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The Role of Local Public Goods for Gender Gaps in the Spatial Economy

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Abstract

We assess the role of local public goods provision for gender gaps in the labour market. We find that higher fiscal revenues of local governments are associated with decreasing gender employment gaps in German labour market areas because it decreases labour supply for male workers at a higher rate than for female workers. The results are robust when we include instrumental variables that address the endogeneity of local public goods provision. To assess the impact of fiscal transfers across regions on gender gaps we quantify a spatial general equilibrium model with multiple types of workers, who are differently affected by local public goods provision in their labour supply decision. We find that transfers reduce disparities across regions. This goes along with smaller gender gaps in employment in treated regions because female workers are disproportionately pulled into market work and regions with low productivity.

Key words: gender, local public goods, labor force participation, taxes, transfers.

JEL classification: H4, H7, J1, J2, J6, R2, R5

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A Introduction

Despite substantial convergence in labour market outcomes across gender over the last decades, there are still wide discrepancies between male and female workers, especially concerning their labour market attachment (Goldin, 2014). To better accommodate female labour supply, many governments invest massively in their public childcare infrastructure (Blau and Currie, 2006; Olivetti and Petrongolo, 2017). Local governments, however, often lack sufficient fiscal resources to invest in the provision of public goods, such as child care. As a result, many countries shift substantial public resources across jurisdictions (Henkel et al., 2021) to ease budget constraints and provide public goods at the local level. These circumstances raise several important questions: What is the role of local public goods in explaining spatial differences in male-to-female employment rates (henceforth, gender employment gaps)? How does the provision of local public goods affect the distribution of economic activity across space? What are the aggregate consequences of public policies for welfare and gender gaps?

In this paper, we study these issues by investigating the impact of local tax revenues after redistribution (henceforth, fiscal capacities) on gender employment gaps and the distribution of economic activity across German labour markets. Our analysis consists of three parts. In the first part, we develop a quantitative spatial model with heterogeneous workers and intergovernmental transfers. The theoretical model features selective sorting across local labour markets and sectors as well as extensive labour supply decisions of female and male workers. In the second part, we employ individual employment and wage data from social security records, together with unique data on tax revenues and transfers at the local level, to structurally estimate the model parameters. In particular, we use infrastructure investments in local childcare as instruments for local fiscal capacities to assess the effect of local public goods provision on the labour supply decisions of heterogeneous workers in the spatial economy. The third step concerns policy analysis: we use the estimated parameters and the model structure to simulate counterfactual policy experiments. In a scenario without fiscal equalization, there are substantial shocks to fiscal capacities because solely tax revenues at the local level finance the provision of public goods. In doing so, we quantify the aggregate economic consequences from local public goods provision on the employment decisions of female and male workers and characterize the spatial implications of fiscal transfers for gender employment gaps.

Identifying the effects of fiscal capacity shocks on employment rates is challenging. Theoretically, there are different channels through which changes in local tax revenues and public goods provision could affect the labour supply decision of heterogeneous workers. On the one hand, there is a trade-off between public goods provision and labour force participation. Financing local public goods requires higher tax rates, which disincentivizes workers to supply labour by decreasing real wage income (henceforth, the "income effect"). On the other hand, there is a long empirical literature (see "Related Literature" below) that documents how a higher provision of different components of local public goods may increase labour force participation, especially for female workers (henceforth, the "substitution effect"). For example, a higher availability or affordability of public childcare increases the opportunity costs of young parents to raise their children privately and facilitates their return to the workplace (Blau and Currie, 2006). In our theoretical framework, each worker, therefore, faces an individual-specific trade-off between remaining in the home-market sector and supplying labour because employment is costly, or workers dislike to work (Fajgelbaum et al., 2019; Chauvin, 2018). As a shortcut to the substitution effect, we further allow this trade-off to depend on the level of local public goods, such that higher public goods provision pulls workers into employment.

From a theoretical point of view, it is unclear which of these effects dominate such that the total impact of fiscal shocks on local employment rates is ambiguous ex-ante. First, higher tax rates are likely to reduce employment for female and male workers via the income effect. However, when only higher fiscal transfers shift fiscal revenues, local labour force participation rates are not affected as workers in donor regions bear the tax burden. Third, the substitution effect could attenuate the initial negative employment effect. Furthermore, as long as the substitution effect is substantially higher for female than male workers, higher public good provision is likely to adversely affect female employment to a smaller extent than for male workers, reducing gender employment gaps. Fourth, by affecting the relative attractiveness of a region, fiscal shocks induce workers to move to other locations. In our theoretical model, only employed workers are free to move across space and sectors, whereas non-employed workers receive cash transfers that constrain them to their place of residence. As long as migration responses are higher for male workers (Ahlfeldt et al., 2020), positive fiscal capacity shocks are then likely to increase gender employment gaps. Besides, the spatial economy might be affected by various externalities that individuals do not recognize when making location decisions. For instance, individuals overlook their impact on others via different agglomeration and congestion forces as well as of their labour supply decision on the provision of public goods. By reducing over-congestion in cities and pulling female workers into market work, public policies that are location-specific may therefore actually mitigate rather than exacerbate misallocations and gender employment gaps.

We take our model to the data to investigate the employment effects of local public goods provision and fiscal transfers in practice. The quantification of the model is demanding because it requires us to break down tax revenues from several governmental layers (Federal, States, and local municipalities) to the local level and identify the actual degree of fiscal transfers (within and between the Federal States). To obtain empirical proxies of the average tax and transfer rates, we follow Henkel et al. (2021) to compute for every district local tax revenues before and after redistribution (and hence net transfers). Our approach assigns these aggregate variables to the 141 German local labour markets (*Arbeitsmarktregionen*) and relates them to local value-added. Our numbers suggest that despite substantial redistribution of around 10 percent of aggregate tax revenues per year, there are wide discrepancies of local fiscal capacities per capita across local labour markets. Peripheral regions (especially in former East Germany) have higher fiscal capacities per capita. For example, in Berlin, annual fiscal revenues per capita exceed $12,000$ euros. Rural regions in western and southern Germany comprising the set of net contributors tend to have resources at their disposal that are up to 20 percent smaller (or $2,500$ Euro per annum and inhabitant).

To structurally estimate the gender-specific impact of local public goods on (non-) employment rates, we leverage the time variation within German labour market areas' employment rates induced by fiscal capacity shocks. The German setting is ideal to analyze the effect of fiscal shocks on gender-specific employment since there is substantial remaining variance in gender-specific employment rates across local labour markets. Most importantly, the spatial variation in transfers across the 141 German local labour markets is not affected by gender-specific employment outcomes. Time-varying preference shocks, however, pose a challenge for causal identification. They would shift out local labour supply and correlate with fiscal capacity as well as price level shocks. Building upon Fajgelbaum et al. (2019) and Colas and Hutchinson (2021) we, therefore, construct two sets of instrumental variables to address these endogeneity concerns: First, we use time variation in the inverse-distance-weighted average of childcare rates in all neighbouring regions to construct an instrument. Furthermore, we leverage the variation in exposure to national tax revenue shocks by tax type (for example, housing, VAT, business, or income tax revenues) across labour market regions to construct Bartik-style instruments.

Our IV estimates imply that a positive fiscal capacity shock affects labour supply of female and male workers differently. The substitution effect almost cancels out the income effect for female workers and is fifty percent larger than the male workers' estimate. In other words, increases in employment rates for male workers are subdued in regions that experience large increases in local fiscal revenues, but female labour force participation is barely affected by fiscal capacity shocks. As a result, the IV estimates predict declining gender employment gaps in response to positive fiscal capacity shocks. Our estimates imply that an increase in fiscal capacity per capita by 1 percent decreases differences in male-to-female non-employment by about 1.22 percent. As a result, the average real tax revenue increase of about 14 percent between the years 2008 to 2014, our main observation period, decreased non-employment gaps in local labour markets by around 1.34 percentage points (relative to an initial non-employment gap of on average 7.86 percentage points in 2008).

In our counterfactual scenario, where we abolish the fiscal transfer system, we observe migration out of the former recipient and towards the former donor regions. In parallel, we find smaller gender employment gaps but larger wage gaps compared to the initial equilibrium. With our baseline specification, our counterfactual simulations imply that gender employment gaps would increase by 2.6% in former recipient regions (mainly in Eastern Germany), and wage gaps increase by 0.1% in the transition to a new long-run spatial equilibrium. The biggest metropolitan areas such as Frankfurt or Munich would see decreases in employment gaps, whereas wage gaps increase for all regions. We find that welfare slightly decreases between the two equilibria. Summing up, our baseline counterfactual suggests that fiscal redistribution of local tax revenues tends to (marginally) widen overall gender employment gaps in employment.

Related literature. Recent empirical literature documents how a higher provision of different components of local public goods increases labour force participation, especially of female workers. Indeed most of the empirical literature tends to find significant positive effects of the availability of public childcare facilities on labour supply decisions, particularly of young mothers (see Blau and Currie (2006) and Olivetti and Petrongolo (2017) for an overview). Besides, public spending on nursing home places for the elderly has positive employment effects for older women since they are more likely to care for their elderly relatives (Bolin et al., 2008; Carmichael and Charles, 2003; Crespo and Mira, 2014). Finally, investments in public transport infrastructure via decreased commuting costs (Le Barbanchon et al., 2021; Black et al., 2014; Liu and Su, 2021), faster broadband internet facilitating working from home and increasing worker productivity (Dettling, 2017; Bloom et al., 2015; Burstein et al., 2019), health care through improving access to fertility treatment (Moreno-Maldonado and Santamaria, 2021), or access to job centers (Kunze and Troske, 2012) may have higher positive employment effects for female workers. This paper bridges a gap between this empirical literature, which credibly identifies causal effects of public policies on extensive labour supply, and general equilibrium models, which allow making predictions about counterfactual outcomes and welfare in the spatial economy.

In doing so, this paper adds to the literature on quantitative spatial models. It builds upon the class of quantitative spatial models featuring occupational sorting under worker heterogeneity and type-specific comparative advantage (Burstein et al., 2019, 2020; Hsieh et al., 2019; Lagakos and Waugh, 2013; Lee, 2020). But, we extend this framework in two directions: First, we add regional sorting of heterogeneous workers to incorporate recent advances in the quantitative spatial economics literature (Allen and Arkolakis, 2014; Ahlfeldt et al., 2015; Monte et al., 2018; Bryan and Morten, 2018; Heblich et al., 2020). More importantly, in this paper, we model the extensive labour supply decisions of heterogeneous workers. In our setting, female workers disproportionally profit from increases in local fiscal capacities and the provision of local public goods by pulling them into employment. So far, the literature mainly abstracts from non-employment, while incorporating it affects the policy implications drawn from public policies (Bilal, 2020).

Besides the already mentioned literature, our paper also closely relates to the literature on the effect of local taxes and transfers on the spatial sorting of workers (Bastani et al., 2020; Colas and Hutchinson, 2021; Fajgelbaum and Gaubert, 2020) and firms (Fajgelbaum et al., 2019; Serrato and Zidar, 2016). The effect of fiscal capacity shocks on employment is closest to the macroeconomic literature using geographic variation in fiscal expenditures over time to estimate multipliers. Chodorow-Reich (2019) gives a thorough review of the literature, which mainly covers the 2008 crisis and the American Recovery and Reinvestment Act. Another strand of literature has focused on the spillovers of local public employment on private sector employment driven by increases in local expenditures (Faggio and Overman, 2014; Moretti, 2010; Guillouzouic et al., 2021) or local amenity spillovers as in Becker et al. (2021). In this paper, we argue that the employment effects of fiscal shocks may be higher for female than male workers. It has been widely documented in the literature that different selection and sorting of male and female workers account for a large part of the remaining gender gaps across local labour markets and occupations (see Blau and Kahn (2017); Olivetti and Petrongolo (2014) and Black and Spitz-Oehner (2010); Calvo et al. (2021) for Germany). However, the aggregate implication of the allocation of female and male workers across local labour markets and market sectors for the economy remains unclear. We add to this literature by showing how the provision of public goods affects selection and gender convergence in general equilibrium.

The rest of the paper reads as follows. Section B describes the institutional setting of local public goods provision and fiscal equalization in Germany. Further, it presents empirical evidence on a negative relationship between gender employment gaps and fiscal capacities at the local level. We introduce the spatial model with heterogeneous agents and fiscal transfers in Section C. Section D describes our data Section, while section E explains how we quantify the model for Germany. The counterfactual analysis is presented in Section F and Section G concludes.

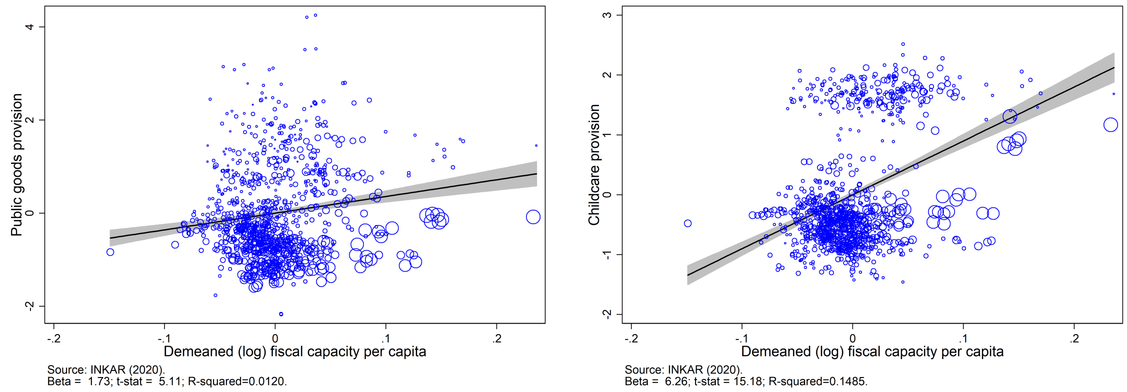
B Institutional Background and Motivating Facts

Article 28 of the German constitution provides the legal basis for regulating local public goods provision in Germany. It guarantees cities, municipalities, and districts the right of local self-government. As a result, they care for everything that neither the 16 State governments (the "Länder") nor the Federal government are responsible for. At the same time, federal or state laws regulate that the municipalities have to provide their citizens with specific public goods. These include, for example, childcare, elementary schools, drinking, and sewage supply, energy and waste management, a fire department, municipal elections, and social institutions. More specifically, municipalities have to build and maintain a sufficient number of kindergartens, nurseries, schools and other child care facilities, but how they do this is their own decision. The financial needs of municipalities then depend on the size and demographic composition of their population.

Lower fiscal revenues limit municipalities in providing local public goods, whereas larger fiscal capacities allow higher public spending. Panel (a) of Figure 1 highlights this relationship. Fiscal capacities per capita are normalized by the working-age population in 2008 and demeaned by their yearly average. The positive relationship indicates that a higher budget of local governments allows providing more public goods. When fiscal budgets are tight, there is no alternative but to save on the provision and maintenance of local public goods, like libraries, swimming pools, parks, youth centers, nurseries, and retirement homes.[1] As a case in point, Panel (b) of Figure 1 highlights the importance of

[1]The financial situation of some municipalities deteriorated when Germany introduced the so-called

Figure 1: Public goods provision and local fiscal capacities per capita



(a) Public goods provision

(b) Childcare provision

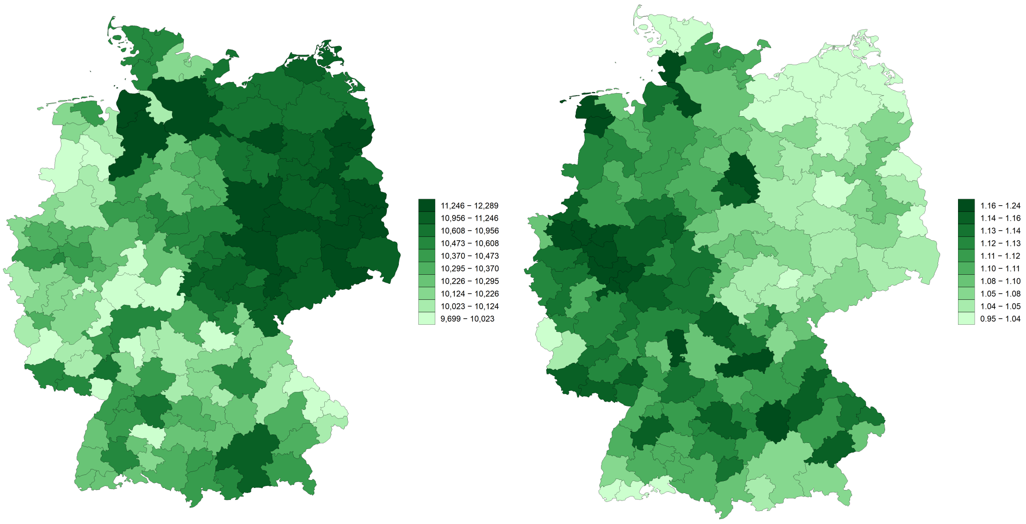
Note: Panel (a) plots an aggregate measure of local public goods provision against fiscal capacity per capita, normalized by the working-age population in 2008 and demeaned by their yearly average. Panel (b) links fiscal capacities per capita to a measure of childcare provision. We use available tax revenues after fiscal redistribution to measure fiscal capacities. Local tax revenues and transfer payments are based on our calculations. We follow the approach in Henkel et al. (2021) to calculate fiscal capacities as the sum of local tax revenues before redistribution and regional transfer payments (that is negative for donors and positive for recipients). Public goods and childcare provision are the outcomes of a first principal component analysis on different measures of public good provision, including, among others, various measures of local public childcare in nurseries and kindergartens, access to fast broadband internet, public transport, and highway infrastructure, as well as investment in retirement homes, local recreational areas, or waste management. See section D of the main paper for details. The size of the marker is proportional to the regional population size in 2008. Data comes from INKAR (2020) and Statistisches Bundesamt (2021b,a); Statistische Ämter des Bundes und der Länder (2021).

sufficient fiscal capacities for local governments to provide public childcare.

To ensure that the local jurisdictions have sufficient fiscal capacities the Federal government and States distribute tax revenues across the different government layers and allocate them to the single States and municipalities according to a complicated set of rules. The legal basis provides Article 72 of the German Constitution according to which living conditions should be "equivalent" across the country. But, despite large-scale fiscal transfers from the Federal government to the States and local jurisdictions in the size of around 53.5 billion Euro per year (that is 10 percent of the aggregate tax revenue), there are still profound and persistent spatial disparities (see Henkel et al. (2021)). Panel (a) of Figure 2 shows considerable variation in the local tax revenues per capita after redistribution - both across and within States. As can be seen, the fiscal equalization scheme in Germany endows peripheral regions (especially in former East Germany) with higher fiscal capacities per capita. Here, annual local tax revenues per capita exceed 12,000 euros (for example, in Berlin, the nation's capital). By contrast, rural regions in western and southern Germany tend to have fiscal resources that are up to 20 percent smaller (or 2,500 Euro per annum and inhabitant).

"Schuldenbremse" in 2009. Since then, Article 109 of the German constitution explicitly prescribes the principle of a balanced budget without net borrowing in a given year for the federal and state governments. Moreover, Article 115 of the Constitution limits net borrowing at the federal level to 0.35 % of national GDP; see Busch and Strehl (2019) for an overview.

Figure 2: Spatial disparities



(a) Fiscal capacities per capita (b) Gender employment gaps

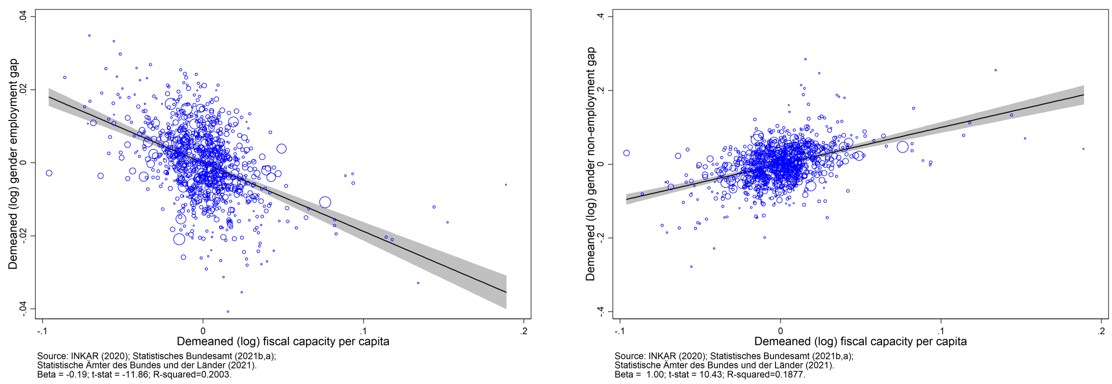
Notes: This figure plots the geographical pattern of fiscal capacities per capita in Panel (a) and of employment gaps in Panel (b) across the 141 German local labour markets (Kosfeld and Werner, 2012) for the years 2008 − 2014. We follow the approach in Henkel et al. (2021) to calculate fiscal capacities as the sum of local tax revenues before redistribution and regional transfer payments (that is, negative for donors and positive for recipients). The gender employment gap measures male-to-female employment rates. The employment rate measures the number of female (male) workers in the labour force relative to the total number of females (males) in the working-age population (15-65 years). Data comes from the INKAR (2020) database. Darker shading indicates higher values.

At the same time, as Panel (b) of Figure 2 documents, there are still substantial differences in gender employment gaps across German local labour markets. Female employment rates are higher in the Eastern and Southern parts of Germany. For example, rates exceed 84 percent along the Swiss border leading to lower gender employment gaps. Some cities of the Ruhr Area, on the other hand, have far lower female employment rates and higher gender employment gaps, for example, Bochum with less than 70 % of women in employment.

Besides these profound disparities, there exists a negative (positive) relationship between fiscal capacities per capita and gender (non-)employment gaps across German local labour markets. Figure 5 shows that gender (non-)employment gaps decrease (increase) in fiscal capacity per capita. It plots the gender (non-)employment gaps against fiscal capacity per capita, normalized by the working-age population in 2008. Both variables are demeaned by their 2008-2014 regional mean and set relative to the yearly average. Figure 1 in the Online Appendix H shows the underlying employment effects for female and male workers separately.

Identifying a causal effect imposes one fundamental challenge: the change in local

Figure 3: Gender employment gaps and local fiscal capacities per capita



(a) Employment gaps

(b) Non-Employment gaps

Note: This figure plots demeaned log (non-)employment gaps (relative to the regional and year specific mean) against the identically demeaned fiscal capacity per capita. Both variables are normalized by the working-age population in 2008. Fiscal capacities measure available tax revenues after fiscal redistribution. Local tax revenues and transfer payments are based on own our calculations. We follow the approach in Henkel et al. (2021) to calculate fiscal capacities as the sum of local tax revenues before redistribution and regional transfer payments (that is, negative for donors and positive for recipients). The gender (non-)employment gap measures male-to-female (non-)employment rates. The employment rate measures the number of female (male) workers in the labour force relative to the total number of females (males) in the working-age population (15-65 years) in the local labour market. The size of the marker is proportional to the regional population size in 2008. Data comes from INKAR (2020) and Statistisches Bundesamt (2021b,a); Statistische Ämter des Bundes und der Länder (2021).

fiscal capacities must be exogenous to labour supply shocks. In the empirical part of the paper, we address this endogeneity concern by using several instrumental variables on the regional level. In the next section, we move forward and set up a quantitative model featuring heterogeneous workers that react differently to fiscal revenue shocks and local public goods provision in extensive labour supply to motivate our empirical approach and the choice of instrumental variables.

C A Quantitative Spatial Model with Extensive Labour Supply of Heterogeneous Workers

We develop a quantitative spatial general equilibrium model featuring sorting of heterogeneous workers across local labour markets (Diamond, 2016; Rossi-Hansberg et al., 2019), local governments supplying local public goods (Fajgelbaum et al., 2019; Henkel et al., 2021), and extensive labour supply decisions of heterogeneous worker groups (Chauvin, 2018) in a unified framework. We add selection into occupational sectors based on comparative advantage or type-specific preferences (Hsieh et al., 2019; Burstein et al., 2020).

The economy consists of J regions and S sectors (one of which is the home market sector). There is a continuous mass of workers L in the economy with a total number of L^g workers bound to a specific type $g \in G$. After deciding whether to work in any of the M market sectors, employed workers move freely across regions and sectors. They decide on the workplace depending on where to achieve the highest utility given each worker's level of human capital and preferences.

C.1 Workers

Preferences. Each worker ω of type g derives utility from the consumption of local final goods, local public goods, and from working and living in a given region $i \in J$ and sector $s \in S$. To maximize utility the budget-constrained worker chooses consumption bundles $C_{i,su}$ of local final consumption goods at prices $P_{i,u}$ in all market sectors $u \in \{1, ..., M\}$ according to

$$V_{i,s}^{g}(\omega) \equiv \max_{\{C_{i,su}^{g}(\omega)\}_{u=1}^{M}} \eta_{i,s}^{g} \left(\frac{R_i}{L_i^{\chi}}\right)^{\alpha} \left[\prod_{u=1}^{M} (C_{i,su}^{g}(\omega))^{\beta_u}\right]^{1-\alpha} \quad \text{s.t.} \quad \sum_{u=1}^{M} P_{i,u} C_{i,su}^{g}(\omega) = I_{i,s}^{g}(\omega),$$

with shares β_u over the consumption of local final goods satisfying $\sum_{u \in M} \beta_u = 1$. $\eta_{i,s}^{g}$ is a region-sector-specific preference component varying across worker types. R_i/L_i^{χ} denotes the utility derived from a local public good R_i in region i, where α is the preference weight of the government sector and $\chi \in (0, 1)$ governs the extent of public goods rivalry.

Consumption. Denoting as $I_{i,s}^{g}(\omega)$ the after-tax income of worker ω employed in region i and sector s we solve for the competitive equilibrium allocation for this problem, such that

$$C_{i,su}^{g}(\omega) = \beta_u \frac{I_{i,s}^{g}(\omega)}{P_{i,u}}, \tag{1}$$

which is increasing in individual income but decreasing in local prices.

Preference shifters. The preference shifter $\eta_{i,s}^{g}$ is a function of a component common to workers in all sectors, which we term "amenities" A_i^{g}, as well as a region-sector-specific part, such that

$$\eta_{i,s}^{g} = A_i^{g} \exp\left[-\mu_{i,s}^{g}\right]. \tag{2}$$

We assume that workers in region i incur positive sector-specific participation costs $\mu_{i,s}^{g} \geq 0$ in terms of utility units when joining either of the sectors. Staying in the home market sector imposes no participation costs, such that we normalize $\mu_{i,h}^{g} = 0$ for all regions $i \in J$ and groups $g \in G$. To account for the fact that workers of different gender have varying preferences for regions (Ahlfeldt et al., 2020) and occupations (Wiswall and Zafar (2018)), we allow amenities and participation costs to differ by worker group. Theoretically, this may come from gender-specific differences in the preferences for flexible hours (Erosa et al. (2017); Wasserman (2019), non-convexities of hourly labour supply (Cha and Weeden, 2014; Cubas et al., 2019)), or the possibility of working from home (Dingel and Neiman (2020)).

Substituting the equilibrium values from (1) in the utility function, we can write the indirect utility for a worker ω of type g working in occupation s and living in region i as a function of the real wage, local public goods and the preference parameter $\eta^g_{i,s}$:

$$V^g_{i,s}(\omega) = \eta^g_{i,s} \left(\frac{R_i}{L^{\chi}_i}\right)^{\alpha} \left[\frac{I^g_{i,s}(\omega)}{P_i}\right]^{1-\alpha}, \tag{3}$$

with $P_i = \prod_{u=1}^{M} (P_{i,u}/\beta_u)^{\beta_u}$ the region-specific price index.

C.2 Market sectors

In a first stage, all workers decide on whether to join the labour force or remain in the home market sector, incorporating an optimal choice of employment in any of the $N * M$ heterogeneous region-sector pairs in the second stage. This modelling choice endogenizes the local number of workers in the home market $L^g_{i,h}$ and the market sectors $L^g_{i,m}$. Aggregate labour market clearing ensures that

$$L^g = \sum_{i\in J} \left(L^g_{i,h} + L^g_{i,m}\right) = \sum_{i\in J} \left(L^g_{i,h} + \sum_{s\in M} L^g_{i,s}\right).$$

Heterogeneous human capital. Employed workers of a given type differ with respect to their individual-specific human capital level. In the following we denote the idiosyncratic human capital level of a worker of type g living and working in region i and sector s as $\Psi^g_{i,s}(\omega) \equiv \Psi^g_d(\omega)$. The human capital level is composed of the individual ability level $a \in \mathcal{A}$ of each worker, and the acquired education level $e \in \mathcal{E}$. The distribution of individual-specific ability a does not differ across workers of different types g. Workers of different types, however, differ with respect to their opportunity costs of acquiring human capital for working in specific sectors. Hence, we model the heterogeneity of employed workers as the result of random human capital draws coming from a type-specific Fréchet distribution:

$$F^g(\tilde{\Psi}_1, ..., \tilde{\Psi}_D) = \exp\left\{-\sum_{s=1}^{S}\sum_{i=1}^{J}[\tilde{\Psi}_{i,s}]^{-\theta^g}\right\}, \tag{4}$$

with $\theta^g > 1$ and $\tilde{\Psi}_{i,s} = \Psi^{1-\alpha}_{i,s}$. The shape parameter of the Fréchet distribution governs the dispersion of random human capital draws inside each region-sector pair. For high values of θ^g there is low variance in the idiosyncratic draws. The parameter θ^g then governs the size of *within-type comparative advantage* in the spirit of Eaton and Kortum (2002).

Selection and Sorting. After having decided on whether to join the labour force, each employed worker ω of type g receives human capital draws for all market sectors according to distribution (4). Associated with these human capital draws is a level of potential wages in each sector and region. Next, given their human capital draws and the preference shifters for all region-sector pairs $\{i,s\}$ all employed workers jointly and simultaneously decide to move to the specific occupation s and local labor market i that maximizes their utility (3), such that worker ω's indirect utility after selection and sorting is $\mathcal{V}^g_{i,s}(\omega) = \max_{i \in N, s \in S} V^g_{i,s}(\omega)$.

Worker Compensation. The wage income of employed workers is given by

$$W^g_{i,s}(\omega) \equiv \tilde{w}^g_{i,s} T^g_{i,s} \Psi^g_{i,s}(\omega), \tag{5}$$

where $T^g_{i,s} > 0$ governs the average human capital of workers of type g in region i for sector s and $\tilde{w}^g_{i,s}$ is the wage per effective unit of labour. To account for the fact that female and male workers might differ concerning their average educational level in some region-sector pairs, we allow the average human capital levels to differ across gender (Greenwood et al., 2016).

Using the properties of the Fréchet distribution, average wages of employed workers in sector s and local labor market i are given by

$$\begin{aligned} W^g_{i,s} &\equiv E\left[\left(W^g_{i,s}(\omega)\right)^{1-\alpha}\right]^{\frac{1}{1-\alpha}} = E[\tilde{\Psi}^g_{i,s}(\omega)]^{\frac{1}{1-\alpha}} T^g_{i,s}\tilde{w}^g_{i,s} \\ &= H^g_{i,s}\tilde{w}^g_{i,s} = \left(\gamma^g \left[\frac{\left(T^g_{i,s}\tilde{w}^g_{i,s}\right)^{(1-\alpha)\theta^g}}{(L^g_{i,s}/L^g_m)}\right]^{\frac{1}{\theta^g}}\right)^{\frac{1}{1-\alpha}}, \end{aligned}$$

where $\gamma^g = \Gamma\left((\theta^g - 1)/\theta^g\right)$, $\Gamma(\cdot)$ denotes the Gamma function and $L^g_{i,s}/L^g_m$ represents the allocation of employed labour across sectors and local labour markets.

Average wages increase in the average human capital and wages per efficiency unit but decrease in the share of workers. This negative selection effect describes how changes in the within-type composition affect the average human capital level. A higher between-type comparative advantage $T^g_{i,s}$ attracts more workers, but also from the lower parts of the human capital distribution. As a result, the average human capital level $H^g_{i,s}$ decreases in the share of workers self-selecting into occupation s in region i (see Appendix I.1 for details). Wage income is taxed at the local rate $\mathcal{T}_i$ in region i to finance local public goods as well as transfers, such that after-tax income of employed workers is $I^g_{i,s}(\omega) = (1-\mathcal{T}_i)\, W^g_{i,s}(\omega)$.

Expected utility. Using the fact that the maximum of a Fréchet-distributed random variable is itself Fréchet distributed, we derive the expected indirect utility of type-g workers in the market sectors as

$$\mathcal{V}^g = \Gamma\left(\frac{\theta^g - 1}{\theta^g}\right)\left(\sum_{s\in M}\sum_{i\in J}\left[\left((1-\mathcal{T}_i)\,\tilde{w}^g_{i,s}T^g_{i,s}\,(P_i)^{-1}\right)^{1-\alpha}\eta^g_{i,s}R^\alpha_i L_i^{-\chi\alpha}\right]^{\theta^g}\right)^{\frac{1}{\theta^g}}, \tag{6}$$

which is increasing in real wages, local public goods, and preference shifters in all region-sector pairs. Perfect worker mobility ensures that expected utility in the market sectors is equalized everywhere in the economy.

Labor supply. Given the assumptions on the functional form of the human capital distribution, we get closed-form solutions for labour supply in spatial equilibrium. The number of workers of type g employed in region i and market sector s is:[2]

$$L_{i,s}^{g} = \frac{\left[\left(\left(1-\mathcal{T}_i\right)\tilde{w}_{i,s}^{g}T_{i,s}^{g}\left(P_i\right)^{-1}\right)^{1-\alpha}\eta_{i,s}^{g}R_i^{\alpha}L_i^{-\chi\alpha}\right]^{\theta^g}}{\sum_{s\in M}\sum_{i\in J}\left[\left(\left(1-\mathcal{T}_i\right)\tilde{w}_{i,s}^{g}T_{i,s}^{g}\left(P_i\right)^{-1}\right)^{1-\alpha}\eta_{i,s}^{g}R_i^{\alpha}L_i^{-\chi\alpha}\right]^{\theta^g}} L_m^g. \tag{7}$$

The attractiveness of region-sector pairs increases in type-specific preferences $\eta_{i,s}^{g}$, local public goods, and real wages, which in turn are a function of average human capital, wages per efficiency unit, and regional price levels.

C.3 Home market sector

In the first stage, all workers L^g decide whether to work in one of the M market sectors or the home market sector. All workers $L_h^g = \sum_{i\in J} L_{i,h}^g$ in the home market sector receive a cash transfer $\bar{I} > 0$ from their local government instead of a market wage. The transfers for non-employed workers are assumed to be constant across labour markets as well as groups of workers and can be used for local consumption. Non-employed workers who switch regions get no cash transfer from local governments and in turn cannot consume, which ensures that it is never worthwhile for them to move across local labour markets.

Extensive labour supply Building upon eq. (3) the indirect utility of home market workers of type g in region i is given as

$$V_{i,h}^{g}(\omega) = \eta_{i,s}^{g}\left(\omega\right)\left(\frac{\bar{I}}{P_i}\right)^{1-\alpha}\left(\frac{R_i}{L_i^{\chi}}\right)^{\alpha} = A_i^g\left(\frac{\bar{I}}{P_i}\right)^{1-\alpha}\left(\frac{R_i}{L_i^{\chi}}\right)^{\alpha}\varphi_i^g\left(\omega\right), \tag{8}$$

where we assume that the indirect utility of home market workers is shifted by an individual preference shifter $\varphi_i^g\left(\omega\right)$. Workers join the home market sector as long as achievable indirect utility (8) exceeds expected utility in the market sectors (6), such that there exists a unique local cut-off level for preference shocks $\bar{\varphi}_i^g$ below which all workers join the labour force:

$$\bar{\varphi}_i^g = \frac{\mathcal{V}^g}{A_i^g\left(\frac{\bar{I}}{P_i}\right)^{1-\alpha}\left(\frac{R_i}{L_i^{\chi}}\right)^{\alpha}}. \tag{9}$$

[2]The probabilities in (7) follow a similar form as the choice probabilities in discrete choice models under Generalized Extreme Value (GEV) distributions (Mcfadden, 1974). See section I.1 in the Online Appendix for details.

Intuitively the cut-off increases in the size of wages, amenities, and public goods in all regions and sectors of the economy relative to those amenities and public goods achievable in region i. Worker groups with high average wages have higher cut-offs, leading to fewer workers in the home market sector.

Idiosyncratic preferences are drawn from a Pareto distribution with a type-specific cumulative distribution function and region-specific scale parameter $B^g_{i,h}$:

$$G^g(\varphi) = 1 - \left(\frac{\varphi}{B^g_{i,h}}\right)^{-\epsilon^g},$$

with $\epsilon^g, B^g_{i,h} > 0$. Under these functional assumptions, the extensive labour supply of all types of workers in the market sectors is given as:

$$L^g_{i,m} = G^g(\bar{\varphi}^g_i)\, L^g_i = \left[1 - \left(\frac{\mathcal{V}^g}{A^g_i B^g_{i,h} \left(\frac{\bar{I}}{P_i}\right)^{1-\alpha} \left(\frac{R_i}{L^X_i}\right)^{\alpha}}\right)^{-\epsilon^g}\right] L^g_i. \tag{10}$$

The group-specific shape parameter of the Pareto distribution ϵ^g governs the size of group-specific labour supply adjustments following shifts in the cut-off $\bar{\varphi}^g_{i,h}$ as defined in (9). The elasticity ϵ^g can be decomposed into a group-invariant and an group-varying component, such that $\epsilon^g = \bar{\epsilon} + \tilde{\epsilon}^g \quad g \in M, F$. Finally, we take male workers as the reference group and normalize $\tilde{\epsilon}^M = 0$.

Local public goods and cut-offs. Inspired by the reduced-form evidence highlighted in section B we allow the scale parameter of the preference distribution to be a function of local public goods:

$$B^g_{i,h} = \bar{B}^g_{i,h} \left(\frac{R_i}{L^X_i}\right)^{-\phi^g}, \tag{11}$$

with $\phi^g > 0$. A higher provision of local public goods shifts the preference distribution for the home market sector downwards, thereby increasing the share of workers whose draw will be below the cut-off for home market participation as defined in equation (9). Again, we decompose the elasticity ϕ^g into a group-invariant and an group-varying component, such that $\phi^g = \bar{\phi} + \tilde{\phi}^g \quad g \in M, F$, where male workers are taken as reference group and normalize $\tilde{\phi}^M = 0$. The size of ϕ^g governs the substitution effect, whereby increases in local public goods provision pull workers into market employment.

C.4 Production in the economy

Firms in all market sectors produce many varieties of intermediate goods. The production technology of intermediate goods requires labour and land and structures as well as materials, which consist of inputs from all sectors (Caliendo et al., 2018). Intermediate good producers vary by their productive efficiency, which we denote by $z_{i,s}$ for each variety.

Intermediate goods producers. The output of a producer of an intermediate variety with efficiency $z_{i,s}$ is given by

$$y_{i,s}\left(z_{i,s}\right) = z_{i,s}\left[\left(h_{i,s}\left(z_{i,s}\right)\right)^{\kappa_{i,s}}\left(l_{i,s}\left(z_{i,s}\right)\right)^{1-\kappa_{i,s}}\right]^{\delta_{i,s}} \prod_{u\in M}\left[M_{i,su}\left(z_{i,s}\right)\right]^{\delta_{i,su}}, \tag{12}$$

where $h_{i,s}(.)$ and $l_{i,s}(.)$ are the demand for land and structures and labour respectively. $M_{i,su}(.)$ denotes material inputs from sector u, demanded by a firm located in region i and operating in sector s under efficiency $z_{i,s}$ to produce $y_{i,s}$ units of an intermediate variety. $\delta_{i,su}$ is the share of materials from occupation u in the production of occupation s in region i, while $\delta_{i,s}$ denotes the share of total value added in gross output. We assume constant returns to scale technology, such that $\sum_{u\in S}\delta_{i,su} = 1-\delta_{i,s}$. Finally, the parameter $\kappa_{i,s}$ denotes the share of land and structures in value added.

We assume that the different labour types are imperfectly substitutable inputs to the production function

$$l_{i,s}\left(z_{i,s}\right) = \left[\sum_{g\in G}\left(H^g_{i,s}L^g_{i,s}\left(z_{i,s}\right)\right)^{\frac{\sigma^g-1}{\sigma^g}}\right]^{\frac{\sigma^g}{\sigma^g-1}}, \tag{13}$$

where $L^g_{i,s}$ denotes the number of workers of type g employed in region-sector pair $\{i,s\}$. $H^g_{i,s}$ is the average human capital supplied by a worker type and $\sigma^g > 1$ denotes the elasticity of substitution between workers of different types in the production of varieties.

Denoting as r_i the rental price of land and structures in region i we obtain the following formulation for the unit price of inputs $\lambda_{i,s}$ in region-sector pair {i,s} (see Appendix I.2 for details):

$$\lambda_{i,s}\left(z_{i,s}\right) = \frac{1}{z_{i,s}}B_{i,s}\left(r_i^{\kappa_{i,s}}\left[\sum_{g\in G}\left(\frac{H^g_{i,s}}{W^g_{i,s}}\right)^{\sigma^g-1}\right]^{\frac{1-\kappa_{i,s}}{1-\sigma^g}}\right)^{\delta_{i,s}} \prod_{u\in M}\left[P_{i,u}\right]^{\delta_{i,su}}, \tag{14}$$

with the constant $B_{i,s} \equiv \left(\delta_{i,s}\left(\kappa_{i,s}\right)^{\kappa_{i,s}}\left(1-\kappa_{i,s}\right)^{\left(1-\kappa_{i,s}\right)}\right)^{-\delta_{i,s}} \prod_{u\in S}\left(\delta_{i,su}\right)^{-\delta_{i,su}}$.

The unit cost for an intermediate good producer with efficiency $z_{i,s}$ is thus $\lambda_{i,s}/z_{i,s}$. Given constant returns to scale and competitive intermediate goods markets, a firm produces only positive amounts of a variety as long as its price is equal to its unit production cost, where $p_{i,s}\left(z_{i,s}\right) = \lambda_{i,s}/z_{i,s}$.

Trade costs are represented by $\tau_{ij,s}$ and are of the 'iceberg' type. One unit of any variety of intermediate good s shipped from region j to i requires producing $\tau_{ij,s} \geq 1$ units in region j. If a good is non-tradable, then $\tau_{ij,s} = \infty$. Final goods producers purchase varieties of intermediate goods from the location j in which the acquisition cost, including trade costs, is the least. Therefore

$$p_{i,s}(\mathbf{z_s}) = \min_{j \in J} \left\{ \frac{\tau_{ij,s}\lambda_{j,s}}{z_{j,s}} \right\},$$

where we denote the vector of productivity draws across regions by $\mathbf{z_s} = (z_{1,s}, z_{2,s}, ..., z_{J,s})$.

Final good producers. Intermediate goods demanded from sector s and all regions are combined into a local CES bundle (final good). Local final goods, in turn, are used as materials for the production of intermediate varieties and final consumption.

In particular, in the following we denote as $Y_{i,s}$ the quantity produced of final goods in region-sector pair $\{i, s\}$ and as $\tilde{y}_{i,s}(\mathbf{z_s})$ the amount demanded of an intermediate good of a given variety from the least-cost producer. Final good production is therefore

$$Y_{i,s} = \left(\int (\tilde{y}_{i,s}(\mathbf{z_s}))^{\frac{\sigma-1}{\sigma}} d\phi_s(\mathbf{z_s}) \right)^{\frac{\sigma}{\sigma-1}}, \tag{15}$$

where $\phi_s(\mathbf{z_s})$ denotes the joint cumulative distribution function for the vector of efficiencies $\mathbf{z_s}$ with marginal functions $\phi_{i,s}(z_{i,s})$ and where σ denotes the elasticity of substitution between varieties. There are no fixed costs or barriers to entry in the production of intermediate and final goods, such that competitive behavior implies zero profits at all times.

Final good producers minimize total production costs. Using the CES assumption, the corresponding demand function for a variety produced in region i and occupation s is

$$\tilde{y}_{i,s}(\mathbf{z_s}) = \left(\frac{p_{i,s}(\mathbf{z_s})}{P_{i,s}} \right)^{-\sigma} Y_{i,s}, \tag{16}$$

where $p_{i,s}(\mathbf{z_s})$ equals the unit cost paid by a final good producer and $P_{i,s} \equiv \left[\int (p_{i,s}(\mathbf{z_s}))^{1-\sigma} d\phi_s(\mathbf{z_s}) \right]^{\frac{1}{1-\sigma}}$ is the ideal cost index for final goods.

Sector-specific efficiencies. We assume that across all varieties, market sectors, and regions the idiosyncratic productivity levels $z_{i,s}$ are independently drawn from a Fréchet distribution such that the joint cumulative distribution function is given by

$$\phi_s(\mathbf{z_s}) = \exp\left\{ \sum_{i \in J} (z_{i,s})^{-\nu_s} \right\}, \tag{17}$$

where we normalize the scale parameter to unity, and the occupation-specific shape parameters $\nu_s > 1$ govern the variance of efficiency draws. A larger ν_s implies less variability across varieties and regions.

Inter-regional trade in intermediate goods. Given the properties of the Fréchet distribution, the price of the aggregate good in sector s and region i is

$$P_{i,s} = \Gamma\left(\gamma_s\right)^{\frac{1}{1-\sigma}} \left[\sum_{j \in J} \left(\lambda_{j,s}\tau_{ij,s}\right)^{-\nu_s}\right]^{-\frac{1}{\nu_s}}, \tag{18}$$

where $\gamma_s \equiv \frac{\nu_s+1-\sigma}{\nu_s}$ and $\Gamma(.)$ denotes the Gamma function. The functional assumptions on the distribution of efficiencies across regions finally allow to derive the share of total expenditures in region-sector pair $\{i,s\}$ that accrues to sector-s-goods from region j as

$$\pi_{ij,s} = \frac{X_{ij,s}}{X_{i,s}} = \frac{\left(\lambda_{j,s}\tau_{ij,s}\right)^{-\nu_s}}{\sum_{n \in J}\left(\lambda_{n,s}\tau_{in,s}\right)^{-\nu_s}}, \tag{19}$$

with $X_{ij,s}$ the expenditure in market $\{i,s\}$ on sector s goods produced in region j and $X_{i,s}$ are total expenditures on goods from occupation s in region i.[3] The cheaper the cost of production in region-sector pair $\{j,s\}$ or the bilateral trade cots between region j and i, the more producers in region i purchase varieties from region j. Bilateral trade shares finally decrease in the denominator of equation (19), the destination-specific 'multilateral resistance' term.

C.5 Market Clearing and Unbalanced Trade

National portfolio. We follow Caliendo et al. (2019) by assuming that there are a mass 1 of rentiers in each region who don't relocate to other locations. They own the land and structures in all regions, rent them to firms at local rates, and send their after-tax rents to a nationwide portfolio.

In return, rentiers in region i receive a constant share ι_i from the global portfolio, with $\sum_{i \in J} \iota_i = 1$, which creates imbalances between the remittances paid by local rentiers and their income from the nationwide portfolio. In particular, imbalances are given by

$$\Upsilon_i = (1-\mathcal{T}_i)\sum_{s \in M}\mathcal{H}_{i,s}r_i - \iota_i \sum_{j \in J}\left[(1-\mathcal{T}_j)\sum_{u \in S}\mathcal{H}_{j,u}r_j - \bar{I}\sum_{g \in G} L^g_{j,h}\right], \tag{20}$$

where $\mathcal{K} \equiv \sum_{j \in J}\left[(1-\mathcal{T}_j)\sum_{u \in S}\mathcal{H}_{j,u}r_j - \bar{I}\sum_{g \in G}L^g_{j,h}\right]$ are total revenues in the nationwide portfolio. $\mathcal{H}_{j,u}$ denotes the total input of land and structures in region-sector pair $\{j,u\}$. The national portfolio is used to finance payments to non-employed workers and the remainder is re-distributed to rentiers. Rentiers spend their entire income from the national portfolio on local final goods.

Local public goods. Regional governments purchase local final goods from all sectors at market prices as input for the provision of a local public good R_i, which is produced

[3] See section (I.2) in the Online Appendix for derivations.

according to a Cobb-Douglas production function under no additional costs with shares β_u^R and where $\sum_{u\in M}\beta_u^R = 1$. Local final goods are used either for private consumption by workers and rentiers or as an input for the local final public good, such that

$$P_{i,u}Y_{i,u} = \beta_u\left[(1-\mathcal{T}_i)\sum_{g\in G}\sum_{s\in M}W_{i,s}^g L_{i,s}^g + \iota_i\mathcal{K} + \bar{I}\sum_{g\in G}L_{i,h}^g\right] + \beta_u^R E_i,$$

where $E_i = R_i P_i^R > 0$ denotes the total expenditure of local governments on final goods and P_i^R is the optimal local price level of regional governments, which differs from worker's local price level as long sectoral expenditure shares differ for private and public consumption [4]. Local governments run balanced budgets and, in the absence of regional re-distribution schemes, could only use local tax revenues to purchase inputs for the provision of the local public good R_i.

In fact, Germany runs a massive redistribution scheme, whereby financial transfers worth more than 53 billion euros are shifted across jurisdictions each year. We, therefore, follow Henkel et al. (2021) and introduce a between-region transfer scheme, which expands local governments' fiscal capacities. Given regional transfers and tax income, the budget available for local public goods provision is given by

$$E_i = (\mathcal{T}_i + \rho_i)\left(\sum_{g\in G}\sum_{s\in M}W_{i,s}^g L_{i,s}^g + \sum_{s\in M}\mathcal{H}_{i,s}r_i\right), \tag{21}$$

where ρ_i denotes the transfer rate, that is proportional to total local value added (and is negative for donor regions and positive for recipients).

Spatial equilibrium. A spatial equilibrium is defined as a set of final good prices $P_{i,s}$, human capital and wages in different market sectors $H_{i,s}^g\tilde{w}_{i,s}^g$, rental rates r_i, intermediate good prices $p_{i,s}(z_{i,s})$, consumption choices $C_{i,su}^g(\omega)$, intermediate variety demand $\tilde{y}_{i,s}(\mathbf{z_s})$, production of intermediate varieties $y_{i,s}(z_{i,s})$, demand for input factors (materials, land and structures, labour of all types) and selection choices of workers, such that

1. Workers optimally choose bundles of final goods from all occupations according to (1), given region-specific price indices P_i and wages $W_{i,s}^g(\omega)$;
2. Employed workers optimally self-select into sectors and locations according to (7);
3. Workers optimally self-select into market employment according to (10);
4. Intermediate good producers demand materials, labour and structures under unit prices (14). These productive inputs are used to produce idiosyncratic intermediate good varieties according to (12) and (13);

[4] For the quantification of the model we fit expenditure shares of local governments and rentiers β_s^R to best explain the observable share of housing in *private* consumption. See identification step 5 in online appendix J.2.1 for details.

5. Final goods producers import intermediates from least cost intermediate producers;

6. Final good producers optimally choose input varieties according to (16) and the price indices $P_{i,s}$;

7. Goods market clearing implies

$$
\begin{aligned}
X_{i,s} =& \beta_s^R \left[(\mathcal{T}_i + \rho_i) \left(\sum_{g \in G} \sum_{u \in M} W_{i,u}^g L_{i,u}^g + \sum_{u \in M} \mathcal{H}_{i,u} r_i \right) + \iota_i \mathcal{K} \right] \\
&+ \beta_s \left(\sum_{g \in G} \sum_{u \in M} (1 - \mathcal{T}_i) W_{i,u}^g L_{i,u}^g + \bar{I} \sum_{g \in G} L_{i,h}^g \right) + \sum_{u \in M} \delta_{i,us} \sum_{j \in J} \pi_{ji,u} X_{j,u},
\end{aligned}
$$

where the first two terms denote final consumption demand in region i by local governments ,rentiers and consumers respectively and where the third term denotes the demand for goods produced in occupation s and region i as material inputs in all regions and market sectors;

8. Labour market-clearing on the production side implies

$$
L_{i,s}^g = \frac{\delta_{i,s} (1 - \kappa_{i,s})}{W_{i,s}^g} \frac{\left(\frac{H_{i,s}^g}{W_{i,s}^g} \right)^{\sigma^g - 1}}{\sum_{g \in G} \left(\frac{H_{i,s}^g}{W_{i,s}^g} \right)^{\sigma^g - 1}} \sum_{j \in J} \pi_{ji,s} X_{j,s}, \tag{22}
$$

where $\sum_{j \in J} \pi_{ji,s} X_{j,s}$ are revenues from each export market. Labour market clearing for all groups $g \in G$, regions $i \in J$ and market sectors $s \in M$ ensures that labour supply (7) equals labour demand (22). Aggregate labour market clearing for workers of all groups implies that workers are either in one of the M market sectors or the home-market sector, such that $L^g = \sum_{i \in J} \left(L_{i,h}^g + L_{i,m}^g \right) = \sum_{i \in J} \left(L_{i,h}^g + \sum_{s \in M} L_{i,s}^g \right)$;

9. Market clearing for land and structures implies on the production side

$$
\mathcal{H}_{i,s} = \frac{\delta_{i,s} \kappa_{i,s}}{r_{i,s}} \sum_{j \in J} \pi_{ji,s} X_{j,s}. \tag{23}
$$

Land and structures market clearing for all regions $i \in J$ and market sectors $s \in M$ ensures that demand for land and structures (23) equals exogenous supply of land and structures $\bar{\mathcal{H}}_i = \sum_{s \in M} \mathcal{H}_{i,s}$.

D Data

In this section, we describe our main data sources.

Employment. We restrict our analysis to the years 2008-2014 and the 141 local labour markets of Germany which were originally delineated as commuting zones by Kosfeld and Werner (2012). Our data consists of employment counts per worker type, industry, and local labour market per year derived from detailed administrative data from Germany. To ensure sufficient data coverage across all region-sector pairs, we construct six sectors (four tradable and two non-tradable, based on ISIC Rev. 4). We use this classification throughout our paper and refer to it as the "occupational sectors" (see appendix J.1 for details).

Wages. To calculate the total wage bill per region and sector, we interact average wages per worker-type and industry from the National Accounts (EU KLEMS, see Stehrer et al. (2018)) with region-sector-specific fixed effects. We extract the fixed effects from a standard Mincerian earnings function (with dummies for three education levels, part-time employment, a cubic age and experience term, and person fixed effects) in an approach similar to Card et al. (2013). Individual wage data comes from the weakly anonymous Sample of Integrated Labour Market Biographies (SIAB).[5]

Material inputs. Information on gross output comes from the Growth and Productivity Accounts (EU KLEMS, see Stehrer et al. (2018)) and gross value-added per region-sector pair from the regional economic accounts provided by the Statistical Office of the European Union (Eurostat). We allocate sector-specific gross output across regions according to region-specific shares of value-added. Information on input-output linkages between sectors comes from the World Input-Output Tables (WIOD, see Timmer et al. (2015)).

Trade Flows. To allocate the region-sector-specific gross output from the EU KLEMS database across trading pairs, we use the bilateral trade shares from the Forecast of Nationwide Transport Relations in Germany 2030. It provides information on inter-regional trade volumes in metric tons between German districts in 2010 (Schubert et al. (2014)). To match our empirical equivalents of regions and occupational sectors, we aggregate trade flows to the commuting zone and sector level (see appendix J.1 for details).

Data on taxes and transfers. We use official tax data provided by the German Statistical Office and the Federal Statistical Office (see Statistisches Bundesamt (2021b);

[5]This study uses the factually anonymous Sample of Integrated Labour Market Biographies (version 1975 - 2017). Data access was provided via a Scientific Use File supplied by the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB). The dataset contains information on gross daily wages, education, gender, age, occupation, employment status, as well as the workplace and location of residence of German workers. To address the censoring of wages at the social security maximum, we apply the imputation method proposed by Card et al. (2013).

Statistisches Bundesamt (2021a); Statistische Ämter des Bundes und der Länder (2021)) to break down tax revenues (Federal, States, and local municipalities) to the local level and identify the effective degree of fiscal transfers (within and between the Federal States). We follow the procedure in Henkel et al. (2021) and compute for every district local tax revenues before and after redistribution (and hence net transfers), aggregate these variables to local labor markets i and relate them to these regions' value added to obtain empirical proxies of the average tax and transfer rates $\mathcal{T}_i$ and ρ_i.

Data on rents and non-tradable prices. We use average land prices provided by the Federal Statistical Office (see Statistische Ämter des Bundes und der Länder (2021)) as the empirical counterpart of rental prices in the theoretical framework. To quantify our model, we consider two sectors of non-tradables: Construction and non-tradable services (for example, Finance and Insurance, Public Administration, and Education). Ahlfeldt et al. (2020) provide mix-adjusted regional real estate price indices as panel data for all German labour markets, which we use as a proxy for price levels in the construction sector.[6] For price levels of non-tradable services, we rely on estimates of price level differences by sector in Weinand and Auer (2020). We control for tradable service prices, aggregate them to the commuting zone level, and finally re-scale all price indices $P_{i,ntS}$ such that their output-weighted average sums to unity.

Data on local public public goods provision. We collect information on local public good provision from the INKAR (2020) database. To determine a single measure of local public goods provision, we convert different measures of public goods to a single measure by taking the first principal component. We include measures of childcare provision, the ease of reaching the next elementary school, public transportation, motorway, airport, train station, the share of households with broadband internet access, drinking, and sewage supply, energy and waste management, as well as publicly financed recreational areas. We then standardize to give this variable a zero mean and unit standard deviation.

E Quantifying the Model

We quantify our model for all years (2008 - 2014), to obtain a panel data-set for all model-inverted parameters. We later leverage this time variation to identify the elasticity of labour supply to regional public good provision. The quantification of the model consists of two steps. First, we obtain values of the structural parameters $\{\alpha, \beta_u, \beta_u^R, \theta^g, \epsilon^g, \delta_{i,s}, \delta_{i,su}, \iota_i, \kappa_{i,s}, \phi^g, \sigma_g, \sigma, \tau_{ij,s}, \nu_s, \chi\}$. We estimate the respective values for most parameters using the structure of the model and observed variables in the data. For the remaining parameters

[6]The computation of the regional real estate price indices follows the methodology outlined in Combes et al. (2019). They rely on the micro data-set "Real-Estate Data for Germany" which is described in great detail in Boelmann and Schaffner (2019) and originally comes from the internet platform Immobilien Scout 24. See the Online Appendix of Ahlfeldt et al. (2020) for more details.

$\{\alpha, \sigma^g, \sigma, \nu_s, \chi\}$ we borrow their values from the literature. Second, to identify the preference parameters and productivity sifters $\{B^g_{i,h}, \eta^g_{i,s}, E_i, H^g_{i,s}, P_i, R_i\}$ as the unique values that are consistent with the model in general equilibrium we invert the model using data together with the estimated parameter values.

E.1 Set parameters

For the elasticity of substitution between men and women in production, we follow Olivetti and Petrongolo (2014) and use $\sigma^g = 2.5$ as our benchmark, which is in the middle of other available estimates.[7] Accurate estimates of the elasticity of substitution of varieties across regions are hard to obtain. We therefore borrow estimates from the international trade literature (see e.g. Bernard et al. (2003)) and set $\sigma = 5$ for our main analysis. Finally, as in Rossi-Hansberg et al. (2019) we set the trade elasticities to $\nu_s = 10$ for all sectors, which is well within the range of values considered by Head and Mayer (2014). Lastly, we assume perfect rivalry for local public goods and set $\chi = 1$ for our main analysis. Assuming $\chi = 1$, Fajgelbaum et al. (2019) obtain a value of $\alpha = 0.16$ for the share of local public goods in the USA, which we also borrow for the quantification of our model.

E.2 Estimated parameters

Shape parameters of human capital distribution. We observe individual wages, shift them by the share of consumption goods $(1 - \alpha)$ and decompose them into group-specific average wages and individual-specific human capital levels as the residuals to a wage decomposition according to the following Mincerian wage regression

$$\ln W^g_{i,s}(\omega) = c^g + X(\omega)b^g + d_i + d_s + d_{i,s} + \ln \tilde{\Psi}^g_{i,s}(\omega), \tag{24}$$

where c^g is a constant, $X(\omega)$ are type-specific controls and d_i, d_s and $d_{i,s}$ denote region and sector dummies as well as their interaction respectively. The residuals $\tilde{\Psi}^g_{i,s}(\omega)$ account for idiosyncratic human capital levels as suggested by equation (5). Individual controls $X(\omega)$ include interactions of worker's age, the days in employment, and a dummy for part-time employment. Under the assumptions on the distribution of individual human capital draws $\tilde{\Psi}_{i,s}$ in equation (4) the residuals from the wage decomposition will be Gumbel-distributed with group-specific scale $1/\theta^g$. We, therefore, fit the distribution of log-wage residuals $\tilde{\Psi}_{i,s}(\omega)$ to a Gumbel distribution and identify its scale parameter using maximum likelihood estimation (MLE) separately for each worker group. The inverse of the estimate identifies the shape parameter of the Fréchet distribution and in turn the labour supply elasticity.

Table 1 summarizes our estimates: in columns (1) and (2) we report the MLE values for $\tilde{\theta}^g \equiv \ln(1/\theta^g)$ that provide the best fit to a Gumbel distribution. Columns (3) and

[7] Depending on the occupation of workers Bhalotra and Fernández (2018) estimate the elasticity of substitution between men and women to be between 1.2 and 2.7 in Mexico, whereas Acemoglu et al. (2004) obtain a slightly larger estimate of 3.

(4) show the corresponding values of the shape parameter θ^g. For all years, we find that idiosyncratic human capital draws of female workers are slightly more dispersed, which results in a smaller estimate of θ^g. Furthermore, dispersion in human capital has increased over the last years for female and male workers, which results in smaller labour supply elasticities.

Our preferred estimates of the labour supply elasticities $(1-\alpha) * \theta^g = 1.69/1.55$ for the year 2008 (and 1.57/1.50 for 2014) are close to, albeit slightly larger than, existing estimates: Hsieh et al. (2019) obtain an estimate of 1.52 for the USA, whereas estimates in Burstein et al. (2019) range from 1.81 to 1.26 when accounting for time trends. In sum, our estimates are well in line with the cross-country comparison values of 1.05 to 1.47 in Lee (2020).

Table 1: Maximum likelihood estimates of θ^g

Time period	(1) $\tilde{\theta}$,Male	(2) $\tilde{\theta}$,Female	(3) θ,Male	(4) θ,Female
2008	-0.70	-0.61	2.01	1.84
	(0.002)	(0.002)		
2014	-0.63	-0.58	1.87	1.78
	(0.002)	(0.002)		

Notes: This table displays estimates of the Maximum Likelihood Estimation (MLE) of the shape parameter of a Fréchet distribution from individual wage residuals and a CDF as outlined in eq. (4). Columns (1) and (2) report the MLE values for $\tilde{\theta}^g \equiv \ln(1/\theta_g)$ that provide the best fit to a Gumbel distribution. Columns (3) and (4) show the corresponding values for the shape parameter θ^g. Standard errors are reported in brackets.

Parameters in production and consumption. To identify model-consistent values for the parameters $\{\delta_{i,s}, \delta_{i,su}, \kappa_{i,s}, \iota_i, \tau_{ij,s}, \beta_s, \beta_s^R\}$ we rely on region-sector-specific data on value-added, gross output, input-output linkages, sectoral trade flows, taxes, and transfers, as well as sectoral wage sums. We calibrate the share of value-added $\delta_{i,s}$ and the share of land and structures $\kappa_{i,s}$ to match their existing data counterparts. Next, to determine the share of sector u goods used in sector s and region i, $\delta_{i,su}$, we rely on national input-output shares δ_{su}, noticing that $\delta_{i,su} = (1-\delta_{i,s})\delta_{su}$. Moreover, observable trade imbalances pin down local shares ι_i of the national portfolio. Using this calibration, there exist unique values of expenditure shares $\{\beta_s, \beta_s^R\}$ which ensure that markets clear for all sectors in the aggregate, given the regional tax and transfer rates. Finally, we derive model-consistent expenditures of all regions that rationalize goods market-clearing (see identification steps 1 - 5 in online appendix J.2.1 for further details and derivations).

For the non-tradable sectors, we treat trade costs as infinite. For the tradable sectors, we follow the standard gravity literature (Head and Mayer, 2014) and model trade costs as a function of distance

$$\tau_{ij,s} = dist_{ij}^{\zeta_s}, \tag{25}$$

where $dist_{ij}$ is the Euclidian distance between the centroids of locations i and j. Following equation (19), we estimate the combined sector-specific parameter $-\nu_s \zeta_s$ using standard gravity regressions based on bilateral trade flows recovered from the Forecast of Nationwide Transport Relations in Germany 2030. We find that the estimated distance coefficients range between -1.43 and -2.14. They are highly statistically significant and firmly in line with available estimates from the gravity literature Head and Mayer (2014). We then parameterize trade costs according to equation (25), while setting trade elasticities to $\nu_s = 10$ for all sectors. Table 2 summarizes our calibration for these parameters as well the data sets used to calibrate or estimate them.

Table 2: Production and consumption parameters

	Parameter	Value	Approach	Data
$\delta_{i,s}$	Share of value added	$0.30 - 0.65$	Cal.	Trade flows/ value added
$\delta_{i,su}$	Share of material inputs	$0 - 0.35$	Cal.	Input-Output Tables
$1 - \kappa_i$	Share of wage expenditures	$0.06 - 0.95$	Cal.	Value added/ wage income
ι_i	Share of national portfolio	$0 - 0.06$	Est.	Trade imbalances
$\tau_{ij,s}$	Trade cost	$1 - 1.03$	Est.	Trade flows
$\beta_s = \beta_s^R$	Expenditure share	$0.001 - 0.42$	Fit.	Equation (48)
$\mathcal{T}_i$	Regional tax rate	0.15 - 0.33	Cal.	Tax revenues
ρ_i	Transfer rate	-0.11 - 0.27	Cal.	Transfer payments

Notes: If the approach is "calibrated" we calibrate the parameter to fit the observable data outlined under "data". If the approach is "estimated", we estimate the parameter following the estimation steps outlined in appendix J.2.1 and using the data sets under "data". If the approach is "fitted", we fit parameters to match the model-consistent equations outlined under "data".

Unit costs, prices, and human capital. The cost-minimizing behaviour of producers ensures that bilateral trade flows decrease in the size of unit production costs. The fact that model-consistent trade flows follow a gravity equation (19), therefore, allows us to identify the unit costs from model-consistent expenditures $X_{j,s}$ in all origin regions $j \in J$ demanded by workers in region i. In all tradable sectors, these directly translate into regional price levels.

We consider two sectors of non-tradables: Construction and non-tradable services (that is, Finance and Insurance, Public Administration, and Education). As a proxy for price levels in the construction sector, we use the mix-adjusted regional real estate price indices from Ahlfeldt et al. (2020). For the aggregate price levels in the non-tradable service sector, we rely on price level differences estimated by Weinand and Auer (2020). Since unit costs can only be identified up-to-scale, we normalize them such that the GDP-weighted sum of regional price levels sums to unity for all sectors.

Finally, we use data on price levels and local rents to identify gender-specific human capital levels as the residual to unit costs. Intuitively, we fit gender-specific human capital levels to trade flows and goods expenditures (controlling for differences in wage remuneration, expenditures on materials and land and structures) implied by the model.[8]

Amenities and participation costs. Preferences $\eta_{i,s}$ for all market sectors come from equation (7) as the residual to observable labour supply by gender, region, and sector after controlling for real wages and local public goods. We decompose preferences into an overall "amenity" term common to all sectors and region-sector-specific participation costs, such that $\ln \eta_{i,s} = c_i^g - \mu_{i,s}$ and with c_i^g a gender-region fixed effect. Since we identify amenities only up-to-scale, we re-scale them to ensure that the participation costs are positive for all region-sector pairs. Table 5 presents all model variables, among others the employment rate and public goods provision per capita in 2008 and the corresponding changes between 2008 and 2014.

Table 3: Model-implied Aggregates

Outcome	2008 Overall	2008 Female	2008 Male	Change Overall	Change Female	Change Male
Labour force participation rate	0.771	0.729	0.812	1.048	1.051	1.046
Public good (€), per capita	3304.70	3306.70	3302.90	1.189	1.189	1.190
Unit costs, weighted	1.422	1.357	1.479	0.992	0.991	0.994
Price levels, weighted	3.869	3.871	3.668	0.959	0.959	0.958
Log TFP, weighted	5.186	5.236	5.143	1.059	1.062	1.056
Log human capital, weighted	-	9.209	9.978	-	0.999	1.001
Amenities, weighted	-	2.592	2.050	-	1.032	1.010
Participation costs, weighted	-	1.067	0.780	-	1.029	1.006
(Inverse) participation costs (exp)	-	0.347	0.463	-	0.971	0.995

Notes: Labour force participation costs observed in the data. All other variables are solved within the model framework. Model-implied variables are weighted by group-region employment.

Public good elasticity. To identify the parameters $\{\phi^g, \epsilon^g\}$ we analyze the effect of local public goods provision on gender-specific non-employment rates. We quantify the model for the years 2008 - 2014 to exploit variation in the variables $\{L_{i,h,t}^g / L_{i,t}^g, \bar{I}_t / P_{i,t}, R_{i,t} / L_{i,t}\}$ within German local labour markets across time using the following regression equation derived from a log-linearised version of eq. (10):

$$\ln\left(\frac{L_{i,h,t}^g}{L_{i,t-1}^g}\right) = a_0 \ln\left(\frac{\bar{I}_t}{P_{i,t}}\right) + a_1 \ln\left(\frac{\bar{I}_t}{P_{i,t}}\right) \times \text{Female} + a_2 \ln\left(\frac{R_{i,t}}{L_{i,t-1}^X}\right) + a_3 \ln\left(\frac{R_{i,t}}{L_{i,t-1}^X}\right) \times \text{Female} + c_t^g + c_i^g + u_{i,t}^g, \tag{26}$$

where the index t denotes the year, and the coefficients $a_0 \equiv \bar{\epsilon}(1-\alpha)$, $a_1 \equiv \tilde{\epsilon}^F(1-\alpha)$, $a_2 \equiv \bar{\epsilon}\left(\alpha - \bar{\phi}\right)$, and $a_3 \equiv \bar{\epsilon}\left(-\tilde{\phi}^F\right) + \tilde{\epsilon}^F\left(\alpha - \left(\bar{\phi} + \tilde{\phi}^F\right)\right)$ are functions of structural parameters. To estimate the gender-specific components of fiscal capacity and price shocks

[8] See identification steps 6 - 9 in online appendix J.2.1 for further details and derivations.

on non-employment we include an interaction term of local public goods provision and a *female* dummy in the regression equation (and similarly for price shocks). We control for the terms $c_i^g + c_t^g \equiv \epsilon^g(\ln \bar{A}_i^g + \ln \bar{B}_{i,h}^g - \ln V_t^g)$, with gender-year and gender-region fixed effects, and finally the terms $u_{i,t}^g = \epsilon^g(\ln \tilde{B}_{i,t,h}^g + \ln \tilde{A}_{i,t}^g)$ represent deviations from these gender-region and gender-year fixed effects in regions' amenities and preference shifters in year t. We exploit the time variation *within* German labour market areas' employment induced by local fiscal capacity shocks, under the assumption that no changes in local labour demand had occurred over the time horizon. In other words, we hold local labour demand $L_{i,t-1}^g$ constant at its base level (in 2008) while using only the time variation in tax and transfer rates to identify the parameters $\{\epsilon^M, \epsilon^F, \phi^M, \phi^F\}$.

In columns (1) and (2) of Table 4 we present the OLS estimates of regression (26). Over our observed time periods, average non-employment rates decreased, but to a lesser degree in regions which experienced large increases in fiscal capacities (column (1)). Consequently, following the introduction of time-gender effects, we predict positive deviations from (negative) aggregate time trends in non-employment rates in those regions (column (2)). Workers of both workers react differently to fiscal capacity shocks, such that we obtain an elasticity of fiscal shocks to non-employment that is almost 80 percent ($= a_2^g/a_1$) smaller for female workers than male workers. Higher regional price levels decrease transfer payments in real terms and therefore induce workers to join the labour force. The coefficient estimate of 0.84 is slightly larger for male workers, but not statistically significant.

Taken together the estimates in column (2) would imply that positive fiscal capacity shocks shift the preference distribution *upwards* for workers of both genders, such that both the income and substitution effect work towards pushing workers out of employment in our framework (as $\phi^g < 0$). The effect is, however, much larger for male workers.

Instruments. One fundamental challenge for identifying a causal effect is that shocks to home market preferences would correlate with changes in local public goods provision and affect the decision of workers to join the labour force. The subsequent outward shift in labour supply is likely to increase local tax revenue and, in turn, local public good provision. As a consequence, OLS estimates of the coefficients could be biased downwards if the fixed effects are not sufficient to capture potential labour supply shocks.

We, therefore, construct a vector of distance-weighted regional shares of toddlers in public child care in all neighbouring regions $j \neq i$ as an instrument to obtain consistent estimates of a_2:

$$\text{InstCHILD}_{i,t} = \sum_{j \neq i} \tilde{d}_{ij} \text{Childcare}_{j,t} \quad \text{with} \quad \tilde{d}_{ij} = \frac{\ln(dist_{ij})}{\sum_{j \neq i} \ln(dist_{ij})}.$$

By constructing our instrument, we exploit the introduction of the "Kinderförderungsgesetz" (KiföG) in 2008. The goal was to provide the legal right to a public childcare place for all children over the age of one in Germany. In 2008 the share of toddlers in public child care varied substantially across regions. While public child care rates of three to six-year-old children were already very high before the reform, attendance by one to three-year-old children was considerably lower, ranging from around 5% in some places in West Germany to 50% in Eastern Germany.[9] To finance the massive investments in public childcare provision, Germany introduced the so-called Sondervermögen "Kinderbetreuungsausbau". This special fund provided 2.73 billion euros of financial aid for the federal states and municipalities between 2008 and 2014.[10] As a result, local investments were mainly financed by intergovernmental transfers. Hence, although the program was national in scope, we can exploit the circumstance that its impact on a given local labor market depended on the already existing number of local childcare places and the size of the female labour force. Moreover, the tax burden associated with the investments fell equally on all residents across local labour markets.

The share of toddlers in public child care in all neighbouring regions impacts local public goods provision via the numerator in equation (10). Higher childcare provision rates in other local labour markets will increase expected indirect utility across all sectors and regions. The preference cut-offs for labour supply will rise in all local labour markets as long as there is free mobility across space. The identifying assumption is that the changes in shares of toddlers in public child care in neighbouring regions are exogenous to omitted local preference shocks for the home market.

To predict gender-specific adjustments to fiscal capacity shocks, we interact the distance-weighted childcare rates in a given year $\tilde{\text{Childcare}}_{i,t}$ with the female dummy. Depending on the local level of public child care provision, the impact of fiscal capacity shocks on extensive labour supply will differ across female and male workers. The intuition is that females rely more on public child care provision than males, as they are still the primary child-carers. A further problem might be a potential correlation between changes in local price indices and shocks to local preferences.

To circumvent the additional endogeneity concern, we, therefore, construct Bartik-style instruments for price level shocks, which leverage upon within-region variation in national tax-type revenue shocks

$$\text{BtkTAX}_{i,t} = \sum_{k \in K} \frac{\text{Rev}_{i,k,2004}}{\text{Rev}_{i,2004}} \frac{\text{Rev}_{k,t} - \text{Rev}_{k,t-1}}{\text{Rev}_{k,t-1}},$$

where $k \in K$ denotes the tax type and $\text{Rev}_{i,k}$ denotes tax revenues in labour market region $i \in J$ from tax type k. National revenue shocks (2008-2014) are weighted by revenues shares that pre-date the observation period.[11] The identifying assumption is that the initial revenue shares from a particular tax type (for example, housing, VAT,

[9]See Figure 2 in the online appendix.

[10]See "Kinderbetreuungsfinanzierungsgesetz vom 18. Dezember 2007 (BGBl. I S. 3022), das zuletzt durch Artikel 3 des Gesetzes vom 14. Juli 2020 (BGBl. I S. 1683) geändert worden ist".

[11]The year 2004 is the earliest year for which information on tax revenues are available to calculate tax revenue shares. In the Online Appendix we show that our results do not depend on the year for which we calculate the initial tax revenue shares due to its high persistence over time.

business, or income tax revenues) are exogenous to omitted shocks to local preferences. Suppose housing tax rates are initially high in region i then the local government would strongly depend on housing tax revenues for fiscal capacities. Our instruments, therefore, would predict higher effects of national house price growth on regional house prices in region i relative to all other local labour markets. The first stage results are reported in Table 2 in section J.3 of the Online Appendix. All instruments have considerable power.

Column (4) of Table 4 presents the IV estimates of regression (26), using the Bartik instruments and distance-weighted childcare rates, as well as their respective interactions with the female dummy. Estimates of the elasticity of fiscal shocks to non-employment slightly increase when we include our instruments. Furthermore, the estimated IV effect on real payments to non-employed workers is significantly higher than under OLS. In our model framework, these estimates imply that a positive fiscal capacity shock shifts the preference distribution *downwards* for workers of both genders, such that the income and substitution effect work now in opposite directions (as $\phi^g > 0$). The model-consistent substitution effect is, however, 50 percent higher for females than for males and almost cancels out the income effect.

The estimates imply that an increase in fiscal capacity per capita by 1 percent is associated with a decrease in non-employment gaps, that is male-to-female non-employment rates, by about 1.22 percent. Given the average increase in fiscal capacities per capita by around 14 percent at the local level - that is, around 1433 Euro - between 2008 and 2014, this corresponds to a decrease in employment gaps of roughly 17 percent, which corresponds to a reduction of around 1.34 percentage points.

Table 4: The effect of public goods provision on non-employment: OLS and IV estimates

	OLS (1)	OLS (2)	IV (3)	IV (4)
$\ln(R_{i,t}/L_{i,t-1})$	-0.68 ***	1.26 ***	-1.21 ***	1.40 ***
	(0.09)	(0.21)	(0.09)	(0.49)
$\ln(R_{i,t}/L_{i,t-1}) \times$ Female	0.23 **	-1.00 ***	0.53 ***	-1.22 **
	(0.10)	(0.23)	(0.11)	(0.54)
$\ln(\bar{I}_t/P_{i,t})$	-2.51 ***	0.84	-1.42 ***	11.56 ***
	(0.32)	(0.69)	(0.17)	(3.01)
$\ln(\bar{I}_t/P_{i,t}) \times$ Female	1.01 ***	-0.30	0.01	-7.42 **
	(0.35)	(0.74)	(0.20)	(3.37)
ϕ^M	-0.10	-4.44	-0.71	0.06
ϕ^F	-0.12	-0.12	-0.32	0.12
ϵ^M	-2.82	0.27	-1.43	13.76
ϵ^F	-1.71	0.94	-1.49	4.93
Region-gender fixed effects	yes	yes	yes	yes
Year-gender fixed effects	no	yes	no	yes
Observations	1974	1974	1974	1974

Notes: This table shows the OLS estimates in columns (1) & (2) and the IV estimates of the second-stage in columns (3) & (4) for the structural parameters entering the extensive labour supply equation (26), as well as model-consistent values for the elasticities $\{\phi^g, \epsilon^g\}$ implied by these estimates given the parameter restriction $\alpha = 0.16$ and $\chi = 1$. Variables in columns (3) & (4) are instrumented by distance weighted leave-one-out shares of toddlers in public child care, and Bartik-style tax-class instruments, as well as their interactions with a female dummy. Standard errors (in parentheses) are clustered at the level of 141 local labour markets. $^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

F Counterfactual analysis: Abolishing fiscal transfers

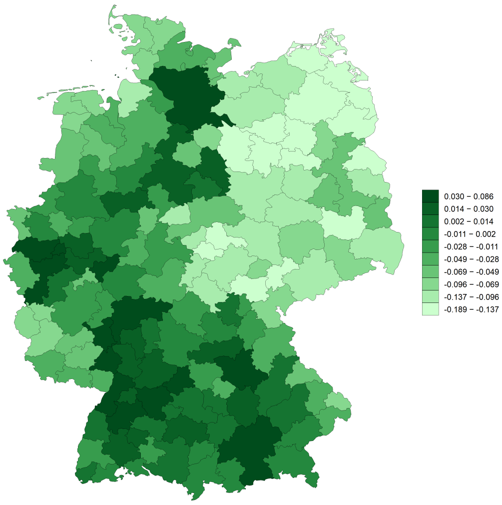
To investigate the employment effects of local public goods provision and fiscal transfers in practice, we simulate a counterfactual scenario without fiscal transfers across regions. In that scenario, there are substantial shocks to fiscal capacities because solely tax revenues at the local level finance the provision of public goods. In doing so, we quantify the aggregate economic consequences from local public goods provision on the employment decisions of female and male workers and characterize the spatial implications of fiscal transfers for gender employment gaps.

Procedure of the counterfactual analysis. In the baseline version of our counterfactual analysis, we assume fixed values of all structural parameters and use inverted exogenous components of preference shifters, amenities, and human capital levels as in the initial equilibrium (that is, in the year 2014). We then set the fiscal transfer rate to zero for all local labour markets $\rho = 0 \; \forall i \in J$ and solve for the new equilibrium values of wages, employment, and prices, which rationalize a spatial equilibrium in the absence of fiscal transfer re-distribution. The new (counterfactual) equilibrium values of real wages, employment gaps, and rents ensure that all goods and factor markets clear in the new equilibrium (see section K.1 in the Online Appendix for details).

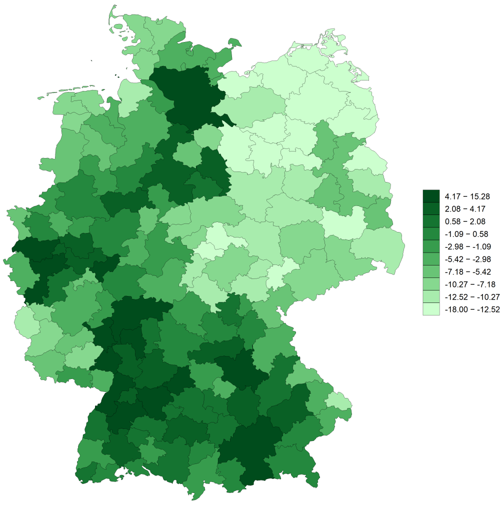
Regional effects. The abolition of the fiscal transfer system implies massive fiscal re-distribution, in particular from East- to West-Germany. As highlighted in panel (a) of Figure 4, fiscal budgets decrease by up to 20 percent in terms of local value-added in some rural Eastern German labour markets. There is also a clear tendency to redistribute funds to the largest metropolitan areas in West Germany (for example, Hamburg, Frankfurt, or Munich) since these regions currently contribute the most to the fiscal transfer system. Negative fiscal revenue shocks directly affect the capacity of governments to supply local public goods, which in turn triggers workers to re-consider their initial residence and labour supply decisions. Workers relocate to regions with higher public good provision, as highlighted in Panel (b) of Figure 4. As workers move to the positively treated regions, they impose downwards pressure on local wages per efficiency unit determined by the interplay of labour supply and demand. Changes in the within-type regional and sectoral composition magnify this effect via changes in average human capital levels. Panel (d) of Figure 4 depicts declining real wages in previous donor regions such that regional utility is again equal across space in the new counterfactual equilibrium. Finally, labour force participation rates decrease in former donor regions, while recipient regions in Eastern Germany are predicted to experience higher rates (Panel b).

Aggregate effects and gender gaps. To highlight the aggregate effects of fiscal transfers, we compute the relative changes in aggregate outcomes as highlighted in Table 5, using employment shares as weights. In doing so, we distinguish between initial *recipient* regions

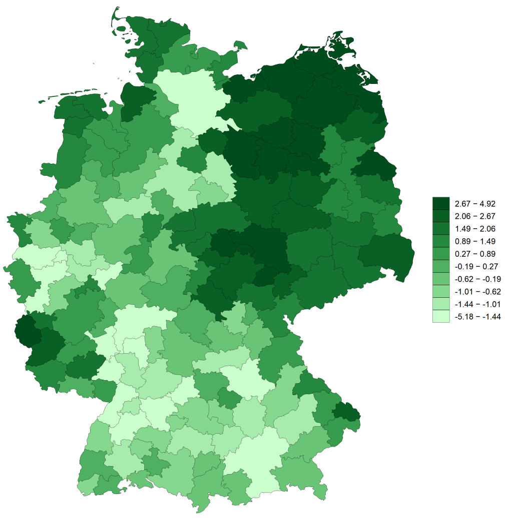
Figure 4: COUNTERFACTUAL ANALYSIS: REGIONAL EFFECTS



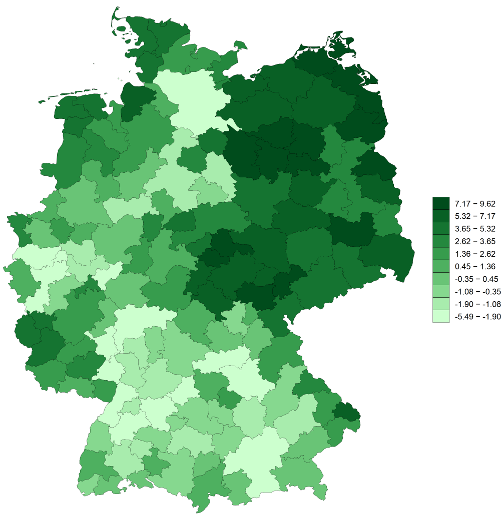
(a) Size of fiscal transfer shock



(b) Population change



(c) Change in participation rates



(d) Real wage change

Notes: Panel (a) displays changes in fiscal transfer rates, which are defined as fiscal transfers over local value-added. The Panels (b) to (d) display percentage changes in total population, employment, and real wages. Real wages are defined as employment-weighted wages over model-consistent regional price levels.

(where $\rho_i > 0$) and *donor* regions. We observe a sizable worker outflow, with *recipient* regions losing 6 percent of their total population and with displacement effects being even larger for male workers. Out-migration decongests local labour markets in *recipient* regions, thereby increasing real wages by almost 3 percent. Worker employment, especially of male workers, increase in former *recipient* regions, since the income effect outweighs the substitution effect. This result is, however, attenuated by endogenous preference shifter increases.

Average welfare (of employed workers) decreases marginally for both worker groups after abandoning the fiscal transfer scheme. *Recipient* GDP, meanwhile, decreases and falls by around 2 percent due to out-migration. Aggregate decreases in labour force participation explain the slight fall of GDP also in the aggregate.

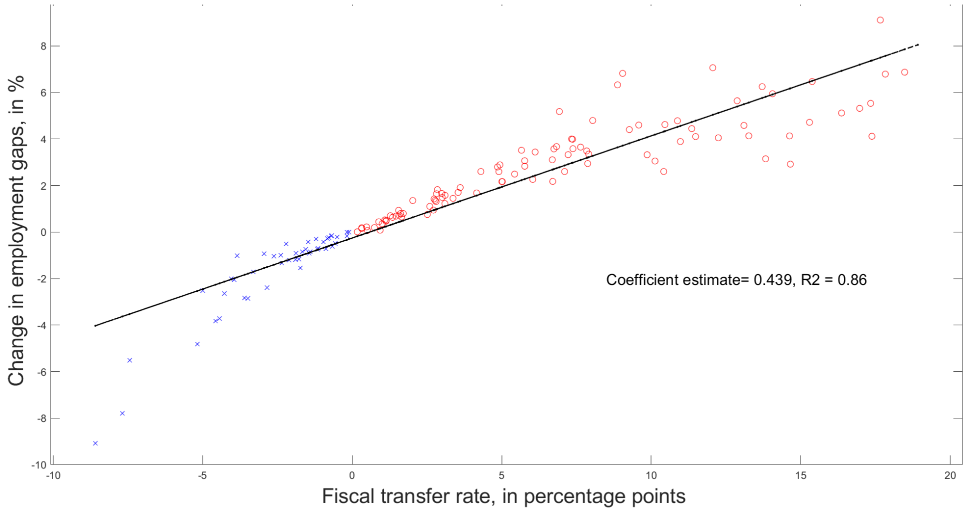
In Panel (a) of Figure 5 we highlight how the existing fiscal re-distribution system has amplified regional differences in gender employment gaps. We find that a one percentage point larger fiscal transfer rate decreases employment gaps between female and male workers by 0.44 percent when incorporating all general equilibrium effects. This, however, comes at the expense of larger gender wage gaps by 0.5 percent for each 10 percent increase in transfer rates (see Panel (b)). Gender differences in average wages decrease in all regions, while this effect is slightly more pronounced in initial donor regions.

Table 5: Aggregate effects of fiscal transfers

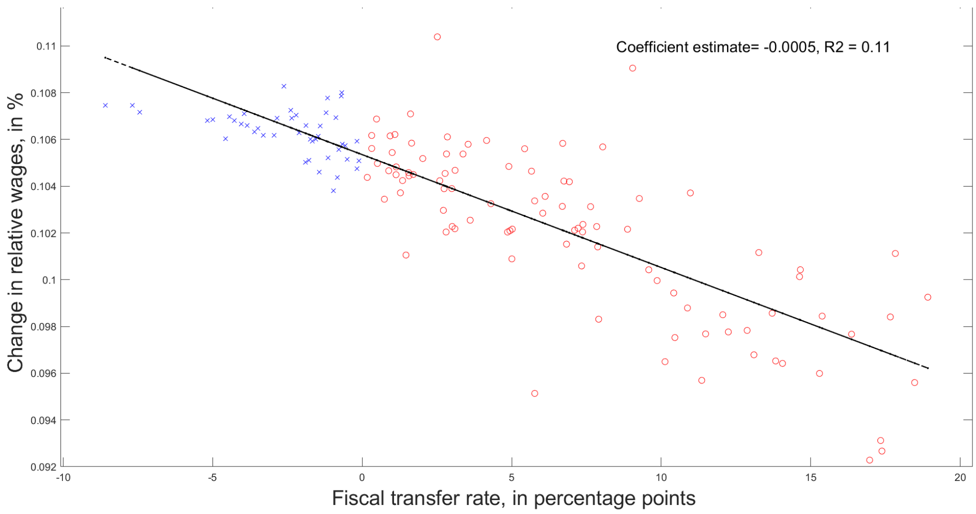
Outcome	Overall All	Overall Female	Overall Male	$\rho > 0$ All	$\rho > 0$ Female	$\rho > 0$ Male
Population	1.000	1.000	1.000	0.942	0.957	0.928
Labour force participation rate	0.991	0.993	0.989	1.012	0.999	1.025
Price levels	1.002	1.002	1.002	0.998	0.998	0.998
Average wages, weighted	-	1.001	1.002	-	1.026	1.027
Preference shifter, weighted	-	1.005	1.004	-	1.022	1.012
Welfare (employed)	-	0.997	0.997	-	0.997	0.997
GDP	0.994	-	-	0.978	-	-
Gender employment gap	0.996	-	-	1.026	-	-

Notes: This table reports changes in aggregate outcomes (using group-region-specific employment shares as weights) when fiscal transfers between locations are abolished. All numbers in the table represent counterfactual values over initial values (in 2014). Initial donors have a negative transfer rate, $\rho < 0$, while recipients have a positive transfer rate.

Figure 5: Changes in gender gaps



(a) Changes in employment gaps



(b) Changes in wage gaps

Note: This figure displays the changes in gender gaps when fiscal transfers between locations are abolished. Panel (a) shows the counterfactual changes in employment gaps (defined as male-to-female employment rates) against the initial transfer rate. Panel (b) plots changes in gender wage gaps (defined as male-to-female average wages) against the initial transfer rate. Average wages are the employment-weighted sum across sectors. Note that donors have a negative transfer rate, $\rho < 0$ marked by crosses (in blue). Recipients with positive transfer rates are marked by circles (in red).

G Conclusion

Gender differences in labour market outcomes declined substantially across many industrialized countries over the last decades. Nevertheless, there has been relatively little work on the equilibrium effects of local public goods provision (in general) and childcare provision (in particular) for this development. In this paper, we investigate the impact of fiscal capacities on differences in male-to-female employment rates and the distribution of economic activity across space.

In our empirical part of the paper, we find that a higher local public goods provision increases the non-employment of male workers, but barely affects female workers. We thereby exploit the time-variation in local fiscal capacities, proxied by trends in childcare rates in neighboring regions. Using this strategy, we estimate a negative effect of local public goods on gender employment gaps, since male workers react stronger to fiscal shocks. Our estimates imply that a one percent increase in fiscal capacities per capita lowers gender employment gaps by about 1.22 percent.

Because higher local fiscal revenues create externalities for other regions via labour mobility and trade linkages, the implied aggregate effects of transferring fiscal revenues across local labour markets are unclear ex-ante. In the theoretical part of the paper, we set up and quantify a spatial equilibrium model featuring costly trade and labour mobility to isolate the effects of local public goods provision and fiscal transfers on the aggregate economy in general and gender gaps in particular. In a counterfactual scenario, where we shut down current fiscal transfers in Germany, massive fiscal resources are shifted from poor (low-productive) to rich (high-productive) locations, thus raising average labour productivity. However, male workers experience greater increases in employment induced by changes in local fiscal capacities than female workers, such that the abolition of transfers leads to larger differences in male-to-female gender employment gaps.

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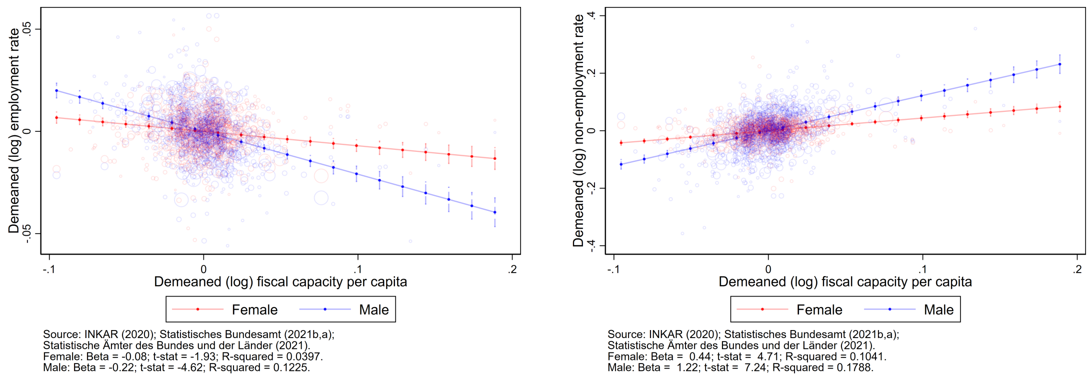
ONLINE APPENDIX

This section presents an Online Appendix containing complementary material.

H Motivation appendix

Figure 1: Gender-specific employment rates and local fiscal capacities per capita



(a) Employment

(b) Non-Employment

Note: This figure plots demeaned log (non-)employment rates (relative to the regional and year specific mean) against the identically demeaned fiscal capacity per capita. Both variables are normalized by the working-age population in 2008. Fiscal capacities measure available tax revenues after fiscal redistribution. Local tax revenues and transfer payments are based on own calculations. We follow the approach in Henkel et al. (2021) to calculate fiscal capacities as the sum of local tax revenues before redistribution and regional transfer payments (that is, negative for donors and positive for recipients). The employment rate measures the number of female (male) workers in the labour force relative to the total number of females (males) in the working-age population (15-65 years) in the local labour market. The size of the marker is proportional to the regional population size in 2008. Data comes from INKAR (2020) and Statistisches Bundesamt (2021b,a); Statistische Ämter des Bundes und der Länder (2021a).

I Theory appendix

I.1 Worker side

I.1.1 Distribution of utilities in market sectors

From (3) indirect utility for working in region i and working in sector s is given as:

$$V^g_{i,s}(\omega) = \eta^g_{i,s}\left(\frac{R_i}{L_i^{\chi}}\right)^{\alpha}\left[\frac{I^g_{i,s}(\omega)}{P_i}\right]^{1-\alpha} = \eta^g_{i,s}\left(\left(1-\mathcal{T}_i\right)T^g_{i,s}\tilde{w}^g_{i,s}\Psi^g_{i,s}(\omega)\right)^{1-\alpha}\left(P_i\right)^{\alpha-1}R_i^{\alpha}L_i^{-\chi\alpha}.$$

There are $d = 1,..,D$ possible region-occupation pairs $\{i,s\}$ (with $D = JxM$) where workers can self-select and sort into. Workers choose the region-occupation pair d that maximizes idiosyncratic utility.

We then define as $F^g(v_1, ..., v_D)$ the cumulative distribution function of indirect utilities for workers of type g:

$$
\begin{aligned}
F^g(\mathbf{v_d}) &= \mathbb{P}\left(V_1^g(\omega) \leq v_1, ..., V_D^g(\omega) \leq v_D\right) \\
&= \mathbb{P}\left(\frac{\eta_1^g\left((1-\mathcal{T}_1)\,\tilde{w}_1^g T_1^g \Psi_1^g(\omega)\right)^{1-\alpha} R_1^\alpha}{P_1^{1-\alpha} L_1^{\chi\alpha}} \leq v_1, ..., \frac{\eta_D^g\left((1-\mathcal{T}_D)\,\tilde{w}_D^g T_D^g \Psi_D^g(\omega)\right)^{1-\alpha} R_D^\alpha}{P_D^{1-\alpha} L_D^{\chi\alpha}} \leq v_D\right) \\
&= \mathbb{P}\left(\tilde{\Psi}_1^g(\omega) \leq \frac{v_1 L_1^{\chi\alpha}\,(P_1)^{1-\alpha}}{\eta_1^g R_1^\alpha\left((1-\mathcal{T}_1)\,\tilde{w}_1^g T_1^g\right)^{1-\alpha}}, ..., \tilde{\Psi}_D^g(\omega) \leq \frac{v_D L_D^{\chi\alpha}\,(P_D)^{1-\alpha}}{\eta_D^g R_D^\alpha\left((1-\mathcal{T}_D)\,\tilde{w}_D^g T_D^g\right)^{1-\alpha}}\right).
\end{aligned}
$$

Under the functional assumptions on the distribution of idiosyncratic human capital draws (4) the joint distribution of utility is

$$
F^g(\mathbf{v_d}) = \exp\Big\{-\Big[\sum_{s=1}^{M}\sum_{i=1}^{J}\Omega_{i,s}^g\,(v_{i,s})^{-\theta^g}\Big]\Big\}, \tag{27}
$$

where $\Omega_{i,s}^g = \left[\left((1-\mathcal{T}_i)\,\tilde{w}_{i,s}^g T_{i,s}^g\,(P_i)^{-1}\right)^{1-\alpha}\eta_{i,s}^g R_i^\alpha L_i^{-\chi\alpha}\right]^{\theta^g}$ is a function of group-specific preference components, wages per efficiency unit, human capital, local public goods and regional price levels for region-occupation pair $\{i, s\}$.

I.1.2 Expected utility

We are interested in the expected utility of individuals of a group g if employed workers choose region-sector pairs to maximize utility. The expected utility is given as:

$$
\begin{aligned}
E^g\left[v_{i,s}\,\Big|_{u=v_{i,s},\forall i,s\in M}\right] \equiv E^g[u] &= \int_0^\infty v_{i,s}\frac{\partial}{\partial v_{i,s}}\exp\Big\{-\Big[\sum_{s=1}^{M}\sum_{i=1}^{J}\Omega_{i,s}^g\,(v_{i,s})^{-\theta^g}\Big]\Big\}\,\Big|_{u=v_{i,s},\forall i,s\in M}\,du \\
&= \int_0^\infty \theta^g u^{-\theta^g}\left[\sum_{s\in M}\sum_{i\in J}\Omega_{i,s}^g\right]\exp\Big\{-\Big[\sum_{s=1}^{M}\sum_{i=1}^{J}\Omega_{i,s}^g\Big]u^{-\theta^g}\Big\}du.
\end{aligned}
$$

Re-defining variables

$$
z^g = \Big[\sum_{s\in M}\sum_{i\in J}\Omega_{i,s}^g\Big]u^{-\theta^g} \quad \text{and} \quad dz^g = -\theta^g\Big[\sum_{s\in M}\sum_{i\in J}\Omega_{i,s}^g\Big]u^{-\theta^g-1}du,
$$

we get

$$
\begin{aligned}
E^g[u] &= \int_0^\infty \exp\Big\{-z^g\Big\}\left[\sum_{s\in M}\sum_{i\in J}\Omega_{i,s}^{gt}\right]^{\frac{1}{\theta^g}}(z^g)^{-\frac{1}{\theta^g}}\,dz^g \\
&= \left[\sum_{s\in M}\sum_{i\in J}\Omega_{i,s}^{gt}\right]^{\frac{1}{\theta^g}}\Gamma\left(\frac{\theta^g-1}{\theta^g}\right),
\end{aligned}
$$

where $\Gamma(.)$ denotes the Gamma function. The expected utility of workers is then equalized across all regions and sectors in the absence of bilateral migration frictions or sector-specific switching costs:

$$E^g[u] = \Gamma\left(\frac{\theta^g - 1}{\theta^g}\right)\left(\sum_{s\in M}\sum_{i\in J}\left[\left((1-\mathcal{T}_i)\,\tilde{w}^g_{i,s}T^g_{i,s}\,(P_i)^{-1}\right)^{1-\alpha}\eta^g_{i,s}R^\alpha_i L_i^{-\chi\alpha}\right]^{\theta^g}\right)^{\frac{1}{\theta^g}}. \tag{28}$$

I.1.3 Region-sector shares

We are interested in the probability that a choice of region-occupation pair d is the maximum among all alternatives:

$$\begin{aligned}
\frac{L^g_d}{L^g_m} &= Pr\{V^g_d(\omega) \geq \max_{n\in D\backslash d} V^g_n(\omega)\} \\
&= \int_0^\infty \exp\Big\{-\Big[\sum_{s=1}^{M}\sum_{i=1}^{J}\Omega^g_{i,s}\Big]u^{-\theta^g}\Big\}\Omega^g_{i,s}\theta^g u^{-\theta^g-1}du \\
&= \frac{\Omega^g_{i,s}}{\sum_{s=1}^M\sum_{i=1}^J\Omega^g_{i,s}}\int_0^\infty \exp\Big\{-\Big[\sum_{s=1}^{M}\sum_{i=1}^{J}\Omega^g_{i,s}\Big]u^{-\theta^g}\Big\}\Big[\sum_{s=1}^{M}\sum_{i=1}^{J}\Omega^g_{i,s}\Big]\theta^g u^{-\theta^g-1}du \\
&= \frac{\Omega^g_{i,s}}{\sum_{s=1}^M\sum_{i=1}^J\Omega^g_{i,s}}.
\end{aligned}$$

Equation (7) follows directly.

I.1.4 Average human capital under selection and sorting

Finally, we derive the average human capital supplied by workers of type g in all region-sector pairs under sorting and selection:

$$E\left[\tilde{\Psi}^g_{i,s}(\omega)\right] = E\left[\frac{v_1 L_1^{\chi\alpha}(P_1)^{1-\alpha}}{\eta^g_1 R^\alpha_1\left((1-\mathcal{T}_1)\,\tilde{w}^g_1 T^g_1\right)^{1-\alpha}}\right] = \frac{L_1^{\chi\alpha}(P_1)^{1-\alpha}}{\eta^g_1 R^\alpha_1\left((1-\mathcal{T}_1)\,\tilde{w}^g_1 T^g_1\right)^{1-\alpha}}E^g\left[v_{i,s}\Big|_{u=v_{i,s},\forall i,s}\right].$$

Using equations (7) and (28) and the definition of $\mu^g_{i,s}$ we get:

$$E\left[\tilde{\Psi}^g_{i,s}(\omega)\right] = \left(L^g_{i,s}/L^g_m\right)^{-\frac{1}{\theta^g}}\Gamma\left(\frac{\theta^g-1}{\theta^g}\right),$$

from which we derive average wages under selection and sorting.

I.2 Production side

I.2.1 Derivation of unit costs

In this appendix, we derive optimal unit costs under the imperfect substitutability of labour types. Intermediate good producers minimize costs, which yields the following first-order conditions for input demand

$$\delta_{i,s}\kappa_{i,s} = \frac{r_i h_{i,s}(z_{i,s})}{\lambda_{i,s}(z_{i,s})\, y_{i,s}(z_{i,s})}$$

$$\delta_{i,su} = \frac{P_{i,u} M_{i,su}(z_{i,s})}{\lambda_{i,s}(z_{i,s})\, y_{i,s}(z_{i,s})}$$

$$\delta_{i,s}(1-\kappa_{i,s})\frac{\partial l_{i,s}(z_{i,s})}{\partial L^g_{i,s}(z_{i,s})} = \frac{W^g_{i,s} l_{i,s}(z_{i,s})}{\lambda_{i,s}(z_{i,s})\, y_{i,s}(z_{i,s})},$$

where

$$\frac{\partial l_{i,s}(z_{i,s})}{\partial L^g_{i,s}(z_{i,s})} = \left(H^g_{i,s}\right)^{\frac{\sigma^g-1}{\sigma^g}} \left(L^g_{i,s}(z_{i,s})\right)^{-\frac{1}{\sigma^g}} \left(l_{i,s}(z_{i,s})\right)^{\frac{1}{\sigma^g}},$$

and $\lambda_{i,s}(z_{i,s})$ denotes the Lagrange multiplier of the cost minimization problem, which in our problem corresponds to the unit cost of inputs as well. This allows deriving type-specific labour demand as:

$$L^g_{i,s}(z_{i,s}) = \frac{l_{i,s}(z_{i,s})}{H^g_{i,s}} \left(\frac{\delta_{i,s}(1-\kappa_{i,s})\lambda_{i,s}(z_{i,s})\, y_{i,s}(z_{i,s})\, H^g_{i,s}}{W^g_{i,s} l_{i,s}(z_{i,s})}\right)^{\sigma^g}.$$

Substituting into $l_{i,s}$ we obtain optimal labour demand as:

$$l^\star_{i,s} = \delta_{i,s}(1-\kappa_{i,s})\lambda_{i,s}(z_{i,s})\, y_{i,s}(z_{i,s}) \left[\sum_{g\in G}\left(\frac{H^g_{i,s}}{W^g_{i,s}}\right)^{\sigma^g-1}\right]^{\frac{1}{\sigma^g-1}}.$$

The first order conditions for workers of all types are then:

$$\delta_{i,s}(1-\kappa_{i,s}) \frac{\left(\frac{H^g_{i,s}}{W^g_{i,s}}\right)^{\sigma^g-1}}{\sum_{g\in G}\left(\frac{H^g_{i,s}}{W^g_{i,s}}\right)^{\sigma^g-1}} = \frac{W^g_{i,s} L^g_{i,s}(z_{i,s})}{\lambda_{i,s}(z_{i,s})\, y_{i,s}(z_{i,s})}.$$

Plugging the optimal input factor demands into the production function we derive unit costs of production of an intermediate good produced in region i and sector s with efficiency $z_{i,s}$ as

$$\lambda_{i,s}(z_{i,s}) = \frac{1}{z_{i,s}} B_{i,s} \left(r_i^{\kappa_{i,s}} \left[\sum_{g\in G}\left(\frac{H^g_{i,s}}{W^g_{i,s}}\right)^{\sigma^g-1}\right]^{\frac{1-\kappa_{i,s}}{1-\sigma^g}}\right)^{\delta_{i,s}} \prod_{u\in S}\left[P_{i,u}\right]^{\delta_{i,su}},$$

with $B_{i,s} \equiv \left(\delta_{i,s}(\kappa_{i,s})^{\kappa_{i,s}}(1-\kappa_{i,s})^{(1-\kappa_{i,s})}\right)^{-\delta_{i,s}} \prod_{u\in S}(\delta_{i,su})^{-\delta_{i,su}}$ a region-sector-specific constant.

I.2.2 Derivation of the ideal cost index

In this appendix we derive the ideal cost index $P_{i,s}$, following the steps outlined in Eaton and Kortum (2002). Let $G_{ij,s}(p)$ be the probability that firms located in region j can offer producers in region i an intermediate variety for a price lower than p. Under the assumptions of perfect competition and a Fréchet distribution of productivities it then holds that:

$$\begin{aligned} G_{ij,s}(p) &= Pr\left\{p_{ij,s}(z_{j,s}) \le p\right\} \\ &= 1 - \phi_{ij,s}\left(\frac{\lambda_{j,s}\tau_{ij,s}}{p}\right) \\ &= 1 - \exp\left\{-\left(\frac{\lambda_{j,s}\tau_{ij,s}}{p}\right)^{-\nu_s}\right\}. \end{aligned}$$

Producers in region i buy intermediate varieties from least cost origins. The probability that producers in region i end up paying a price less than p for the variety is

$$\begin{aligned} G_{i,s}(p) &= 1 - \prod_{n\in J}\left(1 - G_{in,s}(p)\right) \\ &= 1 - \exp\left\{-p^{\nu_s}\Phi_{i,s}\right\}, \end{aligned}$$

where $\Phi_{i,s} = \sum_{n\in J}\left(\lambda_{n,s}\tau_{in,s}\right)^{-\nu_s}$ is a function of unit costs of production and bilateral trade costs.

Substituting the distribution of prices into the ideal cost index yields:

$$P_{i,s}^{1-\sigma} = \nu_s\Phi_{i,s}\int p^{\nu_s-\sigma}\exp\left\{-p^{\nu_s}\Phi_{i,s}\right\}dp.$$

We re-define $x_{i,s} \equiv p^{\nu_s}\Phi_{i,s}$, so with a change of variable we get:

$$\begin{aligned} P_{i,s}^{1-\sigma} &= \int\left(\frac{x_{i,s}}{\Psi_{i,s}}\right)^{\frac{1-\sigma}{\nu_s}}\exp\left\{-x_{i,s}\right\}dx_{i,s} \\ &= \Gamma\left(\frac{\nu_s+1-\sigma}{\nu_s}\right)\left(\Phi_{i,s}\right)^{-\frac{1-\sigma_{i,s}}{\nu_s}}. \end{aligned}$$

The ideal cost index is therefore derived as

$$P_{i,s} = \Gamma\left(\frac{\nu_s+1-\sigma}{\nu_s}\right)^{\frac{1}{1-\sigma}}\left[\sum_{j\in J}\left(\lambda_{j,s}\tau_{ij,s}\right)^{-\nu_s}\right]^{-\frac{1}{\nu_s}},$$

as in equation (18).

I.2.3 Trade shares

We are interested in the fraction of region-i expenditure accruing to region j in all sectors. Define as $\pi_{ij,s}$ the probability that region j is the least-cost provider of a variety for use as intermediate input in region i and sector s:

$$\begin{aligned}
\pi_{ij,s} &= Pr\left\{p_{ij,s}\left(z_{j,s}\right) \leq \min_{n\in J\backslash j} p_{in,s}\left(z_{n,s}\right)\right\} \\
&= \int \prod_{n\in J\backslash j} \left(1 - G_{in,s}\left(p\right)\right) dG_{ij,s}\left(p\right)
\end{aligned}$$

Substituting in the distribution of prices across regions yields:

$$\begin{aligned}
\pi_{ij,s} &= \left(\lambda_{j,s}\tau_{ij,s}\right)^{-\nu_s} \int \nu_s p^{\nu_s - 1} \exp\left\{-p^{\nu_s}\Phi_{i,s}\right\} dp \\
&= \frac{\left(\lambda_{j,s}\tau_{ij,s}\right)^{-\nu_s}}{\Phi_{i,s}} \left[-\exp\left\{-p^{\nu_s}\Phi_{i,s}\right\}\right]_0^{\infty} \\
&= \frac{\left(\lambda_{j,s}\tau_{ij,s}\right)^{-\nu_s}}{\Phi_{i,s}}.
\end{aligned}$$

The expression implies that regions with lower unit costs will comprise a larger fraction of the number of varieties sold to region i. Note that the fraction of *varieties* sold to region i from region j need not generally equal the fraction of i's expenditure spent on region j varieties. Nonetheless, under the assumption that efficiencies follow a Fréchet distribution, it turns out that it does, due to the fact that the distribution of prices for region i is *independent of the origin* (Eaton and Kortum (2002)).

As a result the fraction of varieties that final good producers in region i and sector s purchase from region j equals its fraction of expenditure on goods from region j. Therefore it holds that

$$\pi_{ij,s} = \frac{X_{ij,s}}{X_{i,s}} = \frac{\left(\lambda_{i,s}\tau_{ij,s}\right)^{-\nu_s}}{\Phi_{i,s}},$$

where we denote as $X_{ij,s}$ the expenditure spent by final good producers in region i and sector s on intermediates produced in region j and $X_{i,s}$ are total expenditures.

Finally note that $\Phi_{i,s} = \left(\frac{P_{i,s}}{\Gamma\left(\frac{\nu_s+1-\sigma}{\nu_s}\right)^{\frac{1}{1-\sigma}}}\right)^{-\nu_s}$, which yields a gravity equation for intermediate trade:

$$\pi_{ij,s} = \frac{X_{ij,s}}{X_{i,s}} = \Gamma\left(\frac{\nu_s + 1 - \sigma}{\nu_s}\right)^{-\frac{\nu_s}{1-\sigma}} \left(\lambda_{j,s}\tau_{ij,s}\right)^{-\nu_s} \left(P_{i,s}\right)^{\nu_s}.$$

I.3 Aggregate equilibrium under selection and sorting

The spatial equilibrium of the model is summarized by the following 12 equations in 12 sets of model-implied variables (prices P_i, $P_{i,s}$, $\lambda_{i,s}$, r_i, $w^g_{i,s}$ as well as quantities $Q^g_{i,su}$,

$M_{i,su}, \mathcal{H}_{i,s}, L^g_{i,s}, L^g_{i,m}$ and expenditures $X_{i,s}$, $\pi_{ij,s}$:

$$L^g_{i,s} I^g_{i,s} = L^g_{i,s} \sum_{u=1}^{M} P_{i,u} C^g_{i,su} \qquad \text{(Worker expenditure: G x J x S eqs.)} \tag{29}$$

$$P_i = \prod_{u=1}^{M} (P_{i,u}/\beta^u)^{\beta^u} \qquad \text{(Regional price level: J eqs.)} \tag{30}$$

$$L^g_{i,s} = \frac{\left[\left((1-\mathcal{T}_i)\,\tilde{w}^g_{i,s} T^g_{i,s} (P_i)^{-1}\right)^{1-\alpha} \eta^g_{i,s} R^\alpha_i L_i^{-\chi\alpha}\right]^{\theta^g}}{\sum_{s\in M}\sum_{i\in J}\left[\left((1-\mathcal{T}_i)\,\tilde{w}^g_{i,s} T^g_{i,s} (P_i)^{-1}\right)^{1-\alpha} \eta^g_{i,s} R^\alpha_i L_i^{-\chi\alpha}\right]^{\theta^g}} L^g_m \quad \text{(Labour supply: G x J x M eqs.)} \tag{31}$$

$$L^g_{i,m} = \left[1 - \left(\frac{\mathcal{V}^g}{A^g_i B^g_{i,h} \left(\bar{I}\right)^{1-\alpha} \left(\frac{R_i}{L^X_i}\right)^{\alpha}}\right)^{-\epsilon^g}\right] L^g_i \quad \text{(Extensive labour supply: G x J eqs.)} \tag{32}$$

$$L^g_{i,s} = \frac{\delta_{i,s}(1-\kappa_{i,s})}{W^g_{i,s}} \frac{\left(\frac{H^g_{i,s}}{W^g_{i,s}}\right)^{\sigma^g-1}}{\sum_{g\in G}\left(\frac{H^g_{i,s}}{W^g_{i,s}}\right)^{\sigma^g-1}} \sum_{j\in J} \pi_{ji,s} X_{j,s} \quad \text{(Labour demand: G x J x M eqs.)} \tag{33}$$

$$\sum_{s\in M} \mathcal{H}_{i,s} = \mathcal{H}_i \qquad \text{(Supply of land and structures: J eqs.)} \tag{34}$$

$$\mathcal{H}_{i,s} = \frac{\delta_{i,s}\kappa_{i,s}}{r_i} \sum_{j\in J} \pi_{ji,s} X_{j,s} \qquad \text{(Demand for land and structures: J x M eqs.)} \tag{35}$$

$$M_{i,su} = \frac{\delta_{i,su}}{P_{i,u}} \sum_{j\in J} \pi_{ji,s} X_{j,s} \qquad \text{(Demand for materials: J x } M^2 \text{ eqs.)} \tag{36}$$

$$P_{i,s} = \Gamma(\gamma_s)^{\frac{1}{1-\sigma}} \left[\sum_{j\in J} (\lambda_{j,s}\tau_{ij,s})^{-\nu_s}\right]^{-\frac{1}{\nu_s}} \qquad \text{(Sectoral prices: J x M eqs.)} \tag{37}$$

$$\pi_{ij,s} = \frac{(\lambda_{j,s}\tau_{ij,s})^{-\nu_s}}{\sum_{n\in J}(\lambda_{n,s}\tau_{in,s})^{-\nu_s}} \qquad \text{(Trade shares: } J^2 \text{ x M eqs.)} \tag{38}$$

$$X_{i,s} = \beta_s^R (\mathcal{T}_i + \rho_i) \left(\sum_{g \in G} \sum_{u \in M} W_{i,u}^g L_{i,u}^g + \sum_{u \in M} \mathcal{H}_{i,u} r_i \right)$$
$$+ \beta_s \left(\sum_{g \in G} \sum_{u \in M} (1 - \mathcal{T}_i) W_{i,u}^g L_{i,u}^g + \iota_i \mathcal{K} + \bar{I} \sum_{g \in G} L_{i,h}^g \right) + \sum_{u \in M} \delta_{i,us} \sum_{j \in J} \pi_{ji,u} X_{j,u} \quad \text{(J x M eqs.)}$$

$$\sum_{j \in J} \pi_{ji,s} X_{j,s} = \lambda_{i,s} \left[(\mathcal{H}_{i,s})^{\kappa_{i,s}} (l_{i,s})^{1-\kappa_{i,s}} \right]^{\delta_{i,s}} \prod_{u \in M} [M_{i,su}]^{\delta_{i,su}} \quad \text{(Production: J x M eqs.)} \tag{39}$$

I.4 Total factor productivity

In the spirit of Caliendo et al. (2018) we subsequently define total factor productivity $A_{i,s}$ as

$$\ln A_{i,s} = \ln \frac{\sum_{j \in J} \pi_{ji,s} X_{j,s}}{P_{i,s}} - (\kappa_{i,s} \delta_{i,s}) \ln \mathcal{H}_{i,s} - \sum_{u \in M} \delta_{i,su} \ln M_{i,su}$$
$$- \delta_{i,s} (1 - \kappa_{i,s}) \sum_{g \in G} \hat{l}_{i,s}^g \ln L_{i,s}^g, \tag{40}$$

with $\hat{l}_{i,s}^g = \frac{\left(H_{i,s}^g L_{i,s}^g\right)^{\frac{\sigma^g - 1}{\sigma^g}}}{\sum_{g \in G} \left(H_{i,s}^g L_{i,s}^g\right)^{\frac{\sigma^g - 1}{\sigma^g}}}$, such that group-specific employment is weighted by its relative productivity. Note further that we can express the real cost of the input bundle in terms of own-region trade shares:

$$\frac{\lambda_{i,s}}{P_{i,s}} = \frac{(\pi_{ii,s})^{-\frac{1}{\nu_s}}}{\Gamma(\gamma_s)^{\frac{1}{1-\sigma}}},$$

where $\tau_{ii,s} = 1$ by assumption. As in Caliendo et al. (2018), the shares $\pi_{ii,s}$ govern the negative selection effect: if there is a decrease in unit costs in $\{i, s\}$, then this region-sector pair subsequently produces a greater variety of intermediate goods, since the demand for its goods from all pairs $\{j, u\}$ has risen. However, the idiosyncratic productivities associated with those new varieties of intermediate goods are smaller than those of varieties produced before the change, partially offsetting the initial drop in $\lambda_{i,s}$.

From equations (39) we can furthermore express gross output in terms of input factors:

$$\ln \sum_{j \in J} \pi_{ji,s} X_{j,s} = \frac{1}{\sigma - 1} \ln \Gamma(\gamma_s) + \ln P_{i,s} - \frac{1}{\nu_s} \ln \pi_{ii,s} + (\kappa_{i,s} \delta_{i,s}) \ln \mathcal{H}_{i,s} + \sum_{u \in M} \delta_{i,su} \ln M_{i,su}$$
$$+ \left(\frac{\sigma^g (1 - \kappa_{i,s}) \delta_{i,s}}{\sigma^g - 1} \right) \ln \left[\frac{\left(H_{i,s}^g L_{i,s}^g\right)^{\frac{\sigma^g - 1}{\sigma^g}}}{\hat{l}_{i,s}^g} \right]$$

Combining with equations (40) we derive total factor productivity in all region-occupation pairs only as a function of demand shifters,human capital and the selection effect:

$$\begin{aligned}\ln A_{i,s} =& \delta_{i,s}\left(1-\kappa_{i,s}\right)\left[\ln\left(L_{i,s}^{g}H_{i,s}^{g}\right)-\frac{\sigma^{g}}{\sigma^{g}-1}\ln\hat{l}_{i,s}^{g}-\sum_{g\in G}\hat{l}_{i,s}^{g}\ln\left(L_{i,s}^{g}\right)\right]\\&-\frac{1}{\nu_{s}}\ln\pi_{ii,s}+\frac{1}{\sigma-1}\ln\Gamma\left(\gamma_{s}\right).\end{aligned} \tag{41}$$

Note that equations (41) nest the expression for total factor productivity in Caliendo et al. (2018) as the special case of with only one group of workers and human capital shifters normalized to unity. Let the relative share of effective human capital units to be denoted as: $\tilde{L}_{i,s}^{g}\equiv\frac{\ln\left(H_{i,s}^{g}L_{i,s}^{g}\right)}{\ln\left(H_{i,s}^{f}L_{i,s}^{f}\right)}\quad\forall f\neq g\in G$. In order to derive the group-specific TFP component, we can re-arrange region-occupation productivity such that

$$\ln A_{i,s}-\frac{1}{\sigma-1}\ln\Gamma\left(\gamma_{s}\right)=\hat{\delta}_{i,s}\ln\left[\sum_{g\in G}\left(\frac{H_{i,s}^{g}}{\xi_{i,s}^{g}}\right)^{\frac{\sigma^{g}-1}{\sigma^{g}}}\right]-\frac{1}{\nu_{s}}\ln\pi_{ii,s}, \tag{42}$$

where we denote $\xi_{i,s}^{g}\equiv\exp\left[\ln L_{i,s}^{g}\left(1-\hat{l}_{i,s}^{g}-\hat{l}_{i,s}^{f}\tilde{L}_{i,s}^{f}\right)\right]$ and $\hat{\delta}_{i,s}\equiv\frac{\sigma^{g}(1-\kappa_{i,s})\delta_{i,s}}{\sigma^{g}-1}$. Region-group-specific TFP is decreasing in the selection effect, but increasing in the weighted sum of group-specific human capital $H_{i,s}^{g}$ across all groups.

Note that these weights are governed by the between-group distribution of employment: in region-sector cells with a similar number of employed workers (e.g. $\tilde{L}_{i,s}^{f}\rightarrow 1$), the human capital of all groups receives the same weights (e.g. $\xi_{i,s}^{g}=\xi_{i,s}^{f}=1$).

Similarly, as long as there are more workers of the *other* group employed in region-occupation pair $\{i,s\}$ (e.g. $\tilde{L}_{i,s}^{f}>1$), *own-group* productivity $H_{i,s}^{g}$ is weighted upwards as workers are imperfect substitutes in the production of intermediates.

I.5 Illustrating examples

To illustrate the main components of our model framework we first abstract from worker mobility in the first two illustrating examples [12] therefore restrict analysis to a one sector-one region framework.

No substitution effect. In order to highlight the classic trade-off between higher tax basis, local public good provision and labour force participation, we first abstract from the *substitution effect* and set $\phi^{g}=0$ for all worker groups.

Combining equations (6) and (10) yields a log-linear relationship between average wages in region $i\in J$ and labour force participation rates in the one-region-one-sector

[12] Given that German workers move between labour markets on average only once over their whole employment history (Ahlfeldt et al., 2020), this seems a good first-order approximation to work out the main mechanisms behind our framework.

framework:

$$\begin{aligned}\ln W_i^g =& \frac{1}{1-\alpha}\left[\ln \bar{B}_{i,h}^g + \mu_i^g + (1-\alpha)\left(\ln \bar{I} - \ln\left(1-\mathcal{T}_i\right)\right)\right] \\ &- \frac{1}{\epsilon^g\left(1-\alpha\right)}\left[\ln\left(L_i^g - L_{i,m}^g\right) - \ln L_i^g\right]\end{aligned} \tag{43}$$

Nominal wage increases pull workers into the labour force, thereby raising labour supply. Furthermore, differences in preference shifters solely explain gender-specific components of labour supply schedules in this simplifying example.Financing local public goods then requires higher tax rates, which disincentivizes workers to supply labour by decreasing real wage income and shifts labour supply upwards.

The corresponding log-linear labour demand schedule is derived from equation (22) such that:

$$\ln W_i^g = \ln W_i^f + \frac{\sigma^g - 1}{\sigma^g}\left(\ln T_i^g - \ln T_i^f\right) - \frac{1}{\sigma^g}\left(\ln L_{i,m}^g - \ln L_{i,m}^f\right) \quad \forall f \neq g \in G$$

High average human capital (relative to the other worker group) pushes up the demand schedule. The labour demand elasticity is governed by the elasticity of substitution between the different worker groups.

Income versus Substitution effect. Inspired by the empirical literature on the impact of local public provision on labour supply decision, we next allow preferences to shift endogenously with public goods. The "substitution effect, therefore, shifts labour supply upwards:

$$\begin{aligned}\ln W_i^g =& \frac{1}{(1-\alpha)+\phi^g}\Bigg[\ln \bar{B}_{i,h}^g + \mu_i^g + (1-\alpha)\left(\ln \bar{I} - \ln\left(1-\mathcal{T}_i\right)\right) \\ &+ \phi^g\left(\ln P_i^R + \ln L_i^{\chi} + \ln\left(1-\kappa_i\right) - \ln\left(\mathcal{T}_i + \rho_i\right)\right)\Bigg] \\ &- \frac{1}{\epsilon^g\left[(1-\alpha)+\phi^g\right]}\left[\ln\left(L_i^g - L_{i,m}^g\right) - \ln L_i^g + \epsilon^g \phi^g \ln\left(L_{i,m}^g + \tilde{\zeta}_i^g L_{i,m}^f\right)\right]\end{aligned} \tag{44}$$

where $L_{i,m}^f$ denotes the number of employed workers of the other worker group $f \neq g \in G$ and $\tilde{\zeta}_i^g = \frac{W_i^f}{W_i^m} \quad \forall f \neq g \in G$ the relative average wage of worker groups. The "substitution effect" both changes the intercept and the slope and even more so for female workers. The total effect of changes in regional tax revenue is therefore unclear: it decreases labour supply via the "income effect", which is alleviated via the "substitution effect".

J Quantification appendix

J.1 Data

This section complements Section E in the main paper. For the model quantification, we require five sets of data compiled for consistent spatial units and sectors: Employment, non-employment, wages, bilateral trade flows, and value-added for each region-sector pair. Additionally, we use data on region-specific land rents and aggregate price levels to derive prices and unit costs of non-tradable sectors.

Employment. To quantify the model, we require information on the number of workers of both genders $L^g_{i,s}$ employed in labour market i and sector s. Employment data is available from the Federal Employment Agency ("Bundesagentur für Arbeit") via their online regional database Statistische Ämter des Bundes und der Länder (2021b) for all NUTS-3 regions. In our main analysis, we focus on the 141 commuting zones as the empirical equivalent to the regions i, j of the model framework (Kosfeld and Werner, 2012) and use the Standard Classification of all Economic Activities (ISIC, Rev. 4) to construct six "occupational sectors", which we use as the data equivalent to the "sectors" introduced in the model framework. Table A 1 summarizes how we aggregate ISIC 4 Sectors into "occupational sectors". Sectors 1-4 are tradable, whereas sectors 5 and 6 consists of non-tradables.

Table A 1: ISIC Revision 4 Sector Classification

Description	Sector	Classification ISIC Revision 4
Agriculture, Forestry and Fishing	Agriculture	A
Mining and Quarrying Electricity, gas, steam and air conditioning supply Water supply; sewerage, waste management and remediation activities	Mining and Quarrying	B,D,E
Manufacturing	Manufacturing	C
Wholesale and retail trade; repair of motor vehicles and motorcycles Transportation and Storage Accommodation and food service activities Information and communication	Wholesale/ Retail Trade	G-J
Construction	Construction	F
Financial and insurance activities Real estate activities Professional, scientific and technical activities Administrative and support service activities Public administration and defence; compulsory social security Education Human health and social work activities Arts, entertainment and recreation Other service activities Activities of households as employers Activities of extraterritorial organizations and bodies	Non-tradable and Non-market Services	K-U

Notes: This table displays the six sectors: Agriculture (A), Mining (B/D/E), Manufacturing (C) Wholesale/Retail Trade (G - J), Construction (F) and Non-tradable and non-market services(K - U). Sectors 1 - 4 are tradable sectors, sectors 5 & 6 are non-tradable sectors.

Trade flows. The identification of bilateral trade costs and gross regional output require information on the entirety of inter-regional trade flows for all tradable sectors to match the expenditures in the model, $\sum_{j\in J} \pi_{ji,s} X_{j,s}$. The Clearing House of Transport Data at the Institute of Transport Research of the German Aerospace Center provides information on the entirety of bilateral trade volumes that went through German territory for the year 2010 in their final report for the Forecast of Nationwide Transport Relations in Germany 2030 ('Verkehrsverflechtungsprognose 2030', henceforth VVP).

As an input to the theoretical model we require trade *values* rather than volumes, so we convert the data by using appropriate unit values. We base our measure of region-sector-specific unit values on actual output data, such that the information on the volume of bilateral trade flows obtained from the VVP directly matches measures of aggregate region-sector-specific output. We aggregate trade data to the level of labour market regions and ISIC Revision 4 to match our classification of region-sector pairs.

J.2 Identification of model variables

J.2.1 Identification steps

Our strategy for identifying preferences and average human capital builds upon the strategy outlined in Rossi-Hansberg et al. (2019). The identification of model-implied variables from the data takes places in several steps:

1. **Use data on value added, gross output and input-output linkages to derive model-consistent values $\delta_{i,s}$, $\delta_{i,su}$, κ_i for all region-sector pairs**

   (a) **Share of value added for all region-sector pairs**

   Expenditures on wages as well as land and structures in region-sector pair {i,s} are a fixed share of total expenditures by equations (33) and (35)

   $$\delta_{i,s} = \frac{\sum_{g \in G} W^g_{i,s} \mu^g_{i,s} L^g + r_i \mathcal{H}_{i,s}}{\sum_{j \in J} \pi_{ji,s} X_{j,s}}, \tag{45}$$

   such that the parameters $\delta_{i,s}$ can be identified by the fraction of value added over gross regional output in each region-occupation pair.

   (b) **Shares of material inputs $\delta_{i,su}$ for all regions and sectors**

   Note, that in the aggregate economy total trade flows equal aggregate expenditures, such that

   $$\sum_{i \in J} \sum_{j \in J} \pi_{ji,s} X_{j,s} = \sum_{i \in J} X_{i,s}.$$

   Summing the demand for materials (36) over all regions yields then

   $$\delta_{su} = \frac{\sum_{i \in J} M_{i,su} P_{i,u}}{\sum_{i \in J} X_{i,s}},$$

   where we define as δ_{su} the share of economy-wide material inputs of goods from sector u used in the production of goods from sector s. We observe material inputs in the production of goods from each sector from the World Input-Output

Tables (Timmer et al. (2015)) at the aggregate level. We, however, cannot observe material inputs by sectors separately for each region. We therefore assume that in all regions the value of materials $u \in S$ used as inputs, relative to total material inputs, is constant, such that:

$$\delta_{su} = \frac{\delta_{i,su}}{\sum_{u \in M} \delta_{i,su}} \quad \forall i \in J.$$

The regional share of material inputs is therefore determined as:

$$\delta_{i,su} = (1 - \delta_{i,s})\, \delta_{su}.$$

(c) **Fraction of value-added accruing to workers**

Lastly, we calibrate the fraction of value added accruing to workers for each region-occupation pair as

$$1 - \kappa_{i,s} = \frac{\sum_{g \in G} W^g_{i,s} L^g_{i,s}}{\delta_{i,s} \sum_{j \in J} \pi_{ji,s} X_{j,s}}. \tag{46}$$

2. **Derive expenditures on land and structures and trade imbalances for all regions**

Expenditures on land and structures are a fixed share of total wage expenditures in all region-sector pairs:

$$r_i \mathcal{H}_{i,s} = \frac{\kappa_{i,s}}{1 - \kappa_{i,s}} \sum_{g \in G} W^g_{i,s} L^g_{i,s}, \tag{47}$$

such that total (before tax) income of rentiers in region $i \in J$ is given as

$$\sum_{s \in M} r_i \mathcal{H}_{i,s} = \sum_{s \in M} \frac{\kappa_{i,s}}{1 - \kappa_{i,s}} \sum_{g \in G} W^g_{i,s} L^g_{i,s}.$$

Trade imbalances after re-distribution are finally defined as

$$\Upsilon_i = (1 - \mathcal{T}_i) \sum_{s \in M} \mathcal{H}_{i,s} r_i - \iota_i \sum_{j \in J} \left[(1 - \mathcal{T}_j) \sum_{u \in S} \mathcal{H}_{j,u} r_j - \bar{I} \sum_{g \in G} L^g_{j,h} \right].$$

3. **Determine regional shares of national portfolio**

To determine the regional shares of the national portfolio we match the trade imbalances implied by the model Υ^M_i to the observed imbalances Υ^D_i in the data. We search for the respective contribution shares that minimize the sum of squared residuals $\sum_{i \in J} \left(\Upsilon^M_i - \Upsilon^D_i\right)^2$ subject to the constraints $\iota_i \in [0, 1]$ and $\sum_{i \in J} \iota_i = 1$.

4. **Calculate model-consistent expenditure shares β_s and β^R_s for all sectors**

Aggregate goods markets clear for all sectors, which, jointly with the definition of $\mathcal{K}$, implies that

$$\begin{aligned}\sum_{i\in J} X_{i,s} =&\beta_s^R\left(\sum_{i\in J}\sum_{g\in G}\sum_{u\in M}\left(\mathcal{T}_i+\rho_i\right)\left(W_{i,u}^g L_{i,u}^g+\mathcal{H}_{i,u}r_i\right)+\mathcal{K}\right)\\ &+\beta_s\left(\sum_{i\in J}\sum_{g\in G}\sum_{u\in M}\left(1-\mathcal{T}_i\right)W_{i,u}^g L_{i,u}^g+\bar{I}\sum_{i\in J}\sum_{g\in G}L_{i,h}^g\right)\\ &+\sum_{i\in J}\sum_{u\in M}\frac{\delta_{i,us}}{\delta_{i,u}\left(1-\kappa_{i,u}\right)}\sum_{g\in G}W_{i,u}^g L_{i,u}^g,\end{aligned} \tag{48}$$

Given aggregate wage data, employment data and parameter values for ρ_i and t_i as well as for $\delta_{i,s}$,$\kappa_{i,s}$ and $\delta_{i,us}$ obtained from identification step 1 we solve for model-consistent expenditure shares $\{\beta_s, \beta_s^R\}$ which imply aggregate sector-specific goods market clearing. We hereby assume that local governments and rentiers do not consume housing, but otherwise distribute expenditures similarly as workers across the remaining sectors. This allows to fit private expenditures shares better to observable housing expenditures shares in Germany, under the restriction that goods markets still clear in all regions and sectors (48).

5. **Calculate total expenditures on tradables**
   Goods market clearing in all regions and sectors implies that

$$\begin{aligned}X_{i,s} =&\beta_s^R\left[\left(\mathcal{T}_i+\rho_i\right)\left(\sum_{g\in G}\sum_{u\in M}W_{i,u}^g L_{i,u}^g+\sum_{u\in M}\mathcal{H}_{i,u}r_i\right)+\iota_i\mathcal{K}\right]\\ &+\beta_s\left(\sum_{g\in G}\sum_{u\in M}\left(1-\mathcal{T}_i\right)W_{i,u}^g L_{i,u}^g+\bar{I}\sum_{g\in G}L_{i,h}^g\right)+\sum_{u\in M}\delta_{i,us}\sum_{j\in J}\pi_{ji,u}X_{j,u},\end{aligned}$$

   which we solve for using the model-consistent expenditure shares $\{\beta_s, \beta_s^R\}$ from identification step 4.

6. **Calculate relative unit cost shares $\tilde{\lambda}_{i,s}$ for all tradable goods**
   Substituting the expressions for trade shares (38) as well as the calculated values for total expenditure from above into equations (46) yields

$$\sum_{j\in J} X_{j,s}\frac{\left(\lambda_{i,s}\tau_{ji,s}\right)^{-\nu_s}}{\sum_{n\in J}\left(\lambda_{n,s}\tau_{jn,s}\right)^{-\nu_s}}=\frac{\sum_{g\in G}W_{i,s}^g L_{i,s}^g}{\delta_{i,s}\left(1-\kappa_{i,s}\right)}. \tag{49}$$

   For all pairs $\{i,s\}$ we solve for the relative unit costs $\tilde{\lambda}_{i,s}\equiv\frac{(\lambda_{i,s})^{\nu_s}}{\sum_{n\in J}(\lambda_{n,s})^{\nu_s}}$ that are implied by the structure of trade flows. Unit costs can be identified from equations (49) as smaller relative unit costs imply that a region i is the least-cost producer for a larger number of varieties which increases trade shares towards all regions $j\in J$.

In all sectors where goods are non-tradable, it holds that $\pi_{ji,s} = 0$ as long as $j \neq i$, such that

$$X_{i,nt} = \frac{\sum_{g \in G} W_{i,nt}^{g} L_{i,nt}^{g}}{\delta_{i,nt} \left(1 - \kappa_{i,s}\right)}.$$

where $nt \in \mathcal{S} \subset M$ denotes sectors from the subset of market sectors that are non-tradable.

7. **Compute sector-specific price levels for all tradable goods**
Substituting relative unit costs $\tilde{\lambda}_{j,s}$ into price equations (37) allows to solve for the ideal region-sector-specific cost indices $P_{i,s}$:

$$P_{i,s} = \Gamma\left(\gamma_s\right)^{\frac{1}{1-\sigma}} \left[\sum_{j \in J} \left(\tilde{\lambda}_{j,s}\right)^{-1} \left(\tau_{ij,s}\right)^{-\nu_s}\right]^{-\frac{1}{\nu_s}} * \left(\sum_{n \in J} \left(\lambda_{n,s}\right)^{\nu_s}\right)^{\frac{1}{\nu_s}}, \tag{50}$$

where the $\sum_{n \in J} \left(\lambda_{n,s}\right)^{\nu_s}$ are sector-specific constants to be determined by normalization.
We choose a model-consistent normalization on aggregate sector-specific cost indices: $P_s \equiv \sum_{i \in J} P_{i,s} \pi_{i,s} = 1 \quad \forall s \in TR$, that is we define sector-specific cost aggregates as a weighted average of region-sector-specific costs and normalize them to unity. The weights $\pi_{i,s} = \frac{X_{i,s}}{\sum_{n \in J} X_{n,s}}$ are the share of total spending in occupation s, that accrues to region-i expenditures. Applying the normalization we solve for the occupation-specific constants, such that

$$\left(\sum_{n \in J} \left(\lambda_{n,s}\right)^{\nu_s}\right)^{\frac{1}{\nu_s}} = \frac{1}{\Gamma\left(\gamma_s\right)^{\frac{1}{1-\sigma}} \sum_{i \in J} \pi_{i,s} \left[\sum_{j \in J} \left(\tilde{\lambda}_{j,s}\right)^{-1} \left(\tau_{ij,s}\right)^{-\nu_s}\right]^{-\frac{1}{\nu_s}}}.$$

We subsequently calculate ideal cost indices relative to a weighted average of costs across all regions, that is

$$P_{i,s} = \frac{\left[\sum_{j \in J} \left(\tilde{\lambda}_{j,s}\right)^{-1} \left(\tau_{ij,s}\right)^{-\nu_s}\right]^{-\frac{1}{\nu_s}}}{\sum_{i \in J} \pi_{i,s} \left[\sum_{j \in J} \left(\tilde{\lambda}_{j,s}\right)^{-1} \left(\tau_{ij,s}\right)^{-\nu_s}\right]^{-\frac{1}{\nu_s}}}. \tag{51}$$

Using the normalization for aggregate occupation-specific cost indices once again, we solve for unit costs in levels:

$$\lambda_{i,s} = \frac{\left(\tilde{\lambda}_{i,s}\right)^{\frac{1}{\nu_s}}}{\Gamma\left(\gamma_s\right)^{\frac{1}{1-\sigma}} \sum_{i \in J} \pi_{i,s} \left[\sum_{j \in J} \left(\tilde{\lambda}_{j,s}\right)^{-1} \left(\tau_{ij,s}\right)^{-\nu_s}\right]^{-\frac{1}{\nu_s}}}.$$

8. **Compute price levels in all regions for all non-tradable goods**
The price levels of non-tradable services are defined as

$$P_{i,ntS} = \beta_{ntS} \left(\frac{P_{i,S}}{(P_{i,tS}/\beta_{tS})^{\beta_{tS}}} \right)^{\frac{1}{\beta_{ntS}}},$$

where the price level of tradable services $P_{i,tS}$ and the consumption shares of tradable and non-tradable services $\{\beta_{tS}, \beta_{ntS}\}$ follow from the previous steps. In all non-tradable sectors it holds that $\tau_{ij,s} \to \infty$ for all regions $j \neq i$, such that price levels simplify to:

$$P_{i,nt} = \Gamma(\gamma_s)^{\frac{1}{1-\sigma}} \lambda_{i,nt}.$$

Using regional price data for our choice of non-tradable sectors we subsequently solve also for unit costs in these sectors.

9. **Compute average human capital as compensating differential to unit costs**
Gender-specific labour demand (33) can be re-written in terms of the aggregate wage sum:

$$\frac{W_{i,s}^g L_{i,s}^g}{\sum_{g \in G} W_{i,s}^g L_{i,s}^g} = \frac{\left(\frac{H_{i,s}^g}{W_{i,s}^g}\right)^{\sigma^g - 1}}{\sum_{g \in G} \left(\frac{H_{i,s}^g}{W_{i,s}^g}\right)^{\sigma^g - 1}} \tag{52}$$

Substituting relative human capital $\tilde{H}_{i,s}^g \equiv \frac{H_{i,s}^g}{\sum_{g \in G} H_{i,s}^g}$ into equation (52) and re-arranging terms yields

$$\frac{\left(W_{i,s}^g\right)^{\sigma^g} L_{i,s}^g}{\sum_{g \in G} W_{i,s}^g L_{i,s}^g} = \frac{\left(\tilde{H}_{i,s}^g\right)^{\sigma^g - 1}}{\sum_{g \in G} \left(\tilde{H}_{i,s}^g\right)^{\sigma^g - 1} \left(W_{i,s}^g\right)^{1 - \sigma^g}}$$

Applying the fact that relative human capital $\tilde{H}_{i,s}^g$ sums to unity in all region-sector pairs by construction allows to identify them solely in terms of observable average wages and employment:

$$\tilde{H}_{i,s}^g = \frac{\left(W_{i,s}^g\right)^{\frac{\sigma^g}{\sigma^g - 1}} \left(L_{i,s}^g\right)^{\frac{1}{\sigma^g - 1}}}{\sum_{g \in G} \left(W_{i,s}^g\right)^{\frac{\sigma^g}{\sigma^g - 1}} \left(L_{i,s}^g\right)^{\frac{1}{\sigma^g - 1}}} \tag{53}$$

Intuitively, relative human capital is predicted to be larger if, controlling for differences in wages, there is large demand for group-specific employment.
The levels of human capital can be identified from observable values of aggregate production in all region-occupation pairs. Combining equations (39) with labour

demand, as well as demand for land and structures and materials yields

$$\left(\sum_{g\in G} H_{i,s}^{g}\right)^{\delta_{i,s}(1-\kappa_{i,s})} = \frac{B_{i,s}}{\lambda_{i,s}}\left(r_i^{\kappa_{i,s}}\left[\sum_{g\in G}\left(\frac{\tilde{H}_{i,s}^{g}}{W_{i,s}^{g}}\right)^{\sigma^g-1}\right]^{\frac{1-\kappa_{i,s}}{1-\sigma^g}}\right)^{\delta_{i,s}} \prod_{u\in M}\left[P_{i,u}\right]^{\delta_{i,su}},$$

where we substituted the definition for relative human capital.

Re-arranging terms yields gender-specific average human capital that is increasing in wages, price levels and rents, but decreasing in unit costs:

$$H_{i,s}^{g} = \tilde{H}_{i,s}^{g}\left[\frac{B_{i,s}}{\lambda_{i,s}}\left(r_i^{\kappa_{i,s}}\left[\sum_{g\in G}\left(\frac{\tilde{H}_{i,s}^{g}}{W_{i,s}^{g}}\right)^{\sigma^g-1}\right]^{\frac{1-\kappa_{i,s}}{1-\sigma^g}}\right)^{\delta_{i,s}} \prod_{u\in M}\left[P_{i,u}\right]^{\delta_{i,su}}\right]^{\frac{1}{\delta_{i,s}\left(1-\kappa_{i,s}\right)}}. \tag{54}$$

10. **Compute preferences as compensating differentials to labour supply**
Regional price levels are a Cobb-Douglas aggregate of sector-specific prices by equation (30). Given sector-specific unit cost levels (51), as well as data on wages $W_{i,s}^{g}$, tax rates, public goods and average human capital $T_{i,s}^{g}$, preferences $\eta_{i,s}^{g}$ are recovered as the residual to observable labour supply:

$$L_{i,s}^{g} = \frac{\left[\left(\left(1-t_i\right)\tilde{w}_{i,s}^{g}T_{i,s}^{g}\left(P_i\right)^{-1}\right)^{1-\alpha}\eta_{i,s}^{g}R_i^{\alpha}L_i^{-\chi\alpha}\right]^{\theta^g}}{\sum_{s\in M}\sum_{i\in J}\left[\left(\left(1-t_i\right)\tilde{w}_{i,s}^{g}T_{i,s}^{g}\left(P_i\right)^{-1}\right)^{1-\alpha}\eta_{i,s}^{g}R_i^{\alpha}L_i^{-\chi\alpha}\right]^{\theta^g}}L_m^{g}.$$

Spatial variation in real income identifies average group-specific preferences up to a group-specific constant for each region-sector pair $\{i,s\}$ as long as there is perfect worker mobility both across regions and sectors, which implies group-specific utility equalization.

11. **Compute preference shifters for the home market**
We use estimates for the elasticities of non-employment to local public good provision ϕ^g and shape parameters ϵ^g to recover the region-group-specific scale parameters of the preference distribution from equations (32):

$$B_{i,h}^{g} = \frac{\mathcal{V}^g}{A_i^g\left(\frac{\bar{I}}{P_i}\right)^{1-\alpha}\left(\frac{R_i}{L_i^X}\right)^{\alpha}}\left(\frac{L_{i,h}^{g}}{L_i^{g}}\right)^{\frac{1}{\epsilon^g}}$$

Finally, we split preference shifters into an exogenous and endogenous component such that

$$\bar{B}_{i,h}^{g} = B_{i,h}^{g}\left(\frac{R_i}{L_i^X}\right)^{\phi^g}.$$

J.3 Structural parameters

In this appendix, we highlight the spatial distribution of our model-inverted variables and run several over-identification checks.

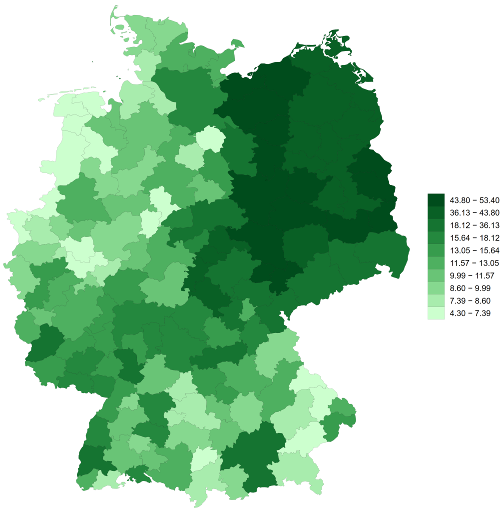
Public good elasticity. This section presents the first-stage regression results of regression equation (26). Real non-market earnings only react to the main Bartik shift-share instrument with an estimate of 0.34. Local public goods provision, however, is responsive to both the vector of distance-weighted regional childcare provision rates and the Bartik instrument, with estimates of 0.54 and 0.09 respectively, whereas the interactions of the instruments with the female dummy do not have any predictive power. As expected, the interaction term of real non-market earnings with the *female* dummy only reacts to the interaction of the Bartik instrument and the female dummy, whereas both interaction instruments explain the public good interaction term.

Table 2: THE EFFECT OF PUBLIC GOODS PROVISION ON NON-EMPLOYMENT: FIRST-STAGE

	$\ln(\bar{I}_t/P_{i,t})$ (1)	$\ln(I_{i,t}/L_{i,t-1}) \times$ Female (2)	$\ln(R_{i,t}/L_{i,t-1})$ (3)	$\ln(R_{i,t}/L_{i,t-1}) \times$ Female (4)
$\text{InstCHILD}_{i,t}$	-0.00	-0.00	0.09***	0.00
	(0.00)	(0.00)	(0.01)	(0.00)
$\text{InstCHILD}_{i,t} \times$ Female	0.00	-0.00	-0.00	0.09***
	(0.00)	(0.00)	(0.02)	(0.01)
$\text{BtkTAX}_{i,t}$	0.34***	0.00	0.54**	0.00
	(0.07)	(0.00)	(0.22)	(0.00)
$\text{BtkTAX}_{i,t} \times$ Female	-0.00	0.34***	0.00	0.54**
	(0.09)	(0.07)	(0.30)	(0.22)
Region fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes
F-statistic instrument	14.75	7.57	53.49	27.72
Observations	1974	1974	1974	1974

Notes: This table reports the first-stage results of the IV estimates. The dependent variable is the log non-employment rate, and the endogenous variables are the log real non-market earnings and the log real tax revenues. These are instrumented with distance-weighted leave-one-out childcare provision rates, Bartik-style tax-class instruments, and their respective interaction with a female dummy. Standard errors (in parentheses) are clustered at the level of 141 local labour markets. $^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 2: Spatial disparities in childcare rates



(a) Childcare rates

Notes: This figure plots the geographical pattern of fiscal capacities per capita across the 141 German local labour markets (Kosfeld and Werner, 2012) in 2008. Data comes from the INKAR (2020) database. Darker shading indicates higher values.

K Counterfactual appendix

K.1 Procedure

To implement the counterfactual we hold parameter values $\{\alpha, \beta_u, \beta_u^R, \theta^g, \epsilon^g, \delta_{i,s}, \delta_{i,su}, \iota_i, \kappa_{i,s}, \phi^g, \sigma_g, \sigma, \tau_{ij,s}, \nu_s, \chi\}$ at their level for the year 2014. We then iteratively up-date guesses for wages per efficiency, rents, prices, and the employment as well as non-employment distribution until in the counterfactual equilibrium

1. Wages per efficiency clears all labour markets and ensure that labour supply (31) equals labour demand (33)

2. Rents adjust to clear the market for land and structure

3. Unit cost adjust to ensure that demand equals supply for all input factors in intermediate production

4. Goods markets clear

5. The number of non-employed workers of both genders has endogenously adjusted to fiscal capacity shocks

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