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# Past and Future Trends in Refugee Migration on the Regional Level in Germany – An Analysis and Projection of Labor Market Effects*

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**Abstract:** Since 2013, more than two million refugees have arrived in Germany and have been allocated across federal states and districts according to legal policies. A steadily increasing number of refugees is now entering the German labor market, albeit under varying economic and demographic contexts. However, regional differences in refugees' labor market integration have received little attention both retrospectively and particularly prospectively, given the projected population decline across Germany. Addressing this apparent shortcoming in the literature, we collect data on refugee arrivals by gender, nationality, approval rates, and regional allocation from 1995 to 2019. Applying principal component analysis and time series analysis, we first analyze past patterns of refugee migration to Germany and project both arrivals and regional allocations by gender and nationality until 2030. Then, combining the collected migration figures for German labor market regions and official labor market statistics, we investigate past regional employment effects from 2008 to 2019. Next, we calculate corresponding future employment effects conditional on our projected refugee figures, our estimation results, and official regional demographic forecasts until 2030. Our findings suggest that refugee migration does not affect German labor market regions equally, but instead has and will continue to lead to distinct regional employment effects. Moreover, the labor market integration differs by gender and origin of the refugees. Consequently, the interaction of regional employment effects with projected population change gives rise to different regional mitigation potentials in view of the upcoming population decline.

**Keywords:** Refugee Integration · Regional labor markets · Population decline · Principal component analysis · Time series analysis

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## 1 Introduction

Germany, like numerous other countries, has seen a surge in refugee migration over the past years. The causes of why refugees are forced to leave their home countries are complex and are often connected to impending or implemented restrictions of individual freedoms and future insecurity (*EASO* 2016). The latter is also a growing consequence of nutritional problems caused, among others, by global warming (*UNHCR* 2020). In host countries, these recent developments have been accompanied by wide-ranging debates on refugee integration and the possible consequences for host communities. For example, some advocates of more restrictive migration policies argue that higher migration numbers might increase crime or terrorism threats (see, for instance, *Vanella/Deschermeier* 2018; *Galantino* 2022 on those discussions) or put an additional strain on social security systems (*Eckert* 2017).

Similarly, the labor market effects of refugee migration are subject to discussions both within society and academia. In the scientific community, a large body of the literature has analyzed the multitude of reasons refugees enter the labor market more slowly compared to natives and other migrants and are subject to worse outcomes, including lower wages (*Brücker/Jaschke/Kosyakova* 2019). Explanations include worse access to and quality of education in their destination country (*Hunkler et al.* 2021), the complicated systems for recognizing and confirming formal qualifications (*BMBF* 2020), and language skills (*De La Rica et al.* 2015). Moreover, the demographic characteristics of refugees are important for their potential labor market integration. Females have a lower ceteris paribus (c.p.) labor market participation than males. Furthermore, the refugees' age may also have a substantial impact on their labor market integration (*Gustafsson et al.* 2017), as labor force participation rates are highly age-dependent (*Fuchs et al.* 2018).

Meanwhile, refugees prevalently arrive in host countries such as Germany, where demographic developments marked by low fertility as the major driver of natural population decline (*Vanella/Deschermeier* 2020) are expected to cause long-term decreases in the labor force (*Fuchs et al.* 2018; *Vanella/Deschermeier* 2019). Furthermore, recent projections indicate that this overall population decline will not take effect at the same magnitude across German regions (*Maretzke et al.* 2021). This raises the question to what extent refugees' labor market integration might contribute to mitigating regional labor supply decline. However, this question has not yet been addressed in the literature. While most research addresses the labor market integration–refugee migration nexus at the individual level, we analyze the potential regional variation in employment effects of refugee migration across German labor market regions in the context of population decline from a macro perspective.

Detailed and longitudinal data on refugee migration are difficult to obtain for Germany. Therefore, as a first step, we construct time series of national refugee immigration data and derive estimates for the subnational level from these. We will explain the approach in the next section. Second, we combine constructed time series with official labor market statistics in an econometric model to derive

long-term trends of future refugee migration and quantify its past regional labor market effects, conditional on sex and nationality. These models are then combined to project the surplus number of employees eligible for social security as a result of observed and expected refugee immigration through 2030. Put differently, we combine an econometric labor market model and a demographic forecast model to project the employment effect of refugee migration for 34 labor market regions in Germany by 2030.

The remainder of the paper is structured as follows. Following a short illustrative literature review of refugee migration projections and the connection between refugee migration and labor market integration (Section 2), we outline the baseline data of our study and our methodological approach (Section 3). Next, we present the study's results (Section 4). After a discussion of our findings and the paper's limitations (Section 5), we outline the need for further, more detailed data and delineate avenues of future research (Section 6).

## 2 Literature review

### 2.1 Refugee migration projections

For destination countries such as Germany, refugee migration constitutes an important share of overall migration (*Vanella/Deschermeier* 2018), which, in turn, is an important component of long-term population forecasts (*Vanella/Deschermeier* 2020) that are indispensable for economic and infrastructural planning (*Vanella et al.* 2020). Nevertheless, the literature on the estimation of future refugee migration is rather scarce. To our knowledge, no long-term refugee migration projections have been conducted to date, with the exception of refugee migration associated with climate change (*UNHCR* 2020). For instance, *UNHCR* (2019) only projects forced migration by target country two years out. Longer forecast horizons are discussed qualitatively, but no quantitative results are presented. For example, *UNHCR* (2020) expects a c.p. increase in globally displaced persons by 2050 due to global warming and related increases in extreme weather events, especially in Sub-Saharan Africa. Most forecasts of international migration do not address refugee migration at all (see, e.g., *Sohst et al.* 2020 for a recent systematic review of migration projections). Those stressing the importance of refugee migration in forecasting future migration flows only address the issue indirectly in their forecasts (see, e.g., for Germany *Deschermeier* 2016 or *Fuchs et al.* 2018). For instance, *Bijak et al.* (2019) discuss a separate Bayesian time series approach for forecasting inflows of asylum seekers in the United Kingdom (UK). However, the authors do not find the results satisfactory. *Vanella* and *Deschermeier* (2018) indirectly include refugee migration by demographics to Germany in their forecast model of net migration via principal component analysis (PCA). They interpret one of the major principal components (PCs) as a crises index, which covers the impact of crises on (refugee) migration. However, their model only covers asylum migration indirectly as a residual which cannot be interpreted directly. Given that refugee migration is subject to

unforeseeable events such as sudden violent conflicts,[1] it is hardly surprising that no long-term projections have been conducted, since such shocks are very difficult to predict in the long term (*Deschermeier* 2016).

## 2.2 Refugee migration and labor market outcomes

A vast number of studies analyze refugees' labor market outcomes, representing a steadily increasing part of the economic literature on the migration-labor market nexus.[2] First, the empirical evidence[3] suggests that, for developed countries, the overall employment share among migrants is lower compared to natives, with converging shares over time. The difference increases further for refugees (refugee gap) (e.g., *Brell et al.* 2020; *Dustmann et al.* 2017; *Fasani et al.* 2018; *Brücker/Jaschke/Kosyakova* 2019). Second, studies have found occupational differences between migrants and natives. *Dustmann/Frattini* (2013) show that immigrants are more likely to work in occupations requiring a lower level of skills. This occupational migrant-native gap is confirmed by *Fasani et al.* (2018) who demonstrate that the differences are more distinct for refugees. Notably, there is substantial occupational underemployment among refugees who arrived in Germany between 2014 and 2016 (*Brücker/Jaschke/Kosyakova* 2019). Third, findings suggest that migrants' wages are lower. *Dustmann/Frattini* (2013) provide evidence that across European countries, migrants are more likely to be in the bottom decile of the earnings distribution than natives. Once again, there is evidence of a more distinct refugee gap (e.g. *Brell et al.* 2020).

Various approaches seek to explain such differences in labor market outcomes, with education generally being considered as a key factor. Among the refugee population in Germany, heterogeneous educational patterns emerge: First, as *Brücker/Jaschke/Kosyakova* (2019) note, the human capital levels among refugees in Germany exhibit large shares at both ends of the educational continuum, that is, either a secondary education or above, or little to no formal education at all. Second, as *Guichard* (2020) shows, the educational background and self-selection of refugees concerning education varies by country of origin. *Basilio et al.* (2017) provide corresponding evidence for Germany. Here, missing formal recognition of education obtained abroad may explain a substantial part of the differences (*Brücker et al*. 2021).

Another factor contributing to the integration and outcomes of migrants is language skills (*De La Rica et al.* 2015). Indeed, empirical evidence suggests that

1 We will discuss this in more detail for the case of Germany in Section 3.1.

2 A comprehensive overview concerning migrants' labor market integration can be found in *De La Rica et al.* (2015). With a narrow focus on the labor market outcomes of refugees, the recent survey by *Becker/Ferrara* (2019) offers a broad view.

3 If not indicated differently, the quoted studies and respective results rely on conditional analyses incorporating individual characteristics, such as education, to account for aggregate differences in native, migrant, and refugee populations. We outline the most important of these characteristics below.

lacking proficiency in the host country's language might explain a large part of the (refugee) employment gap (*Brell et al.* 2020). Furthermore, (mental) health is comparatively worse among refugees than other migrants (*Brell et al.* 2020) due to traumatic experiences during the journey (see, e.g., *Schock et al*. 2016). In labor market research, addressing the role of health for labor force participation has already found a widespread application (e.g., *Cai* 2010). The results presented by *Ruiz/Vargas-Silva* (2018) indicate that this might explain parts of the refugee gap.

## 2.3 Towards a regional perspective

Labor market outcomes are not only determined by (observable[4]) individual characteristics but also by the broader social and economic contexts refugees are embedded in. For example, the institutional setting influences labor market integration and outcomes. In Germany, labor market admission is regulated by federal law.[5] Importantly, the waiting time for employment opportunities has been reduced from twelve to three months in 2014 but, contrarily, asylum seekers from "safe countries of origin" no longer have access to employment (*Brücker/Jaschke/Kosyakova* 2019). Empirical evidence indicates an adverse effect of employment bans (e.g., *Marbach et al.* 2018).

Moreover, the literature suggests that labor force participation rates move cyclically – increasing during times of economic growth, declining during recessions (e.g. *Aaronson et al.* 2014). This is particularly interesting since empirical evidence suggests that the business cycle disproportionally influences the labor market outcomes of migrants. For example, *Dustmann et al.* (2010) show that economic shocks impact the unemployment rates among immigrants in Germany more adversely compared to natives within the same skill group.

As other high-income countries, Germany is expected to experience unprecedented demographic developments in the near future: Aside from further population aging (*Vanella/Deschermeier* 2020), its (potential) labor force will decline substantially (*Fuchs et al.* 2018). As in the past, positive net migration and, more importantly, rising labor force participation rates and digitization could mitigate these developments, but hardly stop them (see, e.g., *Brenke/Clemens* 2017 or *Fuchs et al.* 2019). Regarding age and gender structure, the migrant and refugee populations differ from the total foreign and overall population in Germany to varying degrees (see *Destatis* 2020a). Even though the refugee population is substantially younger, this may not proportionally increase the labor force. While participation rates of males between 15 and 65 years are similar for natives and foreigners (83.9 percent vs. 81 percent), this is not the case for females (77.1 percent vs. 60.8 percent) (*Destatis* 2020b).

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4 In the literature, other explanatory factors which are less easily observable (such as discrimination) are discussed as well. As stated in the beginning, we do not provide an exhaustive literature overview of the comprehensive research on the migration-labor market nexus but refer to corresponding papers noted above.

5 §61 Asylum Act (AsylG).

However, the outlined dimensions do not necessarily affect refugees' labor market integration uniformly across Germany. First, recent projections show very different demographic developments at the regional level until 2040, with some regions (districts) expected to face further population growth while others are likely to experience a substantial decline, in particular among those of working age (see *Maretzke et al.* 2021). Second, there is evidence that labor force participation rates differ regionally (see, e.g., *Wanger* 2020). Third, labor market forecasts indicate that the regional labor demand is expected to vary both by economic sector and skill level in the upcoming decades (*Zika et al.* 2020). Fourth, in Germany, labor market admission is regulated by federal law, thus there are no formal differences across the country. However, the formulation of the federal law gives rise to a three-stage labor market admission procedure, which alters the regional institutional setting for refugee integration as described by *Brücker/Jaschke/Kosyakova* (2019). Additionally, dispersal policies coupled with residency restrictions might play a crucial role. In Germany, arriving refugees are distributed across the 16 federal states according to an agreement called *Königsteiner Schlüssel* (KS). In the literature, the coupling of dispersal policies and residency restrictions are found to impose negative effects on the labor market outcomes of refugees (e.g., *Fasani et al.* 2018 or *Brücker et al.* 2020).

Regional variation of all the discussed aspects – from demographic changes to the institutional setting, from structural differences of regional labor markets to refugees' individual characteristics and internal migration – give rise to the possibility of regionally varying employment effects, in particular in the context of an aging and decreasing population, that is labor supply decline. Yet, to the best of our knowledge, this issue has not been addressed in the literature. Thus, as a working hypothesis, based on the literature review and the argumentation above, we propose that the regional interaction of employment dynamics and demographic changes yield regionally varying mitigation potentials for labor supply decline. As noted in the introduction, while the literature outlined above is strongly focused on micro-level studies, i.e., analyzing the labor market integration of refugees from an individual perspective, we complement the existing research by approaching employment effects from a regional, macro-level point of view.

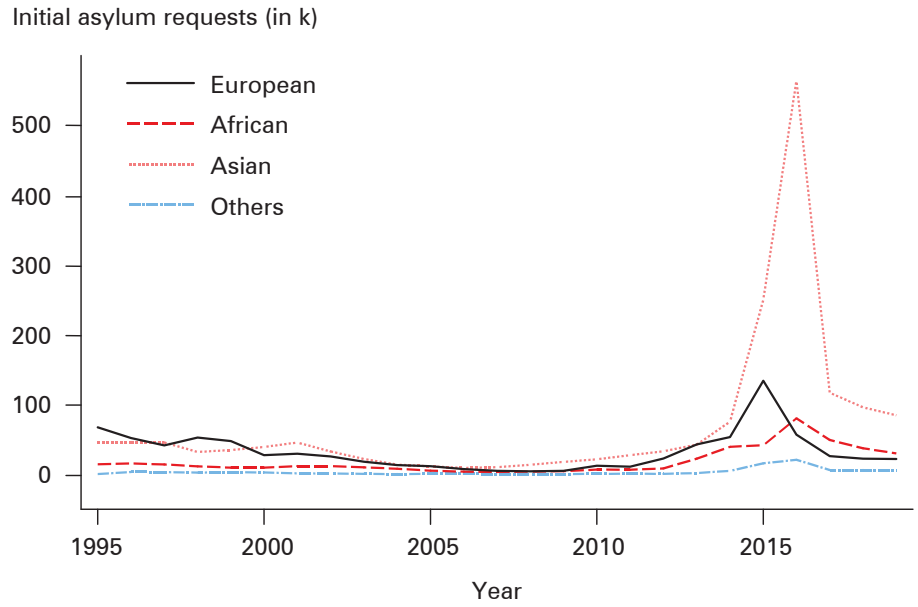
## 3 Data and methods

### 3.1 Forecasting refugee migration and asylum requests

#### *3.1.1 Refugee migration to Germany since 1995 – trends and background*

Our analysis follows a hierarchical approach. As the first step of the analysis, we investigate long-term trends of refugee migration at the national level. For this, we use annual data on initial asylum requests (IARs) in Germany by group of origin, provided by the German Federal Office for Migration and Refugees (*Bundesamt für Migration und Flüchtlinge – BAMF*) and the Federal Ministry of the Interior, Building

**Fig. 1:** Annual initial asylum requests by origin group in thousands




Source: *efms* 2003; *BAMF* 2020b; authors' calculation and design.

and Community (*Bundesministerium des Innern, für Bau und Heimat – BMI*) in their annual migration reports (*BAMF* 2020b; *efms* 2003). Because the definition of IARs was introduced in 1995 (*BAMF* 2017), we choose the period 1995-2019 for our analysis. To retain enough statistical power, we aggregate the exact nationalities of asylum seekers into four origin groups: European, African, Asian, and others. We analyze the long-term trends in IARs in Germany for these four defined origin groups. Figure 1 shows the time series of the four origin groups for the baseline period.

There appear to be high correlations in application numbers among the four origin groups. However, trends in applications by persons with European citizenship tend to precede the other nationality groups by one year. After generally decreasing trends until the mid-2000s, asylum requests started increasing in 2007. Table A1 gives an overview of major refugee inflows to Germany since then, with information on the major origin countries and causes for emigration.

Among all nationalities, the number of IARs from 2011 to 2012 more than doubled from 11.000 to 23.000. In sum, annual increases in new asylum requests in Germany are observable between 2007, the starting year of the financial crisis, and 2016, from 19.000 to 722.000 IARs. In particular, the sharp increases in the mid-2010s are caused by the growing reach and violence of various terror groups, most notably the *Islamic State* in Syria and Iraq, the Taliban in Afghanistan, and Boko Haram in West Africa (*Heidelberg Institute for International Conflict Research* 2016). Since 2017, the number of requests has declined after the EU initiated a series of measures

which made it more difficult to enter the EU at its eastern borders (*SVR Integration und Migration* 2018).

### *3.1.2 Forecast model of initial asylum requests*

Since our goal is not only to describe past trends in asylum applications in Germany, but to also predict their future development, we must consider the observed correlations between the different time series in our analysis. This is done via principal component analysis (PCA), which transforms the original, correlated variables into the same number of uncorrelated, new variables, which are linear combinations of the original variables. PCA chooses the principal components (PCs) such that most high dimensional problems can be covered well by a small number of index variables. PCA moreover allows for including the correlations between the original variables in simulation studies.[6] The method has been applied to forecasting international migration in Germany by *Fuchs et al.* (2018) and *Vanella* and *Deschermeier* (2018). The first PC of the asylum request time series ($p_1^A$) explains 86.5 percent of the variance in the past observations of the four origin-specific asylum request series. Its loadings are negative for all four series (-0.4 for European, -0.45 for Africans, -0.51 for Asians, -0.62 for others); therefore, increases in $p_1^A$ are associated with c.p. decreases in the number of IARs in Germany from all nationality groups. Therefore, we interpret $p_1^A$ as a general *Refugee Migration Index*. The hypothetical course of the Refugee Migration Index with its projected future course is illustrated in Figure 2. The Refugee Migration Index mirrors the overall trends in asylum requests, with increases (i.e., c.p. decreases in asylum requests) until 2008 and rather sharply decreases (i.e., c.p. increases in asylum requests) until 2016, after which we observe slight increases due to the EU measures aimed at containing refugee migration, as mentioned in Section 3.1.1.

No clear long-term trend can be identified, as the index is highly influenced by current crises, which are difficult to predict. We therefore follow a similar assumption as in *Vanella* and *Deschermeier* (2020, 2018), who interpreted a similar index as a general *Crises Index* in their migration forecast model, stating that in the long term $p_1^A$ is expected to converge towards its median over the observed period. However, this assumption is relaxed by fitting an *AR*(1) process to the past data. Thus, the slope of the curve is computed from the past data, not based on further assumptions. The resulting model for year *y* is

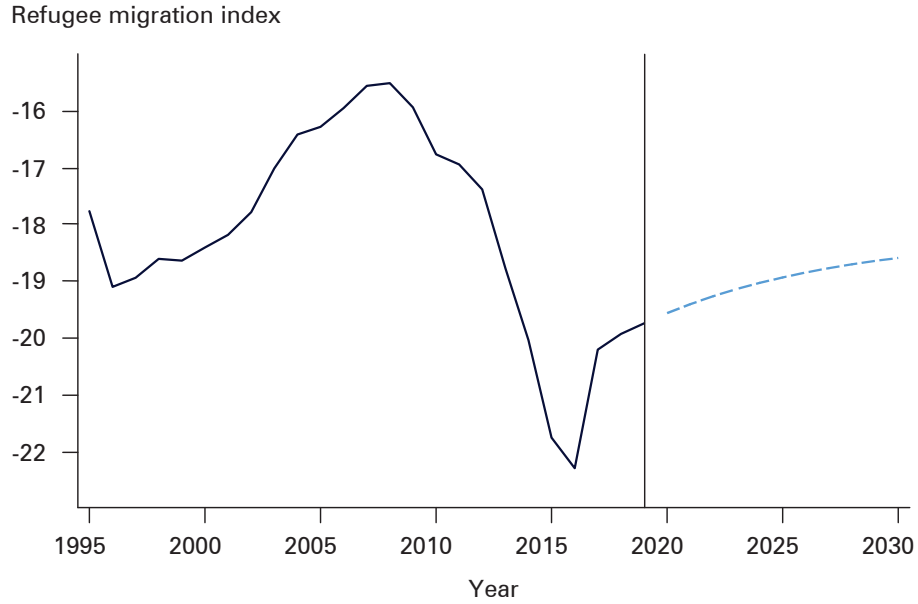
$$\mathbb{E}[p_1^A(y)|p_1^A(y-1)] \approx -18.192 + 0.885 p_1^A(y-1) \quad (1)$$

(1) generates the prediction of $p_1^A$ until 2030.

For the other four PCs, we assume random walk processes without drift in the future, which implicitly predicts the value of, say $\mathbb{E}[p_2^A\ (y+1)]$ to equal the

6 For a more detailed description of PCA and its application in demographic forecasting, see *Vanella* (2018).

**Fig. 2:** Historic development and prediction of the Refugee Migration Index




Source: Authors' computation and design.

observation $p_2^A(y)$. The random walk's expectation is therefore similar to the naive prediction.

## 3.2 Refugee demographics

For Germany, combined data on demographics and origin of refugees are not available. However, we can gather data on age- and sex-specific information for the sum of the IARs, without disaggregation by nationalities. For this, we use *BAMF* reporting data on the demographic structure of persons requesting asylum annually from 2009-2019 (*BAMF* 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019a, 2020a). Appendix Table A2 displays the shares of asylum seekers by age-sex group for this period. We tested these data on the national level for trending behavior in asylum requests. However, a detailed differentiation by age group led to very small numbers of refugees by stratum on the NUTS-3 level (see Section 3.5 for details).

An investigation of the trends in sex-specific requests, however, implies a connection of the share of males to the total level of IARs. As the time series is relatively short, deriving long-term trends via time series methods for the demographic groups would yield misleading estimates.[7] Following our assumption

[7] We tried this in an earlier approach.

that the IARs eventually converge to their long-term median, a similar assumption appears plausible for the demographic distribution among the refugees if these phenomena are connected. Therefore, our prediction follows an *AR*(1) model for both variables, similar to (1). The model for the share of males below age 65 among all IARs is

$$\mathbb{E}[m(y)|m(y-1)] \approx 0.629 + 0.734m(y-1), \tag{2}$$

the corresponding model for females is

$$\mathbb{E}[f(y)|f(y-1)] \approx 0.362 + 0.753f(y-1). \tag{3}$$

Note that this model does not explicitly include correlation among the shares of both genders. In our deterministic approach, this is acceptable. More sophisticated approaches should account for this, however.

(2) and (3) are used as backcast functions to approximate the missing sex-specific data before 2009 and as a forecast function for the years 2020-2030.

### 3.3 Estimated distribution of asylum seekers among federal states

Refugees are distributed among the German federal states following the KS (see 2.3), which takes the population size and the economic strength of the federal states into account. Annual values of the KS from 1995-2018 were provided by the German Joint Science Conference (*Gemeinsame Wissenschaftskonferenz – GKW)*, partly online (*GKW* 2021a), partly upon request (*GWK* 2021b).

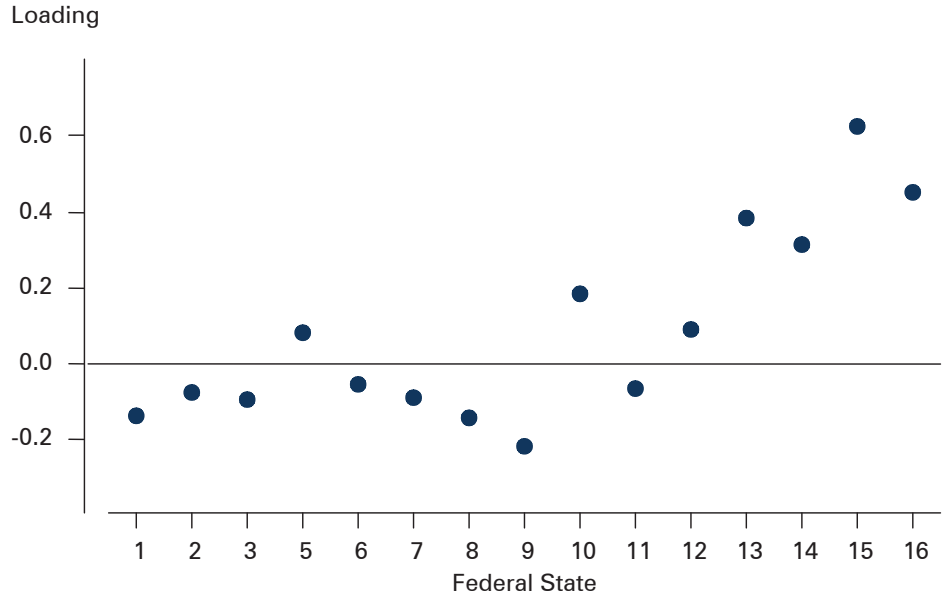
To cover correlations between the time series of the KS, we apply PCA to the logarithmized KS values. Since the annual sum of all KS values is one, we need to include one condition. As Bremen is the federal state with the smallest population, we model its refugee distribution indirectly by subtracting the sum of all other shares from one:

$$KS_{HB} = 1 - \sum_{s=1}^{15} KS_s \tag{4}$$

The first PC explains 93.9 percent of the variance in the refugee distribution among the federal states, therefore we call it the *KS Index.* The loadings of the KS Index for the 15 included federal states ordered by the official geographic numbering are illustrated in Figure 3. The accompanying information on the federal states can be found in Figure 8.

The federal states with positive loadings represent eastern Germany, the former German Democratic Republic (GDR) (states 12-16), except Berlin (11). Interestingly, Saarland at the French border and the most populous federal state, North Rhine-Westphalia in the West of Germany, are positively correlated to the KS Index also.

**Fig. 3:** Loadings of the first principal component of the KS model




Source: Authors' calculations and design.

For a deeper interpretation, we must consider its past trend, which is illustrated in Figure 4, with its predicted future development as explained below.

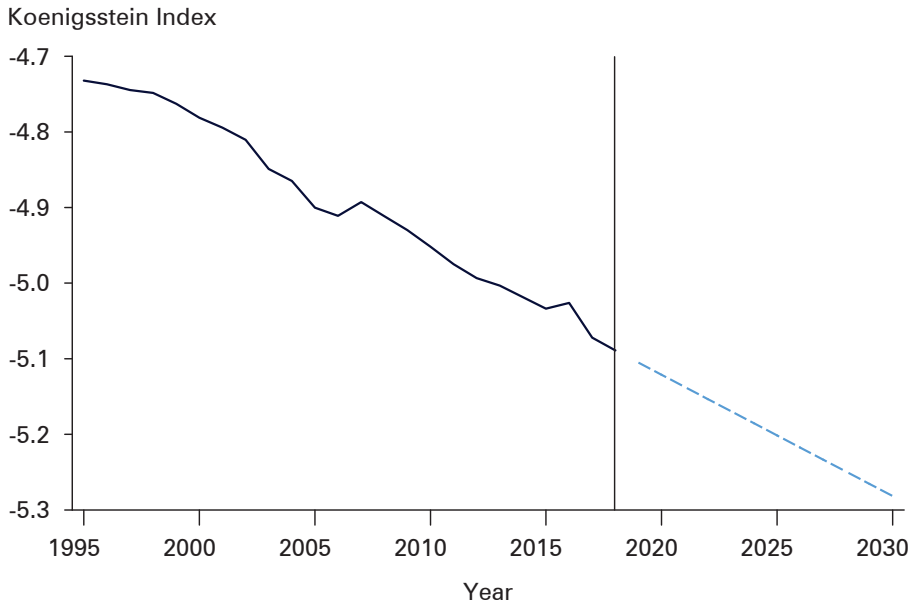
The KS Index shows a clear downward trend over the baseline period, meaning that there are clear trends in the distribution of refugees among the federal states. We extrapolate the trend until 2030 by fitting the following model:

$$\mathbb{E}[p_1^K(y)|p_1^K(y-1)] \approx 27.297 - 0.016y + u_1^K(y-1), \tag{5}$$

with $u_1^K(y-1)$ being the residual of the forecast from the preceding year $u_1^K(y-1) := p_1^K(y-1)\,\mathbb{E}[p_1^K(y-1)|\,p_1^K(y-2)]$.

Figures 5 and 6 illustrate the annual population growth of the 16 federal states from 1995-2018. Ignoring the countrywide decrease in 2011, when the German population count was corrected downwards by 1.3 million in the census-based estimate (*Vanella et al.* 2020), we see a connection between the KS Index and population growth. The federal states in Figure 5 have a negative correlation with the KS Index and witnessed positive trends in population growth since the mid-1990s, whereas the opposite is the case for the federal states in Figure 6. The exception is North Rhine-Westphalia (5), whose long-term population growth does not follow a clear trend but has a positive tendency. However, there is a clear negative long-term trend in North Rhine-Westphalia's population share. An explanation could be the state's comparatively low economic growth. As economic development is

**Fig. 4:** Past course and prediction of the KS Index




Source: Authors' computation and design.

connected to tax income originating from the federal states (*Schulte* 2015), differing economic developments are also mirrored in the KS Index.

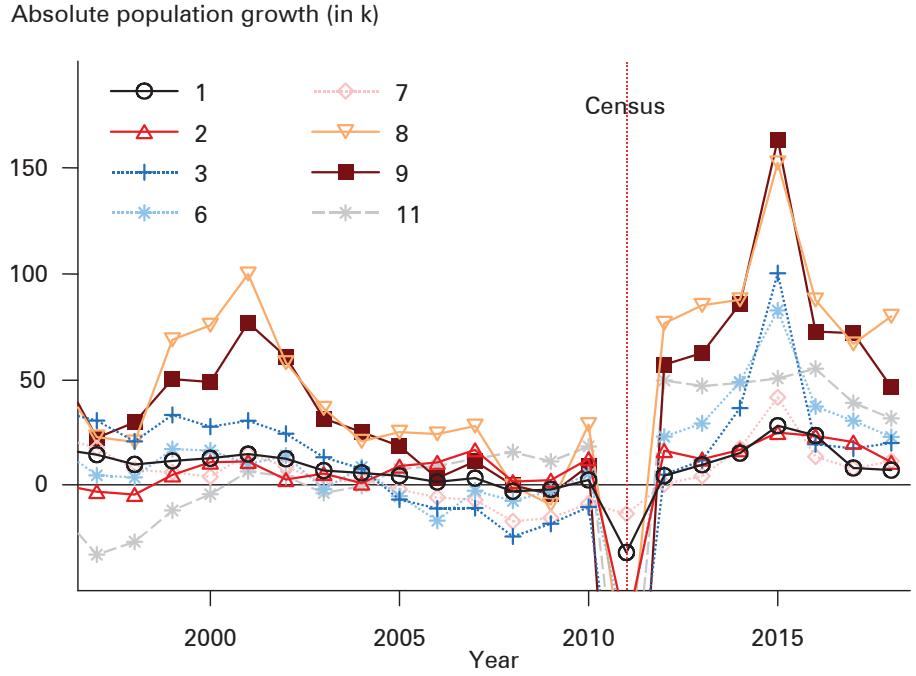
The remaining 14 PCs are assumed to follow random walk processes. The results of the projection of the refugee distribution among the federal states are presented in Section 4.

### 3.4 Trends in asylum decisions by groups of origin

The share of asylum seekers who received a protection status by group of origin is derived from the official data on asylum decisions from 1998-2020 provided to us by the *BAMF* (2021) upon request. There is a variety of different classifications of residence permits in Germany, which define whether a person is allowed to remain in the country permanently, for a limited time, or must leave the country; this defines the amount of financial aid refugees receive.[8] As a thorough analysis of this would exceed the scope of our paper, we refer to the simple binary classification whether asylum seekers are allowed to stay in the country for a (limited) period or must leave immediately. The share of persons allowed to remain in Germany is summarized by the *protection rate*. Figure 7 illustrates the historical development of the protection rates for the defined four groups of origin.

8 An overview, albeit in German, is given, e.g., in *BAMF* 2019a/b.

**Fig. 5:** Annual population growth of federal states with negative loadings in the KS Index

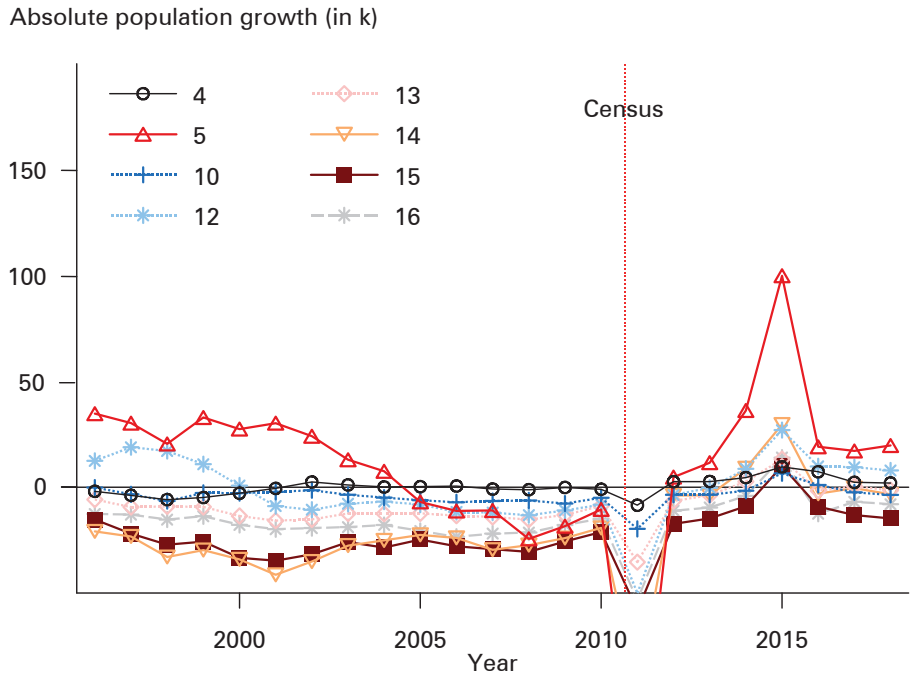



Source: *GENESIS-Online* 2021; authors' computation and design.

Whereas the protection rates of European citizens had a downwards trend until the mid-2010s, we observe a sharp increase since 2016, mainly driven by high and increasing protection rates among Turkish citizens (45.2 percent in 2020). This trend was caused by a failed military coup in the summer of 2016, after which many suspects fled the country. Moreover, the Turkish government has restricted journalism in the country ever since, leading to journalists and opposition figures fleeing the country (*Zeit* 2019). For all other groups of origin, besides some fluctuations, the protection rates show an increasing long-term trend since the mid-2000s. The protection rate of Asian citizens in particular peaks considerably in 2008. This development was caused by the harmonization of the EU asylum system, which was supposed to facilitate the process of refugee protection in the EU (*Haase/Jugl* 2007; *Engler/Schneider* 2015; *EU* 2011).

Protection rates are, although influenced by stochastic phenomena, primarily driven by political decision-making and are therefore by nature deterministic. Therefore, we will not construct a forecast model for them but rather assume a naive scenario which fixes the protection rates at their 2020 values until 2030, i.e., 25.4 percent for Europeans, 27.9 percent for Africans, 60.7 percent for Asians, and 53.9 percent for all others.

**Fig. 6:** Annual population growth of federal states with positive loadings in KS Index, including Bremen

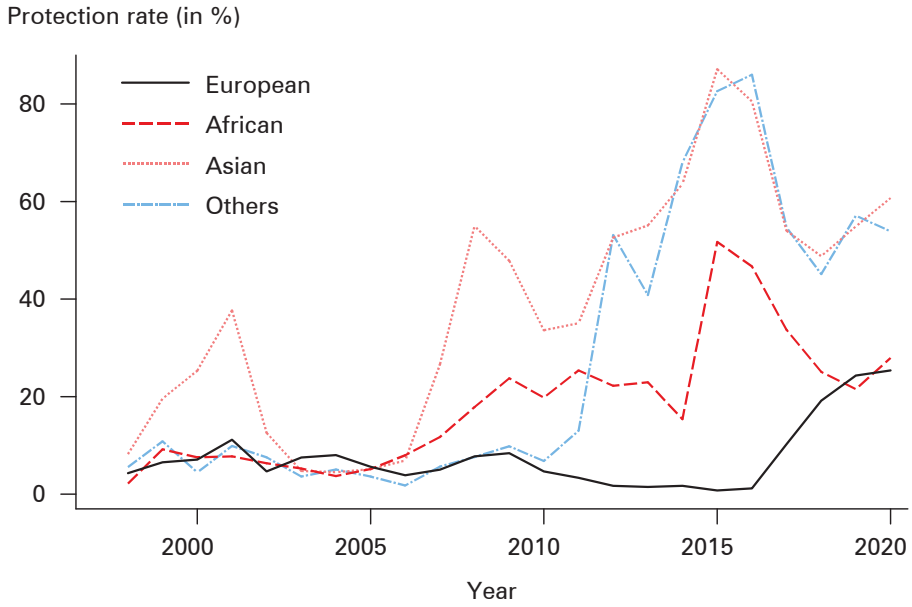



Source: *GENESIS-Online* 2021; authors' computation and design.

### 3.5 The regional distribution of asylum seekers

Refugees assigned to specific federal states are distributed to the NUTS-3 level (*districts*). In most cases, the distribution of refugees is based on the population size of the district relative to the federal state (*Geis/Orth* 2016). As population data in Germany are normally published with a lag of over one year, we assume the second lag of the annual population estimates as the basis for the distribution of refugees to the NUTS-3 level. For this, the end-of-year population numbers for 1995-2019 are downloaded from the database of the federal and state statistical offices (*Statistische Ämter des Bundes und der Länder* 2021). To estimate the distribution of refugees in the districts within the federal states, we assume annual distribution according to the most recent regional population projection of the Federal Institute for Research on Building, Urban Affairs and Spatial Development (*Bundesinstitut für Bau-, Stadt- und Raumforschung – BBSR).* The data was provided upon request by the *BBSR* (2021). We use these BBSR estimates for the future distribution of

**Fig. 7:** Protection rates in Germany by group of origin




Source: *BAMF* 2021; authors' computation and design.

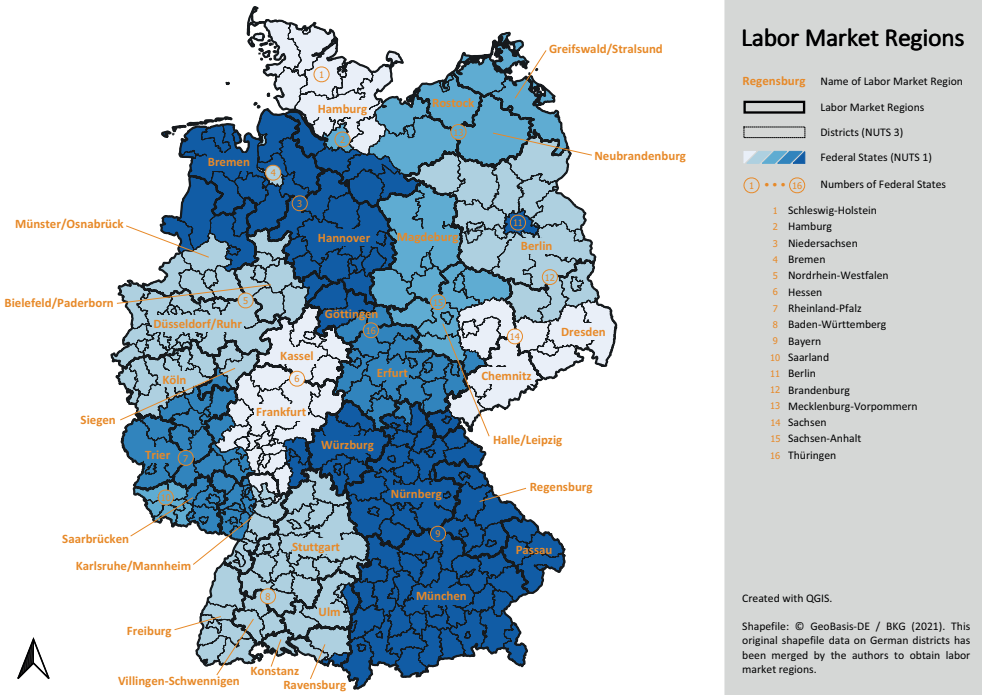
refugees within the federal states to the district level. We interpret this distribution as politically driven and therefore deterministic.[9]

In our analysis, we investigate the effects of refugee migration in 34 different labor market regions (*LMRs*) as suggested by *Zika et al*. (2020), who, in turn, draw on the original classification by *Kropp* and *Schwengler* (2011, 2016). The selection of LMRs for analyses in a regional perspective is widely used in the literature (e.g. *Burstein et al.* 2020). A functional delineation of this kind appears to be preferable to administrative borders since LMRs capture most commuting flows. In other words, residence in the small-area, district level is not necessarily indicative of whether individuals work in the respective region as well, a point of particular importance in the context of this analysis.

However, employment within the LMR of residence can be assumed. The original delineation by *Kropp* and *Schwengler* (2016) correctly estimated about 90 percent of labor commuters in Germany to their respective LMRs. The aggregation by *Zika et al.* (2020), which primarily aims at creating LMRs with sufficient case numbers for projections, further increases this share. Appendix Table A3 gives an overview of the districts included in each LMR. Figure 8 gives a detailed overview of the LMRs

9 In fact, a refugee distribution linked to the more granular units makes it highly stochastic, as the future population size per se is highly volatile, which, in relative terms, holds especially true for relatively small regional populations (*Deschermeier* 2011; *Vanella/Deschermeier* 2020).

**Fig. 8:** Overview of the labor market regions as used in the analysis




Source: Authors' illustration using *BKG* 2021.

and their composition from the NUTS-3 to the NUTS-0 level. The expected annual distribution of refugees below age 65 by sex and group of origin among the LMRs, as derived from our projection, is provided in the Online Data Appendix.

## 3.6 Estimation of labor market effects and projection

In the final part of our analysis, we investigate the regional labor market effects of refugee migration, drawing on our previous results and using the LMR classification outlined above. Given the availability and high dimensionality of regional data and for the sake of a consistent and parsimonious empirical approach throughout our analysis, we rely on PCA. We apply separate PCAs on the annual differences in regionally employed persons from 2007 to 2019 (annual average) for each gender-nationality group, yielding six[10] individual models. In doing so, we account for

[10] We excluded refugees, both male and female, with European citizenship from this part of our analysis. The reliable empirical assessment of their labor market effect is strongly hampered by various factors such as enlargements of the EU. Increased labor-related migration from former refugee-sending countries to Germany because of this enlargement process vastly outperforms the number of asylum requests in the preceding years.

correlations in the regional employment by including simultaneous employment trends in the LMRs in the analysis. As it is difficult to measure interregional migration of persons with an asylum background, PCA indirectly quantifies the gravity of the LMRs for asylum seekers and hence their movements between the LMRs. Moreover, the method enables the modeling of labor market trends for all LMRs by a small number of indices instead of requiring a multitude of separate models for each LMR. The employment data are taken from the statistical database of the Federal Employment Agency (FEA*, Bundesagentur für Arbeit – BA*) and refer exclusively to employees subject to social insurance. In each gender-nationality case, the first of the resulting 34 PCs explains over 89 percent of the variance in the employment differentials. Thus, we regress each first PC, $pc_{gn,t}$, on the gender-nationality specific refugee figures, $ref_{gn,t}$, and the real gross domestic product (GDP) per capita growth rate, $gdp_t$. More formally, our model can thus be written as

$$pc_{gn,t} = c + ref_{gn,t} + gdp_t + e_t \tag{6}$$

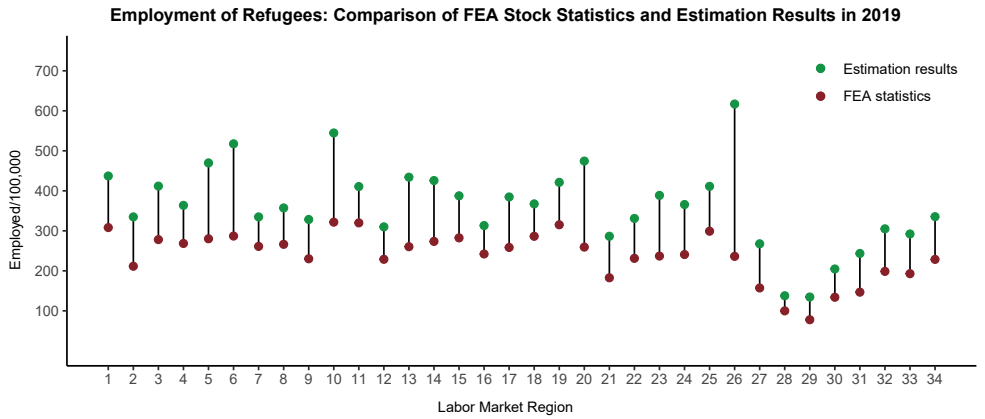
where $c$ is an intercept and $e_t$ is the error term. The refugee figures refer to the aggregated number of the past seven years since survey data indicates that refugees' labor market integration levels out seven years after arrival (*Brücker/Jaschke/Kosyakova* 2019). The real GDP per capita was included as a predictor of overall economic conditions, which, as outlined in Section 2, plays a key role in the labor market participation and economic success of foreigners in general. GDP data was taken from *VGRdL* (2019).

Using the obtained coefficients from (6), we derive both in-sample and out-of-sample projections for each first PC (see Table A5). For in-sample projections, we draw on observed refugee migration and GDP values. For out-of-sample projections, we assume GDP growth according to the compound annual growth rate from 2010 to 2019[11] and rely on the projected refugee figures as outlined above. In both cases, the remaining 33 PCs are again assumed to follow random walks. Applying matrix algebra on the newly derived matrix of PCs and the matrix of eigenvectors, we derive annual regional employment figures. In a second step, we repeat this exercise but exclude refugee migration in the calculation of the first PC. By forming differences between both projections with and without refugee migration, we derive the annual regional employment impact for the past and the future.

We cross-validate the plausibility of our empirical strategy by comparing the in-sample projection results for 2019 to FEA employment stock statistics in Figure 9. The official FEA statistics refer to the stock of employees eligible for social insurance who are labeled as individuals *in the context of refugee migration* in March 2020, which is the first available record of this statistic. This definition encompasses all those persons whose residence status is related to an asylum procedure. Both statistics are shown per 100,000 inhabitants (2019 figures from *Statistische Ämter*

[11] In doing so, we do not account for economic downturns due to the pandemic situation since March 2020.

**Fig. 9:** Comparison of FEA stock statistics and model results




Source: *Statistische Ämter des Bundes und der Länder* 2021; *Federal Employment Agency* 2021; authors' calculation and design

*des Bundes und der Länder* 2021). As can be seen, our model replicates the regional *variation* in employment stock figures fairly well. However, LMRs such as Munich (20) or Berlin (26) show by far larger estimated absolute employment numbers compared to official statistics. This is likely a result of several factors. Economically, regional structural or institutional conditions and differences thereof may not be fully captured by the estimation strategy and, thus, may explain comparatively lower or higher integration of refugees. Demographically, different regional immigration and emigration patterns may hamper a more precise inference and estimation of regional figures. Methodically, the model overestimates the number of people, as we are not able to account for people leaving employment, for example, due to retirement, job loss, or a higher number of job turnovers in general. Additionally, the model does not cover people who stay employed but experience changes in their residence status and thus are no longer classified by official FEA statistics as being "in the context of refugee migration." Below, we account for the outlined shortcomings in terms of overestimation by correcting the estimated values for the period from 2020 to 2030, using the ratio of official and estimated values shown in Figure 9. Thereby, we are implicitly assuming that the difference between annually estimated employment inflow figures and true employment inflow figures is stable over time.

## 4 Results

Maintaining the outlined order of partial models from our empirical strategy, we present the corresponding results below. First, projected IAR figures by gender and nationality group as well as the estimated distribution across labor market regions are shown. Second, we analyze regional labor market impact: We relate the cumulated

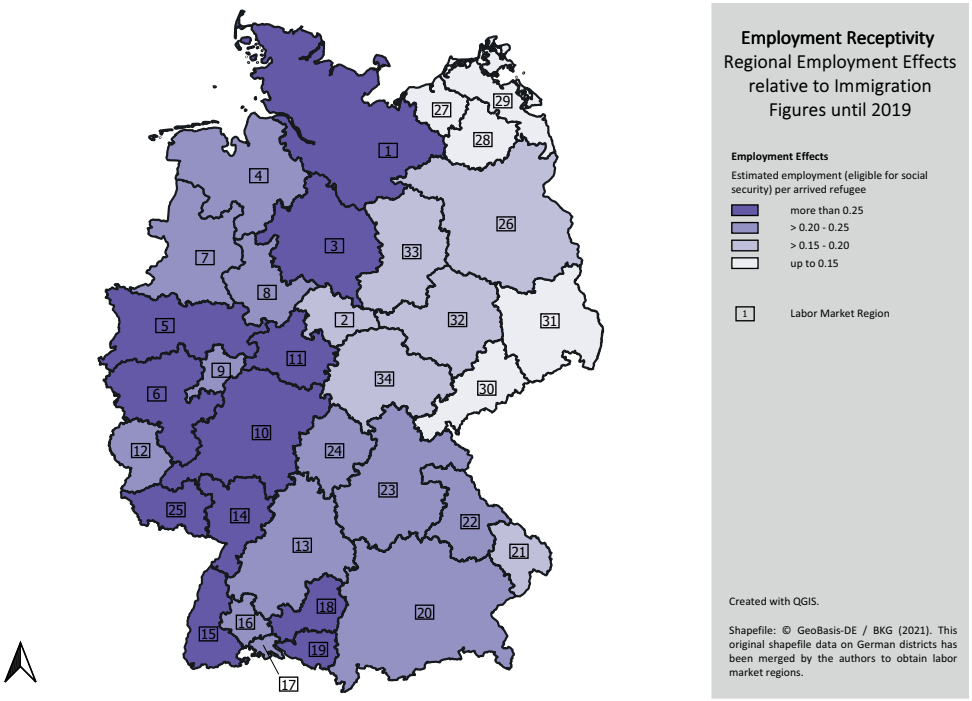
estimated in-sample employment numbers in 2019 to the overall refugee inflow figures in the regions, yielding an interpretation of different degrees of regional employment effects. We then compare employment and unemployment patterns, providing insights on possible regional differences in employment compared to overall labor market integration. Subsequently, we relate the projected employment figures until 2030 to the regional working-age population figures projected by the BBSR (*Maretzke et al.* 2021), thus offering an estimate of the contribution of refugee migration to mitigating the projected labor supply decline.

First, we expect IARs to further decrease beyond 2030, as illustrated by the projected increase in the Refugee Migration Index in Figure 2. Note that due to the negative correlation between that index and the IARs shown in Figure 1, increases in the index are associated with c.p. decreases in the asylum requests. The decline is particularly distinct for Asian citizens, driven by the very high number of IARs in 2015 followed by a subsequent long-term decrease to the median level. Multiplying the estimated future IAR figures with the projections of the shares of males and females below age 65, we derive projections of origin- and gender-specific IARs. These numbers are then multiplied by the federal state shares as outlined in Section 3.3. The predicted annual distribution of the refugees to the federal states is listed in Appendix Table A4.

As noted, using data of past refugee migration to Germany and drawing on our estimates of future developments outlined in the preceding paragraphs, we then investigate corresponding regional employment effects. Figure 10 shows the cumulative employed refugees according to the in-sample projection relative to the cumulative regional refugee inflow numbers. Thus, employment figures refer to 2008-2019, corrected as outlined in Section 3.6, and refugee figures refer to 2001-2018 as we use the cumulated figures of the past seven years in the model. Dark purple values indicate more people being employed relative to inflow numbers, that is, 0.25 or more employees eligible for social security per person who had initially arrived in the respective region. Those regions illustrated by the lightest color have seen 0.15 or less employment increase per person arrived. While Frankfurt am Main (10) experienced the strongest increase (0.35), Greifswald-Stralsund (29) has seen the smallest employment effect (0.08). Notably, these results should not be interpreted as better or worse regional employment integration per se relative to immigration figures, but rather as regional employment *receptivity* to refugee migration, as the results displayed may be influenced by processes such as internal migration. The conceptual differences and limitations thereof are further discussed in the following section.

Figure 11 in turn displays the cumulative corrected estimation results in 2019 relative to the average annual unemployment stock figures of persons in the context of refugee migration according to official FEA statistics. Dark brown values indicate comparatively more refugees being employed than unemployed (1.25 or more). Dark turquoise areas refer to the opposite (0.75 or less). Compared to the previous map, we can observe not only a distinct East–West pattern but also a North–South divide. Munich (20) exhibits the largest value with 2.66. This means that for every

**Fig. 10:** Regional employment effects relative to immigration figures until 2019

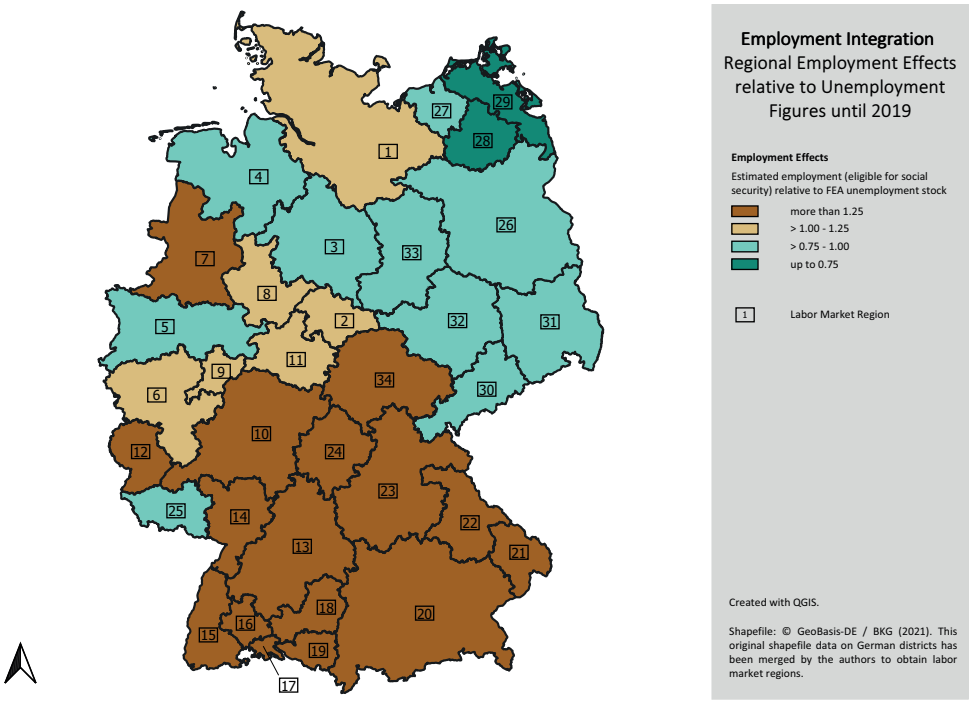



Source: *BKG* 2021; *Federal Employment Agency* 2021; authors' computation and design.

unemployed person in the context of refugee migration, 2.66 persons are employed. The lowest value is 0.52 for Greifswald-Stralsund (29).

Given our interest in the contribution of employment effects by refugee migration for mitigating population and labor supply decline, the projected figures may be related to existing population forecasts. Here, we draw on the demographic projection by *Maretzke et al*. (2021), which indicates a decline of the working-age population (aged 16-64) across all labor market regions through 2030. Figure 12 illustrates the cumulative projected employment effects for 2020-2030 per expected working-age population decline in the same period, measured in absolute numbers. Thus, dark green values indicate stronger mitigation of population decline by refugee migration (more than 0.2, i.e., 20 percent), light green values refer to the opposite (less than 0.1, i.e., 10 percent). Munich (20) again exhibits the highest value among all regions with 0.27, closely followed by Berlin (26) with 0.26. Conversely, Neubrandenburg (28) shows the lowest estimated value, at 0.02.

**Fig. 11:** Regional employment effects relative to unemployment stock figures



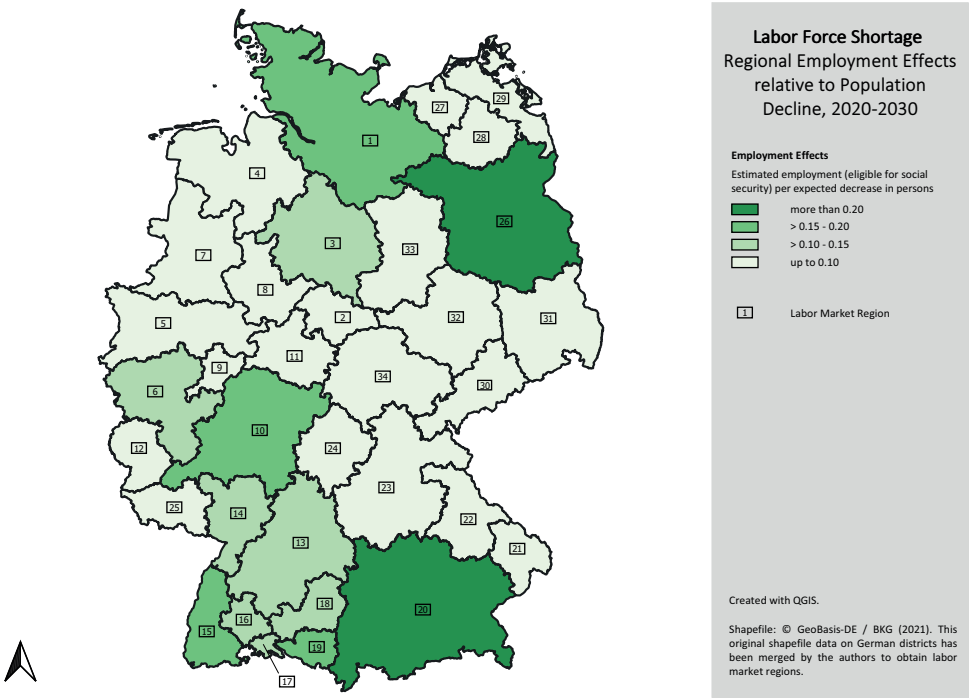

Source: *BKG* 2021; *Federal Employment Agency* 2021; authors' computation and design.

## 5 Discussion

The results presented in the preceding section demonstrate distinct regional employment patterns regarding refugee migration, in particular in the context of population decline. However, the empirical approach applied in this paper and the corresponding results still require a detailed discussion, including their limitations.

The comparisons of cumulated employment figures to both cumulated inflow numbers and stock unemployment in FEA statistics, reveal stark differences across Germany. The results for regional *receptivity* (Fig. 10) display the extent to which a labor market region has experienced employment growth due to refugee migration. Interestingly, the differences largely run along the borders of Western and Eastern German labor market regions. The former have seen disproportionally stronger employment increases, whereas employment growth due to refugee migration has been lower for the latter. However, this observation does not necessarily imply a stronger labor market integration *per se*, but may be the result of only implicitly modeled processes such as internal migration after arrival. To this end, the comparison of employment receptivity to employment *integration* patterns (Fig. 11), the latter by relating the employment effects to stock unemployment figures, provides additional insights. Here, by contrast, clear differences between

**Fig. 12:** Regional employment effects relative to population decline until 2030




Source: *Maretzke et al.* 2021; *BKG* 2021; authors' computation and design.

Western and Eastern labor market regions largely vanish, whereas a distinct North–South gradient emerges. Thus, labor market regions in the South of Germany have seen, at least in relative terms, more refugees and asylum seekers transitioning into employment.

The conjunction of both analyses may point towards a twofold explanation: First, we do not model migration between regions after the arrival explicitly. As outlined in the literature review, the empirical evidence suggests that both free choice of residence and work as well as proximity to ethnic communities intervene in the integration process. Our model does not disentangle these factors and their contribution to the derived results. Detailed analyses of the distribution of refugees with approved protection status support the internal migration assumption (see, e.g., *Rösch et al.* 2020). Similarly, the existence of ethnic networks fosters integration. Given the sharp differences in regional foreign population shares across German regions (see, e.g., *BAMF* 2019c), these networks possibly emerge as another intervening mechanism. Regionally varying labor force participation rates may eventually lead to differing employment effects; however, one may assume these differences to be comparatively small. Second, the observed patterns in employment-to-unemployment ratios largely coincide with regional economic strength (see *VGRdL* 2019). As noted earlier, the literature suggests that migrants'

employment rates are linked to economic conditions. However, given the modeling strategy, we are not able to derive definitive conclusions for these two explanatory approaches.

Interpreting the relation of employment effects and future demographic changes, that is, the contribution of refugee migration to mitigating labor supply decline, is fairly straightforward. Relating the conditional projection of the observed past employment effects until 2030 to projected working-age population declines indicates that future employment effects strongly interact with expected demographic developments. Thus, concerning the working hypothesis in Section 2.3, we find that refugee migration can indeed be expected to mitigate labor supply decline differently across regions. This is particularly visible in the examples of labor market regions surrounding large cities, most of all for Munich and Berlin, which do not belong to the group of LMRs witnessing the largest employment effects relative to immigration but can expect refugee migration to compensate for the decline in the labor supply[12] by more than a quarter. Importantly, according to *Maretzke et al.* (2021), both regions are expected to face significantly smaller declines in the working-age population than the remaining regions. For a multitude of other regions which are expected to face a more distinct decline, the mitigation potential is mostly – but not necessarily – much smaller. For example, economically strong regions in the South-West of Germany, such as Frankfurt am Main, Freiburg, and Ravensburg, with strong employment integration, i.e., large employment-to-unemployment ratios, also exhibit comparatively high mitigation potentials despite stronger population decline. By contrast, labor market regions in Western Germany with large employment effects relative to immigration, do not exhibit similarly large mitigation potentials due to sharper population decline. Moreover, the contribution of refugee migration to cushioning labor supply decline in labor market regions in Eastern Germany, given the expected intensities of population decline, remains limited, even for areas with strong employment integration such as Erfurt. Thus, the results presented above not only illustrate varying mitigation potentials but also point to regionally varying causes thereof.

All these conclusions hold only if one relies on the implicit assumption that both receptivity and integration patterns as observed until 2019 do not change in the future. Put differently, altered internal migration patterns as well as converging or intensifying regional differences in employment-to-unemployment ratios among refugees may increase or decrease the mitigation potentials shown and discussed above. Further research which explicitly examines internal migration and regional unemployment patterns among refugees may offer significant contributions. From a much more general perspective, we might also conclude that in the medium- to long-term, employment effects as a consequence of refugee migration, as observed and estimated in our model, could also provide diverging potentials for economic development among German labor market regions. Once again, we recommend that additional research should be done to support these findings.

[12] Only under the assumption that the decline of the working-age population equals or at least implies a proportional decline in the labor force and employment as well.

Our paper uses a novel hierarchical approach, which quantifies the annual differentials in employees subject to social insurance contributions, stratified by gender and country of origin group, for each LMR. The model accounts for demographic and geographic characteristics while including overall economic development. Previous approaches, as illustrated in the literature review, took a shorter-term perspective, which does not sufficiently reflect the long-term nature of the labor market integration of refugees. Besides an analysis of the past regional labor market effects of refugee migration, we offer an outlook on how refugee migration might impact the 34 discussed LMRs until 2030 in the form of a deterministic, yet data-driven, projection of age-, sex-, and origin-specific refugee immigration. The model also accounts for asylum policy and expected regional demographic developments. Thus, our paper not only provides insights into regionally varying employment effects of refugee migration and the respective interaction with population decline but, from a more methodological point of view, has also shown the general complexity associated with analyzing these effects on regional labor markets in a quantitative and comparative setting.

However, inevitably, our empirical approach is subject to several limitations which must be kept in mind when interpreting the results and drawing conclusions. We group and explain these limitations in three categories below: non-capturing statistical risk, small regional case numbers and data availability, as well as other relevant but not explicitly modeled processes.

First, refugee migration is highly stochastic and therefore difficult to predict, as it is influenced by many political, social, economic, and environmental factors. Throughout this paper, we apply a deterministic modeling strategy, since an appropriate stochastic approach should include stochasticity arising from all partial models. Put differently, the nexus of refugee migration and labor market integration – encompassing, inter alia, the initial regional distribution, legal issues connected to labor market integration, individual characteristics, and regional differences in labor demand – is highly complex. Most of those components within partial models are associated with stochasticity, as outlined in Section 3, calling for a coherent approach to address this "cumulative" stochasticity. However, such an approach is not feasible for two reasons. On the one hand, data limitations largely rule out a reliable stochastic modeling strategy (for instance, regional refugee data are rounded, which could lead to strong biases in the variance estimates for small regions). Similar limitations apply to labor market variables as discussed below. Deriving stochastic estimates for our projections with these limited data, based on, e.g., theoretical assumptions, could lead to biased estimates for the projection intervals (either too narrow because of incorrect assumptions or too wide and therefore less meaningful). On the other hand, assuming the availability of the necessary data, a stochastic approach would also exceed the scope of this paper. We do not intend to present a complete forecast approach of regionally varying employment effects due to refugee migration. Rather, given the obvious undercoverage of labor market effects of refugee migration from an explicitly regional perspective in general and in the context of population decline in particular, we propose a novel, though deterministic, approach to addressing these issues for the first time. Keeping these

limitations in mind, a stochastic extension of our approach could be explored in future research.

Second, as noted, some major limitations emerge due to data availability. In general, the degree of detail of the refugee statistics is very low. Additionally, small-area data on refugee stocks are inaccurately reported by rounding to account for data privacy. This, however, renders the data inadequate for our statistical analyses. Similarly, our modeling strategy of employment effects exhibits shortcomings. Crucial factors discussed in the literature review, such as education, skills, age, or information on the occupation of refugees, were not included in the analysis due to data availability or complexity. Most of the literature on refugee migration and labor market issues draws on individual-level data to address these factors. In the present paper, using corresponding individual instead of administrative data, such as the comprehensive IAB-BAMF-SOEP survey (see, e.g., *Brücker et al.* 2019), would mean relying on more detailed information for refugees' characteristics, but at the same time, and more importantly, on a less appropriate database for comparative macro-level analysis across regions, given the small number of observations across time and the regional coverage in the sampling method. Similarly, relying on detailed administrative data, for example, disaggregated using a classification of occupations, would imply very few or no observations in some gender-country specific groups, in particular for small labor market regions. Thus, given the objective of this paper of presenting a novel and rather general analysis of employment effects across regions in the context of population decline, we rely on aggregated numbers of all persons employed and eligible for social security within a region. This acknowledges the limitations stemming from excluding detailed individual characteristics and leaves this shortcoming open to future research.

Third, other not explicitly modeled processes, such as the discussed internal migration effects or regionally varying economic conditions, may limit the interpretation of the presented results. As noted in Section 3.6, we do not fully mirror regional employment dynamics. By construction, our model does not allow for leaving employment, no matter whether this might have occurred due to retirement, job loss, death, disability, emigration, voluntarily, or for another reason. Also, regional differences such as sectoral structure, the frequency of job turnovers, or the degree of regional labor market tightness and the respective interaction with demographic structure and individual characteristics of refugees is beyond the scope of our approach, and thus only included implicitly. Importantly, we also only use data on employed persons eligible for social insurance but exclude marginal employment. Possibly regional disproportionally higher or lower integration of refugees into marginal employment is thus not reflected in our approach. Similarly, by relating projected employment effects to population decline, we implicitly assume that the decrease in the working-age population equals the decrease in labor supply. Given the evidence in the literature concerning regionally varying and, over time, changing labor force participation rates, this limitation must be kept in mind. Moreover, we only model employment effects as additional employees in the context of refugee migration. Thus, spillover effects, e.g., leading to increased employment among natives or other migrants, are not included. Finally, our labor supply analysis

excludes Europeans, as described in the methods section of this paper. As the input data includes periods of EU enlargement, the number of countries with free movement of workers has increased over time, leading to declining numbers of asylum seekers from Europe. To avoid biased model specifications arising from this, we do not include refugee migration inflows from European countries in the final parts of this study.

## 6 Conclusions

The labor market integration of refugees in Germany and elsewhere has been discussed extensively in recent years. This development is reflected in an increasing body of empirical research, mostly from a micro perspective, as illustrated by a comprehensive literature review in this paper. The process of refugees' labor market integration depends on a multitude of factors. Individually, education and language skills are of crucial importance. Institutionally, bureaucratic hurdles such as employment bans complicate the integration process. Employment effects of refugee migration likely differ across regions, given varying structural and demographic contexts. In particular, this includes varying intensities of projected labor supply decline as well as further intervening processes such as internal migration. Thus, this paper has aimed at investigating whether the region-specific interaction of employment dynamics and demographic changes yields regionally varying opportunities for mitigating labor supply decline. By employing a macro-level approach, we believe our paper addresses a substantial shortcoming in the literature, which is strongly focused on micro-level studies.

We apply a complex empirical approach. First, as there are no long-term projections of refugee migration, particularly at the regional level, we contribute to the literature by proposing a detailed forecasting strategy. We analyze initial asylum requests by country of origin, gender, and protection rates with the regional distribution according to federal guidelines. Based on developments from 1995 to 2019, we project gender-origin-specific refugee migration in German labor market regions until 2030 using principal components analysis. Second, we use past migration values on the one hand and official statistics from the Federal Employment Agency on the other to analyze regional employment effects between 2007 and 2019. That is, we relate the cumulated employment figures from our model to both the cumulated refugee inflow figures and the stock of unemployment according to official statistics. In the last step, we combine both the refugee migration projection results and the findings from the econometric model with existing population projections on the regional level and analyze the corresponding interactions.

The findings suggest that the employment effects due to refugee migration lead to regionally varying opportunities for mitigating labor supply decline. In particular, for labor market regions surrounding large cities such as Munich and Berlin, employment by refugee migration will contribute more strongly to cushioning the demographically induced declines. Similarly, the results indicate that economically more prosperous regions may expect to experience larger mitigation effects. By

contrast, for most of the labor market regions in Eastern Germany, employment effects of refugee migration are likely to contribute to cushioning population decline effects far less.

However, the empirical strategy and the corresponding findings are subject to several limitations, which we outlined in the discussion section of this paper. For example, internal migration after the arrival in Germany, among several other factors, might explain substantial parts of the observed differences. Inevitably, this must be considered in any interpretation of the results.

Based upon the introduced modeling approach, the discussed findings, as well as the outlined limitations of this paper, several avenues for future research emerge. First, the paper has introduced a novel modeling approach to investigating the employment effects of refugee migration from a macro perspective, which may be used and improved by other approaches and researchers. Second, aside from methodological improvements such as stochastic approaches, future research is likely to benefit from better data availability. Individual labor market outcomes of refugees and regional (demographic and economic) development must be understood and analyzed as interdependent processes. Thus, for example, individual-level data coupled with official employment statistics, which is currently not possible, would substantially enhance research results. Third, the observed patterns and corresponding mitigation potentials stem from different, likely interdependent, and in any case interacting processes, such as internal migration, co-ethnic networks, and economic prosperity. Disentangling channels of impact will contribute substantially to our understanding of differing employment and mitigation effects. Fourth, more generally, the findings presented may serve as a starting point for further approaches to investigating past and future economic effects of (refugee) migration in an explicitly regional comparative perspective and across disciplines.

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## Authors' Contributions

Conceptualization: PV; Methodology: PV and TH; Software: PV and TH; Validation: PV, TH, and PD; Formal Analysis: PV and TH; Investigation: TH, PV, and PD; Data Curation: PV and TH; Writing: PV and TH; Visualization: TH and PV; Supervision: PV; All authors have read and approved the final version of the manuscript.

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## Appendix

**Tab. A1:** Major annual changes and causes in initial asylum requests in Germany by origin of refugees

| Year | Largest absolute (relative) increase w.r.t. previous year | Origin | Causes |
|---|---|---|---|
| 2007 | 2,120 (104%) | Iraq | Further escalation of various conflicts as a consequence of the Iraq War |
| 2008 | 2,509 (58%) | Iraq | See above |
| 2009 | 2,718 (414%) | Afghanistan | Armed conflicts, terror attacks by Taliban due to presidential election |
| 2010 | 4,397 (757%) | Serbia | Ability to legally cross EU borders since autumn 2009, aftermath of financial crisis |
| | 2,530 (75%) | Afghanistan | Further escalation of previous conflicts |
| | 2,357 (2,162%) | North Macedonia | Ability to legally cross EU borders since autumn 2009, aftermath of financial crisis |
| | 1,889 (546%) | Somalia | Violence of Al Shabaab against citizens, droughts, economic downturn |
| | 1,305 (112%) | Iran | Emigration after violent suppression of oppositional demonstrations against disputed presidential election of Ahmadinejad in 2009 |
| 2011 | 1,862 (32%) | Afghanistan | See above |
| | 1,699 (202%) | Pakistan | Violent conflicts between various religious groups and the military |
| | 1,144 (77%) | Syria | Armed conflicts in the aftermath of the "Arab Spring" |
| 2012 | 3,898 (85%) | Serbia | Migration after financial crisis, triggered by high inflows from Middle Eastern countries |
| | 3,567 (135%) | Syria | Ongoing conflicts after 2011 |
| | 3,415 (302%) | North Macedonia | See Serbia |
| | 1,720 (564%) | Bosnia and Herzegovina | See Serbia |
| | 1,513 (90%) | Russia | Oppression of oppositional demonstrators by government forces after the third presidential election of Putin |

**Tab. A1:** Continuation

| Year | Largest absolute (relative) increase w.r.t. previous year | Origin | Causes |
|---|---|---|---|
| 2013 | 20,305 (90%) | Central and East Europe | Ongoing "snowball effect" |
| | 14,088 (169%) | Africa | Ongoing "snowball effect", increased aggression by Islamic terror groups in the aftermath of the "Arab Spring" |
| | 9,586 (29%) | Asia | Ongoing "snowball effect", increased aggression by Islamic terror groups in the aftermath of the "Arab Spring" |
| | 1,041 (179%) | Unknown or no citizenship | Ongoing "snowball effect", (in some cases purposely) lost identification documents |
| 2014 | 32,865 (77%) | Asia | Emerging of *Islamic State* (IS) in Syria and Iraq |
| | 16,907 (75%) | Africa | Ongoing "snowball effect", increased aggression by Islamic terror groups, e.g. Boko Haram |
| | 10,518 (125%) | Central and East Europe | Ongoing "snowball effect" |
| | 3,191 (197%) | Unknown or no citizenship | Ongoing "snowball effect", (in some cases purposely) lost identification documents |
| 2015 | 174,778 (232%) | Asia | Increased aggression by various Islamic terror groups |
| | 80,795 (151%) | Central and East Europe | Ongoing "snowball effect" |
| | 10,830 (225%) | Unknown or no citizenship | Ongoing "snowball effect", (in some cases purposely) lost identification documents |
| | 1,283 (33%) | Nigeria | Increased aggression by Boko Haram |

**Tab. A1:** Continuation

| Year | Largest absolute (relative) increase w.r.t. previous year | Origin | Causes |
|---|---|---|---|
| 2016 | 314,272 (126%) | Asia | Increased aggression by various Islamic terror groups, delayed processing of asylum requests |
| | 38,504 (92%) | Africa | Ongoing "snowball effect", delayed processing of asylum requests |
| | 5,728 (109%) | Russia | Escalating conflict between government and opposition, the latter increasingly fleeing the country |
| | 4,843 (31%) | Unknown or no citizenship | Delayed processing of asylum requests |
| | 3,883 (259%) | Türkiye | Flight of opposition after increased suppression by the government in the aftermath of failed military coup, increased pressure on suspected IS collaborators |
| 2017 | 2,644 (49%) | Türkiye | Ongoing emigration by opposition and IS suspects |
| 2018 | 2,357 (30%) | Nigeria | Ongoing conflicts with Islamic terror groups |
| | 2,249 (26%) | Iran | Increased protests against the political system |
| | 2,133 (27%) | Türkiye | Ongoing emigration by opposition and IS suspects |

Source: *BAMF* 2020b; *BMI* 2013; *Hammond* 2014; *Heidelberg Institute for International Conflict Research* 2007, 2009, 2010, 2011, 2014, 2018, 2019; *Human Rights Watch* 2010; *International Centre for Migration Policy Development* 2015; *Rasche* 2012; *Vanella/Deschermeier* 2018.

**Tab. A2:** Distribution of annual initial asylum requests by age and sex [in %]

| *i* | Sex | Age | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Male | 0-15 | 14.60 | 16.41 | 17.71 | 17.71 | 16.68 | 14.9 | 14.59 | 16.68 | 20.75 | 22.95 | 24.18 |
| 2 | Male | 16-17 | 4.81 | 4.84 | 4.30 | 3.50 | 2.67 | 2.87 | 3.68 | 4.71 | 4.35 | 2.95 | 2.37 |
| 3 | Male | 18-24 | 19.28 | 16.20 | 15.62 | 13.74 | 15.70 | 18.07 | 19.94 | 17.86 | 13.62 | 10.08 | 9.05 |
| 4 | Male | 25-29 | 12.00 | 10.60 | 10.81 | 9.75 | 10.72 | 11.38 | 11.50 | 9.96 | 7.55 | 6.48 | 6.12 |
| 5 | Male | 30-34 | 6.62 | 6.51 | 6.66 | 6.73 | 7.07 | 7.54 | 7.45 | 6.33 | 5.21 | 4.98 | 5.08 |
| 6 | Male | 35-39 | 4.01 | 3.78 | 3.96 | 4.13 | 4.32 | 4.75 | 4.80 | 4.03 | 3.45 | 3.45 | 3.52 |
| 7 | Male | 40-44 | 2.04 | 1.95 | 2.25 | 2.53 | 2.58 | 2.90 | 3.10 | 2.46 | 2.15 | 2.21 | 2.43 |
| 8 | Male | 45-49 | 1.16 | 1.17 | 1.32 | 1.42 | 1.52 | 1.75 | 1.94 | 1.61 | 1.40 | 1.52 | 1.54 |
| 9 | Male | 50-54 | 0.56 | 0.64 | 0.74 | 0.94 | 0.93 | 1.06 | 1.07 | 0.92 | 0.85 | 0.96 | 0.95 |
| 10 | Male | 55-59 | 0.43 | 0.44 | 0.48 | 0.57 | 0.55 | 0.65 | 0.54 | 0.54 | 0.52 | 0.54 | 0.62 |
| 11 | Male | 60-64 | 0.19 | 0.31 | 0.30 | 0.36 | 0.31 | 0.35 | 0.29 | 0.33 | 0.33 | 0.34 | 0.38 |
| 12 | Male | 65+ | 0.33 | 0.40 | 0.37 | 0.39 | 0.34 | 0.33 | 0.25 | 0.26 | 0.28 | 0.26 | 0.26 |
| 13 | Female | 0-15 | 12.98 | 14.61 | 14.11 | 15.24 | 14.95 | 13.05 | 11.89 | 13.64 | 18.63 | 21.18 | 22.33 |
| 14 | Female | 16-17 | 1.46 | 1.54 | 1.54 | 1.33 | 1.12 | 0.95 | 0.95 | 1.16 | 1.26 | 1.27 | 1.24 |
| 15 | Female | 18-24 | 6.15 | 6.15 | 5.71 | 5.33 | 5.29 | 5.24 | 4.88 | 5.65 | 5.23 | 5.15 | 4.6 |
| 16 | Female | 25-29 | 4.49 | 4.53 | 4.61 | 4.65 | 4.42 | 4.06 | 3.72 | 4.10 | 3.81 | 4.00 | 3.89 |
| 17 | Female | 30-34 | 3.27 | 3.56 | 3.59 | 3.77 | 3.64 | 3.31 | 3.12 | 3.29 | 3.41 | 3.70 | 3.54 |
| 18 | Female | 35-39 | 1.95 | 2.14 | 2.32 | 2.61 | 2.48 | 2.22 | 2.27 | 2.27 | 2.53 | 2.87 | 2.83 |
| 19 | Female | 40-44 | 1.07 | 1.48 | 1.47 | 1.66 | 1.57 | 1.50 | 1.47 | 1.44 | 1.67 | 1.92 | 1.89 |
| 20 | Female | 45-49 | 0.82 | 0.87 | 1.01 | 1.17 | 1.01 | 1.02 | 0.97 | 1.02 | 1.10 | 1.28 | 1.20 |
| 21 | Female | 50-54 | 0.54 | 0.59 | 0.77 | 0.83 | 0.81 | 0.76 | 0.63 | 0.69 | 0.70 | 0.82 | 0.85 |
| 22 | Female | 55-59 | 0.43 | 0.51 | 0.61 | 0.67 | 0.58 | 0.57 | 0.42 | 0.45 | 0.51 | 0.50 | 0.51 |
| 23 | Female | 60-64 | 0.35 | 0.31 | 0.47 | 0.43 | 0.34 | 0.36 | 0.25 | 0.29 | 0.33 | 0.28 | 0.31 |
| 24 | Female | 65+ | 0.45 | 0.45 | 0.56 | 0.54 | 0.41 | 0.42 | 0.29 | 0.31 | 0.36 | 0.30 | 0.30 |

Source: *BAMF* 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019a, 2020a; authors' calculation and design.

**Tab. A3:** Assignment of districts to labor market regions

| Number | Name | Districts[1] |
|---|---|---|
| 1 | Hamburg | Flensburg, Kiel, Lübeck, Neumünster, LK Dithmarschen, LK Herzogtum Lauenburg, LK Nordfriesland, LK Ostholstein, LK Pinneberg, LK Plön, LK Rendsburg-Eckernförde, LK Schleswig-Flensburg, LK Segeberg, LK Steinburg, LK Stormarn, Hamburg, LK Harburg, LK Lüchow-Dannenberg, LK Lüneburg, LK Stade, LK Uelzen, Schwerin, LK Nordwestmecklenburg, LK Ludwigslust-Parchim |
| 2 | Göttingen | LK Northeim, LK Göttingen, LK Eichsfeld, LK Nordhausen |
| 3 | Hannover | Braunschweig, Salzgitter, Wolfsburg, LK Gifhorn, LK Goslar, LK Helmstedt, LK Peine, LK Wolfenbüttel, LK Region Hannover, LK Hameln-Pyrmont, LK Hildesheim, LK Nienburg (Weser), LK Schaumburg, LK Celle, LK Heidekreis |
| 4 | Bremen | LK Diepholz, LK Cuxhaven, LK Osterholz, LK Rotenburg (Wümme), LK Verden, Delmenhorst, Emden, Oldenburg, Wilhelmshaven, LK Ammerland, LK Aurich, LK Cloppenburg, LK Friesland, LK Leer, LK Oldenburg, LK Wesermarsch, LK Wittmund, Bremen, Bremerhaven |
| 5 | Düsseldorf/Ruhr | Düsseldorf, Duisburg, Essen, Krefeld, Mönchengladbach, Mülheim an der Ruhr, Oberhausen, Remscheid, Solingen, Wuppertal, LK Kleve, LK Mettmann, LK Rhein-Kreis Neuss, LK Viersen, LK Wesel, LK Heinsberg, Bottrop, Gelsenkirchen, LK Recklinghausen, Bochum, Dortmund, Hagen, Hamm, Herne, LK Ennepe-Ruhr-Kreis, LK Hochsauerlandkreis, LK Märkischer Kreis, LK Soest, LK Unna |
| 6 | Köln | Bonn, Köln, Leverkusen, LK Städteregion Aachen, LK Düren, LK Rhein-Erft-Kreis, LK Euskirchen, LK Oberbergischer Kreis, LK Rheinisch-Bergischer Kreis, LK Rhein-Sieg Kreis Koblenz, LK Ahrweiler, LK Cochem-Zell, LK Mayen-Koblenz, LK Neuwied, LK Rhein-Hunsrück-Kreis, LK Westerwaldkreis |
| 7 | Münster/Osnabrück | Osnabrück, LK Emsland, LK Grafschaft Bentheim, LK Osnabrück, LK Vechta, Münster, LK Borken, LK Coesfeld, LK Steinfurt, LK Warendorf |
| 8 | Bielefeld/Paderborn | LK Holzminden, Bielefeld, LK Gütersloh, LK Herford, LK Höxter, LK Lippe, LK Minden-Lübbecke, LK Paderborn |
| 9 | Siegen | LK Olpe, LK Siegen-Wittgenstein, LK Altenkirchen (Westerwald) |
| 10 | Frankfurt | Darmstadt, Frankfurt (Main), Offenbach (Main), Wiesbaden, LK Darmstadt-Dieburg, LK Groß-Gerau, LK Hochtaunuskreis, LK Main-Kinzig-Kreis, LK Main-Taunus-Kreis, LK Odenwaldkreis, LK Offenbach, LK Rheingau-Taunus-Kreis, LK Wetteraukreis, LK Gießen, LK Lahn-Dill-Kreis, LK Limburg-Weilburg, LK Marburg-Biedenkopf, LK Vogelsbergkreis, LK Fulda, LK Bad Kreuznach, LK Birkenfeld, LK Rhein-Lahn-Kreis, Mainz, LK Alzey-Worms, LK Mainz-Bingen, Aschaffenburg, LK Aschaffenburg, LK Miltenberg |

[1] *LK* stands for *Landkreise*, which are districts combined from different (mostly) smaller municipalities.

**Tab. A3:** Continuation

| Number | Name | Districts[1] |
|---|---|---|
| 11 | Kassel | Kassel, LK Hersfeld-Rotenburg, LK Kassel, LK Schwalm-Eder-Kreis, LK Waldeck-Frankenberg, LK Werra-Meißner-Kreis |
| 12 | Trier | Trier, LK Bernkastel-Wittlich, LK Eifelkreis Bitburg-Prüm, LK Vulkaneifel, LK Trier-Saarburg |
| 13 | Stuttgart | Stuttgart, LK Böblingen, LK Esslingen, LK Göppingen, LK Ludwigsburg, LK Rems-Murr-Kreis, Heilbronn, LK Heilbronn, LK Hohenlohekreis, LK Schwäbisch Hall, LK Main-Tauber-Kreis, LK Heidenheim, LK Ostalbkreis, LK Neckar-Odenwald-Kreis, Pforzheim, LK Calw, LK Enzkreis, LK Freudenstadt, LK Reutlingen, LK Tübingen, LK Zollernalbkreis |
| 14 | Karlsruhe/Mannheim | LK Bergstraße, Frankenthal (Pfalz), Landau in der Pfalz, Ludwigshafen am Rhein, Neustadt an der Weinstraße, Speyer, Worms, LK Bad Dürkheim, LK Donnersbergkreis, LK Germersheim, LK Südliche Weinstraße, LK Rhein-Pfalz-Kreis, Baden-Baden, Karlsruhe, LK Karlsruhe, LK Rastatt, Heidelberg, Mannheim, LK Rhein-Neckar-Kreis |
| 15 | Freiburg | Freiburg (Breisgau), LK Breisgau-Hochschwarzwald, LK Emmendingen, LK Ortenaukreis, LK Lörrach, LK Waldshut |
| 16 | Villingen-Schwenningen | LK Rottweil, LK Schwarzwald-Baar-Kreis, LK Tuttlingen |
| 17 | Konstanz | LK Konstanz |
| 18 | Ulm | Ulm, LK Alb-Donau-Kreis, LK Biberach, LK Sigmaringen, LK Neu-Ulm |
| 19 | Ravensburg | LK Bodenseekreis, LK Ravensburg, LK Lindau (Bodensee) |
| 20 | München | Ingolstadt, München, Rosenheim, LK Altötting, LK Berchtesgadener Land, LK Bad Tölz-Wolfratshausen, LK Dachau, LK Ebersberg, LK Eichstätt, LK Erding, LK Freising, LK Fürstenfeldbruck, LK Garmisch-Partenkirchen, LK Landsberg (Lech), LK Miesbach, LK Mühldorf (Inn), LK München, LK Neuburg-Schrobenhausen, LK Pfaffenhofen (Ilm), LK Rosenheim, LK Starnberg, LK Traunstein, LK Weilheim-Schongau, Landshut, LK Kelheim, LK Landshut, LK Rottal-Inn, LK Dingolfing-Landau, Augsburg, Kaufbeuren, Kempten (Allgäu), Memmingen, LK Aichach-Friedberg, LK Augsburg, LK Dillingen (Donau), LK Günzburg, LK Ostallgäu, LK Unterallgäu, LK Donau-Ries, LK Oberallgäu |
| 21 | Passau | Passau, LK Deggendorf, LK Freyung-Grafenau, LK Passau, LK Regen |
| 22 | Regensburg | Straubing, LK Straubing-Bogen, Regensburg, Weiden (Oberpfalz), LK Cham, LK Neustadt (Waldnaab), LK Regensburg, LK Schwandorf |

[1] *LK* stands for *Landkreise*, which are districts combined from different (mostly) smaller municipalities.

**Tab. A3:** Continuation

| Number | Name | Districts[1] |
|---|---|---|
| 23 | Nürnberg | Amberg, LK Amberg-Sulzbach, LK Neumarkt (Oberpfalz), LK Tirschenreuth, Bamberg, Bayreuth, Coburg, LK Bamberg, LK Bayreuth, LK Coburg, LK Forchheim, LK Kronach, LK Kulmbach, LK Lichtenfels, LK Wunsiedel (Fichtelgebirge), Ansbach, Erlangen, Fürth, Nürnberg, Schwabach, LK Ansbach, LK Erlangen-Höchstadt, LK Fürth, LK Nürnberger Land, LK Neustadt (Aisch-Bad Winsheim), LK Roth, LK Weißenburg-Gunzenhausen, LK Sonneberg |
| 24 | Schweinfurt/Würzburg | Schweinfurt, Würzburg, LK Bad Kissingen, LK Rhön-Grabfeld, LK Haßberge, LK Kitzingen, LK Main-Spessart, LK Schweinfurt, LK Würzburg |
| 25 | Saarbrücken | LK Kaiserlautern, Pirmasens, Zweibrücken, Kaiserlautern, LK Kusel, LK Südwestpfalz, LK Regionalverband Saarbrücken, LK Merzig-Wadern, LK Neunkirchen, LK Saarlouis, LK Saarpfalz-Kreis, LK St. Wendel |
| 26 | Berlin | Berlin, Brandenburg (Havel), Frankfurt (Oder), Potsdam, LK Barnim, LK Dahme-Spreewald, LK Havelland, LK Märkisch-Oderland, LK Oberhavel, LK Oder-Spree, LK Ostprignitz-Ruppin, LK Potsdam-Mittelmark, LK Prignitz, LK Teltow-Fläming, LK Uckermark |
| 27 | Rostock | Rostock, LK Rostock |
| 28 | Neubrandenburg | LK Mecklenburgische Seenplatte |
| 29 | Greifswald/Stralsund | LK Vorpommern-Rügen, LK Vorpommern-Greifswald |
| 30 | Chemnitz | LK Hof, Hof, Chemnitz, LK Erzgebirgskreis, LK Mittelsachsen, LK Vogtlandkreis, LK Zwickau |
| 31 | Dresden | Cottbus, LK Elbe-Elster, LK Oberspreewald-Lausitz, LK Spree-Neiße, Dresden, LK Bautzen, LK Görlitz, LK Meißen, LK Sächsische Schweiz-Osterzgebirge |
| 32 | Leipzig | Leipzig, LK Leipzig, LK Nordsachsen, Dessau-Roßlau, Halle (Saale), LK Anhalt-Bitterfeld, LK Burgenlandkreis, LK Mansfeld-Südharz, LK Saalekreis, LK Wittenberg, LK Altenburger Land |
| 33 | Magdeburg | Magdeburg, LK Altmarkkreis Salzwedel, LK Börde, LK Harz, LK Jerichower Land, LK Salzlandkreis, LK Stendal |
| 34 | Erfurt | Erfurt, Gera, Jena, Suhl, Weimar, Eisenach, LK Wartburgkreis, LK Unstrut-Hainich-Kreis, LK Kyffhäuserkreis, LK Schmalkalden-Meiningen, LK Gotha, LK Sömmerda, LK Hildburghausen, LK Ilm-Kreis, LK Weimarer Land, LK Saalfeld-Rudolstadt, LK Saale-Holzland-Kreis, LK Saale-Orla-Kreis, LK Greiz |

[1] *LK* stands for *Landkreise*, which are districts combined from different (mostly) smaller municipalities.

**Tab. A4:** Predicted distribution of refugees among the federal states [in %]

| | Federal State | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 2020 | 3.413 | 2.561 | 9.425 | 0.945 | 21.061 | 7.451 | 4.832 | 13.044 | 15.621 | 1.199 | 5.143 | 3.014 | 1.972 | 4.966 | 2.724 | 2.628 |
| 2021 | 3.421 | 2.565 | 9.440 | 0.927 | 21.035 | 7.458 | 4.839 | 13.075 | 15.677 | 1.195 | 5.149 | 3.010 | 1.960 | 4.942 | 2.697 | 2.610 |
| 2022 | 3.429 | 2.568 | 9.456 | 0.907 | 21.009 | 7.465 | 4.847 | 13.106 | 15.734 | 1.192 | 5.155 | 3.006 | 1.948 | 4.917 | 2.670 | 2.591 |
| 2023 | 3.437 | 2.571 | 9.471 | 0.887 | 20.984 | 7.472 | 4.854 | 13.138 | 15.79 | 1.188 | 5.161 | 3.002 | 1.936 | 4.893 | 2.644 | 2.572 |
| 2024 | 3.445 | 2.575 | 9.486 | 0.865 | 20.958 | 7.479 | 4.862 | 13.169 | 15.847 | 1.185 | 5.167 | 2.998 | 1.925 | 4.868 | 2.618 | 2.554 |
| 2025 | 3.453 | 2.578 | 9.501 | 0.843 | 20.932 | 7.487 | 4.869 | 13.201 | 15.904 | 1.181 | 5.173 | 2.993 | 1.913 | 4.844 | 2.592 | 2.536 |
| 2026 | 3.461 | 2.581 | 9.517 | 0.820 | 20.907 | 7.494 | 4.876 | 13.232 | 15.961 | 1.178 | 5.179 | 2.989 | 1.901 | 4.820 | 2.566 | 2.518 |
| 2027 | 3.468 | 2.585 | 9.532 | 0.795 | 20.881 | 7.501 | 4.884 | 13.264 | 16.019 | 1.175 | 5.185 | 2.985 | 1.890 | 4.796 | 2.540 | 2.500 |
| 2028 | 3.476 | 2.588 | 9.547 | 0.770 | 20.855 | 7.508 | 4.891 | 13.295 | 16.076 | 1.171 | 5.191 | 2.981 | 1.878 | 4.773 | 2.515 | 2.482 |
| 2029 | 3.484 | 2.592 | 9.563 | 0.744 | 20.830 | 7.516 | 4.899 | 13.327 | 16.134 | 1.168 | 5.197 | 2.977 | 1.867 | 4.749 | 2.490 | 2.464 |
| 2030 | 3.493 | 2.595 | 9.578 | 0.716 | 20.804 | 7.523 | 4.906 | 13.359 | 16.192 | 1.165 | 5.203 | 2.973 | 1.856 | 4.725 | 2.466 | 2.446 |

Source: Authors' computation and design. The numbering of the federal states is illustrated in Figure 8.

**Tab. A5:** Regression output

| | Dependent variable: first principal components of annual gender-nationality employment changes | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | African | | Asian | | others | |
| | female | male | female | male | female | male |
| Refugee inflow | -0.041*** | -0.087*** | -0.017*** | -0.033*** | -0.086*** | -0.059*** |
| | (0.002) | (0.005) | (0.001) | (0.002) | (0.008) | (0.006) |
| GDP, growth rate | -1,649.595 | -14,325.730*** | -2,864.182 | -5,928.781 | -2,246.471 | -4,298.711* |
| | (1,051.805) | (4,072.835) | (5,069.215) | (11,464.300) | (1,451.209) | (2,270.598) |
| Constant | -167.032*** | 164.214 | -843.235*** | -280.859 | -430.778*** | -420.682*** |
| | (38.183) | (147.332) | (177.650) | (399.894) | (48.840) | (76.441) |
| Observations | 12 | 12 | 12 | 12 | 12 | 12 |
| R2 | 0.97 | 0.98 | 0.94 | 0.98 | 0.93 | 0.92 |
| Adjusted R2 | 0.97 | 0.97 | 0.93 | 0.97 | 0.92 | 0.90 |
| Residual Std. Error (df = 9) | 92.9 | 359.5 | 447.4 | 1,011.6 | 128.1 | 200.4 |
| F Statistic (df = 2; 9) | 153.5*** | 181.7*** | 70.2*** | 208.2*** | 63.4*** | 49.2*** |

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

Source: Author's computation and the sources outlined in the main text.

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