forego natives who are willing to accept wages below $p$. 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 $\mu$ 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.[16] 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 do not find much 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 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-

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

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

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 datasets are the Sample of Integrated Labour Market Biographies (SIAB) and the Establishment History Panel (BHP), both from the Institute for Employment Research (IAB). We use weakly anonymized data, accessible by remote execution. We rely additionally on 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 study 204 local labor markets (BBSR, 2014) in the SIAB, or 203 in the BHP (which uses a more recent territorial definition, merging two districts). In this data, locations are defined by place of work rather than residence, and "migrants" by nationality rather than birthplace (naturalizations were infrequent in our analysis period).

**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 dependent employees subject to social security contributions. The data are representative for over 80% of the workforce, but exclude civil servants, the self-employed, full-time students, and the military.[17] We focus on individuals aged 16-65 in West Germany (excluding West

[17]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).

Berlin). For the employment analysis, we consider both full- and part-time workers, and construct an annual panel using records from June 30 of each year. We restrict the wage analysis to full-time workers. Wages correspond to the average gross daily wage in the employment spell containing this reference date.[18] The IAB allows users to attach establishment-level characteristics to SIAB worker records: among other outcomes, we merged the AKM firm 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[19] (Gruhl, Schmucker and Seth, 2012). These contain detailed information on employment and wages, for half of all establishments subject to social security. 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 establishments (the SIAB only covers 2% of employees).

## 3.2 National trends in immigration

The early 1990s saw a large and sudden immigration wave, triggered by the fall of the Iron Curtain and Yugoslav War. As Figure 2a shows, between 1988 and 1993, the share of foreign nationals in regular employment grew from 8 to 10% (black line). By 1997, over 5% of the workforce consisted of foreigners who entered after 1988 (blue line), equal to about 1 million workers. Panel b shows that much of the shock originated from Eastern Europe, especially Yugoslavia and Poland. While immigration rose elsewhere in Western Europe 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).

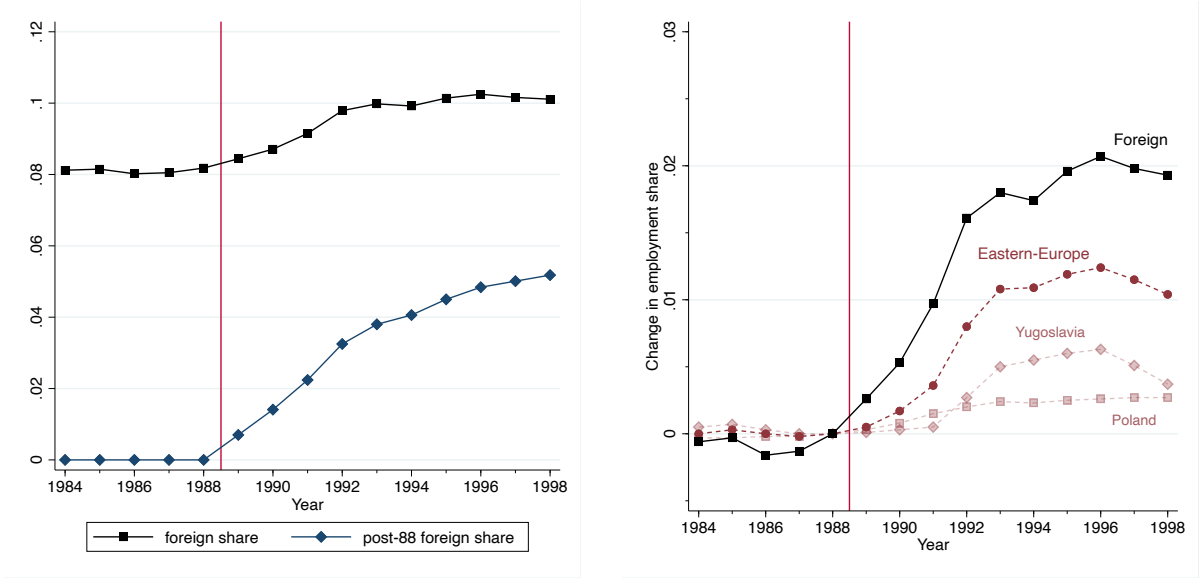
[18] Wages are right-censored at the social security contribution ceiling (less than 6% of all observations): following Dustmann, Ludsteck and Schönberg (2009), we impute censored wages under the assumption that errors are normally distributed, while allowing for different residual variance by gender and year. We also impute missing educational information, following Fitzenberger, Osikominu and Völter (2006).

[19] We use BHP-v7510 to construct local migrant shares and the enclave instrument (as it reports employment by nationality), and BHP-v7519 for all other analysis: this latter version contains more detailed wage data and AKM firm effects (estimated by Bellmann et al., 2020, on the universe of employment records).

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).

## 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 sectors, as shown in Appendix Table A1. Foreign share increased by nearly 11 pp in hospitality, and also grew strongly in agriculture, food manufacturing, household/business services, and construction. Few migrants entered the public sector or industries that were contracting at the time, such as mining. While previous migrants were overrepresented in tradable industries (a legacy of Germany's guest worker program, which filled jobs in mining and heavy manufacturing industries), new arrivals had a similar concentration in tradables to natives (column 9).

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.

# 4 Validation of wage-setting assumptions

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

In Section 4.1, we show that new immigrants were paid 10% less than comparable natives. This differential may be rationalized by low migrant reservation wages in many non-competitive frameworks, not just ours. But we show it is mostly a consequence of migrants *sorting into* low-paying firms, and not wage discrimination *within* firms – just as our model predicts (Proposition 1). Additionally, Section 4.2 shows that pay gaps vary little across the *firm distribution*, suggesting that higher-paying firms do not share rents more generously with natives than migrants. 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 Average pay differentials 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, pre-1989 migrants earned slightly more than natives (4 log points), but new migrants were paid 44 log points less (column 1). Though columns 2-3 show that much of this differential can be statistically explained by age, education, gender and occupation (12-group classification), new migrants still earned 10 points less conditional on these characteristics.[20]

[20]These large wage gaps are specific to the immigration episode we study. In Appendix E.2, we show that in the early 1980s, migrants received similar pay to observably comparable natives.

Table 2: Average migrant wage differentials

| | 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.

We next study whether this residual gap is driven by sorting *across* (as opposed to wage differentials *within*) firms. To this end, we restrict our sample to firms containing both natives and migrants. Though the sample is now 60% smaller, the coefficients remain similar (cf. columns 3 and 4), with a -0.12 effect for new migrants. In column 5, we now introduce firm fixed effects: remarkably, this eliminates most of the gap, which falls below 4%. Conditioning on interacted firm-occupation effects (column 5) reduces the gap still further.

To summarize, the residual wage gap can mostly be attributed to sorting across firms, consistent with the wage-setting mechanism in our model. In Appendix E.5, we confirm that new migrants are concentrated in low-paying firms (with low median wages and low AKM premia).[21] This pay differentiation between firms is consistent with the institutional setting: Germany had no minimum wage during our analysis period, and though there is collective bargaining at the industry-region level, individual employers can choose to opt out of these agreements; small firms are especially likely to do so, and coverage eroded significantly in the 1990s (Jäger, Noy and Schoefer, 2022). Importantly, the overrepresentation of new migrants in small and low-paying firms is not merely a byproduct of "skill sorting" (i.e., assortative matching between productive workers and firms); in line with Swedish evidence from Aslund

[21]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 differentials in other contexts. Like Arellano-Bover and San (2020), we also show in Appendix E.5 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.

et al. (2021), Appendix E.5 shows that new immigrants are much more concentrated in low-paying firms than natives of the same gender, education and age.

While Table 1 reports average wage gaps, these gaps differ across groups. They 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 were paid 13% less than observably similarly natives, conditional on firm fixed effects.[22] This could reflect 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.[23]

## 4.2 Rent sharing across firm distribution

Above, we showed that the *average* native-migrant wage differential (conditional on worker characteristics) is mostly driven by differential sorting across (rather than pay gaps within) firms. We next show that pay gaps vary little across the *firm distribution*, suggesting that higher-paying firms do not share rents more generously with natives than migrants (as in our model). Specifically, we can reject the claim that migrants sort into low-paying firms due to greater pay discrimination higher up the distribution. Though high-paying firms might have more scope to reduce wage offers to migrants, they appear reluctant to do so.

Adopting a similar empirical strategy to Card, Cardoso and Kline (2016), Goldschmidt and Schmieder (2017), Arellano-Bover and San (2020), Dostie et al. (2020), Gerard et al. (2021), Drenik et al. (2023) and Muñoz (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, across those (typically larger) firms which contain both natives and migrants.

We present our estimates in Table 3. The OLS coefficients in columns 1 and 4 are 0.5 or 0.6. This suggests that a firm which pays natives 10% more (conditional on their observables) will typically pay migrants 5 to 6% more (relative to lower-paying firms): i.e.

[22]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 overrepresented among middle-aged workers.

[23]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 (2023) on the pay penalties of posted workers in France.

Table 3: Differential rent sharing

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

Notes: Establishment-level regressions, based on SIAB data over 1990-96. "Previous" migrants 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.

migrants do benefit from firm-specific rents, but not as much as natives. However, these coefficients are attenuated by measurement error in the native firm premia. This bias can be addressed using a "split-sample" IV strategy, as in Goldschmidt and Schmieder (2017) and Drenik et al. (2023), or an empirical Bayes (EB) procedure as described by Angrist, Hull and Walters (2022): see Appendix E.3 for details. With either approach, the estimated coefficients on the native premia are close to 1, for both new and previous migrants.[24]

To summarize, migrants appear to benefit *equally* to natives from working in 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 unable or unwilling to discriminate against them. This observation validates our model's key assumption, and also matches existing evidence from other countries.[25] Perhaps this should not be surprising: the literature mostly finds that wage offers are not typically tailored to individual workers in low-wage markets (Caldwell and Harmon, 2019; Lachowska et al., 2022; Di Addario et al., 2023).

[24]One might worry that our estimates are conflated by unobserved worker heterogeneity across firms. But following a strategy similar to Aslund et al. (2021), we show in Appendix E.4 that natives and migrants who *transition* from firms with low to high AKM premia benefit from similar wage increases.

[25]Dostie et al. (2020) find similar results in Canada; Arellano-Bover and San (2020) estimate that migrants receive 85% of the rents of natives in high-paying firms in Israel (i.e. 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. Interestingly, the pattern appears very different for other, non-regular forms of labor: outsourced workers only receive half the premium paid by the user firm to its regular employees (Drenik et al., 2023), and foreign posted workers only receive 10% (Muñoz, 2023).

# 5 Empirical strategy

We now describe our empirical strategy, which exploits regional variation in immigration (as described by Section 5.1) using a past-settlement instrument (Section 5.2). We also discuss potential confounders related to German reunification 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 $t \in \{1985, ..., 1996\}$:

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

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 $t$, $\Delta m_r$ is a measure of the aggregate regional immigration shock between 1988 (when 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 (12) is expressed in differences, we are implicitly controlling for pre-treatment differences in outcome $y$ across regions (i.e. region fixed effects).

We estimate (12) separately for each year $t$: this allows the impact of both immigration ($\beta_t$) and the controls ($\gamma_t$) to vary by year. For post-treatment years $t > 1988$, the coefficients $\beta_t$ represent the dynamic (reduced-form) impact of the immigration shock $\Delta m_r$ on outcome $y$ in year $t$. For pre-treatment years $t < 1988$, the $\beta_t$ 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 $\Delta m_r$ in (12) for every year $t$, and irrespective of whether the outcome $\Delta y_{rt}$ 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 $\beta_t$ 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 $\Delta m_r$ with the enclave instrument of Altonji and Card (1991) and Card (2001): see Jaeger, Ruist and Stuhler (2018) for a recent survey. 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 denominator $n_{r80}$ is total employment in region $r$ in 1980.[26] We purposely choose a fixed time interval for the enclave shock, as both the treatment intensity and response are plausibly dynamic (and difficult to disentangle from each other).

Contrary to most applications, we use the enclave shock $\Delta m_r$ as an explanatory variable, and not as an instrument for realized foreign inflows. The coefficients $\beta_t$ in (12) can therefore be interpreted as "reduced form" effects of $\Delta m_r$. We have chosen this approach, as we prefer not to take a firm stance on whether the relevant endogenous variable is the overall or post-1988 foreign share (see Figure 2a). 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).[27]

Figure 3 maps the spatial distribution of both the enclave shock $\Delta m_r$ (Panel a) and realized changes in foreign employment share (Panel b) between 1988 and 1993. Visually, the enclave shock appears to predict immigration well: both are clustered in similar regions, including some of the larger cities (such as *Frankfurt, Munich* or *Stuttgart*) but also in other lower-density regions. In Appendix Figure A3, we plot the two variables against one another: the correlation is 0.55, and is driven by both high and low-population regions.

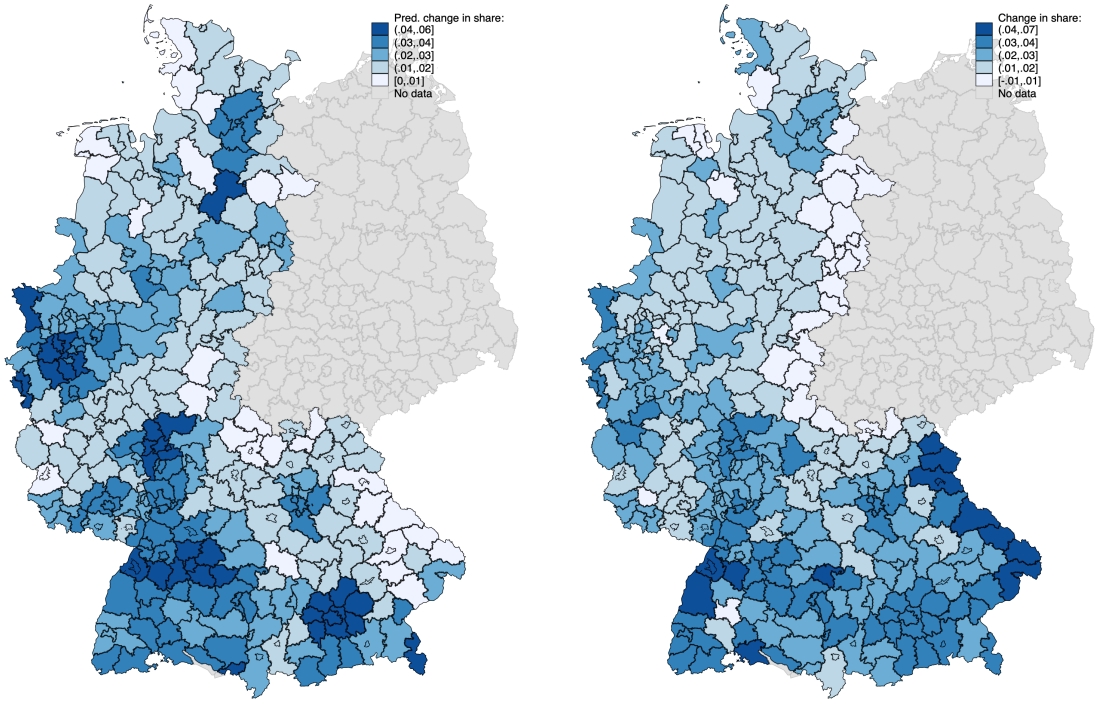
There are some regions however where the enclave shock $\Delta m_r$ lacks predictive power (see Appendix F.2 for details). First, the foreign share grew strongly close to the Czech border

[26] 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).

[27] 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).

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

(a) Predicted: enclave shock $\Delta m_r$ (b) Actual




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

(in the South East), despite the weak enclave instrument. This reflects a special cross-border commuting policy (analyzed in Dustmann, Schoenberg and Stuhler, 2017) that permitted Czech workers to commute into Germany. Second, surprisingly few immigrants settled close to the East-West German border. 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.

## 5.3 Potential confounders and controls

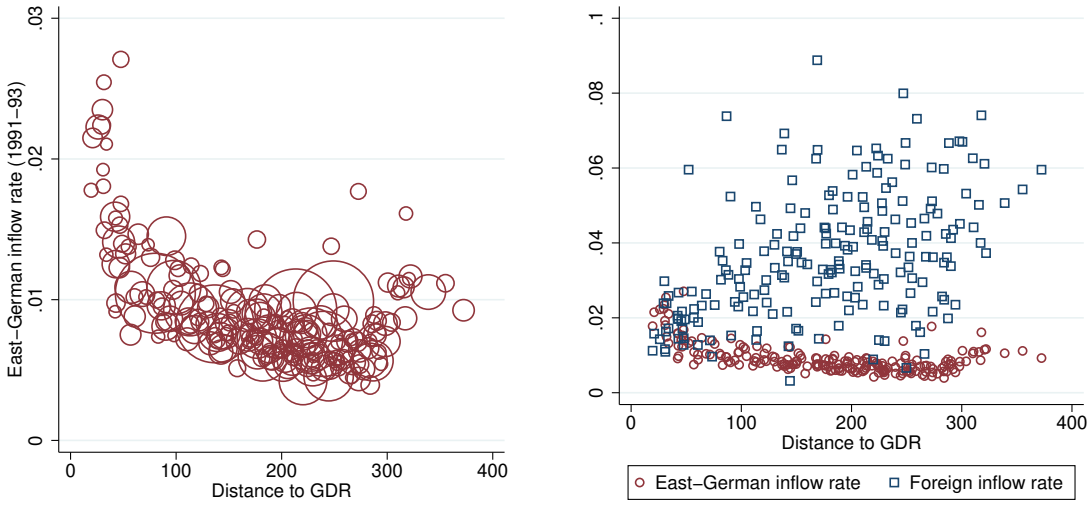
Our setting offers several advantages: external triggers of immigrant inflows ("push factors"), their large size and spatial dispersion, their sharp and unexpected onset after a period of steady foreign shares (allowing for a clean distinction between pre- and post-treatment periods), and high-quality panel data on workers and firms. However, there were other major events in the same period, which may confound our estimates: we discuss each in turn.

**(i) Reunification.** Reunification led to a large inflow of East Germans to the West.

Figure 4: Comparing East German and foreign inflows

(a) East German inflows

(b) East German and foreign inflows




Notes: Federal Statistical Office and SIAB. Panel a plots inflow rates of East Germans between 1991 and 1993 in West German districts (*Kreiswanderungsmatrix*), against distance to the inner German border. Panel b compares these East German inflows with foreign inflows between 1989 and 1993.

While East Germans are not reliably identified in the SIAB, the Federal Statistical Office reports internal population flows between districts from 1991. As Figure 4a shows, inflow rates of East Germans are very strongly predicted by distance to the inner German border (see also Bruns and Priesack, 2019): 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, 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 control for log distance in all regressions. Note this control also captures other (time-varying) distance-related consequences of reunification, such as changes in the spatial distribution of trade.

**(ii) Repatriation of ethnic Germans.** When the Cold War ended (and travel restrictions were lifted), many ethnic Germans in the Eastern Bloc exercised their right to move to Germany (as German nationals). In Appendix F.4, we show that ethnic German and foreign inflows are negatively correlated spatially, but the relationship is weak (and could be part of the impact we aim to capture, if ethnic Germans avoided regions more exposed to foreign inflows). The repatriation of ethnic Germans is therefore not a concern for our analysis.

**(iii) Other demand and supply shocks.** As in most immigration studies, 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 immigration peaked in 1991.[28] To address this challenge, we control for two Bartik-type shift-shares, which predict employment and wage growth (respectively) using each region's 1980 industrial composition.[29] Turning to the supply side, a potential concern is the sharp decline in fertility in West Germany in the 1960s and 1970s; this reduced population growth in subsequent decades, especially in regions where fertility was initially highest (Basten, Huinink and Klüsener, 2011). To exclude this variation, we project working-age (18-59) population growth 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

In this section, we study aggregate effects of immigration on local labor markets, following the example of much of the literature. Though not the heart of our analysis, this will provide important context for what follows. We find large crowd-out of native employment, consistent with non-discriminating monopsonistic firms. In Sections 7 and 8, we will test this interpretation by studying wage and employment effects across the firm pay distribution.

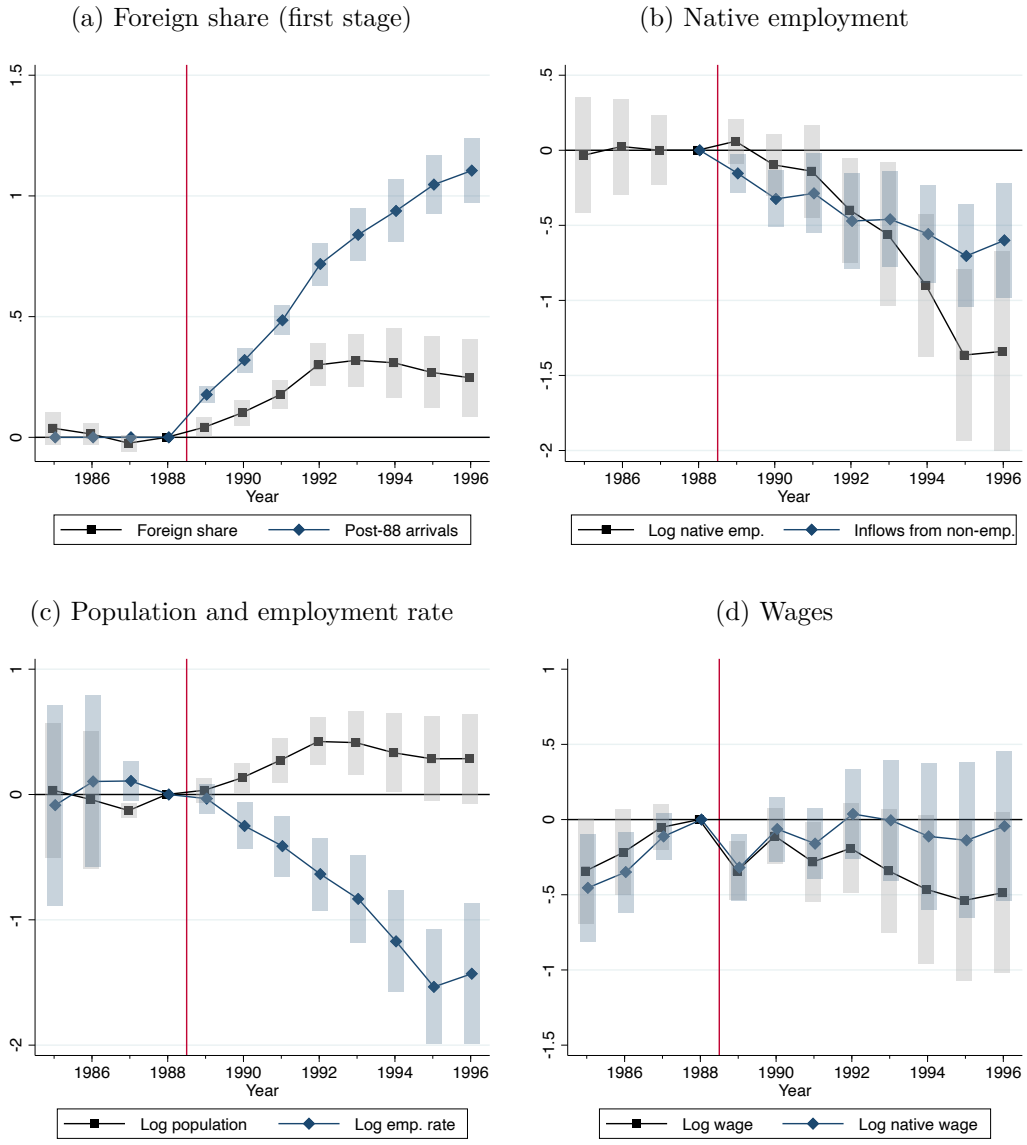
## 6.1 Changes in regional foreign share

In Figure 5a, we plot effects of the enclave shock $\Delta m_r$ 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 $\beta_t$ coefficient peaks at 0.3 in 1993. The blue line traces the share of post-1988 foreigners: the effect is zero by construction before 1988, and reaches 1 by 1995. This coefficient makes it simple to interpret the estimates below: a 1-point change in $\Delta m_r$ corresponds to a 1 pp foreign inflow. Based on our model, it is likely to be the post-1988 arrivals who matter most, as they appear to have low reservation wages (see Section 4).

[28] Note the recession is only a *confounder* if its intensity covaries spatially with the immigration shock. However, it may also amplify the genuine wage-setting effects we seek to identify: as Section 2.2 shows, the model predicts that these effects become more acute if productivity $p$ is low.

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

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.

In Appendix G.2, we show that this response is robust to different controls and regression weights.

## 6.2 Impact on regional employment and wages

Figure 5b shows the impact on log native employment. This is large and negative, reaching -1.3 by 1995 for a 1 pp immigration shock. The effect varies somewhat with choice of controls and regression weights, but remains large in all specifications (Appendix G.2). In the same figure, we show it is partially driven by reduced native *inflows* from non-employment, especially in the first years after treatment (see Appendix G.1 for details).

Our hypothesis does not rest on whether crowd-out exceeds one-for-one: as Proposition 4 shows, the model is ambiguous on this point. However, our model can help rationalize a very large effect (even exceeding one-for-one). Crowd-out here is certainly large compared to other studies in the literature, but not uniquely so: Dustmann, Schoenberg and Stuhler (2017) find that Czech commuters in Germany (in the same period) also induce large displacement; and see Muñoz (2023) 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 Figure 5b are driven by origin groups which typically sort into lower-paying firms (which reflects lower reservation wages), just as our model would predict. In Appendix G.5, we show that crowd-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 average regional wages decline (black line), reflecting the arrival of low-paid migrants; but wages remain stable if migrants are excluded (blue line). This might appear surprising, given the fall in the employment rate. However, as we show below, these wage effects are contaminated by compositional shifts in native employment (as in Bratsberg and Raaum, 2012; Borjas and Edo, 2021; Dustmann et al., 2023): it is disproportionately low-paid workers who are displaced. We address this challenge in Section 8 using a "movers" design, which reveals sizable negative effects on regional wage premia.

# 7 Effects across the firm pay distribution

To test the claims of our model more directly (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. The BHP covers half of all establishments subject to social security contributions, allowing us to track how different parts of the firm pay distribution respond. Throughout, we use the terms "establishments" and "firms" interchangeably.

## 7.1 Firm quartile definitions

We now turn to our key evidence, on wage and employment effects across the firm pay distribution. To test our predictions, we split firms into four quartiles according to their median wage, separately for each region and year.[30] We can then track quartiles of the firm pay distribution 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.[31] Tracking quartiles (rather than percentiles) makes it simple to explore employment effects across the firm distribution. Note the immigration shock has no discernible effect on the number of firms (relative to workforce): we return to this point in Section 7.4, where we discuss effects on firm size.

Table 4 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

[30] One might alternatively rank firms by their AKM wage premia, and we adopt this approach in Section 8.3. As we explain there, each approach offers advantages. Unlike the AKM premia, we observe median wages year-by-year, which allows us to estimate year-by-year effects. On the other hand, the AKM premia condition on worker effects (an important benefit), but are estimated with substantial error.

[31] 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 4: 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 |

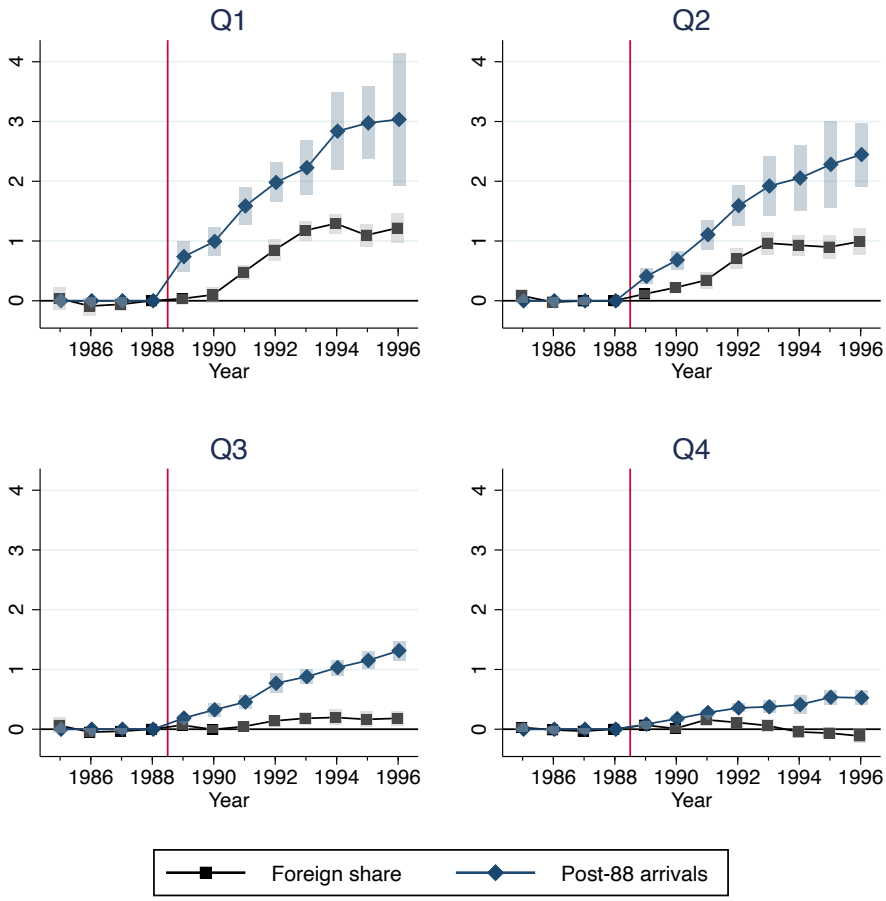
Notes: All data except for final panel based on Establishment History Panel (BHP) in 1988, by quartiles of the median establishment wage (within local labor market and year). Shares of job movers computed using SIAB, 1985-1988. Skill, industry and foreign shares are worker-weighted.

panel of Table 4 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.

## 7.2 Changes in foreign share by firm quartile (Proposition 1)

Figure 6 estimates changes in foreign shares across the distribution of firms. Using equation (12), separately for each firm quartile, we regress changes in (i) the foreign share and (ii) the post-1988 foreign share on the region-level enclave shock $\Delta m_r$. 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. This finding is consistent with **Proposition 1**:

Figure 6: Impact on foreign share by firm wage quartile



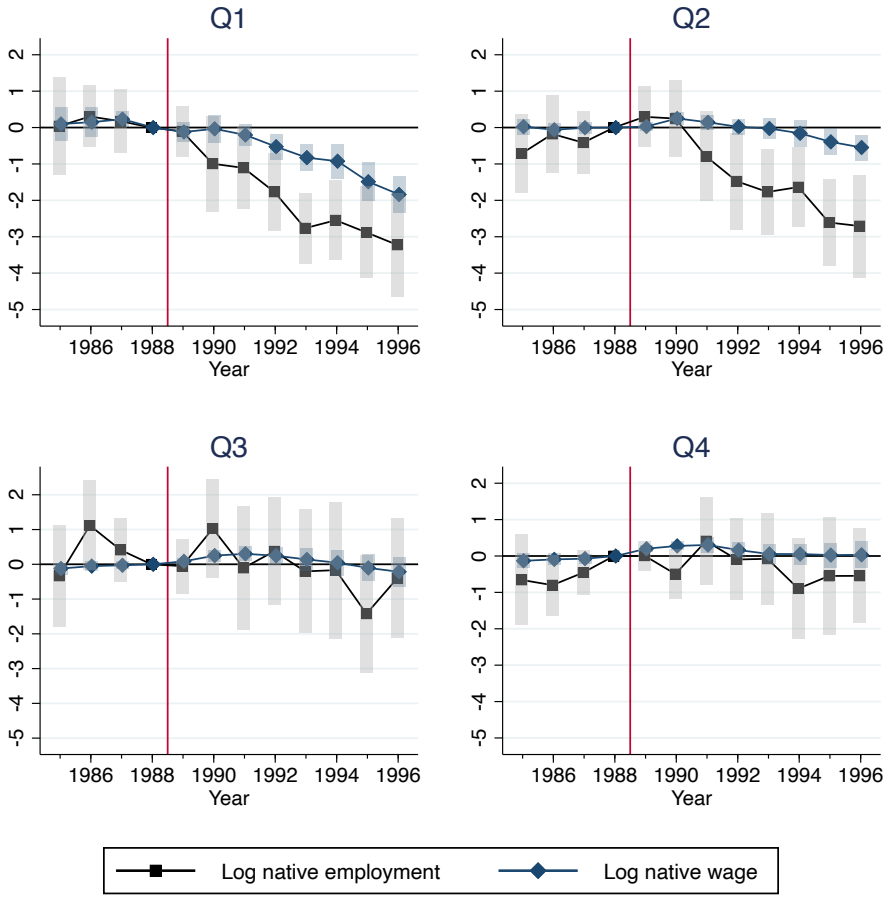

Notes: Regression estimates based on equation (12) across 203 local labor markets with 95% CIs. The dependent variable is the regional change in the foreign employment share (black line, measured in the BHP) or post-1988 arrivals shares (blue line, SIAB) in the respective quartile of the firm wage distribution,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

*migrants concentrate in low-paying firms.* As Appendix E.5 shows, this overrepresentation in low-paying firms is not merely a byproduct of the assortative matching of less-productive workers with lower-paying firms. Our model illustrates how this sorting effect is key to understanding firms' wage-setting response and the impact on native employment.

## 7.3 Wage and employment effects by quartile (Propositions 2-3)

In Figure 7, we trace the impact on mean native wages and 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 5 shows, the wage effects are similar for natives and migrants: this indicates

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.

that they are not merely driven by changes in firm-level migrant composition. The effects are precisely estimated and consistent with **Proposition 2**: *a larger migrant share induces firms to reduce wage offers at the bottom of the pay distribution.*

In magnitude, a 1 pp immigration shock reduces the Q1 native wage by 1.5% by 1995. Since the national-level inflow was nearly 5% by 1995 (Figure 2), this implies a 7.5% average reduction in Q1 across all regions. This is a large effect, but Q1 firms only account for 5% of employment (Table 4). The wage effects are therefore heavily concentrated in a small corner of the labor market. Previous studies have explored distributional effects on local wages within observable skill groups (e.g. Card, 2009; Dustmann, Frattini and Preston, 2012; Gould, 2019); our estimates highlight the role of firms in generating these effects.

In Appendix G.3, we present these same effects in an alternative way, using changes

Table 5: 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.

in firm pay by percentile (rather than by quartile). We also demonstrate that restricting the sample to incumbent firms (present in both 1988 and 1995) does not affect the basic patterns. And finally, motivated by the finding that immigration effects may differ across tradable and non-tradable sectors (Burstein et al., 2020), we show that these distributional effects manifest mostly within detailed industry categories, and not between them.

We next turn to native employment. Consistent with **Proposition 3**, Figure 7 shows a large and rapid reduction in native employment at the bottom of the pay distribution: a 1 pp immigration shock reduces Q1 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. As a result, while new migrants concentrate heavily at the bottom of the firm distribution (Figure 6), native employment becomes increasingly concentrated at the top.

Workplace segregation (as measured by a dissimilarity index) therefore increases sharply. Common interpretations of workplace segregation include ethnic preferences/networks or skill segregation (natives and migrants doing different jobs). But our model shows how such segregation can also arise endogenously from an inability to discriminate on wages: if firms choose to hire migrant labor at low wages (in response to immigration), they must forgo

Table 6: Number of firms and firm size (1988-1995)

| | Log number | Log mean firm size | | Δ Log share of firms with # employees | | | |
|---|---|---|---|---|---|---|---|
| | of firms | All firms | Incumbents | 1-4 | 5-19 | 20-99 | 100+ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Enclave shock $\Delta m_r$ | 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.

natives employees. 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; Ansala, Åslund and Sarvimäki, 2021; Willis, 2022).

## 7.4 Impact on firm size (Proposition 4)

The reduction in native employment is so large that even *total* employment contracts: see Panel B of Table 5. As we now show, this manifests in smaller firm size, a possibility highlighted by **Proposition 4**: *A larger migrant share may cause a reduction in average firm size.*

To interpret the firm size effects, it is useful to first document what happens to the *number* of firms ($k$ in the model). Column 1 of Table 6 shows this expands somewhat, but not significantly.[32] 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, which is robust to specification (Appendix G.2). It is driven by a larger share of small firms (below five workers), and smaller share of medium-sized firms (5-99 workers). It is not merely driven by selective 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 finding appears inconsistent with conventional factor demand theory, according to which firms should expand their employment as more labor becomes available. But as Proposition 4 shows, it can be rationalized

[32]Though there is no significant effect on the *number* of firms, we do find evidence of selective entry (in line with our model): see Section 8.2 below.

by monopsonistic firms trading off native employees for cheaper migrant labor.

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. One possible interpretation is that the "wage-setting" effect (in Proposition 4) is more dominant in our German setting, due to lower migrant reservation wages.

# 8 Impact on AKM firm wage premia

In Figure 7, we found negative wage effects which are concentrated at the bottom of the firm pay distribution. In line with our model, we argued that these represent differential changes in firm wage policies (conditional on workers' marginal products). But there are two potential challenges to this interpretation.

The first is composition bias: if the native employment effects are selective (e.g. concentrated among low-paid workers), wage changes may partly reflect shifts in worker *composition*, rather than the impact on any particular worker (Bratsberg and Raaum, 2012; Ortega and Verdugo, 2022; Borjas and Edo, 2021; Dustmann et al., 2023). The second is assortative matching: if low-paying firms disproportionately employ low skilled workers who compete more heavily with the new migrants, the wage effects may simply reflect a general reduction in the price of this kind of labor (as a competitive model would predict).

However, both challenges can be addressed by studying changes in AKM firm premia (as identified from two-way fixed effect models). Unlike most papers which study AKM premia, our aim is not to decompose wage differentials in the *cross-section*, but rather to study how the premia *change* in response to local shocks. We begin by explaining how the premia are identified (in Section 8.1), and then estimate how they respond to immigration shocks: first mean changes (in Section 8.2) and then distributional changes (Section 8.3).

## 8.1 Estimation of firm premia

We rely on pre-compiled AKM firm premia, as estimated by Card, Heining and Kline (2013) and updated by Bellmann et al. (2020), which have been attached to our BHP establishment data. Bellmann et al. estimate these premia separately for different time intervals, including 1985-92 and 1993-99 (which we treat as our "pre-" and "post-treatment" periods). For each

interval, they extract the premia from the following model for log wages:

$$y_{it} = \alpha_t + \eta_{j(i,t)} + \theta_i + \gamma X_{it} + \varepsilon_{ijt} \tag{14}$$

where $y_{it}$ is the log wage of worker $i$ at year $t$, $\alpha_t$ are year fixed effects, $\eta_{j(i,t)}$ are firm fixed effects (for the firm $j$ in which individual $i$ worked in year $t$), $\theta_i$ are individual fixed effects (which account for time-invariant skill differentials), and the vector $X_{it}$ includes full interactions between education and a cubic in age. Since they control for individual fixed effects, the firm premia $\eta_j$ are identified from workers who move between firms.

Identification relies on an "exogenous mobility" assumption: the sequence of $\varepsilon_{it}$ innovations must be orthogonal to the sequence of worker $i$'s firm choices (see Card, Heining and Kline, 2013). In support of this claim, Appendix G.7 shows that the wage trends of workers switching between low- and high-premia firms are parallel before the move: this suggests these transitions are uncorrelated with other individual determinants of wage growth.

The use of pre-compiled AKM estimates is useful for two reasons. First, they are based on full count employment data, which helps reduce the "limited mobility bias" from observing few movers between firms (Andrews et al. 2008; Lamadon, Mogstad and Setzler 2022). Second, the use of estimates from *other* researchers imposes discipline on our specification. Below, we also discuss evidence on regional wage premia, which we can estimate for more detailed time periods and subgroups, using worker-level panel data from the 2% SIAB sample.

## 8.2 Impact of shock on average firm premia

We begin by studying how immigration affects regional averages of firm premia. Just as individual firm premia are identified by movers between *firms*, regional variation in these premia are identified by movers between *regions*. This approach of tracking movers eliminates the composition bias that might otherwise contaminate estimates of wage effects.[33]

In Table 7, we estimate the impact of the enclave shock $\Delta m_r$ on the average premia, using equation (12). Let $\eta_{r,0}$ denote the mean of the firm premia $\eta_j$ in area $r$, estimated in the 1985-92 interval (i.e. the "pre-period", subscript 0); and $\eta_{r,1}$ the mean of the premia in the 1993-99 interval (i.e. the "post-period", subscript 1). Column 1 shows that the change, i.e. $\eta_{r,1} - \eta_{r,0}$, contracts by 0.72 in response to a 1 pp immigration shock: i.e. immigration did

[33]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, identification in our exercise stems entirely from *movers*. Moreover, since (14) is estimated separately for each period, we implicitly allow for worker fixed effects to differ between the pre- and post-periods.

Table 7: Mean changes in firm wage premia

| | Mean | Contributions | | |
|---|---|---|---|---|
| | AKM | firm incumbents | firm entrants | firm exiters |
| | (1) | (2) | (3) | (4) |
| $\eta_{r,1} - \eta_{r,0}$ | -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.

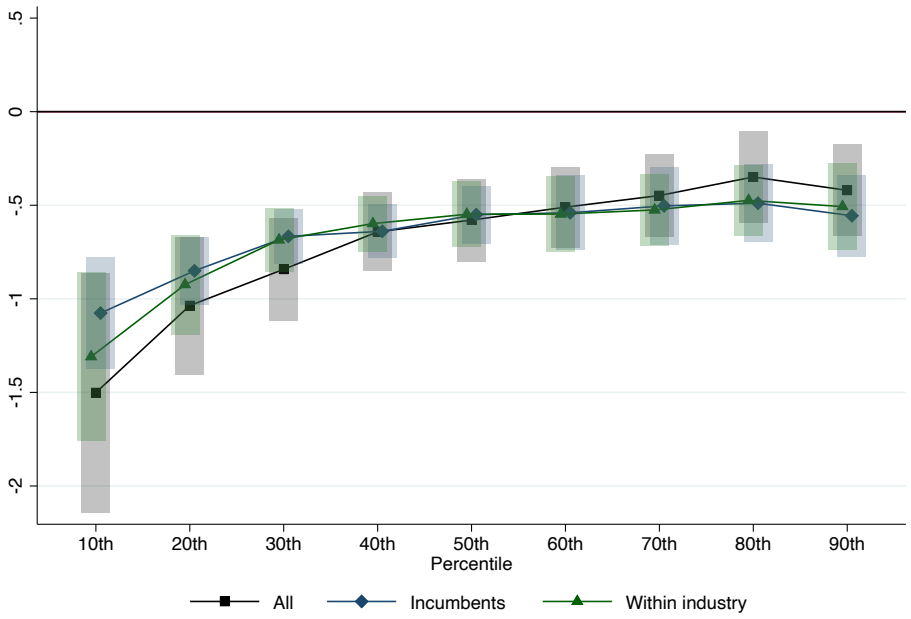
reduce wages for *individuals of fixed characteristics*. This can be reconciled with the absence of mean wage effects (in Figure 5d) by selective crowd-out of low-paid native workers, and we document this explicitly in Section 9 below; and see also the regional premia estimates in Appendix G.9.

This reduction in average premia can be decomposed into (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: see Appendix G.8 for a formal derivation. The incumbent effect can be motivated by our baseline model, and the compositional effect by the "heterogeneous firm" extension in Section 2.4. Columns 2-4 show that incumbent firms account for half the overall effect, and the remainder is driven by the entry of new low-paying firms (exiters make no significant contribution).

In Appendix G.4, we compare how the average 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 show that the wage premia decrease in all sectors, and most strongly in construction.

For the analysis above, we rely on the pre-compiled premia. But regional average premia can be estimated more directly (in our 2% SIAB worker sample), by replacing the firm fixed effect $\eta_j$ in equation (14) with a region fixed effect. This specification of (14) is similar in spirit to Moretti (2004), Roca and Puga (2017) and Card, Rothstein and Yi (2021). We show in Appendix G.9 that this method gives very similar results, closely matching the estimates of column 1 in Table 7. More importantly, it allows us to define our own subsamples, and to show that: (i) dropping migrants from the sample makes little difference to the wage effects, (ii) the enclave shock has no effect on changes in wage premia before 1988, and (iii)

Figure 8: Changes in AKM firm wage premia by percentile




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

the negative wage effect vanishes if we use simple regional means of log wages instead of mover-identified wage premia (i.e., if we do not control for compositional shifts).

## 8.3 Impact of shock on distribution of firm premia

Above, we studied how the enclave shock $\Delta m_r$ affects regional *averages* of AKM firm premia. We next consider how it affects their *distribution*. In Figure 8, we estimate effects on various percentiles (within regions) of the firm premia distribution, again between the 1985-92 and 1993-99 periods. Consistent with Figure 7, the effects are largest at low percentiles. For a 1 pp immigration shock, the 10th percentile AKM contracts by 1.5%, and the 90th percentile 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 3 of Table 7). Finally, the green line shows the impact on AKM residuals, after purging detailed industry effects (97 categories) interacted with time effects. This makes little difference: i.e. the distributional effects manifest mostly *within* industries, rather than between them.

Though the patterns here are similar to Figure 7 above, the AKM analysis offers two key

advantages. First, by using the AKM premia (and conditioning on worker fixed effects), we eliminate the threat of compositional bias in wage changes. Second, it isolates differential changes (across the firm distribution) in firms' *wage policies*, independently of worker types. Since the AKM premia exclude worker fixed effects (i.e. the $\theta_i$ in (14)) in each period, the distributional effects in Figure 7 cannot be attributed to differential changes in the $\theta_i$ of particular *worker types* (e.g. due to changes in their market-level prices) employed by particular firms.[34]

However, the AKM analysis does have important limitations. First, unlike in Figure 7, we are unable to track wage effects year-by-year. And second, the firm premia are estimated with substantial error – especially in smaller firms, where new immigrants are most heavily concentrated. This will bias our distributional estimates towards the mean impact, i.e. cause us to understate the magnitude of the negative effects at low percentiles, and to overstate their magnitude at the top. In particular, the wage effects at the top of the distribution may in reality be negligible, as Figure 7 would suggest.[35]

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 8 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 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. In comparison, a competitive model could motivate why wages decline more in firms employing certain types of workers (e.g., young or low-educated), but not why wage premia decline at the bottom of the firm pay distribution *independently* of worker type.

[34]This conclusion reflects the worker flow evidence in Table 4: firms at different percentiles appear to constitute an integrated labor market, not distinct market segments employing different skill types. Moreover, as Appendix E.5 shows, such "skill sorting" cannot explain the heavy concentration of migrants in low-pay firms.

[35]In Appendix G.3, we show equivalent percentile plots for the distribution of median wages (rather than AKM premia) across firms. Again, the negative effects are concentrated at the bottom of the firm wage distribution; and consistent with Figure 7, we find no effects among the highest-paying firms.

Table 8: 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 "regional movers" design (as in Appendix G.9). Row 2 shows log native employment changes between 1988 and 1995.* p<0.10, ** p<0.05, *** p<0.01.

# 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 8. Each column reports wage and employment effects for different groups of workers. We focus on (i) changes in regional native wage premia, using the "regional movers" design described in Appendix G.9, and comparing the periods 1994-96 (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. 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 (and more precisely estimated) for men. The reduction in native employment is much larger for women, consistent with French evidence

from Borjas and Edo (2021), and the notion that they have more elastic labor supply.

Columns 4-6 show 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).[36] The wage and employment effects for older workers (aged 50+) are close to zero, but these are estimated with vast standard errors, so should be interpreted with caution.[37]

Columns 7-8 show the wage effects are more negative for low-educated workers, but employment effects are similar across education groups.[38] 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[39]: 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.[40] Unsurprisingly then,

[36] A natural interpretation is that the 30-49s have higher reservation wages, so are less willing to accept the reduced wage offers. A similar pattern – with wage and employment effects showing inverse patterns across age groups – is reported by Dustmann, Schoenberg and Stuhler (2017).

[37] 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.

[38] 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.

[39] Specifically, we regress log wages 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 quartiles of their individual fixed effects.

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

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 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). Indeed, we find no evidence that higher-paying firms shared rents more generously with natives than migrants. 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 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 (as in Proposition 4).

The sorting of new immigrants into low-pay firms, coupled with native crowd-out from these same 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: these effects will depend on migrants' reservation wages (which are likely to vary substantially by context) and on labor market institutions that affect monopsony power.

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# A Equilibrium in baseline model

In this appendix, we derive the equilibrium $\phi$ (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 $\delta l(w_0)$, where $l(w)$ is the firm's steady-state labor force. Equating the two, and using (7), we have: $l(w_0) = \frac{n}{k} \cdot \frac{\lambda\mu}{\delta+\lambda}$. The associated profit is then:

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

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

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

## A.2 Equilibrium

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

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

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

3. $\pi(w_1) < \pi(w_0)$ 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 $\phi$ 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 $\mu$, 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 $\lambda$ (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 $\lambda$, 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 $\phi$ 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 $\mu$ 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 $\delta$); 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:

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

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

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

## 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:

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

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 $\phi$ can be derived by inserting (A22) and (A23) into the three cases listed

above. Just as in the baseline model, the equilibrium $\phi$ 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, $\phi$ 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 ($\mu$ 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 $\phi$ which locate in the low-pay sector (i.e. offer wages $w < b_N$). Conditional on this equilibrium $\phi$, 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 $\mu$ induces firms to reduce offers at the bottom of the pay distribution. The continues to be true: the low-pay sector share $\phi$ is increasing in $\mu$ (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 $\mu$ induces firms to shed native employment at the bottom of the pay distribution. This continues to be true: as $\mu$ increases, firms drop into the low-pay sector ($\phi$ increases), and native unemployment $u_N$ expands: see equation (A14).

4. Proposition 4 states that a larger migrant share $\mu$ may induce firms to reduce their employment overall. Equation (A21) reveals that $\mu$ 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 $\mu$ 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 $\mu$ now also generates a negative effect

on natives' *realized* wages. As firms drop into the low-pay sector (i.e. as $\phi$ 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 $\phi$.

# C Model with endogenous contact rate

## C.1 Matching function and free entry

In the baseline model, we have assumed a fixed number of firms ($k$) and hence a fixed contact rate $\lambda$. 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:

$$m(\bar{u}n, k) = \lambda_0 (\bar{u}n)^{\alpha} k^{1-\alpha} \tag{A31}$$

where:

$$\bar{u} = \mu u_M + (1-\mu) u_N \tag{A32}$$

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 $\theta$ as:

$$\theta \equiv \frac{k}{\bar{u}n} \tag{A33}$$

Using the matching function, the contact rate for workers $\lambda$ can then be written as:

$$\lambda = \lambda_0 \theta^{1-\alpha} \tag{A34}$$

## C.2 Equilibrium

The free entry condition requires that:

$$\pi(w) = c \tag{A35}$$

in equilibrium, for any wage offer $w$ (since firms are identical). For simplicity, consider an equilibrium where at least some firms offer the high wage $w_1$ (such that $\phi < 1$): 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:

$$\frac{n}{k}\left[\frac{\mu\lambda}{\delta+\lambda}+\frac{(1-\mu)\lambda}{\delta+(1-\phi)\lambda}\right](p-b_N)=c \tag{A36}$$

Using (A32), (A33) and (A34), this can be rewritten as:

$$\frac{\lambda_0}{\delta}(p-b_N)=c\theta^{\alpha} \tag{A37}$$

Equation (A37) shows that market tightness $\theta$ 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 $\theta$, which increases competition over workers (and hence diminishes profits).

Notice however that market tightness $\theta$ is independent of the migrant share $\mu$. 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), $\mu$ does not enter equation (A37). Since $\mu$ does not affect market tightness $\theta$, it does not affect the contact rate $\lambda$; 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.

Though $\theta$ (and the contact rate $\lambda$) is insensitive to migrant share $\mu$, the stock of firms $k$ is not. From equation (9) in Section 2.1, a larger $\mu$ increases the low-pay sector share $\phi$; and using (A36), this implies a larger $k$. Intuitively, the larger $\mu$ can sustain more firms in equilibrium, as profits increase. But this does not affect the contact rate $\lambda$, as the mean unemployment rate $\bar{u}$ grows proportionally with $k$ (so there are more workers searching).

# 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:

$$\pi(w_0|p^*) = \pi(w_1|p^*) \tag{A38}$$

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 $\phi$ 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 (A38) implies:

$$\phi = \frac{\delta+\lambda}{\lambda}\left[1 - \frac{r}{(r+\delta)\frac{\mu}{1-\mu} \cdot \frac{b_N - b_M}{p^* - b_N} - (\delta+\lambda)}\right] \tag{A39}$$

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 (A39) describes a *negative* equilibrium relationship between $\phi$ 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, $\phi$ 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 $\phi$ (the share of active firms which offer $w_0$):

$$\phi = \frac{H(p^*) - H(w_0)}{1 - H(w_0)} \tag{A40}$$

We call this the "active firm condition". Holding the migrant reservation $w_0$ fixed, (A40) describes a *positive* relationship between $\phi$ and $p^*$: if the marginal firm is more productive (i.e. $p^*$ larger), the share of active firms offering $w_0$ (i.e. $\phi$) 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 $\phi$, since a larger $\phi$ 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 $\phi$ in (A40) increases even more.

To summarize, the wage-setting equation (A39) describes a negative relationship between $\phi$ and $p^*$, and the active firm condition (A40) describes a positive relationship. Putting these together, we therefore have a unique equilibrium in $\phi$ and $p^*$.

## D.2 Impact of immigration

A larger migrant share $\mu$ shifts the wage-setting equation (A39): the low-pay sector share $\phi$ expands for any $p^*$. But migrant share does not enter the active firm condition (A37). Consequently, a larger $\mu$ will reduce $\theta$ and increase $p^*$ in equilibrium. Since $\phi$ 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 $\phi$.[41]

[41] To see how this manifests formally, consider the active firm condition (A40). In the baseline model, all firms have productivity above $w_0$, so the denominator of (A40) collapses to 1. The positive relationship between $\phi$ and $p^*$ in (A40) then becomes shallower, and the overall (positive) impact of migrant share $\mu$ on $\phi$ is therefore smaller in the baseline model.

Table A1: Employment and immigrant shares by industry

| Industry | Share of employment in 1988 (%) (1) | Foreign share within industry in 1988 (%) (2) | Foreign share within industry in 1995 (%) (3) | Change in foreign share 1988-95 (pp) (4) | Post-1988 foreign share in 1995 (%) (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 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 total 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.

## E.2 Migrant wage differentials: 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 and occupation (columns 2 and 3). If we restrict our sample to firms which contain both natives and migrants, we do find a small wage gap 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.

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.

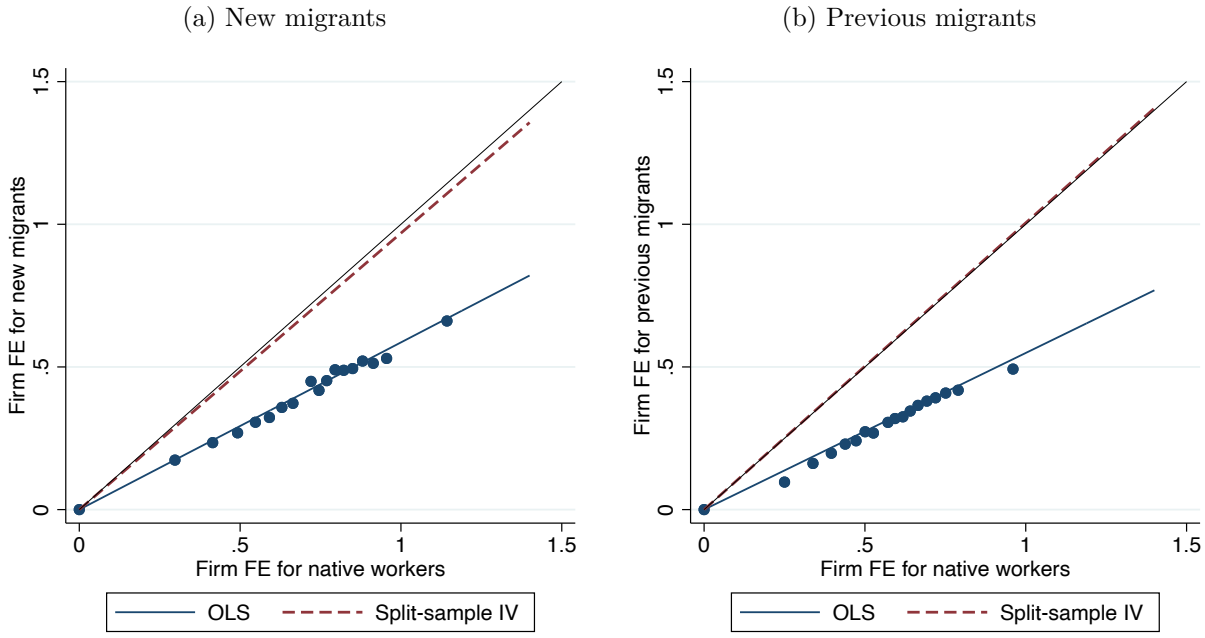
## E.3 Correcting firm wage premia for measurement error

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 practice, 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

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 bottom ventile normalized to zero for both groups), 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.

for native workers (with the bottom ventile normalized to zero for both groups), 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: $\psi_j \sim N\left(\mu_\psi, \sigma^2_\psi\right)$. Given this restriction, a posterior mean for the firm $j$ premium is:

$$\psi_j^* = \frac{\sigma^2_\psi}{\sigma^2_\psi + s^2_j}\hat{\psi}_j + \frac{s^2_j}{\sigma^2_\psi + s^2_j}\mu_\psi \tag{A41}$$

This is a weighted average, which shrinks the premium estimates $\hat{\psi}_j$ towards the mean $\mu_\psi$. The weights depend on the relative size of $\sigma^2_\psi$ (the variance of the firm premium distribution) and $s^2_j$ (the variance of the $\hat{\psi}_j$ estimate). The expected premium $\mu_\psi$ can be estimated as $\hat{\mu}_\psi = \frac{1}{J}\sum_j \hat{\psi}_j$, and its variance can be estimated as $\hat{\sigma}^2_\psi = \frac{1}{J}\sum_j \left[\left(\hat{\psi}_j - \hat{\mu}_\psi\right)^2 - s^2_j\right]$. Plugging these into (A41), we can compute a posterior mean $\psi^*_j$ 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.

## 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 e.g. Goldschmidt and Schmieder, 2017; Drenik et al., 2023) 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:

$$\log w_{ijt} = AKM_j \cdot Migrant_i + X_{it}\beta + \beta_t + \beta_i + \varepsilon_{it} \tag{A42}$$

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 $\beta_i$, 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.

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.

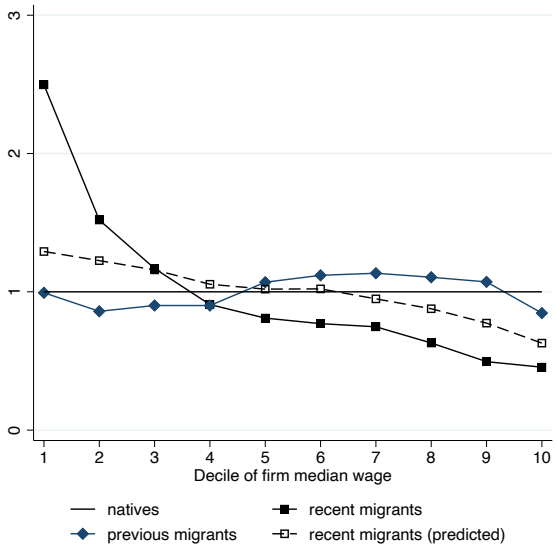
In columns 3 and 4, we now control for worker fixed effects $\beta_i$. That is, we study how individual wages change as workers *transition* from low to high-AKM firms. Column 4 shows that both natives and previous/new migrants benefit similarly from these transitions; and if anything, migrants benefit 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

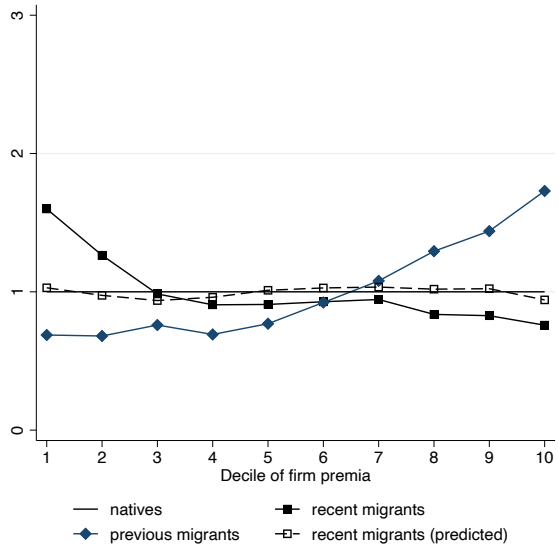
In this section, we describe the distribution of migrants in the firm pay distribution at the national level. Pooling the years 1990-1996 in the SIAB, Figure A2 plots the density of new (post-1988) and previous migrants across the firm pay distribution, relative to natives. In Panel a, we rank firms 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 overrepresented in low-wage firms, while previous migrants are similarly distributed to natives. The presentation of these figures is analogous to Dustmann, Schoenberg and Stuhler (2016), though the support here is firm pay rather than individual wages.

Figure A2: Distribution of migrants over firm pay distribution

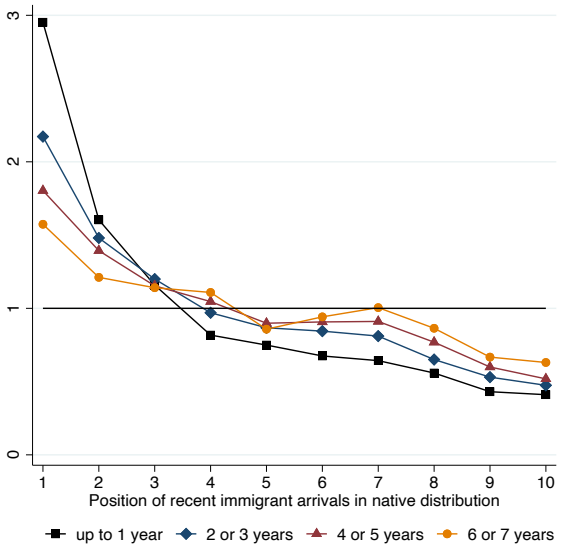
(a) by firm median wage



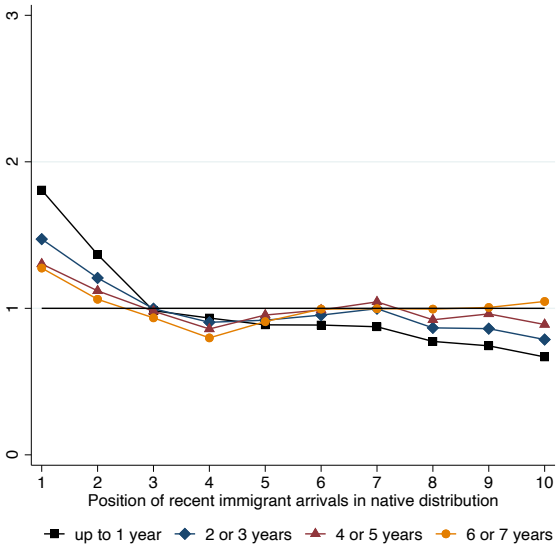

(b) by AKM firm wage premia




(c) over time, by firm median wage




(d) over time, by AKM firm wage premia




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.

The concentration of new migrants at the bottom of the firm pay distribution cannot merely be explained by the sorting of less skilled workers into low-wage firms ("skill sorting"). For illustration, the dashed line in Panel a predicts the distribution of new migrants, based on how comparable natives (with the same age, education and gender) are allocated across the firm deciles.[42] Skill sorting explains only a small fraction of the migrants' overrepresentation in low-wage firms: this is consistent with Swedish evidence from Aslund et al. (2021).

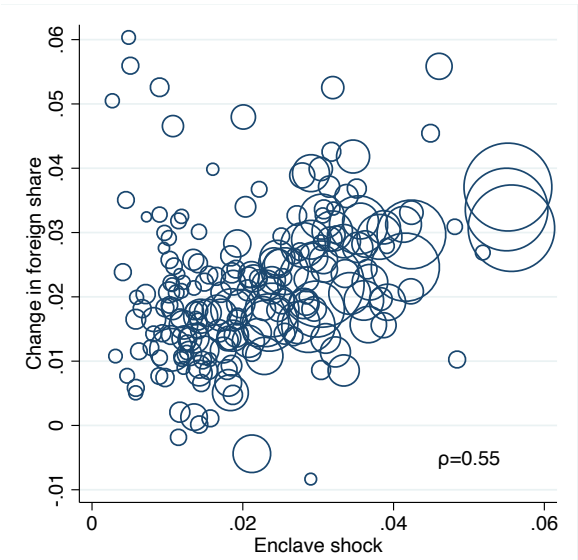
Panel b repeats this exercise, but ordering firms by their AKM wage premia (as estimated by Card, Heining and Kline, 2013). By netting out individual fixed effects, this specification abstracts from compositional differences between firms. New migrants are again overrepresented at the bottom of the distribution, 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 overrepresented in high-premium firms, possibly because earlier "guest worker" cohorts were concentrated in large manufacturing firms that tend to be characterized by high premia. Finally, the dashed line plots the predicted distribution of new migrants, based on their age, education and gender: again, their overrepresentation in the lowest-paying firms cannot be explained by sorting on these observables.

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.

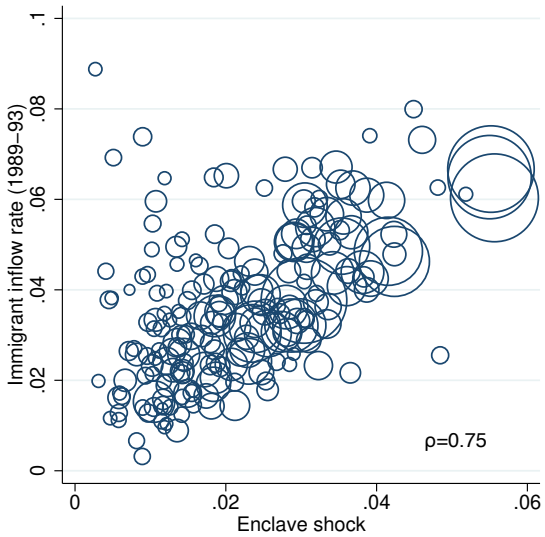
[42] We implement this exercise by re-weighting native employment within age-education-gender cells, to replicate the distribution of new migrants' observables. The dashed line in Panel a shows how these re-weighted natives are allocated across the firm deciles.

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.

# F First stage estimates and potential confounders

## F.1 First stage scatter relation

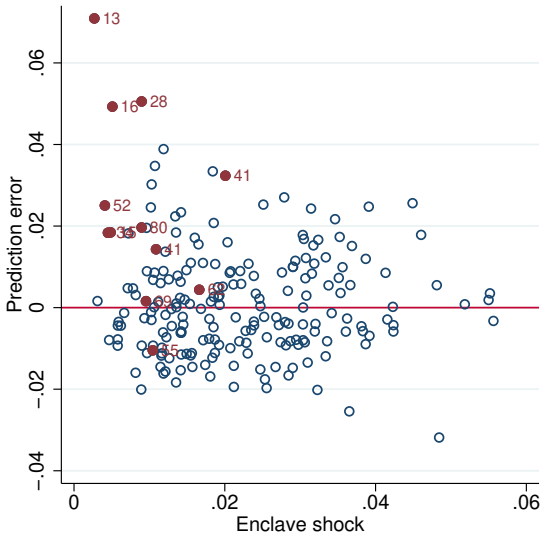
The maps in Figure 3 illustrate the predictive power of the enclave shock $\Delta m_r$ for changes in regional foreign employment share. In Figure A3a, we show this relationship in a scatter plot. In Figure A3b, we show that this "first-stage" relation is even more pronounced when the outcome is the migrant arrival *rate*[43] (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 are likely to play the 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).

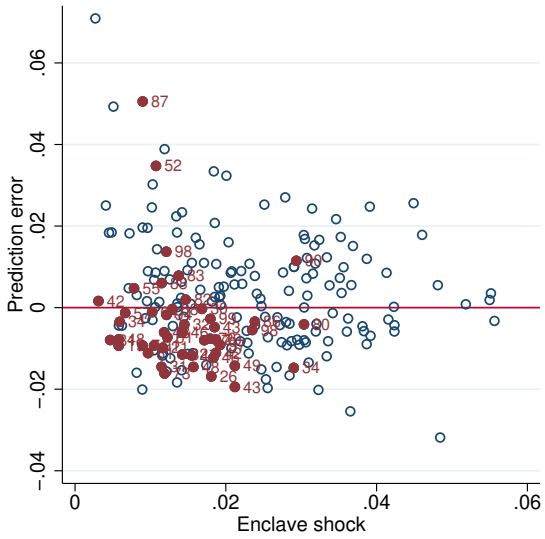
[43]Note we can only observe migrants' year of arrival (and hence arrival rates) in the SIAB worker panel, and not in the BHP establishment panel.

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 $\Delta m_r$, 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).

## F.2 Prediction errors in first stage

As Figure A3 shows, the enclave shock $\Delta m_r$ 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 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 foreign inflows in regions close to the former East-West German border (again, marked in red). As discussed in Section 5.2, new immigrants likely avoided these areas to escape labor market competition with East German commuters and migrants. To partial out this effect, we control for log distance to the former border in our empirical specification.

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.

## 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).

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 $\Delta m_r$), 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.[44]

To summarize, Table A4 suggests that the log distance control can successfully partial out

[44]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.

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).

## 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.[45] 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. Furthermore, this negative effect could be interpreted as part of the impact we aim to capture, if ethnic Germans avoided regions more exposed to

[45] 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) |
| △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.

foreign inflows.

# 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

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 $\Delta m_r$, 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.

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). See also Dustmann et al. (2023).

## G.2 Robustness of regional employment and wage effects

In Table A6, we explore the robustness of estimated effects of the enclave shock $\Delta m_r$, 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 6), and the change in the mean regional AKM firm wage premia (from column 1, Table 7). 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 $\Delta m_r$ (Frankfurt, Munich and Stuttgart). And in column 5, we estimate our basic specification without weighting observations by employment.

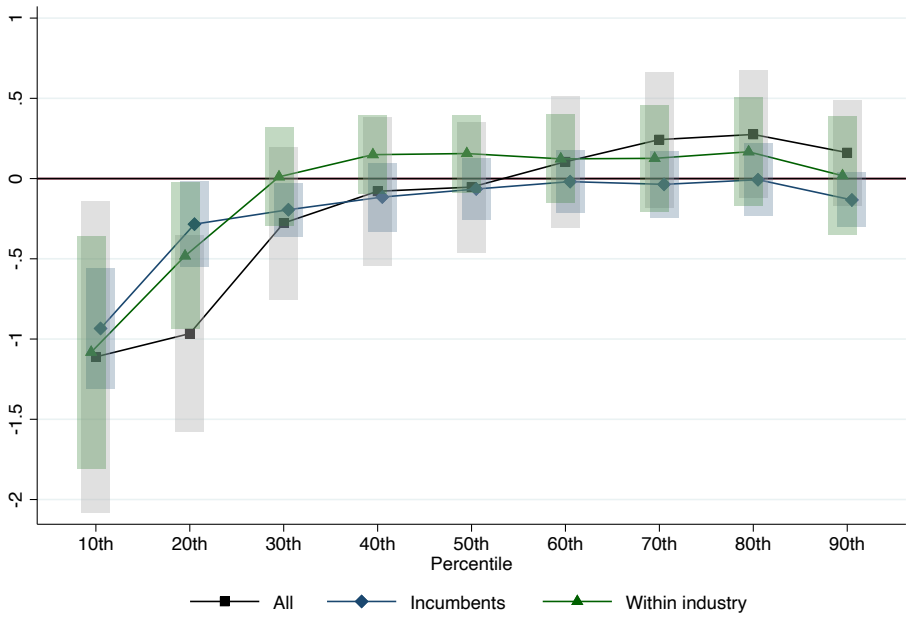
In general, the estimates are robust to these different specification choices. In particular, controlling for distance to the inner German border (column 2) makes little difference, which shows that the influx of East Germans is not driving the effects. It is also reassuring that the unweighted estimates (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 $\Delta m_r$ 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 $\Delta m_r$. 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 8, 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 native median wages (instead of AKM premia), for the 1988-95 interval. Similar to the AKM evidence, the negative effects in Figure A5 are concentrated at the bottom of the firm wage distribution; though these effects are smaller on average. This can be attributed to contamination from changes in worker composition (i.e. crowding-out of low-wage natives), which is addressed by the AKM firm premia. On the other hand, as Section 8.3 explains, there are advantages to using median wages: the AKM premia are subject to large measurement error, which will cause us to understate differential effects across the firm distribution.

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




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

The black line in Figure A5 shows effects across the full firm sample, and the blue line shows effects among incumbent firms (i.e. those which are present in both 1988 and 1995): both loo similar. Finally, the green line shows the impact on wage residuals, after purging detailed industry effects (97 categories) interacted with time effects. This too makes little difference: i.e. the distributional effects manifest mostly within industries, rather than between them.

## 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 reservation wages (as in e.g. Dustmann, Ku and Surovtseva, 2019, or Costas-Fernandez and Lodato, 2023); and this heterogeneity can be exploited as an additional test of 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, Turkey, 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:

$$\Delta m_{Hr} = \frac{\sum_{o \in H} s_{or80} \left( n_{o93} - n_{o88} \right)}{n_{r80}} \tag{A43}$$

$$\Delta m_{Lr} = \frac{\sum_{o \in L} s_{or80} \left( n_{o93} - n_{o88} \right)}{n_{r80}} \tag{A44}$$

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 $\Delta m_r$ with the two origin-specific shocks in our empirical specification:

$$\Delta y_r = \alpha + \beta_H \Delta m_{Hr} + \beta_L \Delta m_{Lr} + \gamma X_r + \varepsilon_r \tag{A45}$$

where $\Delta y_r$ 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 7), we showed that both outcomes respond negatively to the aggregate enclave shock $\Delta m_r$. 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

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.

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 $\Delta m_r$. 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 7). 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.

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.

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 $\Delta m_r$ 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.

## G.6 Impact on workplace segregation

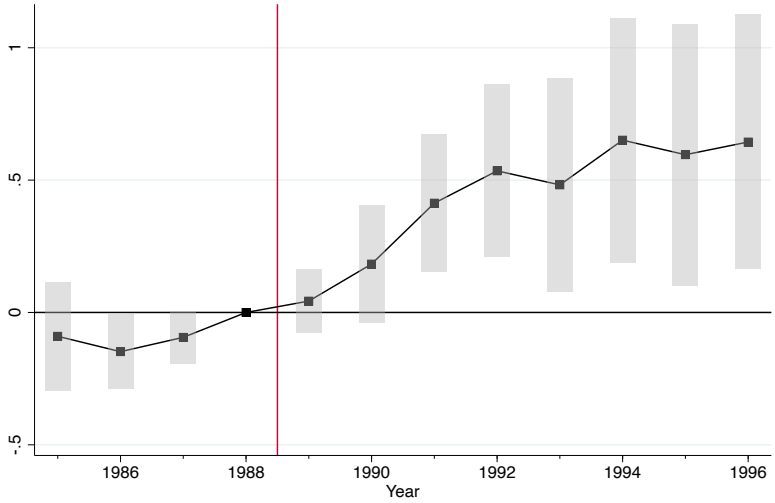
As low-paying firms hire migrant labor and forgo natives, workplace segregation is bound to increase. Figure A6 shows the impact of immigration on the index of dissimilarity, a popular measure of segregation:

$$ID_r = \frac{1}{2} \sum_{j \in r} \left| \frac{\text{Migrants}_j}{\sum_{j \in r} \text{Migrants}_j} - \frac{\text{Natives}_j}{\sum_{j \in r} \text{Natives}_j} \right| \tag{A46}$$

where $j$ 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).

Common interpretations of workplace segregation include ethnic preferences/networks or skill segregation (natives and migrants doing different jobs). But our model shows how such segregation can also arise endogenously from an inability to discriminate on wages: if firms choose to hire migrant labor at low wages (in response to immigration), they must forgo

Figure A6: Impact on workplace segregation



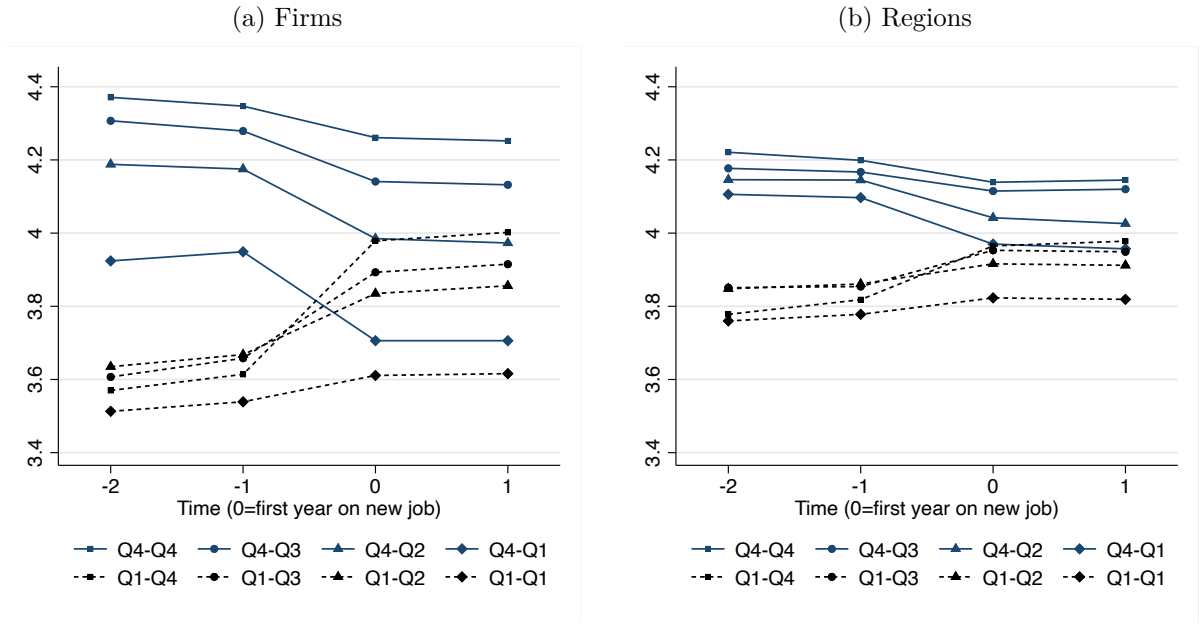

Notes: BHP, regression estimates based on equation (12) across 203 local labor markets with 95% CIs. The dependent variable is the regional change in the index of dissimilarity between 1988 and the indicated year.

natives employees. 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; Ansala, Åslund and Sarvimäki, 2021; Willis, 2022).

## G.7 Validation of firm and regional AKM wage premia

To identify wage premia for firms (as in Section 8) and regions (as in Appendix G.9 below), 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 $\varepsilon_{it}$ in equation (14)) is orthogonal to worker $i$'s firm (or 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 firms/regions into four quartiles, according to their estimated wage premia. And in Figure A7, we show that workers moving between low- and high-premium firms/regions 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 firm or regional wage premia, rather than individual differences in wage trajectories.

Figure A7: Validation of firm and region wage premia




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.

## G.8 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:

- $\eta_{r,1}$: mean post-period AKM in area $r$, among firms active in post-period
- $\eta_{r,0}$: mean pre-period AKM in area $r$, among firms active in pre-period
- $\eta_{r,1inc}$: mean post-period AKM, among "incumbent" firms (active in both periods)
- $\eta_{r,0inc}$: mean pre-period AKM, among "incumbent" firms (active in both periods)
- $\eta_{r,1ent}$: mean post-period AKM, among entrant firms (active only in post-period)
- $\eta_{r,0ex}$: 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:

$$\begin{aligned} \eta_{r,0} &= \frac{N_{r,inc}}{N_{r,0}}\eta_{r,0inc} + \left(1 - \frac{N_{r,inc}}{N_{r,0}}\right)\eta_{r,0ex} \\ &= \eta_{r,0inc} + \left(1 - \frac{N_{r,inc}}{N_{r,0}}\right)(\eta_{r,0ex} - \eta_{r,0inc}) \end{aligned} \tag{A47}$$

and the post-treatment wage premia as:

$$\eta_{r,1} = \left[\frac{N_{r,inc}}{N_{r,1}}\eta_{r,1inc} + \left(1 - \frac{N_{r,inc}}{N_{r,1}}\right)\eta_{r,1ent}\right] \tag{A48}$$

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

$$\begin{aligned} \eta_{r,1} - \eta_{r,0} = & \underbrace{\frac{N_{r,inc}}{N_{r1}}(\eta_{r,1inc} - \eta_{r,0inc})}_{\text{Incumbents}} \\ & \underbrace{+\left(1 - \frac{N_{r,inc}}{N_{r1}}\right)(\eta_{r,1ent} - \eta_{r,0inc})}_{\text{Entrants}} \\ & \underbrace{-\left(1 - \frac{N_{r,inc}}{N_{r0}}\right)(\eta_{r,0ex} - \eta_{r,0inc})}_{\text{Exiters}} \end{aligned} \tag{A49}$$

For the decomposition in Table 7, we estimate the response of each component of (A49) to the enclave shock $\Delta m_r$.

## G.9 Direct estimates of regional wage premia

In Section 8.2, we computed regional averages of the AKM firm premia, i.e. $\eta_{r,0}$ and $\eta_{r,1}$ (in the pre- and post- periods respectively). We then estimated the impact of the enclave shock $\Delta m_r$ on the change in these regional averages, i.e. $\eta_{r,1} - \eta_{r,0}$. However, the regional average premia can in fact be estimated more directly, by simply replacing the firm fixed effect $\eta_{j(i,t)}$ in equation (14) with a region fixed effect $\eta_{r(i,t)}$:

$$y_{it} = \alpha_t + \eta_{r(i,t)} + \theta_i + \gamma X_{it} + \varepsilon_{irt} \tag{A50}$$

Table A9: Mean changes in regional wage premia

| | Movers | | | | Raw wage | Residualized |
|---|---|---|---|---|---|---|
| | 1993-99 v 1985-92 | 1983-85 v 1986-88 | 1991-93 v 1986-88 | 1994-96 v 1986-88 | 1994-96 v 1986-88 | 1994-96 v 1986-88 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| All workers | -0.739*** | -0.110 | -0.326 | -0.827*** | -0.360 | 0.186 |
| | (0.138) | (0.334) | (0.220) | (0.220) | (0.301) | (0.230) |
| Natives only | -0.751*** | -0.060 | -0.301 | -0.944*** | 0.121 | 0.264 |
| | (0.127) | (0.340) | (0.209) | (0.241) | (0.284) | (0.219) |

Notes: SIAB, regression estimates based on equation (12) across 204 local labor markets. Columns 1-4 report the estimated effect on (mover-identified) regional wage premia $\eta_r$, as detailed in Appendix G.9. Columns 5-6 report the effect on raw wages and residualized wages (controlling for age-education-gender interactions, but not individual fixed effects). * p<0.10, ** p<0.05, *** p<0.01.

where $r(i,t)$ subscript denotes the region $r$ in which individual $i$ worked in year $t$. This specification of (14) is similar in spirit to Moretti (2004), Roca and Puga (2017) and Card, Rothstein and Yi (2021); and we are able to implement it ourselves in our SIAB panel (a 2% worker sample). This gives us the flexibility to define our own subsamples: we are no longer restricted to those of Bellmann et al. (2020).

In this appendix, we explore this more direct approach. Similar to the firm premia in Section 8.2, we require an "exogenous mobility" assumption: the sequence of $\varepsilon_{it}$ innovations must be orthogonal to the sequence of worker $i$'s location choices. We validate this assumption in Appendix G.7, just as we did for the firm effects. As it turns out, 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 A9, we estimate the impact of the enclave shock $\Delta m_r$ on changes in the regional wage premia $\eta_r$, between various intervals (along the table columns), and for different worker samples (along the rows). For comparison with Section 8.2, we begin in column 1 by studying changes in the $\eta_r$ region effects between the same intervals as Bellmann et al. (2020), i.e. 1985-92 and 1993-99. In row 1, this yields a coefficient of -0.739 (with a 0.138 standard error): reassuringly, this is very close to the column 1 estimate of Table 7. In row 2, we repeat this exercise, but now excluding migrants from our sample (when estimating the $\eta_r$ region effects): this makes little difference to the results.

Though the Bellmann et al. (2020) intervals provide a reasonable match for our pre- and post-treatment periods, it is not a perfect fit. For the remaining columns, we re-estimate

the $\eta_r$ region effects for finer three-year intervals[46], using 1986-88 as our baseline period. In column 2, we begin by exploring pre-trends, by comparing our baseline period against the 1983-85 interval. Our estimates 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.

We next turn to the post-treatment effects. Column 3 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 native wage premia by 0.9%. This suggests that immigration did reduce wages for workers 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.[47]

To illustrate this problem more explicitly, column 5 shows what happens if we use simple regional means of log wages as our dependent variable (instead of mover-identified wage premia). And in column 6, 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: we conclude that they do not control sufficiently for compositional shifts.

The approach adopted in this appendix grants us valuable flexibility in choosing our subsamples, unlike the pre-compiled AKM firm premia of Bellmann et al. (2020). This allows us to exclude migrants from the sample, and to estimate effects across different time intervals. However, this approach does not allow us to explore the contribution of firms entrants and exiters (as in Section 8.2), nor to estimate differential effects across the distribution of firms (as in Section 8.3). For these exercises in the main text, we therefore rely on the pre-compiled firm premia of Bellmann et al. (2020).

# 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

[46] 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.

[47] We provide more direct evidence on these compositional changes in Section 9.

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) finds 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:

$$\Delta y_{rt} = \alpha_t + \beta \Delta m_{rt}^{US} + \gamma_t X_{rt} + \varepsilon_{rt} \tag{A51}$$

where $\Delta y_{rt}$ 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 $\Delta m_{rt}^{US}$ is an enclave shock:

$$\Delta m_{rt}^{US} = \frac{\sum_o s_{ort-1} \left( n_{ot} - n_{ot-1} \right)}{n_{rt-1}} \tag{A52}$$

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[48] 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 $\Delta m_{rt}^{US}$, 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

[48] 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 A10: 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 (A51), 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.

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 official industry crosswalks to produce consistent series.

## H.3 Empirical estimates

We present our estimates of (A51) in Table A10. In columns 1-4, we study the effect of the enclave shock $\Delta m_{rt}^{US}$ 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 $\Delta m_{rt}^{US}$ 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 (A51) 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 $\Delta m^{US}_{rt-1}$ in column 4: the coefficient on the contemporaneous shock now increases to 0.57, offset by a (smaller) negative coefficient on $\Delta m^{US}_{rt-1}$ (-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: for comparison, we have a coefficient of -1 in Table 6. This is despite a similar response of the migrant share to the enclave shock: compare Table A10 to Figure 5a (black line) in the main text. One possible 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.