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Problem or Opportunity? Immigration, Job Search, Entrepreneurship and Labor Market Outcomes Of Natives in Germany

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Abstract

This paper evaluates the effects of low-skill immigration on small businesses, wages, and employment in Germany. We develop a search and matching model with heterogeneous workers, cross-skill matching, and endogenous entry into entrepreneurship. The model is calibrated using data from the German Socio-Economic Panel (SOEP). Quantitative analysis shows that low-skill immigration increases the welfare of high-skill workers. It also leads to the endogenous expansion of immigrant entrepreneurial activities, generating positive spillovers for all demographic groups except native entrepreneurs. However, the gains are outweighed by the losses in welfare of low-skill workers, and overall, there is a marginal loss of per-worker welfare to the economy. Policies restricting immigrant entrepreneurship relax competition for native small businesses but reduce welfare for all other worker groups.

Keywords: entrepreneurship, small business, self-employment, search frictions, immigration

JEL codes: J23, J31, J61, J64, L26

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1 Introduction

In this paper, we revisit the impact of immigration on receiving countries. We develop a macroeconomic model with search frictions and endogenous entry into entrepreneurship, which is calibrated to the German data. Our study makes three contributions to the literature. First, we develop a general equilibrium framework that allows for the dual role of immigrants as job seekers and as entrepreneurs or job creators. By doing so, we capture both the higher competition native workers face due to immigration and the better outside options due to jobs created by immigrant entrepreneurs. Second, we provide a quantitative assessment of the model mechanism generating new insights into the heterogeneous effects of immigration on wages, employment opportunities of natives and incumbent immigrants, as well as job creation in small businesses in Germany. Third, we evaluate the welfare effects of policies facilitating immigrants' entry into entrepreneurship.

On the one hand, the literature provides evidence that immigrant entrepreneurs contribute to job creation.¹ For example, Sachs et al. (2016) finds that entrepreneurs with a migration background employed at least 1.3 million people in Germany in 2014, while Leicht and Langhauser (2014) reports this number between 1.5 and 2 million. Nonetheless, this literature does not explore the general equilibrium consequences of immigration in host countries. On the other hand, the large body of literature dealing with diverse aspects of migration in receiving countries ignores the immigrants' entrepreneurial role despite its direct implications for the employment opportunities and wages of natives. This literature treats immigrants as workers who compete with natives for jobs and influence their welfare through their impact on wages, employment, and fiscal transfers.²

In this paper, we synthesize the aforementioned strands of literature and address the following questions: 1) does ignoring the role of immigrants as entrepreneurs lead to biased predictions concerning the general equilibrium effects of immigration on labor market outcomes and the welfare of natives? 2) whether policies reducing barriers to self-employment for immigrants may be beneficial in reducing unemployment and increasing output and welfare.

We use data from the German Socio-Economic Panel (2000-2017), a comprehensive survey of German households, to establish empirical regularities. The data is combined with information on vacancies from the Federal Employment Office. We divide the workforce into two groups. The first group is the one that has at least once been engaged in an entrepreneurial activity (as a solo self-employed or working as an entrepreneur operating a business and hiring coworkers) during the observation period. We call them *potential entrepreneurs*. The second group consists of all other workers who did not undertake any entrepreneurial activity during the observation period; they are called *regular workers*.

¹Kerr and Kerr (2020); Riillo and Peroni (2022); Li (2001); Lofstrom (2002); Constant and Zimmermann (2006)

²D'Amuri et al. (2010); Ben-Gad (2008); Borjas (2003, 1999); Dustmann et al. (2017); Pischke and Velling (1997); Busch et al. (2020); Iftikhar and Zaharieva (2019); Battisti et al. (2018)

Several stylized facts emerge from SOEP. Notably, regular workers, making up the majority, remain in paid jobs with an annual probability of at least 97%. In contrast, potential entrepreneurs move frequently between paid jobs and active entrepreneurship, with annual probabilities in the range of 18 to 29%. This shows that most workers do not consider self-employment as an alternative to their job. Nevertheless, also for those who do, self-employment is not a “once and for all” decision and should be modeled dynamically. In addition, there are large differences in the unemployment rates between the two groups, indicating that potential entrepreneurs may use self-employment as a way to avoid unemployment, signaling a necessity motive of entrepreneurship. Poschke (2023) also finds evidence for self-employment out of necessity. At the same time, information on income reveals that the average earnings of entrepreneurs hiring coworkers are higher than the wages of comparable individuals employed in regular paid jobs, suggesting an opportunity component of entrepreneurship.

We develop a search and matching (SaM) model around the empirical facts observed in SOEP. We consider four demographic groups: natives/immigrants and high/low-skilled. Within each group, there are individuals with a high entrepreneurial spirit (potential entrepreneurs) and individuals with a low entrepreneurial spirit (regular workers). Potential entrepreneurs in our model have several options: they can enter solo self-employment, register a small business with coworkers, or search for and accept a regular paid job. Entry into these states is endogenous and depends on the labour market conditions. Regular workers can be employed in regular jobs (large firms) or small businesses operated by self-employed entrepreneurs. Large firms are modeled in a classical SaM tradition with free entry. On a macro-level, output is aggregated using the CES production function.

Our model has several novel features. First, we explicitly allow for the possibility of self-employment “out of necessity”, when self-employed entrepreneurs continue searching for regular paid jobs, and self-employment “out of opportunity”, when the income from entrepreneurial activities is high enough, and there are no gains from job search. Second, the size distribution of small businesses is endogenous. In line with the empirical evidence, the model predicts a decreasing size distribution of small businesses. Third, we incorporate the possibility of cross-skill matching, whereby small businesses founded by high-skill entrepreneurs hire workers from both skill groups. This feature of the model captures the empirical fact that low-skill regular workers are overrepresented in small firms compared to high-skill workers. Hence, if immigration has implications for the job creation in small firms, then low-skill workers could be disproportionately affected by the changes relative to the high-skill workers.

We calibrate our model to mirror the observed employment/job creation patterns and income disparities between distinct groups. Once parametrized, we use our framework to investigate the implications of a 20% increase in the number of low-skill immigrants corresponding to the immigration wave observed in Germany in 2012- 2017.³ In line

³During the Syrian war, the number of immigrants to Germany increased from 15 to 18 million. Also

with previous research, we find that rising low-skill immigration benefits high-skill regular workers with a corresponding gain in welfare (measured by expected income) equal to 1%, but there is a reduction in the welfare of low-skill regular workers equal to -1.3% . The results for potential entrepreneurs are novel and reveal asymmetric effects. Immigrant entrepreneurs (high and low-skill) experience higher profits and their business entry is reinforced by immigration, generating a welfare gain of 3.1%. There is a reduction in welfare (-2%) of low-skill native entrepreneurs due to lower profits and a rise in the probability of staying in solo self-employment. The underlying reason for this finding is that immigrant businesses are more profitable on average, making them more sensitive to the improved chances of hiring coworkers in response to immigration. In contrast, we find that the expected profits of native entrepreneurs are less sensitive on the recruitment margin and fall due to the lower marginal productivity of their low-skill coworkers.

In a nutshell, our results show that low-skill immigration reduces the welfare of an average incumbent worker by 0.4%, but there is pronounced heterogeneity in this effect across demographic groups. In particular, native and immigrant low-skill entrepreneurs are asymmetrically affected. Our findings call for a deeper empirical investigation of entrepreneurship and immigration in Germany; however, some existing studies for the US support our proposed mechanism. For example, Fairlie and Meyer (2003) finds that self-employed immigrants displace self-employed natives in the US.

Addressing the second question, we conduct a counterfactual experiment by introducing legal barriers to self-employment and entrepreneurship for immigrant individuals. This experiment sheds light on the spillover effects of immigrant entrepreneurship for regular workers and native entrepreneurs. We find that immigrant entrepreneurship has moderate positive spillovers in the range $0.2 - 0.4\%$ for the welfare of regular workers. On the one hand, immigrant potential entrepreneurs entering self-employment out of opportunity reduce competition for regular jobs; on the other hand, immigrant entrepreneurs operating small businesses create additional workplaces. On the contrary, our model indicates substantial negative spillovers for native potential entrepreneurs ($1.1 - 1.6\%$ of welfare). This is intuitive since the business entry of immigrant entrepreneurs creates additional competition in recruiting workers for native small businesses. These results suggest that policies restricting immigrant entrepreneurship shield native small businesses from competition but reduce welfare for all other worker groups.

The rest of the paper is organized as follows. Section 2 positions our study in the related literature. Section 3 describes the stylized facts. Section 4 presents the theory, followed by the calibration strategy in Section 5. Section 6 presents the results, including two extensions accounting for the recent immigration cooperation agreement between Germany and India and the role of ethnic segregation in small businesses. Section 7 concludes the paper.

the most recent immigrant wave in 2020-2024 (dominated by the Russian-Ukrainian conflict) is associated with a similar increase from 20 to 23 million as reported by www.destatis.de

2 Related Literature

Our paper contributes to the literature concerning the impact of (low-skilled) migration on the labor market outcomes and welfare of natives in developed countries. The seminal paper by Borjas (1999) and later Ben-Gad (2004) show that an influx of immigrants in the US creates an immigration surplus, assuming homogeneous labour and imperfect substitution between labor and capital. Subsequent papers with heterogeneous labour support varied conclusions regarding wages of competing workers and immigration surplus (Borjas, 2003; Ben-Gad, 2008). Literature on wage effects of immigration is inconclusive, vastly empirical, and assumes perfectly competitive labor markets (Altonji and Card, 1991; Borjas et al., 1997; Card, 2001; Borjas, 2006; D’Amuri et al., 2010). Goldin (1994), Borjas (2003), Aydemir and Borjas (2007), and Aydemir and Borjas (2011) find a negative effect of immigration on native wages. Several papers report a negligible effect.⁴

More recent studies provide evidence for heterogeneous wage effects. For example, the wage effects are considerably larger for younger natives (Dustmann et al., 2017) in Germany, while in the UK, migration negatively affects the wages of low earners but increases the wages of high earners (Dustmann et al., 2013). Our framework accommodates the heterogeneity in immigration’s effects by assuming different skill groups and occupation choices between paid employment and entrepreneurship. D’Amuri et al. (2010), Felbermayr et al. (2010), and Ottaviano and Peri (2012) further find that migration adversely affects the wages of the incumbent immigrants when immigrants are imperfect substitutes to natives in the same skill group. We follow a parsimonious approach in assuming perfect substitution between immigrants and natives in the same skill group. However, assuming productivity differences between ethnic groups with the same skills allows us to compute the effects of migration for incumbent immigrants and natives.

There are mixed findings in the literature discussing the employment consequences of immigration. Some papers find a substantial adverse effect of immigration on native employment (Borjas, 2003, 2006; Dustmann et al., 2017). Others find either a positive, negligible, or no effect of migration on native employment in receiving countries.⁵ Only Dustmann et al. (2017) discuss the interaction between wage and employment effects. Our theoretical framework incorporates interactions between wage and job creation, and the quantitative analysis provides insights into the distributional consequences of migration shock to the German labor market.

The underlying theoretical framework for most of the above-mentioned papers is perfectly competitive. Several recent papers employ SaM models to analyze the general equilibrium effects of immigration. Ortega (2000) is one of the first papers studying the effects of migration in a frictional labor market. However, this paper is theoretical and

⁴Card (2001), Card (2005), Friedberg (2001), D’Amuri et al. (2010), Felbermayr et al. (2010), Ottaviano and Peri (2012), Busch et al. (2020)

⁵Altonji and Card (1991); Hunt (1992); Pischke and Velling (1997); D’Amuri et al. (2010); Scharfbillig and Weissler (2019); Friedberg (2001); Malchow-Møller et al. (2009); Felbermayr et al. (2010)

lacks a detailed data-based quantitative analysis. Liu (2010) develops a dynamic search and matching model with heterogeneous labor but focuses solely on the consequences of illegal migration for the US economy. Chassamboulli and Palivos (2014) extend Liu’s framework with a nested CES production function, low and high-skilled labor, and capital to study the impact of immigration on the US economy. Battisti et al. (2018) calibrate a SaM model featuring two skill types, wage bargaining and a redistributive welfare state for 20 OECD countries. Iftikhar and Zaharieva (2019) extend the framework of Battisti et al. (2018) by considering a two-goods economy and endogenous price setting. Their framework identifies additional effects of immigration on Germany through its impact on domestic demand. Nanos and Schluter (2014) and Moreno-Galbis and Tritah (2016) also use the SaM model to analyse consequences of migration in selected European economies.

The existing literature on immigration is primarily focused on the labor market outcomes of workers in paid employment. Entrepreneurship is a relatively understudied aspect of the overall impacts of immigration on host economies (Fairlie and Lofstrom, 2015). The emerging literature on the topic suggests positive contributions of migrant entrepreneurs to job creation and innovation in receiving countries (Wadhwa, 2007; Hohn et al., 2012; Xavier et al., 2013; Kerr and Kerr, 2020; Riillo and Peroni, 2022).

Another stream of papers on the issue compare the characteristics of native and immigrant entrepreneurs in terms of earnings, human capital, likelihood, and reasons to start a business (Borjas, 1986; Evans and Leighton, 1989; Yuengert, 1995; Fairlie and Meyer, 1996; Clark and Drinkwater, 1998; Basu, 1998; Borooah and Hart, 1999; Li, 2001; Lofstrom, 2002; Constant and Schultz-Nielsen, 2004; Constant et al., 2005; Constant and Zimmermann, 2006). Only a few studies examine the impact of immigrant entrepreneurial activities on the entrepreneurship opportunities of natives (Duleep et al., 2021; Fairlie and Meyer, 2003). Nevertheless, none of these papers discuss the general equilibrium consequences of immigrant entrepreneurship. Entrepreneurs contribute to job creation (Kerr and Kerr, 2020; Azoulay et al., 2022) as well as job destruction (Georgarakos and Tatsiramos, 2009), resulting in direct consequences of immigrant entrepreneurship for wage and employment opportunities of workers in regular employment. Provided this evidence, we propose a unified framework for the entrepreneurial pursuits of natives and immigrants and regular employment activities. We use this framework as a toolbox to quantify the general equilibrium effects of immigration in Germany.

3 Stylized facts

In this section we highlight six stylized facts (SF1 to SF6) that provide the building blocks for the theory in the next section. For this purpose, we use data from the German Socio-Economic Panel (SOEP) waves 2000-2017. SOEP is a representative panel of households and individuals in Germany. It provides detailed information about the respondent’s ethnicity, qualifications, wages, firm size, employment status, and the possi-

bility of self-employment and entrepreneurship. Moreover, it contains information about the entrepreneurs' business size (i.e. the number of coworkers in broad categories). We restrict the sample to labour force participants working full/part-time or actively searching for jobs (workers who report being registered as unemployed at the federal employment agency). Non-participants, retired, marginally employed or military personnel and those below 17 years of age are dropped from the sample. This yields an unbalanced panel with 302686 observations over the spell of 18 years.

We define as *native* (**N**) an individual who is born in Germany or has German nationality since birth. All the other individuals with immigration background, including ethnic Germans from Eastern Europe, are defined as *immigrants* (**I**). Workers with at least 13 years of schooling are defined as *high-skilled* (**H**) while others are considered *low-skilled* (**L**). 13 years of schooling correspond to the upper secondary schooling degree ("Abitur") and grant direct access to tertiary education in Germany. The average share of high and low-skilled natives in the sample is 32.6% and 51.0%, respectively. In comparison, the high and low-skilled immigrants form 2.7% and 13.7% of the sample.

We define the individuals who were observed as self-employed or as small business owners (with or without coworkers) at least once between 2000 and 2017 as *potential entrepreneurs*. Such individuals form 15% of the sample. The remaining 85% of individuals in the sample never reported engaging in entrepreneurial activities in the observation period, so we refer to them as *regular workers*.⁶ The stylized facts below highlight characteristics of potential entrepreneurs and key differences between them and the regular workers. They also reveal differences between the two skill groups as well as natives and immigrants, analyzed in the context of firm size and entrepreneurship. We will parametrize our model to match these facts.

SF1: potential entrepreneurs make frequent transitions between active entrepreneurship and paid jobs while employed regular workers have very high probabilities of staying in paid employment. Table 1 shows average annual transition probabilities of potential entrepreneurs across three states: active entrepreneurship n , paid employment e and unemployment u . State n includes solo self-employment and business ownership with and without coworkers. In addition, column (*) indicates the

⁶We are aware that our classification of potential entrepreneurs and regular workers is not unique. We may underestimate the share of potential entrepreneurs, as some individuals may have been in entrepreneurship before participating in the survey, while others may have dropped out of the sample before being observed in an entrepreneurial state. However, it is a reasonable measure given the lack of detailed information about the interest in entrepreneurship or efforts to open up a business. Nonetheless, we use SOEP data to conduct an empirical analysis that establishes that the two groups are heterogeneous with respect to their preferences, such as risk attitudes and non-cognitive abilities. Our findings indicate that our classification correctly captures the stronger entrepreneurial aspirations among potential entrepreneurs. The results are presented in Table 10 in Appendix A. We find positive correlations between being a potential entrepreneur and having lower risk-aversion, more openness to new experiences, lower neuroticism, and lower agreeableness with others. Our conclusions are supported by the existing research, for example, Zhao et al. (2010) conducted a meta-analysis based on 60 studies and found that lower risk aversion is the strongest predictor of entrepreneurial intentions, followed by openness to experience and emotional stability.

long-term distribution of potential entrepreneurs across states.

Table 1: Potential entrepreneurs by ethnicity and skills: transition probabilities and the long-term distribution across states

Native, low-skilled						Native, high-skilled					
	n	e	u	*	Obs.		n	e	u	*	Obs.
n	0.898	0.095	0.007	0.547	10100	n	0.904	0.094	0.002	0.568	11175
e	0.186	0.786	0.028	0.418	7718	e	0.193	0.794	0.012	0.418	8224
u	0.098	0.369	0.533	0.035	646	u	0.084	0.401	0.514	0.014	276
Immigrant, low-skilled						Immigrant, high-skilled					
	n	e	u	*	Obs.		n	e	u	*	Obs.
n	0.861	0.126	0.013	0.525	2066	n	0.893	0.092	0.015	0.577	873
e	0.295	0.666	0.039	0.426	1676	e	0.266	0.693	0.040	0.384	581
u	0.095	0.360	0.525	0.049	193	u	0.055	0.589	0.356	0.039	59

Note: Authors' calculations using SOEP 2000-2017. The transition matrix shows the probability of moving to a new state in year $t + 1$ conditional on a given employment state in year t .

Table 1 shows that potential entrepreneurs frequently move between active entrepreneurship and paid employment with transition probabilities $e \rightarrow n$ varying in the range 18.6 – 29.5% depending on the demographic group. The opposite transition probabilities $n \rightarrow e$ are lower, but they are not negligible, varying in the range 9.2 – 12.6%. The long-term distribution in column (*) indicates that more than half of potential entrepreneurs are active in conducting entrepreneurial activities, yet, there is a substantial share of them in regular paid employment (between 38.4% and 42.6%). Inline with previous research (Metzger, 2016), we find that low-skill immigrants have higher entry rate into entrepreneurship, but also their exit rate is higher, so the share of active entrepreneurs is comparable to other groups. Overall, this empirical evidence suggests that active entrepreneurship is not an absorbing state, rather individuals with high entrepreneurial potential move dynamically between self-employment and paid employment.

Table 2 shows transitions for the regular workers with variable \bar{e} denoting paid employment and \bar{u} – the state of unemployment. Employed regular workers have very high probabilities of staying in paid employment. The probabilities are above 97% for all four demographic groups. At the same time, their probability of staying unemployed after losing a job ($\bar{u} \rightarrow \bar{u}$) is higher compared to the group of potential entrepreneurs. For example, it is 77.2% in the group of low-skill native workers, but only 53.3% among low-skill natives with high entrepreneurial potential. This leads to the next stylized fact.

SF2: potential entrepreneurs have lower unemployment rates compared to regular workers. Figure 1 (left panel) compares the long-term unemployment rates between potential entrepreneurs and regular workers. The unemployment rates are remarkably low in the group of potential entrepreneurs, while they are relatively high in the group of regular workers. This suggests that some individuals with high entrepreneurial

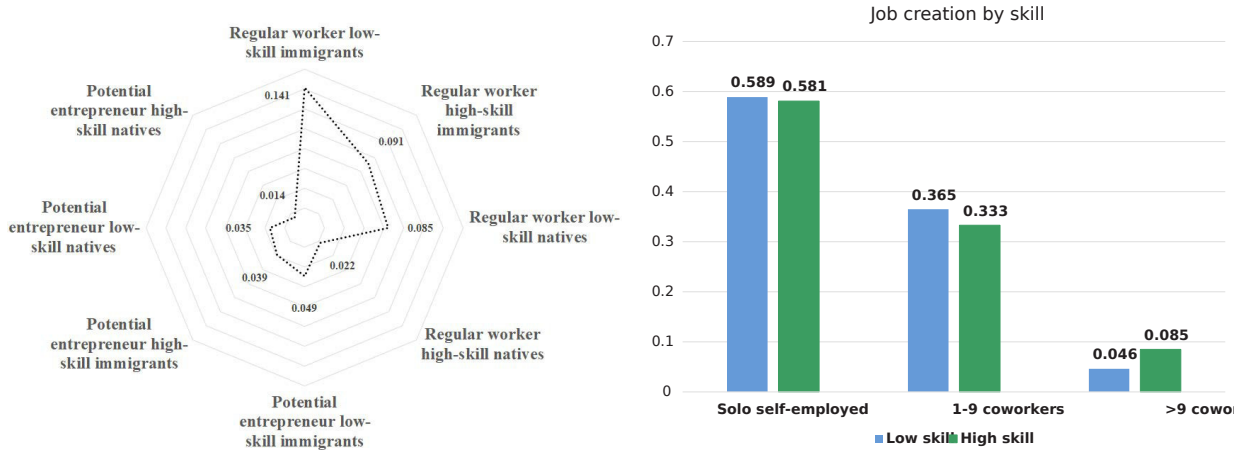
Table 2: Regular workers by ethnicity and skills: transition probabilities and the long-term distribution across states

	Native, low-skilled					Native, high-skilled			
	$\bar{\epsilon}$	\bar{u}	*	Obs.		$\bar{\epsilon}$	\bar{u}	*	Obs.
$\bar{\epsilon}$	0.973	0.027	0.915	124354	$\bar{\epsilon}$	0.993	0.007	0.978	77263
\bar{u}	0.228	0.772	0.085	11552	\bar{u}	0.348	0.652	0.022	1738
	Immigrant, low-skilled					Immigrant, high-skilled			
	$\bar{\epsilon}$	\bar{u}	*	Obs.		$\bar{\epsilon}$	\bar{u}	*	Obs.
$\bar{\epsilon}$	0.975	0.025	0.859	32241	$\bar{\epsilon}$	0.980	0.020	0.909	6053
\bar{u}	0.258	0.742	0.141	5292	\bar{u}	0.178	0.822	0.091	606

Note: Authors' calculations using SOEP 2000-2017. The transition matrix shows the probability of moving to a new state in year $t + 1$ conditional on a given employment state in year t .

potential enter self-employment in order to avoid the state of unemployment, hence, we find support for the *necessity* motive of self-employment in Germany. Our conclusion is in line with the recent research by Camarero and Murmann (2024). The data from the Global Entrepreneurship Monitor (GEM, 2018) also documents that 25% of entrepreneurship in the EU is necessity driven. This signals that ignoring potential entrepreneurs may lead to an upward bias in the unemployment rates predicted for immigrants and overestimate the competition with natives for jobs.

Figure 1: Left: unemployment rates by group. Right: firm size distribution of small businesses by skill



SF3: some potential entrepreneurs work as solo self-employed, while others start small businesses with coworkers. Our data includes information on the type of entrepreneurship distinguishing between solo self-employment s and business ownership with less/more than 9 employees b . This means that $n = s + b$. The long-term averages are summarized in table 3. In all four groups the highest share of active entrepreneurs are working as solo self-employed. This share is close to 60% in all groups except immigrant high skill entrepreneurs who reveal a stronger propensity to hire coworkers. Table 3

shows that only 45% of high skill immigrant entrepreneurs work as solo self-employed, while 55% are operating businesses with coworkers. This is the highest share among all entrepreneurial types. This observation should be considered with caution due to the relatively small sample size in this group. Nevertheless, it suggests that immigrant entrepreneurs may have non-negligible contribution to the job creation.

SF4: most businesses with coworkers managed by the entrepreneurs create less than 9 jobs. Aggregating the numbers from table 3 by skill shows that 36.5% of low-skill entrepreneurs create 1-9 jobs, and only 4.6% create more than 9 jobs. This is illustrated on the right panel of figure 1. The figure also shows that the high-skill entrepreneurs are more likely to create more than 9 jobs compared to the low-skilled. Overall, the data suggests a decreasing firm size distribution with most businesses hiring less than 9 coworkers and only a small fraction hiring more. The decreasing size distribution associated with small businesses in Germany is also supported by Leicht and Langhauser (2014). In their data the share of native-owned businesses with less than 5 employees is 59%, the share of businesses with 6-10 employees is 21%, with 11 – 19 employees – 10%, with 20 – 49 employees – 6% and more than 50 employees – 3%. A similar pattern is also reported for immigrant businesses. Overall, this shows that a vast majority of small businesses (90%) hire less than 20 employees.

Table 3: Potential entrepreneurs: types of active entrepreneurship

	Native, low-skilled				Native, high-skilled			
n	s	b_{1-9}	$b_{>9}$	Sum	s	b_{1-9}	$b_{>9}$	Sum
Share	0.586	0.366	0.048	1.000	0.591	0.326	0.083	1.000
Obs.	5919	3697	484	10100	6604	3643	928	11175
	Immigrant, low-skill				Immigrant, high-skill			
n	s	b_{1-9}	$b_{>9}$	Sum	s	b_{1-9}	$b_{>9}$	Sum
Share	0.607	0.362	0.031	1.000	0.459	0.425	0.116	1.000
Obs.	1254	748	64	2066	401	371	101	873

Note: Authors' calculations using SOEP 2000-2017. The table shows the distribution of active entrepreneurs between solo self-employment s and small businesses with less/more than 9 coworkers b .

SF5: low-skill regular workers are disproportionately more often employed in small firms than high-skill regular workers. Table 4 dwells deeper into the distribution of employed regular workers across small (\bar{e}_0) and large firms (\bar{e}), this means that $\bar{\epsilon} = \bar{e}_0 + \bar{e}$. In the data small firms are defined as those hiring less than 20 employees. We can see that the share of workers employed in small firms varies substantially with the skill group. Whereas more than 25% of low-skill employees are employed in small firms, the share of high-skill workers employed in small firms is less than 20%. The difference is particularly large for native workers and it is supported by the evidence in Castro-Silva and Lima (2021) that small firms struggle to hire and retain high-skill workers. This

feature is relevant in the context of migration, e.g. if immigration has implications for the number of active entrepreneurs starting small businesses and, therefore, job creation or job closures in small firms, then *ceteris paribus* low-skill workers could be disproportionately more affected by the changes than high-skill workers.

Table 4: Regular workers by firm size

	Native, low-skilled			Native, high-skilled		
$\bar{\epsilon}$	$\bar{\epsilon}_0$	$\bar{\epsilon}$	Sum	$\bar{\epsilon}_0$	$\bar{\epsilon}$	Sum
Share	0.256	0.744	1.000	0.156	0.844	1.000
Obs.	31938	92416	124354	12087	65176	77263
	Immigrant, low-skilled			Immigrant, high-skilled		
$\bar{\epsilon}$	$\bar{\epsilon}_0$	$\bar{\epsilon}$	Sum	$\bar{\epsilon}_0$	$\bar{\epsilon}$	Sum
Share	0.262	0.738	1.000	0.201	0.799	1.000
Obs.	8445	23796	32241	1219	4834	6053

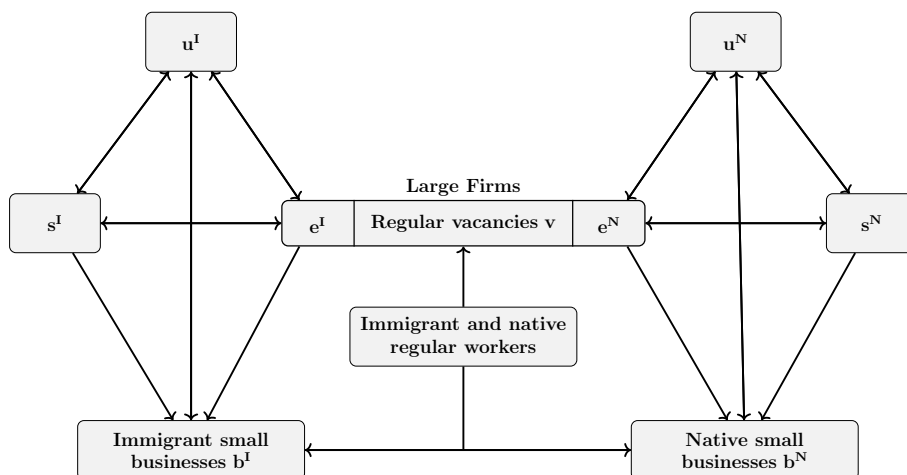
Note: Authors' calculations using SOEP 2000-2017. The table shows the shares of regular workers in small/large firms.

SF6: immigrant small businesses generate higher income than native businesses. Finally, we direct attention to the earnings of regular workers and potential entrepreneurs in different states. We estimate Mincer-type OLS regressions with time fixed effects and multiple interaction terms controlling for skills, ethnic belonging and firm or business size, separately for potential entrepreneurs and regular workers (see Appendix C.1). Figure 2 compares predicted monthly gross log-earnings for all worker groups. Comparing the monthly income of native and immigrant businesses managing small firms with less 9 coworkers, we find that immigrant business owners report higher income (8.0 and 8.5 for low and high-skill owners) compared to native business owners in the same size category (7.9 and 8.3). These log-income differences are statistically significant and substantial, they are also inline with the previous literature (Constant and Zimmermann, 2006). Even though the gap is reversed for businesses with more than 9 coworkers, the share of such businesses is very small as shown in table 3.

Further, figure 2 shows that business owners report the highest monthly gross income with log-values above 7.9, which corresponds to 2.700 EUR. In contrast, individuals in paid employment or solo self-employed receive lower monthly income. In particular, the income values of regular workers employed in small firms are lowest across all demographic groups. High earnings of business owners reveal an important *opportunity* motive of entrepreneurship and connote the importance of distinguishing between necessity and opportunity driven entrepreneurship (Poschke (2013)).

Figure 2: Left: predicted log-earnings of potential entrepreneurs. Right: predicted log-earnings of regular workers

Based on the stylized facts mentioned above, we illustrate possible interactions between potential entrepreneurs and regular workers using Figure 3. It shows that potential entrepreneurs move between paid employment, unemployment, solo self-employment and business ownership with coworkers. Hence, it illustrates that regular workers and potential entrepreneurs may work together as employees supplying their labour to larger firms, but they can also be on different sides of the market as a worker and an employer working together in a small business. It underscores that economic connections between entrepreneurial and regular worker groups will have general equilibrium effects through their impact on job creation, productivity, wages and unemployment rates. Therefore, in the next section, we develop a model around the stylized facts SF1-SF6 that features all the interactions shown in Figure 3 and has mechanisms through which potential entrepreneurship generates general equilibrium effects.



4 The Model

In this section we develop a theoretical model of immigration and entrepreneurship borrowing from the traditional search and matching approach (Mortensen and Pissarides (1994), Pissarides (2000)). Accounting for search frictions allows us to capture the empirically observed transitions of workers between employment, unemployment and entrepreneurship as well as other empirical facts. Moreover, it is a conventional tool for the analysis of job creation and permits a distinction between the necessity and opportunity motives of entrepreneurship.

4.1 The environment

The labour market is populated by four demographic groups: low-skill immigrants d^{IL} , low-skill natives d^{NL} , high-skill immigrants d^{IH} and high-skill natives d^{NH} . All individuals are risk-neutral and discount future income flows at the rate r . Time is continuous. Labour supply is inelastic, and the total labour force is normalized to 1:

$$d^{IL} + d^{NL} + d^{IH} + d^{NH} = 1$$

i denotes the origin of the individual $\{I, N\}$ and j indicates the skill level $\{L, H\}$. Within each demographic group ij , there are two subgroups: potential entrepreneurs with high entrepreneurial spirit l^{ij} and regular workers with low entrepreneurial spirit $d^{ij} - l^{ij}$. This group distinction is exogenous and captures the evidence in SF1 from section 3. Being a *potential* entrepreneur does not imply being an *active* entrepreneur at a given point in time. Potential entrepreneurs can also be observed in paid employment or unemployment. However, their entrepreneurial spirit may lead them to switch from these states to starting a solo self-employment or a business with coworkers.

Regular workers. There are two employment states for regular workers. First, regular workers can be employed in a regular job \bar{e}^{ij} , producing output \bar{y}^{ij} and receiving a wage \bar{w}^{ij} . Regular jobs are positions in large firms. Second, potential entrepreneurs can employ them in a small business \bar{e}_0^{ij} . Hence, we have:

$$\bar{e}^{ij} + \bar{e}_0^{ij} + \bar{u}^{ij} = d^{ij} - l^{ij}$$

where \bar{u}^{ij} is a state of involuntary unemployment for regular workers associated with a flow income $\bar{z}^{ij} - h$. Variable \bar{z}^{ij} is the unemployment benefit, whereas h is the disutility from unemployment (e.g., the stigma of failure). The exogenous shock of job destruction arrives to all employees in regular jobs at rate $\bar{\gamma}^{ij}$, rendering them unemployed.

Potential entrepreneurs. Potential entrepreneurs have a high entrepreneurial spirit, so they can be solo self-employed s^{ij} or operating small businesses with coworkers b^{ij} in line with SF3 from section 3. The decision to become self-employed and start a business

is endogenous and driven by market forces. The stock of potential entrepreneurs in paid employment in a regular job is denoted by e^{ij} and is associated with a flow output y^{ij} and a wage w^{ij} , this yields:

$$s^{ij} + b^{ij} + e^{ij} + u^{ij} = l^{ij}$$

where u^{ij} is a state of unemployment with a flow income $z^{ij} - h$.

Potential entrepreneurs generate business ideas associated with production efficiency α , which follows a distribution $F(\alpha)$, $\alpha \in [0, \bar{\alpha}]$. New realizations of α arrive to potential entrepreneurs at the Poisson rate δ^{ij} . Higher values of α correspond to higher output per unit time. The intuitive idea behind this process is that potential entrepreneurs may start producing the product and selling it as solo self-employed or improve the efficiency of the production process through learning-by-doing and register a small business with coworkers. The idiosyncratic efficiency shocks δ^{ij} are positive since potential entrepreneurs can ignore the new realization of α if it is not beneficial for them. We follow the “business idea ladder” approach (Rissman (2007), Kredler et al. (2014)) and assume that new business ideas can not be stored for future use. In addition, we assume that there are no efficiency shocks δ^{ij} in the state of business ownership with coworkers.

Self-employed entrepreneurs produce the flow output $\sigma^{ij}\alpha$. However, if they decide to register a business they incur a flow cost of capital c_k^{ij} and the cost of posting a vacancy c_h^j . Let the two costs together be denoted by $c^{ij} = c_k^{ij} + c_h^j$, so the individual net output of the business owner becomes $\sigma^{ij}\alpha - c^{ij}$. Profits generated by coworkers and the firm size distribution are introduced later in the paper. Small businesses become bankrupt at the Poisson arrival rate γ^{ij} , where ij is the demographic group of the business owner. In the case of bankruptcy, all coworkers and the business owner become unemployed. The same shock arrives to solo self-employed and leads to involuntary unemployment.

Regular vacancies. Consider matching in the regular market $j = L, H$. Positions in large firms are skill-specific. Posting a vacancy in submarket j is associated with a posting cost \bar{c}_h^j and a flow capital cost \bar{c}_k^j . Let $M^j(\Sigma^j)^\zeta (v^j)^{1-\zeta}$, denote the corresponding Cobb-Douglas matching function, where v^j denotes the number of open vacancies and Σ^j denotes the number of searching workers in intensity units. Σ^j consists of unemployed regular workers \bar{u}^{ij} , unemployed potential entrepreneurs u^{ij} , and searching solo self-employed entrepreneurs weighted by the exogenous search intensity X^{ij} . The solo self-employed entrepreneurs can search for regular jobs if it is optimal for them. We refer to searching self-employed (s_u^{ij}) as self-employed “*out of necessity*” since they would strictly prefer to have a regular job. In contrast, we refer to non-searching self-employed (s_e^{ij}) as self-employed “*out of opportunity*” as they would not accept a regular job even if they get an offer. Given this notation, we have:

$$\Sigma^j = X^{Ij}(\bar{u}^{Ij} + u^{Ij} + s_u^{Ij}) + X^{Nj}(\bar{u}^{Nj} + u^{Nj} + s_u^{Nj})$$

$s^{ij} = s_u^{ij} + s_e^{ij}$ implies that every solo self-employed person can be assigned into a searching or non-searching group based on the optimal job search decision. The matching rate $\lambda(\theta^j)$ and the vacancy filling rate $q(\theta^j)$ in a regular submarket j can be written as:

$$\lambda(\theta^j) = M^j(\theta^j)^{1-\zeta} \quad q(\theta^j) = M^j(\theta^j)^{-\zeta} \quad \theta^j = \frac{v^j}{\Sigma^j}$$

where θ^j is the market tightness in the submarket j . The job-finding rate is then $X^{ij}\lambda(\theta^j)$.

Small businesses. Consider matching between searching workers and small businesses operated by entrepreneurs. Small businesses post vacancies sequentially, meaning that they post at most one vacancy at a time as long as posting is optimal. The next vacancy is posted only after the previous was filled with a worker, which means that small businesses grow over time. If posting is optimal, then the total number of posted vacancies is given by $b^{Nj} + b^{Ij}$ since both native and immigrant small businesses post vacancies. Let $\bar{M}^j(\Sigma_0^j)^\zeta(b^{Ij} + b^{Nj})^{1-\zeta}$ denote the corresponding matching function. Σ_0^j consists of unemployed regular workers \bar{u}^{ij} weighted by their search intensities x^{ij} . We assume that high-skill regular workers can only be hired by the high-skill entrepreneurs, whereas low-skill regular workers are engaged in *cross-skill matching* and apply to all types of small businesses. Accounting for cross-skill matching allows us to accommodate SF5 from section 3 that many low-skill workers and relatively few high-skill workers are employed in small businesses.

Given this setup, the job-finding rate $\bar{\lambda}(\theta_0^j)$ and the vacancy filling rate $\bar{q}(\theta_0^j)$ in submarket j become:

$$\bar{\lambda}(\theta_0^j) = \bar{M}^j(\theta_0^j)^{1-\zeta} \quad \bar{q}(\theta_0^j) = \bar{M}^j(\theta_0^j)^{-\zeta} \quad \theta_0^j = \frac{b^{Nj} + b^{Ij}}{\Sigma_0^j}$$

Where θ_0^j is the market tightness associated with small businesses.

Final output. The final good Y is produced using capital K and a composite labour good Z with a CRS technology. For the composite good Z , we follow the literature (Acemoglu (2001) and Battisti et al. (2018)) and use a CES production function with two intermediate skill-specific inputs, Y_L and Y_H , that is:

$$Y = AK^\eta Z^{1-\eta}, \quad \eta \in (0..1) \quad (1)$$

$$Z = [aY_L^\rho + (1-a)Y_H^\rho]^{\frac{1}{\rho}}, \quad \rho < 1 \quad (2)$$

where $1/(1-\rho)$ is the elasticity of substitution between high and low-skill intermediate inputs. Each intermediate input Y_j is a linear aggregate of output quantities produced in submarket j . Let variable $\bar{\varphi}^{ij}$ denote the quantity one regular worker produces in the group ij . Then the value of this worker's output becomes $\bar{y}^{ij} = \bar{\varphi}^{ij}P^j$, where P^j is the price of the intermediate good j . In a similar way, we define variables φ^{ij} and ς^{ij} , so that $y^{ij} = \varphi^{ij}P^j$ and $\sigma^{ij} = \varsigma^{ij}P^j$. Output quantities $\bar{\varphi}^{ij}$, φ^{ij} and ς^{ij} are exogenous and specific

to each worker group. However, the price of the intermediate good P^j is endogenous and common to all workers in the skill category j . For the self-employed entrepreneurs this means that the output value $P^j \varsigma^{ij} \alpha$ is determined by three components: the price of the intermediate good P^j , the group-specific fixed effect ς^{ij} , and the individual production efficiency α . Intermediate goods are sold to the final good producer in a competitive market, so the price P^j equals the marginal productivity of the intermediate good Y_j . The price of capital is exogenous and denoted by R .

Taxes. All employees in paid and self-employment pay an income tax t . In addition, regular firms and small businesses pay the corporate tax τ on their profits. Income and corporate taxes are proportional to income/profits.

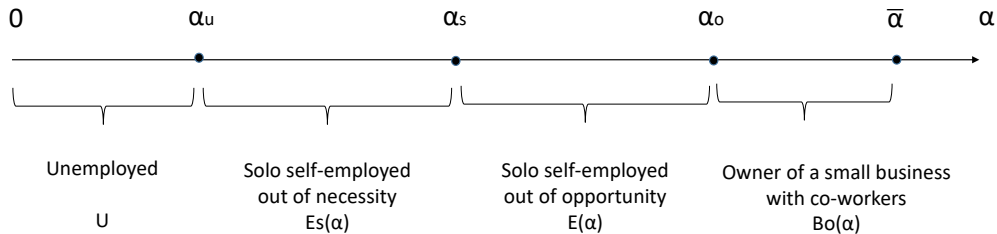
4.2 Entrepreneurial decisions

In this section we explain the decisions of potential entrepreneurs. There are three decisions to be considered: entering solo self-employment, searching for a regular paid job, starting a business with coworkers. All the following equations are specific to the entrepreneurs of the type ij , however, we drop the upper index where possible for the ease of exposition and recover full-scale notation later in the paper. Consider unemployed potential entrepreneurs and let U denote the present value of income in unemployment. Potential entrepreneurs generate business ideas associated with production efficiency α . If the new realization of α crosses the endogenous boundary α_u then potential entrepreneurs enter the state of self-employment and start producing the flow output $\sigma\alpha$. The threshold value α_u follows from the following optimization problem:

$$\max[U, E_s(\alpha)] = \begin{cases} E_s(\alpha) & \text{for } \alpha > \alpha_u \\ U & \text{for } \alpha < \alpha_u \end{cases} \quad \text{and} \quad E_s(\alpha_u) = U$$

where $E_s(\alpha)$ denotes the present value of income in solo self-employment *out of necessity*, if the entrepreneur continues searching for a regular job. We show later that $E_s(\alpha)$ is an increasing function of α . The sequence of labour market decisions for potential entrepreneurs is illustrated on figure 4.

Figure 4: Self-employment states for different values of α



Further, let $W > U$ denote the present value of income in a regular job. If the new

realization of α exceeds the next threshold α_s , then self-employed entrepreneurs stop searching for regular jobs, and become solo self-employment *out of opportunity*. This is because staying in self-employment in this state is associated with a higher present value of income $E(\alpha)$ than regular employment, so we get:

$$\max[E_s(\alpha), E(\alpha)] = \begin{cases} E(\alpha) > W & \text{for } \alpha > \alpha_s \\ E_s(\alpha) < W & \text{for } \alpha < \alpha_s \end{cases} \quad \text{and} \quad E_s(\alpha_s) = W = E(\alpha_s)$$

where again $E(\alpha)$ should be increasing in α .

Finally, for very high realizations of α , such that $\alpha \in [\alpha_0, \bar{\alpha}]$ entrepreneurs register a small business and post vacancies. The present value of profits in this state is denoted by $B_0(\alpha)$, where the subindex refers to the number of coworkers. Any new business starts with 0 coworkers. Later we show that $B_0(\alpha)$ is increasing in α , so the endogenous cut-off α_0 driving the business entry can be obtained as:

$$\max[E(\alpha), B_0(\alpha)] = \begin{cases} B_0(\alpha) & \text{for } \alpha > \alpha_0 \\ E(\alpha) & \text{for } \alpha < \alpha_0 \end{cases} \quad \text{and} \quad E(\alpha_0) = B_0(\alpha_0)$$

4.3 Value functions

Applying the optimal decision strategies of potential entrepreneurs we can write down the present value of unemployment U in the following way:

$$\begin{aligned} rU &= z - h + X\lambda(\theta)(W - U) \\ &+ \underbrace{\delta \int_{\alpha_u}^{\alpha_s} (E_s(x) - U) dF(x)}_{\text{solo-entr. out of necessity}} + \underbrace{\delta \int_{\alpha_s}^{\alpha_0} (E(x) - U) dF(x)}_{\text{solo-entr. out of opportunity}} + \underbrace{\delta \int_{\alpha_0}^{\bar{\alpha}} (B_0(x) - U) dF(x)}_{\text{business with coworkers}} \end{aligned} \quad (3)$$

This equation shows that depending on the production efficiency associated with the business idea α unemployed potential entrepreneurs may decide to stay unemployed, move into solo self-employment, or even register a business hiring coworkers.

Next, we describe the present value of income in solo self-employment out of necessity, which applies for $\alpha \in [\alpha_u, \alpha_s]$:

$$\begin{aligned} rE_s(\alpha) &= \sigma\alpha(1 - t) + \underbrace{\delta \int_{\alpha}^{\alpha_s} (E_s(x) - E_s(\alpha)) dF(x)}_{\text{improving profits}} + \underbrace{\delta \int_{\alpha_s}^{\alpha_0} (E(x) - E_s(\alpha)) dF(x)}_{\text{solo-entr. out of opportunity}} \\ &+ \underbrace{\delta \int_{\alpha_0}^{\bar{\alpha}} (B_0(x) - E_s(\alpha)) dF(x)}_{\text{business with coworkers}} + X\lambda(\theta)(W - E_s(\alpha)) - \gamma(E_s(\alpha) - U) \end{aligned} \quad (4)$$

where $\sigma\alpha(1 - t)$ is the after tax income in self-employment. This equation shows that production efficiency and income of the self-employed entrepreneur are improving over

time. So when the income achieves the level $\sigma\alpha_s(1-t)$, meaning $E_s(\alpha_s) = W$, self-employed entrepreneurs stop searching for regular jobs and focus on their entrepreneurial activities. The present value of entrepreneurship out of opportunity $E(\alpha)$ is given by:

$$\begin{aligned} rE(\alpha) = & \sigma\alpha(1-t) + \underbrace{\delta \int_{\alpha}^{\alpha_0} (E(x) - E(\alpha))dF(x)}_{\text{improving profits}} + \underbrace{\delta \int_{\alpha_0}^{\bar{\alpha}} (B_0(x) - E(\alpha))dF(x)}_{\text{business with coworkers}} \\ & - \gamma(E(\alpha) - U) \quad \text{for } \alpha_s < \alpha < \alpha_0 \end{aligned} \quad (5)$$

where again the first integral on the right hand side accounts for the improving efficiency of the production process α , whereas the second integral refers to the possibility of registering a business and posting vacancies associated with a present value $B_0(\alpha)$.

When modeling small businesses with coworkers we follow the approach in Masters (2016). If posting is optimal, then small businesses post vacancies sequentially, so there is one open position per small business at a given point in time. At rate $\bar{q}(\theta_0)$ small businesses are matched with potential candidates. Consider first the low-skill submarket with applications from low skill regular workers. With endogenous probability μ , the applicant has immigrant background, while it is a native worker with probability $1 - \mu$. The present value of a start-up business $B_0(\alpha)$ is then given by:

$$(r + \gamma)B_0(\alpha) = \sigma\alpha(1-t) - c + \bar{q}(\theta_0)[\mu(B_{10}(\alpha) - B_0(\alpha)) + (1 - \mu)(B_{01}(\alpha) - B_0(\alpha))] + \gamma U$$

where $B_{km}(\alpha)$ denotes the present value of a small business with k immigrant coworkers and m native coworkers and $c = c_k + c_h$ is a total cost. Let y_0^i and w_0^i , $i = I, N$ denote productivity and wages of workers employed in small businesses. We assume that the output of workers in small firms is additive (constant returns to scale), but it is not a restrictive assumption because the output in different labour market segments is further aggregated by means of the CES production function (2). Thus, the present value $B_{km}(\alpha)$ can be written as:

$$\begin{aligned} rB_{km}(\alpha) = & \sigma\alpha(1-t) - c + k(y_0^I - w_0^I)(1 - \tau) + m(y_0^N - w_0^N)(1 - \tau) + \\ & + \bar{q}(\theta_0)[\mu(B_{k+1m}(\alpha) - B_{km}(\alpha)) + (1 - \mu)(B_{km+1} - B_{km}(\alpha))] - \gamma(B_{km}(\alpha) - U) \end{aligned}$$

The value gain from hiring one more coworker, denoted $\Delta^I = B_{k+1m}(\alpha) - B_{km}(\alpha)$ and $\Delta^N = B_{km+1}(\alpha) - B_{km}(\alpha)$, is constant $\forall k, m = 0.. \infty$ and given by (see appendix B.1):

$$\Delta^I = \frac{y_0^I - w_0^I}{r + \gamma}(1 - \tau) \quad \Delta^N = \frac{y_0^N - w_0^N}{r + \gamma}(1 - \tau)$$

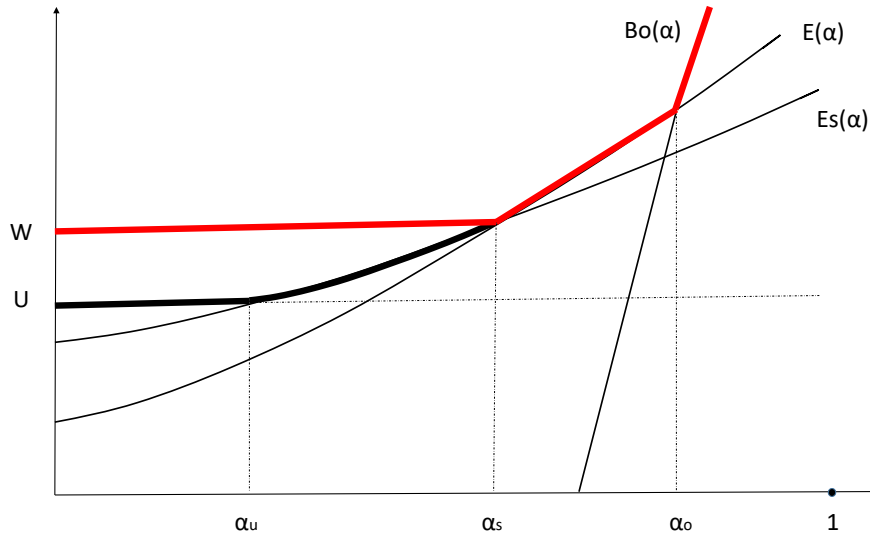
This yields the following expression for a low-skill start-up business:

$$(r + \gamma)B_0(\alpha) = \sigma\alpha(1-t) - c + \bar{q}(\theta_0)\pi + \gamma U, \quad \text{where } \pi = \mu\Delta^I + (1 - \mu)\Delta^N \quad (6)$$

The variable π denotes the expected after-tax profit from hiring coworkers in small businesses. Posting a vacancy is only profitable if $c_h < \bar{q}(\theta_0)\pi$. $B_0(\alpha)$ is a linear increasing function of α with a slope $\sigma(1-t)/(r+\gamma)$. Next we consider high-skill start-up businesses. Recall that high-skill entrepreneurs hire both types of employees, high and low-skill ones. Let μ^{ij} denote the probability of matching and hiring a coworker of type ij , $i = I, N$, $j = L, H$. Applying the same approach as above to high-skill businesses we can show that $\pi = \mu^{IH}\Delta^{IH} + \mu^{NH}\Delta^{NH} + \mu^{IL}\Delta^{IL} + \mu^{NL}\Delta^{NL}$ (details in appendix B.1).

$E(\alpha)$ is an increasing convex function of α with a slope $E'(\alpha) = \sigma(1-t)/(r+\gamma + \delta(1-F(\alpha)))$ (details in appendix B.2). Both functions $E(\alpha)$ and $B_0(\alpha)$ are illustrated on figure 5. Building on this result we can show that there exists a unique cut-off value α_0 making entrepreneurs indifferent between remaining in solo self-employment $E(\alpha_0)$ and starting a small business $B_0(\alpha_0)$, which yields Proposition 1:

Figure 5: Endogenous self-employment cut-offs



Proposition 1: *The endogenous efficiency cut-off α_0 , which is driving the creation of small businesses, can be found from the following **indifference condition** $E(\alpha_0) = B_0(\alpha_0)$, and is implicitly given by:*

$$\delta(1-t) \int_{\alpha_0}^{\bar{\alpha}} \frac{(1-F(x))\sigma}{r+\gamma} dx + c = \bar{q}(\theta_0)\pi \quad (7)$$

$$\text{where } \pi = \begin{cases} \mu\Delta^I + (1-\mu)\Delta^N & \text{for low-skill businesses} \\ \sum_{j=L,H} \mu^{Ij}\Delta^{Ij} + \mu^{Nj}\Delta^{Nj} & \text{for high-skill businesses} \end{cases}$$

The cut-off value α_0 exists and is unique if $0 < (-c + \bar{q}\pi)(r+\gamma) < \delta(1-t)\sigma \int_0^{\bar{\alpha}} (1-F(x))dx$. For given values of endogenous variables $\bar{q}(\theta_0)$ and π , α_0 is increasing in δ , σ , and c .

Proof: appendix B.2.

The left-hand side of equation (7) is the total cost of starting a business. It includes the direct cost of capital and recruitment c and the indirect cost reflected by the integral

term. This is the option value of staying in solo self-employment and waiting for a more efficient production idea (above α_0). The right hand side of equation (7) is the expected (after tax) profit from hiring coworkers. Intuitively, it means that every new beneficial realization of α reduces the option value of staying in solo self-employment, so the business entry becomes optimal when the option value of waiting equalizes with the expected gain from registering a start-up.

The present value of employment in a regular job W paying wage w is given by:

$$rW = w(1-t) + \underbrace{\delta \int_{\alpha_s}^{\alpha_0} (E(x) - W) dF(x)}_{\text{solo-entr. out of opportunity}} + \underbrace{\delta \int_{\alpha_0}^{\bar{\alpha}} (B_0(x) - W) dF(x)}_{\text{business with coworkers}} - \bar{\gamma}(W - U) \quad (8)$$

where $w(1-t)$ is the after tax labour income and $\bar{\gamma}$ is the job destruction rate. This relationship shows that employed potential entrepreneurs continue generating new business ideas and may voluntarily quit the job and enter self-employment (out of opportunity) or start a new business.

At $\alpha > \alpha_s$, self-employed entrepreneurs stop searching and applying for regular paid jobs. This is because their production efficiency becomes sufficiently high, which is associated with a relatively high income $\sigma\alpha(1-t)$. So the cut-off value of α_s is given by the following indifference condition: $E(\alpha_s) = W$. It then holds that $E_s(\alpha_s) = E(\alpha_s)$ since the option of searching for a regular job has zero value for $\alpha = \alpha_s$.

Proposition 2: *The endogenous threshold α_s separating solo self-employed out of necessity and opportunity can be obtained from the following indifference condition: $E_s(\alpha_s) = E(\alpha_s) = W$, which yields:*

$$\sigma\alpha_s = w - \frac{(\bar{\gamma} - \gamma)}{r + \bar{\gamma} + X\lambda(\theta)} \left(w - \frac{z - h}{1 - t} - \delta \int_{\alpha_u}^{\alpha_s} \frac{(1 - F(x))\sigma}{r + \gamma + X\lambda(\theta) + \delta(1 - F(x))} dx \right) \quad (9)$$

The cutoff α_s is increasing in the wage w . It is convex in w if $\gamma > \bar{\gamma}$ and concave otherwise. The slope is given by:

$$\frac{\partial \alpha_s}{\partial w} = \frac{(r + \gamma + X\lambda(\theta) + \delta(1 - F(\alpha_s)))}{\sigma(r + \bar{\gamma} + X\lambda(\theta) + \delta(1 - F(\alpha_s)))} \quad (10)$$

Proof: appendix B.2

Equation (9) is an explicit form of a shorter expression $\sigma\alpha_s(1-t) = w(1-t) - (\bar{\gamma} - \gamma)(W - U)$. First, self-employed entrepreneurs compare their flow incomes $\sigma\alpha(1-t)$ and $w(1-t)$. Second, they also consider the risk of dropping back to the state of unemployment, which is $\bar{\gamma}$ in a regular job and γ in self-employment. In the special case $\bar{\gamma} = \gamma$ we would get $\alpha_s = w/\sigma$. Equation (10) implies that a higher wage w makes regular jobs even more valuable and gives rise to a higher threshold α_s .

The threshold value α_u is given by the indifference condition $E_s(\alpha_u) = U$. $E_s(\alpha)$ is an increasing convex function of α with a slope $E'_s(\alpha) = \sigma(1-t)/(r + \gamma + X\lambda(\theta) + \delta(1 - F(\alpha)))$

as shown on figure 5. Comparing the present value from solo self-employment $E_s(\alpha_u)$ and the present value of unemployment U gives the following result:

Proposition 3: *The endogenous threshold α_u driving the entry into solo self-employment can be obtained from condition $E_s(\alpha_u) = U$, which yields: $\sigma\alpha_u(1-t) = z - h$.*

Proof: appendix B.2

Potential entrepreneurs entering self-employment keep the option of searching for regular jobs, and they also keep the option of starting a small business, so there are no costs of starting self-employment apart from losing the flow income in unemployment $z - h$. The additional gain from self-employment is the flow income $\sigma\alpha(1-t)$, which leads to the finding $\alpha_u = (z - h)/(\sigma(1-t))$. Even though parameters z, h, t are exogenous, the productivity in self-employment is a product of the quantity and the endogenous price ($\sigma = \varsigma P$), making the entry cut-off α_u endogenous as well. Hence, if the output price P is increasing, more potential entrepreneurs decide to enter self-employment.

4.4 Steady-state distribution

The firm size distribution. In this section we discuss the steady-state distribution of the number of employees in small businesses. We start by analyzing low-skill small businesses. Let p_k^I be the number of small businesses with k immigrant coworkers and p_m^N be the number of businesses with m native coworkers. In proposition 4 we characterize these distributions and show that they do not depend on α :

Proposition 4: *The distributions of immigrant and native coworkers in low-skill businesses p_k^I and p_m^N are given by geometric densities with parameters $\gamma/(\gamma + \bar{q}(\theta_0)\mu)$ and $\gamma/(\gamma + \bar{q}(\theta_0)(1 - \mu))$ respectively. The number of all employees per low-skill business has a geometric density with parameter $\gamma/(\gamma + \bar{q}(\theta_0))$. **Proof:** Appendix B.3.*

This proposition allows us to infer the average number of immigrant/native coworkers per low-skill business which is given by $\bar{q}(\theta_0)\mu/\gamma$ and $\bar{q}(\theta_0)(1 - \mu)/\gamma$ respectively. So the average size of a small business is $\bar{q}(\theta_0)/\gamma$. The size distribution of small businesses (p_n) is also given by the geometric density with parameter $\gamma/(\gamma + \bar{q}(\theta_0))$:

$$p_n = \left(\frac{\bar{q}(\theta_0)}{\gamma + \bar{q}(\theta_0)} \right)^n \frac{\gamma}{\gamma + \bar{q}(\theta_0)}$$

This density is decreasing in the whole support, implying that a vast majority of businesses are small and only very few of them survive for a long period of time and become large.⁷ The decreasing size distribution is consistent with SF4 in section 3.

Considering high-skill businesses, the average number of type ij employees, is given by $\bar{q}(\theta_0)\mu^{ij}/\gamma$. Moreover, the unconditional distribution of employees ij in these businesses

⁷Even though in theory the support of the size distribution is infinite, we know from section 3 that 90% of businesses have less than 20 coworkers. So for the purpose of quantitative analysis, we use wages and employment of workers in firms with less than 20 employees as a proxy for the characteristics of small businesses.

also has a geometric density with parameter $\gamma/(\gamma + \bar{q}(\theta_0)\mu^{ij})$.

The distribution of entrepreneurs. Variables s_u and s_e are the numbers of necessity and opportunity entrepreneurs, respectively, so that $s = s_u + s_e$ is a total number of solo-entrepreneurs. Given that the total number of potential entrepreneurs (in the group ij , which we omit for the ease of exposition) is denoted by l , we get: $s_u + s_e + e + u + b = l$. Potential entrepreneurs, who are not business owners $l - b$, register start-up firms at rate $\delta f(\alpha)$ if $\alpha > \alpha_0$. At the same time, businesses are destroyed at rate γ , which gives rise to the following dynamics: $\dot{b}(\alpha) = \delta f(\alpha)(l - b) - \gamma b(\alpha)$. Imposing the steady state condition $\dot{b}(\alpha) = 0$ and integrating $b(\alpha)$ we can find the total number of small businesses b :

$$b = \int_{\alpha_0}^{\bar{\alpha}} b(\alpha) d\alpha = \frac{\delta(1 - F(\alpha_0))(l - b)}{\gamma} \Rightarrow b = \frac{\delta(1 - F(\alpha_0))l}{\gamma + \delta(1 - F(\alpha_0))}$$

This condition postulates a negative monotonous relationship between the entry threshold α_0 and the stock of small businesses b . Intuitively, a higher cut-off α_0 leads to a lower probability of starting a business $1 - F(\alpha_0)$, so the stock of small businesses b declines.

Let $G(\alpha)$ be the equilibrium distribution of solo self-employed out of opportunity with respect to the efficiency α . More precisely it is the accumulated stock of self-employed entrepreneurs with production efficiency in the range $[\alpha_s, \alpha]$. The dynamic equation for $G(\alpha)$ is given by:

$$\dot{G}(\alpha) = \underbrace{(s_u + e + u)}_{=l-b-s_e} \delta(F(\alpha) - F(\alpha_s)) - (\gamma + \delta(1 - F(\alpha)))G(\alpha) \quad (11)$$

Unemployed entrepreneurs u , and those self-employed out of necessity s_u , stop searching for regular jobs, if their production efficiency is above α_s . Also employees in regular employment e quit their jobs and become self-employed out of opportunity if they get a realization of α above α_s . So the first term in equation (11) is the inflow of entrepreneurs into solo self-employment out of opportunity. The second term is the outflow consisting of unsuccessful entrepreneurs dropping back into unemployment (at rate γ) and those becoming more efficient (at rate $\delta(1 - F(\alpha))$). Imposing the steady state condition $\dot{G}(\alpha) = 0$ and taking into account that $s_e = G(\alpha_0)$ we get:

$$s_e = G(\alpha_0) = \frac{\delta(F(\alpha_0) - F(\alpha_s))}{[\gamma + \delta(1 - F(\alpha_0))]} \frac{\gamma l}{[\gamma + \delta(1 - F(\alpha_s))]} \quad (12)$$

Next, consider the steady-state equation for employed potential entrepreneurs:

$$\dot{e} = (u + s_u)X\lambda(\theta) - (\bar{\gamma} + \delta(1 - F(\alpha_s)))e = 0$$

where the first term is the inflow which corresponds to all searching potential entrepreneurs $(u + s_u)$ starting a regular job at rate $X\lambda(\theta)$. Again, the second term is the outflow consisting of those losing regular jobs at rate $\bar{\gamma}$ or quitting their jobs voluntarily and becoming

solo self-employed out of opportunity. Taking into account that $u + s_u = l - b - s_e - e$ we get the equilibrium expression for e :

$$e = \frac{X\lambda(\theta)}{[\bar{\gamma} + X\lambda(\theta) + \delta(1 - F(\alpha_s))]} \frac{\gamma l}{[\gamma + \delta(1 - F(\alpha_s))]} \quad (13)$$

Further, let $H(\alpha)$ be the equilibrium distribution of solo self-employed out of necessity with respect to production efficiency α . It is the accumulated stock of self-employed with efficiency in the range $[\alpha_u, \alpha]$. So we get:

$$\dot{H}(\alpha) = u\delta(F(\alpha) - F(\alpha_u)) - (\gamma + \delta(1 - F(\alpha)) + X\lambda(\theta))H(\alpha)$$

The first term is the inflow and includes unemployed individuals developing business ideas with production efficiency above α_u and starting self-employment. The second term is the outflow consisting of self-employed entrepreneurs taking a regular job (at rate $X\lambda(\theta)$), dropping back into unemployment (at rate γ) and improving efficiency (at rate $\delta(1 - F(\alpha))$). Imposing again the steady state condition $\dot{H}(\alpha) = 0$ and taking into account that $s_u = H(\alpha_s)$ we can find the equilibrium stock of potential entrepreneurs out of necessity s_u and in unemployment u . We summarize these results in proposition 5:

Proposition 5: *The equilibrium number of solo self-employed out of necessity s_u and the number of unemployed potential entrepreneurs u are given by:*

$$\begin{aligned} s_u &= \frac{\delta(F(\alpha_s) - F(\alpha_u))}{[\gamma + X\lambda(\theta) + \delta(1 - F(\alpha_u))]} \frac{(\bar{\gamma} + \delta(1 - F(\alpha_s)))}{[\bar{\gamma} + X\lambda(\theta) + \delta(1 - F(\alpha_s))]} \frac{\gamma l}{[\gamma + \delta(1 - F(\alpha_s))]} \\ u &= \frac{\gamma + X\lambda(\theta) + \delta(1 - F(\alpha_s))}{[\gamma + X\lambda(\theta) + \delta(1 - F(\alpha_u))]} \frac{(\bar{\gamma} + \delta(1 - F(\alpha_s)))}{[\bar{\gamma} + X\lambda(\theta) + \delta(1 - F(\alpha_s))]} \frac{\gamma l}{[\gamma + \delta(1 - F(\alpha_s))]} \end{aligned}$$

Proposition 5 shows that, other things being equal, the stock s_u is decreasing in the cut-off α_u . On the contrary, a higher α_u is associated with a higher stock of unemployed entrepreneurs u .

The distributions of solo self-employed with respect to the production efficiency α can be found due to the fact that $s_u(\alpha) = H'(\alpha)$ and $s_e(\alpha) = G'(\alpha)$. The exact expressions are delegated to appendix B.3.

4.5 Wage setting

In this section we address the determination of wages. Regular firms can be matched with regular workers or potential entrepreneurs seeking to take a paid job, however, small businesses only hire regular workers. This gives rise to several types of wage negotiations which we model by means of Nash bargaining. First, we describe the wage bargaining between regular firms and potential entrepreneurs.

Bargaining with potential entrepreneurs: Consider a match between a regular firm and a potential entrepreneur and let the corresponding present value of a job be

denoted by J , it becomes:

$$rJ = y - \bar{c}_k - w - \bar{\gamma}J - \delta(1 - F(\alpha_s(w)))J$$

where \bar{c}_k corresponds to the flow cost of capital for regular firms. This equation shows that the total job destruction rate associated with potential entrepreneurs is relatively high since there is a positive probability $\delta(1 - F(\alpha_s(w)))$ that they will quit the job and enter self-employment. This reduces the value of the job surplus to the firm.

In order to model wage bargaining between job applicants and regular firms we follow the approach in Gautier (2002). This approach assumes that applicants matched with an employer and negotiating over the wage stop searching for alternative jobs. In addition, we assume that they also disregard their activities in self-employment out of necessity, since paid employment is a superior state of income (i.e. $E_s(\alpha) < W \quad \forall \quad \alpha < \alpha_s$). However, they continue considering self-employment out of opportunity and the possibility of starting a business (which happens for $\alpha > \alpha_s$) while negotiating with a regular employer. The advantage of this approach is that labour contracts are renegotiation proof, meaning that potential entrepreneurs receive the same wage w in paid employment irrespective of their previous income in self-employment. Assuming additionally that potential entrepreneurs still enjoy the unemployment benefit z while bargaining, but no longer the stigma of failure h , gives rise to the following Nash bargaining problem:⁸

$$\max_w \left(\frac{w(1-t) - z}{r + \bar{\gamma}} \right)^\beta \left(\frac{(y - \bar{c}_k - w)}{r + \bar{\gamma} + \delta(1 - F(\alpha_s(w)))} \right)^{1-\beta}$$

This equation shows that higher wages have an ambiguous effect on the present value of firms' profits. On the one hand, there is the direct effect of higher labour costs reducing profits. But on the other hand, paying a higher wage reduces the probability that the potential entrepreneur employed in a regular job will quit into self-employment (i.e. higher $\alpha_s(w)$). This reduces the effective job destruction rate from the perspective of the firm and has a positive effect on the present value of profits.

Proposition 6: *The wage of potential entrepreneurs in paid employment is given by:*

$$w(1-t) = \beta(y - \bar{c}_k)(1-t) + (1-\beta)z + (1-\beta) \frac{(y - \bar{c}_k - w)(w(1-t) - z)\delta f(\alpha_s)}{r + \bar{\gamma} + \delta(1 - F(\alpha_s))} \frac{\partial \alpha_s}{\partial w}$$

where $\partial \alpha_s / \partial w$ is given by equation (10). If the distribution of production efficiency is uniform ($f(\alpha) = 1$) and $\gamma \leq \bar{\gamma}$ then the wage is increasing in the productivity y and in the bargaining power β such that $z \leq w(1-t) \leq (y - \bar{c}_k)(1-t)$.

Proof: appendix B.4

This proposition presents conditions which are sufficient for the wage w to be increas-

⁸The present value of potential entrepreneurs in paid jobs W and their disagreement value W_D are presented in appendix B.4

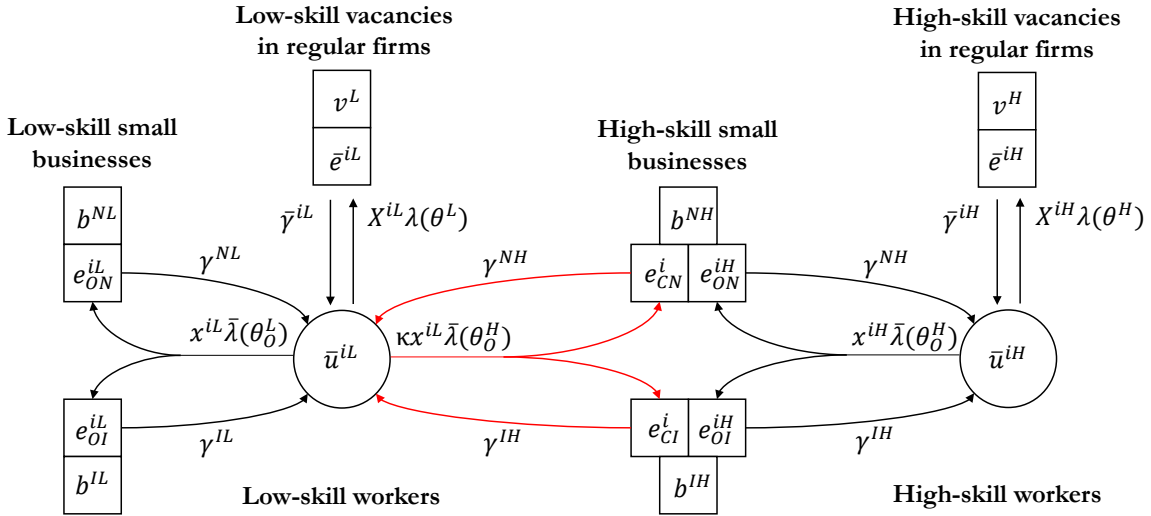
ing in the productivity y and the bargaining power β , however, these conditions are strong and the described properties of the wage hold for a broader range of parameter values.

We follow the same approach and use the renegotiation-proof Nash bargaining for determining wages of regular workers in large and medium-size firms (\bar{w}) and in small businesses ($w_{0N}, w_{0I}, w_{CN}, w_{CI}$). The subindex refers to the type of small business, for example, $0N$ indicates wages paid by native small businesses to their employees, while the subindex $0I$ indicates wages paid by immigrant small businesses. Further, the subindex CN indicates wages paid by native high-skill businesses to low-skill employees, while the subindex CI indicates wages paid by immigrant high-skill businesses to their low-skill workers (engaged in cross-skill matching). In appendix B.4 we show that each wage is a weighted average of the respective productivity ($\bar{y}, y_{0N}, y_{0I}, y_{CN}, y_{CI}$) and the unemployment benefit \bar{z} . We use parameter β_0 for the bargaining power of workers in small businesses. All wages and productivities are specific to a particular demographic group of the individual ij , where the superscript ij was omitted for the ease of exposition.

4.6 Matching and free-entry

In this section we describe matching between searching workers and vacancies in the market for regular jobs, as well as matching between searching workers and openings in small businesses. Figure 6 illustrates all the states and transitions of regular workers.

Figure 6: Labour market states and transitions of regular workers



The middle part of the diagram (red) corresponds to the cross-skill matching whereby low-skill regular workers apply for positions in high-skill small businesses. We use parameter κ to describe the intensity of cross-skill matching.⁹ This parameter allows us to determine the number of regular workers searching and applying for positions in small busi-

⁹A doctor hiring a receptionist or a tax-consultant hiring a secretary are the real life examples of the type of cross-skill matching our model captures.

nesses given by Σ_0^j . Σ_0^L consists of unemployed regular low-skill workers \bar{u}^{iL} weighted by their search intensities x^{iL} , whereas Σ_0^H consists of unemployed regular high-skill workers \bar{u}^{iH} weighted by their search intensities x^{iH} as well as regular low-skill workers weighted by their search intensities κx^{iL} . With this notation we get:

$$\Sigma_0^j = x^{Ij} \bar{u}^{Ij} + x^{Nj} \bar{u}^{Nj} + \mathbb{1}_H \kappa (x^{iL} \bar{u}^{iL} + x^{NL} \bar{u}^{NL})$$

where $\mathbb{1}_H$ takes value 1 for $j = H$ and value 0 for $j = L$.

Next, consider low-skill small businesses. From proposition 4 we know that the average number of immigrant employees per small business is given by $\bar{q}(\theta_0^L) \mu / \gamma^{iL}$, where i reflects the ethnic group of the business owner. At the same time, the average number of native employees is $\bar{q}(\theta_0^L) (1 - \mu) / \gamma^{iL}$. Given that the number of small businesses in this group is equal to b^{iL} , we can find the number of immigrant and native workers employed in these businesses e_{0i}^{iL} and e_{0i}^{NL} :

$$\frac{\bar{q}(\theta_0^L)}{\gamma^{iL}} b^{iL} = \frac{e_{0i}^{iL}}{\mu} = \frac{e_{0i}^{NL}}{1 - \mu} \quad \text{where} \quad \mu = \frac{x^{iL} \bar{u}^{iL}}{x^{NL} \bar{u}^{NL} + x^{iL} \bar{u}^{iL}} \quad (14)$$

Here the superscript $i = N, I$ refers to the ethnic background of the worker, while the subscript refers to the ethnic background of the entrepreneur and 0 stands for small businesses. Next consider high-skill businesses. Here the average number of immigrant high-skill employees is given by $\bar{q}(\theta_0^H) \mu^{iH} / (\gamma^{iH})$, while the average number of native high-skill workers is $\bar{q}(\theta_0^H) \mu^{NH} / (\gamma^{iH})$. In a similar way, we can use information about the average number of immigrant and native low-skill employees. Multiplying the average number of employees per business with the number of businesses b^{iH} yields the following:

$$\frac{\bar{q}(\theta_0^H)}{\gamma^{iH}} b^{iH} = \frac{e_{0i}^{iH}}{\mu^{iH}} = \frac{e_{0i}^{NH}}{\mu^{NH}} = \frac{e_{Ci}^I}{\mu^{iL}} = \frac{e_{Ci}^N}{\mu^{NL}} \quad (15)$$

where the probabilities of hiring an employee of type iH and iL from the perspective of the business owner are given by:

$$\mu^{iH} = \frac{x^{iH} \bar{u}^{iH}}{\sum_{i=I,N} x^{iH} \bar{u}^{iH} + \kappa x^{iL} \bar{u}^{iL}} \quad \text{and} \quad \mu^{iL} = \frac{\kappa x^{iL} \bar{u}^{iL}}{\sum_{i=I,N} x^{iH} \bar{u}^{iH} + \kappa x^{iL} \bar{u}^{iL}}$$

In the benchmark specification these probabilities do not depend on the ethnic background of the business owner, however, we relax this assumption in section D.3, where we study the implications of ethnic segregation in small businesses.

Further, we write down the steady state equation for employees in regular jobs: $X^{ij} \lambda(\theta^j) \bar{u}^{ij} = \bar{\gamma}^{ij} \bar{e}^{ij}$ and take into account that the total number of workers employed in small businesses is given by: $\bar{e}_0^{ij} = e_{0N}^{ij} + e_{0I}^{ij} + \mathbb{1}_L (e_{CN}^i + e_{CI}^i)$, where the indicator function $\mathbb{1}_L$ takes value one for $j = L$ and zero otherwise. This allows us to find the equilibrium unemployment rate of regular workers given by: $\bar{u}^{ij} = d^{ij} - l^{ij} - \bar{e}^{ij} - \bar{e}_0^{ij}$. The exact

expression is presented in appendix B.5.

Finally, we consider vacancy posting in regular jobs. Let $\bar{c} = \bar{c}_h + \bar{c}_k$ be the total cost of capital and posting and V the present value of expected profits associated with an open vacancy. Imposing the free-entry condition $V = 0$ to get:

$$\frac{\bar{c}}{q(\theta)} = \sum_{i=I,N} \underbrace{\frac{X^i \bar{u}^i}{\sum_{i=I,N} X^i (\bar{u}^i + u^i + s_u^i)}}_{\text{matching with regular workers}} \bar{J}^i + \underbrace{\frac{X^i (u^i + s_u^i)}{\sum_{i=I,N} X^i (\bar{u}^i + u^i + s_u^i)}}_{\text{matching with pot. entrepreneurs}} J^i \quad (16)$$

Thus, regular firms create vacancies up to the point, where the expected cost of an open vacancy is equal to the expected present value of profits from a filled job. Writing down these equations for $j = L, H$ allows us to find the equilibrium vacancies v^L and v^H .

4.7 Production of the final good and welfare

The final good is produced using capital K and a composite good Z using the constant returns to scale technology (1). The composite good Z is produced using two intermediate inputs, Y_L and Y_H according to the CES production function (2), where Y_j is a linear aggregate of output quantities produced by regular workers and potential entrepreneurs of type j , so it can be calculated as:

$$\begin{aligned} Y_j = & \sum_{i=I,N} \left(\varsigma^{ij} \int_{\alpha_u^{ij}}^{\alpha_s^{ij}} \alpha s_u^{ij}(\alpha) d\alpha + \varsigma^{ij} \int_{\alpha_s^{ij}}^{\alpha_0^{ij}} \alpha s_e^{ij}(\alpha) d\alpha + \varsigma^{ij} \int_{\alpha_0^{ij}}^{\bar{\alpha}} \alpha b^{ij}(\alpha) d\alpha \right. \\ & \left. + \varphi^{ij} e^{ij} + \bar{\varphi}^{ij} \bar{e}^{ij} + \varphi_{0N}^{ij} e_{0N}^{ij} + \varphi_{0I}^{ij} e_{0I}^{ij} + \mathbf{1}_L (\varphi_{CN}^i e_{CN}^i + \varphi_{CI}^i e_{CI}^i) \right) \end{aligned}$$

where the first three terms include output quantities of self-employed entrepreneurs and business owners, $\varphi^{ij} e^{ij}$ is the output produced by potential entrepreneurs employed in regular jobs, $\bar{\varphi}^{ij} \bar{e}^{ij}$ – output produced by workers in regular jobs, and the remaining terms constitute the output produced by workers employed in small businesses. Finally, the indicator variable takes value 1 for $j = L$ and value zero for $j = H$.

Since capital as well as the two intermediate goods are supplied in competitive markets, their prices R and P^j are equal to the marginal productivities:

$$R = A\eta K^{\eta-1} [aY_L^\rho + (1-a)Y_H^\rho]^{\frac{1-\eta}{\rho}} \quad (17)$$

$$P_L = a(1-\eta)AK^\eta Y_L^{\rho-1} [aY_L^\rho + (1-a)Y_H^\rho]^{\frac{1-\eta-\rho}{\rho}} \quad (18)$$

$$P_H = (1-a)(1-\eta)AK^\eta Y_H^{\rho-1} [aY_L^\rho + (1-a)Y_H^\rho]^{\frac{1-\eta-\rho}{\rho}} \quad (19)$$

where R is the exogenous price of capital including the risk-free interest rate and the cost of capital depreciation. Finally, let $\bar{\Omega}^{ij}$, denote social welfare of regular workers and Ω^{ij} denote the welfare of potential entrepreneurs in the demographic group ij . Since potential entrepreneurs are characterized by production efficiency α , we calculate an

average production efficiency in each group:

$$\bar{\alpha}_{us} = \int_{\alpha_u}^{\alpha_s} \alpha \frac{s_u(\alpha)}{s_u} d\alpha \quad \bar{\alpha}_{s0} = \int_{\alpha_s}^{\alpha_0} \alpha \frac{s_e(\alpha)}{s_e} d\alpha \quad \bar{\alpha}_{01} = \int_{\alpha_0}^{\bar{\alpha}} \alpha \frac{b(\alpha)}{b} d\alpha$$

Variable $\bar{\alpha}_{us}$ stands for the average production efficiency of solo self-employed out of necessity distributed in the range $[\alpha_u \dots \alpha_s]$. Variable $\bar{\alpha}_{s0}$ denotes the average production efficiency of solo self-employed out of opportunity distributed in the range $[\alpha_s \dots \alpha_0]$ and, finally, $\bar{\alpha}_{01}$ corresponds to the average production efficiency of business owners distributed in the range $[\alpha_0 \dots \bar{\alpha}]$. Based on these definitions, the welfare values for all worker groups can be obtained as (we suppress the upper index ij for the ease of exposition):

$$\begin{aligned} \bar{\Omega} &= \frac{1}{d-l} (\bar{u}(\bar{z} - h) + (1-t)(\bar{e}\bar{w} + e_{0N}w_{0N} + e_{0I}w_{0I} + \mathbb{1}_L(e_{CN}w_{CN} + e_{CI}w_{CI}))) + T \\ \Omega &= \frac{1}{l} \left(u(z - h) + (1-t)(ew + s_u\sigma\bar{\alpha}_{us} + s_e\sigma\bar{\alpha}_{s0} + b\sigma\bar{\alpha}_{01}) + \underbrace{b\left(-c + \frac{\bar{q}(\theta_0)}{\gamma}\pi(r + \gamma)\right)}_{\text{net profit from coworkers}} \right) + T \end{aligned}$$

where the indicator function $\mathbb{1}_L$ takes value one for $j = L$ and zero otherwise and variable T is the lump-sum transfer from the public budget. The cash inflow into the public budget consists of revenues from labour income taxes of regular workers and potential entrepreneurs BR_t and corporate taxes paid on flow profits by small businesses and regular jobs BR_τ . The outflow from the public budget consists of expenses for unemployment benefits for all demographic groups BE . Given that total revenues exceed substantially the expenses for unemployment benefits, the surplus of the budget is equally split and distributed as a lump-sum transfer T across all worker groups. The revenues and expenses are calculated as follows:

$$\begin{aligned} BR_t &= t \sum_{ij} \left(\underbrace{\bar{e}\bar{w} + e_{0N}w_{0N} + e_{0I}w_{0I} + \mathbb{1}_L(e_{CN}w_{CN} + e_{CI}w_{CI})}_{\text{income taxes of regular workers}} \right. \\ &\quad \left. + \underbrace{ew + s_u\sigma\bar{\alpha}_{us} + s_e\sigma\bar{\alpha}_{s0} + b\sigma\bar{\alpha}_{01}}_{\text{income taxes of potential entrepreneurs}} \right) \\ BR_\tau &= \tau \sum_{ij} \left(\underbrace{b \frac{\bar{q}(\theta_0)}{\gamma} \frac{\pi(r + \gamma)}{1 - \tau}}_{\text{small businesses}} + \underbrace{(\bar{y} - \bar{c}_k - \bar{w})\bar{e} + (y - \bar{c}_k - w)e}_{\text{regular jobs}} \right) \\ BE &= \sum_{ij} zu + \bar{z}\bar{u} \quad T = \frac{1}{\sum_{ij} d} (BR_t + BR_\tau - BE) \end{aligned} \tag{20}$$

where $\sum_{ij} d$ is the total size of the population. It is normalized to 1 in the benchmark calibration, but will be larger than 1 upon the immigration shock.

5 Calibration

For calibrating the model we use data from the German Socio-Economic Panel (SOEP) for the period 2000-2017. Table 5 shows population shares of the eight demographic groups depending on the ethnic background, skills and entrepreneurial potential. We used the same sample when formulating the stylized facts in section 3. Based on this data we match the population structure (d^{ij} and l^{ij}) for all groups.

Table 5: Sample profile

	Native, low-skilled			Native, high-skilled		
	l	$d - l$	Sum	l	$d - l$	Sum
Share	0.061	0.449	0.510	0.065	0.261	0.326
Obs.	18464	135906	154370	19675	79001	98676
	Immigrant, low-skilled			Immigrant, high-skilled		
	l	$d - l$	Sum	l	$d - l$	Sum
Share	0.013	0.124	0.137	0.005	0.022	0.027
Obs.	3935	37533	41468	1513	6659	8172

Note: Authors' calculations using SOEP 2000-2017. The table shows population shares of all demographic groups. The sample has 302686 observations. All estimates are generated using individual sampling weights.

Beyond the population shares, our model includes a vector of 13 parameters specific to the four demographic groups $i = I, N$ and $j = L, H$: $\{x, X, \gamma, \delta, c, \varsigma, \bar{\gamma}, \varphi_{0I}, \varphi_{0N}, \bar{\varphi}, \varphi, \bar{z}, z\}^{ij}$. Recall that variables φ and ς denote output quantities produced by employed and self-employed individuals, for example, $y_{0I}^{ij} = \varphi_{0I}^{ij} P^j$ and $y_{0N}^{ij} = \varphi_{0N}^{ij} P^j$. This is combined with four parameters $\varphi_{CI}^i, \varphi_{CN}^i, i = I, N$ corresponding to output quantities of low-skill workers employed in high-skill small businesses (cross-skill matching). Five parameters are skill-specific but common to all workers in the same skill group; these parameters include $\{M, \bar{M}, \bar{c}, \beta_0, t\}^j$ for $j = L, H$. There are 11 parameters common to all demographic groups; these are $\{r, \rho, \eta, R, \kappa, \zeta, a, A, h, \tau, \beta\}$.

To summarize, the model has 73 parameters; 50 of these parameters are calibrated by targeting data moments from the SOEP, and the rest are either taken from the literature, normalized to one, or taken from macro data on legally set indicators such as the tax rates and the replacement rate. Table 14 in the appendix contains a complete list of the calibrated parameter values and targeted data moments. The rest of this section is dedicated to providing details of the calibration strategy.

Preset Parameters: One period of time is one quarter, so we set $r = 0.0125$ corresponding to the 5% annual interest rate. Following Ottaviano and Peri (2012) and Battisti et al. (2018), we take $\rho = 0.5$, the parameter governing the elasticity of substitution between high and low-skill labour. Following Chassamboulli and Palivos (2014) and Battisti et al. (2018), we set the quarterly cost of capital for the final goods producer

and the capital share as follows: $R = 0.03$, $\eta = 0.35$.

Calibrated Parameters: The search intensity parameters x^{ij} , X^{ij} and the multipliers of the matching function M^j , \bar{M}^j can not be identified separately from the data, so we normalize $x^{NL} = 1$, $x^{NH} = 1$, $X^{NL} = 1$, $X^{NH} = 1$. Targeting the empirically observed unemployment rates of potential entrepreneurs and regular workers \bar{u}^{ij} , u^{ij} from tables 1 and 2, we compute x^{Ij} , X^{Ij} , M^j and \bar{M}^j . This way we incorporate the empirical evidence from SF3 that regular workers have higher unemployment rates than potential entrepreneurs. We use the remaining data moments from table 1 and table 3 to calibrate parameters $\gamma, \delta, c, \varsigma$ for each group of entrepreneurs ij . In addition, we use information about the tenure of native and immigrant workers in regular jobs from table 13 in the appendix to identify the job-destruction rates $\bar{\gamma}$. We target the average job tenure in small firms, 8.2 years, to obtain the cross-skill matching parameter $\kappa = 0.170$. The calibrated job destruction rates of small businesses γ vary between 0.029 and 0.036 depending on the type of business owner; this corresponds to the 2-year survival probabilities in the range 71 – 76%.

The model has three tax rates: income tax t^L for low-skilled workers, t^H for high-skilled workers, and a corporate tax τ for small businesses and large firms. According to German law, solo self-employed individuals and freelancers are subject to the tax on labour income. The regular income tax varies between 14-45% depending on the taxpayer's income. Therefore, we use an average tax rate of 25% for low-skilled workers and solo self-employed entrepreneurs and a tax rate of 35% for the high-skilled group. We use a 15% tax rate for corporate taxes, in line with the German law.

The information on the share of net wages in the total output (GDP) over the years 2000-2017 with an average equal to 28% is used to obtain workers' bargaining power in regular jobs ($\beta = 0.9$).¹⁰ The relatively high bargaining power suggests that a substantial share of the GDP consists of labour taxes, corporate taxes, and non-labour costs. In contrast, the share of firm profits is relatively low.

The quantity produced by native regular workers in a given skill group is normalized to 1 unit so that $\bar{y}^{NL} = P_L$ and $\bar{y}^{NH} = P_H$. Using these identities combined with equations (18) and (19), we find parameters $A = 2.563$ and $a = 0.555$. To calibrate output quantities for all worker groups, we rely on the Mincer earnings regressions from section 3 with a logarithm of gross monthly wages as dependent variable (see figure 2 and regression tables in appendix C.1). The average wage of native low-skill workers employed in small businesses is normalized to 1, $\bar{w}_0^{NL} = 1$. This means that 1 monetary unit corresponds to 1086 EUR.

According to the German regulation, unemployed individuals eligible for unemployment insurance obtain 60% of the previous net wage for a maximum period of 12 months (ALG I).¹¹ After the unemployment spell of 12 months, the person becomes eligible for

¹⁰www.destatis.de Volkswirtschaftliche Gesamtrechnungen, Fachserie 18, Reihe 1.4, Tabelle 2.1.8

¹¹www.arbeitsagentur.de. The unemployment benefit is slightly higher for families with children, and

social support (ALG II). This support was introduced during the labour market reform in 2005 and remained at 400 EUR until it started increasing in 2017. In order to account for the sharp reduction of the unemployment benefit after the first year of payments, we calculated a permanent flow value such that its present value is equivalent to 60% of the average net wage for 4 quarters and the normalized income 0.368 thereafter. Using wages predicted by the Mincer earnings regression, we find parameters z^{ij} and \bar{z}^{ij} . Further, we take $h = 0.3$ as the disutility from unemployment, ensuring that the model is internally consistent and potential entrepreneurs accept paid jobs ($W > U$) despite attractive opportunities in self-employment and entrepreneurship.

Combining predicted earnings with the Nash bargaining equations for wages allows us to indirectly infer the productivities of employees in paid employment $\{\bar{y}, y\}^{ij}$. Dividing these values by the endogenous prices of intermediate goods P^j , we find the quantities $\{\bar{\varphi}, \varphi\}^{ij}$. Further, combining information on wages of workers in small firms from table 4 and the corresponding profits of small businesses, we obtain the bargaining power parameters in small firms: $\beta_0^L = 0.456$ and $\beta_0^H = 0.422$ (see appendix C.2 for details). Both parameters are relatively close to 50% since bargaining between the self-employed entrepreneur and a worker in a small business is likely to be individual. In contrast, workers in medium and large firms are likely to be covered by collective agreements. Combining these values of β_0 with the Nash bargaining equations and predicted wages of workers in small businesses we find the productivities $\{y_{0I}^{ij}, y_{0N}^{ij}, y_{CI}^i, y_{CN}^i\}$ and the corresponding output quantities $\{\varphi_{0I}^{ij}, \varphi_{0N}^{ij}, \varphi_{CI}^i, \varphi_{CN}^i\}$ $i = I, N, j = L, H$.

To estimate ζ , the elasticity parameter in the Cobb-Douglas matching function, we use statistics from the Federal Employment Office (Bundesagentur für Arbeit) between January 2000 and December 2018. It includes information on the absolute number of unemployed, vacancies and vacancy durations, which are not available in the SOEP survey. We use this information for calibrating ζ (see appendix C.3 for details). In addition, we use information about the average vacancy duration, which was 64 days or 64/92 quarters in the considered period. Targeting this data moment and using the free-entry condition (16) for $j = L, H$ allows us to find the flow cost of a vacancy \bar{c}^j . Further, we rely on the findings by Rebien et al. (2020) for the average recruitment cost. It is 521 EUR for positions with vocational training qualification (i.e., low-skill), whereas 2046 EUR for high-skill positions. Normalized values of these costs yield parameters \bar{c}_h^j for $j = L, H$. The flow cost of capital is then obtained as a residual category $\bar{c}_k^j = \bar{c}^j - \bar{c}_h^j$.

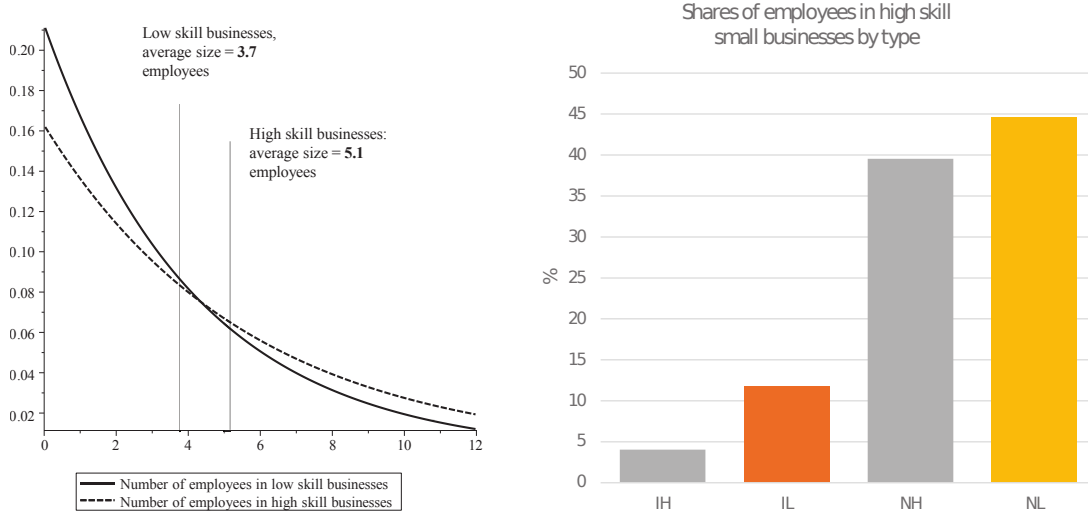
Parameters Validation: In order to check the plausibility of our parameter values, we compare the non-target moments (the average size of micro-enterprises) generated by our model to those provided by the official statistics.¹² The calibration exercise shows that high-skill businesses are larger, with 5.1 employees on average, whereas the size of

the duration of benefits can be longer for older individuals above the age of 50. However, we use the replacement rate of 60% as a benchmark value.

¹²www.destatis.de “Code: 48121-0001, Enterprises, persons employed, turnover and other business and economic figures: Germany, years, enterprise size”.

low-skill businesses is smaller, with 3.7 employees on average. This is illustrated on figure 7. The right panel of this figure shows the calibrated shares of coworkers from different demographic groups in high-skill small businesses.

Figure 7: Left: firm size distribution in small businesses. Right: shares of employees from different demographic groups in high-skill small businesses



In the official statistics, micro-enterprises are defined as businesses with less than 9 coworkers, and their average size equals 2.7 over the period 2008 – 2017. For comparison, we calculated conditional average numbers of employees (less or equal to 9) in our setting. They are equal to 2.6 for low-skill businesses and 3.1 for high-skill businesses. Similarly, our 2-year survival probabilities in the range 71 – 76% are close to the average 2-year survival probability reported for Germany by the OECD and equal to 70.7%.¹³ The values of non-target moments generated by our model are very close to those in the official statistics, which supports our parametrization strategy.

Furthermore, our calibration captures the empirical observation that high-skill workers are more likely to undertake entrepreneurial activities than low-skill workers. In the calibrated model the shares of active entrepreneurs among native and immigrant low skill individuals are equal to 6.6% and 5% respectively. In contrast, the shares are almost two times higher in the high-skill subgroup reaching 11.4% and 10.6% among natives and immigrants. We find that this model property is supported by the previous empirical research. For example, Ahn and Winters (2023) provide causal evidence that formal education enhances entrepreneurship. Combining the two skill groups together yields an average share of active entrepreneurs in the population equal to 8%. The official time series by Destatis (2005-2017) show that 9.9% of the workforce are active entrepreneurs, hence our estimate is only slightly smaller than the one in the official statistics.)¹⁴

¹³OECD.stat SDBS Business Demography Indicators (ISIC Rev. 3): Enterprise survival rates

¹⁴The figure is generated using data based on the microcensus on “occupational status” for the population by migration background available in Table 16 of Subject Series 1, Series 2.2 “Population with a Migration Background”.

6 Results

In this section, we discuss the results of two experiments. First, we analyze the labor market's response to an exogenous low-skill immigration shock similar to the one observed in Germany in 2012 – 2017. Second, we conduct a counterfactual experiment restricting immigrants from entering entrepreneurship and quantify how such a ban affects the welfare of all demographic groups. In addition, in section 6.3 we briefly discuss the implications of the recently established cooperation between Germany and India on worker mobility and summarize our conclusions related to the ethnic segregation of small businesses.

6.1 Low-skill immigration

Aggregate statistics reveal that the increase in the number of registered immigrants with own migration experience in 2012 – 2017 was approx. 3 million, whereas the starting stock of individuals with immigration background in 2012 was 15 million.¹⁵ This corresponds to the net immigration inflow of 20%. Since the immigration to Germany in this period consisted predominantly of the refugee influx, it is considered low-skill biased (Busch et al., 2020). Another reason is the skill degradation of immigrants upon arrival (Dustmann et al., 2013), as many high-skill workers take low-skill jobs. Hence, we study the implications of a 20% increase in the immigrant labour force attributed to low-skill immigration. This corresponds to a 24% increase in the number of low-skill immigrants and no change in the stock of high-skill immigrants, i.e., $\Delta d = 0.2(d^{IL} + d^{IH}) = 0.24d^{IL} = 0.033$. This implies an increase in the total population equal to 3.3% and an increase in the share of the low-skill population from 64.6% to 65.9%.

Table 6 displays changes in the key labour market indicators, namely: aggregate outputs Y_j , prices P^j , market tightness θ^j and θ_0^j , the capital cost rK , and the lump-sum transfer from the budget T . Table 7 summarizes our findings and presents %-changes in welfare for all worker groups compared to the benchmark (before migration shock) equilibrium in row (0). When analyzing the results, we decompose the total effect of immigration into four steps (A)-(D) with a step-wise adjustment of the key aggregate variables such as capital, fiscal transfers and the business entry thresholds. Even though our findings are limited to the steady state analysis and capture the long-run adjustment, first steps of the decomposition could also be informative of the short-run effects. The decomposition includes the following four steps:

- (A) In this step, we keep constant the capital stock K , the lump-sum transfer T , and the business entry thresholds α_0^{ij} for all potential entrepreneurs. Thus, the main effect of immigration at this stage is the change in the prices of intermediate goods P^j , $j = L, H$, which are directly linked to the productivities and wages of all workers. The market tightness variables θ^j and θ_0^j respond endogenously.

¹⁵www.destatis.de Bevölkerung mit Migrationshintergrund, Fachserie 1, Reihe 2.2

- (B) In this step, we allow for an endogenous adjustment of the capital stock K , but the lump-sum transfer T and the business entry thresholds α_0^{ij} for all potential entrepreneurs remain constant. The demand for capital is given by equation (17).
- (C) In this step, we update the lump-sum transfer T , but the business entry thresholds α_0^{ij} are still constant for all potential entrepreneurs. The new value of T follows from the budget constraint (20).
- (D) In the final step, we allow for the endogenous adjustment of the entry thresholds α_0^{ij} based on the business entry condition from proposition 1.

Table 6: Detailed changes of variables upon a 20% increase in low-skill immigration.

	Low-skilled				High-skilled				Aggregate	
	P^L	Y_L	θ_0^L	θ^L	P^H	Y_H	θ_0^H	θ^H	rK	T
(0)	5.221	0.459	0.443	0.103	5.303	0.287	1.356	0.626	0.879	0.493
(A)	5.171	0.471	0.417	0.091	5.307	0.288	1.280	0.632	0.879	0.493
(B)	5.199	0.476	0.426	0.096	5.340	0.291	1.312	0.673	0.903	0.493
(C)	—	—	—	—	—	—	—	—	—	0.486
(D)	5.198	0.476	0.427	0.096	5.341	0.291	1.316	0.675	0.904	0.487

Note: The table decomposes the impact of low-skill migration on endogenous variables in several steps. Row (C) only includes an adjustment of the lump-sum transfer T . Row (D) shows values in the post-migration equilibrium after a full adjustment.

Table 6 (row-A) shows that low-skill immigration is associated with a lower price of the low-skill intermediate good P^L and a higher price of the high-skill intermediate good P^H . This is a classical effect of immigration reducing productivity and wages in the same skill group and raising the productivity and wages of the other group of workers. At the same time, increasing numbers of low-skill immigrants imply that there are more applicants for low-skill positions posted by regular firms, making it easier for firms to hire workers. This effect boosts job creation in the low-skill submarket; thus, regular firms respond by creating more vacancies. This positive job creation effect increases aggregate output Y_L despite a drop in the marginal productivity of low-skill workers, reflected in the lower price P^L (table 6, row-A). Nevertheless, a larger number of applicants for regular jobs creates competition among workers, which is not compensated by the increase in vacancies. Due to this process, the market tightness θ_L and the job-finding rate in the low-skill submarket fall (table 6, row-A).

This development comes along with a lower welfare of low-skill individuals Ω^{iL} and $\bar{\Omega}^{iL}$ and an increase in welfare of high-skill individuals Ω^{iH} and $\bar{\Omega}^{iH}$, $i = I, N$ (Table 7, row-A). Moreover, it fosters the reallocation of native potential entrepreneurs with low skills from regular paid jobs to solo self-employment. Table 8 column (2) shows that the fraction of native potential entrepreneurs employed in regular jobs falls by 5.7%, and their wages also fall substantially in column (3). At the same time, their fraction in solo

self-employment (column (4)) is increasing by 8.9%. The losses in the welfare of low-skill entrepreneurs (Table 7, row-A) are smaller compared to regular workers because the probability of hiring employees $\bar{q}(\theta^L)$ is increasing (note a lower θ_0^L), which moderates the negative effect of lower productivity on business profits. For the same reason, high-skill entrepreneurs' welfare gains are higher than high-skill regular workers.

In step (B), capital K adjusts endogenously. Firms in the final goods sector increase capital K , which has a positive effect on the productivity and welfare of all worker groups via changes in prices and market tightness. Due to capital adjustment, the welfare losses in step (A) are slightly compensated for low-skill workers.

In step (C), we update the lump-sum budget transfer T and welfare values. This transfer is measured per person and is lower in the post-immigration equilibrium. There are two reasons for this reduction. First, a composition effect is emerging because the net fiscal contribution of an average low-skill immigrant is lower than that of an average native. Second, there is an endogenous adjustment of equilibrium variables described in table 6 reducing wages of low-skill workers and their net fiscal contribution below the pre-immigration level. A combination of these effects leads to a lower lump-sum transfer per person $0.486 < 0.493$ in the post-immigration equilibrium, reducing the welfare of all worker groups (Table 7, row-C).

Table 7: Increase in immigration by 20%, low-skill scenario

	Low-skilled				High-skilled			
	Regular workers		Pot. entrepreneurs		Regular workers		Pot. entrepreneurs	
	N $\bar{\Omega}^{NL}$	I $\bar{\Omega}^{IL}$	N Ω^{NL}	I Ω^{IL}	N $\bar{\Omega}^{NH}$	I $\bar{\Omega}^{IH}$	N Ω^{NH}	I Ω^{IH}
(0)	1.552	1.405	1.523	1.497	1.988	1.641	1.970	1.810
(A)	Keeping K , T and α_0^{ij}							
	-2.05%	-2.21%	-1.09%	-0.92%	+0.28%	+0.29%	+0.34%	+0.76%
(B)	Keeping T and α_0^{ij} fixed							
	-0.94%	-1.03%	-0.54%	-0.36%	+1.26%	+1.39%	+0.77%	+0.83%
(C)	Keeping α_0^{ij} fixed							
	-1.36%	-1.50%	-0.97%	-0.80%	+0.78%	+0.93%	+0.44%	+0.47%
(D)	Full adjustment							
	-1.27%	-1.37%	-2.04%	+3.15%	+1.00%	+1.08%	+0.34%	+3.10%
	Representative worker: -1.59%				Representative worker: +0.9%			
	Incumbent worker: -1.27%							
	Representative worker: -0.88%							
	Incumbent immigrant: -0.47%							
	Incumbent worker: -0.37%							

Note: The table decomposes the impact of low-skill migration on welfare (expected income) of different demographic groups in several steps. Row (D) shows the change in welfare after a full adjustment of endogenous variables in the post-migration equilibrium. The second last panel reports welfare changes for a representative/incumbent worker in a given skill group. The last panel reports welfare changes for a representative/incumbent worker in the economy.

In the final step (D), we allow endogenous adjustment of the entrepreneurial business entry cutoffs α_0^{ij} . This is the novel part of our model, so we zoom in on the job creation process and potential entrepreneurs' business entry decisions in table 8 starting with the low-skill submarket. On the one hand, hiring workers for open positions becomes easier ($d\bar{q} > 0$). However, on the other hand, a drop in the price of the low-skill intermediate good makes workers in low-skill businesses less productive and leads to a lower profit per person ($d\pi^i < 0, i = I, N$). Table 8 shows that the first effect is dominating for businesses operated by immigrant entrepreneurs. Their profits in column (8) increase, making such businesses more attractive for their owners:

$$d\bar{q}\pi^I = \pi^I d\bar{q} + \bar{q} d\pi^I > 0$$

As a response, we observe a 13% increase in the fraction of immigrant potential entrepreneurs operating small businesses in column (6), inducing a reallocation of immigrant potential entrepreneurs away from regular jobs and solo self-employment towards operating small businesses. These effects are associated with a sizable increase in the welfare of immigrant potential entrepreneurs Ω^{IL} in table 7.

Table 8: Detailed changes in the steady-state distribution of potential entrepreneurs upon a 20% increase in low-skill immigration

Group	(1) u/l	(2) e/l	(3) w	(4) $(s_u + s_e)/l$	(5) $\sigma\bar{\alpha}_{u0}$	(6) b/l	(7) $\sigma\bar{\alpha}_{01}$	(8) $\bar{q}(\theta_0)\pi/\gamma$
Low-skill								
Natives	0.035	0.418	1.222	0.259	1.145	0.288	1.291	1.971
Change	+0.001	-0.057	-0.019	+0.089	+0.019	-0.032	-0.004	-0.001
Low-skill								
Immigr.	0.049	0.426	1.245	0.251	1.100	0.274	1.314	2.077
Change	+0.001	-0.054	-0.019	-0.077	-0.102	+0.130	-0.019	+0.01
High-Skill								
Natives	0.014	0.418	1.884	0.290	1.883	0.277	1.953	3.763
Change	-0.001	+0.072	+0.030	-0.070	+0.010	-0.001	+0.014	-0.000
High-Skill								
Immigr.	0.039	0.384	1.309	0.206	1.199	0.370	1.374	5.270
Change	-0.001	+0.056	+0.026	-0.093	-0.092	+0.037	+0.006	+0.004

Note: $\bar{\alpha}_{u0}$ is the average entrepreneurial ability in the range $[\alpha_u, \alpha_0]$, calculated as $(s_u\bar{\alpha}_{us} + s_e\bar{\alpha}_{s0})/(s_u + s_e)$. $\bar{\alpha}_{01}$ is the average entrepreneurial ability in the range $[\alpha_0, \bar{\alpha}]$. Variables in columns (1), (2), (4), (6) are shares and add up to 1. Variables in columns (3), (5), (7), (8) have monetary interpretation; one monetary unit corresponds to 1086 EUR.

Considering the situation of native businesses, we find that the drop in productivity is dominating and leads to a slight decrease in profits in column (8):

$$d\bar{q}\pi^N = \pi^N d\bar{q} + \bar{q} d\pi^N < 0$$

Thus, operating small businesses becomes less attractive for native entrepreneurs. Their

fraction in column (6) is falling by 3.2% inducing a reallocation away from regular employment and businesses towards solo self-employment. These effects are associated with a decrease in the welfare of native potential entrepreneurs Ω^{NL} . The asymmetric response of small businesses towards the immigration shock can be explained by the fact that immigrant businesses are more profitable on average, meaning that the expected profits per recruitment are also higher ($\pi^I > \pi^N$, inline with the stylized fact SF6 in section 3). This makes immigrant businesses more sensitive to the job-filling rate since $\pi^I d\bar{q} > \pi^N d\bar{q}$. The profits of native entrepreneurs are lower, making them less responsive to changes in the probability of filling positions.

Next, we consider the high-skill submarket. High-skill workers become more productive, reflected in the higher price of the high-skill intermediate good P_H . This boosts job creation in the high-skill submarket, leading to a higher market tightness θ_H and a higher job-finding rate. Thus, there is a sizable increase in the fraction of high-skill potential entrepreneurs employed in regular paid jobs in column (2): 7.2% for natives and 5.6% for immigrant potential entrepreneurs. This process is accompanied by increasing wages in column (3) of table 8 and leads to the increased welfare of regular high-skill workers $\bar{\Omega}^{IH}$ and $\bar{\Omega}^{NH}$ in table 7.

Higher productivity of coworkers is also beneficial for high-skill small businesses, but the productivity of low-skill coworkers employed in high-skill businesses is decreasing. We find that the second effect dominates, so the average productivity of coworkers in small businesses operated by high-skill entrepreneurs decreases moderately. However, at the same time, filling positions becomes easier, especially low-skill positions; thus, the market tightness θ_0^H is decreasing, while the job-filling rate is increasing. Again, we find that immigrant and native entrepreneurs operating businesses are asymmetrically affected. Column (8) of table 8 shows that the positive effect of a higher job-filling rate is dominating for immigrant entrepreneurs, and there is a slight increase in their profits. This makes immigrant businesses more attractive for their owners and induces the reallocation of immigrant entrepreneurs from solo self-employment to operating small businesses equal to 3.7%. Overall, we observe a sizable increase in the welfare of high-skill immigrant entrepreneurs Ω^{IH} in table 7. This is partially due to higher profits from operating small businesses and the reallocation from low-income activities in solo self-employment to regular jobs. More specifically, table 8 shows that the income of immigrant self-employed (1.199) is well below their wages in regular paid jobs (1.309).

For native high-skill entrepreneurs, the situation is different. The lower productivity of an average coworker neutralizes the positive effect of a higher job-filling rate. Thus, the profits and the fraction of native high-skill business owners are hardly changing, and the only meaningful change is a shift towards regular jobs. However, the difference in income between these two states is negligibly tiny, compare columns (5) and (3) in table 8, so there is only a slight increase in the welfare of native entrepreneurs Ω^{NH} in table 7.

Detailed wage and employment changes for regular workers are presented in table 15

in appendix D. Wages of low-skill regular workers fall (column (3)); moreover, finding jobs becomes more difficult since both market tightness variables θ_0^L and θ^L are falling due to the stronger competition among workers. This leads to slightly higher unemployment rates in column (1) of table 15 and a moderate reduction in welfare $\bar{\Omega}^{NL}$ and $\bar{\Omega}^{IL}$.

To understand the relevance of entrepreneurship for the consequences of immigration, compare rows (C) and (D) of table 7. It is clear that by not considering endogenous job creation by immigrant/native entrepreneurs, one may underestimate the positive welfare effects of immigration. More importantly, certain groups, such as the low-skilled immigrant entrepreneurs, may be incorrectly identified as losers. This influences the policy recommendations regarding the groups that must contribute to the redistribution and those who should receive the compensation.

Finally, our results suggest a marginal decrease of about 0.5% in the welfare of an incumbent immigrant. A moderate decline of 0.88% is observed in the welfare of a representative worker. It reflects a combination of lower welfare of incumbent workers reduced by 0.37% and a composition effect since a representative worker becomes “more immigrant” and “more low skilled” on average. At the same time, we find that the average estimate hides substantial heterogeneity of the effect across worker groups. Contrary to the previous studies reporting wage and welfare losses for the incumbent immigrant population (D’Amuri et al. (2010), Ottaviano and Peri (2012)), we find that immigrant entrepreneurs experience sizable welfare gains from a new immigration wave equal to 3.1%.

6.2 Value of immigrant entrepreneurship

In this section, we conduct a counterfactual experiment on the legal barriers to self-employment and entrepreneurship for immigrants. We set $\delta^{IL} = 0$ and $\delta^{IH} = 0$, implying that the legal entry barrier into self-employment and business ownership is infinitely high for immigrant potential entrepreneurs so that none of them are observed in the states s^{Ij} and b^{Ij} , $j = L, H$. We consider the benchmark model without an immigration shock and analyze how the lack of immigrant entrepreneurial activity affects the welfare of workers compared to the benchmark model with the option of entrepreneurship.

The goal of this experiment is twofold. First, it allows us to estimate the option value of entrepreneurship for immigrants. Second, we can estimate the spillover effects of immigrant entrepreneurship for all other groups producing insights about the entry barriers policies for immigrant small businesses. The results are summarized in table 9, where line (0) corresponds to the benchmark equilibrium and line (E) contains welfare changes for all worker groups in the counterfactual setting with entry barriers.

Table 9 shows that the welfare losses of high-skill potential entrepreneurs are dramatic and amount to 30.5% of their welfare. This is primarily driven by unemployment increasing from 3.9% to 11% (see table 16 in the appendix). The losses of low-skill potential

Table 9: Welfare changes in the counterfactual scenario without immigrant entrepreneurship

	Low-skilled				High-skilled			
	Regular workers		Pot. entrepreneurs		Regular workers		Pot. entrepreneurs	
	N	I	N	I	N	I	N	I
	Ω^{NL}	Ω^{IL}	Ω^{NL}	Ω^{IL}	Ω^{NH}	Ω^{IH}	Ω^{NH}	Ω^{IH}
(0)	1.552	1.405	1.523	1.497	1.988	1.641	1.970	1.810
(E)	-0.35%	-0.43%	+1.62%	-15.2%	-0.17%	-0.18%	+1.08%	-30.5%

Note: Row (0) shows the welfare of workers in the benchmark model. Row (E) shows the change in welfare in the counterfactual case of a complete ban on immigrant entrepreneurship.

entrepreneurs are also large, reaching 15.2% and caused by the corresponding increase in unemployment from 4.9% to 18%. This indicates a very high value of the entrepreneurship option for immigrant individuals with a high entrepreneurial spirit. They also suggest that entrepreneurship is an efficient way of reducing unemployment for immigrants.

Further, we observe moderate negative spillovers for regular workers with reduced welfare. These welfare losses suggest that policies reducing entry barriers for immigrant entrepreneurs are likely to be beneficial for regular workers (native and immigrant). Their welfare is higher in the benchmark scenario with immigrant entrepreneurship. The reasons for higher welfare are threefold: first, immigrant potential entrepreneurs entering self-employment reduce competition for regular jobs; second, immigrant small businesses create new working places for all worker groups; and third, the lump-sum transfer T is higher due to higher net fiscal contributions of immigrants. Table 9 reveals that the welfare of native potential entrepreneurs is lower in the benchmark scenario with immigrant entrepreneurship. The reason is stronger competition with immigrant businesses, suggesting that entry barriers for immigrant entrepreneurs shield native businesses from competitive forces. Germany introduced several amendments in its Residence Act for non-German entrepreneurs between 2004 and 2012. These amendments relaxed the conditions required for entrepreneurial ventures and offered incentives to foreigners to invest in Germany.¹⁶ Our experiment helps evaluate the effectiveness of these policies.

6.3 Extensions

In this section we briefly discuss the implications of two model extensions: (1) skill-neutral immigration motivated by the recent agreement with India and the role of ethnic segregation in small businesses.

(1) Cooperaton with India. Germany signed the “Migration and Mobility Partnership Agreement” (MMPA) with India in December 2022. It is the first migration agreement between Germany and a non-EU country. The agreement aims to promote the

¹⁶Residence Act 2004, Act to Implement Residence- and Asylum-Related Directives of the European Union 2007, Labour Migration Control Act 2009, Residence Act 1st August 2012

mobility of high-skill immigrants from India to Germany. Recent developments in October, 2024 led Germany to agree to increase the annual number of visas granted to skilled Indian workers from 20,000 to 90,000. Given the increasing refugee migration to the developed world, we expect the low-skill scenario to dominate. However, policies facilitating high-skill immigration in Germany may, at best, result in skill-neutral immigration. These developments motivate the experiment of a skill-neutral immigration scenario to analyze the possible effects of increased Indian immigration to Germany. Therefore, in appendix D.3 we report the implications of a 20% skill-neutral migrant influx.

Our analysis suggests that in the case of skill-neutral immigration an incumbent worker will experience a smaller welfare loss (-0.27%) compared to the low-skill scenario (-0.37%). Moreover, the welfare of incumbent immigrant workers will increase ($+0.38\%$). The reason is that hiring coworkers becomes easier for all types of small businesses, boosting immigrant entrepreneurs' welfare. Combined with higher wages and the welfare of high-skill immigrant workers, this effect is dominating despite a slight reduction in the welfare of low-skill immigrants. The welfare loss of a representative worker will also be smaller (-0.66%) than the one experienced in a low-skill scenario (-0.88%).

(2) Ethnic segregation. The literature on social networks documents ethnic homophily, meaning a higher probability of creating social ties with individuals of the same ethnic origin (McPherson et al. (2001)). Dustmann et al. (2016) reports for Germany that a new hire is more likely to be an immigrant if there is already a large share of immigrant workers in the firm. Additionally, ethnic segregation could be an outcome of hiring discrimination (see Kaas and Manger (2012) for a field experiment). Given the empirical evidence in Kaas and Manger (2012) that hiring discrimination is stronger in small firms and the findings in Goldberg et al. (1995) that it is more (less) pronounced in low (high) skill jobs, we extend the model to account for the ethnic segregation in low-skill small businesses.

Remaining agnostic about the reason for ethnic segregation, we introduce parameter $\psi > 0$, capturing the co-ethnic bias in matching (see appendix D.3). We consider a marginal change in ethnic segregation equal to 1% and set $\psi = 0.01$. The implications of ethnic segregation for low-skill businesses are as follows. First, native workers are more productive on average. So, it leads to a higher specialization on the more productive group of native workers in native businesses. This is associated with higher profits, higher business entry and higher welfare of native entrepreneurs. Second, there is a higher specialization of immigrant businesses on the less productive group of immigrant workers leading to lower profits. As a result immigrant entrepreneurs move intensively to solo self-employment, which is associated with lower welfare. Third, changes in the composition of small businesses are associated with lower earnings of native regular workers and lower welfare despite a higher probability of getting jobs in native businesses.

Overall, our findings indicate that ethnic segregation could be beneficial to native low-skill businesses but it seems to be detrimental to the profits and entry of immigrant

businesses in the same submarket leading to the underutilization of entrepreneurial potential in this group.

7 Conclusion

In this paper, we develop a unified framework that incorporates the dual role of immigrants as workers and entrepreneurs. As workers, migrants compete with native workers for jobs in the regular job market. In contrast, as entrepreneurs, they compete with native entrepreneurs but create employment opportunities for other natives and migrants looking for jobs. The theoretical setup combined with survey data from the SOEP is used to quantify the impact of low-skill immigration on small businesses, unemployment rates, wage structure, and welfare of native and incumbent immigrants in Germany.

We consider a low-skilled migration shock similar in intensity to the refugee wave of 2012 – 2017. Consistent with the literature, we find that it is associated with increased unemployment and reduced wages for all low-skilled workers, negatively affecting their welfare. Similarly, the high-skilled workers gain from such an inflow. Nonetheless, we extend the literature by providing a more detailed picture of the effects of migration on small businesses and entrepreneurs. Contrary to the existing literature, suggesting a negative impact of migration on incumbent migrants, we find that incumbent immigrant entrepreneurs in both skill groups gain from immigration and expand their entrepreneurial activities. This amplifies the welfare gains of high-skill regular workers and reduces the welfare losses of the low-skilled. Yet, we document an adverse effect on native entrepreneurs, especially the low-skilled, losing welfare from the lower productivity of their coworkers and facing stronger recruitment competition from immigrant small businesses. We also find that recent German-Indian cooperation on skilled-worker mobility can reduce the losses from low-skilled migration.

The counterfactual experiment suggests that restricting the entry of immigrants into entrepreneurship leads to an overall welfare loss for the economy. All demographic groups incur welfare losses except for the native entrepreneurs who gain from reduced competition with immigrant businesses. Finally, quantifying the impact of ethnic segregation in small businesses, we find that low-skill native entrepreneurs and high-skill immigrant entrepreneurs gain while all other groups of workers lose welfare from such segregation.

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Appendices

A Stylized facts

Table 10: Correlation between entrepreneurial qualities and the probability of being classified to the potential entrepreneur group

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Risk propensity	1.613*** (0.036)	1.387*** (0.088)	1.061*** (0.090)	1.044*** (0.090)	1.037*** (0.092)	1.029*** (.092)	1.007*** (0.099)
Neuroticism		−0.434*** (0.095)	−0.551*** (0.095)	−0.547*** (0.095)	−0.542*** (0.096)	−0.539*** (0.096)	−0.398*** (0.099)
Openness			1.814*** (0.108)	1.953*** (0.112)	1.961*** (0.118)	1.941*** (0.119)	1.916*** (0.122)
Agreeableness				−0.830*** (0.137)	−0.816*** (0.141)	−0.834*** (0.143)	−0.613*** (0.147)
Extroversion					−0.034 (0.128)	−0.059 (0.131)	0.178 (0.136)
Conscientiousness						0.193 (0.156)	−0.268* (0.160)
Female							−0.285*** (0.039)
Age							0.157*** (0.007)
Age ²							−0.001*** (0.000)
Constant	−2.730*** (0.044)	−2.263*** (0.071)	−3.213*** (0.093)	−2.645*** (0.130)	−2.635*** (0.139)	−2.751*** (0.163)	−6.314*** (0.246)

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

Note: Logistic regression with binary variable taking value one for potential entrepreneurs and zero for regular workers. Year fixed effects for 2009, 2012, 2013, and 2017 are used in all models. In all except column (7), the benchmark observation is regular worker in the year 2009. In the last column the benchmark observation is a male regular worker observed in 2009. For details regarding the construction of the entrepreneurial qualities variables using SOEP data see Anger and Heineck (2010) and Damdinsuren et al. (2024).

B Theory

B.1 Hiring in small businesses

In this part of the appendix we derive the value gains from hiring one more native (Δ_m^N) or immigrant (Δ_k^I) coworker:

$$(r + \gamma)\Delta_k^I = (y_0^I - w_0^I)(1 - \tau) + \bar{q}(\theta_0)\mu\Delta_{k+1}^I - \bar{q}(\theta_0)\mu\Delta_k^I + \bar{q}(\theta_0)(1 - \mu)\Delta_k^I - \bar{q}(\theta_0)(1 - \mu)\Delta_k^I$$

In a similar way, let $\Delta_m^N = B_{tm}(\alpha) - B_{tm-1}(\alpha)$, $\forall t = 0.. \infty$ $\alpha > \alpha_0$ then we get:

$$(r + \gamma)\Delta_m^N = (y_0^N - w_0^N)(1 - \tau) + \bar{q}(\theta_0)\mu\Delta_m^N - \bar{q}(\theta_0)\mu\Delta_m^N + \bar{q}(\theta_0)(1 - \mu)\Delta_{m+1}^N - \bar{q}(\theta_0)(1 - \mu)\Delta_m^N$$

In a stationary environment we get: $\Delta^I = \Delta_k^I = \Delta_{k+1}^I$ and $\Delta^N = \Delta_m^N = \Delta_{m+1}^N$.

Next, consider native high-skill businesses facing a business destruction rate γ^{NH} , hiring 4 types of workers and paying wages w_{0N}^{iH} to native/immigrant high-skill workers and w_{CN}^{iL} to native/immigrant low-skill workers (engaged in cross-skill matching). At the same time immigrant high-skill businesses are facing a business destruction rate γ^{IH} , hiring 4 types of workers and paying wages w_{0I}^{iH} to native/immigrant high-skill workers and w_{CI}^{iL} to native/immigrant low-skill workers (engaged in cross-skill matching). The associated outputs and profits are given by:

$$\Delta_N^{iH} = \frac{y_{0N}^{iH} - w_{0N}^{iH}}{r + \gamma^{NH}} \quad \Delta_N^{iL} = \frac{y_{CN}^{iL} - w_{CN}^{iL}}{r + \gamma^{NH}} \quad \Delta_I^{iH} = \frac{y_{0I}^{iH} - w_{0I}^{iH}}{r + \gamma^{IH}} \quad \Delta_I^{iL} = \frac{y_{CI}^{iL} - w_{CI}^{iL}}{r + \gamma^{IH}}$$

B.2 Proof of propositions 1, 2, 3:

Proof of proposition 1: Consider the first and second integrals in (5), using integration by parts they can be rewritten as:

$$\begin{aligned} & \int_{\alpha}^{\alpha_0} (1 - F(x))E'(x)dx - (1 - F(\alpha_0))(E(\alpha_0) - E(\alpha)) \\ & \int_{\alpha_0}^{\bar{\alpha}} (1 - F(x))B_0'(x)dx + (1 - F(\alpha_0))(B_0(\alpha_0) - E(\alpha)) \end{aligned}$$

Inserting both expressions back into (5) and taking into account that $E(\alpha_0) = B_0(\alpha_0)$ we get the final expression for $E(\alpha)$:

$$(r + \gamma)E(\alpha) = \sigma\alpha(1 - t) + \delta \int_{\alpha}^{\alpha_0} \frac{(1 - F(x))\sigma(1 - t)}{r + \gamma + \delta(1 - F(x))}dx + \delta(1 - t) \int_{\alpha_0}^{\bar{\alpha}} \frac{(1 - F(x))\sigma}{r + \gamma}dx + \gamma U$$

Evaluating $E(\alpha)$ at α_0 and using the definition $E(\alpha_0) = B_0(\alpha_0)$ we get equation (7). \square

Proof of proposition 2: Using integration by parts to rewrite the first, second and third integrals in equation (4) we get:

$$\begin{aligned} & \int_{\alpha}^{\alpha_s} (E_s(x) - E_s(\alpha))dF(x) = \int_{\alpha}^{\alpha_s} (1 - F(x))E_s'(x)dx - (1 - F(\alpha_s))(E_s(\alpha_s) - E_s(\alpha)) \\ & \int_{\alpha_s}^{\alpha_0} (1 - F(x))E'(x)dx - E(\alpha_0)(1 - F(\alpha_0)) + E(\alpha_s)(1 - F(\alpha_s)) + E_s(\alpha)(F(\alpha_s) - F(\alpha_0)) \\ & \int_{\alpha_0}^{\bar{\alpha}} (B_0(x) - E_s(\alpha))dF(x) = \int_{\alpha_0}^{\bar{\alpha}} (1 - F(x))B_0'(x)dx + (1 - F(\alpha_0))(B_0(\alpha_0) - E_s(\alpha)) \end{aligned}$$

Inserting all three expressions back into (4) and taking into account that $E_s(\alpha_s) = E(\alpha_s)$ and $B_0(\alpha_0) = E(\alpha_0)$ we get the final expression for $E_s(\alpha)$:

$$\begin{aligned} (r + \gamma)E_s(\alpha) &= \sigma\alpha(1 - t) + X\lambda(\theta)(W - E_s(\alpha)) + \delta \int_{\alpha}^{\alpha_s} \frac{(1 - F(x))\sigma(1 - t)}{r + \gamma + X\lambda(\theta) + \delta(1 - F(\alpha))}dx \\ &+ \delta \int_{\alpha_s}^{\alpha_0} \frac{(1 - F(x))\sigma(1 - t)}{r + \gamma + \delta(1 - F(x))}dx + \delta(1 - t) \int_{\alpha_0}^{\bar{\alpha}} \frac{(1 - F(x))\sigma}{r + \gamma}dx + \gamma U \end{aligned}$$

Next, we consider the first and second integrals in eq. (8), rewriting them we get:

$$\begin{aligned} & \int_{\alpha_s}^{\alpha_0} (1 - F(x))E'(x)dx - E(\alpha_0)(1 - F(\alpha_0)) + E(\alpha_s)(1 - F(\alpha_s)) + W(F(\alpha_s) - F(\alpha_0)) \\ & \int_{\alpha_0}^{\bar{\alpha}} (B_0(x) - W)dF(x) = \int_{\alpha_0}^{\bar{\alpha}} (1 - F(x))B'_0(x)dx + (1 - F(\alpha_0))(B_0(\alpha_0) - W) \end{aligned}$$

Inserting both expressions back into (8) and taking into account that $E_s(\alpha_s) = E(\alpha_s) = W$ and $B_0(\alpha_0) = E(\alpha_0)$ we get the final expression for W :

$$(r + \bar{\gamma})W = w(1 - t) + \delta \int_{\alpha_s}^{\alpha_0} \frac{(1 - F(x))\sigma(1 - t)}{r + \gamma + \delta(1 - F(x))}dx + \delta(1 - t) \int_{\alpha_0}^{\bar{\alpha}} \frac{(1 - F(x))\sigma}{r + \gamma}dx + \bar{\gamma}U$$

Evaluating $E_s(\alpha)$ at α_s and using the definition $E_s(\alpha_s) = W$ we can find the cut-off α_s in equation (9). Next, we show that α_s is increasing in the wage w by differentiating equation (9) and dividing both parts by $(1 - t)$:

$$\frac{\partial \alpha_s}{\partial w} = \frac{(r + \gamma + X\lambda(\theta) + \delta(1 - F(\alpha_s)))}{\sigma(r + \bar{\gamma} + X\lambda(\theta) + \delta(1 - F(\alpha_s)))} \quad \frac{\partial^2 \alpha_s}{\partial w^2} = \frac{\delta f(\alpha_s)(\gamma - \bar{\gamma})}{\sigma(r + \bar{\gamma} + X\lambda(\theta) + \delta(1 - F(\alpha_s)))^2} \frac{\partial \alpha_s}{\partial w}$$

Hence, $\partial^2 \alpha_s / \partial w^2$ is positive for $\gamma > \bar{\gamma}$ and negative otherwise. \square

Proof of proposition 3: Using integration by parts we can rewrite the first, second and third integrals in equation (3) as:

$$\begin{aligned} & \int_{\alpha_u}^{\alpha_s} (1 - F(x))E'_s(x)dx - E_s(\alpha_s)(1 - F(\alpha_s)) + E_s(\alpha_u)(1 - F(\alpha_u)) + U(F(\alpha_u) - F(\alpha_s)) \\ & \int_{\alpha_s}^{\alpha_0} (1 - F(x))E'(x)dx - E(\alpha_0)(1 - F(\alpha_0)) + E(\alpha_s)(1 - F(\alpha_s)) + U(F(\alpha_s) - F(\alpha_0)) \\ & \int_{\alpha_0}^{\bar{\alpha}} (B_0(x) - U)dF(x) = \int_{\alpha_0}^{\bar{\alpha}} (1 - F(x))B'_0(x)dx + B_0(\alpha_0)(1 - F(\alpha_0)) + U(F(\alpha_0) - 1) \end{aligned}$$

Inserting these expressions back into (3) we get the final expression for U :

$$\begin{aligned} rU &= z - h + X\lambda(\theta)(W - U) + \delta \int_{\alpha_u}^{\alpha_s} \frac{(1 - F(x))\sigma(1 - t)}{r + \gamma + X\lambda(\theta) + \delta(1 - F(x))}dx \\ &+ \delta \int_{\alpha_s}^{\alpha_0} \frac{(1 - F(x))\sigma(1 - t)}{r + \gamma + \delta(1 - F(x))}dx + \delta(1 - t) \int_{\alpha_0}^{\bar{\alpha}} \frac{(1 - F(x))\sigma}{r + \gamma}dx \end{aligned} \quad (21)$$

B.3 Proof of proposition 4:

Let b_k^I denote the number of small businesses with k immigrant coworkers, and b_m^N be the number of small businesses with m native coworkers. These unconditional densities can be derived as follows:

$$\dot{b}_1^I = \bar{q}\mu b_0^I - (\gamma + \bar{q}\mu)b_1^I = 0 \quad \dot{b}_2^I = \bar{q}\mu b_1^I - (\gamma + \bar{q}\mu)b_2^I = 0 \quad \dot{b}_3^I = \bar{q}\mu b_2^I - (\gamma + \bar{q}\mu)b_3^I = 0$$

Repeating equations for native employees b_m^N and continuing by induction we get:

$$b_k^I = \left(\frac{\bar{q}\mu}{\gamma + \bar{q}\mu} \right)^k b_0^I \quad b_m^N = \left(\frac{\bar{q}(1 - \mu)}{\gamma + \bar{q}(1 - \mu)} \right)^m b_0^N$$

Adding up all values for $k = 0..\infty$ and for $m = 0..\infty$ we get:

$$b^I = \sum_{k=0}^{\infty} b_k^I = \sum_{k=0}^{\infty} \left(\frac{\bar{q}\mu}{\gamma + \bar{q}\mu} \right)^k b_0^I \Rightarrow b_0^I = \frac{\gamma b^I}{\gamma + \bar{q}\mu} \quad \text{and} \quad b_0^N = \frac{\gamma b^N}{\gamma + \bar{q}(1-\mu)}$$

Therefore, the two distributions are given by geometric densities with parameters $\gamma/(\gamma + \bar{q}(\theta_0)(1-\mu))$ and $\gamma/(\gamma + \bar{q}(\theta_0)\mu)$ respectively:

$$p_k^I = \frac{b_k^I}{b^I} = \left(\frac{\bar{q}(\theta_0)\mu}{\gamma + \bar{q}(\theta_0)\mu} \right)^k \frac{\gamma}{\gamma + \bar{q}(\theta_0)\mu} \quad p_m^N = \frac{b_m^N}{b^N} = \left(\frac{\bar{q}(\theta_0)(1-\mu)}{\gamma + \bar{q}(\theta_0)(1-\mu)} \right)^m \frac{\gamma}{\gamma + \bar{q}(\theta_0)(1-\mu)}$$

Finally, we consider the distributions of solo self-employed with respect to the production efficiency α . These can be found due to the fact that $s_u(\alpha) = H'(\alpha)$ and $s_e(\alpha) = G'(\alpha)$. The distributions are then given by $s_e(\alpha)/s_e$ for $\alpha \in [\alpha_s..\alpha_0]$ and $s_u(\alpha)/s_u$ for $\alpha \in [\alpha_u..\alpha_s]$, where:

$$\begin{aligned} \frac{s_e(\alpha)}{s_e} &= \frac{\delta f(\alpha)(\gamma + \delta(1 - F(\alpha_s)))}{[\gamma + \delta(1 - F(\alpha))]^2} \frac{(\gamma + \delta(1 - F(\alpha_0)))}{[\delta(F(\alpha_0) - F(\alpha_s))]} \\ \frac{s_u(\alpha)}{s_u} &= \frac{\delta f(\alpha)(\gamma + \delta(1 - F(\alpha_u)) + X\lambda(\theta))}{[\gamma + \delta(1 - F(\alpha)) + X\lambda(\theta)]^2} \frac{(\gamma + X\lambda(\theta) + \delta(1 - F(\alpha_s)))}{[\delta(F(\alpha_s) - F(\alpha_u))]} \end{aligned}$$

Note that $G(\alpha_s)/s_e = 0$, $G(\alpha_0)/s_e = 1$, $H(\alpha_u)/s_u = 0$ and $H(\alpha_s)/s_u = 1$.

B.4 Wage setting:

The disagreement value W_D is given by:

$$rW_D = z + \delta \int_{\alpha_s}^{\alpha_0} \frac{(1 - F(x))\sigma(1-t)}{r + \gamma + \delta(1 - F(x))} dx + \delta(1-t) \int_{\alpha_0}^{\bar{\alpha}} \frac{(1 - F(x))\sigma}{r + \gamma} dx - \bar{\gamma}(W_D - U)$$

Proof of proposition 6. The Nash maximization problem gives rise to the following first order condition:

$$\beta(y - \bar{c}_k - w) = -(1 - \beta)(w - \frac{z}{1-t})[\Lambda(y, w) - 1] \quad \text{where} \quad \Lambda(y, w) = J\delta f(\alpha_s) \frac{\partial \alpha_s}{\partial w}$$

Note that the Nash bargaining condition requires $J'_w < 0$ implying that $[\Lambda(y, w) - 1] < 0$, since otherwise the worker and the firm would both gain from a higher wage. Implicitly differentiating the wage with respect to output y we get:

$$\frac{\partial w}{\partial y}(1 - \beta) \left[\Lambda(y, w) - 1 + (w - \frac{z}{1-t})\Lambda'_w \right] = -\beta - (1 - \beta)(w - \frac{z}{1-t})\Lambda'_y$$

where the right hand side is negative since $\Lambda'_y = J'_y \delta f(\alpha_s) \frac{\partial \alpha_s}{\partial w} > 0$ due to the fact that firm profits are increasing in output ($J'_y > 0$).

Implicitly differentiating the wage with respect to the bargaining power β we get:

$$\frac{\partial w}{\partial \beta}(1 - \beta) \left[\frac{-\beta}{1 - \beta} + \Lambda(y, w) - 1 + (w - \frac{z}{1-t})\Lambda'_w \right] = -(y - \bar{c}_k - w) + \beta(w - \frac{z}{1-t})[\Lambda(y, w) - 1]$$

where the right hand side is also negative since $[\Lambda(y, w) - 1] < 0$. Next, we differentiate

the auxiliary function $\Lambda(y, w)$ w.r.t. w :

$$\Lambda'_w = J'_w \delta f(\alpha_s) \frac{\partial \alpha_s}{\partial w} + J \delta \frac{\partial f(\alpha_s)}{\partial \alpha_s} \left(\frac{\partial \alpha_s}{\partial w} \right)^2 + J \delta f(\alpha_s) \frac{\partial^2 \alpha_s}{\partial w^2}$$

If the distribution of production efficiency is uniform, then $f(\alpha) = 1$ and the second term becomes zero. Finally, from proposition 2 we know that $\partial^2 \alpha_s / \partial w^2 \leq 0$ if $\gamma \leq \bar{\gamma}$. Thus, we can show that $\gamma \leq \bar{\gamma}$ is a sufficient condition for $\partial w / \partial y > 0$ and $\partial w / \partial \beta > 0$ if the distribution of production efficiency is uniform.

Bargaining with regular workers: Consider bargaining between firms and regular workers. Let \bar{W} denote their present value of employment, \bar{W}_D be the payoff in disagreement and \bar{J} be the present value of a job given by:

$$\begin{aligned} r\bar{W} &= \bar{w}(1-t) - \bar{\gamma}(\bar{W} - \bar{U}) & r\bar{W}_D &= \bar{z} - \bar{\gamma}(\bar{W}_D - \bar{U}) \\ r\bar{J} &= (\bar{y} - \bar{c}_k - \bar{w})(1-\tau) - \bar{\gamma}(\bar{J} - V) \end{aligned}$$

Formulating the Nash bargaining problem we get: $\bar{w}(1-t) = \beta(\bar{y} - \bar{c}_k)(1-t) + (1-\beta)\bar{z}$. In addition, these workers can be employed in small businesses run by self-employed entrepreneurs. Jobs in small businesses pay wages w_{0N} if the business is operated by the native owner, and w_{0I} if the business is operated by the immigrant owner.¹⁷ Let W_{0N} and W_{0I} be the corresponding present values of employment in small businesses:

$$rW_{0N} = w_{0N}(1-t) - \gamma^N(W_{0N} - \bar{U}) \quad rW_{0I} = w_{0I}(1-t) - \gamma^I(W_{0I} - \bar{U})$$

The job destruction rates are specific to the type of the business owner. Thus, all workers in a small firm are subject to the same job destruction rate γ^N if the business owner is a native entrepreneur, and γ^I if the owner is an immigrant entrepreneur. The disagreement payoffs in the bargaining state are denoted by W_{DN} and W_{DI} and can be written as:

$$rW_{DN} = \bar{z} - \gamma^N(W_{0N} - \bar{U}) \quad rW_{DI} = \bar{z} - \gamma^I(W_{0I} - \bar{U})$$

Workers then seek to maximize their job rent $W_{0N} - W_{DN}$ or $W_{0I} - W_{DI}$ depending on the type of the business. Let β_0 denote the bargaining power of workers negotiating with small businesses. The Nash bargaining problem then becomes:

$$\max_{w_{0N}} (w_{0N}(1-t) - \bar{z})^{\beta_0} (y_{0N} - w_{0N})^{1-\beta_0} \Rightarrow w_{0N}(1-t) = \beta_0 y_{0N}(1-t) + (1-\beta_0)\bar{z}$$

and the same for immigrant business owners, so we get $w_{0I}(1-t) = \beta_0 y_{0I}(1-t) + (1-\beta_0)\bar{z}$. In addition, wages of low-skill workers employed in high-skill small businesses can be obtained as $w_{CI}(1-t) = \beta_0 y_{CI}(1-t) + (1-\beta_0)\bar{z}$ and $w_{CN}(1-t) = \beta_0 y_{CN}(1-t) + (1-\beta_0)\bar{z}$ where the subindex C stands for cross-skill matching.

B.5 Unemployment of regular workers

The equilibrium unemployment of regular workers \bar{u}^{ij} , $i = I, N$, $j = L, H$ is given by:

$$\bar{u}^{ij} = \left[d^{ij} - l^{ij} - \mu^{ij} \bar{q}(\theta_0^H) \left(\frac{b^{NH}}{\gamma^{NH}} + \frac{b^{IH}}{\gamma^{IH}} \right) - \mathbf{1}_L \mathbf{M} \bar{q}(\theta_0^L) \left(\frac{b^{NL}}{\gamma^{NL}} + \frac{b^{IL}}{\gamma^{IL}} \right) \right] \frac{\bar{\gamma}^{ij}}{\bar{\gamma}^{ij} + X^{ij} \lambda(\theta^j)}$$

¹⁷With full scale notation the two wages are written as: w_{0N}^{ij} for workers of type ij , $i = I, N$, $j = L, H$ employed in small businesses operated by the native owner, and w_{0I}^{ij} for workers of type ij employed in small businesses operated by the immigrant owner.

where variable M takes value μ for immigrant low-skill workers and $1 - \mu$ for native low-skill workers.

C Empirical data

C.1 Mincer earnings regressions

The information on gross monthly wage/income for regular workers and potential entrepreneurs is available in SOEP. We use data for 2000-2017 and run the following Mincer earnings regressions for regular workers:

$$\begin{aligned} \ln w_{it} = & \phi_0 + \phi_1 N_{it} + \phi_2 FS_{it} + \phi_3 HS_{it} + \phi_4 N_{it} \times FS_{it} + \phi_5 N_{it} \times HS_{it} \\ & + \phi_6 HS_{it} \times FS_{it} + \phi_7 N_{it} \times HS_{it} \times FS_{it} + \phi_8 t + \varsigma_{it} \end{aligned}$$

Where w_{it} is the wage of worker i observed in year t . N_{it} is the indicator function that takes the value 1 for natives, FS_{it} is the indicator function with value 1 for large firms, HS_{it} takes value 1 for high-skill workers. We introduce interaction terms ($N_{it} \times FS_{it}$) and ($HS_{it} \times FS_{it}$) in order to capture variation in the effect of firm size on wages by ethnicity and skill. Similarly, ($N_{it} \times HS_{it}$) captures the fact that the return to schooling could be different for native and immigrant workers.

For the potential entrepreneurs we run the following regression

$$\begin{aligned} \ln w_{it} = & \phi_0 + \phi_1 N_{it} + \phi_2 HS_{it} + \phi_3 N_{it} \times HS_{it} + \sum_{l=1}^3 \phi_{4l} PE_{it}^l + \sum_{l=1}^3 \phi_{5l} N_{it} \times PE_{it}^l \\ & + \sum_{l=1}^3 \phi_{6l} HS_{it} \times PE_{it}^l + \sum_{l=1}^3 \phi_{7l} HS_{it} \times PE_{it}^l \times N_{it} + \phi_8 t + \epsilon_{it} \end{aligned}$$

where PE_{it}^l is the indicator function, such that $l = 1$ for potential entrepreneurs in solo self-employment, $l = 2$ for business owners with less than 9 coworkers, $l = 3$ for business owners with more than 9 coworkers. Potential entrepreneurs in paid employment serve as a reference category. The interaction terms $N_{it} \times PE_{it}^l$ and $HS_{it} \times PE_{it}^l$ capture the ethnicity specific and skill specific fixed effects for entrepreneurs in different economic states. $N_{it} \times HS_{it}$ captures the skill fixed effects specific to the two ethnic groups. The coefficients from both regressions are summarized in tables 11 and 12 respectively. We use these results to predict gross earnings of different worker groups. These are used as target moments for the calibration of productivities of workers and the related parameters.

Table 11: Wage regression for regular workers, SOEP 2000-2017

Variable	Coefficient	Standard error	Predicted $\ln(w)$	Normalized wage
Native	0.142***	(0.012)	$\bar{e}_0^{NH}: 7.25$	$w_0^{NH} = 1.295$
Fsize	0.609***	(0.012)	$e^{NH}: 7.93$	$\bar{w}^{NH} = 2.557$
Native \times Fsize	-0.064***	(0.014)	$\bar{e}_0^{NL}: 6.99$	$w_0^{NL} = 1$
HSkill	0.251***	(0.029)	$\bar{e}^{NL}: 7.53$	$\bar{w}^{NL} = 1.715$
Native \times HSkill	0.008	(0.030)	$\bar{e}_0^{IH}: 7.10$	$w_0^{IH} = 1.120$
Fsize \times HSkill	0.048	(0.330)	$\bar{e}^{IH}: 7.76$	$\bar{w}^{IH} = 2.158$
Native \times Fsize \times HSkill	0.086**	(0.034)	$\bar{e}_0^{IL}: 6.85$	$w_0^{IL} = 0.870$
Constant	6.779***	(0.013)	$\bar{e}^{IL}: 7.46$	$\bar{w}^{IL} = 1.599$
Observations	180699			

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Fsize = 1 for large firm with more than 20 workers

Table 12: Wage regression for potential entrepreneurs, SOEP 2000-2017

Variable	Coefficient	Standard error	Predicted $\ln(w)$	Normalized wage/profit
PE $type_1$	-0.009	(0.043)	s^{NH} : 7.43	1.551
PE $type_2$	0.770***	(0.048)	s^{NL} : 7.26	1.309
PE $type_3$	1.078***	(0.119)	$b_{<9}^{NH}$: 8.34	3.854
HSkill	0.049	(0.060)	$b_{<9}^{NL}$: 7.89	2.458
PE $type_1 \times$ HSkill	0.131	(0.082)	$b_{>9}^{NH}$: 8.71	5.580
PE $type_2 \times$ HSkill	0.460***	(0.091)	$b_{>9}^{NL}$: 8.37	3.972
PE $type_3 \times$ HSkill	0.182	(0.191)	e^{NH} : 7.62	1.876
Native	-0.018	(0.034)	e^{NL} : 7.19	1.220
PE $type_1 \times$ Native	0.081*	(0.046)	s^{IH} : 7.38	1.476
PE $type_2 \times$ Native	-0.077	(0.052)	s^{IL} : 7.20	1.232
PE $type_3 \times$ Native	0.101	(0.126)	$b_{<9}^{IH}$: 8.50	4.523
HSkill \times Native	0.383***	(0.063)	$b_{<9}^{IL}$: 7.99	2.716
PE $type_1 \times$ HSkill \times Native	-0.398***	(0.085)	$b_{>9}^{IH}$: 8.52	4.614
PE $type_2 \times$ HSkill \times Native	-0.443***	(0.095)	$b_{>9}^{IL}$: 8.29	3.666
PE $type_3 \times$ HSkill \times Native	-0.272	(0.199)	e^{IH} : 7.26	1.309
Constant	7.111***	(0.038)	e^{IL} : 7.21	1.245
Observations	37831			

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

PE $type_1$ = Solo self-employed or helpers in family business, PE $type_2$ = self-employed with less than 9 coworkers

PE $type_3$ = self-employed with more than 9 coworkers, PE $type_4$ = in paid employment

Table 13: Average tenure for different demographic groups of workers

Group	Tenure
Regular workers, immigrants average tenure	8.781
Regular workers, native average tenure	11.547
Regular workers, average tenure (native and immigrants combined)	8.237
Regular workers, small firms natives average tenure	8.504
Regular workers, small firms natives average tenure	6.750

C.2 Bargaining power in small firms

Combining information on wages of workers in small firms and the corresponding profits of small businesses we obtain the bargaining power parameter β_0 . More specifically, for low-skill businesses we set the following expressions equal to the pre-tax profits predicted from a Mincer regression:

$$\underbrace{\sigma \int_{\alpha_0}^1 \frac{f(\alpha)}{1 - F(\alpha_0)} d\alpha - c}_{\text{individual earnings}} + \frac{\gamma + \bar{q}(\theta_0)}{\gamma} \underbrace{\frac{(1 - \beta_0)}{\beta_0(1 - t)} \left(\mu(w_0^I(1 - t) - \bar{z}^I) + (1 - \mu)(w_0^N(1 - t) - \bar{z}^N) \right)}_{\text{average profit per coworker}}$$

where $(\gamma + \bar{q}(\theta_0))/\gamma$ is the average number of coworkers conditional on hiring at least one. For high-skill businesses we extend the expression to account for cross-skill matching. Based on these target values for profits we find $\beta_0^L = 0.456$ and $\beta_0^H = 0.422$.

C.3 Matching function

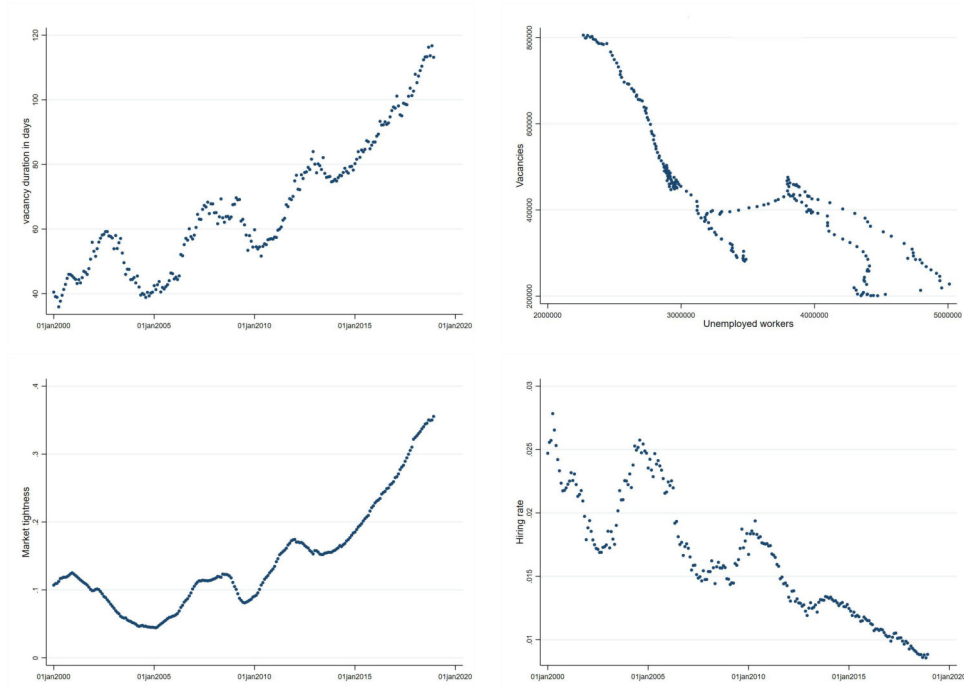
The Federal Employment Office (Bundesagentur für Arbeit) data includes information on the absolute number of unemployed, vacancies and vacancy durations (in days) which are not available in the SOEP survey. In total there 228 monthly observations. We use this data to construct an economy wide average market tightness ($\theta_t = \frac{V_t}{U_t}$) and the hiring rate ($q(\theta_t)$). These variables are illustrated on Fig 8. The upper left panel of this figure shows a sharp increase of the average vacancy duration between the years 2000 and 2018. Whereas

it was only 41.5 days on average in the year 2000, it almost tripled and reached a level 112 days by 2018. The top right panel of figure 8 shows the corresponding Beveridge curve for Germany showing a stable negative relationship between unemployment and vacancies. The bottom left panel shows the market tightness, while the aggregate job-filling rate $q(\theta)$ is illustrated in the bottom right panel of figure 8. Using this information we estimate the following regression:

$$\ln q(\theta_t) = cst - \zeta \ln \theta_t + Year + \iota_t \quad (22)$$

We control for time fixed effects by introducing a dummy for each year. This regression gives us a value of the slope parameter ζ equal to 0.47.

Figure 8: Vacancy duration and market tightness.



Note: Authors' calculations using statistical information of the Federal Employment Office (Bundesagentur für Arbeit) between January 2000 and December 2018.

Table 14: Parameters calibrated using SOEP data 2000-2017

Prm.	Empirical moment/target				Definition and calibrated values			
	NL	IL	NH	IH	NL	IL	NH	IH
$\bar{\gamma}$	Average tenure of regular workers 11.55 8.78 11.55 8.78				Regular job destruction rate 0.0198 0.0270 0.0206 0.0269			
γ	Share of workers in small businesses $\bar{e}_0/(\bar{e}_0 + \bar{e})$ 0.265 0.270 0.165 0.212				Business destruction/exit rate 0.0296 0.0358 0.0305 0.0292			
δ	Share of active entrepreneurs $(b + s)/l$ 0.547 0.525 0.568 0.577				Transition rate to entrepreneurship 0.5893 0.5355 1.1149 0.5173			
x	Unempl. rate of immigrant workers $\bar{u}/(d - l)$ - 0.141 - 0.091				Search intensity for small businesses 1 0.5713 1 0.2851			
X	Unempl. rate of immigrant pot. entrepreneurs u/l - 0.049 - 0.039				Search intensity for regular jobs 1 0.7593 1 0.2750			
c	Share of solo-entrepreneurs $(b_0 + s)/(b + s)$ 0.586 0.607 0.591 0.459				Flow cost of a small business 1.1636 1.2919 2.2448 3.0985			
ς	Businesses with 1-9 coworkers $\sum_{n=1}^9 b_n/(b + s)$ 0.366 0.362 0.326 0.425				Entrepreneurial productivity 0.2499 0.255 0.3703 0.2635			
φ_{0N}	Profits of small businesses with coworkers 2.63 2.77 4.20 4.52				Quantities in small (native) businesses 0.2973 0.2398 0.4109 0.3363			
φ_{0I}	Av. wages in small businesses \bar{w}_0 1 0.8674 1.2950 1.1144				Quantities in small (immigrant) businesses 0.3437 0.3097 0.5293 0.4227			
$\bar{\varphi}$	Av. wages of workers in regular jobs \bar{w} 1.625 1.492 2.940 2.630				Quantities of workers in regular jobs 1 0.9727 1 0.9157			
φ	Wages of pot. entrepreneurs in regular jobs w 1.222 1.246 1.884 1.309				Quantities of pot. entrepr. in regular jobs 0.8954 0.9004 0.8619 0.7440			
z	60% replacement rate in the 1st year and ALG II assistance afterwards 0.3719 0.3723 0.3757 0.3709				Unemployment benefits of pot. entrepreneurs 0.3719 0.3723 0.3757 0.3709			
\bar{z}	60% replacement rate in the 1st year and ALG II assistance afterwards 0.3838 0.3809 0.3948 0.3869				Unemployment benefits of regular workers 0.3838 0.3809 0.3948 0.3869			
M	Unempl. rate of native entrepreneurs u/l 0.035 - 0.014 -				Matching multiplier, regular jobs 0.5319 0.9955			
\bar{M}	Unempl. rate of native workers $\bar{u}/(d - l)$ 0.085 - 0.022 -				Matching multiplier, small businesses 0.0748 0.1809			
\bar{c}_k	Average job-filling rate $q(\theta)$ 1.5500 1.2398				Capital cost in regular firms 3.3821 2.5642			
c_h	Rebien, Stops, Zaharieva (2020) 0.7431 2.3344				Vacancy posting cost 0.7431 2.3344			
β_0	Assumption $w_{0I}^N/w_{0I}^I = \bar{w}^N/\bar{w}^I$ 1.0819 1.1905				Bargaining power of workers in small firms 0.4564 0.4222			
r	Annual discount rate = 5% 0.0125				(Quarterly) Discount rate 0.0125			
η	Chassamboulli and Palivos (2014) Battisti et al. (2018) 0.350				Elasticity of subst. between K and Z 0.350			
ρ	Ottaviano and Peri (2012) Battisti et al. (2018) 0.500				Elasticity of subst. between Y^H and Y^L 0.500			
R	Chassamboulli and Palivos (2014) Battisti et al. (2018) 0.030				(Quarterly) cost of capital 0.030			
A	Normalization $\bar{y}^{NH} = P_H$ 2.5630				Total factor productivity 2.5630			
a	Normalization $\bar{y}^{NL} = P_L$ 0.5547				Income share of Y_L 0.5547			
κ	Average tenure in small firms 8.2369				Cross-skill matching parameter 0.1700			
ζ	Regression $\ln q(\theta)$ on $\ln \theta$ 0.47				Elasticity of the matching function 0.47			
β	Ratio of nominal wages to GDP 0.28				Bargaining power of workers in regular jobs 0.9084			

D Results

D.1 Low-skilled immigration

We define $e_0 = e_{0N} + e_{0I}$ – total employment of workers in small businesses within their own skill group with the corresponding average wage $\bar{w}_0 = (w_{0N}e_{0N} + w_{0I}e_{0I})/(e_{0N} + e_{0I})$. Further, $e_C = e_{CN} + e_{CI}$ – total employment of low-skill workers in high-skill small businesses with the corresponding average wage $\bar{w}_C = (w_{CN}e_{CN} + w_{CI}e_{CI})/(e_{CN} + e_{CI})$.

Table 15: Changes for regular workers upon a 20% increase in low-skill immigration

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Group	$\bar{u}/(d-l)$	$\bar{e}/(d-l)$	\bar{w}	$e_0/(d-l)$	\bar{w}_0	$e_C/(d-l)$	\bar{w}_C
Low-skill							
Natives	0.085	0.680	1.718	0.135	1.002	0.100	0.997
Change	+0.003	-0.003	-0.021	-0.001	+0.009	+0.002	-0.002
Low-skill							
Immigr.	0.141	0.634	1.588	0.129	0.871	0.096	0.862
Change	+0.004	-0.004	-0.021	-0.002	+0.016	+0.001	-0.001
High-Skill							
Natives	0.022	0.825	2.544	0.153	1.295		
Change	-0.001	+0.007	+0.034	-0.007	+0.009		
High-Skill							
Immigr.	0.091	0.726	2.163	0.182	1.120		
Change	-0.002	+0.010	+0.031	-0.007	+0.007		

Note: variables in columns (1), (2), (4), (6) are shares and add up to 1. Variables in columns (3), (5), (7) have monetary interpretation; one monetary unit corresponds to 1086 EUR.

D.2 Entrepreneurship entry barriers

Table 16: The distribution of potential entrepreneurs upon business entry barriers

Group	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	u/l	e/l	w	$(s_u + s_e)/l$	$\sigma\bar{\alpha}_{u0}$	b/l	$\sigma\bar{\alpha}_{01}$	$\bar{q}(\theta_0)\pi/\gamma$
Low-skill								
Natives	0.035	0.418	1.222	0.259	1.145	0.288	1.291	1.971
Change	-0.000	-0.002	-0.001	-0.052	-0.032	+0.054	-0.004	+0.003
Low-skill								
Immigr.	0.049	0.426	1.245	0.251	1.100	0.274	1.314	2.077
Change	+0.132	+0.393	-0.001	-0.251	-	-0.274	-	-
High-Skill								
Natives	0.014	0.418	1.884	0.290	1.883	0.277	1.953	3.763
Change	-0.000	+0.002	+0.001	-0.027	-0.005	+0.025	-0.001	+0.001
High-Skill								
Immigr.	0.039	0.384	1.309	0.206	1.199	0.370	1.374	5.270
Change	+0.072	+0.504	+0.001	-0.206	-	-0.370	-	-

Note: Variables in columns (1), (2), (4), (6) are shares and add up to 1. Variables in columns (3), (5), (7), (8) have monetary interpretation; one monetary unit corresponds to 1086 EUR.

D.3 Extensions

(1) Cooperation with India.

In this extension we consider skill-neutral immigration and increase proportionally the number of low and high-skill immigrants by 20%. Our results are summarized in table 17.

Table 17: Increase in immigration by 20%, skill-neutral scenario

Low-skilled				High-skilled			
Regular workers		Pot. entrepreneurs		Regular workers		Pot. entrepreneurs	
N	I	N	I	N	I	N	I
Ω^{NL}	Ω^{IL}	Ω^{NL}	Ω^{IL}	Ω^{NH}	Ω^{IH}	Ω^{NH}	Ω^{IH}
1.552	1.405	1.523	1.497	1.988	1.641	1.970	1.810
-0.77%	-0.83%	-1.56%	+2.95%	+0.52%	+0.53%	-0.08%	+4.24%
Representative worker: -1.05%				Representative worker: +0.24%			
Incumbent worker: -0.78%							
				Representative worker: -0.68%			
				Incumbent immigrant: +0.38%			
				Incumbent worker: -0.27%			

The changes in wages, productivities and welfare of regular workers are less pronounced compared to the low-skilled scenario. This holds for the losses of regular low-skill workers (approx. -0.8% instead of -1.3%) and for the gains of the regular high-skill workers (approx. $+0.5\%$ instead of $+1\%$). The effect is also more moderate for the welfare of low-skill entrepreneurs, but it is more pronounced for the profits and welfare ($+4.2\%$) of high-skill immigrant entrepreneurs. This is intuitive since hiring high-skill coworkers becomes easier in the case of skill-neutral immigration.

(2) Ethnic segregation.

In this appendix we introduce parameter $\psi > 0$, capturing the co-ethnic bias in matching. Table 18 shows that higher values of ψ increase the share of matches between native workers and native-owned small businesses and the share of matches between immigrant workers and immigrant-owned businesses (on the matrix's main diagonal). At the same time, it reduces the share of matches between workers and business owners with different ethnic origins (off the diagonal). The benchmark equilibrium with unbiased matching can be recovered when $\psi = 0$, where μ is the probability of hiring an immigrant coworker identical for both types of businesses, and $1 - \mu$ is the probability of hiring a native coworker. Note that parameter ψ only influences the shares of matches of a particular type but does not enter the expression for the total number of matches created per unit time.

Table 18: Matching bias ψ giving rise to ethnic segregation in small businesses

Biased pairwise matching	Immigrant coworker	Native coworker	Sum
Immigrant business owner	$(\mu + \psi) \frac{b^{IL}}{b^{NL} + b^{IL}}$	$(1 - \mu - \psi) \frac{b^{IL}}{b^{NL} + b^{IL}}$	$\frac{b^{IL}}{b^{NL} + b^{IL}}$
Native business owner	$(\mu - \psi) \frac{b^{NL}}{b^{NL} + b^{IL}}$	$(1 - \mu + \psi) \frac{b^{NL}}{b^{NL} + b^{IL}}$	$\frac{b^{NL}}{b^{NL} + b^{IL}}$

We augment the corresponding equations for the profits of small businesses in the

following way:

$$\pi^I = (\mu + \psi)\Delta_I^I + (1 - \mu - \psi)\Delta_I^N \quad \pi^N = (\mu - \psi)\Delta_N^I + (1 - \mu + \psi)\Delta_N^N$$

where the upper (lower) index indicates the type of the worker (business owner). In addition, we adjust equations for the numbers of workers employed in small businesses:

$$\frac{\bar{q}(\theta_0^L)}{\gamma^{IL}} b^{IL} = \frac{e_{0I}^{IL}}{\mu + \psi} = \frac{e_{0I}^{NL}}{1 - \mu - \psi} \quad \text{and} \quad \frac{\bar{q}(\theta_0^L)}{\gamma^{NL}} b^{NL} = \frac{e_{0N}^{IL}}{\mu - \psi} = \frac{e_{0N}^{NL}}{1 - \mu + \psi}$$

Next, we consider a marginal change in ethnic segregation equal to 1% and set $\psi = 0.01$. Our results for the welfare effects are summarized in table 19, whereas table 20 shows predicted changes in labour market states of potential entrepreneurs.

Table 19: Welfare changes upon a marginal increase in ethnic segregation, $\psi = 0.01$

	Low-skilled				High-skilled			
	Regular workers		Pot. entrepreneurs		Regular workers		Pot. entrepreneurs	
	N	I	N	I	N	I	N	I
	Ω^{NL}	Ω^{IL}	Ω^{NL}	Ω^{IL}	Ω^{NH}	Ω^{IH}	Ω^{NH}	Ω^{IH}
(0)	1.552	1.405	1.523	1.497	1.988	1.641	1.970	1.810
(F)	-0.18%	-0.07%	+1.74%	-7.63%	-0.12%	-0.14%	-0.15%	+0.95%

Note: Row (0) shows the welfare of workers in the benchmark model. Row (F) shows the change in welfare upon ethnic segregation in low-skill businesses, $\psi = 0.01$.

Table 20: The distribution of potential entrepreneurs upon ethnic segregation

Group	(1) u/l	(2) e/l	(3) w	(4) $(s_u + s_e)/l$	(5) $\sigma\bar{\alpha}_{u0}$	(6) b/l	(7) $\sigma\bar{\alpha}_{01}$	(8) $\bar{q}(\theta_0)\pi/\gamma$
Low-skill								
Natives	0.035	0.418	1.222	0.259	1.145	0.288	1.291	1.971
Change	-0.000	+0.005	+0.001	-0.057	-0.035	+0.052	-0.003	+0.003
Low-skill								
Immigr.	0.049	0.426	1.245	0.251	1.100	0.274	1.314	2.077
Change	-0.000	+0.004	+0.001	+0.247	+0.107	-0.251	+0.016	-0.006
High-Skill								
Natives	0.014	0.418	1.884	0.290	1.883	0.277	1.953	3.763
Change	-0.000	-0.005	-0.002	+0.006	-0.001	-0.001	-0.001	-0.000
High-Skill								
Immigr.	0.039	0.384	1.309	0.206	1.199	0.370	1.374	5.270
Change	+0.000	-0.004	-0.002	-0.010	-0.009	+0.014	-0.002	+0.001