Online Appendix for "Market Size and Spatial Growth - Evidence from Germany's Post-War Population Expulsions"

[NOT FOR PUBLICATION]

A-1 Appendix: Theoretical Results

A-1.1 Static Allocations

Consider the manufacturing sector in region r. Let P_M be the price for the aggregate good and w the wage rate. The profits of the final good firm are given by

$$\Pi = \max_{[x_i]} \; P_M \mathcal{Q} X - \int_0^N p_i x_i di,$$

where $X = \left(\int_0^{N_{rt}} x_{it}^{\frac{\rho-1}{\rho}} di \right)^{\frac{\rho}{\rho-1}}$. Standard arguments imply that prices, sales and profits of inputs producers are given by $p_i = \frac{\rho}{\rho-1} w$ and $\pi_i = \frac{1}{\rho} P_X X \frac{1}{N}$, where the price index for the aggregate input bundle is given by $P_X = \frac{\rho}{\rho-1} w N^{-\frac{1}{\rho-1}}$. This implies that $P_M = P_X / \mathcal{Q} = \frac{\rho}{\rho-1} \frac{1}{\mathcal{Q}} \frac{1}{N^{\frac{1}{\rho-1}}} w$. Symmetry implies that $x_{it} = H_P / N$ where H_P is aggregate employment in the production of inputs. Hence,

$$Y_M = \mathcal{Q} X = \mathcal{Q} N^{\frac{1}{\rho-1}} H_P.$$

Total labor payments to production workers relative to sectoral sales are given by

$$\frac{w H_P}{P \mathcal{Q} X} = \frac{w H_P}{\frac{\rho}{\rho-1} \frac{1}{\mathcal{Q}} w N^{-\frac{1}{\rho-1}} \mathcal{Q} N^{\frac{1}{\rho-1}} H_P} = \frac{\rho - 1}{\rho}.$$

This implies that individual profits are

$$\pi_i = \frac{1}{\rho} P_X X \frac{1}{N} = \frac{1}{\rho} P \mathcal{Q} X \frac{1}{N} = \frac{1}{\rho - 1} \frac{H_P w}{N}.$$

Aggregate nominal income in region r is given by

$$P_r Y_r = w_{rA} H_{rA} + R_r T_r + w_{rM} \left(H_{rP} + H_{rE} \right) + \Pi_r,$$

where aggregate profits Π_r are given by $\Pi_r = N_r \pi_{ir} - w_{rM} H_{rE}$. This implies that

$$P_r Y_r = \frac{1}{\gamma} w_{rA} H_{rA} + \frac{\rho}{\rho - 1} w_{rM} H_{rP}.$$

Given the total manufacturing labor supply, H_{rMt} labor market clearing implies that $H_{rMt} = H_{rPt} + H_{rEt}$.

If there is entry in equilibrium, then

$$N_{rt} = \frac{1}{(\rho - 1) f_E} N_{rt-1}^{\lambda} H_{rPt}.$$

The total mass of labor allocated to entry activities is

$$H_{rEt} = f_E N_{rt-1}^{-\lambda} \left(N_{rt} - (1-\delta) N_{rt-1} \right) = \frac{1}{\rho - 1} H_{rPt} - (1-\delta) f_E N_{rt-1}^{1-\lambda}.$$

Hence,

$$\begin{aligned} H_{rPt} &= \frac{\rho - 1}{\rho} H_{rMt} + \frac{\rho - 1}{\rho} (1-\delta) f_E N_{rt-1}^{1-\lambda} \\ H_{rEt} &= \frac{1}{\rho} H_{rMt} - \left(\frac{\rho - 1}{\rho} \right) (1-\delta) f_E N_{rt-1}^{1-\lambda}. \end{aligned}$$

Along a steady state where the number of varieties is constant, these expressions simplify to

$$\frac{H_{rP}}{H_{rM}} = \frac{\rho - 1}{\rho - 1 + \delta} \text{ and } \frac{H_{rE}}{H_{rM}} = \frac{\delta}{\rho - 1 + \delta}.$$

If $w_{rMt} h_{rt}^{E} > \pi_{irt}$, there is no entry in equilibrium and the growth rate of varieties is negative, i.e. $N_{rt} = (1-\delta) N_{rt-1}$. Equation (6) implies that this is the case if

$$w_{rMt} f_E N_{rt-1}^{-\lambda} > \frac{1}{\rho - 1} \frac{w_{rMt} H_{rPt}}{N_{rt}} = \frac{1}{\rho - 1} \frac{w_{rMt} H_{rPt}}{(1-\delta) N_{rt-1}}.$$

In this case we have $H_{rPt} = H_{rMt}$ and $H_{rEt} = 0$. Hence, there is no entry if and only if

$$f_E (1-\delta) N_{rt-1}^{1-\lambda} > \frac{1}{\rho - 1} H_{rMt}. \tag{A-1}$$

A-1.2 Static Equilibrium

Market clearing Consider the consumers in region j. Let the prices they face from the goods produced in region r be denoted by P_{rj}. The CES structure of preferences implies that

$$\frac{P_{rj} C_{rj}}{P C_j} = \frac{P_{rj}^{1-\sigma}}{\sum_r P_{rj}^{1-\sigma}} = \left(\frac{P_{rj}}{P_j} \right)^{1-\sigma} \text{ where } P_j = \left(\sum_r P_{rj}^{1-\sigma} \right)^{1/(1-\sigma)}.$$

Hence, total spending on goods in region r is given by

$$\text{Spending on } r = \sum_j P_{rj} C_{rj} = \sum_j \left(\frac{P_{rj}}{P_j} \right)^{1-\sigma} P C_j.$$

Note that total spending on manufacturing goods is given by $PC_j = (1-\alpha)\,PY_j$ and that total income in j is given by $PY_j = \frac{w_{jA}H_{jA}}{\gamma} + \frac{\rho}{\rho-1}w_{jM}H_{jP}$. Naturally, total spending on manufacturing goods in region r is given by $PY_{rM} = \frac{\rho}{\rho-1}w_{rM}H_{rP}$. Moreover,

$$P_{rjM} \quad = \quad \tau_{rj}P_{rrM} = \tau_{rj}\varsigma\frac{1}{\mathcal{Q}_{rt}}\frac{1}{N_{rt-1}^{\lambda\vartheta}}\frac{1}{H_{rPt}^{\vartheta}}w_{rMt}. \tag{A-2}$$

Hence, the market clearing equation for region r is given by

$$\frac{\rho}{\rho-1}w_{rM}H_{rP} = \sum_j \frac{\tau_{rj}^{1-\sigma}P_{rrM}^{1-\sigma}}{\sum_m \tau_{mj}^{1-\sigma}P_{mmM}^{1-\sigma}}(1-\alpha)\left(\frac{w_{jA}H_{jA}}{\gamma} + \frac{\rho}{\rho-1}w_{jM}H_{jP}\right) \tag{A-3}$$

where P_{rrM} is given in (A-2). Similarly, market clearing in the agricultural sector requires that

$$\frac{w_{rA}H_{rA}}{\gamma} = \sum_j \frac{\tau_{rj}^{1-\sigma}P_{rrA}^{1-\sigma}}{\sum_m \tau_{mj}^{1-\sigma}P_{mmA}^{1-\sigma}}\alpha\left(\frac{w_{jA}H_{jA}}{\gamma} + \frac{\rho}{\rho-1}w_{jM}H_{jP}\right) \tag{A-4}$$

where $P_{rrA} = \frac{1}{Q_{rt}}\frac{w_{Art}}{\gamma}\left(\frac{H_{rAt}}{T_r}\right)^{1-\gamma}$.

The labor market clearing conditions are given by

$$H_{rAt} \quad = \quad \Gamma_\theta \sum_{k=R,N}\sum_{\nu=I,F} L_{rt}^{\nu k}\phi_A^{\nu k}\left(\frac{w_{rAt}}{\overline{w}_{rt}^{\nu}}\right)^{\theta-1} \tag{A-5}$$

$$\frac{\rho}{\rho-1}H_{rPt} - (1-\delta)\,f_E N_{rt-1}^{1-\lambda} \quad = \quad \Gamma_\theta \sum_{k=R,N}\sum_{\nu=I,F} L_{rt}^{\nu k}\phi_M^{\nu k}\left(\frac{w_{rMt}}{\overline{w}_{rt}^{\nu}}\right)^{\theta-1}. \tag{A-6}$$

Given $\{\mathcal{Q}_{rt}, N_{rt-1}\}_r$ and $\left\{\left[L_{rt}^{\nu k}\right]_{\nu,k}\right\}_r$, equations (A-3), (A-4), (A-5) and (A-6) are $4R$ equations in $4R$ unknowns: $\{H_{rAt}, H_{rPt}, w_{rAt}, w_{rMt}\}_r$.

A-1.3 Deriving the Impulse Response Function $\Psi_d(p,\lambda)$

The change in the number of varieties N_{rt} in response to a change in the manufacturing workforce $\{d\ln H_{rPj}\}_{j=t_0}^{t_o+t}$ is given by

$$d\ln N_{rd} = \sum_{j=t_0}^{t_0+d}\lambda^{-(j-(t_0+d))}d\ln H_{rPj}.$$

Assume that the initial shock at t_0 dies out slowly, i.e. $d\ln H_{rPj} = d\ln H_{rPt_0} \times p^{j-t_0}$where $p \leq 1$. This implies that

$$\begin{aligned}\sum_{j=t_0}^{t_0+d} \lambda^{-(j-(t_0+d))} d\ln H_{rPj} &= \sum_{j=t_0}^{t_0+d} \lambda^{-(j-(t_0+d))} d\ln H_{rPt_0} \times p^{j-t_0} = d\ln H_{rPt_0} \left(\sum_{j=t_0}^{t_0+d} \lambda^{-(j-(t_0+d))} p^{j-t_0} \right) \\ &= d\ln H_{rPt_0} \left(\lambda^{\tau} \sum_{i=0}^{d} \left(\frac{p}{\lambda}\right)^i \right) = d\ln H_{rPt_0} \frac{\lambda^{d+1} - p^{d+1}}{\lambda - p}.\end{aligned}$$

Hence, $\Psi_d(p,\lambda) \equiv \frac{d\ln N_{rd+t_0}}{d\ln H_{rPt_0}} = \frac{\lambda^{d+1}-p^{d+1}}{\lambda-p}$.

A-2 Appendix: Empirical Results

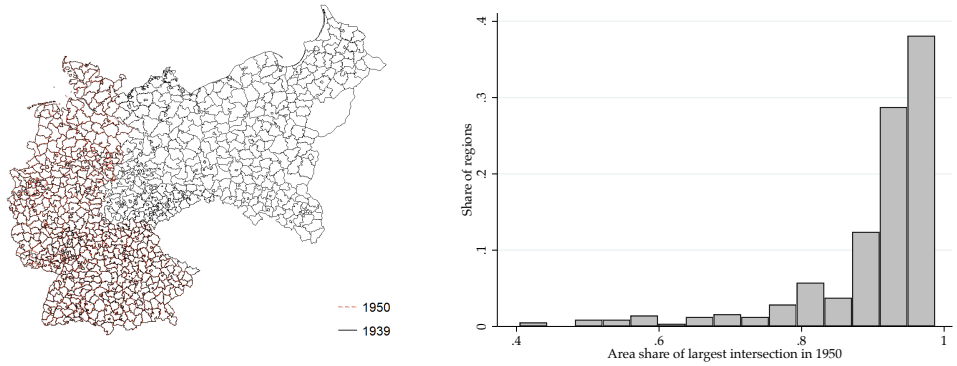
A-2.1 Datasources

The data for the years 1933 and 1939 is published in Statistisches Reichsamt (1936) and Statistisches Reichsamt (1939). For the post-war data I had to rely on numerous publications for the individual states. For the state of North Rhine Westphalia (*Nordrhein-Westfalen*) the data is taken from Statistisches Landesamt Nordrhein-Westfalen (1952) and Statistisches Landesamt Nordrhein-Westfalen (1964). For the state of Bavaria (*Bayern*) the data is taken from Bayerisches Statistisches Landesamt (1953) and Bayerisches Statistisches Landesamt (1963b). For the state of Rhineland Palatinate (*Rheinland-Pfalz*) the data is taken from Statistisches Landesamt Rheinland-Pfalz (1950) and Statistisches Landesamt Rheinland-Pfalz (1961). For the state of Lower Saxony (*Niedersachsen*) the data is taken from Niedersächsisches Amt für Landesplanung und Statistik (1952) and Niedersächsisches Amt für Landesplanung und Statistik (1964). For the state of Hesse (*Hessen*) the data is taken from Hessisches Statistisches Landesamt (1952) and Hessisches Statistisches Landesamt (1962). The share of refugees in 1946 is taken from Ausschuss der Deutschen Statistiker für die Volks- und Berufszählung 1946 (1949). This data was only available for a subset of states.

A-2.2 Construction of Time-invariant Boundaries

To perform my analysis, I construct a map of Western Germany with time-invariant district boundaries since the 1930s. To construct this crosswalk, I use GIS to perform a partition of the respective maps. Given this partition, I then aggregate all variables to the level of 1950 for the main analysis and to the level of 1975 for the analysis of the long-run response of income per capita. GDP response. I aggregate the respective data by using the size of the area as weights.

In Figures A-1-A-4 I depict for the respective episodes the overlay of the GIS maps with the district boundaries (left panel) and the distribution of the largest share of the intersections of the districts to be aggregated (right panel). More specifically, consider an "origin" map M^O that we want to aggregate to a "destination" map M^D. For example, to calculate the population in 1939 in the



(a) Map

(b) Distribution of $\xi(o)$

Notes: The left panel shows the districts of the map of West Germany in 1950 (red boundaries) and the map of the German Reich in 1939 (black boundaries). The right panel shows the distribution of largest share of area of a county in 1950 within a district in 1939. Formally, it displays the distribution of $\xi(o) = \max_{i \in k(o)} \{a_i/a_o\}$, where o refers to a county in 1950, $k(o)$ the set of intersections between o and the map in 1939 and a_i (a_o) is the geographical area of a given intersection (a given origin county).

Figure A-1: Construction of Time-invariant Boundaries: 1939 - 1950

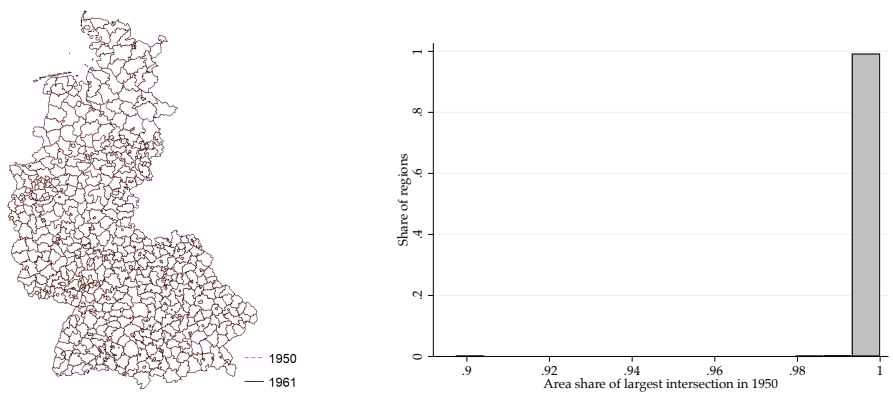
borders in 1950, the 1939 map would be the origin map and the map in 1950 would be the destination map. Let $\mathcal{R}^O$ and $\mathcal{R}^D$ denote the set of regions in the origin and destination map and let $\mathcal{R}^I$ the set of intersections between M^O and M^D. Then consider a region o in the origin map, $o \in \mathcal{R}^O$. Let for each region $o \in \mathcal{R}^O$ the set of intersection be $k(o)$. If o gets mapped to a single region $d \in \mathcal{R}^D$, then $k(o) = d$. If o gets split and is now partly contained in the three countries d_1 d_2 and d_3, then $k(o) = \{d_1, d_2, d_3\}$.

Let a_i denote the geographical area of a given intersection and a_0 the area of the origin county o. Then consider the statistic $\xi(o) = \max_{i \in k(o)} \left\{\frac{a_i}{a_o}\right\}$, i.e. the maximum area share of an origin locations that is left intact. If $\xi(o) = 1$,the location is fully contained in the new destination region. The smaller $\xi(o)$ the more severe the aggregation bias of constructing the crosswalk.

In Figure A-1 I show the intersection of the maps in 1939 and 1950. I depict the borders of 1939 in black and the one in 1950 in red. The 1950 borders are only drawn for the area of Western Germany, which is the area of my analysis. Both the map (left panel) and the histogram (right panel) show that the majority of counties in 1950 were already part of a single county in 1933. For almost 90% of counties, more than 80% of the county's area remained intact.

My main empirical analysis focuses on the time period between 1950 and 1961. This analysis did not require any crosswalk because there were no border changes between 1950 and 1961. This is seen in Figure A-2, which shows the intersection of the maps in 1950 and 1961.

Finally, the analysis of the effect on income per capita in the 70s, 80s and 90s, required substantial aggregation of the data because the 1970s saw a variety of reforms where district boundaries where changed. In Figures A-3 and A-4 I show the intersection of the maps in 1950 and 1975 and between 1975 and 1988. Figure A-3 shows that the number of counties shrank considerably between 1950 and



(a) Map

(b) Distribution of $\xi(o)$

Notes: The left panel shows the districts of the map of West Germany in 1950 (red boundaries) and 1961 (black boundaries). The right panel shows the distribution of largest share of area of a county in 1950 within a district in 1961. Formally, it displays the distribution of $\xi(o) = \max_{i \in k(o)} \{a_i / a_o\}$, where o refers to a county in 1950, $k(o)$ the set of intersections between o and the map in 1961 and a_i (a_o) is the geographical area of a given intersection (a given origin county).

Figure A-2: Construction of Time-invariant Boundaries: 1950 - 1961

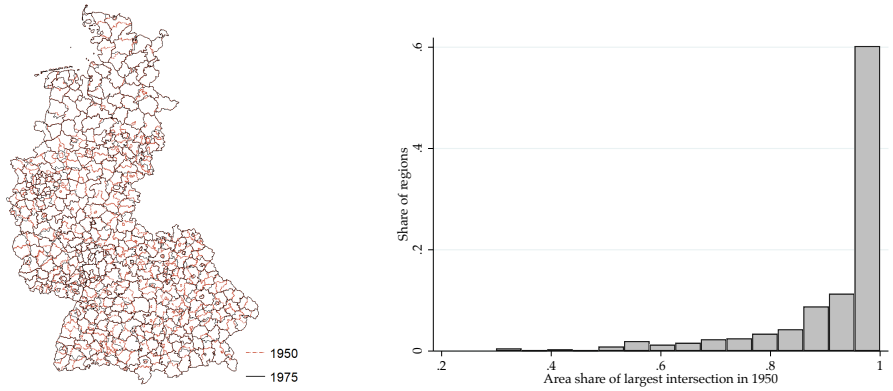
1975. At the same time, some borders were changed in a way so that a given county in 1950 was split. Still, for the vast majority of counties, the largest share of their area was still contained in a single district in 1975. By contrast, Figure A-4 shows that the border changes between 1975 and 1988 were minor.

A-2.3 Additional Empirical Results

In this section I report additional empirical results on the historical setting.

Ethnic Germans in Eastern Europe before 1939 In Figure A-5 I display two aspects of the spatial distribution of economic activity in the pre-war period: the agricultural employment share in 1933 and the population density in 1939. As also highlighted in Section 2 in the main text, the maps in Figure A-5 show that the German Territories of Eastern Europe were more agricultural and rural than West Germany prior to the war.

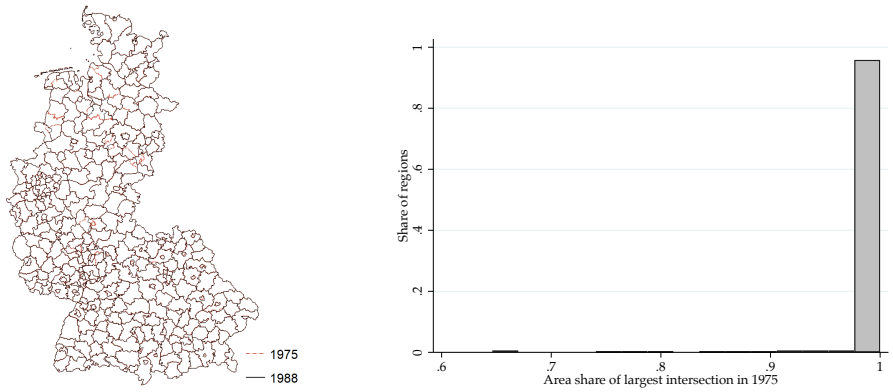
The Spatial Composition of Refugee Inflows In Table A-1 I show that there is little evidence that refugees were spatially sorted. In particular, conditional on the local housing supply and hence the main determinant of the size of refugee inflows shown in Table 4, neither the manufacturing share nor GDP per capita predicts the share of refugees coming from the industrialized Sudetenland or the Eastern Territories. To see that this absence of spatial sorting is particular to the refugees, the last two columns report the same regression for the share of the population that fled the Soviet Occupied Zone. These individuals are a natural control group as they were not part of the organized refugee treks but were free to settle. The last two columns of Table A-1 show these migrants do in



(a) Map (b) Distribution of $\xi(o)$

Notes: The left panel shows the districts of the map of West Germany in 1950 (red boundaries) and 1975 (black boundaries). The right panel shows the distribution of largest share of area of a county in 1950 within a district in 1975. Formally, it displays the distribution of $\xi(o) = \max_{i \in k(o)} \{a_i/a_o\}$, where o refers to a county in 1950, $k(o)$ the set of intersections between o and the map in 1975 and a_i (a_o) is the geographical area of a given intersection (a given origin county).

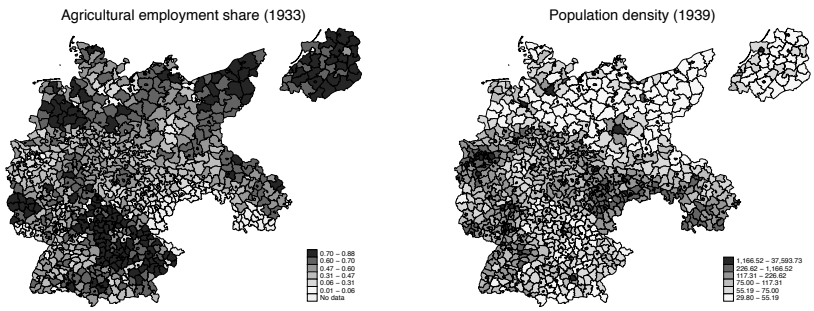
Figure A-3: Construction of Time-invariant Boundaries: 1950 - 1975



(a) Map (b) Distribution of $\xi(o)$

Notes: The left panel shows the districts of the map of West Germany in 1975 (red boundaries) and 1988 (black boundaries). The right panel shows the distribution of largest share of area of a county in 1975 within a district in 1988. Formally, it displays the distribution of $\xi(o) = \max_{i \in k(o)} \{a_i/a_o\}$, where o refers to a county in 1975, $k(o)$ the set of intersections between o and the map in 1988 and a_i (a_o) is the geographical area of a given intersection (a given origin county).

Figure A-4: Construction of Time-invariant Boundaries: 1975 - 1988



Notes: The map on the left shows the agricultural employment share in 1933. The map on the right shows population density in 1939.

Figure A-5: Economic Geography in the Pre-War Period

	Share of refugees from				Share of population from	
	Sudetenland		Eastern Territories		Soviet Occupied Zone	
$\ln y_{1935}$	0.003		-0.011		0.006***	
	(0.016)		(0.015)		(0.001)	
Manufacturing share in 1939		0.079		-0.039		0.022***
		(0.078)		(0.077)		(0.008)
State FE	✓	✓	✓	✓	✓	✓
ln pop dens 1939	✓	✓	✓	✓	✓	✓
Wartime destr.	✓	✓	✓	✓	✓	✓
Geography	✓	✓	✓	✓	✓	✓
N	523	535	523	535	466	476
R^2	0.798	0.796	0.786	0.785	0.616	0.602

Note: Standard errors are clustered at the level of 37 *Regierungsbezirke*. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively.

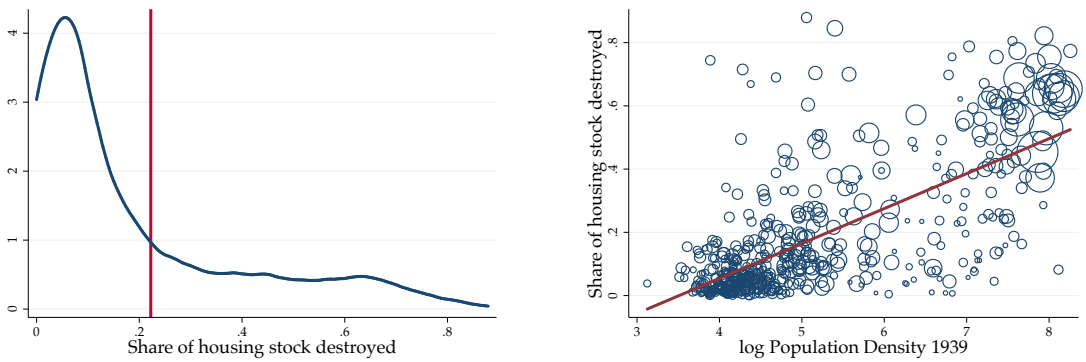
Table A-1: Local Composition of refugee flows

fact settle systematically in richer and more manufacturing intensive locations.

Wartime Destruction In the left panel of Figure A-6 I depict the cross-sectional distribution of wartime destruction, as measured by the share of the housing stock which was damaged in the war. It is apparent that there are many counties, where more than 60% of their housing stock was damaged during the war. The red line shows the share of the aggregate housing stock, which was destroyed during the war, which amounts to roughly 20%. In the right panel I display the correlation of wartime destruction with pre-war population density. As expected there is a strong positive correlation. The size of the markers reflect the county population in 1939.

The Experience of Different Cohorts: Additional Results From Micro Data In Section 3.3 I documented pronounced differences in the way how refugees and natives changed their sectoral of employment along the life-cycle. In this section I provide additional evidence along these lines.

Consider first Table A-2, which contains additional results on the occupational and sectoral employment shares between refugees and natives. The first two columns contain the results for natives



Notes: The figure shows the distribution of the share of the housing stock that was destroyed during the war across all counties in West Germany (left panel) and the correlation with population density in 1939 (right panel). The size of the markers in the right panel reflects the total county population in 1939.

Figure A-6: Wartime Destruction

and to-be refugees in 1939, i.e. prior to the expulsion. Consistent with the higher agricultural employment shares in the Eastern Territories, individuals living in West Germany in 1971 but having lived in the expulsion regions in 1939 were more likely to work in agriculture and less likely to work in manufacturing. In terms of their occupational standing, they were about as likely as their native peers to be self-employed in agriculture and there is no difference in the likelihood to work in an unskilled occupation.

The next two columns show the same data in 1950, i.e. immediately after the expulsion. While the employment patterns for native almost the same as in 1939, they are vastly different for refugees in West Germany. In particular, their employment share in agriculture declines by more than 50%. At the same time, manufacturing employment among refugees increases dramatically, exceeds 50% and is now higher than for natives. The occupational data in the lower panel has additional information on these reallocation patterns: the decline in agricultural employment is essentially accounted for by a decline in self-employed farmers, i.e. famers who lost their land when being expelled. After the expulsion, these individuals take unskilled jobs, which are mostly in the manufacturing sector. The remaining columns in Table A-2 show that these reallocation patterns in 1950 are not transitory but they persist throughout the 1950s and 1960s.

To see this even more directly, consider Table A-3, where I show the occupational employment distribution for native and refugee workers for both the agricultural and the manufacturing sector. Consider first the agricultural sector. The first column shows that 75% of all native workers in agriculture are either self-employed or family members. This relative absence of hired hands is of course the consequence of most farms being small. Now consider the case of refugees. Not only are very few refugees employed in agriculture to begin with, but conditional on actually working in the agricultural sector, almost all of them are in fact hired workers. The reason is obviously that few refugees were able to acquire land, both because they did not have any assets and because the supply of land for sale prior to the currency reform in 1949 was very limited. While it also the case

	Pre expulsion		Post expulsion					
	1939		1950		1960		1971	
	Natives	Refugees	Nat.	Ref.	Nat.	Ref.	Nat.	Ref.
Sectoral composition of employment								
Agriculture	18.7	**26**	17.4	**12.6**	12.8	**4.9**	10	2.5
Manufacturing	43.6	**35.9**	46.5	**51.9**	47.8	**56.6**	45.3	52
Services	24.7	23.2	23.9	21	25.2	22	26	24.7
Public Sector	12.9	14.9	12.1	14.5	14.1	16.4	18.7	20.8
Occupational composition of employment								
Self-employed (Agricult.)	17.1	**18.8**	16.6	**3.6**	13.6	**2.8**	11.3	2.6
Skilled Employee	5	5.4	5.4	5.3	7	7	9.6	9.6
Unskilled Employee	12.1	12.3	10.5	10.3	11.8	11.8	12.4	13
Skilled Worker	2.2	1.9	2.4	2	1.9	1.9	2.3	2.5
Unskilled Worker	30.3	**29.7**	27.9	**46.3**	26.1	**37.5**	23.3	31.6

Note: This table reports sectoral and occupational employment shares for the 1939, 1950, 1960 and 1971 by refugee status. The data stems from the MZU 71.

Table A-2: Sectoral and Occupational Mobility from 1939 to 1971

Occupation	Agriculture		Manufacturing	
	Natives	Refugees	Natives	Refugees
Self-employed	24.4	2.5	18.2	9.7
Family employment	49.9	5.1	5.6	1.5
Employee	0.6	1.3	11.1	8.9
Workers	25.1	90.9	65.2	79.9

Note: This table reports the occupational employment shares within sectors for refugees and natives in 1950.

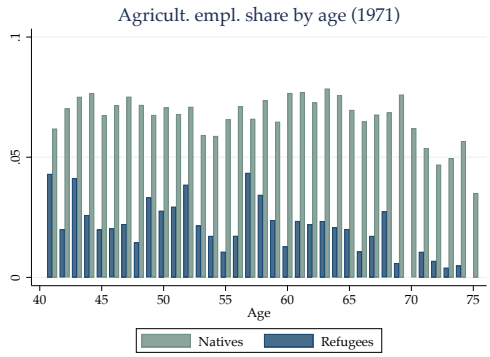
Table A-3: Occupational Distribution within Sectors: Natives vs Refugees

that natives were more likely to be self-employed in the manufacturing sector, the difference between natives and refugees was much less severe.

In Figure A-7, which is also taken from the supplement of the 1971 Census, I show the agricultural employment share in 1971 for different age groups. I focus on all cohorts older than 40, i.e. born before 1930. Hence, these are cohorts who completed most of their educational experience prior to the expulsion. The figure shows vividly that - despite living in agriculturally specialized countries in West Germany - refugees are much less likely to work in the agricultural sector.

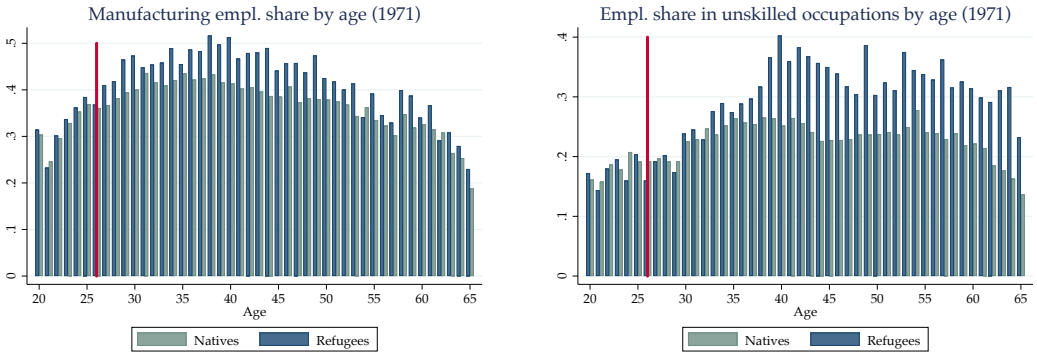
How then did the younger generation among the refugees react to the expulsion experience? In Figure A-8 I display the age-profile of manufacturing employment shares (left panel) and employment shares in unskilled occupations (right panel). I also superimpose a red line at age 26, which is the cohort of individuals born in 1945, i.e. after the expulsion. Figure A-8 suggests that cohort effects were very important for the economic integration of refugees. While older refugees are much more likely to work in the manufacturing sector and in unskilled occupations, this is not true for the younger cohorts. Among the individuals who grew up in West Germany, the differences between natives and refugees are hardly noticeable.

This pattern of a relatively successful integration of younger cohorts is also apparent in self-reported assessments about individuals' social mobility. More specifically, the supplement of the 1971 Census asked individuals if they felt they were doing better than their fathers. In Figure A-9 I



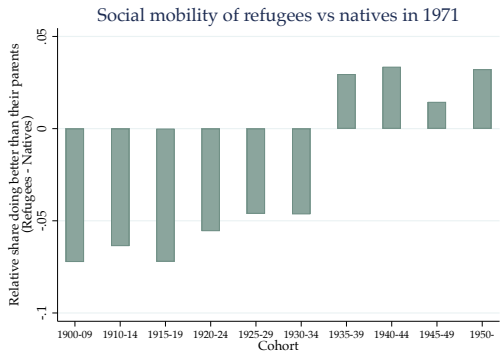
Notes: The figure shows the agricultural employment share in 1971 for different age groups for both natives and refugees

Figure A-7: Agricultural Employment Shares by Age



Notes: The figure shows the employment share in manufacturing (left panel) and in unskilled occupations (right panel) in 1971 for different age groups for both natives and refugees.

Figure A-8: Employment Shares in Manufacturing and Unskilled Occupations



Notes: The figure shows the relative social mobility of refugees relative to natives. Let p_a^{Ref} and p_a^{Nat} the share of refugees and natives of age a who report doing economically better than their parents. In the figure I report $\Delta_a = p_a^{Ref} - p_a^{Nat}$ for different cohorts.

Figure A-9: Self-reported Social Mobility: Refugees vs Natives

report this measure of social mobility of refugees relative to natives. More specifically, let p_c^{Ref} and p_c^{Nat} be the share of refugees and natives among cohort c who consider themselves doing economically better than their parents. In Figure A-9 I report $\Delta_a = p_a^{Ref} - p_a^{Nat}$ for different cohorts. The pattern of catch-up is clearly apparent. For all cohorts born prior to 1930, refugees experience *less* social mobility relative to natives, i.e. the share of people who consider themselves doing worse than their parents is higher among refugees. For the later cohorts this pattern flips. Precisely because the older generation of refugees experienced a stark break in their professional careers, their children see themselves doing relatively better. This finding is qualitatively consistent with the results reported in Becker et al. (2020), who, using data from Poland, argue that families with an experience of forced migration invest more in human capital.

Finally, in Table A-4 I show that this pattern of perceived social mobility is also apparent in the micro data on earnings taken from the EVS 62 data. More specifically I regress log earnings on let the dummy on the refugee status of the individual differ by age. I define "young" individual as being younger than 30 in 1962, i.e. born after 1932. In column 1 I replicate for comparison the baseline earnings difference between refugees and natives that I target in the quantitative model. Columns 2 and 3 show that this "refugee discount" is much lower (and in fact not statistically significant) among younger refugees.

A-2.4 Additional Results for "The Economic Effects of Refugee Inflows" (Section 3.2)

A-2.4.1 Robustness of Results

In this section I provide additional results for the empirical results reported in Section 3.

	log income		
Refugee	-0.075***	-0.083***	-0.081***
	(0.007)	(0.008)	(0.008)
Refugee × Young		0.067***	0.052***
		(0.019)	(0.020)
State FE	✓	✓	✓
Demographics	✓	✓	✓
Cohort FE			✓
N	23831	23831	23831
R^2	0.111	0.111	0.112

Note: Robust standard errors in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. "Young" is an indictor for whether the individual is below 30 years old in 1961. All specifications control for age, the squared of age and male dummy ("Demographics") and state fixed effects. Column 4 controls for fixed effects for 4 cohorts (below 30 years, 30-40, 40-50 and above 50 years).

Table A-4: Relative Earnings by Cohort: Refugees vs Natives

OLS Estimates (Table 5)

For brevity Table 5 only reported the coefficient on the share of refugees in 1950, which is the main coefficient of interest. For completeness, in Tables A-5 and A-6 I report the coefficients on the remaining covariates. I focus on specification 3 for 1950 (see Table A-5) and specification 7 for 1961 (see Table A-6).

In Table A-7 I replicate the estimates of Table 5 with robust instead of clustered standard errors. This strengthens the results because the clustered standard errors turn out to be generally larger.

Finally, I consider a variety of robustness tests. In Table A-8 I report the results in the short-run (i.e. 1939 to 1950), in Table A-9 I focus on the long-run (i.e. 1939 to 1961). For parsimony I focus on the baseline specification, which is contained in columns 2 and 6 in Table 5. This specification controls for state fixed effects, population density in 1939, the share of wartime destruction, the level of respective dependent variable in 1939, the distance to the inner-german border and a dummy for whether a county is directly at the border. I then consider the following variations of my baseline specification:

1. weighing counties by their population in 1939 to put more weight on (ex-ante) large localities (column 2).

2. explicitly controlling for regional variation in labor supply as proxied by the employment share and the share of male inhabitants (column 3)

3. controlling for local construction need as proxied by the share of the housing stock built after 1945 (column 4)

4. incorporating fixed effects at the city × state level, where "cities" are the roughly 120 counties, that mostly contain only a single city (that naturally tends to be large) (column 5),

5. excluding the state of Bavaria, where counties are decisively smaller as in other states (column 6),

	Population growth 39-50	Change in ... share Manufac 39-50	Agric. 33-50	Service 33-50	GDP pc growth 35-50	Plant growth 33-50
Share of refugees in 1950	1.286***	0.322***	-0.228***	-0.059	-0.017	0.653**
	(0.137)	(0.075)	(0.062)	(0.055)	(0.369)	(0.283)
ln pop dens. 1939	-0.132***	0.001	-0.087***	0.044***	0.433***	0.745***
	(0.038)	(0.005)	(0.017)	(0.013)	(0.093)	(0.054)
ln pop dens. 1933	0.088**	0.007	0.008	-0.005	-0.219**	-0.734***
	(0.034)	(0.005)	(0.020)	(0.013)	(0.089)	(0.061)
Share of housing stock damaged	-0.235***	0.026	0.027	-0.079***	0.001	0.165
	(0.031)	(0.019)	(0.030)	(0.025)	(0.148)	(0.112)
Manufacturing share in 1939	0.208**	-0.177**	-0.486***	-0.169**	0.108	-0.207
	(0.081)	(0.078)	(0.085)	(0.068)	(0.325)	(0.151)
Agricultural share in 1933	-0.037	-0.079	-0.872***	0.022	-0.007	-0.361**
	(0.069)	(0.051)	(0.079)	(0.062)	(0.294)	(0.142)
Service share in 1933	-0.112	-0.096	-0.271	-0.534**	-0.671	-0.460
	(0.162)	(0.216)	(0.165)	(0.203)	(0.688)	(0.305)
$\ln y_{1935}$	0.025	-0.013***	-0.023***	0.023***	-0.583***	-0.011
	(0.015)	(0.004)	(0.006)	(0.005)	(0.074)	(0.035)
ln num of manufac. plants (1933)	-0.032***	-0.005	0.009	-0.008*	0.070	-0.182***
	(0.010)	(0.003)	(0.006)	(0.004)	(0.047)	(0.045)
lndistance	-0.007	0.018	-0.018	0.011	-0.000	0.098
	(0.031)	(0.018)	(0.035)	(0.035)	(0.098)	(0.095)
Border with East Germany	-0.095	-0.005	0.013	-0.006	0.099	-0.136**
	(0.057)	(0.008)	(0.015)	(0.013)	(0.083)	(0.051)
State FE	✓	✓	✓	✓	✓	✓
N	519	519	519	519	519	519
R^2	0.698	0.421	0.776	0.442	0.540	0.664

Note: Standard errors are clustered at the level of 37 *Regierungsbezirke*. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. The results correspond to specification 3 in Table A-5.

Table A-5: OLS Results in 1950: Coefficients on Remaining Covariates

	Population growth 39-61	Change in ... share Manufac 39-61	Agric. 33-61	Service 33-61	GDP pc growth 35-61	Plant growth 33-56
Share of refugees in 1950	1.235***	0.244***	-0.151**	-0.054	0.658***	0.830*
	(0.227)	(0.087)	(0.060)	(0.068)	(0.210)	(0.456)
ln pop dens. 1939	-0.165**	-0.023***	-0.051***	0.039***	0.084***	0.784***
	(0.066)	(0.008)	(0.015)	(0.012)	(0.028)	(0.066)
ln pop dens. 1933	0.131*	0.008	0.001	-0.003	-0.044	-0.809***
	(0.067)	(0.008)	(0.017)	(0.012)	(0.029)	(0.067)
Share of housing stock damaged	-0.018	0.003	0.022	-0.049*	0.120*	-0.104
	(0.068)	(0.022)	(0.033)	(0.029)	(0.068)	(0.180)
Manufacturing share in 1939	0.686***	-0.128	-0.499***	-0.195***	0.576***	2.318***
	(0.176)	(0.077)	(0.080)	(0.069)	(0.132)	(0.396)
Agricultural share in 1933	0.053	-0.035	-0.895***	0.014	-0.127	-0.250
	(0.171)	(0.049)	(0.067)	(0.062)	(0.095)	(0.279)
Service share in 1933	0.260	0.002	-0.287*	-0.559**	-0.466**	0.235
	(0.315)	(0.217)	(0.152)	(0.217)	(0.225)	(0.790)
$\ln y_{1935}$	0.053	-0.013**	-0.017**	0.020***	-0.904***	0.108**
	(0.032)	(0.006)	(0.007)	(0.006)	(0.019)	(0.047)
ln num of manufac. plants (1933)	-0.111	-0.007	0.012	-0.010*	0.028	-0.240***
	(0.071)	(0.007)	(0.009)	(0.005)	(0.028)	(0.074)
lndistance	0.094*	-0.010	-0.028	0.037	0.166***	-0.085
	(0.047)	(0.024)	(0.032)	(0.038)	(0.044)	(0.122)
Border with East Germany	-0.016	-0.010	0.006	0.011	0.036	-0.099
	(0.129)	(0.010)	(0.011)	(0.014)	(0.040)	(0.109)
State FE	✓	✓	✓	✓	✓	✓
N	472	519	519	519	515	519
R^2	0.286	0.357	0.818	0.283	0.906	0.617

✓

Note: Standard errors are clustered at the level of 37 *Regierungsbezirke*. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. The results correspond to specification 7 in Table A-5.

Table A-6: OLS Results in 1961: Coefficients on Remaining Covariates

	Panel A: Population growth: $\ln L_{rt} - \ln L_{r1939}$							
	1939-1950				1939-1961			
Share of refugees in 1950	2.032***	1.255***	1.286***	1.367***	1.246***	1.147***	1.235***	1.339***
	(0.106)	(0.113)	(0.116)	(0.105)	(0.240)	(0.198)	(0.205)	(0.198)
N	536	523	519	472	488	475	472	472
R^2	0.610	0.683	0.698	0.732	0.173	0.175	0.283	0.338
	Panel B: Manufacturing employment: $\pi^M_{rt} - \pi^M_{r1939}$							
	1939-1950				1939-1961			
Share of refugees in 1950	0.203***	0.317***	0.322***	0.353***	0.451***	0.241***	0.244***	0.255***
	(0.041)	(0.048)	(0.048)	(0.042)	(0.048)	(0.060)	(0.061)	(0.058)
N	535	535	519	472	535	535	519	472
R^2	0.301	0.393	0.423	0.539	0.230	0.351	0.357	0.424
	Panel C: Agricultural employment: $\pi^A_{rt} - \pi^A_{r1933}$							
	1933-1950				1933-1961			
Share of refugees in 1950	-0.454***	-0.186**	-0.228***	-0.423***	-0.716***	-0.097	-0.151**	-0.326***
	(0.110)	(0.080)	(0.073)	(0.060)	(0.122)	(0.082)	(0.071)	(0.062)
N	523	523	519	472	523	523	519	472
R^2	0.091	0.701	0.776	0.842	0.122	0.761	0.817	0.858
	Panel D: Service employment: $\pi^S_{rt} - \pi^S_{r1933}$							
	1933-1950				1933-1961			
Share of refugees in 1950	-0.089	0.014	-0.059	0.051	-0.098*	0.017	-0.054	0.057
	(0.058)	(0.056)	(0.055)	(0.046)	(0.056)	(0.059)	(0.058)	(0.054)
N	523	523	519	472	523	523	519	472
R^2	0.211	0.359	0.441	0.602	0.053	0.172	0.276	0.448
	Panel E: GDP per capita growth: $\ln y_{rt} - \ln y_{r1935}$							
	1935-1950				1935-1961			
Share of refugees in 1950	-1.219***	-0.083	-0.017	-0.017	1.159***	0.502***	0.658***	0.746***
	(0.317)	(0.312)	(0.315)	(0.279)	(0.391)	(0.190)	(0.179)	(0.185)
N	523	523	519	472	519	519	515	468
R^2	0.110	0.511	0.540	0.582	0.101	0.889	0.905	0.903
	Panel F: Growth of industrial plants: $\ln N_{rt} - \ln N_{r1933}$							
	1933-1950				1933-1956			
Share of refugees in 1950	-0.450	0.726**	0.653***	0.817***	-0.819	0.697	0.830*	1.169***
	(0.306)	(0.296)	(0.198)	(0.200)	(0.547)	(0.542)	(0.423)	(0.416)
N	520	520	519	472	520	520	519	472
R^2	0.045	0.393	0.664	0.680	0.140	0.372	0.617	0.626
State FE	✓	✓	✓	✓	✓	✓	✓	✓
Pop. density (1939)		✓	✓	✓		✓	✓	✓
Wartime destr.		✓	✓	✓		✓	✓	✓
Geography		✓	✓	✓		✓	✓	✓
Levels of dep. variable		✓	✓	✓		✓	✓	✓
Pre-war controls			✓	✓			✓	✓
Addtl. pre-war controls				✓				✓

Note: Robust standard errors in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. The dependent variables are population growth (Panel A), changes in sectoral employment shares (Panels B - D), income per capita growth (Panel E) and the growth in the number of industrial plants (Panel F). The various specifications control for the share of the destroyed housing stock ("Wartime destr."), the distance to the inner german border and a fixed effect for whether a county is a border county ("Geography"), the respective dependent variable in levels in the pre-war period ("Levels of dep. variable"), all six dependent variable in levels in the pre-war period in Panels A-F ("Pre-war controls") and the population share in cities with less than 2000 inhabitants in 1939, population density in 1933, the manufacturing share in 1933 and the GDP share in manufacturing and agriculture in 1935 ("Addtl. pre-war controls").

Table A-7: OLS Results (Table 5): Estimates with Robust Standard Errors

6. using the share of refugees in 1946 as the measure of refugee inflows (column 7),

7. estimating the regression on the same sample of counties as in column 8 but using the refugee share in 1950 as the dependent variable (column 8).

For comparison, I always report the baseline estimate from Table 5 in column 1.

Tables A-8 and A-9 show that my baseline results are mostly robust with respect to these considerations. Here I focus on the few cases, where the results differ. Consider first the short-run results reported in Table A-8. The elasticity of population growth is lower when I focus on the share of refugees in 1946 (Panel A, column 7). This is expected because - as seen in Figure 2 - a large number of refugees arrived only in 1946 and the following years. Using this variation, neither the relationship with the agricultural employment share, nor the one with the growth rate of plants is significantly different from zero (Panel C and F, column 7). Finally, controlling for local labor supply, changes the relative composition between agricultural and service employment. In Table A-8 I consider the robustness of the long-run results. In that case, the only result that differs from the baseline estimates is that the conditional correlation between GDP growth and population growth and the allocation of refugees in 1946 is not statistically significantly different from zero.

Instrumental Variable Estimates (Table 6)

In Table A-10 I report the first stage relationship between the share of refugees and the distance to expulsion regions. For completeness I report both the specification with robust standard errors (columns 1 - 4) and with clustered standard error (columns 5 - 8). The table show why it is important to allow for the relationship between the expulsion distance and the refugee share to vary by state. Columns 1 and 5 show that the relationship is - on average - negative. However, the remaining columns show that in Bavaria, which is a relatively large state in the South of Germany with many small counties, the relationship is essentially flat. This is in stark contrast to the other states.[44] The reason for this qualitative difference between Bavaria and the rest of Germany is most likely a problem of measurement. By being on south-eastern border of Germany, Bavaria was a natural destination for many expellees from Czechoslovakia, Hungary and Rumania. Because these regions were not part of the German Reich, I do not have access to their population at the county-level. Hence, they are not part of the "Expulsion distance". Counties in Bavaria that were relatively close to such regions (and hence received a large share of refugees) therefore appear to have a larger distance to the expulsion regions as they effectively did.

In Table A-11 I present the reduced form estimates using the same set of controls as for the IV estimates reported in Table 6. Given these measurement concern about the role of the expulsion distance in Bavaria, I allow for the reduced form effect to differ between Bavaria and the rest of Germany (see columns 2 and 6 in Table A-10).[45] Focusing on the role of the expulsion distance

[44] The only exception is "Rhineland Palatinate" (RhPf), which is relatively small.

[45] For brevity I restrict the reduced form effects among states other than Bavaria to be identical. In the IV

	Base-line	Weights	Labor supply	Constr. activity	City × state FE	Excl. Bavaria	1946 Ref. share	1946 sample
Panel A: Population growth: $\ln L_{r1950} - \ln L_{r1939}$								
Share of refugees (1950)	1.255***	1.423***	1.175***	1.260***	1.354***	1.271***		1.229***
	(0.142)	(0.155)	(0.131)	(0.142)	(0.133)	(0.185)		(0.172)
Share of refugees (1946)							0.758**	
							(0.286)	
N	536	536	536	536	488	345	404	404
R^2	0.686	0.773	0.691	0.687	0.716	0.699	0.578	0.624
Panel B: Manufacturing employment: $\pi^M_{r1950} - \pi^M_{r1939}$								
Share of refugees (1950)	0.317***	0.299***	0.282***	0.315***	0.309***	0.294***		0.246**
	(0.074)	(0.061)	(0.072)	(0.074)	(0.079)	(0.073)		(0.094)
Share of refugees (1946)							0.224*	
							(0.110)	
N	535	535	535	535	488	344	403	403
R^2	0.390	0.339	0.459	0.392	0.388	0.288	0.357	0.366
Panel C: Agricultural employment: $\pi^A_{r1950} - \pi^A_{r1933}$								
Share of refugees (1950)	-0.186**	-0.223***	0.014	-0.169**	-0.219***	-0.184		-0.104
	(0.072)	(0.080)	(0.079)	(0.075)	(0.069)	(0.111)		(0.100)
Share of refugees (1946)							0.134	
							(0.144)	
N	523	523	523	523	475	338	396	396
R^2	0.701	0.711	0.764	0.717	0.736	0.637	0.724	0.723
Panel D: Service employment: $\pi^S_{r1950} - \pi^S_{r1933}$								
Share of refugees (1950)	0.014	0.069	-0.114**	0.007	0.040	-0.099		0.021
	(0.058)	(0.068)	(0.056)	(0.062)	(0.061)	(0.069)		(0.084)
Share of refugees (1946)							-0.077	
							(0.096)	
N	523	523	523	523	475	338	396	396
R^2	0.363	0.354	0.514	0.375	0.495	0.378	0.402	0.400
Panel E: GDP per capita growth: $\ln y_{r1950} - \ln y_{r1935}$								
Share of refugees (1950)	-0.083	0.097	-0.035	-0.096	-0.200	-0.382		0.009
	(0.382)	(0.541)	(0.354)	(0.379)	(0.363)	(0.542)		(0.524)
Share of refugees (1946)							0.040	
							(0.494)	
N	523	523	523	523	475	338	396	396
R^2	0.511	0.608	0.543	0.513	0.532	0.454	0.499	0.499
Panel F: Growth of industrial plants: $\ln N_{r1950} - \ln N_{r1933}$								
Share of refugees (1950)	0.726*	0.570	0.494	0.721*	0.890**	0.458		0.427
	(0.410)	(0.528)	(0.378)	(0.398)	(0.387)	(0.553)		(0.448)
Share of refugees (1946)							-0.116	
							(0.459)	
N	520	520	520	520	472	335	394	394
R^2	0.393	0.385	0.403	0.393	0.491	0.445	0.303	0.306

Note: Standard errors at clustered at the level of 37 administrative units (*Regierungsbezirke*). *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. See main text for details on the different specifications. All specification control for state fixed effects, log population density in 1939, the extent of wartime destruction, the log distance of the inner german border and a dummy if a county is at the inner german border and the level of respective dependent variable in 1939.

Table A-8: OLS Results in 1950 (Table 5): Robustness

	Base-line	Weights	Labor supply	Constr. activity	City × state FE	Excl. Bavaria	1946 Ref. share	1946 sample
Panel A: Population growth: $\ln L_{r1961} - \ln L_{r1939}$								
Share of refugees (1950)	1.147***	1.074***	1.182***	1.104***	1.327***	1.301***		1.114***
	(0.257)	(0.221)	(0.249)	(0.248)	(0.298)	(0.385)		(0.296)
Share of refugees (1946)							0.284	
							(0.387)	
N	488	488	488	488	488	297	356	356
R^2	0.237	0.381	0.250	0.263	0.282	0.295	0.159	0.192
Panel B: Manufacturing employment: $\pi^M_{r1961} - \pi^M_{r1939}$								
Share of refugees (1950)	0.241***	0.166**	0.253***	0.237***	0.266***	0.242***		0.207*
	(0.086)	(0.065)	(0.088)	(0.087)	(0.090)	(0.062)		(0.109)
Share of refugees (1946)							0.161	
							(0.135)	
N	535	535	488	535	488	344	403	403
R^2	0.352	0.508	0.355	0.357	0.360	0.406	0.320	0.328
Panel C: Agricultural employment: $\pi^A_{r1961} - \pi^A_{r1933}$								
Share of refugees (1950)	-0.097	-0.105	-0.116	-0.077	-0.141*	-0.169*		-0.060
	(0.078)	(0.075)	(0.085)	(0.088)	(0.079)	(0.096)		(0.107)
Share of refugees (1946)							0.196	
							(0.153)	
N	523	523	475	523	475	338	396	396
R^2	0.761	0.835	0.771	0.778	0.782	0.801	0.763	0.761
Panel D: Service employment: $\pi^S_{r1961} - \pi^S_{r1933}$								
Share of refugees (1950)	0.017	0.080	-0.002	0.010	0.003	-0.045		0.022
	(0.071)	(0.073)	(0.067)	(0.073)	(0.073)	(0.077)		(0.098)
Share of refugees (1946)							-0.051	
							(0.108)	
N	523	523	475	523	475	338	396	396
R^2	0.186	0.164	0.279	0.199	0.332	0.128	0.202	0.201
Panel E: GDP per capita growth: $\ln y_{r1961} - \ln y_{r1935}$								
Share of refugees (1950)	0.502**	0.484*	0.597***	0.490**	0.581**	0.455		0.642**
	(0.227)	(0.255)	(0.213)	(0.236)	(0.236)	(0.348)		(0.267)
Share of refugees (1946)							-0.001	
							(0.277)	
N	519	519	471	519	471	334	392	392
R^2	0.889	0.918	0.891	0.891	0.889	0.865	0.887	0.889
Panel F: Growth of industrial plants: $\ln N_{r1956} - \ln N_{r1933}$								
Share of refugees (1950)	0.697	-0.467	0.518	0.645	1.038	0.478		0.441
	(0.756)	(0.898)	(0.822)	(0.724)	(0.758)	(1.053)		(0.940)
Share of refugees (1946)							-0.660	
							(0.874)	
N	520	520	520	520	472	335	394	394
R^2	0.373	0.379	0.378	0.381	0.400	0.433	0.316	0.315

Note: Standard errors at clustered at the level of 37 administrative units (*Regierungsbezirke*). *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. See main text for details on the different specifications. All specification control for state fixed effects, log population density in 1939, the extent of wartime destruction, the log distance of the inner german border and a dummy if a county is at the inner german border and the level of respective dependent variable in 1939.

Table A-9: OLS Results in 1961 (Table 5): Robustness

	Share of refugees in 1950							
	Robust standard errors				Clustered standard errors (37 clusters)			
ln Exp. Dist.	-0.142***	-0.446***			-0.142	-0.446***		
	(0.045)	(0.046)			(0.127)	(0.112)		
ln ED × Bavaria		0.394***	-0.038	-0.028		0.394***	-0.038	-0.028
		(0.041)	(0.044)	(0.044)		(0.106)	(0.102)	(0.095)
ln ED × BW			-0.672***	-0.642***			-0.672***	-0.642***
			(0.057)	(0.062)			(0.086)	(0.072)
ln ED × Hesse			-0.267***	-0.215***			-0.267*	-0.215
			(0.076)	(0.078)			(0.144)	(0.134)
ln ED × NRW			-0.248***	-0.201***			-0.248**	-0.201**
			(0.058)	(0.060)			(0.100)	(0.087)
ln ED × LS			-0.464***	-0.446***			-0.464***	-0.446***
			(0.062)	(0.062)			(0.126)	(0.116)
ln ED × RhPf			-0.075	-0.063			-0.075	-0.063
			(0.107)	(0.107)			(0.121)	(0.133)
ln ED × SH			-0.336***	-0.305***			-0.336***	-0.305***
			(0.088)	(0.086)			(0.088)	(0.084)
State FE	✓	✓	✓	✓	✓	✓	✓	✓
ln pop dens 1939	✓	✓	✓	✓	✓	✓	✓	✓
Wartime destr.	✓	✓	✓	✓	✓	✓	✓	✓
Geography	✓	✓	✓	✓	✓	✓	✓	✓
Pre-war empl.				✓				✓
lny 1935				✓				✓
N	536	536	536	522	536	536	536	522

Note: *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. Standard errors are robust (columns 1-4) or clustered at the level of 37 *Regierungsbezirke* (columns 5 - 8). The expulsion distance ("ED") is calculated according to (1). Specifications 4 and 8 control for the manufacturing employment share in 1939 and the agricultural employment share in 1939 ("pre-war empl.").

Table A-10: First Stage

outside of Bavaria, regions with a larger distance to the expulsion regions experience lower population growth, slower growth in manufacturing employment, less declines in agricultural employment and slower growth in industrial plants. There is no statistically significant impact on income growth and service employment growth. Moreover, the effect on manufacturing and agricultural employment is also only significant in some specifications.

In Table A-12 I replicate the results from Table 6 when I weigh each observation with its local population in 1939. These results, which are very similar to the baseline estimates in Table 6, ease the concern that only small counties account for a large part of the variation. In Table A-13 I report the results from Table 6 when I use robust standard errors instead of clustered standard errors. The main differences of this specification are that the relationship with the service share is now statistically positive in some specifications and that the effect on long-run GDP is just shy of being significant at the 10% level.

Finally, in Tables A-14 and A-15 I report the same robustness checks for the IV specification as I did for the OLS specification in Tables A-8 and A-8. The only meaningful difference with respect to the baseline specification (which I again replicate in the first column) is that the long-run effect on GDP per capita and the number plants is smaller once the state of Bavaria is excluded. Note however that doing do also increases the standard errors substantially because the sample size decreases by roughly 190 counties.

A-2.4.2 Pre-trends

The OLS results rely on the assumption of parallel trends: conditional on pre-war controls, different regions would have developed similarly in the absence of refugee inflows. In Table A-16 I report a set of regression of various outcomes on the share of refugees that suggest that my controls appropriately control for eventual pre-trends. The first four columns show that the residual share of refugees is uncorrelated with manufacturing and agricultural employment shares in the pre-war period. The last three columns show that there is no correlation between the share of refugees and population growth or the growth of manufacturing plants in the pre-war period and that the share of refugees is if anything negatively correlated with the change in the manufacturing employment share between 1933 and 1939. Thus, there is no evidence that regions with higher refugee inflows were on a more promising trajectory in the pre-war period.

A-2.4.3 Nonlinear effects of population density

The nature of the allocation rule implies that refugees were settled to relatively rural, low population density locations. Even though all my results reported in Tables 5 and 6 control for the population density in 1939, one might still be concerned that counties that differed in their pre-war population density were on different trends and that such differences are not captured by the controls used in

estimates, I instrument the share of refugees with the interaction between the distance to the expulsion region and a state fixed effect.

	Panel A: Population growth: $\ln L_{rt} - \ln L_{r1939}$							
	1939-1950				1939-1961			
ln ED × Rest	-0.657***	-0.386	-0.447**	-0.481**	-0.599*	-0.488	-0.660*	-0.553**
	(0.211)	(0.231)	(0.196)	(0.200)	(0.320)	(0.384)	(0.338)	(0.257)
ln ED × Bavaria	0.150	0.195	0.163	0.170	0.446***	0.457**	0.372*	0.404**
	(0.092)	(0.164)	(0.127)	(0.114)	(0.120)	(0.222)	(0.187)	(0.148)
	Panel B: Manufacturing employment: $\pi^M_{rt} - \pi^M_{r1939}$							
	1939-1950				1939-1961			
ln ED × Rest	-0.031	-0.117	-0.101	-0.198***	-0.103**	-0.016	0.015	-0.085
	(0.045)	(0.096)	(0.097)	(0.071)	(0.043)	(0.106)	(0.102)	(0.079)
ln ED × Bavaria	0.031	-0.045	-0.015	-0.031	0.046	0.076	0.128	0.116*
	(0.048)	(0.080)	(0.080)	(0.061)	(0.057)	(0.082)	(0.077)	(0.062)
	Panel C: Agricultural employment: $\pi^A_{rt} - \pi^A_{r1933}$							
	1933-1950				1933-1961			
ln ED × Rest	0.099	0.101	0.237**	0.287***	0.058	-0.051	0.088	0.142
	(0.060)	(0.137)	(0.105)	(0.103)	(0.083)	(0.139)	(0.115)	(0.106)
ln ED × Bavaria	-0.051	-0.132	-0.063	-0.029	-0.077	-0.226**	-0.171*	-0.136
	(0.074)	(0.103)	(0.080)	(0.083)	(0.100)	(0.110)	(0.093)	(0.082)
	Panel D: Service employment: $\pi^S_{rt} - \pi^S_{r1933}$							
	1933-1950				1933-1961			
ln ED × Rest	-0.045	-0.129	-0.068	-0.060	0.025	-0.105	-0.037	-0.026
	(0.038)	(0.093)	(0.104)	(0.081)	(0.038)	(0.107)	(0.123)	(0.096)
ln ED × Bavaria	0.105**	0.078	0.083	0.069	0.112*	0.049	0.061	0.044
	(0.048)	(0.047)	(0.052)	(0.043)	(0.055)	(0.050)	(0.058)	(0.046)
	Panel E: GDP per capita growth: $\ln y_{rt} - \ln y_{r1935}$							
	1935-1950				1935-1961			
ln ED × Rest	0.201	-0.031	-0.155	-0.056	0.274	0.417	0.152	0.180
	(0.224)	(0.420)	(0.371)	(0.340)	(0.252)	(0.298)	(0.235)	(0.232)
ln ED × Bavaria	-0.849***	0.105	0.083	0.022	-0.907*	0.753**	0.681**	0.698**
	(0.257)	(0.334)	(0.362)	(0.292)	(0.454)	(0.294)	(0.267)	(0.256)
	Panel F: Growth of industrial plants: $\ln N_{rt} - \ln N_{r1933}$							
	1933-1950				1933-1956			
ln ED × Rest	0.139	-1.264***	-1.180***	-1.229***	-0.778	-0.459	-1.201**	-1.588***
	(0.276)	(0.409)	(0.305)	(0.278)	(0.528)	(0.862)	(0.453)	(0.394)
ln ED × Bavaria	0.223	-0.486	-0.536**	-0.518**	-0.041	0.362	-0.193	-0.345
	(0.276)	(0.289)	(0.200)	(0.194)	(0.604)	(0.522)	(0.327)	(0.252)
State FE	✓	✓	✓	✓	✓	✓	✓	✓
Pop. density (1939)		✓	✓	✓		✓	✓	✓
Wartime destr.		✓	✓	✓		✓	✓	✓
Geography		✓	✓	✓		✓	✓	✓
Levels of dep. variable		✓	✓	✓		✓	✓	✓
Pre-war controls			✓	✓			✓	✓
Addtl. pre-war controls				✓				✓

Note: Standard errors are clustered at the level of 37 *Regierungsbezirke*. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. The dependent variables are population growth (Panel A), changes in sectoral employment shares (Panels B - D), income per capita growth (Panel E) and the growth in the number of industrial plants (Panel F). The various specifications control for the share of destroyed housing stock ("Wartime destr."), the distance to the inner german border and a fixed effect for whether a county is a border county ("Geography"), the respective dependent variable in levels in the pre-war period ("Levels of dep. variable"), all six dependent variable in levels in the pre-war period in Panels A-F ("Pre-war controls") and the population share in cities with less than 2000 inhabitants in 1939, population density in 1933, the manufacturing share in 1933 and the GDP share in manufacturing and agriculture in 1935 ("Addtl. pre-war controls"). The expulsion distance "ED" is calculated according to (1).

Table A-11: The Effects of Refugee Inflows on the Local Economy: Reduced Form

	Panel A: Population growth: $\ln L_{rt} - \ln L_{r1939}$							
	1939-1950				1939-1961			
Share of refugees in 1950	2.021***	1.718***	1.740***	1.700***	0.999***	1.540***	1.628***	1.591***
	(0.312)	(0.204)	(0.227)	(0.204)	(0.215)	(0.299)	(0.267)	(0.256)
N	526	526	509	463	526	526	509	463
F-Stat	23.735	14.228	12.466	14.460	18.174	17.052	14.866	17.578
	Panel B: Manufacturing employment: $\pi^M_{rt} - \pi^M_{r1939}$							
	1939-1950				1939-1961			
Share of refugees in 1950	0.041	0.308**	0.344***	0.407***	0.245**	0.246**	0.262**	0.316***
	(0.147)	(0.130)	(0.125)	(0.082)	(0.106)	(0.124)	(0.119)	(0.093)
N	535	535	519	472	535	535	519	472
F-Stat	18.097	17.807	16.098	17.503	18.097	17.807	16.098	17.503
	Panel C: Agricultural employment: $\pi^A_{rt} - \pi^A_{r1933}$							
	1933-1950				1933-1961			
Share of refugees in 1950	-0.388**	-0.346**	-0.484***	-0.520***	-0.360	-0.213	-0.327**	-0.352**
	(0.184)	(0.143)	(0.131)	(0.153)	(0.325)	(0.159)	(0.138)	(0.156)
N	523	523	519	472	523	523	519	472
F-Stat	18.286	17.912	16.098	17.503	18.286	17.912	16.098	17.503
	Panel D: Service employment: $\pi^S_{rt} - \pi^S_{r1933}$							
	1933-1950				1933-1961			
Share of refugees in 1950	0.153	0.191	0.193	0.182	-0.054	0.213	0.184	0.160
	(0.137)	(0.212)	(0.183)	(0.205)	(0.115)	(0.240)	(0.199)	(0.216)
N	523	523	519	472	523	523	519	472
F-Stat	18.286	19.515	16.098	17.503	18.286	19.515	16.098	17.503
	Panel E: GDP per capita growth: $\ln y_{rt} - \ln y_{r1935}$							
	1935-1950				1935-1961			
Share of refugees in 1950	-0.707	0.934	0.364	-0.129	-0.506	0.905**	0.589***	0.483**
	(0.881)	(0.970)	(0.950)	(0.572)	(0.922)	(0.408)	(0.218)	(0.193)
N	523	523	519	472	519	519	515	468
F-Stat	18.286	19.464	16.098	17.503	17.663	19.148	16.188	17.101
	Panel F: Growth of industrial plants: $\ln N_{rt} - \ln N_{r1933}$							
	1933-1950				1933-1956			
Share of refugees in 1950	-0.246	2.562***	2.476***	2.481***	1.517	1.459	1.638*	1.632***
	(0.850)	(0.810)	(0.742)	(0.547)	(1.008)	(1.050)	(0.859)	(0.624)
N	520	520	519	472	520	520	519	472
F-Stat	17.224	16.952	16.098	17.503	17.224	16.952	16.098	17.503
State FE	✓	✓	✓	✓	✓	✓	✓	✓
Pop. density (1939)		✓	✓	✓		✓	✓	✓
Wartime destr.		✓	✓	✓		✓	✓	✓
Geography		✓	✓	✓		✓	✓	✓
Levels of dep. variable		✓	✓	✓		✓	✓	✓
Pre-war controls			✓	✓			✓	✓
Addtl. pre-war controls				✓				✓

Note: Standard errors are clustered at the level of 37 *Regierungsbezirke*. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. The dependent variables are population growth (Panel A), changes in sectoral employment shares (Panels B - D), income per capita growth (Panel E) and the growth in the number of industrial plants (Panel F). The various specifications control for the share of destroyed housing stock ("Wartime destr."), the distance to the inner german border and a fixed effect for whether a county is a border county ("Geography"), the respective dependent variable in levels in the pre-war period ("Levels of dep. variable"), all six dependent variable in levels in the pre-war period in Panels A-F ("Pre-war controls") and the population share in cities with less than 2000 inhabitants in 1939, population density in 1933, the manufacturing share in 1933 and the GDP share in manufacturing and agriculture in 1935 ("Addtl. pre-war controls"). The share of refugees is instrumented with the population-weighted distance to the expulsion regions (see (1)) interacted with state fixed effects. All observations are weighted with the local population in 1939.

Table A-12: IV Results (Table 6): Estimates with Population Weights

	Panel A: Population growth: $\ln L_{rt} - \ln L_{r1939}$							
	1939-1950				1939-1961			
Share of refugees in 1950	1.897***	1.459***	1.563***	1.614***	1.018***	1.227***	1.450***	1.501***
	(0.132)	(0.133)	(0.146)	(0.139)	(0.184)	(0.216)	(0.225)	(0.216)
N	526	526	509	463	526	526	509	463
F-Stat	47.905	26.685	22.276	27.334	47.109	26.326	21.728	26.908
	Panel B: Manufacturing employment: $\pi^M_{rt} - \pi^M_{r1939}$							
	1939-1950				1939-1961			
Share of refugees in 1950	0.124**	0.271***	0.297***	0.406***	0.279***	0.199*	0.222*	0.333***
	(0.062)	(0.077)	(0.085)	(0.067)	(0.084)	(0.106)	(0.114)	(0.099)
N	535	535	519	472	535	535	519	472
F-Stat	47.538	26.231	23.145	27.484	47.538	26.231	23.145	27.484
	Panel C: Agricultural employment: $\pi^A_{rt} - \pi^A_{r1933}$							
	1933-1950				1933-1961			
Share of refugees in 1950	-0.337**	-0.441***	-0.573***	-0.607***	-0.261	-0.294**	-0.449***	-0.472***
	(0.158)	(0.154)	(0.128)	(0.103)	(0.181)	(0.145)	(0.119)	(0.101)
N	523	523	519	472	523	523	519	472
F-Stat	45.863	24.747	23.145	27.484	45.863	24.747	23.145	27.484
	Panel D: Service employment: $\pi^S_{rt} - \pi^S_{r1933}$							
	1933-1950				1933-1961			
Share of refugees in 1950	0.146	0.307**	0.228**	0.188**	-0.007	0.271**	0.202*	0.143
	(0.091)	(0.121)	(0.115)	(0.094)	(0.087)	(0.129)	(0.121)	(0.111)
N	523	523	519	472	523	523	519	472
F-Stat	45.863	25.204	23.145	27.484	45.863	25.204	23.145	27.484
	Panel E: GDP per capita growth: $\ln y_{rt} - \ln y_{r1935}$							
	1935-1950				1935-1961			
Share of refugees in 1950	-0.400	0.221	0.341	-0.003	-0.671	0.208	0.517	0.471
	(0.608)	(0.621)	(0.621)	(0.518)	(0.616)	(0.349)	(0.331)	(0.299)
N	523	523	519	472	519	519	515	468
F-Stat	45.863	23.799	23.145	27.484	45.897	24.072	23.293	27.898
	Panel F: Growth of industrial plants: $\ln N_{rt} - \ln N_{r1933}$							
	1933-1950				1933-1956			
Share of refugees in 1950	-0.290	1.675**	1.553**	1.851***	1.449	1.583	2.097**	2.567***
	(0.689)	(0.726)	(0.774)	(0.409)	(1.068)	(1.080)	(1.012)	(0.705)
N	520	520	519	472	520	520	519	472
F-Stat	45.377	25.658	23.145	27.484	45.377	25.658	23.145	27.484
State FE	✓	✓	✓	✓	✓	✓	✓	✓
Pop. density (1939)		✓	✓	✓		✓	✓	✓
Wartime destr.		✓	✓	✓		✓	✓	✓
Geography		✓	✓	✓		✓	✓	✓
Levels of dep. variable		✓	✓	✓		✓	✓	✓
Pre-war controls			✓	✓			✓	✓
Addtl. pre-war controls				✓				✓

Note: Robust Standard errors in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. The dependent variables are population growth (Panel A), changes in sectoral employment shares (Panels B - D), income per capita growth (Panel E) and the growth in the number of industrial plants (Panel F). The various specifications control for the share of destroyed housing stock ("Wartime destr."), the distance to the inner german border and a fixed effect for whether a county is a border county ("Geography"), the respective dependent variable in levels in the pre-war period ("Levels of dep. variable"), all six dependent variable in levels in the pre-war period in Panels A-F ("Pre-war controls") and the population share in cities with less than 2000 inhabitants in 1939, population density in 1933, the manufacturing share in 1933 and the GDP share in manufacturing and agriculture in 1935 ("Addtl. pre-war controls"). The share of refugees is instrumented with the population-weighted distance to the expulsion regions (see (1)) interacted with state fixed effects.

Table A-13: IV Results (Table 6): Estimates with Robust Standard Errors

	Base-line	Labor supply	Constr. activity	City × state FE	Excl. Bavaria	1946 Ref. share	1946 sample
				Panel A: Population growth: $\ln L_{r1950} - \ln L_{r1939}$			
Share of refugees in 1950	1.413***	1.232***	1.501***	1.410***	1.489***		1.258*
	(0.347)	(0.383)	(0.329)	(0.354)	(0.272)		(0.730)
Share of refugees in 1946						1.368	
						(0.975)	
				Panel B: Manufacturing employment: $\pi^M_{r1950} - \pi^M_{r1939}$			
Share of refugees in 1950	0.295**	0.171	0.273**	0.291**	0.455***		0.115
	(0.123)	(0.148)	(0.121)	(0.122)	(0.157)		(0.205)
Share of refugees in 1946						0.126	
						(0.277)	
				Panel C: Agricultural employment: $\pi^A_{r1950} - \pi^A_{r1933}$			
Share of refugees in 1950	-0.576***	-0.240	-0.416***	-0.570***	-0.260**		-0.774***
	(0.166)	(0.157)	(0.141)	(0.175)	(0.117)		(0.276)
Share of refugees in 1946						-0.866**	
						(0.397)	
				Panel D: Service employment: $\pi^S_{r1950} - \pi^S_{r1933}$			
Share of refugees in 1950	0.229	0.135	0.154	0.226	-0.037		0.518*
	(0.201)	(0.202)	(0.175)	(0.206)	(0.171)		(0.302)
Share of refugees in 1946						0.563	
						(0.410)	
				Panel E: GDP per capita growth: $\ln y_{r1950} - \ln y_{r1935}$			
Share of refugees in 1950	0.404	0.796	0.125	0.183	0.460		0.617
	(0.670)	(0.674)	(0.672)	(0.578)	(0.870)		(0.986)
Share of refugees in 1946						0.563	
						(1.190)	
				Panel F: Growth of industrial plants: $\ln N_{r1950} - \ln N_{r1933}$			
Share of refugees in 1950	1.767***	1.381**	1.687***	1.831***	0.752		1.658*
	(0.592)	(0.556)	(0.551)	(0.596)	(0.699)		(0.980)
Share of refugees in 1946						2.563*	
						(1.421)	
State FE	✓	✓	✓	✓	✓	✓	✓
ln pop dens 1939	✓	✓	✓	✓	✓	✓	✓
Wartime destr.	✓	✓	✓	✓	✓	✓	✓
Geography	✓	✓	✓	✓	✓	✓	✓
Pre-war controls	✓	✓	✓	✓	✓	✓	✓

Note: Standard errors at clustered at the level of 37 administrative units (*Regierungsbezirke*). *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. See main text for details on the different specifications. All specification control for state fixed effects, log population density in 1939, the extent of wartime destruction, the log distance of the inner german border and a dummy if a county is at the inner german border and the level of respective dependent variable in 1939.

Table A-14: IV Results in 1950 (Table 6): Robustness

	Base-line	Labor supply	Constr. activity	City × state FE	Excl. Bavaria	1946 Ref. share	1946 sample
				Panel A: Population growth: $\ln L_{r1961} - \ln L_{r1939}$			
Share of refugees in 1950	1.821***	1.852***	1.450***	1.689***	1.369**		2.153**
	(0.597)	(0.644)	(0.526)	(0.477)	(0.581)		(1.060)
Share of refugees in 1946						2.235	
						(1.530)	
				Panel B: Manufacturing employment: $\pi^M_{r1961} - \pi^M_{r1939}$			
Share of refugees in 1950	0.219	0.214*	0.166	0.202	0.422***		0.111
	(0.134)	(0.122)	(0.138)	(0.138)	(0.164)		(0.186)
Share of refugees in 1946						-0.029	
						(0.278)	
				Panel C: Agricultural employment: $\pi^A_{r1961} - \pi^A_{r1933}$			
Share of refugees in 1950	-0.449***	-0.283**	-0.243	-0.456**	-0.200		-0.767***
	(0.173)	(0.142)	(0.163)	(0.180)	(0.167)		(0.269)
Share of refugees in 1946						-0.766*	
						(0.408)	
				Panel D: Service employment: $\pi^S_{r1961} - \pi^S_{r1933}$			
Share of refugees in 1950	0.203	0.098	0.117	0.217	-0.039		0.533*
	(0.218)	(0.184)	(0.189)	(0.227)	(0.172)		(0.299)
Share of refugees in 1946						0.623	
						(0.414)	
				Panel E: GDP per capita growth: $\ln y_{r1961} - \ln y_{r1935}$			
Share of refugees in 1950	0.530**	0.602**	0.283	0.473**	-0.065		0.971**
	(0.266)	(0.234)	(0.272)	(0.225)	(0.460)		(0.383)
Share of refugees in 1946						0.437	
						(0.724)	
				Panel F: Growth of industrial plants: $\ln N_{r1956} - \ln N_{r1933}$			
Share of refugees in 1950	2.332***	2.541**	1.863**	2.125***	0.411		2.378
	(0.816)	(1.016)	(0.780)	(0.733)	(1.326)		(1.527)
Share of refugees in 1946						3.090	
						(2.078)	
State FE	✓	✓	✓	✓	✓	✓	✓
ln pop dens 1939	✓	✓	✓	✓	✓	✓	✓
Wartime destr.	✓	✓	✓	✓	✓	✓	✓
Geography	✓	✓	✓	✓	✓	✓	✓
Pre-war controls	✓	✓	✓	✓	✓	✓	✓

Note: Standard errors at clustered at the level of 37 administrative units (*Regierungsbezirke*). *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. See main text for details on the different specifications. All specification control for state fixed effects, log population density in 1939, the extent of wartime destruction, the log distance of the inner german border and a dummy if a county is at the inner german border and the level of respective dependent variable in 1939.

Table A-15: IV Results in 1961 (Table 6): Robustness

	Manufac. share		Ag. share	Growth: 1933 - 39		
	(1933)	(1939)	(1933)	Population	Man. share	Plants
Share of refugees (1950)	-0.005	-0.150	-0.037	0.205	-0.163**	0.352
	(0.108)	(0.114)	(0.134)	(0.320)	(0.070)	(0.328)
ln pop dens 1939	✓	✓	✓	✓	✓	✓
Wartime destr.	✓	✓	✓	✓	✓	✓
Geography	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓
N	523	535	523	523	522	504
R^2	0.559	0.489	0.691	0.092	0.142	0.084

Note: Standard errors are clustered at the level of 37 *Regierungsbezirke*. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. In columns 1 - 3 the dependent variables are the manufacturing employment share in 1939 and 1933 and the agricultural employment share in 1933. In columns 4 - 6 the dependent variables are population growth, the change in the manufacturing share and the growth rate of the number of plants between 1933 and 1939.

Table A-16: Pre-trends

Tables 5 and 6. In Table A-17 I therefore address this concern by controlling for pre-war population density and pre-war urbanization in very flexible way. In particular, I include fixed effects for 20 quantiles of the distribution of population density in 1939, population density in 1933 and the county-level share of urbanization, i.e. the share of population living large cities. Hence, this specification includes 60 fixed effects to control for population density and the urban configuration of the county. For parsimony I focus on the three outcomes I also use for my structural estimation: population growth, changes in the manufacturing employment share and income per capita. All specifications also include the controls present in my main specification, i.e. state FE, the extent of war-time destruction and the initial level of respective dependent variable. For each outcome I report both the short-run and the long-run effect. Table A-17 shows that even this level of saturation leaves the relationship between refugee inflows and subsequent growth unchanged - the estimates are statistically indistinguishable from my baseline results reported in Table 5.

A-2.4.4 Evidence across Bavarian villages

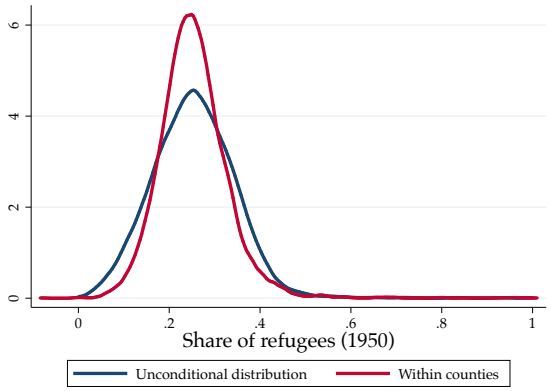
In Table 7 in the main text I analyzed the relationship between the allocation of refugees and subsequent population growth and industrialization across 6000 communities within counties in Bavaria. In Figure A-10 I display the cross-sectional distribution of the local refugee share across villages. The red line shows the overall variation, the blue line shows the the variation within counties, i.e. after taking out a full set of county fixed effects. The local heterogeneity in the absorption of refugees across villages is very large even within counties. This is consistent with the historical narrative that the abruptness of the refugee arrival combined with dire political and economic situation in the immediate post-war period did not allows for a more equitable distribution of refugees across space.

Table 7 in the main text showed that the relationship between the share of refugees in 1950 and economic outcomes in 1961 across villages is substantially weaker than the one across counties. I now

	Pop. growth		Manufac. growth		Income growth	
	1939-50	1939-61	1939-50	1939-61	1935-50	1935-61
Share of refugees in 1950	1.435***	1.175***	0.320***	0.247***	0.012	0.677***
	(0.103)	(0.180)	(0.072)	(0.089)	(0.380)	(0.180)
State FE	✓	✓	✓	✓	✓	✓
ln pop density 1939	✓	✓	✓	✓	✓	✓
Wartime destr.	✓	✓	✓	✓	✓	✓
Geography	✓	✓	✓	✓	✓	✓
Lagged dep. variable	✓	✓	✓	✓	✓	✓
FE for 1939 pop density	✓	✓	✓	✓	✓	✓
FE for 1933 pop density	✓	✓	✓	✓	✓	✓
FE for 1939 urbanization	✓	✓	✓	✓	✓	✓
N	513	513	522	522	523	519
R^2	0.855	0.530	0.443	0.420	0.593	0.917

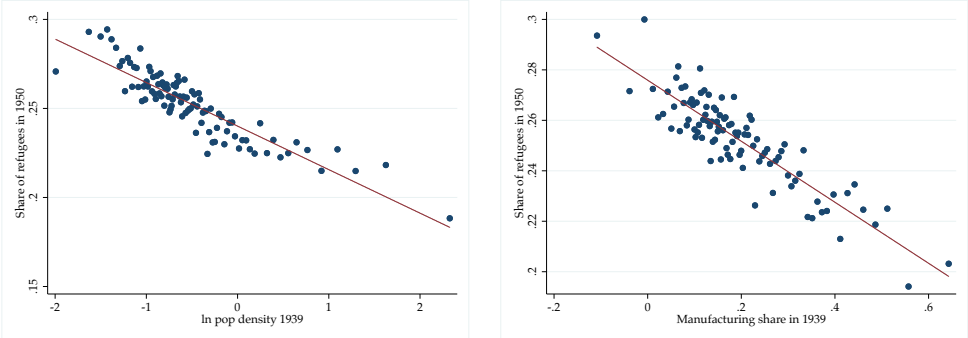
Note: Standard errors are clustered at the level of 37 *Regierungsbezirke*. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. All specifications control for state fixed effects, population density in 1939, the share of wartime destruction, the distance to the inner-german border, a dummy for whether a county is directly at the border and 20 fixed effects for the respective 5% quantiles of population density in 1933, population density in 1939 and the share of the population living in cities with less than 2000 people.

Table A-17: The Role of Pre-war Population Density and Urbanization

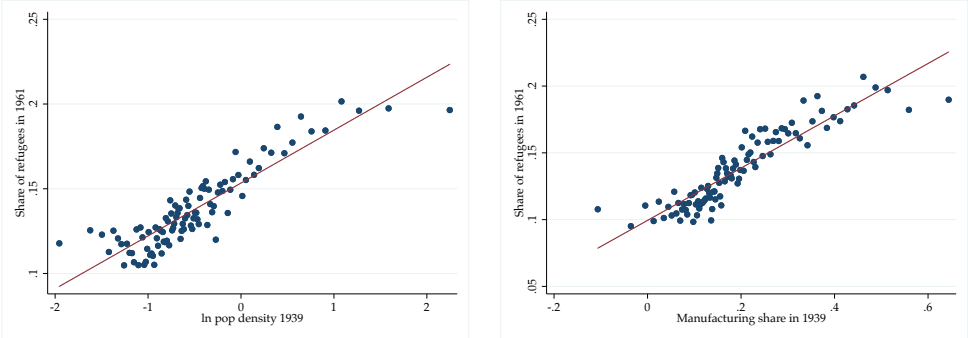


Notes: The figure shows the distribution of the local refugee share across 6000 villages in Bavaria in 1950. The unconditional distribution is shown by the red line. The blue line depicts the residual variation within counties after controlling for county fixed effects.

Figure A-10: The Initial Allocation of Refugees Within and Across Counties



(a) Refugees and Pre-War Economic Development: 1950



(b) Refugees and Pre-War Economic Development: 1961

Notes: The figure shows binned scatter plots for 100 percentiles of the refugee share in 1950 against population density and the manufacturing employment share in 1950 and 1961 after controlling for county fixed effects.

Figure A-11: Refugees' Spatial Mobility Towards Urban Centers: 1950-1961

show that this "attenuation" is consistent with a relatively high degree of spatial mobility between villages. To see this, consider Figure A-11. In the upper panel I show the within-county correlation between the share of refugees in 1950 and local population density in 1939 (left panel) and the share of manufacturing employment in 1939 (right panel). As expected, there is a strong negative correlation because - like in the allocation across counties - refugees were initially sent to rural villages. In the lower panel I show the exact same plot using the share of refugees in 1961. Strikingly, the correlations are now positive. This is exactly what one would expect if refugees were to move within their counties to locations, whose employment structure is less agriculturally specialized.

To see this behavior more closely, consider Table A-18. In the first three columns I regress population growth between 1950 and 1961 on the initial share of refugees. The relationship is strongly negative indicating a substantial degree of mean reversion in population growth. To see that this mean version if special to refugees, in column 2 I control for population density in 1939 and population size in 1950. Hence, holding population size and population growth constant, if this growth is due to refugee inflows (as opposed to other sources of population growth), population growth is lower in the subsequent period. This is exactly what one would expect if the refugees were initially "misplaced".

To see that this "misplacement" is to a large extent driven by rural villages, in column 3 I allow

	Population growth 1950-61			Share of refugees (1961)	
Share of refugees (1950)	-1.010***	-0.681***		0.405***	
	(0.104)	(0.051)		(0.023)	
Share of refugees × 1939 pop dens. qtile 1			-0.774***		0.357***
			(0.051)		(0.023)
Share of refugees × 1939 pop dens. qtile 2			-0.794***		0.360***
			(0.051)		(0.023)
Share of refugees × 1939 pop dens. qtile 3			-0.653***		0.411***
			(0.058)		(0.024)
Share of refugees × 1939 pop dens. qtile 4			-0.611***		0.433***
			(0.064)		(0.027)
Share of refugees × 1939 pop dens. qtile 5			-0.434***		0.532***
			(0.072)		(0.028)
County FE	✓	✓	✓	✓	✓
ln Population 1950		✓	✓	✓	✓
Pop. dens. 1939		✓	✓	✓	✓
N	6046	6018	6018	5948	5948
R^2	0.193	0.374	0.384	0.468	0.484

Note: Standard errors are clustered at the county level. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. "pop dens quintile x" is a dummy variable for the xth quantile of the population density in 1939.

Table A-18: Spatial mobility within counties: 1950-1961

the effect of refugee-induced population growth to differ by initial population density (which I capture through five quantiles). A clear pattern emerges. The extent of mean revision is particularly strong in the most rural locations as the refugees are particularly eager to leave these locations. This result is also corroborated in the last two columns. The overall correlation between the local share of refugees is positive but - compared to the one across counties - small. In the last column, I allow this correlation to depends on the pre-war population density. As expected, the autocorrelation of the local refugee share is much lower in the least dense villages compared to the more urban location within counties.

A-2.4.5 An Alternative IV strategy

This sections contains the details of an alternative IV strategy to estimate (2). Table 4 showed that the local housing supply as measured by the local population density and the extent or war-time destruction was an important determinant of the inflow of refugees. The share of refugees is also correlated with another aspect of the local housing supply: the average number of rooms. The reason why the number of rooms within natives' houses was an important determinant of the allocation of refugees is that initially many refugees were housed *within* the apartments of natives whenever spare rooms were available. While a family of four was often forced to accept refugees into their three bed-room apartment, this was less the case if only 2 bedrooms were available. This margin of housing supply was, however, only tapped into when other options to house refugees were exhausted. Hence, the average size of existing houses was a more important determinant of refugee flows the higher the

	Full Sample		low ED	large ED	Full Sample
Avg num of rooms (rooms/apt)	0.034***	0.039***	0.033***	0.010	1.019*
	(0.010)	(0.010)	(0.011)	(0.009)	(0.585)
Avg rooms * Exp. Dist.					-0.074
					(0.044)
State FE	✓	✓	✓	✓	✓
ln Expulsion Distance		✓	✓	✓	✓
ln pop dens 1939	✓	✓	✓	✓	✓
Wartime destr.	✓	✓	✓	✓	✓
Geography	✓	✓	✓	✓	✓
Prewar Industrial Structure	✓	✓	✓	✓	✓
N	522	522	267	255	522
R^2	0.797	0.805	0.705	0.832	0.809

Note: Standard errors are clustered at the level of 37 *Regierungsbezirke*. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. The regression is at the county level. "Share of housing stock damaged" is the share of the housing stock, which was damaged during the war. "Avg num of rooms" denotes the average number of rooms per house within the county. "ln Expulsion Distance" denotes the distance to the expulsion regions (see (1)). "Avg rooms * Exp. Dist." denotes the interaction between "ln Expulsion Distance" and "Avg num of rooms". "Multiroom share * Exp. Dist" denotes the interaction between "ln Expulsion Distance" and "Share of apts with more than 4 rooms". Column 4 (5), indicated by "low ED" ("large ED") conditions on counties, whose expulsion distance is below (higher than) the median of the expulsion distance distribution. All specification control for state fixed effect, log population density in 1939, the extent of wartime destruction, the manufacturing employment share in 1939 and 1933, the log distance of the inner german border and a dummy if a county is at the inner german border.

Table A-19: The Allocation of Refugees, the Expulsion Distance and the Size of Houses

potential of a given county to receive refugee inflows. Because this potential was particularly high for counties geographically close to the expulsion regions, I expect the *interaction* between the average house size and the distance to the expulsion regions to be a predictor of refugee flows.

In A-19 I show this is the case. Columns 1 and 2 shows that the average number of rooms positively predicts the share of refugees. In column 3 I restrict the sample to counties, which are geographically close to the expulsion regions. Specifically, I consider all counties, whose expulsion distance is below the median of the observed distribution. For these counties, average house size remains an important predictor of refugees inflows. In contrast, column 4 shows that for counties far away from the expulsion regions (i.e. whose distance exceeds the median distance) the local housing stock is not a predictor of refugee inflows. Hence, the existence of marginal rooms is particularly important in counties, which are close to the expulsion regions and which therefore receive a large refugee inflow. In the last column I focus on this interaction effect directly: larger houses as measured by the average room size or the share of apartment with more than four rooms, are better predictors for refugee inflows the closer the county is to the expulsion regions. However, this differential trend is only significant just below the 10% level.

These patterns can be used as an alternative instrument variable strategy. Under the assumption that regions with small and large houses are not affected *differentially* by their geographical location after the war, the *interaction* between the distance to the expulsion regions and average room size is a valid instrument for the allocation of refugees. As for the baseline specification I rely on the variation within states, i.e. I instrument the share of refugees with the interactions of average room size, the distance to the expulsion regions and state fixed effects. In Table A-20 I report the results of this IV strategy. The table has the same structure as the baseline results in Table 6, i.e. I consider

all six outcomes, both in the short- and the long-run for a variety of specifications. While the results are noticeably less precisely estimated, this alternative strategy delivers roughly the same qualitative patterns as local growth in population, manufacturing employment, GDPpc and the number of plants is increasing in the allocation of refugees. In contrast to the main results, this strategy points to a reallocation between manufacturing and services rather then agriculture.

A-2.5 Identification and Estimation

In this section I provide further details on the identification and the estimation of the model. I first describe the construction of the different moment reported in Table 9. Then I discuss how these moments identify particular parameters of interest. In Section A-2.5.3 I describe in more detail how I estimate the the german division and the loss of market access.

A-2.5.1 Moments and Estimation

As highlighted in Table 9, I use 17 moments to estimate the model. These are:

1. Local income growth (as in (2))

$$\ln y_{rt} - \ln y_{r1935} = \delta_s + \beta_t^y \mu_{r1950} + \alpha \ln y_{r1935} + \phi \ln \ell_{r1939} + \varphi \text{wd}_r + \tau \text{dist}_r + u_r$$

   for $t = 1950, 1961$ and 1980.

2. Local manufacturing growth (as in (2))

$$\pi_{rt}^M - \pi_{r1939}^M = \delta_s + \beta_t^M \mu_{r1950} + \alpha \pi_{r1939}^M + \phi \ln \ell_{r1939} + \varphi \text{wd}_r + \tau \text{dist}_r + u_r$$

   for $t = 1950$ and 1961.

3. Local population growth (as in (2))

$$\ln L_{rt} - \ln L_{r1939} = \delta_s + \beta_t^\ell \mu_{r1950} + \phi \ln \ell_{r1939} + \varphi \text{wd}_r + \tau \text{dist}_r + u_r$$

   for $t = 1950, 1961$ and 1980.

4. Local population growth between 1950 and 1955

$$\ln L_{r1955} - \ln L_{r1950} = \delta_s + \beta_{55}^{popgr} \mu_{r1950} + \phi \ln \ell_{r1939} + \varphi \text{wd}_r + \tau \text{dist}_r + u_r$$

5. The correlation of the local refugee share within states

$$\mu_{rt} = \delta_s + \beta_t^\mu \mu_{r1950} + u_r$$

	Panel A: Population growth: $\ln L_{rt} - \ln L_{r1939}$							
	1939-1950				1939-1961			
Share of refugees in 1950	1.900***	1.500***	1.195***	1.397***	1.059***	0.936**	0.382	1.074***
	(0.310)	(0.220)	(0.218)	(0.225)	(0.388)	(0.435)	(0.353)	(0.330)
N	526	526	509	463	526	526	509	463
F-Stat	314.434	18.190	13.102	10.811	291.597	16.855	12.593	10.560
	Panel B: Manufacturing employment: $\pi^M_{rt} - \pi^M_{r1939}$							
	1939-1950				1939-1961			
Share of refugees in 1950	0.208	0.398**	0.435***	0.459***	0.112	0.119	0.149	0.108
	(0.163)	(0.180)	(0.160)	(0.116)	(0.140)	(0.189)	(0.150)	(0.124)
N	535	535	519	472	535	535	519	472
F-Stat	300.672	20.505	16.034	11.409	300.672	20.505	16.034	11.409
	Panel C: Agricultural employment: $\pi^A_{rt} - \pi^A_{r1933}$							
	1933-1950				1933-1961			
Share of refugees in 1950	-0.243	0.011	0.432	-0.116	-0.352	0.126	0.596*	0.062
	(0.353)	(0.349)	(0.343)	(0.313)	(0.443)	(0.338)	(0.340)	(0.312)
N	523	523	519	472	523	523	519	472
F-Stat	292.630	28.035	16.034	11.409	292.630	28.035	16.034	11.409
	Panel D: Service employment: $\pi^S_{rt} - \pi^S_{r1933}$							
	1933-1950				1933-1961			
Share of refugees in 1950	-0.258	-0.687***	-0.690***	-0.409*	0.036	-0.377	-0.432*	-0.073
	(0.247)	(0.231)	(0.226)	(0.224)	(0.326)	(0.291)	(0.256)	(0.234)
N	523	523	519	472	523	523	519	472
F-Stat	292.630	26.116	16.034	11.409	292.630	26.116	16.034	11.409
	Panel E: GDP per capita growth: $\ln y_{rt} - \ln y_{r1935}$							
	1935-1950				1935-1961			
Share of refugees in 1950	-1.214	-0.185	-1.149	-0.366	0.286	1.490*	0.746	1.678**
	(0.991)	(1.536)	(1.360)	(1.137)	(1.761)	(0.840)	(0.723)	(0.695)
N	523	523	519	472	519	519	515	468
F-Stat	292.630	21.928	16.034	11.409	332.517	22.248	16.455	12.058
	Panel F: Growth of industrial plants: $\ln N_{rt} - \ln N_{r1933}$							
	1933-1950				1933-1956			
Share of refugees in 1950	0.539	1.090	1.679*	2.001**	2.504	5.255**	3.679**	4.469***
	(1.201)	(0.737)	(1.007)	(0.955)	(2.704)	(2.335)	(1.656)	(1.503)
N	520	520	519	472	520	520	519	472
F-Stat	289.260	21.302	16.034	11.409	289.260	21.302	16.034	11.409
State FE	✓	✓	✓	✓	✓	✓	✓	✓
Pop. density (1939)		✓	✓	✓		✓	✓	✓
Wartime destr.		✓	✓	✓		✓	✓	✓
Geography		✓	✓	✓		✓	✓	✓
Levels of dep. variable		✓	✓	✓		✓	✓	✓
Pre-war controls			✓	✓			✓	✓
Addtl. pre-war controls				✓				✓

Note: Standard errors are clustered at the level of 37 *Regierungsbezirke*. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. The dependent variables are population growth (Panel A), changes in sectoral employment shares (Panels B - D), income per capita growth (Panel E) and the growth in the number of industrial plants (Panel F). The various specifications control for the share of destroyed housing stock ("Wartime destr."), the distance to the inner german border and a fixed effect for whether a county is a border county ("Geography"), the respective dependent variable in levels in the pre-war period ("Levels of dep. variable"), all six dependent variable in levels in the pre-war period in Panels A-F ("Pre-war controls") and the population share in cities with less than 2000 inhabitants in 1939, population density in 1933, the manufacturing share in 1933 and the GDP share in manufacturing and agriculture in 1935 ("Addtl. pre-war controls"). The share of refugees is instrumented with the population-weighted distance to the expulsion regions (see (1)) interacted with state fixed effects and the average number of rooms per house in each county. All specifications also control for the main effects of the average number of rooms per house and the population-weighted distance to the expulsion regions interacted with state fixed effects.

Table A-20: The Effects of Refugee Inflows on the Local Economy: An Alternative IV Strategy

for $t = 1955$ and 1961 as also shown in Figure 3.

6. The effect of distance to the East on long-run GDP growth

$$\ln y_{r1961} - \ln y_{r1935} = \delta_s + \tau^y_{61}\text{dist}_r + \beta^y_t \mu_{r1950} + \alpha \ln y_{r1935} + \phi \ln \ell_{r1939} + \varphi \text{wd}_r + u_r$$

These are 12 moments that stem directly from regression estimates that exploit the regional variation in refugee in flows

$$\Omega = \left(\underbrace{\beta^y_{50}, \beta^y_{61}, \beta^y_{80}}_{\text{GDP}}, \underbrace{\beta^M_{50}, \beta^M_{61}}_{\text{Man share}}, \underbrace{\beta^\ell_{50}, \beta^\ell_{61}, \beta^\ell_{80}, \beta^{popgr}_{55}}_{\text{Population}}, \underbrace{\beta^\mu_{55}, \beta^\mu_{61}}_{\text{Refugee correlation}}, \underbrace{\tau^y_{61}}_{\text{Distance}} \right).$$

I summarize these results in Table A-21.

In addition, I use five additional moments for identification. In particular, I target

1. the share of migrants that move within states. More specifically, let S denote the set of states with a typical element s. Consider county $r \in S$. The total number of outflows from region r are given by

$$\text{Total outflows from } r = \psi \sum_{v=F,I} \left[L^\nu_{rt-1} \left(1 - \frac{(V_r \overline{w}^\nu_{rt}/\Psi_r)^\varepsilon}{\sum_{k=1}^R \left(\mu_{rk} V_k \overline{w}^\nu_{kt}/\Psi_k\right)^\varepsilon} \right) \right],$$

where Ψ_r denotes the price index in region r. The total outflows that end up in the same state are given by

$$\text{Total outflows from } r \text{ within the same state} = \psi \sum_{v=F,I} \left[L^\nu_{rt-1} \frac{\sum_{j \in s(r)} \left(\mu_{rj} V_j \overline{w}^\nu_{jt}/\Psi_j\right)^\varepsilon}{\sum_{k=1}^R \left(\mu_{rk} V_k \overline{w}^\nu_{kt}/\Psi_k\right)^\varepsilon} \right],$$

where $j \in s(r)$ denotes the set of counties, which are in the same state as county r. Hence, I target the moment

$$\text{Within-state migration share} = \frac{\sum_{v=F,I} \sum_{r=1}^R \left[L^\nu_{rt-1} \frac{\sum_{j \in s(r)} \left(\mu_{rj} V_j \overline{w}^\nu_{jt}/\Psi_j\right)^\varepsilon}{\sum_{k=1}^R \left(\mu_{rk} V_k \overline{w}^\nu_{kt}/\Psi_k\right)^\varepsilon} \right]}{\sum_{v=F,I} \sum_{r=1}^R \left[L^\nu_{rt-1} \left(1 - \frac{(V_r \overline{w}^\nu_{rt}/\Psi_r)^\varepsilon}{\sum_{k=1}^R \left(\mu_{rk} V_k \overline{w}^\nu_{kt}/\Psi_k\right)^\varepsilon} \right) \right]}. \tag{A-7}$$

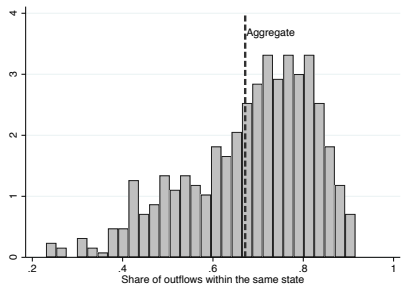
This moment is helpful to discipline the extent to which migration costs rise in distance. Empirically, the aggregate share is given by 0.67. In Figure A-12 I show the distribution of this statistic across counties.

2. the average earnings premium in manufacturing relative to agriculture. This object is sometimes

	GDP pc growth			Δ Manufac share		Pop. growth				Share of refugees	
	35-50	35-61	35-80	39-50	39-61	39-50	39-61	39-80	50-55	1955	1961
Share of refugees (1950)	-0.083	0.502**	0.201	0.317***	0.241***	1.359***	1.029***	1.041*	-0.342***	0.735***	0.586***
	(0.382)	(0.227)	(0.198)	(0.074)	(0.086)	(0.112)	(0.211)	(0.521)	(0.071)	(0.033)	(0.044)
log distance		0.090									
		(0.058)									
State FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ln pop dens 1939	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Wartime destr.	✓	✓	✓	✓	✓	✓	✓	✓	✓		
log GDPpc 1935	✓	✓	✓								
Manufac. share 1939				✓	✓						
Population 1939						✓	✓	✓			
Geography	✓	✓	✓	✓	✓	✓	✓	✓	✓		
N	523	519	329	535	535	526	526	331	526	536	504
R^2	0.511	0.889	0.919	0.390	0.352	0.825	0.299	0.228	0.756	0.859	0.726

Note: Standard errors are clustered at the level of 37 *Regierungsbezirke*. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. See main text for details on the different specifications.

Table A-21: Moments for Quantitative Analysis



Notes: The figure shows the distribution of the share of outflows that remain within the same state.

Figure A-12: Migration: Share of outflows that remain within the same state

also referred to as the "agricultural productivity gap" (Gollin et al., 2014). In the model it is calculated as

$$\frac{\overline{w}_M}{\overline{w}_A} = \frac{\sum_r w_{rMt} H_{rMt} / \sum_r L^M_{rt}}{\sum_r w_{rAt} H_{rAt} / \sum_r L^A_{rt}}, \tag{A-8}$$

where the sectoral labor supply H_{rst} is given by $H_{rst} = \sum_\nu L^\nu_{rt} \phi^\nu_s \left(w_{rst}/\overline{w}^\nu_{rt}\right)^{\theta-1}$ and L^s_{rt} denotes the number of people working in sector s. As a target a I rely on a number of 1.5, which is consistent with the results reported in Gollin et al. (2014).

3. the relative wage of refugees relative to natives in 1961, which in the model I define as

$$\beta^{w,Ref} = \ln\left(\frac{\text{avg earnings}^{Refugee}}{\text{avg earnings}^{Natives}}\right).$$

Empirically, I rely on micro data from the EVS and estimate a Mincer-type regression of log earnings on demographics and a dummy for whether or not the individual is a refugee, i.e.

$$\ln earnings_i = \alpha + \beta^{w,Ref} \times Refugee_i + x_i'\xi + u_i \tag{A-9}$$

where x_i contains a set of age and education dummies. Empirically I find an estimate of $\beta^{w,Ref} = -0.075$ with a standard error of 0.007.

4. the dispersion of GDP pc at the regional level from the regression

$$\ln y_{rt} = \alpha_r + \beta^\varrho \ln y_{rt-1} + v_{rt}, \tag{A-10}$$

which I run for the years 1957, 1961, 1964 and 1966. Here α_r is a county fixed effect so that this specification mirrors the structural productivity process for $\mathcal{Q}_{rt}$. I run the same specification in the model-generated data and target the dispersion in the estimated residuals, i.e. $sd\left(\hat{v}_{rt}\right)$. Empirically I find that $sd\left(\hat{v}_{rt}\right) = 0.041$.

5. an elasticity of trade flows with respect to distance of -1.29 as reported in Monte et al. (2018).

I parametrize the trade costs as a power function of the geographic distance, i.e. $\tau_{rj} = \tau_0 d_{rj}^{\zeta}$. Suppose that the distance within a location is given by d^{min}. Hence, $\tau_{rr} = \tau_0 \left(d^{min}\right)^{\zeta}$. Setting $\tau_{rr} = 1$ yields $\tau_{rj} = \left(d_{rj}/d^{min}\right)^{\zeta}$. In practice, I take d^{min} to be the 5% quantile of the observed distances across regions.

Given these moments, I construct my criterion function as

$$\begin{aligned}\mathscr{M} \quad = \quad & \sum_{m\in\Omega} \left(m_{Model} - m_{Data}\right)^2 + \left(sd\left(\hat{v}_{rt}\right)^{Model} - sd\left(\hat{v}_{rt}\right)^{Data}\right)^2 + \left(\left(\beta^{w,Ref}\right)^{Model} - \left(\beta^{w,Ref}\right)^{Data}\right)^2 \\ & + \left(\frac{\text{Ag-prod gap}^{Model} - \text{Ag-prod gap}^{Data}}{\text{Ag-prod gap}^{Data}}\right)^2 + \left(\frac{\text{State-share}^{Model} - \text{State-share}^{Data}}{\text{State-share}^{Data}}\right)^2,\end{aligned}$$

and estimate the parameters by minimizing $\mathscr{M}$ through a search of Sobol grid points.[46]

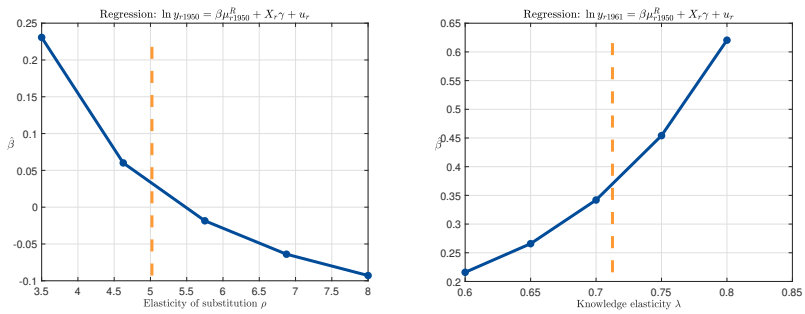
A-2.5.2 Identification

Even though all parameters are estimated jointly, there is still a tight link between particular moments and parameters. I now discuss this link for the main parameters of interest.

Growth & Scale: ρ and λ The the two scale parameters ρ and λ are mostly identified from the short-run and the long-run relationship between refugee inflows and GDP per capita. The lower ρ, the more potent the static agglomeration force and the higher the impact of the inflow of refugees on income per capita in the short-run. If ρ is large, the effects of locally decreasing returns through the agricultural sector and elastic demand dominate and the effect of refugee inflows on GDP per capita is negative. The relationship between refugee inflows and long-run GDP per capita is increasing in λ, as λ amplifies the strength of the dynamic agglomeration force. This intuition is contained in Figure A-13, where I report the estimated regression coefficients as function of ρ (left panel) and λ (right panel). Both moments are monotone in the respective parameters. The higher ρ, the lower the short-run scale elasticity. This tends to reduce the effect of refugee inflows on GDP pc, making it eventually negative. The right panel shows the relationship between refugee inflows and GDP per capita in 1961. As expected, this relationship is increasing in λ.

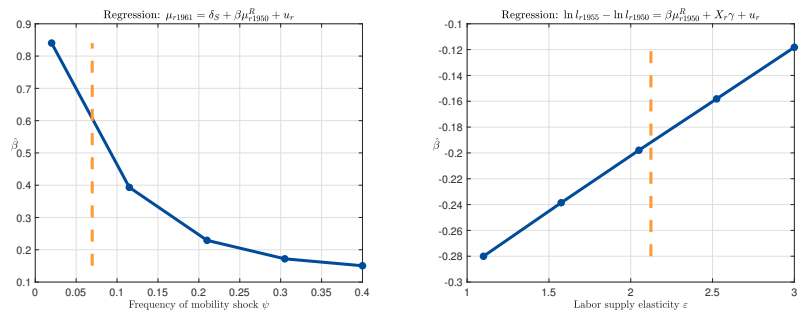
Spatial Mobility: ε, ψ, β and κ The Calvo parameter ψ governs the extensive margin of population mobility. It is mostly identified from the autocorrelation of refugee shares because the higher ψ, the faster will the distribution of refugees mimic the ones of natives, i.e. regions with an initial "excess" of refugees revert quickly to the mean.In particular, if $\psi = 1$, the model predicts that the share of refugees should be equalized across space within a single period if moving costs η_{rj} were constant across regions of origin. In the left panel of Figure A-14 I report the regression coefficient

[46] Note that, by choice of $\xi = 1.29/(\sigma - 1)$, my model matches the distance elasticity exactly.



Note: The figure shows the regression coefficient β_t from specifications 1 and 2 of Table A-21 for different values of ρ (left panel) and λ (right panel). All other structural parameters are held constant. The estimated parameters are depicted as the orange dashed line.

Figure A-13: Identification of ρ and λ



Note: The left panel shows the regression coefficient β_t from specifications 11 of Table A-21 for different choices of ψ. The right panel shows the regression coefficient β_t from specifications 9 of Table A-21 for different choices of ε. All other structural parameters are held constant. The estimated parameters are depicted as the orange dashed line.

Figure A-14: Identification of ψ and ε

as a function of ψ holding all other parameters constant. As expected, there is a strong negative relationship.

The parameter ε is mostly identified from the correlation between the initial refugee allocation and subsequent population growth. If ε is small, this initial allocation is not very well aligned with individuals' idiosyncratic tastes and we would expect a strong negative correlation between the refugee share in 1950 and subsequent growth. This is the case as shown in the right panel of Figure A-14.

The migration costs are parametrized as a function of distance: $\eta_{rj} = \left(\frac{d_{rj}}{d^{min}}\right)^{-\kappa}$. Hence, the higher κ the more are migration costs increasing in distance. The parameter κ is thus informed by the share of outflows, which are within the state of a given a county (see equation (A-7)). Finally, the congestion parameter of amenities β governs the long-run relationship between refugee inflows and population growth and is thus informed by β^{ℓ}_{80}.

Skill distribution: ϕ^I_M, ϕ^I_A and χ To estimate the average human capital of industrialists in the manufacturing and the agricultural sector, ϕ^I_M and ϕ^I_A and the share of industrialists χ, I use three sets of moments. First of all, I target the relationship between refugee inflows and the expansion

of the local manufacturing sector both in 1950 and in 1961. The lower ϕ_A^I, the more will industrialist natives sort towards urban areas. The inflow of refugees will therefore trigger a larger increase in the local manufacturing sector. Secondly, I target the "agricultural productivity gap" as defined in (A-8). Holding ϕ_A^I fixed, the parameter ϕ_M^I increases relative human capital of industrialists in the manufacturing sector and hence the measured agricultural gap. Finally, I exploit differences in earnings between refugees and natives at the micro-level. In addition to the regional effects of refugee inflows on the manufacturing share, spatial sorting also matters for relative earnings. Without skill heterogeneity, there would be no differential sorting between refugees and natives by skill. With skill heterogeneity, industrial workers among natives sort towards regions, which are specialized in non-agricultural production and which offer higher wages. In contrast, refugees are not sorted upon their arrival but only sort gradually. The parameter χ is therefore an additional important determinant of the relative earnings between natives and refugees. Empirically, refugees earn about 7.5% less than natives on average - see Table A-21

Spatial fundamentals $[\mathcal{Q}_r, \mathcal{A}_r, \mathcal{T}_r]$ and the agricultural expenditure share α To estimate the spatial fundamentals, I assume that the economy is in a steady-state in 1933 and calibrate $[\mathcal{Q}_r, \mathcal{A}_r, \mathcal{T}_r]$ by matching the population distribution $\{L_{r1933}\}_r$, the sectoral employment shares $\{s^M_{r1933}\}_r$ and income per capita $\{y_{r1933}\}_r$. Formally, for a given set of structural parameters, there is a one-to-one mapping between the three fundamentals and the three moments for each region and the agricultural expenditure share α. Note also that the steady-state implies a particular endogenous distribution of the number of varieties N_{r1933} and the extent of spatial sorting, i.e. the allocation of industrial types ω^I_{r1933} across counties. In Section AR-1.4 in the Online Appendix I describe this mapping in more detail.

A-2.5.3 The German Division and the Loss of Market Access: Details

To incorporate the loss of market access in my calibrated model, I use the following procedure. A location in my model is fully characterized by the tree dimensional tupel $(\mathcal{Q}_r, \mathcal{T}_r, \mathcal{A}_r)$ and its distance to all other locations. Moreover, given the other structural parameters, the three fundamentals $(\mathcal{Q}_r, \mathcal{T}_r, \mathcal{A}_r)$ are fully determined from data on the manufacturing employment share π_r^M, the total population L_r and income per capita y_r. I model the "East" as an additional $R+1$th location. To measure its distance I take the midpoint from GIS. I directly measure the total population and the manufacturing share in 1933. Finally, I model income per capita in the east as being proportion to income per capital in the West, i.e.

$$y_{33}^{East} = \eta \times y_{33}^{West}$$

and take the factor of proportionality η as a structural parameter that I estimate as part of the Sobol grid. In my theory I model the division as a prohibitive increase in trade and mobility costs in 1945. The moment that most closely maps to η is the elasticity between income growth and the distance of the inner german border. Intuitively, the higher η, the richer the East and the larger the relative

income loss, counties that were close to the East experience after the division.

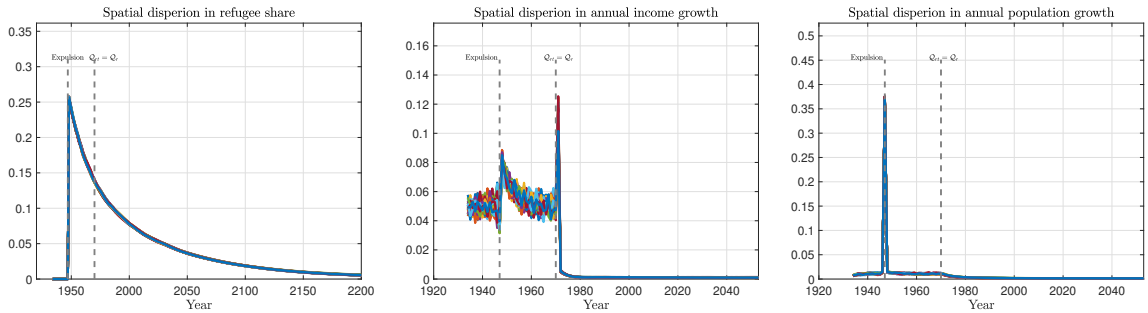
A-2.6 The Implications of Path Dependence

As discussed in the main text, at the estimated parameters my model features persistence. Hence, the long-run outcome of the model might depends on the particular history of shocks the different localities experienced. In this section I discuss the implications of this feature in more detail. In particular, I show that the model converges to a steady state eventually but that these steady-states depend on the history of shocks. To quantify the importance of path dependence at the aggregate level, I then study a parametrization of my model that does not feature path dependence because of large dispersion forces on the labor supply side. Specifically, this model features a lower value for the supply elasticity ε and a higher value of the congestion in amenities β but the same production function parameters λ and ρ.

Convergence and Path Dependency To see that my model converges to a steady state, consider the following exercise: take 50 histories of local productivity $[\mathcal{Q}_{rt}]$ between 1933 and 2200 with the following feature: they all start at the respective long-run level in 1933, i.e. $\mathcal{Q}_{r1933} = \mathcal{Q}_r$, and after 1970, productivity is constant and again given by $\mathcal{Q}_{rt} = \mathcal{Q}_r$. Hence, these different histories only differ in that the sequence of shocks between 1933 and 1970 were different. If the model converges to a steady state, the share of refugees should be equalized across regions. Moreover, the annual growth rates in GPD pc and population should be zero for each location and hence also equalized.

In Figure A-15 I depict the cross-sectional dispersion in the share of refugees (left panel), annual GDP pc growth (middle panel) and annual population growth (right panel) for each of the 50 histories. Hence, each figure contains 50 lines. For each outcome I measure dispersion as the difference between 90% and 10% quantile of the respective variable. If the model converges to a steady state, all lines should go to zero in the long-run.

As seen in Figure A-15, this is indeed the case. Consider first the share of refugees in the left panel. The cross-sectional dispersion spikes up at the time of the expulsion in the late 1940s and subsequently declines. Note that this pattern is almost identical across all 50 histories so that the different lines are virtually on top of each other. Because there is no innate difference between refugees and natives conditional on their type, the dynamics of the refugee share are very long-lived and it takes almost 200 years for the refugee shares to be fully equalized across space. In the middle panel I show the dispersion in annual income growth. Prior to 1970 the dispersion is sizable due to productivity shocks. At the time of the expulsion the dispersion increases because of decreasing returns and scale effects. Once the exogenous productivity is constant after 1970, the dispersion in income growth converges to zero for each of the 50 sample paths. The right panel shows that this is also the case of local population growth. Expectedly, the population inflow at the time of the expulsion generates vast regional differences in population growth. Once productivity is constant, the economy converges to a steady-state for each of the 50 different histories. Note also that the



Note: The left panel shows the cross-sectional dispersion in the share of refugees. The middle (right) panel shows the cross-sectional dispersion of annual growth rates in income pc (population). I always measure the cross-sectional dispersion as the difference between 90% and 10% quantile of the respective variable. Each plot contains 50 lines for the 50 different sample paths. The sample path differ in the history of productivity shocks $\mathcal{Q}_{rt}$ between 1933 and 1970. Starting in 1970, local productivity $\mathcal{Q}_{rt}$ is set to its long-run value $\mathcal{Q}_r$ and constant over time.

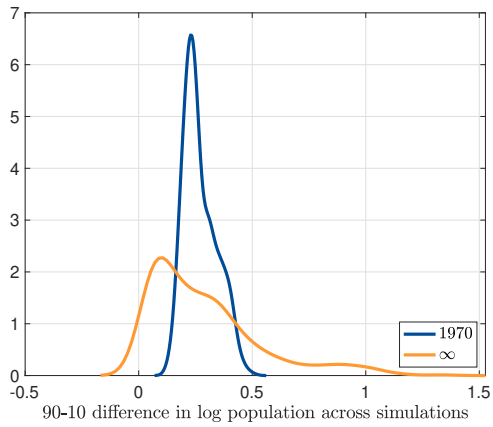
Figure A-15: Stationarity of the Model

convergence in population and income growth is much faster than for the share of refugees and hence I depict them on different x-axis.

Even though the model converges to a steady state for each sample path, this steady state might not necessarily be the same across sample paths. If the steady-states are different, the model features path dependence in the sense of Allen and Donaldson (2020): shocks that occurred in the past have permanent consequences. To see this is the case at the estimated parameters of my model, let $l_{rt}^{(h)}$ denote the population in region r at time t in history $h = 1, 2, ...50$. Recall that each history only differs in the shocks that occurred between 1933 and 1970. Let q_{rt}^{90} and q_{rt}^{10} denote the 90% and 10% quantile of $l_{rt}^{(h)}$ across histories h for region r at time t. Let $d_{rt} = q_{rt}^{90} - q_{rt}^{10}$. Hence, d_{rt} is a measure of how different the population in region r at time t could be, given the different realizations of shocks between 1933 and 1970.

In Figure A-16 I depict the density of this measure in 1970 in blue and in the steady state in orange. Consider first the blue line. The fact that d_{r70} is between 0.1 and 0.5 means that across 50 different productivity realizations, most locations could experience differences in size between 0.1 and 0.5 log points. If these differences were only driven by the particular realizations of shocks, we would expect this density to collapse in the long-run. Figure A-16 shows that this is not the case. In particular, the distribution shows more dispersion on both sides: some regions experience less variation in population size across histories in the long-run, some regions experience more. The fact that $d_{r\infty}$ is not 0 for all location is an example of path dependence: different realization of shocks between 1933 and 1970 lead to different long-run outcomes.

Aggregate Implications To gauge the quantitative importance of the path dependency shown in Figure A-16, I compare this calibration with a different parametrization of the model that features no persistence. Persistence is more likely to occur if local agglomeration forces are large (i.e. λ is large and ρ is small) and dispersion forces are small (i.e. ε is large and β is small). Because I am



Note: Let $l_{rt}^{(h)}$ denote the population in region r at time t in history h. Let q_{rt}^{90} and q_{rt}^{10} denote the 90% and 10% quantile of $l_{rt}^{(h)}$ across histories h for region r at time t. Let $d_{rt} = q_{rt}^{90} - q_{rt}^{10}$. The figure shows the distribution of d_{r1970} across locations in blue and the steady-state distribution $d_{r\infty}$ in orange.

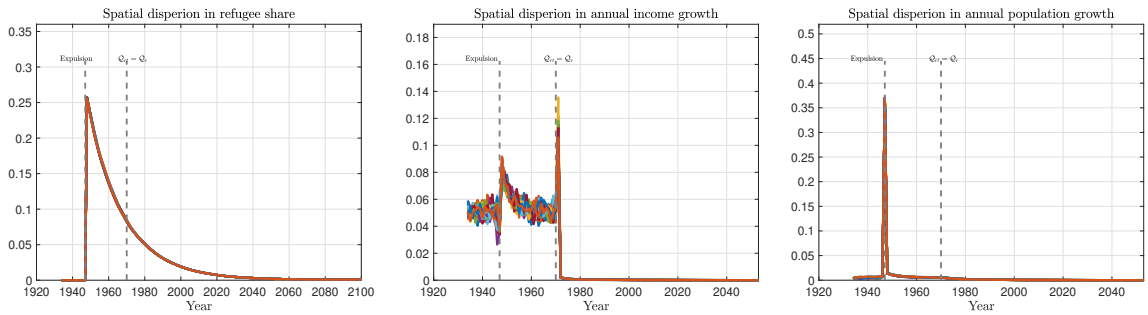
Figure A-16: Long-run Persistence

mostly interested in the implications for aggregate GDP, I leave the technological parameters λ and ρ unchanged and only increase the amenity congestion externality β from its estimated value 0.25 to 0.8 and reduce the spatial labor supply elasticity ε from 2.1 to 1.

Figures A-17 and A-18 contain the analogues to Figures A-15 and A-16 for this parametrization of the model. The left panel of Figure A-18 shows that this model does not feature path dependence: whereas the population distribution in 1970 has more dispersion than in the baseline model, the long-run distribution is the same for all histories of shocks.[47] Figure A-17 shows that this model generates much more convergence in the local population - the distribution of refugees is essentially equalized by 2050 and hence a century earlier than in the calibrated model. Finally, in the right panel of Figure A-18 I show that this model implies that the semi-elasticity between population growth and the initial refugee share is sharply declining and essential equal to its long-run level of around 0.2 by the year 2000. This is in stark contrast to the data, which showed a semi-elasticity of around 1 in the late 1990s.

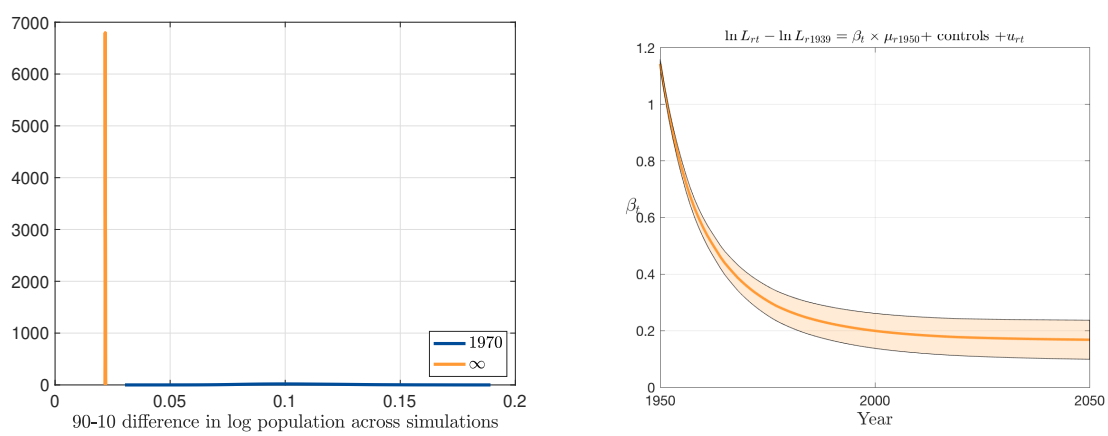
To see whether the aggregate consequences of the inflow of refugees depends on the existence of path dependence in an important way, in Figure A-19 I compare the aggregate GDP impact of the refugee inflow in the calibrated model (orange line at the top) with the model with higher dispersion forces (grey line at the bottom). The calibrated model implies a somewhat larger aggregate impact. This is due to the fact that the lower dispersion forces make workers more sensitive to regions with higher wages (because the spatial labor supply elasticity ε is large) and allow for more agglomeration (because the amenity congestion elasticity β is small). Quantitatively, however, the aggregate impact is broadly similar: the model with higher dispersion forces shaves off 1 or 2 percentage points at the

[47] The fact that $d_{r\infty}$ has a point mass at 0.01 rather than 0 is a consequence of numerical imprecision: across all sample paths, the 90-10 difference in the long-run population is equal to 0.01.



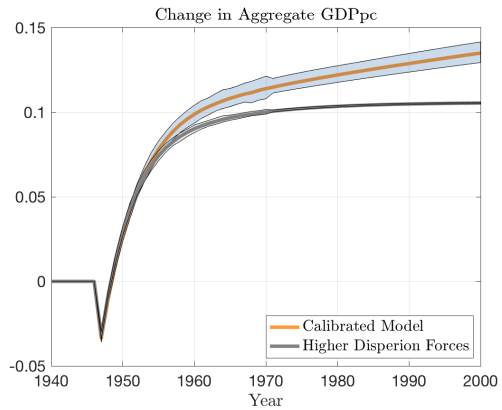
Note: The left panel shows the cross-sectional dispersion in the share of refugees. The middle (right) panel shows the cross-sectional dispersion of annual growth rates in income pc (population). I always measure the cross-sectional dispersion as the difference between 90% and 10% quantile of the respective variable. Each plot contains 50 lines for the 50 different sample paths. The sample path differ in the history of productivity shocks $\mathcal{Q}_{rt}$ between 1933 and 1970. Starting in 1970, local productivity $\mathcal{Q}_{rt}$ is set to its long-run value $\mathcal{Q}_r$ and constant over time.

Figure A-17: Stationarity of the Model without Persistence



Note: Let $l_{rt}^{(h)}$ denote the population in region r at time t in history h. Let q_{rt}^{90} and q_{rt}^{10} denote the 90% and 10% quantile of $l_{rt}^{(h)}$ across histories h for region r at time t. Let $d_{rt} = q_{rt}^{90} - q_{rt}^{10}$. The left panel of the figure shows the distribution of d_{r1970} across locations in blue and the steady-state distribution $d_{r\infty}$ in orange. The right panel show the coefficients of a regression of local productivity growth on the share of refugees.

Figure A-18: No Persistence



Note: The figure shows the change in the local manufacturing employment share (right panel), relative to an allocation without refugee inflows, for the historical allocation (orange) and a counterfactual allocation policy that equalizes the initial share of refugees across counties.

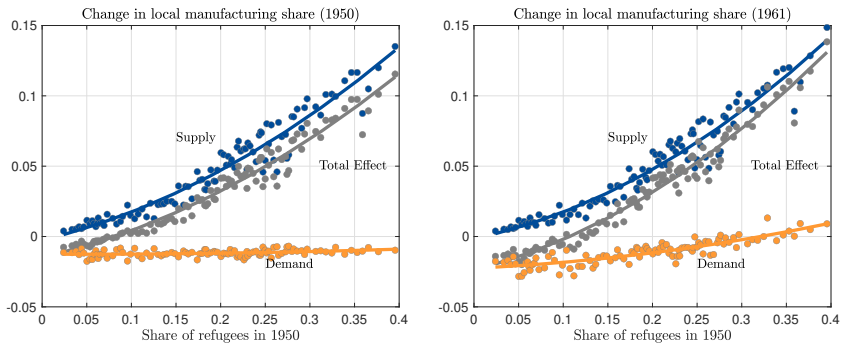
Figure A-19: Aggregate GDP Impact: Baseline Model versus Model without Path Dependence

horizon of four to five decades.

A-2.7 The Spatial Consequences of Refugee Inflows: Supply vs Demand

In Figure 7 in the main text I decomposed the impact of refugee inflows on local income per capita into a supply and demand component. Figure 7 is constructed in the following way: First I calculate the equilibrium path in the baseline calibration with the inflow of refugees. Then I calculate the counterfactual equilibrium in the absence of refugee flows. From these two allocations, I can calculate the total spatial impact on manufacturing employment and income per capita. I then decompose this total impact into a demand and supply component using the following procedure. Take region r and calculate an equilibrium path where refugees only arrive in region r. The difference between this equilibrium path and the path without any refugee flows is the supply component for region r. Now take again region r and calculate an equilibrium path where refugees arrive in all regions but region r. The difference between this equilibrium path and the path without any refugee flows is the demand component for region r. Doing this for all regions in the sample allows me to calculate the supply and demand effects for all locations.

Manufacturing Employment While Figure 7 focused on income per capita, in Figure A-20 I report the same decomposition for the local manufacturing share. First of all note that an increase in the manufacturing employment share does not necessarily go hand-in-hand with an increase in income per capita if local technology accumulates slowly. In the short-run, the manufacturing sector absorbs the rising population for a given level of technology. This reduces productivity due to selection as the marginal manufacturing worker is worse than the average worker. To see this directly, suppose



Note: The figure shows the spatial impact on the local manufacturing employment share in 1950 (left row) and 1961 (right row) as binned scatter plots for 100 percentiles of the refugee share in 1950. In each case it displays the total effect, the supply effect (i.e. if refugees had only arrived in the particular region) and the demand effect (i.e. if refugees had only arrived in all other regions).

Figure A-20: The Impact of Refugee Inflows on Local Manufacturing Employment: Demand vs Supply

for simplicity that there is no type heterogeneity and that production labor H_{rPt} is proportional to the total labor force in the manufacturing sector H_{rMt}. Letting π_{rMt} denote the employment share in the manufacturing sector, total sectoral output per manufacturing worker is given by[48]

$$\frac{Y_{rMt}}{L_{rt}\pi_{rMt}} \propto \mathcal{Q}_{rt} N_{rt-1}^{\lambda\vartheta} \phi_M^{\frac{1+\vartheta}{\theta}} \underbrace{L_{rt}^{\vartheta}}_{\text{Spatial scale}} \underbrace{\pi_{rMt}^{\frac{\vartheta(\theta-1)-1}{\theta}}}_{\text{Sectoral scale}} .$$

This expression highlights the divergence between local scale L_{rt} and sectoral scale π_{rMt}. While a bigger population L_{rt} increases output per workers due to the static agglomeration forces encapsulated in the short-run scale elasticity ϑ, the effect of a bigger employment share on output per worker depends on the relative strength between agglomeration forces and the deterioration of average human capital through selection. In particular, a higher employment share in manufacturing reduces output per worker in the manufacturing sector if $\vartheta < \frac{1}{\theta-1}$, i.e. if the short-run scale elasticity ϑ is small relative to the dispersion in sector-specific efficiency units. According to my estimates, this inequality is satisfied. In the long-run, a larger manufacturing labor force obviously triggers entry and hence an upward shift in the labor demand schedule through the dynamic increase in N_{rt}.

Furthermore, Figure A-20 showed that the cross-sectional variation in manufacturing employment and income per capita is almost entirely driven by the supply side. To see more clearly why this is the case, consider a special case of the model where (i) region r is small relative to the rest of economy and (ii) labor is homogenous $\left(\phi_j^F = \phi_j^I\right)$ and perfectly substitutable across sectors ($\theta \to \infty$). The first feature implies that local demand is dissociated from local factor prices. The second simplifies

[48] Recall that (8) implies that $Y_{rMt} = \varsigma_2 \mathcal{Q}_{rt} N_{rt-1}^{\lambda\vartheta} H_{rPt}^{1+\vartheta}$ and that (in the absence of type heterogeneity) the total supply of manufacturing human capital is given by $H_{rMt} = \Gamma_\theta L_{rt} \phi_M^{\frac{1}{\theta}} \pi_{rMt}^{\frac{\theta-1}{\theta}}$ (see (A-6)). If $H_{rPt} \propto H_{rMt}$, which will be the case along the spatial BGP, output per manufacturing worker $\frac{Y_{rMt}}{L_{rt}\pi_{rMt}}$ is given by the expression in the main text.

the algebra by abstracting from within-region substitution across industries. As I show in detail in Section AR-1.2 in the Online Appendix, the model then implies that (close to a balanced growth path), local market size H_{rPt} is given by

$$H_{rPt} = \varsigma \pi_{rMt} \times \underbrace{L_{rt}}_{\text{Supply}} \quad \text{where} \quad \pi_{rMt} = h\left(\underbrace{\frac{N_{rt-1}^{(\sigma-1)\lambda\vartheta}}{T_r^{(\sigma-1)(1-\gamma)}}}_{\text{Dynamic CA}} \times \underbrace{L_{rt}^{(\vartheta+(1-\gamma))(\sigma-1)}}_{\text{Supply}} \times \underbrace{\frac{\mathcal{D}_{rM}}{\mathcal{D}_{rA}}}_{\text{Demand}} \right), \tag{A-11}$$

the function $h(.)$ is strictly increasing and $\mathcal{D}_{rj} = \alpha_j \sum_m \tau_{rm}^{1-\sigma} \overline{P}_{mjt}^{\sigma-1} Y_{mt}$.

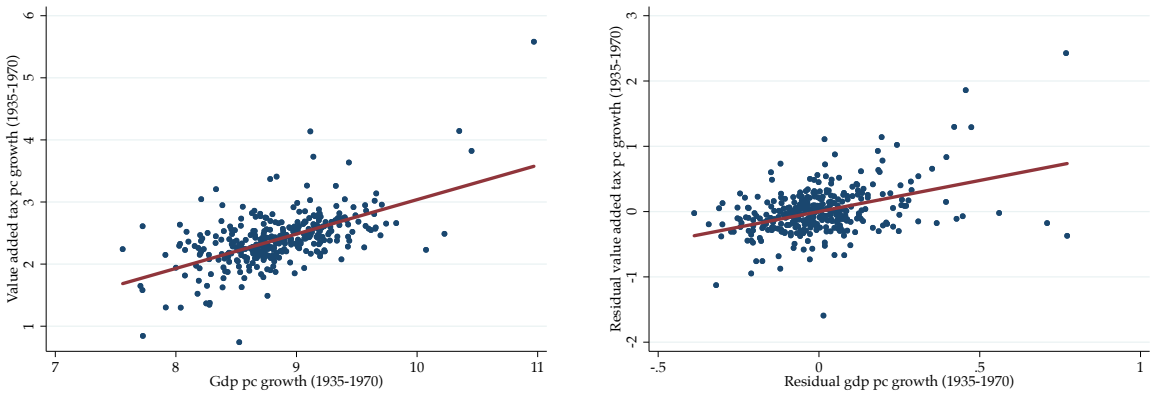
Equation (A-11) highlights why local labor supply plays a dominant role for the local creation of varieties and for the manufacturing employment share. For a given manufacturing employment share π_{rMt}, local market size is directly proportional to local labor supply L_{rt}. Thus, population inflows cause local productivity growth. In addition, π_{rMt} is endogenously determined and depends on three objects. First, it depends on the region's comparative advantage, which is governed by the existing productivity in manufacturing N_{rt-1} (see (8)) relative to the endowment of land T_r. Second, local labor supply L_{rt} has a direct effect on sectoral employment, because the agricultural sector is subject to decreasing returns while manufacturing has increasing returns. If both sectors were to operate under constant returns to scale technologies, $\gamma = 1$ and $\vartheta = 0$ and π_{rMt} would be independent of L_{rt}. Finally, relative aggregate demand affects $\mathcal{D}_{rM}/\mathcal{D}_{rA}$ affects local market size through its effect on "market access". If demand for manufacturing goods from region r increases, and the manufacturing share s_{rMt} goes up and with it the creation of local varieties. The same intuition is also true in the general model. Imperfect substitution across sectors induces an upward sloping sector supply curve and if region r is not infinitesimal, local demand $\mathcal{D}_{rM}/\mathcal{D}_{rA}$ depends directly on the size of the population L_{rt}. However, as seen in Figure A-20, the main determinant of local manufacturing market size is the local population.

A-2.8 Robustness of Quantitative Results

In this section I perform two robustness checks to my quantitative results.

The first concerns the measurement of income per capita. As highlighted in the main text, I could not find direct data on GDP pc in 1950. As a substitute I had to rely on a measure of value added taxes. This naturally raises the question whether the discrepancy between the small short-run and the larger long-run effects is due to these differences in measurement. To address this problem, I collected data on value added taxes in the post-war period. The only year where I could find this information was for 1970. Because I also have data for GDPpc in 1970, I can compare implied elasticities with respect to refugee inflows.

In Figure A-21 I display the correlation between income per capita growth measured by GDP pc in 1970 (x-axis) and regional growth measured by value added in 1970 (y-axis). In the left panel I



Note: The left panel shows the raw correlation between income growth measured by GDPpc and value added taxes per capita. The right panel shows the residual correlation after controlling for state fixed effects and $\ln y_{r1935}$.

Figure A-21: Local Income Growth: GDP versus Value Added Taxes

report the raw correlation, in the right panel I report the residual correlation after controlling for state FE and the level of log value added per capita in 1939. While the correlation is robustly positive, the relationship is quite noisy.

In Table A-22 I report a set of specifications similar to the ones reported in Table 5, i.e.

$$\ln y_{rt} - \ln y_{r1935} = \delta_s + \beta\mu_{r1950} + \alpha \ln y_{r1935} + \phi \ln \ell_{r1939} + \varphi \mathrm{wd}_r + x_r'\zeta + u_r,$$

where $\ln y_{rt}$ denotes income per capita in region r at time t, l_{r1939} is population density in 1939, wd_r is the extent of wartime destruction and x_r is a set of control variables. In columns 1 - 4 estimate the semi-elasticity of refugee inflows on income per capita growth (as measured by GDPpc) for the years between 1966 and 1974. The relationship is positive, significant and quantitatively very similar to the semi-elasticity in 1961 reported in Table 5. In the last column I use value added taxes per capita in 1970. In contrast to the GDPpc data the coefficient is small, imprecisely estimated and not statistically significantly different from zero. This discrepancy between the value added and income per capita data highlights that the estimated income per capita response in 1950 is likely to be less reliable as a moment than many of the other moments I employ.

The second concerns my treatment of refugees' human capital endowment. For my baseline model I assumed the parameters $\left(\chi, \phi_M^I, \phi_A^I\right)$ to be common across groups. While this is in line with the empirical finding that refugees and natives had a similar distribution of educational attainment (see Table 3), one might expect refugees to have less human capital than natives. First, given the reliance on agricultural employment in the Eastern Territories, the quality of education might be lower. Second, and more importantly, to the extent that refugees' skills were only partly transferable across regions, we would expect refugees' human capital to be less efficient.

I therefore extended the model to allow for a sector neutral shifts in the human capital distribution

	GDPpc growth				Growth in va taxes pc
	1935-66	1935-70	1935-72	1935-74	1935-70
Share of refugees in 1950	0.404*	0.453**	0.498***	0.456**	0.034
	(0.228)	(0.180)	(0.173)	(0.171)	(0.411)
State FE	✓	✓	✓	✓	✓
ln pop dens 1939	✓	✓	✓	✓	✓
Wartime destr.	✓	✓	✓	✓	✓
Geography	✓	✓	✓	✓	✓
$\ln y_{1935}$	✓	✓	✓	✓	✓
N	329	329	329	329	329
R^2	0.897	0.882	0.898	0.887	0.446

Note: Standard errors are clustered at the level of 37 *Regierungsbezirke*. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. All specifications control for state fixed effects, population density in 1939, the share of wartime destruction, $\ln y_{r1935}$, the distance to the inner-german border and a dummy for whether a county is directly at the inner-german border.

Table A-22: Local Income Growth and Refugees: GDP versus Value Added Taxes

of refugees. Formally, the distribution of refugees' human capital of type ν in sector j is governed by the parameters $k\phi_j^\nu$ where k parametrizes the relative efficiency of refugee human capital (relative to natives). Because these human capital differences are sector neutral, sectoral employment shares conditional on the skill-type ν are still equalized between natives and refugees. However, refugees have lower earnings and refugee inflows lower the average human capital of the local economy.

To analyze whether these considerations affect my baseline estimation, I reestimate my model without using the 1950 GDP response as a moment and in the presence of such human capital differences. Even after adding k as an additional parameter and after dropping the 1950 GDP coefficients as a moment, the model still has more moments than parameters. The results of this exercise are contained in Table A-23. In the first two columns I report the estimated parameters of my baseline model and this alternative specification. In the last three columns I report the implied moments.

Table A-23 shows that the results are very similar to the baseline calibration. There are two reasons for this to be the case. First, the baseline model already successfully replicated the fact that refugees have lower earnings than natives. Hence, it is not surprising that the estimated level of relative human capital k is close to unity. As for the short-run GDP effect: this moment mostly disciplines the elasticity of substitution ρ. However ρ also affects the long-run GDP response and the change in the local manufacturing share. And given that the baseline model replicated the time series of these moments very well, there is no real cost in matching the short-run GDP response. This implies that my results are unlikely to hinge on measuring the short-run response in output precisely.

Structural Parameters			Moments			
	Baseline	Robustness		Data	Baseline	Robustness
ρ	5.020	5.021	Pop growth 39-50	1.359	1.119	1.172
λ	0.713	0.692	Pop growth 39-61	1.029	0.934	0.872
ϕ_A^I	0.839	0.839	Pop growth 39-80	1	0.914	0.834
ϕ_M^I	13.607	13.574	Manuf. growth 39-50	0.317	0.272	0.266
ψ	0.070	0.075	Manuf. growth 39-61	0.241	0.298	0.259
ε	2.123	2.233	Income growth 39-50	-0.083	-0.002	0.001
κ	-1.098	-1.085	Income growth 39-61	0.502	0.358	0.329
ϖ	0.050	0.052	Income growth 39-80	0.201	0.388	0.338
χ	0.586	0.585	Refugee share 1955	0.735	0.763	0.748
β	0.157	0.157	Refugee share 1961	0.586	0.555	0.535
α	0.24	0.24	Pop growth 50-55	-0.342	-0.183	-0.217
y_{33}^{East}	2.438	2.435	Distance and income growth	0.06	0.012	0.014
k	na	1.003	Agricul. prod. gap	1.5	1.517	1.515
			Earnings diff. of refugees	-0.075	-0.073	-0.071
			Share of outflows within states	0.67	0.611	0.624
			Std dev of resid. of inc growth	0.041	0.037	0.037

Note: The table reports the parameters and moments

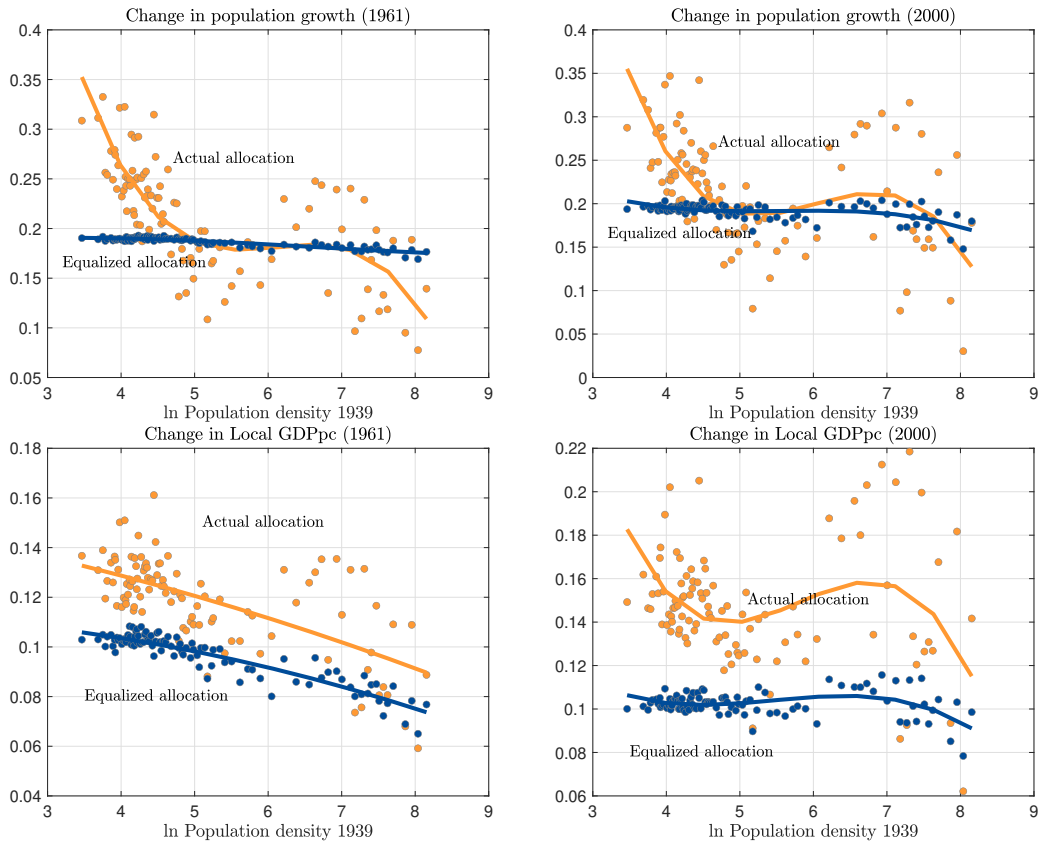
Table A-23: Robustness of Quantitative Results

A-2.9 Persistent Effects of the Historical Allocation Rule: Additional Results

In Section 5.5 I showed that the policy of sending the refugees to predominantly rural counties played an important role for the industrialization process of these communities. If the initial refugee share had been equalized, the expansion of the manufacturing sector in rural communities had been much less pronounced. In this section I offer a more detailed analysis of these two different policies.

Consider first Figure A-22, where I show relative population growth (top row) and income growth (bottom row) as a function of pre-war population density for both the actual allocation (orange) and a counterfactual policy which equalized the local refugee share (blue). All outcomes are relative to a situation where no refugees arrived but the sequence of productivity shocks $\mathcal{Q}_{rt}$ is the same as with the refugee "treatment".

The top row of Figure A-22 shows that the allocation of refugees was an important source of population growth for rural labor markets, both in 1961 and 2000. If the share of refugees had been equalized initially, population growth had been much more balanced. The bottom row of Figure A-22 shows the relative growth in income per capita. Interestingly, and consistent with the findings for local industrialization shown in Figure 8 in the main text, the inflow of refugees would have been pro-rural even in the absence of the pro-rural initial allocation policy. However, this pattern is even more pronounced under the actual allocation. Also note that under both allocation rules some regions with relatively high density (in the range around 7) were large beneficiaries of the refugee inflow, in particular under the actual allocation rule. These regions are - on average - close to the german



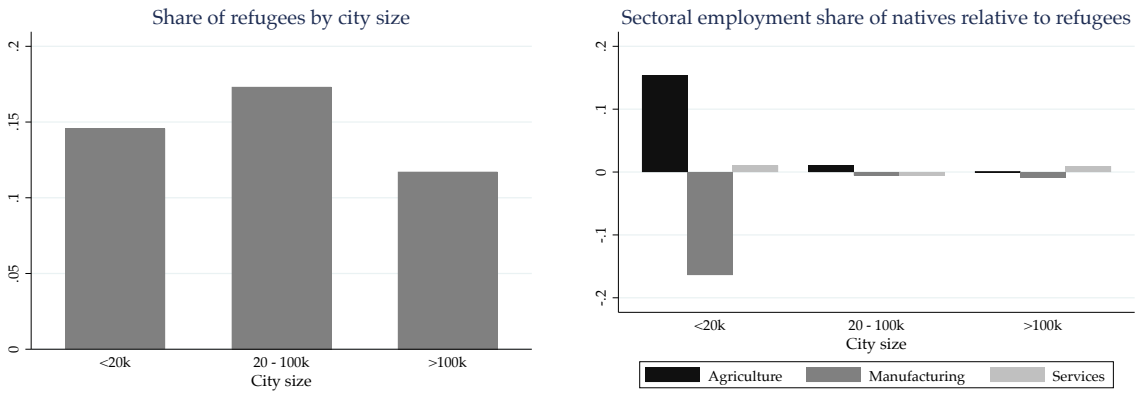
Note: The figure shows local population growth (top row) and local income pc growth (bottom row), relative to an allocation without refugee inflows, for the historical allocation (orange) and a counterfactual allocation policy that equalizes the initial share of refugees across counties.

Figure A-22: Persistent Effects of the Refugee Settlement: Rural Income and Population Growth

border and hence received a large inflow despite their relatively large density. Without the refugee inflow they would have been adversely affected from the loss in market access.

A-2.10 Spatial Sorting: Additional evidence

In Table 10 I presented regression evidence that suggested that the share of industrial workers among refugees exceeded the ones of natives in rural areas. The EVS micro data offer another way to look at the implications of spatial sorting. Recall that the EVS data stems from the year 1962. While this data does not contain identifiers for the specific county individuals live in, they do report the size of the respondent's city. In the left panel of Figure A-23 I report the share of refugee by the size of the city. The spatial distribution of refugees is tilted towards cities in the range of 20-100.000 people. This pattern that refugees leave the very small cities is consistent with the analysis of the Bavarian village-level data, which is contained Section A-2.4.4 in the Appendix. More interestingly, in the right panel I study differences in the sectoral employment share between natives and refugees



Note: The left panel shows the share of refugees by three city size categories in 1962. The right panel shows the relative sectoral employment share $\pi^{Ref}_{rst} - \pi^{Nat}_{rst}$.

Figure A-23: Refugees' relative sectoral employment shares by city size

in cities of different size. Specifically, I show $\pi^{Natives}_{sector,city} - \pi^{Refugee}_{sector,city}$ for the three sectors and the three city size categories. Refugees have a very large comparative advantage in the manufacturing sector in the smallest locations but sectoral employment shares are close to equalized in the larger locations. This pattern is consistent with the results in Table 10 that the initial refugee inflow was particularly biased towards the manufacturing in the most rural locations.

Similarly, one can look at the earnings data. If natives are indeed better spatially sorted than natives, the refugee "discount" should be higher in larger locations that have a comparative advantage in the non-agricultural sector. In Table A-24 I report the results of a cross-sectional regression of log wages on a refugee dummy interacted with a dummy for the city size categories. The first column shows that refugees earn – on average – 7.5% less than natives. This is the overall native premium that is targeted in the main text. In column 3 I now let this effect vary by city size and also control for the main effect of city size. Refugees earn relatively less in larger cities but the effect is noisy. In columns 4 and 5 I show the same specification when I control for a set of six occupation fixed effects. This not only reduces the refugee effect but within occupations, such lower relative earnings accrue entirely in larger cities. Hence, at least qualitatively, the results in Table A-24 and Figure A-23 are consistent with the mechanism of spatial sorting highlighted in my theory.

A-3 A Dynamic Version of the Model

My analysis assumes that workers and firms behave myopically. This assumption simplifies the analysis, especially the structural estimation that hinges on the transitional dynamics of the system, considerably.

In this section I present a full dynamic version of my theory where I allow agents to be forward-looking. In Section A-3.1 I characterize the dynamic equilibrium system. In Section A-3.2 I discuss

	ln income				
Refugee	-0.075***	-0.082***	-0.073***	-0.030***	-0.004
	(0.007)	(0.007)	(0.011)	(0.007)	(0.010)
Refugee × Medium city			-0.020		-0.045**
			(0.020)		(0.019)
Refugee × Large city			-0.013		-0.047***
			(0.016)		(0.015)
Demographics	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓
Occupation FE				✓	✓
Citytype FE		✓	✓	✓	✓
N	23831	23822	23822	23822	23822
R^2	0.111	0.124	0.124	0.251	0.251

Note: Robust standard errors in parenthesis. *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively. All specifications control for state fixed effect and demographics (age, age squared and a male dummy). Specifications with city type fixed effects control for 5 fixed effects of different size categories (<2k, 2-20k, 20-100k, 100-500k, >500k) and 5 fixed effects the type of the city (urban center, urban fringe, industrial zone, agricultural zone and mixed). Specifications with occupation fixed effects control for 10 occupation fixed effects.

Table A-24: Refugee earnings by city size

the main differences between the myopic model and the specification with forward-looking agents. I also characterize the steady state of the forward-looking model and show that the main theoretical implications are qualitatively similar to the model with myopic agents. In Section A-3.3 I discuss how existing approaches in the literature address the problem of computational complexity with forward-looking agents and why these approaches are not applicable in my setting. Finally, in Section A-3.4, I argue why my estimation strategy, which relies on indirect inference, might make the myopic approach less susceptible to the problem of model misspecification.

A-3.1 The Model with Forward-Looking Agents

I now characterize the solution of the model when agents - both workers and firms - are forward-looking.

A-3.1.1 Households

I follow Caliendo et al. (2019) and Desmet et al. (2018) and assume that households do not engage in inter-temporal saving. Hence, the per-period expected consumption utility of an individual of type ν when residing in location r at time t before knowing the realization of her efficiency draws $z^i = \left(z_A^i, z_M^i\right)$ is given by

$$u_{rt}^{\nu} = \frac{\overline{w}_{rt}^{\nu}}{P_{rMt}^{1-\alpha} P_{rAt}^{\alpha}}, \tag{A-12}$$

where, as before, $\overline{w}_{rt}^{\nu} = \left(\phi_A^{\nu} w_{rAt}^{\theta} + \phi_M^{\nu} w_{rMt}^{\theta}\right)^{1/\theta}$.

Given (A-12), I can write the life-time utility of an individual of type ν residing in region r

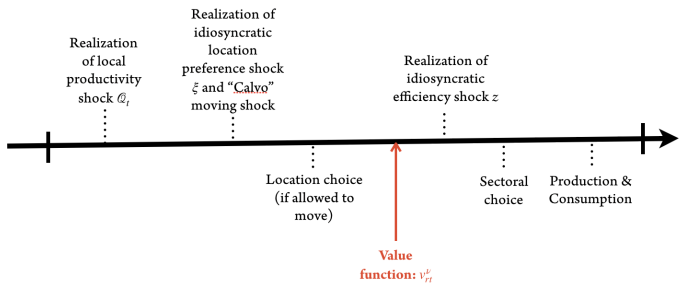


Figure A-24: Timing of Events

recursively. The timing of events is summarized in Figure A-24. Let v^{ν}_{rt} be the value of type ν to reside in region r at time t before the realization of her efficiency draw $z^i = \left(z^i_A, z^i_M\right)$. This value function can be written as

$$v^{\nu}_{rt} = u^{\nu}_{rt}\mathcal{A}_r + (1-\psi)\,\beta E_t\left[v^{\nu}_{rt+1}\right] + \psi\beta E_t\left[\int_{\bar{\xi}} \max_{j\in R}\left\{v^{\nu}_{jt+1} + \xi_j - \eta_{rj}\right\} dF\left(\bar{\xi}\right)\right], \tag{A-13}$$

where - as before - ξ_j denotes the realization of the idiosyncratic shock for location j, $\bar{\xi}$ is the vector of shocks for all locations, η_{rj} denotes the moving costs from r to j and $\mathcal{A}_r$ denotes the amenities in region r. Note that v^{ν}_{rt+1} is a random variable as of time t because wages and prices are stochastic due to the presence of productivity shocks $\mathcal{Q}_{rt}$.

For simplicity I denominate both the moving costs and the idiosyncratic preference shocks in terms of per-period utility so that they enter additively. Under the assumption that ξ_j is distributed iid according to a Type-I Extreme value distribution with variance $1/\varepsilon$, we have that

$$\int_{\bar{\xi}} \max_{j\in R}\left\{v^{\nu}_{jt+1} + \xi_j - \eta_{rj}\right\} dF\left(\bar{\xi}\right) = \frac{1}{\varepsilon}\ln\left(\sum_{j=1}^{R}\exp\left(v^{\nu}_{jt+1} - \eta_{rj}\right)^{\varepsilon}\right). \tag{A-14}$$

Hence, v^{ν}_{rt} solves the recursive equation

$$v^{\nu}_{rt} = u^{\nu}_{rt}\mathcal{A}_r + (1-\psi)\,\beta E_t\left[v^{\nu}_{rt+1}\right] + \psi\beta\frac{1}{\varepsilon}E_t\left[\ln\left(\sum_{j=1}^{R}\exp\left(v^{\nu}_{jt+1} - \eta_{rj}\right)^{\varepsilon}\right)\right]. \tag{A-15}$$

For given parameters and a given stochastic process for utilities $\{u^{\nu}_{rt}\}_{rt\nu}$ (which vary across types ν and locations r) one can solve (A-15) for $\{v^{\nu}_{rt}\}_{rt\nu}$.[49] Given $\{v^{\nu}_{rt}\}_{rt\nu}$ the moving probabilities between

[49]Equation (A-15) highlights why it is convenient to specify both the idiosyncratic preference shocks ξ and the moving costs additively. Under these assumptions, $\int_{\bar{\xi}} \max_{j\in R}\left\{v^{\nu}_{jt+1} + \xi_j - \eta_{rj}\right\} dF\left(\bar{\xi}\right)$ has a the analytic expression given in (A-14). With the multiplicative formulation as in the baseline model, the recursive formulation would be the following. Let k^{ν}_{rt} denote the value of type ν in region r after the productivity shock

periods t and $t+1$ from r to j are given by

$$m^{\nu}_{jrt+1} = \frac{\exp\left(v^{\nu}_{jt+1} - \eta_{rj}\right)^{\varepsilon}}{\sum_l \exp\left(v^{\nu}_{lt+1} - \eta_{rl}\right)^{\varepsilon}}. \tag{A-16}$$

Given these moving probabilities m^{ν}_{jrt+1}, the resulting law of motion for the local population is given by the same equation as in the baseline model

$$L^{\nu}_{rt} = (1-\psi)\, L^{\nu}_{rt-1} + \psi \sum_{j=1}^{R} L^{\nu}_{jt-1} m^{\nu}_{jrt}. \tag{A-17}$$

A-3.1.2 Firms' problem

Let the profits of a manufacturing firm in region r at time t be given by π_{rt}. Note that because of symmetry these profits are equalized across firms within a location. The present discounted value of profits is then given by

$$\Pi_{rt} = \pi_{rt} + E_t\left[\sum_{n=1}^{\infty}\left(\frac{1-\delta}{1+r}\right)^{n}\pi_{rt+n}\right] = \pi_{rt} + \frac{1-\delta}{1+r}E_t\left[\Pi_{rt+1}\right],$$

where r is the exogenous discount rate and δ is the exogenous probability of exit. Free entry requires that

$$\Pi_{rt} = w_{rMt}h^{E}_{rt} = w_{rMt}f_E N^{-\lambda}_{rt-1}.$$

Hence, if the free entry condition holds between t and $t+1$ in region r,

$$w_{rMt}f_E N^{-\lambda}_{rt-1} = \pi_{rt} + \frac{1-\delta}{1+r}E\left[w_{rMt+1}f_E N^{-\lambda}_{rt}\right].$$

Rearranging terms yields

$$1 = \frac{\pi_{rt}}{f_E w_{rMt}}N^{\lambda}_{rt-1} + \frac{1-\delta}{1+r}\frac{1}{f_E}\left(\frac{N_{rt-1}}{N_{rt}}\right)^{\lambda}E\left[\frac{w_{rMt+1}}{w_{rMt}}\right].$$

As in the baseline model, monopolistic competition with constant markups still implies that profits are a constant fraction of aggregate revenue and labor market earnings, i.e. $\pi_{rt} = \frac{1}{\rho-1}\frac{w_{rM}H_{rP}}{N_r}$. Hence, the optimal number of varieties N_{rt} is given by

$$N_{rt} = \frac{1}{f_E}\frac{1}{\rho-1}H_{rPt}N^{\lambda}_{rt-1} + \frac{1-\delta}{1+r}\frac{1}{f_E}N^{\lambda}_{rt-1}N^{1-\lambda}_{rt}E\left[\frac{w_{rMt+1}}{w_{rMt}}\right]. \tag{A-18}$$

$\mathcal{Q}_{rt}$ is realized but before agents had the option to move and before the realization of ξ_j. Then

$$k^{\nu}_{rt} = (1-\psi)\left(u^{\nu}_{rt}\mathcal{A}_{rt} + \beta E_t\left[k^{\nu}_{rt+1}\right]\right) + \psi\int_{\bar{\xi}}\max_j\left(u^{\nu}_{jt}\mathcal{A}_{jt}\xi_j + \beta E_t\left[k^{\nu}_{jt+1}\right]\right)dF\left(\bar{\xi}\right).$$

In contrast to (A-14), $\int_{\bar{\xi}}\max_j\left(u^{\nu}_{jt}\mathcal{A}_{jt}\xi_j + \beta E_t\left[k^{\nu}_{jt+1}\right]\right)dF\left(\bar{\xi}\right)$ does not have an analytical expression.

The equilibrium mass of varieties in region r at time t is therefore given by a function

$$N_{rt} = N\left(\underbrace{H_{rPt}}_{+}, \underbrace{N_{rt-1}}_{+}, \underbrace{\frac{1-\delta}{1+r}E\left[\frac{w_{rMt+1}}{w_{rMt}}\right]}_{+}\right).$$

As in the baseline model, H_{rPt} is still a sufficient static for the level of *contemporaneous* market size. With forward-looking firms, however, the expected growth rate of regional skill prices $E\left[\frac{w_{rMt+1}}{w_{rMt}}\right]$ also matters because these capture the long-run value of the firm, which - because of free entry - is tied to the future entry costs and hence grows at the same rate as the local wage. Finally, again as in the baseline model, N_{rt} is also dependent on N_{rt-1} so that the process of regional productivity features persistence. The solution to (A-18) coincides with the one of the baseline model if $\delta = 1$ or $r \to \infty$.

A-3.1.3 Trade and labor market equilibrium

The trade and labor market equilibrium is similar to the baseline model. Because workers still receive a constant share γ and β of sectoral revenue, aggregate income in region r is still given by $PY_r = \frac{w_{Ar}H_{Ar}}{\gamma} + \frac{\rho}{\rho-1}w_{Mr}H_{rP}$. Hence, the trade market equilibrium is still given by

$$\frac{\rho}{\rho-1}w_{rMt}H_{rPt} = \sum_{j=1}^{R}\left(\frac{\tau_{rj}P_{rMt}}{\overline{P}_{jMt}}\right)^{1-\sigma}(1-\alpha)\left(\frac{w_{jAt}H_{jAt}}{\gamma} + \frac{\rho}{\rho-1}w_{jMt}H_{jPt}\right) \quad \text{(A-19)}$$

$$\frac{w_{rAt}H_{rAt}}{\gamma} = \sum_{j=1}^{R}\left(\frac{\tau_{rj}P_{rAt}}{\overline{P}_{jAt}}\right)^{1-\sigma}\alpha\left(\frac{w_{jAt}H_{jAt}}{\gamma} + \frac{\rho}{\rho-1}w_{jMt}H_{jPt}\right), \quad \text{(A-20)}$$

where $P_{rMt} = \frac{1}{Q_{rt}}\frac{1}{\varsigma}w_{rMt}N_{rt}^{-\frac{1}{\rho-1}}$, $P_{rAt} = \frac{1}{Q_{rt}}w_{rAt}\left(\frac{H_{rAt}}{T_r}\right)^{1-\gamma}$ and $\overline{P}_{jst} = \left(\sum_r(\tau_{rj}P_{rst})^{1-\sigma}\right)^{1/(1-\sigma)}$, where N_{rt} is implicitly determined from (A-18).

Similarly, the labor market clearing conditions are given by

$$H_{rAt} = \Gamma_\theta \sum_{\nu=I,F} L_{rt}^{\nu}(\phi_A^{\nu})\left(\frac{w_{rAt}}{\overline{w}_{rt}^{\nu}}\right)^{\theta-1} \quad \text{(A-21)}$$

$$H_{rPt} + f_E N_{rt-1}^{-\lambda}(N_{rt} - (1-\delta)N_{rt-1}) = \Gamma_\theta \sum_{\nu=I,F} L_{rt}^{\nu}(\phi_M^{\nu})\left(\frac{w_{rMt}}{\overline{w}_{rt}^{\nu}}\right)^{\theta-1}, \quad \text{(A-22)}$$

where, again, N_{rt} is the solution determined by (A-18). Taking $\{L_{rt}^{\nu}\}$ as given, equations (A-19), (A-20), (A-21), (A-22) and (A-18) are $5\times R\times T$ equations in the $5\times R\times T$ unknowns $\{w_{rAt}, w_{rMt}, H_{rAt}, H_{rMt}, N_{rt}\}$. Note that these equations are not independent across periods because N_{rt} depends on w_{rt+1}.

A-3.1.4 Steady state

Consider a stationary equilibrium of this economy. In such an equilibrium both the number of varieties and the local wages are constant. Hence, the number of varieties N_{rt} defined in (A-18) is given by

$$N_{rt} = \left(\frac{\frac{1}{\rho-1}\frac{1}{f_E}}{1 - \frac{1-\delta}{1+r}\frac{1}{f_E}} \right)^{\frac{1}{1-\lambda}} H_{rPt}^{\frac{1}{1-\lambda}}.$$

Hence, compared to (13), the full model with forward-looking agents contains an additional scaling variable $\left(1 - \frac{1-\delta}{1+r}\frac{1}{f_E}\right)^{-1}$ in the denominator. However, the cross-sectional implications are exactly the same as in the baseline model because $N_{rt} \propto H_{rPt}^{\frac{1}{1-\lambda}}$.

A-3.2 The Consequences of the Myopia Assumption

The main conceptual difference between this full dynamic model and the simplified baseline analysis can be seen in the law of motions for the dynamic state variables $\{L_{rt}^{\nu}\}$ and $\{N_{rt}\}$, which I replicate here for convenience:

1. ***Spatial labor supply:*** The dynamic labor supply equation is

$$L_{rt}^{\nu} = (1-\psi)\, L_{rt-1}^{\nu} + \psi \sum_{j=1}^{R} L_{jt-1}^{\nu} m_{jrt+1}^{\nu},$$

where

$$m_{jrt+1}^{\nu} = \begin{cases} \dfrac{\left(\eta_{rj}\mathcal{A}_j \frac{\overline{w}_{rt}^{\nu}}{P_{rMt}^{1-\alpha} P_{rAt}^{\alpha}}\right)^{\varepsilon}}{\sum_k \left(\eta_{rj}\mathcal{A}_j \frac{\overline{w}_{rt}^{\nu}}{P_{rMt}^{1-\alpha} P_{rAt}^{\alpha}}\right)^{\varepsilon}} & \text{with myopic agents} \\ \dfrac{\exp\left(v_{jt+1}^{\nu} - \eta_{rj}\right)^{\varepsilon}}{\underbrace{\sum_l \exp\left(v_{lt+1}^{\nu} - \eta_{rl}\right)^{\varepsilon}}_{\text{Future wages}}} & \text{with forward looking agents} \end{cases},$$

and v_{jt+1}^{ν} solves the dynamic value function in (A-15).

2. ***Local variety creation:*** The law of motion for local varieties is given by

$$N_{rt} = \begin{cases} \frac{1}{\rho-1}\frac{1}{f_E} H_{rPt} \left(N_{rt-1}\right)^{\lambda} & \text{with myopic agents} \\ N_{rt} \text{ solves } N_{rt} = \left(\frac{1}{f_E}\frac{1}{\rho-1} H_{rPt} + \frac{1-\delta}{1+r}\frac{1}{f_E} N_{rt}^{1-\lambda} \underbrace{E\left[\frac{w_{rMt+1}}{w_{rMt}}\right]}_{\text{Future wages}} \right) N_{rt-1}^{\lambda} & \text{with forward looking agents} \end{cases},$$

Hence, in the case with forward looking agents, solving for the regional population at time t, L_{rt}^{ν}, and the mass of local varieties at time t, N_{rt} , requires the entire future path of local utilities $\{u_{rt}^{\nu}\}_{rt}$

and local wages $\left\{w^{\nu}_{rMt+1}\right\}_{rt}$. The equilibrium path is a dynamic fixed point. In the baseline model with myopic agents, neither L_{rt} nor N_{rt} depends on any future variables but the system is purely backward looking.

These forward-looking decisions complicate the quantitative analysis considerably. In particular, calculating the equilibrium path involves a dynamic fixed point problem. Moreover, in the presence of local productivity shocks $\mathcal{Q}_{rt}$, one has to integrate over the entire future distribution of potential shocks. To see why this is challenging, suppose first that there are no productivity shocks, that is $\mathcal{Q}_{rt} = \mathcal{Q}_r$. To calculate the equilibrium for a given set of structural parameters and for a given set of initial conditions $\left[L^I_{r0}, L^F_{r0}, N_{r0}\right]$, one has to iterate on the entire sequence of the cross-sectional population distribution. More specifically, for a given guess of $\{L^{\nu}_{rt}\}_{t=1}^{\infty}$, one can use equations (A-19), (A-20), (A-21), (A-22) and (A-18) to solve for equilibrium wages, prices and varieties. To do so, one has to find another dynamic fixed point to make N_{rt} consistent with equilibrium wage growth. Finally, the sequence $\{L^{\nu}_{rt}\}_{t=1}^{\infty}$ has to be consistent with the implied sequence of wages and hence per-period utility.

A pseuo-code looks as follows:

1. Guess a path of $\{L^{\nu}_{rt}\}_{t=1}^{\infty}$
   (a) Solve for $\{w_{rst}, N_{rt}\}_{t=1}^{\infty}$. To do so, guess $\{N_{rt}\}_{t=1}^{\infty}$, solve for $\{w_{rst}\}_{t=1}^{\infty}$ taking $\{N_{rt}\}_{t=1}^{\infty}$ as given and update $\{N_{rt}\}_{t=1}^{\infty}$ given the resulting $\{w_{rst}\}_{t=1}^{\infty}$
   (b) Given $\{w_{rst}\}_{t=1}^{\infty}$, calculate the path of local utilities $\{u^{\nu}_{rt}\}_{rt}$.
   (c) Given $\{u^{\nu}_{rt}\}_{rt}$, calculate the optimal migration choices $\left\{\hat{L}^{\nu}_{rt}\right\}_{t=1}^{\infty}$.
2. Find a fixed point between $\left\{\hat{L}^{\nu}_{rt}\right\}_{t=1}^{\infty}$ and $\{L^{\nu}_{rt}\}_{t=1}^{\infty}$.

Hence, the outer loop consists of a fixed point in $2 \times R \times T$ variables. The inner loop consists of a fixed point in $R \times T$ variables. In the presence of stochastic shocks $\{\mathcal{Q}_{rt}\}_{r,t}$, this procedure has to be done for each sequence of shocks and then integrated over the distribution of $\{\mathcal{Q}_{rt}\}_{r,t}$. Doing so as part of the estimation algorithm makes the quantitative analysis extremely challenging.

A-3.3 Dynamic models of migration in the literature

The recent literature on quantitative models of economic geography contains two contributions that are particularly relevant, because they also employ dynamic model of regional migration and labor reallocation but allow explicitly for forward-looking agents. In this section I discuss why the these methods are not directly applicable to my context.

"The Geography of Development" (Desmet et al., 2018) The paper by Desmet et al. (2018) is the closest in spirit to my paper. They also study a model, where individuals face frictions

to spatial mobility and firms can invest in future productivity growth. Hence, in principle, both individuals and entrepreneurs face forward looking problems like in the dynamic model above.

One of the theoretical contributions of Desmet et al. (2018) is that they manage to impose sufficient theoretical restrictions to ensure that all policy functions end up being static. On the innovation side, *"they assume that innovation spills over locally after one period, and new firms can freely enter at any point in time. Hence, entry drives down firms' profits to zero in all future periods, and they only innovate to the extent that maximizes their current profits"* (Nagy, 2021, Footnote 17). This specification was developed in Desmet and Rossi-Hansberg (2014). For individuals, they assume a form of migration costs that also make individuals "current utility maximizers".

In fact, in their model, the endogenous population distribution is given by (see Desmet et al. (2018, Equations (3) and (7))

$$\frac{H(r)\,\overline{L}_t(r)}{\overline{L}} = \frac{u_t(r)^{1/\Omega}\, m_2(r)^{-1/\Omega}}{\int u_t(v)^{1/\Omega}\, m_2(v)^{-1/\Omega}\, dv} = \frac{\left(\frac{a_t(r)y_t(r)}{m_2(r)}\right)^{1/\Omega}}{\int \left(\frac{a_t(v)y_t(v)}{m_2(v)}\right)^{1/\Omega} dv}, \tag{A-23}$$

where $H(r)\,\overline{L}_t(r)$ is the total population in region r at time t[50], $\overline{L}$ is the total world population, $y_t(r)$ is real consumption in r, $a(r)$ denotes regional amenities and $m_2(r)$ is a regional disutility term that captures migration costs. Hence, as in my baseline model, individuals' spatial mobility decisions only depend on current utility - future wages do not enter in their decision making.

Note that equation (A-23) has another important implication that makes it not suitable for my analysis: the population distribution does not does not depend on $\overline{L}_{t-1}(r)$ and hence does not feature any persistence. Recall that the law of motion for the population in my analysis was given by

$$L^{\nu}_{rt} = (1-\psi)\, L^{\nu}_{rt-1} + \psi \sum_{j=1}^{R} L^{\nu}_{jt-1} \frac{(V_r \eta_{jr} \overline{u}^{\nu}_{rt})^{\varepsilon}}{\sum_k (V_k \eta_{jk} \overline{u}^{\nu}_{rt})^{\varepsilon}}. \tag{A-24}$$

If $\psi = 1$ (i.e. individuals are free to move each period) and $\eta_{jr} = \eta_r$ (i.e. migration frictions are not origin-destination specific but only destination specific) this equation reduces to

$$L^{\nu}_{rt} = \frac{(V_r \eta_r \overline{u}^{\nu}_{rt})^{\varepsilon}}{\sum_k (V_k \eta_k \overline{u}^{\nu}_{rt})^{\varepsilon}} \sum_{j=1}^{R} L^{\nu}_{jt-1} = \frac{(V_r \eta_r \overline{u}^{\nu}_{rt})^{\varepsilon}}{\sum_k (V_k \eta_k \overline{u}^{\nu}_{rt})^{\varepsilon}} L^{\nu},$$

where $L^{\nu} = \sum_{j=1}^{R} L^{\nu}_{jt-1}$ denotes the total population. This expression is isomorphic to equation (A-23). In terms of my context this implies that the initial "drop" in refugees would not show any persistence, which is counterfactual. In fact, the Poisson mobility shock ψ is one of the parameters I estimated and the data pointed to number substantially smaller than 1. The assumption of individuals

[50] In their model $H(r)$ is the amount of land in location r and $\overline{L}_t(r)$ is population per unit of land at r in period t.

being myopic thus allows me to estimate the more general migration equation in (A-24) rather than having to rely on (A-23).

"Trade and labor market dynamics: General equilibrium analysis of the china trade shock" (Caliendo et al., 2019) Another recent contribution that makes substantial progress regarding the problem of forward-looking migration decisions is Caliendo et al. (2019). They study the labor market implications of changes in trade policy in settings where individuals face sectoral and regional mobility frictions and are forward looking. The methodological contribution of Caliendo et al. (2019) is that they demonstrate that many questions of interest - like counterfactual changes in trade policy - can be answered without having to estimate many parameters of the model (a procedure that they refer to as "dynamic hat algebra").

There are two reasons why the insights from Caliendo et al. (2019) are not applicable to my setting. The first is conceptual: the Caliendo et al. (2019) methodology relies on the fact that regional productivity is an exogenous fundamental. While it can be varying, their method is not directly applicable to a setting where local productivity responds endogenously to market conditions. This endogeneity of local productivity, however, is a key aspect of my analysis.

The second is empirical: a key methodological insight of Caliendo et al. (2019) is to use a "revealed preference" approach, where observable data can be directly substituted in some equilibrium conditions. In their words: *"Aside from data that directly map into the model's equilibrium conditions, the only parameters we need in order to solve the full transition of the dynamic model are the trade elasticities, the migration elasticity, and the intertemporal discount factor."* Caliendo et al. (2019, p. 742) This is particularly relevant to solve agents' dynamic migration problem in (A-15): if individuals' migration choices can be observed in the initial period (say $t = 0$), these "choice probabilities" m^{ν}_{rj0} can be used to infer the initial value of life-time utility V^{ν}_{r0}, that rationalizes such choices. Given these initial value functions, the recursive equation in (A-15) can then be iterated forward and hence jointly solved with the distribution of wages. In order to apply this procedure to my setting, I would need to observe the matrix of migration choices for both types ν. However, not only do I treat the type ν as an unobserved latent variable, but even if I were to abstract from such unobserved types, I do not have data on migration flows for all origin-destination pairs in the initial period, i.e. in 1950 after the inflow of refugees.

A-3.4 Implications

The key question is of course to what extent my substantive results hinge on the assumption of myopic agents. Without actually computing the solution to the full dynamic model, it is difficult to answer this question. However, it is worthwhile to point out that my empirical strategy suggests that for many outcomes of interest of this study, namely the aggregate and regional effects of refugee inflows on income per capita and industrialization, the discrepancy between the myopic and the full dynamic model might be small.

The reason is the following: as highlighted in the characterization of the dynamic equilibrium in Section A-3.1, both models have the exact same solution given a time path for the population distribution $\{L^{\nu}_{rt}\}$ and the regional varieties $\{N_{rt}\}$. Hence, the two models' implications only differ to the extent that they imply different paths for these dynamic state variables.

However, in my empirical strategy, I discipline my structural parameters directly by targeting moments, that are tightly linked to the evolution of exactly such state variables: the impact on short- and long-run population growth, the auto-correlation of the refugee share and the impact on income per capita, again both in the short- and long-run. In addition I also directly target moments related to agents' observed choices, namely the ratio of new to gross flows and the share of migration to out-of-state counties.

If a fully dynamic model were to be estimated to the same moments, the implied structural parameters would of course be different, but the response of the model to the population inflows would be - by construction - the same. It is therefore not immediate that the two models would have very different implications if such flows had been absent. It is in that sense that my empirical strategy of relying on indirect inference might deliver credible results even if the model was misspecified.

This is, of course, not to say that these different models would have similar results to *all* shocks. An announcement of a sizable refugee inflows in five years time would naturally have immediate consequences in the fully dynamic model while nothing would happen in the myopic model. Similarly, a quantification of the welfare consequences might yield very different results.

Additional Results for "Market Size and Spatial Growth - Evidence from Germany's Post-War Population Expulsions"

AR-1 Additional Results

AR-1.1 Sectoral Labor Supply and Earnings

In this section I derive some convenient properties of the selection model. Recall that the distribution of individual skills is given by $F_s(z) = e^{-\phi_s z^{-\theta}}$, where ϕ_j parametrizes the average level of productivity of individuals in sector s and θ the dispersion of skills. The following result will turn out to be useful

Lemma 3. *Let $\{x_i\}_{i=1}^n$ be distributed iid according to*

$$F_{x_i}(x) = e^{-A_i x^{-\theta}}.$$

Then

$$E\left[x_i | x_i = \max_i [x_i]\right] = \Gamma\left(1 - \frac{1}{\theta}\right)\left(\sum_{i=1}^n A_i\right)^{1/\theta}. \tag{AR-1}$$

Note that this object does not depend on i.

Proof. Suppose that $i = 1$ and let us derive the conditional distribution of x_1, conditional that x_1 is the highest $\{x_j\}_j$. The joint distribution of $\{x_j\}_j$ is given by

$$F(x_1, x_2, ..., x_3) = \prod_{j=1}^n F(x_i) \tag{AR-2}$$

because of independence. Hence, we get that

$$\begin{aligned}
P\left(x_1 \leq m | x_1 = \max_j [x_j]\right) &= \frac{1}{P(x_1 = \max_j [x_j])} \int_0^m \prod_{j=2}^n P(x_j < x)\, dF_{x_1}(x) \\
&= \frac{1}{P(x_1 = \max_j [x_j])} \int_0^m \prod_{j=2}^n e^{-A_j x^{-\theta}} A_1 \theta x^{-\theta-1} e^{-A_1 x^{-\theta}} dx \\
&= \frac{A_1}{P(x_1 = \max_j [x_j])} \int_0^m \theta x^{-\theta-1} \prod_{j=1}^n e^{-A_j x^{-\theta}} dx \\
&= \frac{A_1}{P(x_1 = \max_j [x_j])} \int_0^m \theta x^{-\theta-1} e^{-(\sum_j A_j) x^{-\theta}} dx.
\end{aligned}$$

Now let us derive $P(x_1 = \max_j [x_j])$. We get that

$$P\left(x_1 = \max_j [x_j]\right) = P(x_j \leq x_1 \text{ for all } j \geq 2) = \int_{x_1} \frac{\partial F}{\partial x_1}(x_1, x_1, x_1, ..)\, dx_1.$$

Using (AR-2), we get that

$$\begin{aligned}
\frac{\partial F(x_1, x_2, ..., x_3)}{\partial x_1} &= \frac{\partial F(x_1)}{\partial x_1}\left(\prod_{j=2}^{n} F(x_i)\right) = e^{-A_1 x^{-\theta}} A_1 \theta x_1^{-\theta-1}\left(\prod_{j=2}^{n} e^{-A_i x_j^{-\theta}}\right) \\
&= A_1 \theta x_1^{-\theta-1}\left(\prod_{j=1}^{n} e^{-A_i x_i^{-\theta}}\right) \\
&= A_1 \theta x_1^{-\theta-1} e^{-\sum_i^n A_i x_i^{-\theta}}.
\end{aligned}$$

Hence,

$$\begin{aligned}
\int_{x_1} \frac{\partial F}{\partial x_1}(x_1, x_1, x_1, ..)\, dx_1 &= \int_{x_1} A_1 \theta x_1^{-\theta-1} e^{-\left(\sum_i^n A_i\right) x_1^{-\theta}} dx_1 \\
&= \frac{A_1}{\sum_i^n A_i} \int_{x_1} \frac{\theta}{\left(\sum_i^n A_i\right)^{1/\theta}} \left(\frac{x_1}{\left(\sum_i^n A_i\right)^{1/\theta}}\right)^{-\theta-1} e^{-\left(\frac{x_1}{\left(\sum_i^n A_i\right)^{1/\theta}}\right)^{-\theta}} dx_1 \\
&= \frac{A_1}{\sum_i^n A_i}.
\end{aligned}$$

Substituting this above yields

$$\begin{aligned}
P\left(x_1 \leq m | x_1 = \max_j [x_j]\right) &= \left(\sum_i^n A_i\right) \int_0^m \theta x^{-\theta-1} e^{-\left(\sum_j A_j\right) x^{-\theta}} dx \\
&= \int_0^m \frac{\theta}{\kappa}\left(\frac{x}{\kappa}\right)^{-\theta-1} e^{-\left(\frac{x}{\kappa}\right)^{-\theta}} dx,
\end{aligned}$$

where $\kappa = \left(\sum_j A_j\right)^{1/\theta}$. This is a Frechet distribution with shape θ and scale κ, i.e.

$$F_{x_1|x_1=\max_j[x_j]}(m) = e^{-\left(\frac{x}{\left(\sum_j A_j\right)^{1/\theta}}\right)^{-\theta}} = e^{-\left(\sum_j A_j\right) x^{-\theta}}.$$

This implies (AR-1) □

Lemma 3 is useful because it allows us to calculate sectoral earnings and the sectoral supply of efficiency units. Consider first sectoral earnings. Let $y_{rs}^i = w_{rs} z_s^i$ be the earnings of individual i in region r working in sector s. The distribution of earnings is

$$P\left(y_{sr}^i < y\right) = P\left(z_s^i < \frac{y}{w_{rs}}\right) = e^{-\phi_s\left(\frac{y}{w_{rs}}\right)^{-\theta}} = e^{-\phi_s w_{rs}^{\theta} y^{-\theta}}.$$

Hence, Lemma 3 implies that

$$E\left[y_{rs}^i | y_{rs}^i = \max_s \left\{y_{rs}^i\right\}\right] = \Gamma\left(1 - \frac{1}{\theta}\right)\left(\sum_s \phi_s w_{rs}^{\theta}\right)^{1/\theta}.$$

Similarly, the average labor supply in sector s is given by

$$\begin{aligned}
E\left[z_s^i | y_{rs}^i = \max_s \left\{y_{rs}^i\right\}\right] &= E\left[z_s^i | w_{rs} z_s^i = \max_s \left\{w_{rs} z_s^i\right\}\right] \\
&= E\left[z_s^i | z_s^i = \max_k \left\{\frac{w_{rk}}{w_{rs}} z_k^i\right\}\right] \\
&= \Gamma\left(1 - \frac{1}{\theta}\right)\left(\phi_s + \sum_{k \neq s} \phi_k \left(\frac{w_{rk}}{w_{rs}}\right)^{\theta}\right)^{1/\theta} \\
&= \Gamma\left(1 - \frac{1}{\zeta}\right) \frac{1}{w_{rs}} \left(\sum_s \phi_s w_{rs}^{\theta}\right)^{1/\theta}.
\end{aligned}$$

Also, the share of people working in sector s is given by

$$\pi_{rs} = P\left(y_{rs}^i = \max_k \left\{y_{rk}^i\right\}\right) = \frac{\phi_s w_{rs}^{\theta}}{\sum_s \phi_s w_{rs}^{\theta}} = \phi_s \left(\frac{w_{rs}}{\left(\sum_s \phi_s w_{rs}^{\theta}\right)^{1/\theta}}\right)^{\theta}.$$

It is useful to define the endogenous scalar of *average earnings in region r as*

$$\overline{w}_r = \left(\sum_s \phi_s w_{rs}^{\theta}\right)^{1/\theta}.$$

Then we can write the sectoral employment share π_{rs} as

$$\pi_{rs} = \phi_s \left(\frac{w_{rs}}{\overline{w}_r}\right)^{\theta},$$

and the aggregate amount of sectoral earnings $w_{rs} H_{rs}$ as

$$\begin{aligned}
w_{rs} H_{rs} &= L_r P\left(y_{rs}^i = \max_k \left\{y_{rk}^i\right\}\right) E\left[y_{rs}^i | y_{rs}^i = \max_s \left\{y_{rs}^i\right\}\right] \\
&= L_r \Gamma\left(1 - \frac{1}{\theta}\right)\left(\pi_{rs} \overline{w}_r\right).
\end{aligned}$$

Note that we can write

$$\pi_{rs} \overline{w}_r = \phi_s w_{rs}^{\theta} \left(\overline{w}_r\right)^{1-\theta}.$$

Hence,

$$w_{rs} H_{rs}^h = L_r \Gamma\left(1 - \frac{1}{\theta}\right) w_{rs}^{\theta} \left(\phi_s \left(\overline{w}_r\right)^{1-\theta}\right).$$

Note that the aggregate level of aggregate human capital of individuals working in sector s in region r is given by

$$\begin{aligned}
H_{rs} &= L_r \Gamma\left(1 - \frac{1}{\theta}\right) w_{rs}^{\theta-1} \left(\phi_s \left(\overline{w}_r\right)^{1-\theta}\right) = L_r \Gamma\left(1 - \frac{1}{\theta}\right)\left(\phi_s \left(\frac{w_{rs}}{\overline{w}_r}\right)^{\theta-1}\right) \\
&= L_r \Gamma\left(1 - \frac{1}{\theta}\right)\left(\phi_s \left(\frac{\pi_{rs}}{\phi_s}\right)^{\frac{\theta-1}{\theta}}\right) = L_r \Gamma\left(1 - \frac{1}{\theta}\right)\left(\left(\phi_s\right)^{\frac{1}{\theta}} \pi_{rs}{}^{\frac{\theta-1}{\theta}}\right).
\end{aligned}$$

This also implies that *aggregate* earnings in region r, Y_r, are given by

$$Y_r = \left[\sum_s w_{rs} H_{rs}\right] = L_r \Gamma \left(1 - \frac{1}{\theta}\right) (\overline{w}_r).$$

AR-1.2 Market Size and Variety Creation: Supply vs Demand

Equation (7) highlights that the growth of local varieties is fully determined by mass of local production workers H_{rPt}

$$\frac{N_{rt}}{N_{rt-1}} = \frac{1}{\rho - 1} \frac{1}{f_E} H_{rPt} \times N_{rt-1}^{\lambda-1}.$$

Because H_{rPt} is an equilibrium outcome, both demand and supply forces are at play. To distinguish these forces, it is useful to consider a special case of the model where regions are sufficiently small to not affect the economy-wide aggregates. This implies that neither the size of the local population nor local factor prices affect the demand for tradable goods.

Using the two market clearing conditions for agricultural and manufacturing goods ((A-3) and (A-4)) and the equilibrium market size H_{rPt} relative to the manufacturing work force H_{rMt} yields

$$\begin{aligned} w_{rA}^{\sigma} H_{rA}^{1+(1-\gamma)(\sigma-1)} &= T_r^{(\sigma-1)(1-\gamma)} Q_{rt}^{\sigma-1} \gamma^{\sigma} \mathcal{D}_{rAt} \\ w_{rMt}^{\sigma} \left(\frac{\rho-1}{\rho}\right)^{1-\vartheta(\sigma-1)} \left(H_{rMt} + (1-\delta) f_E N_{rt-1}^{1-\lambda}\right)^{1-\vartheta(\sigma-1)} &= Q_{rt}^{\sigma-1} N_{rt-1}^{(\sigma-1)\lambda\vartheta} \varsigma^{1-\sigma} \beta \mathcal{D}_{rMt}, \end{aligned}$$

where $\mathcal{D}_{rMt} = (1-\alpha) \sum_j \frac{\tau_{rj}^{1-\sigma} Y_{jt}}{\sum_m \tau_{mj}^{1-\sigma} P_{mmM}^{1-\sigma}}$ and $\mathcal{D}_{rAt}$ similarly. Together with the labor supply functions

$$H_{rjt} = \Gamma_\theta L_{rt} \left(\omega_{rt}^I \phi_j^I \left(\frac{w_{rjt}}{\overline{w}_{rt}^I}\right)^{\theta-1} + \omega_{rt}^F \phi_j^F \left(\frac{w_{rjt}}{\overline{w}_{rt}^F}\right)^{\theta-1}\right) \text{ for } j = A, M,$$

these four equations determine the four unknowns $(w_{rMt}, w_{rAt}, H_{rAt}, H_{rMt})$ as a function of local technologies $(T_r.Q_{rt}, N_{rt-1})$ and demand $(\mathcal{D}_{rMt}, \mathcal{D}_{rAt})$. The restriction that region r is small implies that we can treat $\mathcal{D}_{rjt}$ as exogenous from the point of view of region r.

To simply these expressions, assume first that labor supply is perfectly substitutable across sectors and abstract from type heterogeneity, that is $\theta \to \infty$ and $\phi_j^F = \phi_j^A = 1$. This implies that wages equalizes across sectors, $w_{rAt} = w_{rMt} = w_{rt}$, and that labor market clearing can be written as

$$H_{rAt} = (1 - s_{rMt}) L_{rt} \text{ and } H_{rMt} = s_{rMt} L_{rt}.$$

Furthermore, assume that the allocation is close to a steady-state. This implies that $H_{rP} = \frac{\rho-1}{\rho-1+\delta} H_{rMt}$. Under these assumptions, the local employment allocation s_{rMt} is determined from

$$\frac{(s_{rMt})^{1-\vartheta(\sigma-1)}}{(1 - s_{rMt})^{1+(1-\gamma)(\sigma-1)}} = \xi \times L_{rt}^{(\vartheta+1-\gamma)(\sigma-1)} \times \frac{N_{rt-1}^{(\sigma-1)\lambda\vartheta}}{T_r^{(\sigma-1)(1-\gamma)}} \times \frac{\mathcal{D}_{r,M}}{\mathcal{D}_{r,A}},$$

where ξ is a constant. Note that the LHS is strictly increasing in s_{rMt}. Hence, as required in (A-11),

$$s_{rMt} = h\left(L_{rt}^{(\vartheta+1-\gamma)(\sigma-1)} \times \frac{N_{rt-1}^{(\sigma-1)\lambda\vartheta}}{T_r^{(\sigma-1)(1-\gamma)}} \times \frac{\mathcal{D}_{r,M}}{\mathcal{D}_{r,A}}\right)$$

and $h(.)$ is increasing.

AR-1.3 Computational Algorithm

In this section I gather all equations and parameters to implement the theory computationally.

1. **Exogenous regional fundamentals**: In our theory, locations are characterized by land supplies, amenities and innate productivities
$$\{T_r, V_r, Q_{rt}\}_{r=1}^{R}. \tag{AR-3}$$
While land supplies and amenities are assumed to be constant, innate productivity evolves according to
$$\ln Q_{rt} = (1-\varrho)\ln Q_r + \varrho \ln Q_{rt-1} + \varpi u_{rt}, \tag{AR-4}$$
where $u_{rt} \sim \mathcal{N}(0,1)$.

2. **Spatial labor supply:** Let L_{rt-1}^{Nv} and L_{rt-1}^{Rv} denote the number of natives and refugees of type $v = I, R$. The total supply of workers of type v in region r at time t is given as
$$L_{rt}^{\nu} = (1-\psi) L_{rt-1}^{\nu} + \psi \sum_{j=1}^{R} L_{jt-1}^{v} m_{jrt}^{v}, \tag{AR-5}$$
where $L_{rt}^{\nu} = L_{rt}^{Nv} + L_{rt}^{Rv}$ and
$$m_{jrt}^{v} = \frac{\left(V_r \mu_{jr} \overline{u}_{rt}^{\nu}\right)^{\varepsilon}}{\sum_k \left(V_k \mu_{jk} \overline{u}_{rt}^{\nu}\right)^{\varepsilon}}. \tag{AR-6}$$

3. **Sectoral labor supply:** Given, L_{rt}^{ν}, total labor supply in sectors A and M are given by
$$H_{rAt} = \Gamma_\theta \sum_{v=I,R} L_{rt}^{\nu} \phi_A^v \left(\frac{w_{rAt}}{\overline{w}_{rt}^{\nu}}\right)^{\theta-1} \tag{AR-7}$$
$$H_{rMt} = \Gamma_\theta \sum_{v=I,R} L_{rt}^{\nu} \phi_M^v \left(\frac{w_{rMt}}{\overline{w}_{rt}^{\nu}}\right)^{\theta-1}, \tag{AR-8}$$
where $\overline{w}_{rt}^{\nu}$ is given as
$$\overline{w}_{rt}^{\nu} = \left(\phi_A^v w_{rAt}^{\theta} + \phi_M^v w_{rMt}^{\theta}\right)^{1/\theta}. \tag{AR-9}$$
and $\Gamma_\theta = \Gamma(1-1/\theta)$ and $\Gamma(.)$ is the gamma function.

4. **Goods market clearing:** The two goods market clearing conditions are given as
$$\frac{\rho}{\rho-1} w_{rMt} H_{rPt} = (1-\alpha) \sum_{j=1}^{R} \left(\frac{P_{rjM}}{P_{jM}}\right)^{1-\sigma} \left(\frac{w_{jAt} H_{jAt}}{\gamma} + \frac{\rho}{\rho-1} w_{jMt} H_{jPt}\right) \tag{AR-10}$$
$$\frac{w_{rAt} H_{rAt}}{\gamma} = \alpha \sum_{j=1}^{R} \left(\frac{P_{rjA}}{P_{jA}}\right)^{1-\sigma} \left(\frac{w_{jAt} H_{jAt}}{\gamma} + \frac{\rho}{\rho-1} w_{jMt} H_{jPt}\right), \tag{AR-11}$$
where $P_{rjM} = \frac{\tau_{rj} w_{rMt}}{Q_{rt} N_{rt-1}^{\lambda\vartheta} H_{rPt}^{\vartheta}}$, $P_{rjA} = \frac{\tau_{rj} w_{rAt}}{Q_{rt}} \frac{H_{rAt}}{T_r}$ and $P_{jM} = \left(\sum_r P_{rjM}^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$ and $P_{jA} = \left(\sum_r P_{rjA}^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$ and the short-run scale elasticity is $\vartheta = \frac{1}{\rho-1}$.

5. **Labor market clearing:** The labor market clearing condition for the manufacturing sector is given by
$$H_{rMt} = \frac{\rho}{\rho-1} H_{rPt} - (1-\delta) f_E N_{rt-1}^{1-\lambda}. \tag{AR-12}$$

6. **Dynamic evolution of state variable:** The dynamic state variable, the number of firms N_{rt}, evolves according to
$$N_{rt} = \frac{1}{\rho-1} \frac{1}{f_E} H_{rPt} \times N_{rt-1}^{\lambda}. \tag{AR-13}$$

7. **Initial conditions:** The initial conditions of the endogenous state variables are given by the number of plants N_{r0} and the labor supply by natives and refugees from either type

$$\left\{N_{r0}, L_{r0}^{NI}, L_{r0}^{NR}, L_{r0}^{RI}, L_{r0}^{RR}\right\}_{r=1}^{R}. \tag{AR-14}$$

These equations fully characterize the dynamic equilibrium. To see this, let the initial conditions in (AR-14) and the exogenous fundamentals in (AR-3) and (AR-4) be given. Let a vector of wages $[w_{rA1}, w_{rM1}]_r$ be given. Note that the system is homogenous of degree zero in the level of wages, because we did not pick a numeraire yet. Let us use the numeraire

$$w_{1M1} = 1$$

for an arbitrarily selected region 1. From (AR-5) and (AR-6) we can calculate $\left[L_{r1}^{I}, L_{r1}^{NI}\right]$. From (AR-7), (AR-8) and (AR-9) we can calculate $[H_{rAt}, H_{rMt}]$. From (AR-12) we can calculate $[H_{rP1}]$. Then we still have (AR-10) and (AR-11), which are $2 \times R$ equations, to solve for $[w_{rA1}, w_{rM1}]_r$. Given the equilibrium values for $[w_{rA1}, w_{rM1}]_r$, we can then use (AR-13) to calculate $[N_{r1}]$. This determines the set of new state variables $\left\{N_{r1}, L_{r1}^{I}, L_{r1}^{R}\right\}_{r=1}^{R}$ and we can solve for the equilibrium in the next period. Note that the equilibrium requires that the free entry condition is satisfied, i.e. that net investment in firms is positive.

$$N_{rt} > (1-\delta)\, N_{rt-1},$$

Using (AR-13) this implies $\frac{1}{(\rho-1)f_E} H_{rPt} > (1-\delta)\, N_{rt-1}^{1-\lambda}$.

AR-1.4 Inferring Fundamentals

Step 1: Infer equilibrium wages $[w_{rA}, w_{rM}]_r$ and prices $[P_{rrA}, P_{rrM}]_r$ Let the structural parameters be given. We can then infer $[w_{rA}, w_{rM}]_r$ from the following iterative procedure

1. Guess average for each type in region r, $\left[\overline{w}_r^F, \overline{w}_r^I\right]_r$ and the aggregate price index for each r, $\Psi_r \equiv P_{rA}^{\alpha} P_{rM}^{1-\alpha}$. Note that we guess directly Ψ_r, not the individual P_{rA} and P_{rM}. Set $\Psi_1 = 1$.
2. Given $\left[\overline{w}_r^F, \overline{w}_r^I, \Psi_r\right]_r$ solve for V_r and the share of high types across space ω_r^I. To do so we can use the following procedure
   (a) Guess $\left[\omega_r^I\right]_r$, i.e. the share of high types in region r
   (b) Let $l_r = \frac{L_r}{L}$ be the observed population share. Then calculate the number of industrialists $L_r^I = \omega_r^I l_r$.
   (c) Given L_r^I solve the amenities from the steady state equations

$$L_r^I = \sum_k \frac{\left(\mu_{kr} V_r \frac{\overline{w}_{rt}^I}{\Psi_r}\right)^{\varepsilon}}{\sum_j \left(\mu_{kj} V_j \frac{\overline{w}_{jt}^I}{\Psi_j}\right)^{\varepsilon}} L_k^I. \tag{AR-15}$$

   To do so,
   i. Guess $[V_r]$ and normalize $\left(\sum V_r^{\varepsilon}\right)^{1/\varepsilon} = 1$
   ii. Then use (AR-15) to solve for V_r as

$$V_r = \left(\frac{L_r^I}{\sum_k \frac{\left(\mu_{kr} \frac{\overline{w}_{rt}^{\nu}}{\Psi_r}\right)^{\varepsilon}}{\sum_j \left(\mu_{kj} V_j \frac{\overline{w}_{jt}^{\nu}}{\Psi_j}\right)^{\varepsilon}} L_k^I} \right)^{1/\varepsilon} \tag{AR-16}$$

   Hence, given a guess $\left[V_r^0\right]$, we can use (AR-16) to update $\left[V_r^1\right]_r$ and then iterate on (AR-16) until $\left[V_r^{n+1}\right]_r \approx [V_r^n]_r$. Note that whenever we use (AR-16) to update $\left[V_r^1\right]_r$ we need to

impose $\left(\sum V_r^{\varepsilon}\right)^{1/\varepsilon} = 1$.

(d) Once we found a converged $[V_r]$, we can use the spatial labor supply equation for the famers to get an update for our guess ω_r^I. In particular, Given our guess ω_r^I we can calculate the number of famers in location r as

$$L_r^F = \sum_k \frac{\left(\mu_{kr} V_r \frac{\overline{w}_{rt}^F}{\Psi_r}\right)^{\varepsilon}}{\sum_j \left(\mu_{kj} V_j \frac{\overline{w}_{jt}^F}{\Psi_j}\right)^{\varepsilon}} \left(1 - \omega_k^I\right) l_k$$

Given L_r^F we can update our guess for ω_r^I as $\tilde{\omega}_r^I = \max\left\{1 - \frac{L_r^F}{l_r}, 0\right\}$Note that we should impose the max operator as there is no guarantee that $L_r^F < l_r$ for a given V_r.

(e) If $\tilde{\omega}_r^I \approx \omega_r^I$, stop as we have converged. Otherwise go back to (a) with $\tilde{\omega}_r^I$.

3. Given $\left[\overline{w}_r^F, \overline{w}_r^I, \Psi_r\right]_r$ and $\left[\omega_r^I\right]$ we can calculate the sectoral skill prices w_{rA} and w_{rM} from the same equations as in our current procedure. In particular,

(a) calculate w_{rA} from agricultural employment share s_{rA} as

$$w_{rA} = \left(\frac{s_{A,r}}{\sum_\nu \omega_r^\nu \phi_A^\nu \left(\frac{1}{\overline{w}_r^\nu}\right)^\theta}\right)^{1/\theta}, \tag{AR-17}$$

(b) Calculate w_{rM} from

$$py_r = \Gamma_\theta \left(\frac{1}{1 - \frac{(1-\delta)(1-\beta)}{\rho}} \sum_{\nu=I,F} \omega_r^\nu \left(\phi_A^\nu w_{rA}^\theta + \phi_M^\nu w_{rM}^\theta\right)^{1/\theta} \left(1 - \pi_{rA}^\nu\right) + \frac{1}{\gamma} \sum_{v=I,F} \omega_r^\nu \left(\phi_A^\nu w_{rAt}^\theta + \phi_M^\nu w_{rM}^\theta\right)^{1/\theta} \pi_{rA}^\nu\right),$$

where π_{Ar}^ν is the employment share in agriculture of type ν and ω_r^ν is the share of ν-types and py_r denotes income per capita in region r

4. Given (w_{rM}, w_{rA}) we can calculate the implied average income by type $\overline{w}_r^{\nu,impl} = \left(\phi_A^v w_{rA}^\theta + \phi_M^v w_{rM}^\theta\right)^{1/\theta}$ and calculate an updated guess for $\left[\overline{w}_r^R, \overline{w}_r^I\right]_r$ as $\overline{w}_r^{\nu,new} = \zeta \overline{w}_r^\nu + (1-\zeta)\, \overline{w}_r^{\nu,impl}$, where $\zeta \in (0,1)$ is a weight to update our wage guess and iterate on $\overline{w}_r^\nu$ until we find a fixed point.

5. Given (w_{rM}, w_{rA}) we can calculate H_{rM} and H_{rA}. Given H_{rM} we can calculate the number of production workers as

$$H_{rP} = \frac{\rho - 1}{\rho - 1 + \delta} H_{rM}.$$

6. Then we can calculate the parameter α, which is consistent with the data as

$$\alpha = \frac{\sum_r \frac{w_{rA} H_{rA}}{\gamma}}{\sum_j \left(\frac{w_{jA} H_{jA}}{\gamma} + \frac{\rho}{\rho-1} w_{jM} H_{jP}\right)}$$

Note that the RHS is known.

7. Then we can determine the regional prices P_{rrM} and P_{rrA}, i.e. the price of region r goods in region r. In particular, market clearing for the manufacturing sector requires that

$$P_{rrM} = \left(\frac{\rho - 1}{\rho} \frac{1}{w_{rM} H_{rP}}\right)^{\frac{1}{\sigma-1}} \left(\sum_j \frac{\tau_{rj}^{1-\sigma} (1-\alpha) \left(\frac{w_{jA} H_{jA}}{\gamma} + \frac{\rho}{\rho-1} w_{jM} H_{jP}\right)}{\sum_m \tau_{mj}^{1-\sigma} P_{mmM}^{1-\sigma}}\right)^{\frac{1}{\sigma-1}} \tag{AR-18}$$

Note again that P_{rrM} are only identified up to scale. Hence, we can solve for P_{rrM} by the following procedure

(a) Guess $\left[P^0_{rrM}\right]_{r=1}^R$ and impose that $P^0_{11M} = 1$

(b) Plug $\left[P^0_{rrM}\right]_{r=1}^R$ in the RHS of (AR-18) to get P^1_{rrM} from the LHS

(c) Check if $P^1_{rrM} \approx P^0_{rrM}$. If yes, stop. If no, take $\left[P^1_{rrM}\right]_{r=1}^R$ as the new guess and impose that $P^1_{11M} = 1$ (i.e. divide P^1_{rrM} by P^1_{11M}) and go back to (b).

We can use the exact same procedure to solve for $[P_{rrA}]_{r=1}^R$ from the equation, which is implied by (A-4)

$$P_{rrA} = \left(\frac{\gamma}{w_{rA} H_{rA}} \sum_j \frac{\tau_{rj}^{1-\sigma} \alpha \left(\frac{w_{jA} H_{jA}}{\gamma} + \frac{\rho}{\rho-1} w_{jM} H_{jP} \right)}{\sum_m \tau_{mj}^{1-\sigma} P_{mmA}^{1-\sigma}} \right)^{\frac{1}{\sigma-1}}$$

8. Given $[P_{rrA}]_{r=1}^R$ and $[P_{rrM}]_{r=1}^R$ we can calculate the implied $\tilde{\Psi}_r = P_{rA}^{\alpha} P_{rM}^{1-\alpha}$. Note that $\tilde{\Psi}_1 = 1$ by construction. If $\tilde{\Psi}_r \approx \Psi_r$ we are done and found a solution. If $\tilde{\Psi}_r \neq \Psi_r$ we can update $\Psi_r^{new} = \zeta \Psi_r + (1-\zeta) \tilde{\Psi}_r$for some ζ

Step 2: Infer regional fundamentals Given $[P_{rrA}, P_{rrM}]_r$ inferring the actual fundamentals is trivial. For the manufacturing sector we get that $P_{rMt} = \frac{\rho}{\rho-1} \frac{1}{\mathcal{Q}_{rt}} w_{rMt} N^{-\frac{1}{\rho-1}}$ and $N_{rt} = \left(\frac{1}{\rho-1} \frac{1}{f_E} \right)^{\frac{1}{1-\lambda}} H_{rPt}^{\frac{1}{1-\lambda}}$. Hence

$$\mathcal{Q}_{rt} = \frac{\rho}{\rho-1} \frac{w_{rMt}}{P_{rMt}} \left(\frac{1}{\rho-1} \frac{1}{f_E} \right)^{-\frac{1}{\rho-1} \frac{1}{1-\lambda}} H_{rPt}^{-\frac{1}{\rho-1} \frac{1}{1-\lambda}}. \tag{AR-19}$$

For the agricultural sector we get that $P_{rAt} = \frac{w_{rAt}}{Q_{rt}} \left(\frac{H_{rAt}}{T_r} \right)^{1-\gamma}$, so that

$$T_r = \left(\frac{w_{rAt}}{Q_{rt} P_{rAt}} \right)^{\frac{1}{1-\gamma}} H_{rAt}. \tag{AR-20}$$

Hence, equations (AR-19) and (AR-20) contain expressions for T_r and $\mathcal{Q}_r$ in terms of observables.[51]

AR-1.5 The Model with Traded Intermediate Goods

In my baseline analysis I assumed that final goods are tradable, but intermediate goods are not. This modeling device is useful to highlight that productivity growth, which I here model as an expansion of varieties, is to a large extent local in nature. To see this more specifically, abstract for simplicity from the agricultural sector and suppose that intermediate goods were traded and also subject to a trade cost $\tau^I_{rj} \geq 1$, with $\tau^I_{rr} = 1$. Also assume that the manufacturing sector uses labor, i.e.

$$Y_M = \mathcal{Q}_{rt} H_{rP}^{\beta} X_{rt}^{1-\beta}.$$

The baseline model in the main text is the special case of $\beta = 0$. The intermediate good in location r then has a price of

$$P_{rXt} = \left(\sum_j \int_{i \in N_{jt}} p_{jrt}^{1-\rho} \right)^{\frac{1}{1-\rho}} = \left(\sum_j N_{jt} \left(\tau^I_{jr} \right)^{1-\rho} w_{jt}^{1-\rho} \right)^{\frac{1}{1-\rho}}.$$

[51] Note also that a common level shift of GDPpc $[py_r]$ maps one-to-one in common level shifts of $[w_{rM}, w_{rA}]$. Suppose that $[w_{rM}, w_{rA}]$ solves the system above. Now suppose we scale the data on $[py_r]$ by a shifter κ. Scaling both $[w_{rM}, w_{rA}]$ by κ will also scale $\left[\overline{w}^I_r, \overline{w}^F_r\right]$ by κ. This will leave the inferred amenities $[V_r]$ and the sorting across space $[\omega^{\nu}_r]_r$ the same. It will also match the same agricultural shares $[s_{A,r}]$ as these only depend on $w_{rA}/\overline{w}^{\nu}_r$.

The price of the final good from region r is then given by

$$\begin{aligned} P_{rt} &= \frac{1}{\mathcal{Q}_{rt}}\left(\frac{w_{rt}}{\beta}\right)^{\beta}\left(\frac{P_{rXt}}{1-\beta}\right)^{1-\beta} \\ &= \frac{1}{\mathcal{Q}_{rt}}\left(\frac{1}{\beta}\right)^{\beta}\left(\frac{1}{1-\beta}\right)^{1-\beta}\left(N_{rt}+\sum_{j\neq r}\left(\tau_{jr}^{I}\right)^{1-\rho}N_{jt}\left(\frac{w_{jt}}{w_{rt}}\right)^{1-\rho}\right)^{\frac{1-\beta}{1-\rho}} w_{rt} \end{aligned}$$

Hence, labor productivity in region r is given by

$$TFP_{rt} \propto \mathcal{Q}_{rt} \times \left(N_{rt}+\sum_{j\neq r}\left(\tau_{jr}^{I}\right)^{1-\rho}N_{jt}\left(\frac{w_{jt}}{w_{rt}}\right)^{1-\rho}\right)^{\frac{1-\beta}{\rho-1}}.$$

Total profits of a given intermediate producer in region r are given by

$$\pi_{rt} = \frac{1}{\rho}\frac{1-\beta}{\beta}w_{rt}^{1-\rho}\sum_{j}\frac{\left(\tau_{jr}^{I}\right)^{1-\rho}}{\sum_{m}N_{mt}\left(\tau_{mj}^{I}\right)^{1-\rho}w_{mt}^{1-\rho}}w_{jt}H_{jPt}$$

Hence, free entry requires that

$$w_{rt}f_{E}N_{rt-1}^{-\lambda} = \pi_{rt} = \frac{1}{\rho}\frac{1-\beta}{\beta}w_{rt}^{1-\rho}\sum_{j}\frac{\left(\tau_{jr}^{I}\right)^{1-\rho}}{\sum_{m}N_{mt}\left(\tau_{mj}^{I}\right)^{1-\rho}w_{mt}^{1-\rho}}w_{jt}H_{jPt}.$$

This implies that

$$w_{rt}^{\rho}f_{E}N_{rt-1}^{-\lambda} = \frac{1}{\rho}\frac{1-\beta}{\beta}\sum_{j}\frac{\left(\tau_{jr}^{I}\right)^{1-\rho}}{\sum_{m}N_{mt}\left(\tau_{mj}^{I}\right)^{1-\rho}w_{mt}^{1-\rho}}w_{jt}H_{jPt}. \tag{AR-21}$$

To solve for the mass of workers engaged in the production of intermediate goods, note that total labor payments in the intermediate sector are proportional to total profits

$$w_{rt}H_{rXt} = (\rho-1)\,N_{rt}\pi_{rt}.$$

Hence,

$$H_{rXt} = (\rho-1)\,N_{rt}\frac{\pi_{rt}}{w_{rt}} = (\rho-1)\,N_{rt}f_{E}N_{rt-1}^{-\lambda}.$$

Finally, the number of entry workers are given by

$$H_{rEt} = f_{E}N_{rt-1}^{-\lambda}N_{rt} - (1-\delta)\,f_{E}N_{rt-1}^{1-\lambda}$$

Hence, labor market clearing requires

$$L_{rt} = H_{rPt} + \rho N_{rt}f_{E}N_{rt-1}^{-\lambda} - (1-\delta)\,f_{E}N_{rt-1}^{1-\lambda}. \tag{AR-22}$$

The market clearing for the traded final good is given by

$$w_{rt}H_{rPt} = \sum_{j=1}^{R}\left(\frac{\tau_{rj}P_{rMt}}{\overline{P}_{jMt}}\right)^{1-\sigma}\left(w_{jt}H_{jPt}\right), \tag{AR-23}$$

where $P_{rMt} = \frac{1}{\mathcal{Q}_{rt}\times\left(N_{rt}+\sum_{j\neq r}\left(\tau_{jr}^{I}\right)^{1-\rho}N_{jt}\left(\frac{w_{jt}}{w_{rt}}\right)^{1-\rho}\right)^{\frac{1-\beta}{\rho-1}}}w_{rt}$, $\overline{P}_{jMt} = \left(\sum_{r}\left(\tau_{rj}P_{rMt}\right)^{1-\sigma}\right)^{1/(1-\sigma)}$. Given the state variables N_{rt-1} and L_{rt}, the equilibrium is described by $R\times 3$ unknowns: $\{w_{rt}, N_{rt}, H_{rPt}\}_{r=1}^{R}$. These

unknowns are determined from (AR-21), (AR-22) and (AR-23).

Prohibitive costs for intermediate goods: $\tau^I_{rj} = \infty$ To see that this setup is a strict generalization of the model the main text, suppose that intermediate goods are not traded, i.e. $\tau^I_{rj} = \infty$ and $\tau^I_{rr} = 1$. Equation (AR-21) then reduces to

$$N_{rt} = \frac{1}{f_E}\frac{1-\beta}{\beta\rho}H_{rPt}N^{\lambda}_{rt-1},$$

which is the equation in the main text. Hence, in the absence of trade, local varieties only depends on local factor supply. Additionally, the labor market clearing condition in (AR-22) also simplifies to

$$L_{rt} = \frac{1}{\beta}H_{rPt} - (1-\delta)\, f_E N^{1-\lambda}_{rt-1}.$$

Hence, these two equations directly determine N_{rt} and H_{rPt} as a function of local labor supply. Local wages $\{w_{rt}\}$ are then determined from the general equilibrium condition (AR-23).

Free trade for intermediate goods: $\tau^I_{rj} = 1$ The other interesting special case is the one where intermediate goods are freely tradable. In that case, the free entry condition requires that

$$w^{\rho}_{rt} = \frac{1}{f_E}\frac{1-\beta}{\rho\beta}N^{\lambda}_{rt-1}\Phi_t, \tag{AR-24}$$

where $\Phi_t = \frac{\sum_j w_{jt}H_{jPt}}{\sum_j N_{jt}w^{1-\rho}_{jt}}$. Hence, local wages are independent of local factor supplies and directly tied to the existing number of varieties N_{rt-1}. Intuitively: If intermediate products are freely traded, profits are dissociated from local demand and are given by

$$\pi_{rt} = w^{1-\rho}_{rt} \times \Lambda_t,$$

where Λ_t is constant across space. The free entry condition requires that π_{rt} are tied to the entry costs, which are proportional to $w_{rt}N^{-\lambda}_{rt}$. Putting these together yields (AR-24). Given wages, the number of local varieties N_{rt} and the mass of production workers H_{rPt} are then determined from (AR-22) and (AR-23). However, note that local prices P_{rMt} are given by

$$P_{rMt} = \frac{1}{\mathcal{Q}_{rt}\left(\sum_{j\neq r} N_{jt}w^{1-\rho}_{jt}\right)^{\frac{1-\beta}{\rho-1}}}w^{\beta}_{rt},$$

i.e. relative prices across regions only depend in $\mathcal{Q}_{rt}$ and w_{rt} and not local market size. Even though local wages do not depend on the local population conditional on N_{rt-1} (see (AR-24)), a population shock does affect local wages through variety creation. In particular, an increase in L_{rt} will in general increase both H_{rPt} and N_{rt}.[52]

AR-1.6 The Model with Vertical Innovation

For the main analysis I used a model with horizontal innovation in the spirit of Romer (1990). To see that this focus on variety gains is a modeling device, in this section I consider a model with vertical innovations, i.e. improvements in quality, that delivers a very similar structure.

The setup is exactly as in the baseline model. The only difference is that the local intermediate input X_{rt} is given by

[52] For example. in a steady state $N_{rt} = N_{rt-1} = N_r$, the labor market clearing condition (AR-22) implies that $d\ln H_{rPt} = d\ln L_{rt}$ and $d\ln N_{rt} = \frac{1}{1-\lambda}d\ln L_{rt}$.

$$X_{rt} = \left(\int_0^1 z_{irt}^{\frac{1}{\rho_Z}} x_{irt}^{\frac{\rho_Z-1}{\rho_Z}} di\right)^{\rho_Z/(\rho_Z-1)},$$

where z_{irt} denotes the quality of input i at time t in region r and x_{irt} denotes the quantity. The number of firms in region r is normalized to unity and remains constant over time.

Firms have access to a technology that allows them to increase the quality of their products. Assume that to change the quality from z_{irt-1} to ϖz_{irt-1}, a firm needs to hire

$$h\left(\varpi; z_{irt-1}, Z_{rt-1}\right) = f_Z z_{it-1} \varpi^{\zeta} Z_{rt-1}^{-\lambda_Z}$$

units of labor, where $\zeta > 1$ and $\lambda_Z > 0$. Three comments are in order. First, note the dependence of innovation costs on z_{it-1} and Z_{rt-1}. Innovation costs are rising in z_{it-1}, reflecting the fact that quality improvements are more expensive the higher the base quality. Also, innovation costs are decreasing in Z_{rt-1} (provided that $\lambda > 0$), capturing the possibility of local innovation spillovers. Second, innovation costs are convex in ϖ. Third, I do not restrict $\varpi > 1$. This is for analytical convenience. As an economic justification, it captures the idea that firms need to spend some resources to keep their technology usable.

This model has almost the same implications as the baseline model. The profit of firm i with quality z_{it} in region r is given by

$$\pi_{irt} = \frac{1-\beta_Z}{\beta_Z \rho_Z} \frac{z_{irt}}{Z_{rt}} w_{rt} H_{rPt} \text{ where } Z_{rt} = \int z_{irt} di.$$

Hence, firms' optimal innovation choice is given by

$$\varpi_{rt}\left(z\right) \equiv \max_{\varpi} \left\{ \frac{1-\beta_Z}{\beta_Z \rho_Z} \frac{\varpi z}{Z_{rt}} w_{rt} H_{rPt} - f_Z z \varpi^{\zeta} Z_{rt-1}^{-\lambda_Z} w_{rt} \right\}.$$

The solution $\varpi_{rt}\left(z\right)$ is thus defined by

$$\frac{1-\beta_Z}{\beta_Z \rho_Z} \frac{1}{Z_{rt}} H_{rPt} = \zeta f_Z \varpi_{rt}\left(z\right)^{\zeta-1} Z_{rt-1}^{-\lambda_Z}.$$

Hence, $\varpi_{rt}\left(z\right) = \varpi_{rt}$ and $Z_{rt} = \varpi_{rt} Z_{rt-1}$. This implies that

$$\varpi_{rt} = \left(\frac{1-\beta_Z}{\beta_Z \rho_Z} \frac{1}{\zeta f_Z}\right)^{1/\zeta} H_{rPt}^{1/\zeta} Z_{rt-1}^{-\frac{1-\lambda_Z}{\zeta}}$$

and

$$Z_{rt} = \varpi_{rt} Z_{rt-1} = \left(\frac{1-\beta_Z}{\beta_Z \rho_Z} \frac{1}{\zeta f_Z}\right)^{1/\zeta} H_{rPt}^{1/\zeta} Z_{rt-1}^{1-\frac{1-\lambda_Z}{\zeta}}. \tag{AR-25}$$

The aggregate production function for the tradable good in region r is given by

$$Y_{rt} = \mathcal{Q}_{rt} \left(\frac{1-\beta_Z}{\beta_Z} \frac{\rho_Z - 1}{\rho_Z}\right)^{1-\beta_Z} Z_{rt}^{\frac{1-\beta_Z}{\rho_Z-1}} H_{rPt}.$$

Substituting (AR-25) yields

$$Y_{rt} = \varsigma_Z \mathcal{Q}_{rt} Z_{rt-1}^{\left(1-\frac{1-\lambda_Z}{\zeta}\right)\frac{1-\beta_Z}{\rho_Z-1}} H_{rPt}^{1+\frac{1}{\zeta}\frac{1-\beta_Z}{\rho_Z-1}}, \tag{AR-26}$$

where ς_Z is an inconsequential constant.[53]

To see the similarity between this model and the model in the main text, define $\mathcal{Z}_{rt} = Z_{rt}^{\zeta}$. (AR-25) then

[53] This constant is given by $\varsigma_Z = \left(\frac{1-\beta_Z}{\beta_Z} \frac{\rho-1}{\rho}\right)^{1-\beta_Z} \left(\frac{1-\beta_Z}{\beta_Z \rho} \frac{1}{\zeta f_Z}\right)^{\frac{1}{\zeta}\frac{1-\beta_Z}{\rho-1}}$.

implies that

$$\mathcal{Z}_{rt} = \left(\frac{1-\beta_Z}{\beta_Z \rho_Z}\frac{1}{\zeta f_Z}\right) H_{rPt}\mathcal{Z}_{rt-1}^{1-\frac{1-\lambda_Z}{\zeta}}. \tag{AR-27}$$

Similarly, (AR-26) reads

$$Y_{rt} = \varsigma_Z \mathcal{Q}_{rt}\mathcal{Z}_{rt-1}^{\left(1-\frac{1-\lambda_Z}{\zeta}\right)\frac{1}{\zeta}\frac{1-\beta_Z}{\rho_Z-1}} H_{rPt}^{1+\frac{1}{\zeta}\frac{1-\beta_Z}{\rho_Z-1}}. \tag{AR-28}$$

In the baseline model, the production function and the law of motion for N_{rt} are given by (see (8) and (7))

$$\begin{aligned} Y_{rMt} &= \varsigma \mathcal{Q}_{rt} N_{rt-1}^{\lambda\frac{1-\beta}{\rho-1}} H_{rPt}^{1+\frac{1-\beta}{\rho-1}} \\ N_{rt} &= \frac{1-\beta}{\rho\beta}\frac{1}{f_E} H_{rPt} N_{rt-1}^{\lambda}. \end{aligned}$$

Hence, the law of motion for productivity and the aggregate production function are isomorphic as long as

$$1-\lambda_Z = (1-\lambda)\zeta \tag{AR-29}$$

$$\frac{1}{\zeta}\frac{1-\beta_Z}{\rho_Z-1} = \frac{1-\beta}{\rho-1}. \tag{AR-30}$$

In terms of equilibrium labor allocations, it is easy to verify that the share of production workers $\left(H_{rPt}/H_{rt}^M\right)$, innovation workers $\left(H_{rZt}/H_{rt}^M\right)$ and workers for intermediate production $\left(H_{rXt}/H_{rt}^M\right)$ satisfy

$$s_{rPt} = \frac{\beta_Z}{1-\frac{1-\beta_Z}{\rho_Z}\frac{\zeta-1}{\zeta}} \quad s_{rXt} = \frac{\beta_Z}{1-\frac{1-\beta_Z}{\rho_Z}\frac{\zeta-1}{\zeta}}\frac{\rho_Z-1}{\rho_Z}\left(\frac{1-\beta_Z}{\beta_Z}\right) \quad s_{rZt} = \frac{\beta_Z}{1-\frac{1-\beta_Z}{\rho_Z}\frac{\zeta-1}{\zeta}}\frac{1-\beta_Z}{\rho_Z\beta_Z}\frac{1}{\zeta}.$$

Hence, the allocation of workers across activities within the manufacturing sector is constant. This is the only implication, which is different in the baseline model, if varieties are long-lived. However, if $\delta = 1$ and varieties depreciate fully, the baseline model implies that

$$s_{rPt}^{Base} = \beta \quad s_{rXt}^{Base} = \beta\frac{\rho-1}{\rho}\left(\frac{1-\beta}{\beta}\right) \quad s_{rEt}^{Base} = \beta\frac{1-\beta}{\rho\beta}.$$

Note that the equilibrium allocation only depend on H_{rPt}. Hence, the equilibrium path is exactly the same in both models as long

$$\beta = \frac{\beta_Z}{1-\frac{1-\beta_Z}{\rho_Z}\frac{\zeta-1}{\zeta}}. \tag{AR-31}$$

For given parameters in the baseline model, we can hence find λ_Z, ρ_Z and β_Z to satisfy the restrictions (AR-29), (AR-30) and (AR-31) while still ensuring that $\zeta > 1$, $0 < \beta < 1$ and $\rho > 1$.