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ABSTRACT

The Labor Demand Effects of Refugee Immigration: Evidence from a Natural Experiment*

We study the labor demand effect of immigration on local labor markets by exploiting the fact that refugees in Germany are banned from working in the first few months after arrival. This natural experiment allows isolating a pure immigration-induced labor demand effect. For empirical identification we rely on the local presence of vacant military bases and on allocation quotas from a dispersal policy. The results are in line with our predictions from a theoretical framework with non-homothetic demand, where an increasing share in the consumption of necessities is associated with rising demand of labor-intensive goods: As the number of recently arrived refugees and thus the demand for locally produced goods increases, local employment increases particularly in non-tradable sectors in the short run. At the same time, unemployment drops while individual wages do not change significantly which can be traced back to widespread labor market rigidities in Germany. The isolation of labor demand effects complements the literature that isolates labor supply shocks from immigration, so as to gain a more comprehensive understanding of how immigration affects labor markets.

JEL Classification: J23, J60, H50, R10

Keywords: labor demand, employment, immigration, refugees, natural experiment

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1 Introduction

How does immigration affect natives' employment and wages? While the labor supply effects from immigration on local labor markets have been extensively studied (and empirically isolated by Dustmann et al., 2017 and Beerli et al., 2021), labor demand effects from immigration have not been a focus of academic and public debate. Nonetheless, such labor demand effects have the potential to affect the wages or employment of domestic workers substantially (Bodvarsson et al., 2008; Borjas, 2013) and to partly counteract potentially negative labor supply effects. Usually it is empirically impossible to isolate labor demand effects from immigration, because they occur at the same time as supply shocks. We fill this gap by exploiting a natural experiment of refugees to Germany who are banned from working for the first few months after their arrival.

Germany was the largest receiving country in absolute terms from the sharp and unexpected surge in the influx of refugees to Europe in the years 2015 and 2016. In these two years, 1.3 million people newly applied for asylum in Germany, making up more than 1.6 % of the resident population (BAMF, 2017). Asylum seekers[1] were strictly banned from working in the initial phase after arrival. Moreover, they were dispersed administratively across German regions and municipalities and forced to stay there by a residential obligation. Private consumption of the asylum seeker population was close to subsistence level and subject to administrative allocation. It consisted mainly of necessities such as housing, food and other subsistence goods. Moreover, public services accounted for a high share in expenditures per refugee. This implied that the consumption basket of the refugee population consisted of a disproportionally large share of locally provided non-tradable goods and services compared to that of natives.

We base our analysis of the demand effects from refugee immigration on a theoretical framework with non-homothetic demand, where the share of luxury goods in consumption relative to necessities increases with income and with rising earnings inequality. Empirical evidence for Germany shows that the share of tradable goods in private consumption monotonically increases

[1] We refer to "asylum seekers" for all immigrants who initially filed an asylum application, regardless whether the application is later approved.

with income level (Statistisches Bundesamt, 2021). Given that non-tradable goods and services are labor intensive, the relatively low income level of the refugee population means that local labor demand tends to increase, an effect that is reinforced by public service expenditures for asylum seekers. In a setting with rigid labor markets, the demand shift towards non-tradables can increase employment rather than wages. The effect fades out in the medium run when immigrants' consumption structure converges to that of natives, when immigrants take up employment, or when the capital stock adjusts. The outlined mechanism holds irrespective of deficit spending in the economy but hinges, instead, on the different consumption structure of poor relative to rich households in general, and the specific consumption patterns of refugees compared with natives in particular. The insights from the model have generalizable implications, since consumption patterns of immigrants are expected to differ systematically from that of natives, depending on their income levels and on the impact of immigration on the dispersion of earnings.

For the empirical identification of the demand effects we exploit a natural experiment that created regional variation in the number of refugees subject to an employment ban. Refugees have been dispersed in Germany according to local and regional government quotas. Despite these administrative dispersal policies, some endogenous sorting of refugees remained, which potentially threatens the empirical identification of the local labor-market effects of the refugee influx. To address this, we use two instruments for the actual allocation of refugees: the availability of vacant military bases that were frequently used as provisional large-scale accommodations as well as administrative quotas from the dispersal policy. Unlike actual refugee arrivals, both instruments are uncorrelated with local labor market trends prior to the immigration shock.

The empirical results corroborate our theoretical expectations: the influx of asylum seekers subject to an employment ban induces significant additional short-term regional employment growth, which is fully driven by non-tradable service sectors, especially those in public administration and in temporary agency work. One newly arrived asylum seeker increases local employment by 0.42 in the short run. Put differently, 2.4 additional refugees increase local employment by one job. At the same time, the tradable sector shows no discernible employment effects. The

effects on wages are small and not statistically significant in the short run, which is in line with the theoretical predictions in a setting with imperfect labor markets and rigid wages. In line with the strong employment effects at the local level, unemployment decreases substantially, corresponding to 55% of the magnitude of the observed employment gains. Unemployment reductions are disproportionally large for low skilled workers and for foreigners from non-refugee countries. When considering the mid-term persistence of the effects two years after the onset of the considered inflow of refugees, only about 20% of the original impact on employment growth remains, which we attribute to gradual employment take-up and the relocation of refugees.

The contribution of this paper to the literature on the labor-market effects of immigration is fourfold. First and foremost, we isolate the impact of immigration on local labor demand by exploiting the natural experiment of an employment ban. This is a novelty in the immigration literature, which usually analyzes immigration as a supply shock. The demand effects resulting from shifts in consumption patterns are either ruled out in structural models employing one-good production functions[2] or are only implicitly considered in reduced-form regressions.[3] In contrast to this literature, empirical evidence regarding the effects of immigration on labor demand is scant. A small set of empirical studies finds that (positive) consumer demand effects can be substantial and thus can offset the (negative) labor substitution effects from immigration (Bodvarsson and Van den Berg, 2006; Bodvarsson et al., 2008; Hong and McLaren, 2015; Cengiz and Tekgüç, 2021). However, these studies are unable to fully rule out simultaneous labor supply effects from immigration. We attribute the problems in the empirical identification of the impact of demand effects to a lack of suitable setups and data.

This paper complements the literature that isolates labor supply shocks from immigration based on cross-border commuting (Dustmann et al., 2017; Beerli et al., 2021) and that suggests that labor demand effects from immigration are due to skill complementarities (*ibid.*). We abstain from analysis of this type of labor demand effect, focusing instead on consumption-induced labor

[2] Borjas (2003), Brücker et al. (2014), Dustmann et al. (2013) and Ottaviano and Peri (2012).

[3] Greenwood and Hunt (1984), Card (1990), Pischke and Velling (1997), Card (2005). The reviews of the literature provided by Friedberg and Hunt (1995) and Lewis and Peri (2015) are likewise agnostic on the demand effects.

demand effects.

Second, we present a novel framework for analyzing the labor-market effects based on non-homothetic demand. This framework allows us to analyze the different demand patterns of immigrants and natives and their labor market implications in a systematic manner by considering the fact that the composition of demand depends on income levels. This distinguishes our model from previous approaches such as Borjas (2013), which derives the demand effect from a trade model with complete specialization, or Bodvarsson et al. (2008), where the demand effects depend on whether immigrants consume disproportionally more or fewer goods from the sectors in which they are employed. In both cases the outcomes depend on preferences of the immigrant population, which may differ in one way or another from those of natives.

Third, our findings also contribute to the debate on the economic effects of hosting refugees. We argue that beyond the general migration literature, the demand side is particularly important to fully understand the effects of humanitarian immigration, because refugees tend to need more time to pick up employment and are often confronted with employment bans (Dustmann et al., 2017; Brell et al., 2020; Fasani et al., 2021). Nevertheless, the rapidly growing literature on the effects of refugee immigration on host countries' labor markets has focused on labor supply (e.g. Tumen, 2016, Borjas and Monras, 2017, Ceritoglu et al., 2017, Fallah et al., 2019). The paper by Cengiz and Tekgüç (2021) is an exception as it documents additional labor demand from refugee immigration and shows native-migrant labor complementarities within the group of low-skilled individuals. We show that while refugees might compete for jobs, they also stimulate the local economy and create additional employment opportunities for the resident population through the goods and services they consume.

Finally, we add to the literature that exploits natural experiments for estimating causal effects of immigration by developing a novel identification strategy. While dispersal policies have been used before to instrument the allocation of refugees (Glitz, 2012; Foged and Peri, 2016), we show how in the setting of the so-called European Refugee Crisis of 2015—2016 some

endogenous regional sorting remains.[4] We therefore suggest a novel instrument: vacant military compounds. We argue that military rather than economic considerations have determined the vacancy of military compounds and show statistically insignificant pre-trends with respect to local economic conditions. As a second, complementary instrumental variable we use the administrative allocation quotas. By providing these new instruments for the spatial distribution of recently arrived asylum seekers in Germany, we advance the empirical literature and open up new research.

This paper proceeds as follows. The next section outlines the institutional background including potentially endogenous deviations from the dispersal policy. Building on this, Section 3 presents the theoretical framework for our analysis. Section 4 lays out the empirical model and explains the identification strategy. Section 5 describes the data. The empirical results are presented in Section 6. Section 7 concludes.

2 Institutional Background

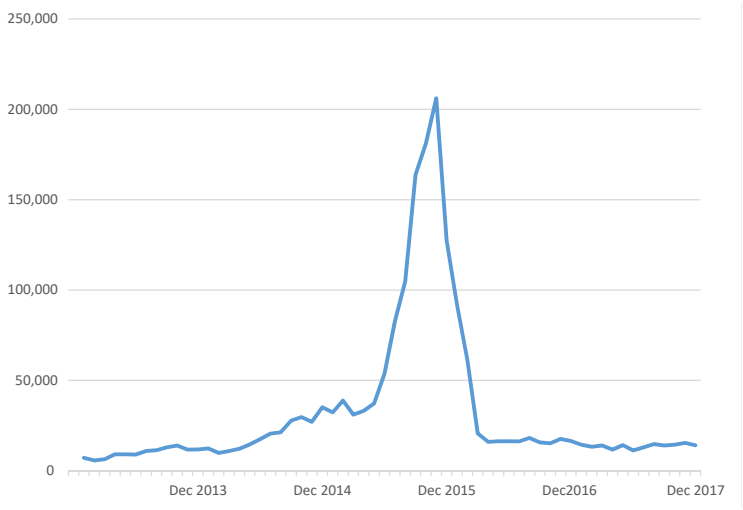
2.1 Dispersal Policy

From June 2015 to February 2016, an unexpectedly large number of asylum seekers arrived in Germany (Figure 1). The government assigned the asylum seekers to regions using a dispersal policy based on quotas and we use the quotas for our identification strategy (Appendix B.2 for details on the calculation of the quotas).

Although the distribution quotas can be influenced neither by local authorities nor by refugees themselves, anecdotal and empirical evidence suggests that during the peak of the immigration episode, substantial deviations from the dispersal policy occurred (Appendix B.3 for more details). In particular, local authorities were overwhelmed by the sheer number of arrivals and had to make pragmatic decisions to avoid homelessness. Accordingly, they sent new incomers to places where housing was still available. Publicly owned property played a very important role for creating provisional housing because it was available at very short notice. About 480 different

[4] For that reason, Steinmayr (2020) uses the availability of group accommodations to instrument the distribution of asylum seekers in Upper Austria.

Figure 1: Monthly Registrations of Asylum Seekers in Germany



Source: Adapted from the registrations in the "EASY" system from the Federal Office for Migration and Refugees (BAMF).

properties[5] with a total capacity for about 155,000 persons[6] were provided by federal authorities, and probably many more were in the ownership of states and municipalities themselves. An important share of the federal properties that were used to house asylum seekers consists of unused military bases that had been abandoned by German or foreign armed forces. These were frequently transformed into group accommodations, some of which could house up to several thousand people.[7] Especially when it came to locations for new Initial Reception Facilities (IRF) where asylum claims were submitted and processed, military bases had the advantage that buildings suitable for housing many people (e.g. with sanitary facilities) and office space were usually already in place. In the state of Baden-Württemberg, for instance, about 78% of asylum seekers living in IRFs in 2015 were hosted in previous military compounds.

Table 1 shows that endogenous deviations from the official distribution mechanisms occurred by showing a disproportional (actual) placement of recently arrived asylum seekers into rural regions, regions with high unemployment rates and regions that possess a vacant military base. Vacant housing in the private market did not play a major role. Columns (2) and (3) suggest

[5] As of mid-2016—the list was retrieved from the Federal Institute for Real Estate. See Section 5.

[6] These figures are from the year 2017. Data from the Federal Ministry of Finance.

[7] This is true in Bad Fallingbostel, Heidelberg and in many other cases. In Baden-Württemberg in late 2015, 10 out of 40 IRFs hosted more than 1000 asylum seekers.

that our instruments do not correlate with these regional characteristics.

Table 1: Endogeneity of Refugee Distribution

	(1) $\Delta AS/pop$	(2) IV: Military Base	(3) IV:Quotas
Unemployment rate (one-year lag)	3.79**	-0.43	0.01
	(1.47)	(0.66)	(0.71)
Real GDP pc (one-year lag)	1.73	0.24	0.12
	(1.08)	(0.20)	(0.11)
Rural region (dummy)	21.97**	-4.50	-6.64
	(10.49)	(4.34)	(5.68)
Foreigner share (one-year lag)	-2.40	-0.81	-1.46
	(1.63)	(0.70)	(0.96)
Percentage vacant housing (one-year lag)	-2.31	-0.82	-1.31
	(2.07)	(0.78)	(1.06)
Vacant military base (dummy)	35.71**		-0.34
	(14.93)		(3.28)
Observations	2,639	2,639	2,639

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table shows OLS regressions with the per-capita inflow of asylum seekers without labor market access (column 1), military bases interacted with a dummy for the peak of refugee immigration in 2015h2—2016h2 (column 2) and the predicted per capita inflow based on distribution quotas and EASY assignments (column 3) as dependent variables. All dependent variables are measured in percentage points. All regressions cover the period 2014—2017 and include time fixed effects. Standard errors are clustered on the level of districts and displayed in parentheses. All estimations are weighted with the population in base year 2013, excluding refugees.

2.2 Employment and Mobility Restrictions for Asylum Seekers

In order to isolate a potential labor demand effect from immigration, we focus on immigrants who are banned from working. This restriction concerns asylum seekers within the first three months of their stay in Germany and those who are obliged to live in an IRF (up to 18 months, or as long as the asylum procedure lasts for refugees from certain "safe" countries). Importantly, the same group of asylum seekers that is subject to an absolute employment ban also faces a strict rule not allowing them to change their place of residence ("residence obligation").[8] Therefore, when

[8] Asylum seekers lose entitlements to benefits when violating this obligation. They may only move if they can afford their own living expenses. If they move to another place without permission of the authorities in charge, they can be subject to enforcement measures and even imprisonment.

studying the labor-market effects of asylum seekers that are not allowed to work themselves, the legal setting does not allow for any self-selection of immigrants into regions, neither at arrival nor after. Our instruments can account for resulting biases in the case of deviations from the dispersal policy.

2.3 Benefits and Support for Asylum Seekers

Asylum seekers in Germany receive social benefits as well as publicly provided support. They receive specific social benefits which include housing, food and other daily needs as well as basic health insurance.[9] The total benefits paid to an asylum seeker during the first year of stay amount to 4,368 euros, of which a large part is paid in-kind rather than in cash. This holds in particular for asylum seekers living in centralized group accommodations, i.e the group we focus on. On top of these benefits, further expenses occur as public authorities provide different types of services to asylum seekers. The total amount of public spending is estimated to lie between 10,000 and 15,000 Euro per asylum seeker per year (Czerny, 2018)[10], which is about double to threefold the social benefit expenses. Thus, consumption of the refugee population was largely characterized by an administrative allocation of publicly provided services such as centralized collective housing, integration and labor market programs, education, security services, etc., which required substantial administrative effort. Most of these services are labor intensive and need to be provided locally (such as staff for administration, security, housing and integration programs) and several require specially trained personnel such as trained decision makers, case workers, social workers, translators, psychologists and other administrative staff. These services are provided predominantly by the public sector—potentially with the help of temporary agency

[9] According to the Asylum Seekers Benefits Act ("Asylbewerberleistungsgesetz"), this applies during the first 15 months after arrival in Germany or until their asylum application has been accepted. Since March 2016, the monthly rate to cover basic needs is 219 euros for a single adult. This rate excludes rent and health insurance and differs for couples and children (§17(2) AsylbLG). In addition to these basic needs, asylum seekers also receive transfers for "other necessary personal needs" of nearly 150 euros that are usually paid in cash, even to those living in shared accommodation (§17(1) AsylbLG).

[10] In 2014, lump-sum refunds per asylum seeker per year varied across federal states and lay between 6,000 and 9,000 euros. For the years 2013—2015, Czerny (2018) estimates annual local government spending from municipal budgets to average 13,700 euros per asylum seeker. Across Germany as a whole in 2016, 9.26 billion euros were reimbursed to the districts and municipalities by the central government. This translates into reimbursements of roughly 10,000 euros per asylum seeker per year. For more details, see Appendix B.4.

workers—which is where we expect to find the largest effects.

3 Theoretical Background

In this section we present a theoretical model that analyzes the mechanisms by which an immigration-induced demand-shift towards non-tradable goods and services increases local labor demand. The theoretical framework is based on a non-homothetic demand system that relies on the fundamental assumption that the consumption share of necessities compared with luxury goods declines with income level. This framework follows the tradition of the "Price Independent Generalized Linearity (PIGL)" preferences (Muellbauer, 1975, 1976) and the "Almost Ideal Demand System (AIDS)" by Deaton and Muellbauer (1980), which ensure the aggregation of individual preferences but are more general than homothetic or quasi-homothetic demand systems fulfilling the criteria of Gorman's polar form. Since preferences are non-homothetic, the aggregate demand of necessities and luxury goods depend in mean income and the dispersion of income in the economy in our specification of the demand system.

The model builds on the assumption that poor households consume a disproportionally high share of necessities. Empirical evidence suggests in turn that necessities consist of a disproportionally high share of non-tradable goods: the share of tradables in private consumption tends to increase with the income level. We demonstrate this by exploiting the German Income and Consumption Survey (Statistisches Bundesamt, 2021) (Table 2). While expenditure shares for housing are particularly high for poor households, rich households tend to spend higher shares for transport equipment, consumer electronics, and leisure and entertainment equipment. On top of that, as the previous section has demonstrated, public spending for refugees is disproportionally high, such as for education, labor market and integration programs, which also have to be administered publicly. Those programs consist almost entirely of non-tradable services.

In a nutshell, the immigration of refugees involves a shift in relative demand towards non-tradable goods and services. This in turn increases labor demand since non-tradables are produced more intensively than tradable goods in local labor markets (Appendix Table B1). As

a consequence, the demand shift towards non-tradables tends to increase wages, and, if labor markets are characterized by wage rigidities, raises employment.

Table 2: Private Consumption of Tradables and Non-tradables by Income Level in Germany 2020 (by percentage)

	Household income in EUROs						
	< 1,300	1,300-1,700	1,700-2,600	2,600-3,600	3,600-5,000	> 5,000	total
Tradable goods and services[1]	**36.7**	**41.5**	**42.2**	**42.9**	**45.1**	**48.0**	**45.2**
of these:							
Food and clothing	21.8	21.5	20.3	19.8	19.4	17.6	19.2
Transport equipment, fuels	2.0	6.6	6.9	7.6	9.4	11.3	9.3
Consumer electronics, sport, leisure and entertainment equipment	4.7	5.9	6.4	6.9	7.6	9.4	11.3
Furniture, household equipment	4.5	4.2	4.7	4.6	5.3	6.2	5.4
Non-tradable goods and services[2]	**63.3**	**58.5**	**57.8**	**57.1**	**54.9**	**52.0**	**54.8**
of these:							
Housing incl. incidental costs	49.7	43.3	41.2	39.5	36.9	31.5	37.0
Restaurants and hotels	2.4	2.9	3.2	3.8	4.5	4.7	4.1
Transport services	3.0	3.3	3.6	3.8	3.5	4.7	3.8
Telecommunication services	3.5	3.4	3.0	2.7	2.2	1.8	2.4
Number of observations	773	604	1,457	1,391	1389	1,899	7,513

Notes: 1) Food, beverages, tobacco, clothing and shoes (w/o repair), interior, household goods (w/o services), health goods, cars and vehicles (w/o repair), fuels, phones and communication equipment, consumer electronics, photo equipment, sport equipment etc., jewelery, watches, body care equipment, etc.– 2) Housing incl. incidental costs, household services, health services, repairs of transport equipment, transport services, postal and telecommunication services, leisure and cultural services, educational services, body care services.
The findings are based on the "Einkommens- und Verbrauchsstichprobe" in Germany, a survey of 7,513 households that allows representative inferences on the population residing in Germany.
Source: German income and consumption sample ("Einkommens- und Verbrauchsstichprobe") of the Federal Statistical Office; aggregation and calculations are our own.

In this section we capture these mechanisms in a stylized model with two goods, non-tradables and tradables, and two factors of production, labor and capital. The heterogeneity of the labor force is captured by differences in individual labor productivity, which is assumed to be exogeneously distributed across the employed workforce and can differ between native and migrant workers. To simplify issues, we also assume that the labor force participation rate is exogenous

and may vary between natives and migrants. The empirically relevant case of an employment ban is modeled by setting the labor force participation rate for migrants to zero. Furthermore, in order to capture the labor demand effects of migration, we employ a simple wage-setting framework where wages respond imperfectly to changes in the unemployment rate. Non-employed households receive a benefit which equals a fraction of mean total income (including capital income) and is funded by a uniform tax rate on all sorts of income. As a consequence of the non-homethetic demand framework, migration can affect wages and the employment of natives even if refugees are banned from working, since the tax-transfer system affects mean income and the dispersion of earnings in the economy. The framework is comparative-static and rules out savings. The budget constraint also implies that transfers to the non-employed are entirely funded by the tax system.

Our framework addresses the labor market impact of a demand shift under the assumption of a balanced budget. An alternative way to address the demand effects of refugee migration would be to employ a neo-Keynesian framework with sticky prices on goods and factor markets at the macro level. In this setting, public transfers to refugees might temporarily increase labor demand if there is deficit spending, i.e. if additional expenditures are funded neither by higher taxes nor by social security contributions and if Ricardian equivalence does not hold. We acknowledge that such effects may play a role but we do not require them, i.e. the mechanisms of our model work even in the absence of deficit spending. Moreover, the mechanisms we outline here, can be generally applied to the labor market effects of migration, i.e. when demand and supply effects occur simultaneously and for all cases where immigrants' income differ from that of natives. We can also capture long-term effects of migration when possible Keynesian demand effects have disappeared.

The novelty of the approach is that we start from the observation that the composition of demand varies with the income level which allows addressing the effects of migration in a systematic manner. This distinguishes our framework from other approaches relying on homothetic- or quasi-homethetic demand systems, such as those of Borjas (2013) and Bodvarsson and Van den

Berg (2006). There, the labor demand effects of migration depend on the assumption that the preferences of migrants differ from those of natives, e.g. that they consume a higher share of goods produced in foreign countries compared with natives (Borjas, 2013) or that they tend to consume more goods from sectors in which they are employed (Bodvarsson and Van den Berg, 2006). By contrast, we do not need to make assumptions on differences in preferences.

3.1 Demand

We follow Boppart (2014)[11] and write the indirect utility function as

$$V(X_N, X_T, e_h) = \frac{1}{\epsilon}\left(\frac{e_h}{p_T}\right)^{\epsilon} - \frac{\beta}{\gamma}\left(\frac{p_N}{p_T}\right)^{\gamma} - \frac{1}{\epsilon} + \frac{\beta}{\gamma}, \tag{1}$$

where $V(\cdot)$ is the indirect utility function. There is a continuum of households of size H, where $H = N+M$ and N are natives and M migrants, indexed by h over the interval $[0\ H]$. [AG]Herbert: Please check! X_j for $j = N, T$ denotes non-tradable and tradable goods, respectively; e_h income of household h, p_j for $j = N, T$ the price of non-tradable and tradable goods, respectively; ϵ and γ are parameters determining the price and income elasticities and β is constant.[12]

As shown in Appendix A.1, we can derive from the indirect utility function in equation (1) the aggregate demand system as

$$d\ln\left(\frac{X_N}{X_T}\right) = -\sigma_D d\ln\left(\frac{p_N}{p_T}\right) - \frac{\epsilon}{\theta_T} d\ln\bar{e} + \frac{1}{\theta_T} d\ln\psi, \tag{2}$$

where $\theta_T \equiv \frac{p_T X_T}{p_N X_N + p_T X_T}$ is the expenditure share of tradable goods in total expenditures and $\bar{e}$ is mean income. The aggregate price elasticity of substitution, σ_D, is given by

$$\sigma_D = 1 - \gamma - (\gamma - \epsilon)\frac{\beta\left(\frac{p_N}{p_T}\right)^{\gamma}}{\left(\frac{\bar{e}\ \psi^{-1/\epsilon}}{p_T}\right)^{\epsilon} - \beta\left(\frac{p_N}{p_T}\right)^{\gamma}}, \tag{3}$$

which depends on average income and an inequality index since demand is non-homothetic. The

[11] See Egger and Habermeyer (2022) for an application of this indirect utility function in the trade context.

[12] The functional form in equation (1) is well behaved if $0 \leq \epsilon \leq \gamma \leq 1$ and a valid specification of the indirect utility function if and only if $e_h^{\epsilon} \geq \frac{1-\epsilon}{1-\gamma}\ \beta p_N^{\gamma} p_T^{\epsilon-\gamma}$ (Boppart, 2014). We assume throughout the paper that these conditions are fulfilled.

inverse inequality index ψ is given by $\psi = \int_0^{(} H) \left(\frac{e_h}{\bar{e}}\right)^{1-\epsilon} dh$. It is scale-invariant and defined over the interval [0 1]. The index depends on the distribution of income and thus on individual labor productivity, the employment share and the redistribution of income via the tax-transfer system as shown below.

The consumption of non-tradables (necessities) relative to tradables (luxury goods) increases if (i) the relative price of non-tradables falls, (ii) mean income declines, or (iii) the distribution of income becomes more egalitarian. The last point results from the fact that the expenditure share of the poor tends to increase if the distribution of income is more equal. These results apply only if demand is non-homothetic, i.e. if $\epsilon > 0$. In the limiting case of homothetic demand, i.e. if $\epsilon \to 0$, mean income and the income dispersion no longer affect the relative demand of tradable and non-tradable goods.[13]

3.2 Production

The production side of the economy is characterized as follows and is similar to Jones (1965) and Rivera-Batiz (1982, 1983). There are two sectors, one producing a non-tradable good and the other producing a tradable good, and both are based on two factors of production, labor and capital. To keep the framework simple, we assume that production is characterized by constant returns to scale and that profit-maximizing firms operate in an environment with perfect competition. Thus, firms are price-takers in goods and factor markets. We also employ the small country assumption implying that the price of the composite tradable good is determined by international markets and will remain constant.[14] Finally, we assume that the non-tradable sector is labor intensive which is a well-established stylized fact in the empirical literature and illustrated for Germany by table B.1 in the appendix.

We capture the heterogeneity of labor by differences in labor productivity, such that the effective labor input of households, $\tilde{L}$, is given by $\tilde{L} = L \int_{\underline{\alpha}}^{\bar{\alpha}} \alpha \; \ell(\alpha) \; d \; \alpha = \tilde{\alpha} L$ where α denotes

[13] Note that if $\epsilon = 0$ the inverse inequality index ψ is constant.

[14] Note that in a framework with three goods - one non-tradable and two tradables that differ in their factor intensity - factor price equalization holds such that neither changes in factor endowments nor in the composition of consumption affects factor prices or, in a setting with imperfect labor markets, employment opportunities. We rule out this possibility here.

individual labor productivity continuously distributed over the interval $[\underline{\alpha}\ \bar{\alpha}]$, $\ell(\alpha)$ the density function of effective labor supplies, $\tilde{\alpha}$ the average labor productivity in the economy and $\tilde{L}$ the total labor input in efficiency units. The labor force participation rate for natives and migrants is assumed to be exogenous, but may differ between natives and migrants. Thus L/H may vary with the size of M. We consider below the limiting case of an employment ban for refugees, i.e. where the labor force participation rate of migrants is zero.

As outlined in Appendix 2, the assumptions on production technologies and the equilibrium conditions in goods and factor markets for the change of the log wage with respect to migration allow us to derive the following:

$$\frac{d\ln w}{d\ln M} = -\frac{1}{\sigma}\ \frac{d\ln(\tilde{L}/K)}{d\ln M} - \epsilon\frac{1}{\sigma}\frac{|\lambda|}{\theta_T}\ \frac{d\ln\bar{e}}{d\ln M} + \frac{1}{\sigma}\frac{|\lambda|}{\theta_T}\frac{d\ln\psi}{d\ln M}, \tag{4}$$

where w denotes the wage rate per efficiency unit of labor in terms of the price of the tradable good, M the amount of migrant households and K the capital stock. Note that the wage rate equals the marginal product of labor. The composite elasticity of substitution σ is the weighted sum of the elasticity of substitution on the demand-side and on the supply-side, where the demand-side elasticity is determined by equation (3) and the supply-side elasticity by the parameters of the model. More specifically, σ is defined as $\sigma \equiv \frac{|\theta||\lambda|(\sigma_D+\sigma_S)}{\theta_{KT}}$, where $|\theta|$ denotes the determinant of factor income shares, θ_{ij}, where e.g. $\theta_{\tilde{L}N} \equiv \frac{w\tilde{L}_N}{p_N X_N}$; and $|\lambda|$ denotes the determinant of the factor input shares, λ_{ij}, which is defined as the share of factor input i in sector j in the total input of factor i in the economy. Both determinants are positive given the assumption that the production of non-tradables is labor-intensive. The elasticity of substitution on the supply side, σ_S, is defined as $\sigma_S \equiv \frac{1}{|\lambda||\theta|}(\varepsilon_{\tilde{L}} + \varepsilon_K)$, where $\varepsilon_{\tilde{L}}$ denotes the elasticity of changes in labor intensity with respect to wage changes and ε_K denotes the elasticity of changes in the capital intensity with respect to changes in the rental rate of capital at constant output. Finally, θ_{KT} denotes the factor income share of capital in the tradable sector (see Appendix A.2 for details).

Equation (4) delivers the main results of the model. First, we obtain the expected result that the wage rate is declining if the capital endowment per efficiency unit of labor in the economy

falls due to migration. Second, the wage rate is increasing if migration triggers a decrease in mean household income –as is expected for refugees– since the consumption of non-tradables increases when average income levels decrease. Finally, a more egalitarian distribution of labor productivity unambiguously increases the wage level since higher earnings of the poor relative to the rich tend to increase the consumption of non-tradables. The latter two effects capture the effects of a demand shift through migration.

Consider the limiting case of an employment ban (on refugees) such that the labor force participation of the migrant population is zero while that of the native population remains constant, i.e. that $\frac{d\ln L}{d\ln M} = 0$. In this case equation (4) simplifies to

$$\begin{aligned}\frac{d\ln w}{d\ln M} &= -\frac{1}{\sigma}\frac{|\lambda|}{\theta_T}\left[\epsilon\,\frac{d\ln \bar{e}}{d\ln H} - \frac{d\ln \psi}{d\ln H}\right]\frac{d\ln H}{d\ln M}, \\ &= \frac{1}{\sigma}\frac{|\lambda|}{\theta_T}\left[\frac{\frac{L}{H}\left[b^{1-\epsilon} - \psi_\alpha b\right] + \epsilon b\left[\frac{L}{H}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}\right]}{\left[\frac{L}{H} + \left(1-\frac{L}{H}\right)b\right]\left[\frac{L}{H}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}\right]}\right]\frac{d\ln H}{d\ln M} \geq 0, \qquad (5)\end{aligned}$$

where we have decomposed average income, $d\ln \bar{e}$ and the inverse inequality index, $d\ln \psi$, into its components to achieve the results in the second line (see Appendix A.3). While this decomposition leaves $\bar{e}$ unaffected, the inverse inequality index depends on the exogeneous distribution of the labor productivity of the employed workforce, ψ_α, the labor force participation rate L/H and the transfer rate b.

The first term from equation (4) disappears in equation (5) since labor supply and average labor productivity remain constant if migrants cannot participate in the labor force. The remaining term is unambiguously positive if (i) demand is non-homothetic, i.e. if $\epsilon > 0$, and (ii) transfers exist, i.e. $b > 0$. The latter result is due to the fact that we assume zero demand effects of migration if they receive neither wages nor transfers. As a result, when immigrants do not work but receive some transfers, immigration unambiguously increases wages.

3.3 Imperfect Labor Markets and Employment Effects

So far we have assumed that labor markets are perfect, i.e. that a higher labor supply through immigration or a demand shift affects only wages but not employment. Building on Brücker and Jahn (2011) and Brücker et al. (2014) we now apply a wage-setting framework replacing the conventional labor supply curve with a wage-setting function to analyze the wage and employment effects of migration simultaneously. This wage-setting function relies on the assumption that wages decline with the unemployment rate, albeit imperfectly. This relationship is empirically widely supported, both at the macro level (Layard and Nickell, 1986; Nickell et al., 2005) and at the regional level (Blanchflower and Oswald, 1994, 2005). Theoretically, the wage-setting function can be derived from right-to-manage models of collective bargaining (Nickell and Andrews, 1983) and efficiency wage theories derived from models with turnover cost (Salop, 1979) or shirking (Shapiro and Stiglitz, 1984). These models have in common the idea that the slope of the wage-setting curve depends on both the mark-up of the wage over the outside option of workers, and on the value of the outside option.

To capture the impact of a demand shift when refugees do not participate in the labor market, we distinguish labor force participation and unemployment. Define the labor force that participates in the labor market as $\hat{L} \leq H$, i.e. not all individuals or households participate in the labor market. We can write thus the unemployment rate as $u = 1 - \frac{L}{\hat{L}}$. As before, all non-employed households, i.e. both unemployed and non-participants in the labor force, receive unemployment benefits b, a fraction of mean income and these are entirely funded by the tax rate τ on income.

In the first stage of the decision process, firms and employees agree on wages as a function of the unemployment rate. Labor force participation does not affect the wage-setting function, however. This enables us to write the aggregate wage-setting equation as

$$w = \phi(u), \qquad \phi' \leq 1,$$

where ϕ is a function that captures the response of the wage to the unemployment rate. In a

second step, given perfect competition on goods and factor markets, firms hire workers until the marginal product of labor equals the wage rate, i.e. $w = Y_L$. This allows us to equate the marginal product of labor with the wage-setting function ϕ and to solve for the employment response by differentiating this system implicitly (see Appendix A.4). For the log change of employment with respect to a log change of the population through migration this yields

$$\begin{aligned}\frac{d\ln L}{d\ln M} = &\left[\frac{1}{\sigma}\frac{d\ln\tilde{L}}{d\ln L} + \frac{1}{\sigma}\frac{|\lambda|}{\theta_T}\left(\epsilon\frac{d\ln\bar{e}}{d\ln L} - \frac{d\ln\psi}{d\ln L}\right) + \mu\frac{\bar{L}}{L}\right]^{-1} \\ &\times\left[\frac{1}{\sigma}\frac{|\lambda|}{\theta_T}\left(\frac{d\ln\psi}{d\ln H} - \epsilon\frac{d\ln\bar{e}}{d\ln H}\right) + \mu\frac{\bar{L}}{L}\frac{d\ln\bar{L}}{d\ln H}\right]\frac{d\ln H}{d\ln M},\end{aligned} \tag{6}$$

where $\mu \equiv -\frac{\partial\phi}{\partial u}\frac{1}{\phi}$ is the semi-elasticity between the wage and the unemployment rate. We can rewrite equation (6) by decomposing $\bar{e}$ and ψ into their components as

$$\begin{aligned}\frac{d\ln L}{d\ln M} = &\left[\frac{1}{\sigma}\left(1 + \epsilon\frac{|\lambda|}{\theta_T}(1-\theta_{KT})\right)\frac{d\ln\tilde{L}}{d\ln L} - \frac{1}{\sigma}\frac{|\lambda|}{\theta_T}\left(\omega + \xi\frac{d\ln\psi_\alpha}{d\ln L}\right) + \mu\frac{\bar{L}}{L}\right]^{-1} \\ &\times\left[\frac{1}{\sigma}\frac{|\lambda|}{\theta_T}(\epsilon-\omega) + \mu\frac{\bar{L}}{L}\frac{d\ln\bar{L}}{d\ln H}\right]\frac{d\ln H}{d\ln M},\end{aligned} \tag{7}$$

where ω is a short-cut for $\frac{L}{H}\frac{\psi_\alpha b - b^{1-\epsilon} + \epsilon[1-b]\left[\frac{L}{H}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}\right]}{\left[\frac{L}{H} + \left(1-\frac{L}{H}\right)b\right]\left[\frac{L}{H}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}\right]}$ and ξ is a short-cut for $\frac{\frac{L}{H}\psi_\alpha}{\frac{L}{H}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}}$. The term $\epsilon - \omega = \frac{\frac{L}{H}\left[b^{1-\epsilon} - \psi_\alpha b\right] + \epsilon b\left[\frac{L}{H}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}\right]}{\left[\frac{L}{h} + \left(1-\frac{L}{H}\right)b\right]\left[\frac{L}{h}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}\right]} \geq 0$. This term is positive if demand is non-homothetic, i.e. $\epsilon > 0$ and if the transfer rate $b > 0$.

Equation (7) delivers the employment effects of the model. First, if the wage rate responds perfectly elastic to a change in the unemployment rate, i.e. if $\mu \to \infty$, $\frac{d\ln L}{d\ln M} \to \frac{d\ln\bar{L}}{d\ln H}\frac{d\ln H}{d\ln M}$, the percentage change of employment equals the percentage change of the labor force through migration. Second, if wages do not adjust to a change in the unemployment rate at all, i.e. if $\mu = 0$, there is only an employment effect if $\epsilon - \omega > 0$, i.e. if demand is non-homothetic and if there are transfers. In this case, employment tends to increase due to the demand-shift effect but less than the increase in the labor force. Third, in the intermediate cases, i.e. if $0 < \mu < \infty$ and if $\epsilon > 0$ and $b > 0$, the employment response to migration is positive but might be smaller than the increase in the labor force through migration. It tends to increase if (i) the wage elasticity

with respect to the unemployment rate increases, (ii) $\epsilon - \omega$ tends to increase, which is the case if demand becomes more non-homothetic, and (iii) the equality in the distribution of the labor productivity, ψ_α, tends to rise. It tends to decline if labor supply measured in efficiency units tends to increase.

In the limiting case of an employment ban, i.e. if the labor force participation of migrants is zero, equation (7) simplifies to

$$\frac{d\ln L}{d\ln M} = \left[\mu\frac{L}{\bar{L}}\right]^{-1} \times \left[\frac{1}{\sigma}\frac{|\lambda|}{\theta_T}(\epsilon - \omega)\right]\frac{d\ln H}{d\ln M} \geq 0. \tag{8}$$

which is positive if $\epsilon - \omega > 0$ and if the elasticity of wages with respect to unemployment is not infinite. Thus, in the case of an employment ban, the demand effect of hosting migrants unambiguously triggers additional employment of natives if the demand of consumers is not homothetic and as long as wages do not completely adjust to labor demand changes.

3.4 Capital Stock Adjustment and Long-Term Effects

Following Ottaviano and Peri (2006) and Borjas (2013) we assume that capital stocks adjust to labor supply changes, or, more precisely, to the rental rate of capital. Suppose that the relationship between the interest rate and the inverse elasticity of capital supply is given by $r = K^{\frac{1}{\sigma_K}}$, where σ_K is the elasticity of the response of the capital stock with respect to a change of the interest rate. Using this and the fact that $d\ln r = -\frac{\theta_{LT}}{\theta_{KT}} d\ln w$ and that $\theta_{LT} = 1 - \theta_{KT}$ we can rewrite the wage equation (4) as

$$d\ln w = -\frac{\theta_{KT}}{\sigma + (1-\theta_{KT})\sigma_K}\left[\frac{d\ln \tilde{L}}{d\ln M} + \epsilon\frac{|\lambda|}{\theta_T}\frac{d\ln \bar{e}}{d\ln M} - \frac{|\lambda|}{\theta_T}\frac{d\ln \psi}{d\ln M}\right], \tag{9}$$

and, analogously, we can rewrite the employment equation (6) as

$$\begin{aligned}\frac{d\ln L}{d\ln M} = &\left[\frac{\theta_{KT}}{\sigma + (1-\theta_{KT})\sigma_K}\left(\frac{d\ln \tilde{L}}{d\ln L} + \epsilon\frac{|\lambda|}{\theta_T}\frac{d\ln \bar{e}}{d\ln L} - \frac{|\lambda|}{\theta_T}\frac{d\ln \psi}{d\ln L}\right) + \mu\frac{L}{\bar{L}}\right]^{-1} \\ &\times \left[\frac{\theta_{KT}}{\sigma + (1-\theta_{KT})\sigma_K}\left(\frac{|\lambda|}{\theta_T}\frac{d\ln \psi}{d\ln H} - \epsilon\frac{|\lambda|}{\theta_T}\frac{d\ln \bar{e}}{d\ln H}\right) + \mu\frac{L}{\bar{L}}\frac{d\ln \bar{L}}{d\ln H}\right]\frac{d\ln H}{d\ln M}.\end{aligned} \tag{10}$$

Thus, the wage and employment effects of migration disappear if $\sigma_K \to \infty$, i.e. if the capital stock adjusts completely to labor supply and demand changes in consumption. We consider this to be the long-term effect.

3.5 Conclusions for the Empirical Investigation

From these theoretical considerations we conclude the following four results. First, in the short run, the non-homothetic demand framework predicts that an increase of households with low income through refugee migration involves a demand shift towards the consumption of necessities, which cover a disproportionally high share of non-tradable goods and services that are labor intensive. Second, in case of an employment ban, this demand shift translates either into higher wages or –if there are wage rigidities– into higher employment rates of natives, or both. Given that the institutional framework in Germany has a high coverage of collective bargaining, it is likely that changing consumption patterns affect employment in particular and that the wage effects are rather moderate. Third, when the employment ban is lifted, refugee migration displays both labor demand and labor supply effects. The labor supply effects are mitigated due to the lower labor productivity of the immigrant population, which reduces average income and, hence, increases the consumption of non-tradables relative to tradables, and, hence, employment or wages. The visible effects at the aggregate level are ambiguous, given that even when the employment ban is lifted, the labor market participation and employment rates of the refugee population are rather low to start. Fourth, in the long run, we expect that most effects disappear, since the capital stock adjusts to the changing demand and labor supply conditions.

4 Empirical Approach

4.1 Empirical Model

We estimate the labor demand effect of immigration on labor market outcomes of the local population. For that purpose, we focus on the regional inflow of only those asylum seekers who

are subject to a strict employment ban. We start from the following regression model:

$$y_{dt} = \alpha + \beta \times m_{dt} + \delta_d + \delta_s + \pi_t + (\delta_d \times \pi_t) + (\delta_s \times \delta_t) + \epsilon_{dt}, \tag{11}$$

where y_{dt}, covers three different outcome variables: the aggregate employment rate in a district, L_{dt}/POP_{d0}; the employment rate in a specific sector and district, L_{jdt}/POP_{d0}; and the unemployment rate in a district, U_{dt}/POP_{d0}. These are all normalized by the local population, POP_{d0}—including both natives and migrants except for any refugees—in the initial year 2013. The variable of interest, m_{dt}, is defined as the share of asylum seekers without labor market access, AS_{dt} in the pre-existing local population, i.e. $m_{dt} \equiv AS_{dt}/POP_{d0}$. Because this group consists mainly of refugees that have lived in Germany for only a few months, it can be interpreted as the recent per capita inflow of asylum seekers without labor market access. By using district fixed effects, δ_d, federal state fixed effects, δ_s, a linear time trend, π_t, the interaction of district fixed effects with the linear time trend $(\delta_d \times \pi_t)$ and the interaction of state fixed effects with time fixed effects, $(\delta_s \times \delta_t)$, we control for constant and time-varying differences in the economic conditions at the aggregate level and across regions.[15] The remaining variation to identify β stems from variations in the number of asylum seekers within districts across time, disregarding district-specific time trends and state-specific shocks.

For the purpose of estimation, we take yearly differences and obtain:

$$\Delta y_{dt} = \beta \times \Delta m_{dt} + \delta_d + \delta_s + (\delta_s \times \delta_t) + \varepsilon_{dt}, \tag{12}$$

where Δ denotes the first difference operator. Taking first differences does not change the interpretation of β. The district fixed effects δ_d result from the district-specific time trends in equation 11 and the coefficients for the state fixed effects control similarly for time trends at the

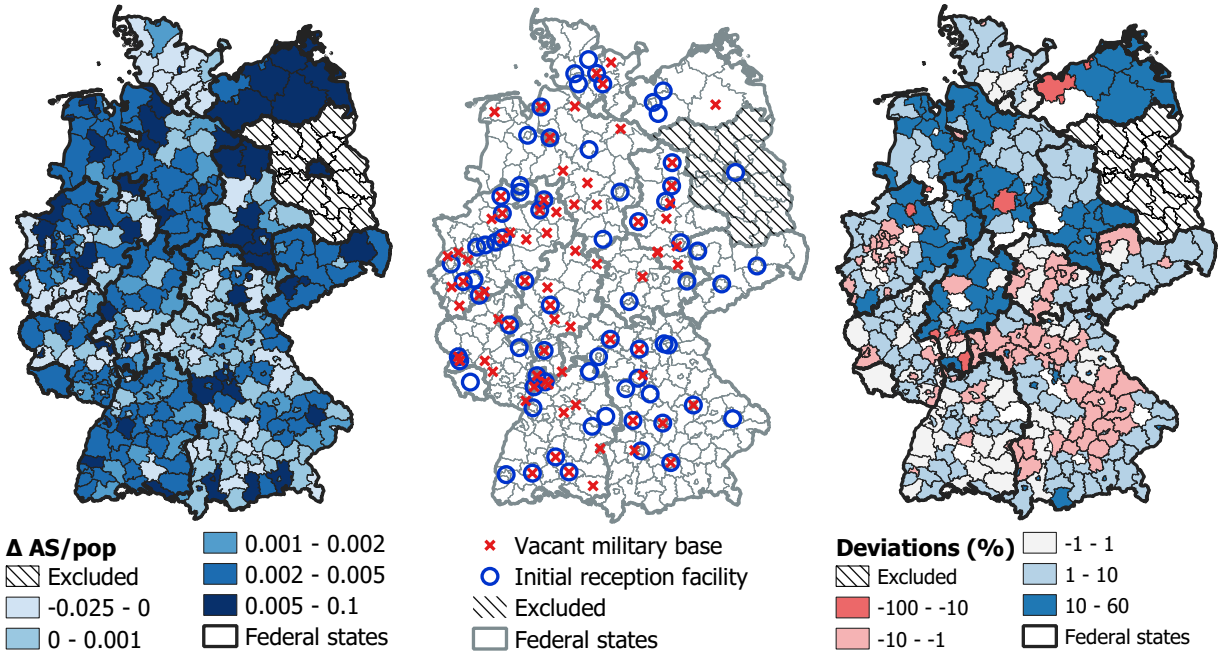
[15] We prefer to include these linear time trends as we find indications that asylum seekers were selected into regions not only with different labor market characteristics, but also with different labor-market trends (column 1 of Table 3). d, s, j and t indexes districts, federal states, sectors and time, respectively. By including federal state × time fixed effects we also control for regional differences in the implementation of asylum and integration policies that are usually defined on the state level as well as for variations in the Königstein Key (the state specific refugee quotas that are based on tax revenues and population).

state level. The interaction of state fixed effects with a linear time trend ($\delta_s \times \delta_t$) controls for the time trend of shocks at the state level.

We are interested in identifying β as the effects of the (per capita) inflow of new asylum seekers on different labor market outcomes (per capita). In order for β to estimate a causal effect, the allocation of immigrants must be orthogonal to time-varying local labor market shocks around the district-specific linear trends. In Section 2.1 and Appendix B.3 we provide evidence that despite the dispersal policy this condition did not hold. This point is reiterated by Panel (A) of Table 3, which indicates (marginally) less favorable pre-treatment unemployment trends in regions that later received more refugees. For those reasons we base our analysis on an instrumental variables approach.

Figure 2: Regional Variation of Endogenous Variable and Instruments on 31 December 2015

(a) Endogenous Var.: $\Delta AS/pop$ (b) IV 1: Barracks and IRFs (c) IV 2: Δ Quotas/pop



Notes: The state of Brandenburg is dropped from the analyses (hatched areas). Maps 2a and 2c show numbers for 31 December 2015. Map 2b indicates districts that hosted an initial reception facility (as reported in the AZR) at any time between 2013h2 and 2017h2 and vacant military bases in mid-2015. Map 2c shows percentage deviations from a hypothetically uniform distribution by working age population in each state. In blue districts, more asylum seekers have been assigned and in red areas less asylum seekers have been assigned than in a uniform distribution.

4.2 Instrumental Variables Approach

Figure 2a shows the variation in our endogenous variable, i.e. the inflow of asylum seekers without labor market access per capita. It shows substantial variation within and across states in late 2015, which should have not been the case had asylum seekers been distributed proportionally to the population. Addressing this type of regional sorting by a classical shift-share IV approach is not feasible in the case of refugees because hardly any individuals from the asylum countries were living in Germany prior to the recent immigration episode.[16] This is why we rely on new instruments.

As a first instrument, we exploit the presence of large vacant military compounds that were often used as initial reception facilities and as large-scale temporary group accommodations (Figure 2b). Thus, this first instrument especially captures those refugees who have recently arrived and therefore still live in an IRF. For the purposes of estimation, we construct a dummy variable that takes the value of 1 if in a certain district a military base was available in 2015 which was no longer in use (Barracks). We interact this variable with another dummy for the peak of refugee immigration during the second half of 2015 and the full year of 2016 (D[2015/16]):

$$\text{IV1} = \text{Barracks} \times \text{D}[2015/16]. \tag{13}$$

Vacant military compounds have the advantage that their location was chosen based on military and not on economic considerations. Nevertheless, the previous closure of a military base could have posed a negative demand shock that struck the regions before the refugees arrived—which is especially relevant in case a closure took place shortly before.[17] To prove whether this is a threat for the validity of our instrument we take four steps. First, we provide results based on only those military bases that have been vacant for a period of at least five years (Section 6.6). After this period, the potential adjustment processes as a consequence of its closure have most probably

[16] For example, Syrians were the largest group arriving in 2015—2016 (nearly 750,000 living in Germany in 2018 or nearly 0.9% of the population). However, prior to this immigration episode, only about 30,000 Syrians (0.04% of the population) lived in Germany. Source: Statistisches Bundesamt (Destatis) (2019).

[17] Indeed, Moore and Spitz-Oener (2012) indeed suggest that the withdrawal of the US Army from many German bases after the fall of the Iron Curtain was a negative demand shock for local labor markets.

disappeared or become negligible. Second, we show that districts that had a vacant military base in 2015 do not systematically differ in their pre-treatment labor market trends from those who do not. Figure B1 in the appendix illustrates that once the fixed effects from our empirical model have been accounted for, employment growth in districts with and without vacant military bases evolves flat and parallel until mid-2015, but increases as refugee immigration peaks in districts that host a vacant military compound. Third, Table B2 in the appendix compares districts with and without military bases in late 2013, i.e. before the arrival of asylum seekers. It reiterates that the district that hosted a vacant military base did not differ statistically significantly from other districts in terms of various labor market characteristics and labor market trends. Finally, the insignificant pre-trends results in panel (B) of Table 3 suggest the same.

Table 3: Pre-Trends

Main coef. of interest	Δ Employment/pop			Δ Unemployment/pop
	All	Non-tradables	Tradables	
	(1)	(2)	(3)	(4)
Panel (A): Outcome: Endogenous variable (Δ AS/POP)				
Δ*Emp/pop* (one-year lag)	-0.04	-0.03	0.00	0.07*
	(0.03)	(0.02)	(0.01)	(0.04)
R^2	0.31	0.31	0.31	0.31
Observations	2,639	2,639	2,639	2,639
Panel (B): Outcome: IV 1 (Barracks×D[2015/16])				
Δ*Emp/pop* (one-year lag)	-1.08	-1.32	0.32	3.68
	(2.47)	(1.59)	(2.19)	(4.58)
R^2	0.56	0.56	0.56	0.56
Observations	2,639	2,639	2,639	2,639
Panel (C): Outcome: IV 2 (Δ assigned AS/POP)				
Δ*Emp/pop* (one-year lag)	-0.01	-0.00	-0.00	0.02
	(0.01)	(0.01)	(0.01)	(0.02)
R^2	0.87	0.87	0.87	0.87
Observations	2,639	2,639	2,639	2,639
Time × state FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The pre-trends estimates regress the two instruments separately on the different labor market outcomes with a one-year lag. Standard errors are clustered on the level of districts and displayed in parentheses. The administrative quotas and the labor market outcomes are expressed as yearly differences and normalized by population excluding refugees in the base year 2013. All estimations are weighted with the normalization variable.

As a second instrument we use the hypothetical number of assigned refugees to districts based

on the administrative quotas (Figure 2c). This second instrument is based on the allocation quotas, which apply to the allocation from IRFs to subsequent allocation and therefore captures refugees who have already left an IRF. For this purpose we multiply the number of refugees actually assigned in the "EASY" algorithm to federal states by the official within-state quotas that were effective at the time. This yields[18]

$$\frac{\text{assigned AS}_{\text{dt}}}{\text{POP}_{\text{d0}}} = \underbrace{\frac{1}{\text{POP}_{\text{d0}}}}_{Normalization} \times \underbrace{\frac{\text{assigned AS}_{\text{dt}}}{\text{assigned AS}_{\text{st}}}}_{District-quota} \times \underbrace{\text{assigned AS}_{\text{st}}}_{State-assignments}, \tag{14}$$

where assigned AS stands for the number of asylum seekers that are assigned by administrative dispersal mechanisms to the state level (s) and the district level (d), respectively. For the purposes of estimation, we construct this second instrument as we did with the dependent variable of interest:

$$\text{IV 2} = \Delta\left(\frac{\text{assigned AS}_{\text{dt}}}{\text{POP}_{\text{d0}}}\right) = \frac{1}{\text{POP}_{\text{d0}}} \times \Delta\left(\frac{\text{assigned AS}_{\text{dt}}}{\text{assigned AS}_{\text{st}}} \times \text{assigned AS}_{\text{st}}\right), \tag{15}$$

i.e. where the first difference of the administratively assigned asylum seekers in a district is given by the change in the quota of the asylum seekers of the district times the change in the number of asylum seekers dispersed to the federal state by the EASY system.

The number of hypothetically assigned refugees based on the administrative quotas can be influenced neither by local authorities nor by asylum seekers themselves, which removes potential biases from regional sorting. The quotas are defined centrally in each state and are based on objective criteria—population first and foremost. In addition, the EASY-allocations were recorded automatically and are therefore less prone to potential measurement error that may afflict AZR register data. After normalizing by population and controlling for district fixed effects, we argue that the quotas are very unlikely to reflect local labor market conditions.[19] Nevertheless, the allocation criteria could in principle be correlated with our outcome variables,

[18] See Appendix B.2 for details.

[19] The only exception where we doubt this assumption is the state of Brandenburg, which uses local employment shares in addition to population to calculate the distribution quotas. Therefore we have dropped Brandenburg from the analyses.

which we will now test empirically. Table 3, panel (C) shows the results of pre-trend regressions with the quota-based instrument as the dependent variable and lagged labor market outcomes as the explanatory variables. All coefficients are statistically insignificant, which indicates that the quotas do not correlate with previous labor market trends.[20]

In sum, the first instrument focuses on recently arrived asylum seekers (still living in IRFs) while the second one applies later in the allocation process (from IRFs to districts). Thus, they complement each other. Importantly, both do not correlate with past employment trends.

4.3 First Stage

Table 4 shows the results of the first-stage regressions of both instruments on the endogenous variable (the yearly change in asylum seekers without labor market access per population). The first two columns refer to the single instruments, while column three combines both. The coefficients of the two instruments remain stable in column (3), which supports our argument that they are uncorrelated and predict different types of refugee inflows.

Both instruments are positively and significantly correlated with the arrival of refugees without labor market access. We estimate effective F-statistics to test for weak identification in the case of clustered standard errors (see Montiel-Olea and Pflueger, 2013; Pflueger and Wang, 2015; and Andrews et al., 2019).[21] If we define strong instruments to have a maximal relative bias (τ) of 5% (compared with the bias of OLS), we can reject weak instruments at a confidence level (α) of 5% only if we use both instruments jointly (because $10.012 > 8.561$). This is why we choose column (3), i.e., the combination of both instruments as our preferred specification. Figure B2 illustrates the first-stage relationship in a scatter plot. As for the remaining variation, which is used in the second stage, Figure B3 shows the variation between the residualized explanatory variable (i.e. after the first stage) and the outcome variable on total employment. Both plots

[20] This instrument reflects within-state quotas that allocate asylum seekers across districts for subsequent accommodation. Therefore it has no predictive power for asylum seekers that still live in reception facilities and have not yet been allocated to subsequent accommodation by the second step of the allocation procedure. For this reason, we set the instrument to zero in districts that host an IRF.

[21] These effective F-statistics are not comparable between estimations with different numbers of instruments. Instead, they need to be compared with the specific critical values for the case of one or two instruments. These critical values for the maximal relative bias are shown at the bottom of Table 4.

Table 4: First Stage

	(1)	(2)	(3)
D[Military Base] Δ D[time 2015h2-2016h2]	0.001***		0.001**
	(0.000)		(0.000)
Δ Quota-based assignments/pop		0.432***	0.426***
		(0.107)	(0.107)
Time × State FE	Yes	Yes	Yes
District FE	Yes	Yes	Yes
Observations	2,639	2,639	2,639
Effective F-stat	5.93	14.1	10.01
Crit. value 5% bias	*37.42*	*37.42*	*8.56*
Crit. value 20% bias	*15.06*	*15.06*	*4.75*
Hansen J (overid)	0.00	0.00	0.88
P-val. Hansen J			0.35

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Standard errors are clustered at the level of districts and displayed in parentheses. All variables are expressed in yearly differences and normalized by population excluding refugees in the base year 2013. All regressions are weighted with the normalization variable. The coefficients shown are for asylum seekers without labor market access. The effective F-statistics are calculated based on Montiel-Olea and Pflüger (2013) and their critical values are used accordingly.

show no outliers, or suspicious patterns.

We use a two-stage-least-squares procedure for estimation based on equation (12). We cluster standard errors on the level of districts and weight our estimates by the working age population in each district if not stated otherwise.

5 Data and Estimation

Our analysis is based on a bi-annual panel of 377 districts[22] that covers the period 2014—2017 (Appendix B.5 for details). It combines novel data on asylum seekers in Germany with the allocation quotas. We further append the resulting data set with publicly available regional data from official population and employment statistics.

We retrieved a customized extract from the Central Registry of Foreigners (AZR), a database that is administered by the Federal Office for Migration and Refugees (BAMF) and used by

[22]These correspond to NUTS 3-level ("Kreise und kreisfreie StÃ¤dte") with an average of 200,000 inhabitants.

many public authorities. In contrast to other data sets that have been used so far, this extract provides not only information on the number of refugees by nationality and district of residence, but also on the month of arrival in Germany and the authority that is in charge of registration (e.g. an IRF or a district authority). This is crucial because it allows us to identify precisely all asylum seekers who do not have labor market access either due to having arrived recently (within the last three months) or due to living in an IRF. We use the AZR data on a half-yearly basis starting in the second half year of 2013 until the end of 2018.[23]

From the BAMF, we also obtained a data set with the exact monthly assignments of asylum seekers to federal states by the EASY system. Finally, we contacted the responsible ministries in all federal states to provide us with the quotas that they used each year to decide how many refugees the districts were to receive. For as far as we know, neither such a detailed breakdown of the AZR, nor the regional EASY allocations nor the within-state quotas for districts have been used in the literature.[24]

Our data on military compounds stems from the Institute for Federal Real Estate ("Bundesanstalt für Immobilienaufgaben"). This agency manages the real estate owned by the Federal Republic of Germany. The administration of military bases on German territory that have been abandoned by German, American, British, French or Soviet armed forces are among the objects that fall under the agency's tasks. During the large refugee inflow, the Institute for Federal Real Estate was able to rent out large spaces to local authorities at very short notice, which were then frequently transformed into provisional housing or reception facilities. We obtained a list from the institute with all vacant army barracks (i.e. military buildings that could be used for residential purposes) that were under its administration in late 2015. It includes a brief description of the

[23] Alternative data on the recipients of asylum seeker benefits are unsuitable for this kind of analysis because asylum seekers drop out of the data as soon as they receive a positive asylum decision. For this reason, (1) benefit recipient data also includes refugees who have labor market access and are working, (2) refugees reported in the data are selected based on the duration of their application process, and (3) comparisons across time are impossible due to strongly varying durations of the asylum application processes.

[24] Hennig (2019) in an unpublished manuscript employs likely the same within-state allocation quotas but uses only the differences between the quotas and the hypothetical distribution had only population been used in the quota. Hence, variation stems only from those four (out of 16) federal states that distribute based on more than population alone.

properties, the land size and the date when they were put under administration of the agency.

We obtain data on the aggregate numbers of employees in different industries[25] as well as on the number of unemployed individuals by gender, age, educational level and nationality groups from the official statistics of the Federal Employment Agency (BA). Employment and unemployment data are available on a monthly basis. For the individual wage regressions, we also rely on the SIAB register data[26], a 2% sub-sample of all German social security records that allows us to track individuals over time. Both the employment data set and the SIAB only cover employees who are dependent employees, unemployed or benefit recipients and excludes both public servants and the self-employed. Data on regional population numbers were obtained from the Federal Statistical Office.

6 Results

6.1 Main Results

This section reports the main results, i.e. the effects of the number of asylum seekers without labor market access on local employment in tradable and non-tradable sectors and on unemployment. The top panel of Table 5 presents results from our preferred IV specification: hosting one additional asylum seeker in a district leads to a statistically significant increase in local employment by about 0.42. Put differently, for roughly every 2.4 asylum seekers, local employment increases by one job. Simultaneously, regions with a higher inflow of asylum seekers also experience significant reductions in local unemployment with a magnitude of about 55% of the employment gains (-0.23, column 4). The employment effects are entirely driven by employment in non-tradable sectors (with a coefficient of about 0.53), while point estimates for tradable sectors are statistically insignificant. Together, these findings support the hypothesis from our theoretical framework that hosting refugees induces substantial labor demand effects that are heavily concentrated in

[25]The tradable sectors include agriculture and manufacturing and the non-tradable sectors subsume all other sectors (Table 7). In June 2014, one quarter (7.25 million employees) worked in tradable sectors and three quarters (22.69 million employees) in non-tradable sectors.

[26]This is documented in Frodermann et al. (2021), DOI: 10.5164/IAB.SIAB7519.de.en.v1 and https://fdz.iab.de/en/FDZ_Individual_Data/integrated_labour_market_biographies/IAB_SIAB7519.aspx

non-tradable goods and services. These core results (positive and significant employment effects that stem from non-tradable services) do not depend on the selection of fixed effects (appendix Table B6)[27] and are robust to controlling for refugees *with* labor market access and other forms of immigration (Table B7).

Table 5: Main Results

Outcome	Δ Employment/pop			Δ Unemployment/pop
	All	Non-tradables	Tradables	
	(1)	(2)	(3)	(4)
Panel A: IV				
Δ AS /pop	0.42**	0.53***	-0.14	-0.23***
	(0.20)	(0.19)	(0.10)	(0.09)
Observations	2,639	2,639	2,639	2,639
Panel B: OLS				
Δ AS /pop	0.04	0.09*	-0.05	-0.04***
	(0.03)	(0.04)	(0.04)	(0.01)
Observations	2,639	2,639	2,639	2,639

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Standard errors are clustered on the level of districts and displayed in parentheses. All variables are expressed in yearly differences and normalized by population in working age. All regressions are weighted with the normalization variable. The coefficients are for asylum seekers without labor market access. All estimates include district fixed effects and time-state fixed effects. IV estimates include both barracks and quotas as instruments.

When OLS is compared with the IV results (bottom panel of table 5), the IV estimates are between 5 and 10 times larger than OLS estimates despite pointing into the same direction. We attribute this to several reasons. First, OLS estimates are most likely downward biased because asylum seekers were disproportionally assigned to regions with unfavorable labor market conditions (Section 2.1). Second, measurement error in the AZR data will lead the OLS to underestimate the true effect (attenuation bias).[28] Third, the IV estimates must be interpreted

[27] In contrast to employment, the effects on unemployment depend strongly on the inclusion of the state-specific time trends, which can be interpreted as stemming from refugees being overrepresented in federal states with unfavorable unemployment trends, masking the positive (i.e., decreasing) effect on unemployment. We interpret this as an argument in favor of including the full set of fixed effects in our baseline.

[28] There was heavy under-reporting in this register data, especially during the peak of the refugee immigration in late 2015. In fact, the statistical offices estimate that about one-third of those refugees that arrived in 2015 did not

analogously to local average treatment effects (LATE).[29] This LATE is likely to be larger than an average treatment effect (ATE) because we use vacant military bases as instruments. In this case, the "compliers" consist of those districts that hosted large number of refugees only because they had such a compound. These compounds were often used for large-scale accommodations and for initial reception facilities that provide labor-intensive services related to initial accommodation and the processing of asylum procedures. It is reasonable, therefore, that additional labor demand per refugee was particularly large in these districts and that it is mainly this effect that we capture.[30]

Importantly, our results *cannot* be extrapolated to the national level for two reasons besides the LATE interpretation of the IV estimates. First, part of the regional effects could be explained by changing commuter flows into regions with more refugees that go unconsidered at more aggregated levels.[31] Put differently, the estimated effects include mobility responses across districts, which do not translate to the aggregate (also Dustmann et al., 2017). Second, we can identify only the effects on those jobs that are created on the same local level to which refugees are assigned, and not, say, those created in the central administration.

Summing up our main results, the IV estimates show substantial increases in local employment, mainly in non-tradables, and a large reduction in local unemployment. This corroborates the predictions of our theoretical model in equation (8) according to which, the demand shift towards non-tradable goods in the case of an employment ban and strong wage rigidities, will increase employment and reduce unemployment.

enter in the register until the following year, i.e. in 2016 (Statistisches Bundesamt, 2020a, p.11). Our instruments from other data sources eliminate this bias.

[29] More precisely, in the present case of a continuous endogeneous variable, the IV estimator should be interpreted as a weighted average of different effects for different subgroups (Angrist and Pischke, 2009, p. 181ff.).

[30] Appendix Table B3 shows results when using the IVs separately and supports the hypothesis that the LATE is particularly large when using the barracks instrument.

[31] We find suggestive evidence that about a quarter of the overall employment gains could be attributed to increasing commuter inflows into regions with high refugee immigration (Table B4).

6.2 Individual Wages

So far, we have discussed the effects of hosting additional refugees on employment and unemployment growth. However, from theory, we also expect that wages will tend to increase if they respond to the demand shift towards tradable goods and services. In order to test for wage effects, we shift the analysis to the individual level and analyze incumbent workers at their sector of employment in 2014, i.e. before the onset of the refugee inflow.

Specifically, we adapt equation (12) to read:

$$\Delta \ln w_{ifdt} = \beta \times \Delta m_{dt} + \gamma' \Delta \mathbf{x}_{ifdt} + \phi_i + \delta_d + \delta_{st} + \xi_{ifdt} \tag{16}$$

where w_{ifdt} is the daily wage of individual i in district d at time t and $\mathbf{x}_{ifdt}$ is a vector of time-varying characteristics at the individual and firm level (firm size, job tenure and its square, highest educational attainment and four categories for task requirements). On top of the previously used district and time×state fixed effects, the vector ϕ_i controls for individual fixed effects. β is identified from wage variation within individuals over time controlling for unobserved time constant characteristics, while allowing for firm or sector switches as part of the treatment effect.

Column (1) of Table 6 presents the coefficients of interest β.[32] In the present context, an increase of about 0.005 asylum seekers without labor market access per population—corresponding to the upper quintile of refugee immigration in late 2015—would translate into wage growth of about 0.20 log points for total wages, 0.18 log points in non-tradable sectors and 0.14 log points in tradable sectors. Yet, these effects are all not statistically significant.[33] Thus, although the coefficients of the wage regressions have the expected signs, we cannot conclude that the influx of refugees has raised wages at the local level. Finding significant employment but insignificant wage effects is not surprising in the context of German labor market institutions with a high

[32] The coefficients in the first line can be interpreted as follows. An increase in $\frac{\Delta(AS_{dt})}{pop_{d,t0}}$ of 1, i.e. an increase in the inflow of asylum seekers of the total size of the local working-age population, would increase wages of incumbent full-time workers by 41 log points (approximately percentage points). The interpretation of the individual level wage regressions differs from the previous regressions at the aggregate level, because only the latter outcomes can be normalized by population.

[33] The same holds for wage effects across a two-year or three-year window (results available upon request).

Table 6: Individual Wage Effects

	Outcome: Δ Individual wages		
	All	Non-tradables	Tradables
	(1)	(2)	(3)
Δ AS /pop	0.41	0.37	0.27
	(0.33)	(0.33)	(0.52)
Observations	2,209,975	1,488,000	721,975
District FE	×	×	×
Time × state FE	×	×	×
Individual FE	×	×	×
Firm FE	×	×	×

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Standard errors are clustered at the level of individuals and displayed in parentheses. The estimation is based on equation (16). All variables are expressed in yearly differences and the refugee inflow is normalized by population size excluding asylum seekers in the base year 2013. The coefficients shown are for asylum seekers without labor market access. All regressions are IV estimations including the barracks and quotas as instruments.

coverage of collective bargaining and widespread wage rigidities. This holds true in particular for all forms of public sector employment, including education, integration and labor market programs, but also for the construction sector and temporary agency work. Here, wages are usually fixed at the sectoral level and have small variances across firms and regions. In a nutshell, finding zero wage effects in the short run is highly plausible in the context of the German labor market institutions and wage-setting mechanisms under study here.

6.3 Heterogeneity by Industry Sectors

Which industry sectors generated additional employment growth as a response to local refugee hosting? Starting from the differences between employment in tradable vs. non-tradable sectors reported above, we disaggregate these further into 16 industry sectors (Table 6).[34] The estimation results show that three of these sectors display statistically significant coefficients. (i) As expected, we observe significant employment growth in public administration (roughly 20% of the total

[34]We use a disaggregation of 16 one-digit sectors that is used in the employment reporting of the federal employment agency. This is based on the 2008 classification of sectors (WZ2008, "Wirtschaftsabschnitte").

effect). This is reasonable because most of the refugees that are subject to an employment ban still live in reception facilities where the asylum procedures are managed and public authorities required additional staff. Also many different kinds of service personnel such as clerks or social workers will appear in this sector if they are directly hired by public authorities. Public sector employees are often hired in temporary contracts at first, which explains the relatively high degree of short-term employment flexibility in the public sector. (ii) The largest (marginally) significant effect is for temporary agency work, which accounts for 0.0989 jobs per refugee, or more than a quarter of the total employment effect. This suggest that temporary agency work is an important channel through which local firms and authorities recruit additional staff on short notice. In particular, low-skilled jobs for security, cleaning, maintenance and catering were often filled with temporary agency workers. (iii) Finally, effects for financing, insurance and real estate are marginally significant, which might be related to the importance of the the provision of housing and real estate for the accommodation of refugees. Estimation results for all other sectors are statistically insignificant, partly because they are imprecisely estimated, partly because the effect is close to zero. Note that in large sectors like construction the effects are more difficult to identify since the impact on overall employment there is smaller relative to sectors that are smaller and more directly affected by the demand shift through the refugee influx.

6.4 Heterogeneity by Different Population Groups

Table 8 shows the effects of newly arriving asylum seekers on employment and unemployment among several different population subgroups. This is of particular relevance from a distributional and policy perspective.

Female employment benefits somewhat more from additional labor demand through asylum immigration compared with men (but the gender difference is not statistically significant). While for males, employment gains are almost fully accounted for by reductions in unemployment, this is not the case for women. It is very likely that a substantial number of women entered the workforce from inactivity.

Table 7: IV Results by Sectors

Dependent Variable: Δ Employment/pop	Coefficient	(Standard Error)
Tradable sectors		
Agric., Mining, Energy, Water	0.015	(0.017)
Manufacturing	-0.155	(0.101)
Non-tradable sectors		
Scientific and Technical Serv.	0.137	(0.086)
Temporary Agency Work	0.099*	(0.056)
Education	0.086	(0.071)
Public Administration	0.083**	(0.036)
Information and Communication	0.075	(0.046)
Social Sector	0.044	(0.045)
Finance, Insurance, Real Estate	0.044*	(0.025)
Wholesale/Retail Trade	0.038	(0.061)
Other Personal Services	0.022	(0.027)
Construction	0.008	(0.021)
Human Health	-0.000	(0.027)
Accommodation and Food Services	-0.001	(0.018)
Other Commercial Services	-0.031	(0.043)
Transportation and Storage	-0.055	(0.047)

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

Notes: Standard errors are clustered at the level of districts and displayed in parentheses. All variables are expressed in yearly differences and normalized by population in working age. All regressions are weighted with the normalization variable. The coefficients shown are for asylum seekers without labor market access. All regressions are IV estimations including the barracks and quotas as instruments.

When distinguishing by educational levels, employment gains are roughly evenly distributed across skill-groups, i.e. workers with different occupational degrees. The effect is largest for the highly skilled, which probably has to do with new jobs created in public administration, while the effects for low-skilled employees likely contain more temporary agency workers. At the same time, the reductions in local unemployment are strongest among low skilled workers (with a statistically significant coefficient of about -0.15, corresponding to about 65% of the total unemployment effect).

The largest employment effects stem from German nationals indicating that native workers benefited overall from locally arriving refugees without labor market access in the short run. This result also stresses that the employment effects are by no means driven by refugees themselves taking up employment. Generally, foreigners who arrived at an earlier point of time are at

Table 8: IV Results by Population Subgroups

	(1) Δ Employment/pop		(2) Δ Unemployment/pop	
	Coefficient	(Standard error)	Coefficent	(Standard error)
		Total population		
Total employment	0.42**	(0.20)	-0.23***	(0.09)
		By gender		
Males	0.19	(0.12)	-0.14**	(0.05)
Females	0.23**	(0.09)	-0.09**	(0.04)
		By education		
No degree	0.12**	(0.05)	-0.15**	(0.07)
Vocational degree	0.13	(0.10)	-0.03	(0.04)
Academic degree	0.17**	(0.08)	-0.04***	(0.01)
		By nationality		
Germans	0.36**	(0.16)	-0.12**	(0.05)
Foreigners	0.06	(0.06)	-0.11**	(0.04)
Asylum countries	0.00	(0.01)		
		By age groups		
Age 15-25	0.11***	(0.04)	-0.03	(0.02)
Age 25-55	0.25*	(0.15)	-0.16**	(0.06)
Age 55-65	0.06*	(0.04)	-0.03	(0.02)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Standard errors are clustered at the level of districts and displayed in parentheses. All variables are expressed in yearly differences and normalized by population excluding asylum seekers in the base year 2013. All regressions are weighted with the normalizing variable. The coefficients shown are for asylum seekers without labor market access. All regressions are IV estimations including the barracks and quotas as instruments.

particular risk of being negatively affected by newly incoming foreigners (D'Amuri et al., 2010; Brücker et al., 2014). Yet, the results suggest that at least in the short run, immigrants from other countries than refugee-sending countries also benefit from additional employment growth and from large reductions in local unemployment. The strong reductions in local unemployment for low-skilled employees and for former non-refugee migrants are of great policy relevance, especially because these groups are particularly at risk when refugees enter the labor market themselves.[35]

[35] A likely explanation for the unemployment effects being larger than the ones on employment for this group is that the data used records only employment subject to social security contributions (SSC), and thus does not consider marginal employment. it is likely that many foreigners took on marginal employment, i.e. so-called minijobs, which shows up empirically in decreasing unemployment but not in increasing SSC employment.

Finally, additional employment growth is disproportionally high among workers younger than the age of 25, a population group that contains many new labor market entrants and students that work part-time during their studies. This group is particularly mobile and flexible. Large employment effects in combination with only small reductions in unemployment among young people suggests that the arrival of asylum seekers accelerated labor market entry among groups that are not (yet) strongly attached to the labor market. By contrast, the clearest effects on unemployment stem from persons in the main working age (25—55).

6.5 Persistence of Effects

So far, the analysis has focused on the contemporaneous effect during the same year in which asylum seekers arrive. We now turn to testing whether the effects persist in the medium term.

As pointed out in the theoretical framework in Section 3, we expect the strong and positive demand effects that we find during this initial period will be mitigated over time for three reasons. First, after asylum applications have been decided and refugees leave IRFs and other collective housing, they receive more cash instead of in-kind benefits and demand fewer locally produced non-tradable services, reducing the impact on local labor demand. Second, refugees will start working themselves, slowly phasing in a labor supply effect that increases over time. That has two implications: on the one hand, they tend to increase labor supply gradually and thus increasingly compete with the pre-existing labor force; on the other, the household income of the refugee population tends to increase with employment, which, in turn, reduces the demand effect. Third, the capital stock tends to adjust to demand and labor supply changes, which neutralizes the potential labor-market effects from the refugee influx. Next, therefore, we investigate the effects of newly arrived asylum seekers over longer periods.

For that purpose, we prolong the time horizon of the outcome variables so that they are measured as differences over two- or three-year windows, instead of one-year differences. Specifically, in the baseline estimates, the outcome was measured as $\Delta L_{d,t} = L_{d,t} - L_{d,t-1}$ (one-year window), which we now change to $\Delta L_{d,t} = L_{d,t+1} - L_{d,t-1}$ (two-year window) or $\Delta L_{d,t} = L_{d,t+2} - L_{d,t-1}$

(three-year window), respectively. This means that only the left-hand-side variable in equation (12) is modified, while the right-hand side and the first stage remain unchanged. Importantly, these estimates cannot be interpreted any more as pure demand effects, because asylum seekers gain labor market access and slowly start taking up employment.

Table 9: Effects over Longer Time Spans

Outcome	Δ Employment/pop			Δ Unemployment/pop
	All	Non-tradables	Tradables	
	(1)	(2)	(3)	(4)
Panel A: 1-year window (baseline)				
Δ AS /pop	0.42**	0.53***	-0.14	-0.23***
	(0.20)	(0.19)	(0.10)	(0.09)
Observations	2,639	2,639	2,639	2,639
Panel B: 2-year window				
Δ AS /pop	0.32*	0.41**	-0.12	-0.10
	(0.19)	(0.20)	(0.12)	(0.08)
Observations	2,639	2,639	2,639	2,639
Panel C: 3-year window				
Δ AS /pop	0.15	0.02	-0.09	-0.10
	(0.18)	(0.28)	(0.20)	(0.08)
Observations	2,639	2,639	2,639	2,639

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Standard errors are clustered on the level of districts and displayed in parentheses. The estimation is based on equation (12): All variables are normalized by population size excluding asylum seekers in base year 2013. All regressions are weighted with population excluding asylum seekers. The coefficients shown are for asylum seekers without labor market access. All regressions are IV estimations including the barracks and quotas as instruments.

The key result is that over the medium run, the employment effects of hosting refugees remain positive, but fade out and become insignificant over the three-year window (Table 9). The effects on unemployment dilute even faster. An explanation for this finding is provided by considering population subgroups (appendix Table B5). New jobs for low-skilled workers are particularly short lived, and these are most likely to be filled by the unemployed. Only high skilled employment gains are persistent, which might be because the kind of services that asylum seekers require change over time. While in the very short run, emergency accommodation was

the priority, over time, integration services that require skilled instructors like language training and integration courses become more important.

6.6 Robustness of Different Specifications

In this section we test the results for robustness to different specifications.

The results could be sensitive to the specification of the estimation equation with regard to different sets of fixed effects (appendix Table B6). The employment effects remain of the same magnitude but are slightly smaller (and not larger as one might expect). The effects on unemployment are substantially smaller than in our preferred specification and not statistically significant any more when leaving out state-specific time trends. The fact that unemployment effects depend strongly on the inclusion of the state-specific time trends can be interpreted as stemming from refugees being overrepresented in federal states with unfavorable unemployment trends, thus masking the positive (i.e., decreasing) effect on unemployment. We interpret these results as underlining the importance of including the full set of fixed effects.

The estimates could be confounded if the arrival of asylum seekers subject to an employment ban was correlated with a simultaneous increase of other immigrant groups, e.g. of asylum seekers allowed to work or of other foreigners. The results in Table B7 suggest that this was not the case since the IV estimates remain almost unchanged when we include additional immigrant groups as control variables. This supports the view that the (contemporaneous) results are indeed driven by those asylum seekers who are banned from working.

We estimate the model only for the period of the major refugee influx insofar as we study only the years 2015 and 2016. The effects that are displayed in column (2) of Table B8 are of similar magnitude to those in the baseline specification. We interpret this as an indication that our results stem from the period around the peak of the refugee inflow. This not only confirms our expectations concerning the timing of the effects; it also supports our argument that we have measured short-run effects from the recent immigration shock and that longer-run adjustments to previous migration exposure are unlikely to bias our estimates.

Robustness checks for a few further variations are displayed in Table B8. First, we check whether the effects are driven by a relatively small group of districts that host an IRF. Column (3) indicates that when dropping those districts with IRFs from the regressions, the instruments get weaker and the estimates lose their statistical significance, but remain large. We interpret this to indicate that reception facilities are an important source of variation but not the only driver of the results. Second, we have experimented with including and excluding more and fewer Federal States in the estimations. In column (4) we include Brandenburg, which is not part of the baseline study because it allocates refugees based on regional employment shares, which could violate the exclusion restriction. Column (5) excludes not only Brandenburg, but also Hesse, which uses foreigner shares in its distribution quotas. In both cases, the results change only marginally, supporting the robustness of the results.

Finally, we show that the results remain robust if we restrict the barracks instrument to those military bases that have been abandoned and put under the administration of the Federal Institute for Real Estate prior to 2010 (column 6). If any labor market adjustments to the withdrawal of troops have occurred in these districts, they are very likely to be concluded by the arrival of the asylum seekers in 2015. Again, the results remain very close to the baseline results and as such very robust.

7 Conclusions

This paper analyzes how the demand induced by immigration affects employment and wages on local labor markets. The large and unexpected inflow of refugees to Germany constitutes a natural experiment providing a unique opportunity for studying the demand effect. It does so for three reasons. First, asylum seekers were banned from working in the initial phase after arrival, which allows us to analyze the demand effects in isolation from labor supply effects. Second, refugees consume at near subsistence level and receive largely in-kind social benefits. The high share of necessities in private consumption (such as housing) together with the high expenditures of publicly provided services (such as administration, education, integration programs and security)

involve a demand shift towards labor-intensive non-tradable sectors. Third, the administrative dispersal of refugees together with a binding residence requirement allows the identification of a causal effect. Empirical identification is not straightforward as some endogeneous regional sorting remains due to a combination of overburdened authorities, the attrition of refugees, systematic measurement error and political lobbying. We solve this issue by exploiting exogenous variation that stems from the availability of vacant military bases and administrative allocation quotas. Both instruments are uncorrelated with labor market outcome variables as demonstrated by analyzing the trends prior to the refugee immigration surge. Form this, we argue that our identification strategy delivers causal estimates.

The theoretical framework predicts that the shift in the consumption structure and corresponding changes of goods and factor prizes will induce growing relative wages or employment since non-tradable sectors are intensive in domestic labor. These theoretical expectations are corroborated by our empirical findings. The empirical results show that the employment effects of the refugee influx in the initial phase after arrival, i.e. in the phase when the employment ban is effective, are substantial: a one percentage point increase in the local population through the immigration of asylum-seekers increases the employment rate by 0.42 percentage points in the short-run. Put differently, for every 2.4 asylum seekers hosted, one job is created in the respective district. Employment gains are fully driven by non-tradable sectors, especially in public administration and in temporary agency work, while the tradable sectors are unaffected. At the same time, unemployment is reduced substantially, making up about 55% of employment gains. The coefficients for individual wages have the expected positive signs but statistically are no different from zero. Finding labor demand effects from immigration on employment and unemployment rather than on wages is well in line with German labor market institutions which are characterized by high levels of collective bargaining coverage and wage rigidities. Our findings also demonstrate that the initial employment gains tend to get diluted in the medium term, i.e. two or three years after the refugee inflow, and most coefficients no longer appear statistically significant. This is also in line with our expectations from theory, since the rising labor supply

of the refugee population, the adjustment of capital stocks and the mitigation of demand-shift effects by rising income levels should neutralize positive demand effects in the medium term or longer.

The results presented here advance our understanding of how immigration affects host-country labor markets in three ways. First, we isolate a pure labor demand effect of immigration on the resident population, which is about half the size of the pure supply effects from immigration that have been found by Dustmann et al. (2017). We therefore argue that potential labor-demand effects need to be considered when studying the effect of immigration on labor markets. Otherwise, researchers might miss important mechanisms and potentially overrate resulting (negative) labor-market effects. Thus, this paper contributes to explaining why many studies find that migration has little to no effect on wages and employment.

Second, our theoretical framework illustrates the underlying mechanism according to which non-homothetic demand functions translate immigration into a demand shift towards non-tradables. The theoretical framework and empirical analysis indicate that the relative importance of such demand effects is particularly large (1) if short-run effects are studied and potential other adjustments to the labor market shock have not yet taken place, (2) if immigrants differ from natives in terms of their income and, hence, their consumption structure, and (3) if immigrants do not (immediately) take up employment after arrival. The latter scenario is highly relevant beyond refugee migration, such as when thinking about migration for family reunification or educational purposes. Condition (2) is expected to hold in a variety of migration settings because in many contexts the average household income, especially of recent arrivals, is well below that of the native population average. Hence, we argue that demand effects are relevant for many immigration settings.

Third, we contribute to the discussion about the local costs and benefits of hosting refugees. Our study emphasizes that during the first one to two years after arrival, the positive effects of hosting asylum seekers on local labor demand are substantial and can outweigh labor supply effects. Policy makers should take particular note that employment gains were strongest among

women, many of whom newly entered the labor force. Low-skilled individuals and foreigners benefited strongly from short-run decreases in unemployment. These two groups in particular are usually at highest risk from competition by new immigrants. However, these effects fade out after about two years.

Finally, we claim that the novel empirical identification approach provided in this paper is of particular relevance. Future research could build on this approach to study a wide range of labor market outcomes, integration dimensions, fiscal effects, etc. which are important to understand due to the historical size of the inflow of asylum seekers. Last but not least, the consumption patterns of immigrants in general and of refugees in particular are not yet well documented and understood, but they may have long-lasting effects on host economies.

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Appendix

A The Model

A.1 Demand

The indirect utility function in equation (1) of the main text belongs to the family of PIGL-preferences, for which the indirect utility function can be written in its most general form as

$$V(P,e) = \left[\frac{e}{b(P)}\right]^{\upsilon} \left[\frac{a(P)}{b(P)}\right]^{\upsilon},$$

where e is expenditure, P a vector of prices, $a(P)$ and $b(P)$ linear homogenous functions of the price vector, and $\upsilon > 0$ a parameter (Muellbauer, 1976). The specific form we apply in equation (1) of the main text has been proposed by Boppart (2014). This indirect utility function has only a closed form representation in the limiting case that $\epsilon = \gamma$. In this case the indirect utility function simplifies to $V(\cdot) = \ln \frac{e_h}{p_T} - \left(\frac{p_N}{p_T}\right)^{\gamma} + \frac{\beta}{\gamma}$ and we can write the direct utility function as

$$U^h(X_N, X_T) = \frac{1}{\epsilon} X_T^{\epsilon} \frac{\left(\frac{X_N}{\beta}\right)^{\frac{\epsilon}{1-\epsilon}} - \beta}{\left[\left(\frac{X_N}{\beta}\right)^{\frac{1}{1-\epsilon}} - X_N\right]^{\epsilon}} - \frac{1-\beta}{\epsilon},$$

which is *inter alia* used by Egger and Habermeyer (2022) and others. In our further analysis, however, we employ the more general form of the indirect utility function in equation (1) of the main text. This indirect utility function is only valid if and only if $e_h^{\epsilon} \geq \frac{1-\epsilon}{1-\gamma}\, \beta p_N^{\gamma} p_T^{\epsilon-\gamma}$ (Boppart, 2014), which we assume to hold.

We can derive the expenditure function e_h of household h by rewriting the indirect utility function ($V^h \equiv V(X_N, X_T, e_h)$) in equation (1) of the main text to

$$e(p_N, p_T, V^h) = \left[\epsilon \left[V^h + \frac{\beta}{\gamma}\left(\frac{p_N}{p_T}\right)^{\gamma} + \frac{1}{\epsilon} - \frac{\beta}{\gamma}\right]\right]^{\frac{1}{\epsilon}} p_T. \tag{A.1}$$

Differentiating the expenditure function with respect to prices delivers the Marshallian demand functions

$$X_N^h = \beta \left(\frac{e_h}{p_T}\right)^{1-\epsilon} \left(\frac{p_T}{p_N}\right)^{1-\gamma}, \qquad X_T^h = \left(\frac{e_h}{p_T}\right)^{1-\epsilon} \left[\left(\frac{e^h}{p_T}\right)^{\epsilon} - \beta \left(\frac{p_T}{p_N}\right)^{1-\gamma}\right]. \tag{A.2}$$

The Allen-Uzawa formula for the elasticity of substitution is given by $\sigma_D^h = \frac{\partial^2 e^h}{\partial p_T \partial p_N} \frac{e^h}{\partial e^h/\partial p_N \partial e^h/\partial p_T}$, where $\frac{\partial e_h}{\partial p_N}$ and $\frac{\partial e_h}{\partial p_T}$ are given by A.2 and

$$\frac{\partial^2 e^h}{\partial p_T \partial p_N} = \beta p_N^{-(1-\gamma)} p_T^{-\gamma} \left(\frac{e^h}{p_T}\right)^{1-2\epsilon} \left[\beta(1-\epsilon)\left(\frac{p_N}{p_T}\right)^{\gamma} - (1-\gamma)\left(\frac{e^h}{p_T}\right)^{\epsilon}\right].$$

Substituting these expressions into the Allen-Uzawa formula yields

$$\sigma_D^h = 1 - \gamma - (\gamma - \epsilon)\frac{\beta\left(\frac{p_N}{p_T}\right)^{\gamma}}{\left(\frac{e_h}{p_T}\right)^{\epsilon} - \beta\left(\frac{p_N}{p_T}\right)^{\gamma}}, \tag{A.3}$$

which is smaller than one if $\gamma > 0$ and declines if household income increases provided that $\gamma \geq \epsilon$.

The expenditure shares of the households can be written as

$$s_N^h = \beta\left(\frac{p_T}{e_h}\right)^{\epsilon}\left(\frac{p_N}{p_T}\right)^{\gamma}, \quad s_T^h = 1 - \beta\left(\frac{p_T}{e_h}\right)^{\epsilon}\left(\frac{p_N}{p_T}\right)^{\gamma}. \tag{A.4}$$

Thus, $\frac{\partial s_N}{\partial e_h} \leq 0$ and $\frac{\partial s_T}{\partial e_h} \geq 0$, i.e. the expenditure share of non-tradables tends to fall with increasing household income, i.e. the Engel-curves are non-linear.

Aggregating the expenditure shares delivers

$$s_N = \beta\left(\frac{E}{p_T H}\right)^{-\epsilon}\left(\frac{p_N}{p_T}\right)^{\gamma}\psi, \quad s_T = 1 - \beta\left(\frac{E}{p_T H}\right)^{-\epsilon}\left(\frac{p_N}{p_T}\right)^{\gamma}\psi, \tag{A.5}$$

where the aggregate consumption expenditures are defined as $E \equiv \int_0^H e_h dh$. Furthermore, the scale-invariant inverse inequality index ψ is defined as $\psi \equiv \int_0^H \left[\frac{e_h H}{E}\right]^{1-\epsilon} dh = \int_0^H \left[\frac{e_h}{\bar{e}}\right]^{1-\epsilon} dh$, where $\bar{e} \equiv E/H$ captures average household income. The inequality index ψ is defined over the interval [0 1] and declines if the inequality of income tends to increase when demand is non-homothetic, i.e. if $\epsilon > 0$.

This also determines the aggregate Marshallian demand functions, i.e.

$$X_N = \beta p_N^{-(1-\gamma)} p_T^{\epsilon-\gamma} E^{1-\epsilon} H^{\epsilon}\psi, \quad X_T = \frac{E}{p_T} - \beta p_N^{\gamma} p_T^{-(1-\epsilon+\gamma)} E^{1-\epsilon} H^{\epsilon}\psi. \tag{A.6}$$

From equations (A.4) and (A.5) we can derive the income level where the expenditure share of the individual household is equal to the aggregate expenditure share in the economy:

$$e_h = e^{RA} = \psi^{-\frac{1}{\epsilon}}.$$

This expenditure share is equal to the expenditure share of the representative agent in Muellbauer's sense. Using the income level of the representative agent we can derive the price elasticity of consumers as

$$\sigma_D = 1 - \gamma - (\gamma - \epsilon)\frac{\beta\left(\frac{p_N}{p_T}\right)^{\gamma}}{\left(\frac{\bar{e}\psi^{-1/\epsilon}}{p_T}\right)^{\epsilon} - \beta\left(\frac{p_N}{p_T}\right)^{\gamma}}. \tag{A.7}$$

The income elasticities of demand are given by

$$\frac{\partial x_N}{\partial \bar{e}}\frac{\bar{e}}{x_N} = 1 - \epsilon, \quad \frac{\partial x_T}{\partial \bar{e}}\frac{\bar{e}}{x_T} = 1 + \epsilon\,\frac{p_N}{p_T}\frac{x_N}{x_T}, \tag{A.8}$$

where we have written the average consumption per household as $x_N \equiv X_N/H$ and $x_T \equiv X_T/H$.

The elasticities of the average consumption of non-tradables and tradables with respect to income dispersion are

$$\frac{\partial x_N}{\partial \psi}\frac{\psi}{x_N} = 1, \qquad \frac{\partial x_T}{\partial \psi}\frac{\psi}{x_N} = -\frac{p_N\, x_N}{p_T\, x_T}. \tag{A.9}$$

The price elasticity of consumer demand in equation (A.7), the income elasticities of mean consumption per household in equation (A.8) and the elasticities with respect to income dispersion in equation (A.9) deliver the aggregate demand system in equation (2) of the main text.

A.2 Production

The production side of the economy is modeled in a standard framework with two goods; tradables and non-tradables; two sectors and two factors of production, labor and capital. Production technologies are characterized by constant returns to scale, and competition on goods and factor markets is perfect. This framework is rather standard in the literature and has been outlined *inter alia* by Rivera-Batiz (1982, 1983) and others. It builds on a general equilibrium framework originally developed by Jones (1965). We thus limit the presentation on the main assumptions and results here.

The state of technologies in our $2 \times 2 \times 2$ economy is characterized by the matrix of input coefficients

$$A = \begin{pmatrix} a_{LN} & a_{LT} \\ a_{KN} & a_{KT} \end{pmatrix}, \tag{A.10}$$

where the coefficients a_{ij} represent the amount of input i ($i = \tilde{L}, K$) used in the production of output j ($j = N, T$). We assume that $a_{LN} > a_{LT}$ and that $a_{KN} < a_{KT}$, i.e. that the non-tradable sector is labor-intensive, and rule out factor intensity reversal. Note that labor is always measured in efficiency units.

Given the assumptions on production technologies we can write the matrix of factor input shares for our $2 \times 2 \times 2$ economy as

$$\lambda = \begin{pmatrix} \lambda_{LN} & \lambda_{LT} \\ \lambda_{KN} & \lambda_{KT} \end{pmatrix}, \tag{A.11}$$

where λ_{ij} is defined as the share of the factor input i in sector j in the total factor input i, e.g. $\lambda_{LN} = a_{LN}\frac{X_N}{\tilde{L}} = \frac{\tilde{L}_N}{\tilde{L}}$. The determinant of this matrix is given by

$$|\lambda| = \lambda_{LN} - \lambda_{KN},$$

which is positive due to the assumption that the non-tradable sector is labor intensive.[36]

Analogously, we can write the matrix of factor income shares as

$$\theta = \begin{pmatrix} \theta_{LN} & \theta_{KN} \\ \theta_{LT} & \theta_{KT} \end{pmatrix}, \tag{A.12}$$

where θ_{ij} is defined as the income share of factor i in the value product of sector j, e.g.

[36] Note that $\lambda_{LN} + \lambda_{LT}$ and $\lambda_{KN} + \lambda_{KT}$ add up to unity, such that $|\lambda| = \lambda_{LN} - \lambda_{KN}$.

$\theta_{LN} = a_{LN}\frac{w}{p_N} = \frac{w\tilde{L}_N}{p_N X_N}$. The determinant from the matrix is given by

$$|\theta| = \theta_{LN} - \theta_{LT},$$

which is again positive since the non-tradable sector is labor intensive.

We start with the assumption that factor inputs in the economy equal total factor supplies. This assumption will be relaxed below in a setting with imperfect labor markets. This delivers for the factor inputs in each sector

$$a_{LN}X_N + a_{LT}X_T = \tilde{L}, \qquad a_{KN}X_N + a_{KT}X_T = K. \tag{A.13}$$

Furthermore, the condition that unit costs equal factor prices under perfect competition implies that

$$a_{LN}w + a_{KN}r = p_N, \qquad a_{LT}w + a_{KT}r = p_T. \tag{A.14}$$

Based on this notation outlined in equation (A.10) - (A.12) and the equilibrium conditions in equations (A.13) and (A.14) we can write the system in log changes as

$$\lambda_{LN}\ d\ln X_N + \lambda_{LT}\ d\ln X_T = d\ln \tilde{L} - (\lambda_{LN}\ d\ln a_{LN} + \lambda_{LT}\ d\ln a_{LT}), \tag{A.15.1}$$

$$\lambda_{KN}\ d\ln X_N + \lambda_{KT}\ d\ln X_T = d\ln K - (\lambda_{KN}\ d\ln a_{KN} + \lambda_{KT}\ d\ln a_{KT}), \tag{A.15.2}$$

$$\theta_{LN}\ d\ln w + \theta_{KN}\ d\ln r = d\ln p_N - (\theta_{LN}\ d\ln a_{LN} + \theta_{KN}\ d\ln a_{KN}), \tag{A.15.3}$$

$$\theta_{LT}\ d\ln w + \theta_{KT}\ d\ln r = d\ln p_T - (\theta_{LT} d\ln a_{LT} + \theta_{KT}\ d\ln a_{KT}), \tag{A.15.4}$$

(Jones 1965).

Using the zero-profit condition and dividing by prices we get

$$\theta_{LN}\ d\ln a_{LN} + \theta_{KN}\ d\ln a_{KN} = 0, \tag{A.16}$$

and

$$\theta_{LT}\ d\ln a_{LT} + \theta_{KT}\ d\ln a_{KT} = 0. \tag{A.17}$$

The response of the factor intensity in each industry to a change in factor endowments depends on the elasticity of substitution in each industry. This allows to write the ratio of changes in the factor intensity to the ratio of changes in factor prices in the non-tradable and tradable sector in terms of the elasticities

$$\sigma_N = \frac{d\ln a_{KN}}{d\ln a_{\tilde{L}N}}\frac{d\ln w}{d\ln r}, \tag{A.18}$$

and

$$\sigma_T = \frac{d\ln a_{KT}}{d\ln a_{\tilde{L}T}}\frac{d\ln w}{d\ln r}. \tag{A.19}$$

The last four equations can be used to solve for the changes of the factor intensities in each sector by substituting in pairs, which delivers

$$d\ln a_{Lj} = -\sigma_j\theta_{Kj}\,(d\ln w - d\ln r), \tag{A.20}$$

$$d\ln a_{Kj} = \sigma_j \theta_{\tilde{L}j} \left(d\ln w - d\ln r \right). \tag{A.21}$$

Substituting these expressions delivers for the system of log changes in equations (A.15.1) to (A.15.4)

$$\lambda_{LN}\ d\ln X_N + \lambda_{LT}\ d\ln X_T = d\ln \tilde{L} - \varepsilon_L \left(d\ln w - d\ln r \right), \tag{A.22.1}$$

$$\lambda_{KN}\ d\ln X_N + \lambda_{KT}\ d\ln X_T = d\ln K - \varepsilon_K \left(d\ln w - d\ln r \right), \tag{A.22.2}$$

$$\theta_{LN}\ d\ln w + \theta_{KN}\ d\ln r = d\ln p_N, \tag{A.22.3}$$

$$\theta_{LT}\ d\ln w + \theta_{KT}\ d\ln r = d\ln p_T, \tag{A.22.4}$$

where ε_L and ε_K are the elasticities of substitution weighted by the factor input and factor income shares, i.e.

$$\varepsilon_L = \sigma_N \lambda_{LN} \theta_{KN} + \sigma_T \lambda_{LT} \theta_{KT}$$

and

$$\varepsilon_K = \sigma_N \lambda_{KN} \theta_{LN} + \sigma_T \lambda_{KT} \theta_{LT}.$$

By subtracting equation (A.22.2) from (A.22.1) and noting that the determinant $|\lambda| = \lambda_{LN} - \lambda_{KN}$ and that $\lambda_{LT} = 1 - \lambda_{LN}$ and $\lambda_{KT} = 1 - \lambda_{KN}$ if factor markets clear, we receive for the supply function of the economy in log changes

$$d\ln\left(\frac{X_N}{X_T}\right) = \frac{1}{|\lambda|} d\ln\left(\frac{\tilde{L}}{K}\right) + \frac{\varepsilon_L - \varepsilon_K}{|\lambda|} d\ln\left(\frac{w}{r}\right). \tag{A.23}$$

Analogously, we can subtract equation (A.22.4) from (A.22.3) to obtain the relationship between factor prices and goods prices as

$$d\ln\left(\frac{w}{r}\right) = \frac{1}{|\theta|} d\ln\left(\frac{p_N}{p_T}\right), \tag{A.24}$$

where we have used the fact that $|\theta| = \theta_{LN} - \theta_{LT}$ and that $\theta_{KN} = 1 - \theta_{LN}$ and $\theta_{KT} = 1 - \theta_{LT}$ if profits are zero.

We can use this and rewrite the supply function in terms of relative prices on goods markets as

$$d\ln\left(\frac{X_N}{X_T}\right) = \frac{1}{|\lambda|} d\ln\left(\frac{\tilde{L}}{K}\right) + \sigma_S d\ln\left(\frac{p_N}{p_T}\right), \tag{A.25}$$

where the elasticity of substitution on the supply side is defined as $\sigma_S \equiv \frac{1}{|\lambda||\theta|}(\varepsilon_{\tilde{L}} + \varepsilon_K)$.

Finally, the overall equilibrium of the economy is determined by the mutual interaction of demand and supply on clearing goods markets. Thus, equating (A.25) with equation (2) of the main text delivers for relative prices of goods

$$d\ln\left(\frac{p_N}{p_T}\right) = -\frac{1}{|\lambda|(\sigma_S + \sigma_D)} d\ln\left(\frac{\tilde{L}}{K}\right) - \frac{\epsilon}{\theta_T(\sigma_S + \sigma_D)} d\ln \bar{e} + \frac{1}{\theta_T(\sigma_S + \sigma_D)} d\ln \psi. \tag{A.26}$$

Using the relationship between relative factor prices and relative goods prices from equation (A.24) and noting that the log change of the wage rate is given by $d\ln w = \frac{\theta_{KT}}{|\theta|} d\ln \frac{p_N}{p_T}$ we arrive

at the wage equation (4) in the main text from these equilibrium conditions in goods and factor markets.

A.3 Decomposition of the Wage Equation

The change of the labor-to-capital ratio in efficiency units can be written as

$$d\ln(\tilde{L}/K) = d\ln\tilde{\alpha} + d\ln(L/K). \tag{A.27}$$

Mean income is a function of the capital-labor-ratio, $k \equiv K/\tilde{L}$, and mean labor productivity, $\tilde{\alpha}$. We can therefore write mean income as

$$\bar{e} = \frac{w\tilde{L} + rK}{H} = \tilde{\alpha}\frac{L}{H}\left(w + rk\right).$$

Differentiating this totally and dividing by average income delivers

$$\begin{aligned} d\ln\bar{e} &= d\ln\tilde{\alpha} + d\ln L/H + \left[\theta_{\tilde{L}T}\frac{d\ln w}{d\ln k} + \theta_{KT}\left(1 + \frac{d\ln r}{d\ln k}\right)\right] d\ln k \\ &= (1-\theta_{KT})d\ln\tilde{\alpha} - \theta_{KT}d\ln L/K + d\ln L/H, \end{aligned} \tag{A.28}$$

where we have used the fact that $d\ln r = -\frac{\theta_{\tilde{L}T}}{\theta_{KT}}d\ln w$. Thus, migration can affect average income via changes of (i) the average productivity of the labor force, (ii) the labor-capital-ratio and (iii) the labor force participation rate of the population.

The decomposition of the inverse inequality index is more complex, since it depends on assumptions about the distribution of the capital stock and transfers. We simplify the analysis here by assuming that the capital stock and, hence, capital income, is a fixed proportion of all types of income. This relationship would emerge if the saving rate is a constant fraction of income, which is of course an arbitrary assumption though it simplifies matters here. Thus, the capital stock owned by household h is given by

$$K_h = \kappa\ w\ \tilde{L}_h,$$

where κ is a constant factor related to labor earnings. The total capital stock in the economy is thus given by $K = \kappa\ w\ \tilde{\alpha}\ L$.

The inverse inequality index is affected by non-employment and transfers. We assume here that the non-employed receive benefits which are a fraction of average income, i.e. $b \times \tilde{\alpha}(w + rk)$, and that the transfers to the non-employed are funded by a uniform tax rate τ on all sorts of income. This delivers for the tax rate

$$\tau = \frac{(1 - L/H)b}{L/H + (1 - L/H)b}, \quad 1 - \tau = \frac{L/H}{L/H + (1 - L/H)b}.$$

The inverse inequality index can be written in case of non-employment and transfers

$$\psi = \int_0^1 \left(\frac{e_h}{\bar{e}}\right)^{1-\epsilon} dh = \frac{1}{[L/H + (1 - L/H)b]^{1-\epsilon}}\left[\frac{L}{H}\psi_\alpha + \left(1 - \frac{L}{H}\right)b^{1-\epsilon}\right], \tag{A.29}$$

where $\psi_\alpha = \int_{\underline{\alpha}}^{\bar{\alpha}} \left(\frac{\alpha}{\bar{\alpha}}\right)^{1-\epsilon} d\alpha$ denotes the dispersion of labor productivity.

Differentiating this and assuming that the tax-transfer rate is constant delivers for the log change of the inverse inequality index

$$\begin{aligned} d\ln\psi = &\frac{L}{H}\frac{\psi_\alpha b - b^{1-\epsilon} + \epsilon(1-b)\left[\frac{L}{H}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}\right]}{\left[\frac{L}{H} + \left(1-\frac{L}{H}\right)b\right]\left[\frac{L}{H}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}\right]} d\ln\left(\frac{L}{H}\right) \\ &+ \frac{L}{H}\frac{\psi_\alpha}{\frac{L}{H}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}} d\ln\psi_\alpha. \end{aligned} \tag{A.30}$$

Note that the sign of the derivative with respect to the employment rate is ambiguous, since non-employment does not necessarily increase inequality. On the one hand, it increases inequality since the average income of the non-employed is below that of the employed. On the other hand, non-employment reduces it, since the dispersion of income among the non-employed who all receive the same benefits is zero. By contrast, the inverse inequality index of labor productivity unambiguously increases the inverse earnings inequality index.

Substituting the expressions from equations (A.27), (A.28) and (A.30) into equation (4) delivers, after some rearranging for the wage equation,

$$\begin{aligned} \frac{d\ln w}{d\ln M} = &-\frac{1}{\sigma}\left[1 - \epsilon\frac{|\lambda|}{\theta_T}\theta_{KT}\right]\frac{d\ln L/K}{d\ln M} - \frac{1}{\sigma}\left[1 + \epsilon\frac{|\lambda|}{\theta_T}(1-\theta_{KT)}\right]\frac{d\ln\tilde{\alpha}}{d\ln L}\frac{d\ln L}{d\ln M} \\ &- \frac{1}{\sigma}\left[\frac{|\lambda|}{\theta_T}(\epsilon-\omega)\right]\frac{d\ln L/H}{d\ln M} + \frac{1}{\sigma}\frac{|\lambda|}{\theta_T}\frac{L}{H}\frac{\psi_\alpha}{\frac{L}{H}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}}\frac{d\ln\psi_\alpha}{d\ln L}\frac{d\ln L}{d\ln M}, \end{aligned} \tag{A.31}$$

where the short-cut $\omega = \frac{L}{H}\frac{\psi_\alpha b - b^{1-\epsilon} + \epsilon(1-b)\left[\frac{L}{H}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}\right]}{\left[\frac{L}{H} + \left(1-\frac{L}{H}\right)b\right]\left[\frac{L}{H}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}\right]}$. Note that

$$\epsilon - \omega = \frac{\frac{L}{H}\left[b^{1-\epsilon} - \psi_\alpha b\right] + \epsilon b\left[\frac{L}{H}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}\right]}{\left[\frac{L}{h} + \left(1-\frac{L}{H}\right)b\right]\left[\frac{L}{h}\psi_\alpha + \left(1-\frac{L}{H}\right)b^{1-\epsilon}\right]} \geq 0.$$

The term $\epsilon - \omega = 0$ if $\epsilon = 0$ or if $b = 0$ and $\epsilon - \omega > 0$ if $\epsilon > 0$ and if $b > 0$.

Thus, we can conclude (i) that an increase in the labor-capital-ratio reduces the wage, but this effect is mitigated by the factor $\epsilon\frac{|\lambda|}{\theta_T}\theta_{KT}$ due to the demand shift towards labor-intensive production if mean income falls; (ii) that an increase in labor productivity unambiguously reduces the wage in terms of efficiency units of labor since this reduces the capital-labor-ratio in efficiency units and the higher average income involves a demand shift towards capital-intensive goods; (iii) that an increased labor-force participation rate reduces the wage for the same reasons; and (iv) that a higher equality in the distribution of labor productivity raises the wage level since this involves a higher share of labor intensive goods in consumption. Note that the demand-shift effects of migration are particularly large if the average labor productivity and the labor force participation rate falls and the tax-benefit system ensures a high level of income equality.

In the limiting case of an employment ban of the migrant population, equation (A.30) is

reduced to

$$\frac{d\ln w}{d\ln M} = \frac{1}{\sigma}\left[\frac{|\lambda|}{\theta_T}(\epsilon-\omega)\right]\frac{d\ln H}{d\ln M},$$

which corresponds to equation (5) in the main text. Since in this case immigrants do not affect the capital-labor-ratio, average labor productivity and the dispersion of labor productivity of the employed workforce, only the demand effect of an increasing population remains. The expression on the right-hand side is positive if $\epsilon > 0$ and $b > 0$ if $\epsilon - \omega > 0$.

A.4 Employment Impact under Imperfect Labor Markets

According to the wage-setting approach outlined in the main text, wages decline with the unemployment rate, albeit imperfectly, such that the wage-setting function is given by $\phi(u)$ with $\phi' \leq 0$. Moreover, the main text distinguishes for analytical purposes between the non-participation in the labor force, which might be forced by an employment ban, and the unemployment rate as an outcome of an imperfect adjustment of wages to labor supply changes. Given the definition for the unemployment rate, $u \equiv 1 - \frac{L}{\bar{L}}$, where $\bar{L}$ is the total labor supply of households, the employment rate of the economy in terms of the labor force is given by $\frac{L}{\bar{L}}$ and in terms of the total population by $(1-u)\frac{\bar{L}}{H} = \frac{L}{H}$. Moreover, unemployment benefits are paid to both unemployed persons and non-participants in the labor force. Under these assumptions the expressions for $\bar{e}$ and ψ as well as for their log changes in equations (A.28) and (A.30) remain the same.

We can therefore rewrite the system as the implicit function

$$\Omega(L,M) = Y_L\left(\tilde{L}(L), \bar{e}(L,H(M),\psi(L,H(M),\right) - \phi\left(u(L,\bar{L}(H(M))\right) = 0, \tag{A.32}$$

where we have ruled out the adjustment of the capital stock, i.e. considered the short-term case. Differentiating this for the log change in employment with respect to a log change in the number of households through migration delivers

$$\begin{aligned}\frac{d\ln L}{d\ln M} = &\left[\frac{d\ln Y_L}{d\ln \tilde{L}}\frac{d\ln \tilde{L}}{d\ln L} + \frac{d\ln Y_L}{d\ln \bar{e}}\frac{d\ln \bar{e}}{d\ln L} + \frac{d\ln Y_L}{d\ln \psi}\frac{d\ln \psi}{d\ln L} - \frac{d\ln \phi}{d\ln u}\frac{d\ln u}{d\ln L}\right]^{-1} \times \\ &\left[\frac{d\ln \phi}{d\ln u}\frac{d\ln u}{d\ln \bar{L}}\frac{d\ln \bar{L}}{d\ln H} - \frac{d\ln Y_L}{d\ln \bar{e}}\frac{d\ln \bar{e}}{d\ln H} - \frac{d\ln Y_L}{d\ln \psi}\frac{d\ln \psi}{d\ln H}\right]\frac{d\ln H}{d\ln M}.\end{aligned} \tag{A.33}$$

Substituting for the derivatives of Y_L with respect to the effective labor supply, $\tilde{L}$, mean income, $\bar{e}$ and the inverse inequality index, ψ, delivers equation (6) in the main text. Using the decomposition of $d\ln \tilde{L}$, $d\ln \bar{e}$ and $d\ln \psi$ in equations (A.27), (A.28) and (A.30) yields after some rearranging equation (7) in the main text.

B Additional Material

B.1 Labor Intensity of Tradable and Non-Tradable Sectors

Table B1: Labor Intensity Indicators of Tradable and Non-Tradable Industries in Germany, 2021

	Value added per worker in EUROs	Capital stock per worker in EUROs	Ratio wage sum to value added in %
Tradable industries[1]	**94,170**	**410,366**	**58**
Of these:			
Agriculture, forestry, fishing	54,619	692,180	27
Producing industries w/o construction	96,916	390,814	60
Non-tradable industries[2]	**58,631**	**302,023**	**68**
Of these:			
Construction	68,601	52,615	54
Trade, transport, restaurants & hotels	52,183	170,606	63
Information & communication	113,912	264,939	63
Finance	113,305	363,219	61
Business services	61,445	176,957	63
Public sector, education, health	53,652	307,821	82
Other services	38,430	174,349	63
Total	**80,074**	**319,663**	**59**

Notes: 1) Agriculture, forestry, fishing and all producing industries w/o construction. – 2) Construction and all service industries w/o real estate. The real estate sector is generally excluded since it covers large parts of the housing stock.

Source: Statistisches Bundesamt (2022); the aggregation and calculations are our own.

B.2 Institutional Details of the Dispersal Policy

B.2.1 Assignment Quotas

In Germany, the regional distribution of asylum seekers takes place in two steps: across federal states and within federal states to districts. After arriving the border, asylum seekers are first assigned to a federal state by the so-called "EASY" registration system, an algorithm that distributes applicants in real time.[37] Then, within each state, asylum seekers are immediately sent to an initial reception facility ("IRF", based on nationality, capacity, and distance) where they submit their asylum application. If their asylum claim is accepted, which can take several weeks or months, or if they have good prospects of being allowed to stay in Germany, asylum seekers are in a second step allocated within state across districts. The within-state distribution quotas differ between states: while all states assign quotas based on population size, several states also use additional characteristics to calculate their quotas (see Table B2 for details). Notwithstanding, quotas differ across states and over time due to different base years (for the population numbers)[38] and different deduction rules (e.g. for districts with an IRF).

Table B2: Assignment Rules by Federal State

Federal state	Criteria included in allocation key	Population data from
Baden-Württemberg	Population	Previous year
Bavaria	Population & Urban indicator	2006 (until 2016)
Berlin	*Not applicable bc. city state*	
Brandenburg	Population & Area & Share soc. sec. employees*	Previous year
Bremen	*Not applicable bc. city state*	
Hamburg	*Not applicable bc. city state*	
Hesse	Population & Large share of foreigners indicator	Previous year 30.06.
Mecklenburg-West Pomerania	Population	Previous year 31.12.
Lower Saxony	Population	Unspecified
North Rhine-Westphalia	Population & Area	Unspecified
Rhineland Palatinate	Population	Two years ago 31.12.
Saarland	Population	Considers deviations
Saxony	Population	Previous year 30.06.
Saxony-Anhalt	Population	Half-yearly 15.01. & 15.07.
Schleswig-Holstein	Population	Previous year 30.03.
Thuringia	Population	Unspecified

Source: Own collection of federal state legislations.

* Brandenburg is excluded from the main regressions due to the inclusion of potentially endogenous criteria in the quota.

B.2.2 Initial Reception Facilities (IRF)

The federal states are obliged by federal law (§44(1) AsylG) to grant all incoming refugees a place in an initial reception facility run by the federal state. Prior to 2015, most federal states had

[37] The regional distribution is based on the population share and tax revenue of the states, i.e. the so-called "Königssteiner" key. Our state × time fixed effects absorb any variation that stems from this first distribution step.

[38] Some federal states update their quotas every year.

only one initial reception facility ("Erstaufnahmeeinrichtungen"), but during the large inflow in 2015, new ones were opened quickly. The choice of location for new initial reception facilities was made under pressure and governed by the availability of large unused buildings or facilities that could accommodate a large number of refugees, often unused military facilities. These include Ellwangen, Sigmaringen, Mannheim and Schwetzingen in Baden-Württemberg. Oldenburg in Lower-Saxony was a former military hospital.

Legally, asylum seekers can be obliged to stay in a reception facility while their asylum requests are filed and processed for up to 18 months for adults or up to 6 months for families with minors.[39] In practice however, the time asylum seekers spend in reception centers varies strongly, and in many cases asylum seekers had to leave the reception centers before a decision had been made on their cases or even before they were able to submit their application in order to free scarce capacities for new arrivals. In Lower Saxony, the state government decided to try to accommodate refugees longer in initial reception facilities to provide the districts with time to prepare for the large amount of refugees for which they are responsible. To do this, the capacities in initial reception facilities changed by a factor of 18 (Oct. 2015 relative to the the first half year of 2015; see Gedaschko et al., 2016).

B.3 Potential Endogeneity Issues in the Regional Allocation of Refugees

Deviations from the dispersal policy have likely occurred for four reasons. On one the hand, local authorities were overwhelmed by the sheer number of arrivals and had to take pragmatic decisions to avoid homelessness and sent new incomers to any places where housing was still available. This led at least in the short run to disproportionally more asylum seekers being assigned to areas with large vacant premises and cheap rents.[40] Table 1 supports this argument in our datasets and shows that these were regions with high unemployment rates and predominantly rural regions. In addition, a substantial share of asylum seekers did not arrive at the places they originally had been assigned to (for instance because they preferred to continue their journey and apply for asylum at another place).[41] This attrition is another risk of endogenous location choice. Third, some cities lobbied for hosting more refugees than stipulated, such as Cottbus, Goslar and Hettstedt, while others aimed at hosting fewer refugees, e.g. Göttingen.[42] Finally, there is likely a non-random measurement error in the central registry of foreigners data set ("Ausländerzentralregister", AZR). It is documented that in late 2015, the total number of asylum seekers was systematically under-reported[43] because local authorities worked at their limits at the time and had other priorities than reporting numbers to the register. In order to account for these four issues, we argue that the use of instrumental variables for consistent causal estimates of the regional effects of the recent refugee immigration in Germany is inevitable.

[39] §47(1) AsylG
[40] See, for instance, Brücker et al., 2020.
[41] Some authorities we talked to mention attrition rates of about 20%.
[42] Weblinks last retrieved 13.9.2022.
[43] See Statistisches Bundesamt (2020a, p.11), and Statistisches Bundesamt (2020b, p.15).

Table B3: Federal Budget on Refugees, Different Categories (in euro billions)

	2016	2017	2018
Registration and accommodation during procedure	1.14	1.02	1.02
Integration efforts	1.80	3.11	3.72
Social transfers after procedure	1.71	2.68	3.29
Transfers to states and municipalities	9.26	6.78	6.81
Sum	**13.91**	**13.59**	**14.84**

Source: Deutscher Bundestag (2017, Table 6, p. 36)

B.4 Cost Refund for Asylum Seeker Expenses

While the costs for the asylum procedures are directly covered by the federal government, expenses for the accommodation of refugees are first borne by the district (or community) and then refunded by the federal state. This way, local expenditures on asylum seekers do not depend on the financial conditions of local authorities. Policy makers frequently emphasized that the additional spending on the integration of refugees (Table B3) could be covered by an unexpected surplus of the federal government budget so that neither did expenditures in other sectors have to be cut nor did debts have to be taken up as a response to the arrival of asylum seekers.[44] Social benefit expenditures for asylum seekers accrue *per capita* and therefore depend directly on the number of asylum seekers in a district.[45]

The refunding of costs is implemented by means of a lump sum (or flat rate), a reimbursement or a combination of both. Comparisons across federal states are complicated by the fact that different types of costs are considered and the administrative details vary (Wendel, 2014). In federal states with a lump sum, the level per asylum applicant per year varied in 2014 from nearly 6,000 euros (in Rhineland-Palatinate and Lower Saxony) to about 9,000 euros (in Brandenburg; ibid., p. 26 f.). This money is meant to cover the district costs for housing, other infrastructure and support and social benefits for asylum seekers. Additional transfers from the federal government can support districts in caring for unaccompanied minors, creating new child care facilities and in the construction of new housing (Bundesregierung, 2017).[46]

B.5 Data Appendix

This appendix provides further details on the data. Our empirical analysis is on the district level. A few of the 401 German districts share a common immigration authority and therefore do not report the number of residing foreigners separately. In this case we have merged several districts

[44] In fact, there were plans to use unexpected surplus to repay government debt.

[45] State policies also differ with respect to how much of the benefits is paid in cash or in kind. In particular, there is a large variation between states in the share of asylum seekers living in decentralized apartments and that receive almost exclusively cash payments. In 2013, they ranged from 34% in Baden-Württemberg up to 90% in Rhineland-Palatinate.

[46] While data on cost recovery are hard to obtain, the example of the federal state of Thuringia for the year 2012 shows a substantial variation across districts with cost recovery varying by district between 46% and 104% (ibid., p. 30f.)

for our analysis. This is the case for (1) the entire state of the Saarland; (2) Stadt and Landkreis Kassel; (3) Stadt Cottbus and Spree-Neiße Kreis; and (4) Lankreis Göttingen and Landkreis Osterrode im Harz. In addition we dropped the state of Brandenburg from our analysis because it distributes asylum seekers based on regional employment. These restrictions leave us with data on 377 districts.

From the AZR data set, we include the following residence status levels for asylum seekers: (1) Foreign nationals who expressed their wish to seek asylum at the border but have not yet formally filed an asylum application (*"Asylgesuch gestellt"*); (2) Foreigners whose asylum application is still processed (*"Aufenthaltsgestattung"*); (3) Refugees who have a residence permit because their asylum application has been (at least temporarily) accepted (*"Aufenthaltserlaubnis aus völkerrechtlichen, humanitären oder politischen Gründen"*); (4) Foreign nationals whose asylum application has been rejected but who are tolerated in Germany because they cannot be deported (*"Duldung"*); and (5) Foreign nationals without any formal residence status if they possess the nationality of one of the eight most frequent asylum seeker countries of origin (Afghanistan, Eritrea, Iraq, Iran, Nigeria, Pakistan, Somalia, Syria).

C Additional Tables

C.1 Descriptive Statistics

Table B1: Characteristics of Economic Sectors

Sector	Employment	Annual growth (%)
Tradable sectors		
Agriculture, Mining, Energy, Water	781,839	-2.67
Manufacturing	6,472,069	0.89
Non-tradable sectors		
Construction	1,693,763	1.953
Wholesale/Retail Trade	4,170,470	1.57
Transportation and Storage	1,551,716	3.27
Accomodation and Food Services	938,367	4.20
Information and Communication	924,838	3.54
Finance, Insurance, Real Estate	1,226,697	0.09
Scientific and Technical Services	1,925,461	3.55
Other Commercial Services	1,233,937	4.82
Temporary Agency Work	791,861	3.99
Public Administration	1,700,185	1.14
Education	1,156,119	2.54
Human Health	2,251,308	2.02
Social Sector	2,001,573	4.31
Other Personal Services	1,120,917	1.25
Total Employment	**29,941,120**	**2.07**

Note: Column 3 shows total number of people employed subject to social security contributions in June 2014. Annual employment growth is averaged over the years 2014—2016.

Table B2: Balancing Table: Districts with and without Vacant Military Bases

	Military base mean	No military base mean	Difference b	t
Population	265,244	195,473	69,772*	(1.80)
Urban region (%)	56.43	46.68	9.75	(0.94)
AS without lm access /1000pop	0.71	0.65	0.06	(0.40)
AS with lm access /1000pop	4.90	4.46	0.44	(0.64)
Percentage foreign employment	8.14	7.56	0.58	(0.57)
Percentage high-skilled empl.	13.43	12.15	1.28	(0.72)
Percentage empl. in non-trad. sect.	75.72	73.98	1.74	(0.95)
Unemployment rate	6.76	6.85	-0.09	(-0.16)
Δ Emp/1000pop (All sectors)	4.99	4.37	0.62	(0.66)
Δ Emp/1000pop (Non-tradables)	4.66	4.05	0.60	(0.72)
Δ Emp/1000pop (Tradables)	0.15	0.28	-0.13	(-0.99)
Δ Emp/1000pop (Foreigners)	0.002	0.002	0.0002	(0.45)
Δ Emp/1000pop (High skilled)	0.004	0.003	0.0005	(0.56)
Δ Unemp/1000pop (Total)	0.62	0.42	0.19	(0.71)
Observations	69	308	377	

Notes: The distinction is whether a district has a vacant military base available. The covariates are measured in 2013h2. All variables are weighted by population in working age. Robust T-statistics are in parentheses (* p<0.1, ** p<0.05, *** p<0.01)

C.2 Further Results and Robustness Checks

Table B3: Baseline Results (Different Instrument Combinations)

	IV (1)	IV (2)	IV (3)
Outcome: Δ Total employment/pop			
Δ AS /pop	0.63*	0.34*	0.42**
	(0.35)	(0.20)	(0.20)
Observations	2,639	2,639	2,639
Outcome: Δ Employment non-tradable/pop sectors			
Δ AS /pop	1.00**	0.35*	0.53***
	(0.44)	(0.20)	(0.19)
Observations	2,639	2,639	2,639
Outcome: Δ Employment tradable sectors/pop			
Δ AS /pop	-0.38	-0.05	-0.14
	(0.30)	(0.08)	(0.10)
Observations	2,639	2,639	2,639
Outcome: Δ Unemployment/pop			
Δ AS /pop	-0.34*	-0.19*	-0.23***
	(0.19)	(0.10)	(0.09)
Observations	2,639	2,639	2,639
Time × state FE	Yes	Yes	Yes
District FE	Yes	Yes	Yes
IV 1: Barracks	×		×
IV 2: Quota assignments		×	×
Effective F-stat	5.93	14.1	10.01
Crit. value 5% bias	*37.42*	*37.42*	*8.56*
Crit. value 20% bias	*15.06*	*15.06*	*4.75*

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Standard errors are clustered at the level of districts and displayed in parentheses. All variables are expressed in yearly differences and normalized by population excluding refugees in the base year 2013. All regressions are weighted with working-age population. The coefficients shown are for asylum seekers without labor market access.

Table B4: Effects on Commuter Flows

	(1) Inflows	(2) Outflows	(3) Netflows
Δ AS/pop	0.12	-0.0004	0.12
	(0.08)	(0.06)	(0.10)
Time × State FE	Yes	Yes	Yes
District FE	Yes	Yes	Yes
Observations	2,639	2,639	2,639

Standard errors in parentheses

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

Notes: Standard errors are clustered on the level of districts and displayed in parentheses. Refugee inflow is expressed in yearly differences and normalized by population excluding refugees in the base year 2013. All regressions are weighted with the normalizing variable. The coefficients shown are for asylum seekers without labor market access. All regressions are IV estimations including the quotas and barracks as instruments. The commuter numbers are only available on a yearly basis (30 June of each year) and are linearly interpolated for the December data points.

Table B5: Medium-Run Effects by Population Subgroups

	Employment Time window			Unemployment Time window		
	1 year (1)	2 years (2)	3 years (3)	1 year (4)	2 years (5)	3 years (6)
			Total population			
Total	0.42**	0.32*	0.15	-0.23***	-0.10	-0.10
	(0.20)	(0.19)	(0.18)	(0.09)	(0.08)	(0.08)
			By gender			
Male	0.19	0.20	-0.03	-0.14**	-0.06	-0.03
	(0.12)	(0.13)	(0.13)	(0.05)	(0.05)	(0.05)
Female	0.23**	0.13*	0.00	-0.09**	-0.04	-0.07*
	(0.09)	(0.07)	(0.09)	(0.04)	(0.04)	(0.04)
			By education			
No degree	0.12**	0.03	-0.01	-0.15**	-0.06	-0.02
	(0.05)	(0.06)	(0.06)	(0.07)	(0.06)	(0.05)
Vocational degree	0.13	0.06	-0.22**	-0.03	0.03	0.01
	(0.10)	(0.09)	(0.10)	(0.04)	(0.04)	(0.03)
Academic degree	0.17**	0.21**	0.23**	-0.04***	-0.02	-0.02**
	(0.08)	(0.10)	(0.11)	(0.01)	(0.01)	(0.01)
			By nationality			
Germans	0.36**	0.26*	0.16	-0.12**	-0.04	-0.05
	(0.16)	(0.16)	(0.17)	(0.05)	(0.05)	(0.05)
Foreigners	0.06	0.06	-0.02	-0.11**	-0.06	-0.05
	(0.06)	(0.06)	(0.06)	(0.04)	(0.04)	(0.04)
Asylum countries	0.00	0.03	0.05**			
	(0.01)	(0.02)	(0.02)			

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Standard errors are clustered at the level of districts and displayed in parentheses. All variables are normalized by population excluding refugees. All regressions are weighted with the normalizing variable. The coefficients shown are for asylum seekers without labor market access. All regressions are IV estimations including the quotas and barracks as instruments.

Table B6: Main Results with Different Sets of Fixed Effects

	(1)	(2)	(3)
Outcome: Δ Total employment/pop			
Δ AS /pop	0.42**	0.25***	0.33**
	(0.20)	(0.08)	(0.14)
Observations	2,639	2,639	2,639
Outcome: Δ Employment non-tradable sectors/pop			
Δ AS /pop	0.53***	0.21**	0.29**
	(0.19)	(0.09)	(0.14)
Observations	2,639	2,639	2,639
Outcome: Δ Employment tradable sectors/pop			
Δ AS /pop	-0.14	0.01	-0.01
	(0.10)	(0.06)	(0.06)
Observations	2,639	2,639	2,639
Outcome: Δ Unemployment/pop			
Δ AS /pop	-0.23***	0.04	0.06
	(0.09)	(0.04)	(0.04)
Observations	2,639	2,639	2,639
Observations	2,639	2,639	2,639
Effective F-stat	10.01	45.56	49.61
Crit. value 5% bias	*8.56*	*25.93*	*26.63*
Crit. value 20% bias	*4.75*	*10.94*	*11.2*
District FE	Yes	Yes	No
Time × state FE	Yes	No	No

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Standard errors are clustered at the level of districts and displayed in parentheses. The estimation is based on equation (12): All variables are expressed in yearly differences and normalized by population size excluding asylum seekers in the base year 2013. All regressions are weighted with the normalizing variable. The coefficients shown are for asylum seekers without labor market access. All regressions are IV estimations including the barracks and quotas as instruments.

Table B7: Controlling for Other Immigrant Groups

	(1)	(2)
Outcome: Δ Total employment/pop		
Δ AS without lm access /pop	0.42**	0.44**
	(0.20)	(0.20)
Δ AS with lm access		0.12
		(0.08)
Δ Foreigners excl. AS/pop		0.06**
		(0.03)
Observations	2,639	2,639
Outcome: Δ Employment non-tradable sectors/pop		
Δ AS without lm access /pop	0.53***	0.57***
	(0.19)	(0.20)
Δ AS with lm access		0.22**
		(0.09)
Δ Foreigners excl. AS/pop		0.06**
		(0.03)
Observations	2,639	2,639
Outcome: Δ Employment tradable sectors/pop		
Δ AS without lm access /pop	-0.14	-0.16
	(0.10)	(0.10)
Δ AS with lm access		-0.10*
		(0.05)
Δ Foreigners excl. AS/pop		-0.00
		(0.01)
Observations	2,639	2,639
Outcome: Δ Unemployment/pop		
Δ AS without lm access /pop	-0.23***	-0.23***
	(0.09)	(0.09)
Δ AS with lm access		-0.02
		(0.03)
Δ Foreigners excl. AS/pop		-0.00
		(0.01)
Observations	2,639	2,639
Effective F-stat	10.01	9.54
Crit. value 5% bias	*8.56*	*8.65*
Crit. value 20% bias	*4.75*	*4.79*
Time × state FE	×	×
District FE	×	×

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Standard errors are clustered at the level of districts and displayed in parentheses. All variables are expressed in yearly differences and normalized by population excluding refugees in the base year 2013. All regressions are weighted with the normalization variable. The coefficients shown are for asylum seekers without labor market access. All regressions are IV estimations including the barracks and quotas as instruments.

Table B8: Robustness Checks

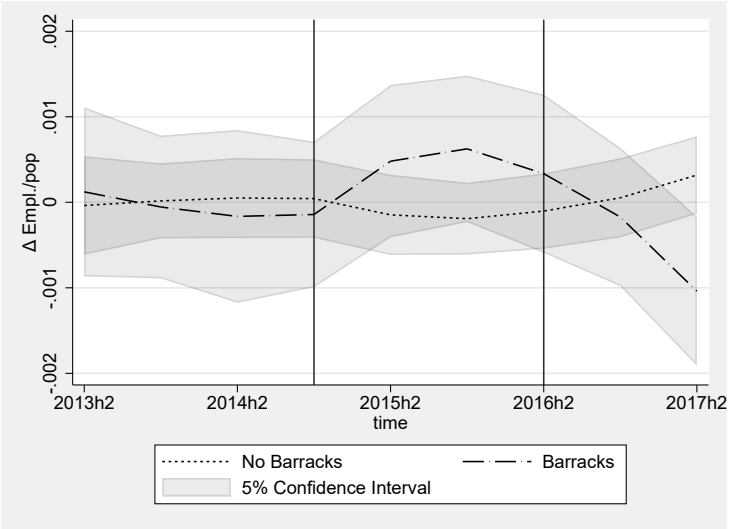
	(1) Baseline	(2) Excl. 2017	(3) No IRFs	(4) incl. BB	(5) excl. BB+HE	(6) altern. IV
Outcome: Δ Total employment/pop						
Δ AS /pop	0.42**	0.37*	0.54	0.38*	0.44**	0.39*
	(0.20)	(0.20)	(0.51)	(0.19)	(0.22)	(0.21)
Observations	2,639	1,885	2,328	2,758	2,443	2,639
Outcome: Δ Employment non-tradable sectors/pop						
Δ AS /pop	0.53***	0.43**	0.94	0.48**	0.56**	0.43**
	(0.19)	(0.19)	(0.58)	(0.19)	(0.22)	(0.21)
Observations	2,639	1,885	2,328	2,758	2,443	2,639
Outcome: Δ Employment tradable sectors/pop						
Δ AS /pop	-0.14	-0.09	-0.41	-0.13	-0.15	-0.07
	(0.10)	(0.09)	(0.28)	(0.09)	(0.10)	(0.09)
Observations	2,639	1,885	2,328	2,758	2,443	2,639
Outcome: Δ Unemployment/pop						
Δ AS /pop	-0.23***	-0.24***	-0.55	-0.23***	-0.25**	-0.22**
	(0.09)	(0.09)	(0.41)	(0.08)	(0.10)	(0.09)
Observations	2,639	1,885	2,328	2,758	2,464	2,639
Including Year 2017	×		×	×	×	×
Including IRFs	×	×		×	×	×
Including Brandenburg				×		
Including Hesse	×	×	×	×		×
IV: Quota-assignment	×	×	×	×	×	×
IV: Vacant milit. bases	×	×	×	×	×	
IV: Bases vacant > 5 years						×
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Time × state FE	Yes	Yes	Yes	Yes	Yes	Yes
Effective F-stat	10.01	11.49	13.68	10.79	8.23	10.22
Crit. value 5% bias	*8.56*	*19.58*	*29.39*	*9.06*	*7.61*	*19.79*
Crit. value 20% bias	*4.75*	*8.67*	*12.18*	*4.93*	*4.42*	*8.72*

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Standard errors are clustered at the level of districts and displayed in parentheses. The estimation is based on equation (12). All variables are expressed in yearly differences and normalized by population excluding asylum seekers in the base year 2013. All regressions are weighted with with the normalizing variable. The coefficients shown are for asylum seekers without labor market access.

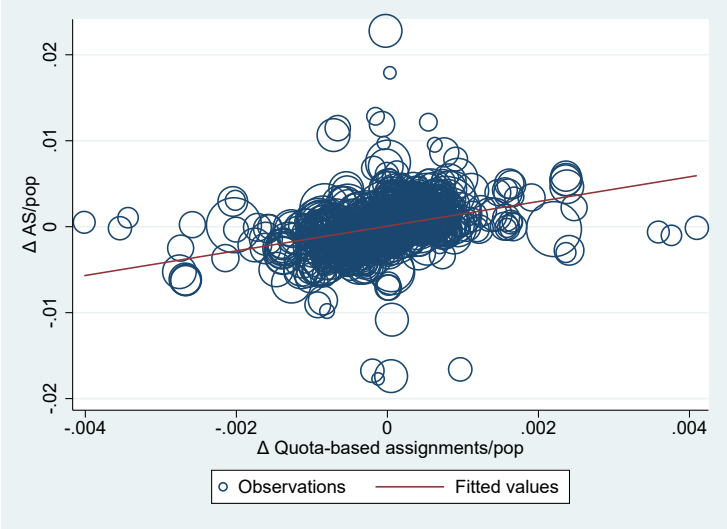
D Additional Figures

Figure B1: Labor Market Trends in Districts with and without Vacant Military Bases



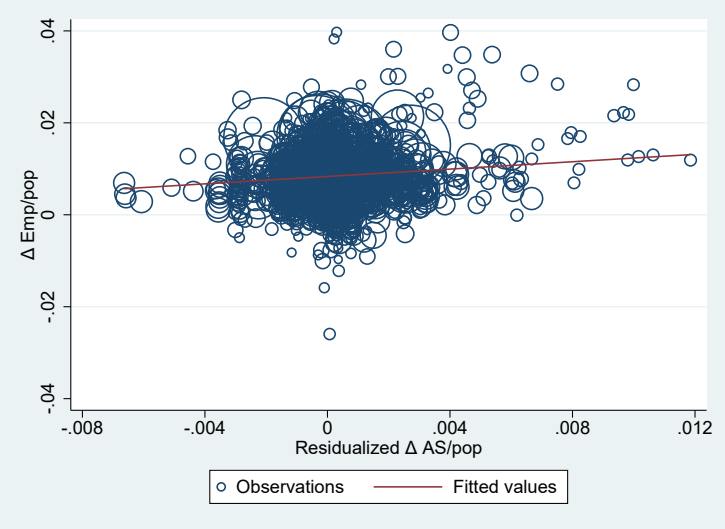
Note: The labor market outcomes are measured in yearly differences and normalized by population excluding refugees in the baseyear 2013. District and time x state fixed effects are controlled for.

Figure B2: Scatter Plot: First Stage



Notes: Both variables are normalized with population excluding refugees in the base year 2013 and net of district and state x time fixed effects. The sample consists of half-yearly data 2014h2—2017h2. Data points are weighted with the population in the base year (excluding refugees).

Figure B3: Scatter Plot: Second Stage



Notes: Both variables are normalized with population excluding refugees in the base year 2013. The x-axis depicts the outcomes of the first stage. The sample consists of half-yearly data 2014h2—2017h2. Data points are weighted with the population in the base year (excluding refugees).