Spatial Policies and Heterogeneous Employment Responses*

Fabian Bald† Marcel Henkel‡

January 28, 2026

Abstract

Place-based policies influence not only where people work, but also whether they work at all. We use quasi-experimental variation from Germany's 2011 Census to show that redistributive transfers to local governments increase female labor force participation. These transfers fund local public services that reduce structural barriers to market entry. To explain these results, we develop a spatial general equilibrium model in which workers decide on their location and whether to work in the market or the home sector, and this decision is impacted by local public goods provision. The endogenous participation margin creates a novel externality: market entry increases output and taxes, but congests public services, thereby affecting others' participation decisions. Optimizing spatial policies for the German economy generates welfare gains of 2.7 % and real GDP gains of 2.1 %, substantially larger than gains predicted by models without endogenous labor supply. These gains arise from reallocating approximately 400,000 workers, predominantly women, from home to market work in high-productivity cities, demonstrating that spatial policies can mobilize underutilized labor in economies facing demographic pressure.

JEL Codes: H41, H73, J16, J22, J61, R23, R58

Keywords: Place-Based Policies, Local Public Goods, Labor Force Participation, Fiscal Transfers, Spatial Sorting

*We are grateful to Gabriel Ahlfeldt, Costas Arkolakis, Maximilian von Ehrlich, Stephan Heblich, David Jinkins, Pierre Magontier, Ana Moreno-Maldonado, Ferdinand Rauch and Tobias Seidel, as well as seminar, conference, and workshop participants at BQSE (HU Berlin), Copenhagen (CBS), CEP (LSE), EEA, Heidelberg (Uni), IAB, IIPF, Max Planck Institute and the Urban Economics Association for comments and suggestions. The usual disclaimer applies.

†European University Viadrina Frankfurt (Oder), Berlin School of Economics.
Email: Bald@europa-uni.de

‡University Bern. Email: marcel.henkel@unibe.ch

1 Introduction

Place-based policies are among the most sizeable fiscal interventions in developed economies, with governments redistributing resources across regions to address spatial inequality. A large spatial economics literature emphasizes how these policies shape the spatial distribution of firms and workers (Ehrlich and Overman, 2020; Kline and Moretti, 2014; Neumark and Simpson, 2015). We introduce an additional margin of adjustment: local labor force participation (LFP). Place-based policies generate spatially heterogeneous employment responses not only by influencing where people work, but also whether they work. They do so by altering the trade-off between market work and home production through funding local public services such as childcare and transportation, which are often underprovided by the private market due to positive externalities or credit constraints. Incorporating this LFP margin substantially alters the optimal design of place-based policy.

We explore this channel and quantify its impact on the design of place-based policies within a spatial general equilibrium model of worker allocation. In the framework, individuals differ by demographic group, idiosyncratic location preferences, and their productivity in the home market relative to market sectors. This heterogeneity governs allocation both between regions and within them – specifically, between market work and a productive home sector. Local public finance is central to this allocation. Public services can substitute for privately produced home goods, reducing opportunity costs of market work. However, these services have to be funded by local taxes and inter-regional transfers, and their quality is subject to local congestion.

The German economy, with pronounced regional disparities and extensive fiscal transfer system, offers a compelling setting to empirically establish this result. We first record a stark urban labor force participation gap: female LFP does not rise with average wages in a location, unlike male LFP. These participation gaps suggest that female labor may not be used to its full potential across regions, motivating an investigation into the spatial variation in these market entry barriers. Variation in local provision of public services, such as childcare and commuting infrastructure, offers a natural explanation.[1]

We establish a causal link between place-based policy, local government expenditures, and female LFP by exploiting quasi-experimental variation from Germany's 2011 Census and the existing fiscal redistribution scheme between local governments. This system follows a formula-based approach, in which fiscal transfers to local governments are determined by the difference between a region's assessed fiscal needs and its fiscal capacity. While fiscal capacity varies with the local economic base, fiscal needs are mechanically tied to population size, typically calculated as a fixed per-capita target adjusted for specific municipal characteristics. Following Serrato and Wingender (2016) and Helm and Stuhler

[1] There is complementing evidence for the role of local public services in explaining spatial LFP variation from other settings: Moreno-Maldonado (2023) identifies inadequate or costly childcare as a key driver of lower participation rates among young mothers in the largest US cities, while Soto Vieira (2026) documents that commuting costs create spatial gradients in female labor force participation in São Paulo, with women on the urban periphery facing particularly high barriers to market entry due to transportation constraints.

(2024), we use unexpected population revisions from the Census as an exogenous shock to local fiscal transfers, uncorrelated with local economic and fiscal conditions.[2] Using a difference-in-differences design, we show that the Census-induced fiscal transfer shocks shifted labor from home to market work, especially for women and in areas with limited infrastructure and public childcare usage. This supports the hypothesis that public spending substitutes for private home production, influencing the LFP margin (Baker et al., 2008; Bick, 2016).

Incorporating endogenous LFP has significant implications for the optimal design of place-based policy. Where optimal spatial policy models under full employment have typically focused on correcting inefficient worker sorting across locations (Fajgelbaum and Gaubert, 2020, 2024; Rossi-Hansberg et al., 2025; Henkel et al., 2021), our framework, in contrast, treats labor supply as an outcome of individual choices constrained by structural barriers. Optimal policy design thus has an expanded objective: efficient sorting across regions and addressing heterogeneous constraints to market entry within regions. This second margin is important because the social returns to market work and labor supply responses to policy vary systematically across space and demographic groups. Viewed through the lens of optimal taxation with tagging (Akerlof, 1978; Saez, 2002; Gaubert et al., 2021), location serves as a 'tag' that allows the planner to condition policy on location-specific labor supply elasticities, shaped by the access to local public services.

Optimizing place-based policy design can boost overall welfare and efficiency since spatial differences in labor supply responses create location-specific fiscal and technological externalities. For example, a worker who joins the labor force helps create agglomeration economies and increases the local tax base. At the same time, individual participation can add to congestion in the very public services that enable market entry. This, in turn, raises the cost of market work for others, making it less likely they will enter the labor force. We term this last externality the 'labor supply fiscal externality'.

The sign and magnitude of this externality are location-specific and policy-dependent. For example, it acts as a congestion force in high-wage locations (where lost market output is costly) or in areas with a large home sector (where the marginal social value of additional home market production is lower). Aggregate efficiency requires balancing the net effect of all spatial externalities by aligning private and social returns to LFP. In our framework, the optimal policy that internalizes spillovers then depends on more than differences in local wages. It balances local productivity, participation rates, and the varying social value of market versus home production. We provide closed-form solutions for the optimal spatial policy instruments (e.g., tax rates, fiscal transfers, and wage subsidies) that a benevolent social planner would choose to manage all these different types of spatial externalities (agglomeration, congestion, and the labor supply fiscal externality) to maximize aggregate welfare.

[2] Although transfers are not strictly proportional to population due to the capacity offset, this institutional link ensures that population updates generate variation in municipal budgets that can be exploited for identification purposes.

We formalize the trade-offs in a quantitative spatial model where heterogeneous workers make two choices. First, they sort across locations based on preferences and economic conditions. Second, they select into market work or the home sector. This follows a Roy-style model of selection into sectors (Roy, 1951; Hsieh et al., 2019): individuals join the labor force if the market utility exceeds the value of home production. Local public policy directly influences this choice. Public services, such as subsidized childcare or transport infrastructure, substitute for home production and lower the opportunity cost of market employment. We recover this substitution elasticity by building on our reduced-form evidence from the Census shock. However, these services are rivalrous and link individual participation decisions to others' welfare.

We embed this trade-off in a spatial general equilibrium framework. Local governments fund public goods via local income taxes and inter-regional fiscal transfers (Henkel et al., 2021; Fajgelbaum et al., 2019). Taxes on immobile factor rents finance compensation for non-employed workers. Competitive firms combine mobile labor with immobile factors to produce traded and non-traded goods (Caliendo et al., 2018) for private consumption and public services. Wages, prices, taxes, and transfers, as well as worker allocation, are thus determined endogenously within this framework.

In our counterfactual simulations, we leverage our theoretical results to optimize the existing fiscal redistribution system and assess the aggregate implications for productivity, employment, and welfare. This analysis yields two main findings. First, optimal policy differs from the current system and from predictions originating from full-employment models common in the spatial economics literature: it involves less broad-based redistribution and more targeted tax incentives to encourage market-sector reallocation into the most productive and urban locations. Second, implementing this policy increases real GDP by 2.1% and welfare by 2.7%, gains significantly larger than in a benchmark model without endogenous LFP adjustment.

These gains originate from two sources: first, female workers are incentivized to locate in large, productive places, where fiscal and agglomeration externalities are high. Second, the optimal policies draw approximately 400,000 additional workers, primarily women, into market employment in urban centers where structural barriers are high, and LFP is relatively small ex ante. These counterfactual results indicate that optimizing place-based policy could already achieve up to 20% of the aggregate increase in female LFP that would be attained in a counterfactual scenario where the structural barriers of females were to fully converge to the level of male workers' over time (Hsieh et al., 2019; Goldin, 2014). Mobilizing underutilized labor is a priority for economies facing demographic pressures. This paper argues that place-based policy is a powerful lever for this, offering potentially significant aggregate gains.

Our analysis builds on and contributes to three main literatures. First, we extend the literature on public finance within quantitative spatial economics. While foundational models focused on how endogenous amenities and productivity explain location choice (Allen and Arkolakis, 2014; Roback, 1982; Redding and Rossi-Hansberg, 2017), recent

work has turned to characterizing the role of place-based policies, particularly in the presence of spatial frictions and externalities (Colas and Hutchinson, 2021; Blouri and Ehrlich, 2020; Fajgelbaum et al., 2019; Fajgelbaum and Gaubert, 2020; Henkel et al., 2021; Rossi-Hansberg et al., 2025). These models typically assume full employment and focus on how fiscal transfers should correct for the inefficient spatial sorting of workers by balancing local productivity benefits in urban areas against consumption value in areas of high marginal utility (typically rural areas), accounting for congestion. Our primary contribution is to relax the full-employment assumption and introduce an endogenous labor force participation margin. In doing so, we identify a labor supply fiscal externality that alters the optimal policy calculus, forcing the planner to consider not only the spatial allocation of workers but also their sectoral allocation between market and home production.

Second, we connect the spatial economics literature with the macro-labor literature on home production. Seminal work in macroeconomics establishes the importance of the household sector in explaining aggregate labor market dynamics and gender gaps (Becker, 1965; Benhabib et al., 1991; Doepke and Tertilt, 2016). Our framework spatializes this concept, showing how local frictions, such as labor market mismatch and search frictions, and the availability of childcare (Goldin, 2014; Kleven et al., 2019) or commuting constraints (Le Barbanchon et al., 2021; Soto Vieira, 2026), create regional variation in the opportunity cost of market work. This generates spatially heterogeneous gender gaps and a misallocation of talent that place-based policy can directly address, extending insights on aggregate misallocation (Albanesi and Olivetti, 2016; Hsieh et al., 2019) to a regional context.

Third, we complement research on frictional labor markets (Bilal, 2023; Jung et al., 2023; Kline and Moretti, 2013; Kuhn et al., 2021; Schmutz and Sidibé, 2019) and the empirical evaluation of place-based policies (Kline and Moretti, 2014). We identify a specific, empirically-grounded channel–the substitutability of public goods for home production–through which policy can address barriers to LFP.[3] This complements recent findings on the labor demand side: just as 'business inputs' can be more cost-effective than cash incentives (Bartik, 2020), we show that 'participation inputs' (public services) generate higher fiscal multipliers by unlocking the extensive margin of labor supply.

The remainder of the paper proceeds as follows. Section 2 establishes empirical evidence for the participation channel using quasi-experimental variation from Germany's 2011 Census. Section 3 develops the theoretical framework, characterizing optimal spatial policies when labor supply is endogenous. Section 4 describes the quantification strategy and calibration to German data. Section 5 presents counterfactual policy experiments and quantifies aggregate welfare gains. Section 6 concludes.

[3]While our framework primarily focuses on labor force participation choices, in an extension we show how the main labor supply equation can alternatively be derived as the steady-state outcome in a dynamic search-and-matching model of frictional unemployment, connecting our approach to the spatial unemployment literature.

2 Empirical Evidence

Our analysis is motivated by a spatial disconnect between wages and female labor force participation. While the literature has identified substantial urban wage premia (Baum-Snow et al., 2018; Dauth et al., 2022; Glaeser and Maré, 2001), we investigate whether analogous patterns exist for labor force participation. We analyze German districts (*Kreise*, $N = 400$) over the period 2008–2018 and measure market engagement by the employment-to-population ratio.[4] Conversely, non-employment is defined as the share of the working-age population not engaged in market work.[5] Detailed data sources and institutional background on Germany's fiscal federalism system are provided in Online Supplement **??** of this paper.

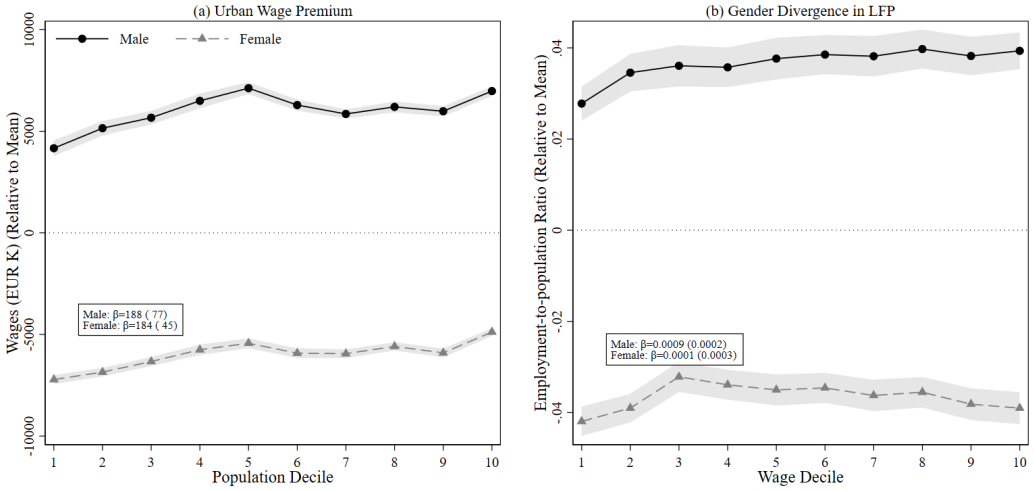


Figure 1: Urban Premia and Gender Gaps

Notes: This figure plots binned scatter plots of residualized data for German districts (*Kreise*, $N = 400$), 2008–2018. Variables are residualized on federal state and year fixed effects, focusing on within-state variation. Panel (a) uses population deciles; Panel (b) uses overall regional wage deciles (average of male and female wages), ensuring both series span all deciles. Solid lines are averages within each bin for men and women. The dotted line represents the global mean. Shaded areas are 95% confidence intervals. Slope coefficients (β) are estimated by regressing bin means on decile ranks separately by gender; standard errors are given in parentheses. Wage measures are constructed using SIAB data; see Section 4 for details.

Figure 1 demonstrates the key empirical pattern. Panel (a) confirms the urban wage premium: larger, denser districts offer significantly higher wages for both men and women. The slope coefficient is approximately 188 € per population decile ($p < 0.05$). However,

[4] We utilize districts rather than commuting zones ($N = 141$) for these stylized facts to maximize within-state variation. For the quantification of the structural model, we will employ the coarser commuting zone geography, which is delineated to minimize between-region commuting.

[5] Non-employed individuals encompass all working-age persons outside market employment, including the economically inactive (e.g., those in home production, education, or early retirement) and the unemployed. Our quantitative framework models this group as engaged in a productive home sector, consistent with Austin et al. (2018), who argue that the distinction between unemployment and non-participation is empirically arbitrary and often reflects measurement conventions rather than behavioral differences.

Panel (b) demonstrates that this wage premium does not necessarily translate into higher female labor force participation. While male participation rises with local wages ($\beta_M = 0.0009$, $p < 0.01$), female participation remains unresponsive ($\beta_F \approx 0$, $p = 0.88$). The female coefficient is statistically indistinguishable from zero and economically small relative to the observed variation in participation rates. We term this phenomenon the "Urban Participation Gap." Despite high market returns, women in high-productivity locations appear to face compensating differentials or structural barriers, such as labor market frictions and skill mismatch, that offset wage incentives in the most productive locations.

While Baum-Snow et al. (2018) attribute rising U.S. urban wage premia to skill sorting, our findings suggest that for women, these premia may not necessarily induce higher participation without complementary (public) service provision that can mitigate the impact of these structural barriers. While these descriptive patterns are consistent with structural barriers constraining female labor supply especially in large cities, they do not establish causality. To identify the mechanism linking public goods provision to labor force participation, we exploit quasi-experimental variation in local fiscal transfers.

2.1 Empirical Evidence: The Census Shock

A central prediction of our theory is that the provision of local public goods influences labor supply decisions. To test this mechanism, we exploit institutional features of the German fiscal system combined with quasi-experimental variation from the 2011 Census. Germany operates one of the world's most comprehensive fiscal redistribution systems (*Finanzausgleich*), transferring nearly 10 % of nominal GDP between government layers and regions annually. This formula-based system links fiscal transfers to the difference between local fiscal needs and local governments' fiscal capacity. Because population counts directly determine transfer allocations, the Census-induced revisions in local population counts created an ideal natural experiment to assess the impact of windfall gains on local government expenditures.

The 2011 Census revealed significant accumulated errors in population registries and projections, with magnitudes that varied both quantitatively and qualitatively across districts. Updating the population counts then led to unexpected and permanent shocks to municipal fiscal transfers from the redistribution system that are uncorrelated with recent economic or fiscal budget shocks (Helm and Stuhler, 2024; Serrato and Wingender, 2016). The transfer corrections resulted in exogenous windfall gains and losses for local governments in the following years, without altering local tax rates or the underlying private economy (see Online Supplement **??** for details).

Empirical Specification. Using a difference-in-differences design with Augmented Inverse Probability Weighting (AIPW) (Sant'Anna and Zhao, 2020), we compare regions receiving above-average positive shocks to their population registry (treated) to those with smaller or negative shocks. Treatment intensity is defined as the unanticipated change in

transfers per capita induced by the subsequent Census revision. In particular, we estimate the dynamic average treatment effect on the treated (ATT) via the following regression specification:

$$Y_{it} = \alpha_i + \lambda_{s,t} + \sum_{\tau=-K}^{L} \delta_\tau \mathbb{1}(t - E_i = \tau) + X_{it}'\gamma + \varepsilon_{it} \tag{1}$$

Outcome variables are fiscal transfers and labor force participation by gender and year, while α_i and $\lambda_{s,t}$ denote district and state-by-year fixed effects. E_i denotes the event year, which is 2013, two years after the actual Census, for all treated regions.[6] Control variables include log net wages, population, and four annual lags of the outcome variable. We balance treatment groups on pre-treatment dynamics of wages, population, and the outcome variable.

Results. We find that an above-average population shock led to an exogenous and permanent increase in per capita transfers of 166 € per year, or 2.4% of previous transfers, relative to control locations. Helm and Stuhler (2024) show that local governments respond to unforeseen lump-sum budget increases primarily through increased investment spending rather than debt restructuring, tax adjustments, or public employment changes. Online Supplement A confirms these findings for the 2011 Census shock, since we do not find effects on public debt holdings, tax rates, or investment in public personnel in treated locations.

Female non-employment rates decline by 1.3% in the medium run (Table 1), while the effect on male participation is about one-quarter smaller and not statistically significant at conventional levels. Taken together, these ATT effects suggest that a one percent increase in local public revenues is associated with a decrease in female non-employment rates of 0.15 percentage points at the gender-specific average rates of 2014 (28.2%), while the effect on male workers' rates would be about 50% smaller given their average non-employment rate (20.54%). Results are robust to continuous treatment definitions (see Online Supplement Table A.2).[7]

Heterogeneity. Columns (2)–(5) explore treatment effect heterogeneity by local infrastructure access. We construct composite measures of public service availability using principal component analysis. For transport access, we combine standardized distance measures to public transportation with average travel times to the nearest motorway, airport, and train station. For childcare, we combine standardized enrollment rates from the INKAR (2020) database: the share of children under three and between three and five

[6] Because population data are released with a lag, state governments base fiscal need calculations on counts from two years earlier. As a result, updated figures from the 2011 Census only began fully influencing fiscal transfers in 2013.

[7] We assess sensitivity to potential parallel trends violations following Rambachan and Roth (2023). For the binary AIPW specification, the effect remains significant for post-treatment deviations up to $\bar{M} \approx 1.5$ times the maximum pre-treatment deviation. The continuous specification shows a breakdown value of $\bar{M} \approx 0.75$, reflecting the more demanding identification requirements when exploiting treatment intensity variation. See Online Supplement A.4 for details.

Table 1: Effects of Fiscal Transfer Shocks on Employment

		Childcare Usage		Transport Access	
	Pooled	Low	High	Low	High
	(1)	(2)	(3)	(4)	(5)
Panel A: Fiscal Transfers per Capita (EUR)					
ATT	165.847**	—	—	—	—
	(70.115)	.	.	.	.
Panel B: Log Non-employment Rate (Female)					
ATT	-0.013**	-0.016**	-0.011	0.004	-0.000
	(0.006)	(0.007)	(0.008)	(0.010)	(0.008)
Panel C: Log Non-employment Rate (Male)					
ATT	-0.010	-0.016	-0.012	0.010	-0.003
	(0.012)	(0.019)	(0.012)	(0.011)	(0.013)
Observations	4,000	2,018	1,982	2,270	1,730
Controls	Yes	Yes	Yes	Yes	Yes
State × Year FE	Yes	Yes	Yes	Yes	Yes
Pre-treatment Dynamics	Yes	Yes	Yes	Yes	Yes

Notes: This table reports average treatment effects on the treated (ATT) from an augmented inverse probability weighting (AIPW) difference-in-differences estimator (Sant'Anna and Zhao, 2020). Treatment is defined as an above-median population revision from the 2011 Census; effects are realized in 2013 due to the two-year lag in fiscal transfer calculations. Column (1) reports the pooled ATT for the full sample. Columns (2)–(3) split the sample by pre-treatment childcare access; columns (4)–(5) by pre-treatment transport access. Both indices are constructed using principal component analysis: childcare access combines enrollment rates for children aged 0–2 and 3–5 years; transport access combines distance to public transit and travel time to major transport hubs. Regions are classified as or based on pre-treatment median splits (childcare index: -0.02; transport index: -0.31). Controls include log net wages, population, and four lags of the outcome. Standard errors clustered at the county level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

years old in institutional care. This measure reflects take-up (children actually enrolled) rather than capacity (slots available), capturing the equilibrium outcome of local supply and demand for childcare.

Observable childcare utilization admits two interpretations (Berlinski et al., 2024). Low enrollment may indicate either (i) supply constraints, where limited infrastructure makes it difficult for women to combine market work with care responsibilities, or (ii) weak demand, where local preferences or labor market conditions reduce reliance on institutional care.[8]

Our identification strategy addresses this ambiguity. The Census shock provides a supply-side fiscal windfall unrelated to local demand conditions. We compare employment

[8]Demand for institutional childcare varies across locations if labor supply non-convexities, such as the ability to work from home or the emotional costs associated with maintaining a career, are shaped by local labor market conditions (Le Barbanchon et al., 2021; Cubas et al., 2023; Erosa et al., 2022). Spatial variation in preferences or cultural norms may also matter (Boelmann et al., 2025; Jessen et al., 2023). Our data do not measure facility quality (e.g., child-to-carer ratios, opening hours).

effects across treated and control locations, stratified by initial childcare utilization. The results are striking: the effect on female non-employment in low-childcare regions (-1.6%, $p < 0.05$) is approximately 50 percent larger than in high-childcare regions (-1.1%, not significant). Transport access shows no differential pattern.

These findings support the view that public spending addresses supply-side constraints rather than acting solely as a wealth transfer. The results also suggest that the substitution elasticity between public goods and home production varies with local infrastructure. Our structural model incorporates this non-linearity and replicates the observed heterogeneous treatment effects. We return to these patterns in Section 4.4, where we validate that estimated structural barriers correlate with observable infrastructure proxies.

3 Theoretical Framework

3.1 The Participation Margin: Key Mechanism

The empirical evidence in Section 2 reveals two key patterns: (1) fiscal expenditure shocks increase female LFP, and (2) effects concentrate where public services are scarce. To explain these findings and derive implications for optimal policy design, we develop a spatial model in which individuals allocate time between market and home sectors. The model builds on quantitative spatial economics frameworks with frictional migration but incorporates a participation margin that alters the implications for place-based policy.

Structural barriers that differ across local labor markets govern labor force participation decisions. Public goods that substitute for home production can shift labor supply decisions, with heterogeneous effects across local labor markets. The treatment effects in Table 1, which are larger where public service provision is scarce, help identify this elasticity and confirm it varies with existing infrastructure. The participation margin generates a novel spatial externality: when a worker migrates to a high-wage city and enters the labor market, she increases agglomeration and fiscal budgets, but also congests local public goods, raising the opportunity cost of market work for existing residents and inducing some to exit.

3.2 Environment

The economy comprises $i \in J$ regions and is populated by L heterogeneous individuals belonging to different demographic groups $g \in G$ (e.g., men and women). Workers select locations based on individual preference draws, local market conditions, and public goods availability, while individual productivity draws determine whether workers join the market ($s = m$) or the home market sector ($s = h$).

3.3 Preferences and Home Production

Each worker ω of group g in location i and sector $s \in \{h, m\}$ derives utility from four components: individual amenity valuation, consumption of market goods, work disutility, and benefits from home production as a function of public goods access. The utility function is:

$$U^g_{s|i}(\omega) = a^g_i(\omega) \left(C^g_{s|i}\right)^{1-\alpha} \cdot \left(\Lambda^g_s\right)^{-1} \cdot b^g_{s|i}(\omega), \tag{2}$$

where $a^g_i(\omega)$ represents individual location-specific preferences, $C^g_{s|i}$ denotes consumption from private goods with preference parameter $0 < 1-\alpha < 1$, $\left(\Lambda^g_s\right)^{-1}$ represents the disutility of working in $s \in m, h$ (and taken to be equal across groups or sectors in the following), and $b^g_{s|i}(\omega)$ captures the benefits from home production and public goods access.

Individual location preferences $a^g_i(\omega)$ follow a Fréchet distribution with shape parameter $\theta > 1$: $F^g_i(a) = \exp(-A^g_i \cdot a^{-\theta})$, and scale parameter $A^g_i = \bar{A}^g_i L_i^{-\eta}$, where $\bar{A}^g_i$ is an exogenous fundamental amenity term shifted endogenously by local population $L_i = \sum_{g \in G} L^g_i$ with constant elasticity $-\eta < 0$ (Allen and Arkolakis, 2014; Diamond, 2016).

Each worker allocates one unit of time to either market work or home production.[9] We model home production as a utility-generating activity whose value varies across people and places. Utility from home production depends on individual ability, regional characteristics, and local public goods R_i. Market workers benefit directly from public goods, while home-sector workers benefit at a reduced intensity:

$$b^g_{s|i}(\omega) = \begin{cases} \left(R_i / L_i^{\chi}\right)^{\alpha} & \text{if } s = m, \\ \exp\left[B^g_{h|i}\right] \left[\left(R_i / L_i^{\chi}\right)^{\alpha}\right]^{1-\rho^g} \varphi(\omega) & \text{if } s = h \end{cases} \tag{3}$$

Workers in both the market and the home sector benefit from public goods, but with different intensities governed by $1-\rho^g$. When $\rho^g \in [0,1]$, public goods are substitutes for home production (for example, public childcare partly reduces the need for private childcare). A larger local population, however, reduces the effectiveness of public goods due to congestion. The congestion parameter $\chi \in [0,1]$ captures this rivalry in public goods: $\chi = 0$ implies pure public goods, $\chi = 1$ full rivalry. Public goods are endogenously financed through local taxation; see Section 3.5 for details.

For market workers, public goods perfectly substitute for private home production activities, lowering the opportunity cost of market work. For workers in the home sector, utility depends on two additional components that drive the core trade-off. First, $\varphi(\omega)$ is an idiosyncratic productivity draw for home market tasks, following a Pareto distribution $Q^g(\varphi) = 1 - \varphi^{-\epsilon^g}$ with shape parameter $\epsilon^g > 1$. This idiosyncratic term enters the production function only for workers who actually allocate time to home production and is normalized relative to market-sector productivity. Second, $\exp\left[B^g_{h|i}\right]$ captures exogenous, systematic differences in structural barriers to market entry across locations. The subscript

[9] We focus on the extensive labor supply margin assuming indivisible labor, i.e., single workers cannot split their time endowment between the two uses (Doepke and Tertilt, 2016).

$h|i$ denotes barriers faced by workers in the home sector in location i—that is, frictions that impede transition *from* home *to* market work. We interpret this term as a reduced-form friction that raises the reservation wage for market entry, such as care responsibilities, commuting costs, search frictions, or skill mismatches.

3.4 Market Production

Production. Firms combine labor l_i and immobile, exogenous factors h_i (land and structures) under perfect competition, with production function

$$y_i = h_i^{\kappa_i} l_i^{1-\kappa_i}, \tag{4}$$

and $1-\kappa_i$ the labor share in production. Labor is a composite, combining different worker types with substitution elasticity $\sigma^g > 1$:

$$l_i = \left[\sum_{g \in G} \left(Z_i^g (1 - \xi_{h|i}^g) L_i^g \right)^{\frac{\sigma^g - 1}{\sigma^g}} \right]^{\frac{\sigma^g}{\sigma^g - 1}}, \tag{5}$$

where $\xi_{h|i}^g \equiv L_{h|i}^g / L_i^g$ represents the local non-employment share. Similarly, $\xi_{m|i}^g \equiv L_{m|i}^g / L_i^g = 1 - L_{h|i}^g / L_i^g$. Labor productivity $Z_i^g = \bar{Z}_i^g \left(\sum_{g \in G} (1 - \xi_{h|i}^g) L_i^g \right)^{\zeta^g}$ includes both an exogenous component and agglomeration economies that increase with local employment under constant group-specific elasticity $\zeta^g > 0$ (Combes and Gobillon, 2015; Rosenthal and Strange, 2004). Firms minimize costs, such that unit costs (λ_i) are a CES aggregate of group-specific wages (w_i^g) and rents for the immobile production factors (r_i).

Final Goods and Price Normalization. Final goods are non-tradable and produced locally using a CES aggregate of intermediates produced in all locations and with elasticity σ. Since intermediates are freely traded, geographic frictions do not affect their prices. We choose the final good as the numéraire and normalize its price to one: $P_i \equiv 1 \quad \forall i$. This normalization does not affect relative prices or allocations, but it provides a common reference for determining wages and factor returns across regions.[10]

3.5 Public Finance Structure

The model captures the core features of fiscal federalism - income taxation, intergovernmental transfers, and local public goods provision - in a form that is generalizable beyond Germany.

[10] Section 4.1 develops an extended framework that incorporates multiple market sectors, frictional trade, heterogeneous firms, and distinct consumption goods, including non-tradable residential housing. This comprehensive structure enables precise alignment with occupational sorting of heterogeneous workers and serves as the foundation for quantification and counterfactual analysis. Despite this stylization, the baseline model sufficiently captures agglomeration and congestion effects through the provision of public goods and endogenous amenities.

Income and Transfers. Workers receive after-tax income combining market wages, taxes ($t_{s|i}$), and lump-sum transfers from the federal government ($x^g_{s|i}$):

$$I^g_{s|i} = (1 - t_{s|i})w^g_i + x^g_{s|i}, \tag{6}$$

where $t_{s|i}$ may vary by employment status and location, and $x^g_{s|i}$ denotes wage subsidies from a national redistribution system.

Non-employed workers receive a fraction of after-tax labor income as non-employment compensation, such that $t_{h|i} > t_{m|i}$. These payments are financed by taxing the rents from the immobile production factors at the federal level. All workers also receive equal per-capita dividends from the remaining national portfolio of immobile factor rents as federal transfers: $\mathcal{K} = \sum_{j \in J} \left(r_j h_j - (1 - t_{h|j}) \sum_{g \in G} \xi^g_{h|j} w^g_j L^g_j \right)$, where $r_i h_i$ denotes local rents from immobile factors in region i, and we assume $x^g_{s|i} = x = \mathcal{K}/L$ for all groups, locations, and workers of all employment statuses.[11]

Local Public Goods. Local governments fund public services via local taxation of (employed) workers and transfers from other parts of the economy (Fajgelbaum et al., 2019; Henkel et al., 2021):

$$E_i = (t_{m|i} + \iota_i) \sum_{g \in G} (1 - \xi^g_{h|i}) w^g_i L^g_i, \tag{7}$$

where ι_i is the transfer rate. This flexible structure accommodates additional funds in recipient regions ($\iota_i > 0$) that must be fully funded by donor locations ($\iota_i < 0$) in the aggregate. We treat $t_{s|i}$, ι_i, and $x^g_{s|i}$ as exogenous policy instruments, without modelling the political economy of their determination (Agrawal et al., 2025). This allows us to: (1) match observed fiscal data (see Section 4), and (2) conduct clean counterfactuals without modelling endogenous policy responses. Workers respond to regional variation in taxes, transfers, and public goods through migration and participation decisions. Public goods are treated as given when making location decisions–an assumption appropriate for short-to-medium analysis.

3.6 Labor Force Participation and Spatial Sorting

Participation Decision. After choosing a location, each worker decides whether to join the market sector by comparing the utility from market work with that from home production. This decision hinges on their individual home productivity draw, $\varphi(\omega)$, and local economic conditions. The properties of the Pareto distribution then yield the number

[11] We assume a national portfolio of rents to abstract from inefficiencies arising from local ownership of fixed factors, which can create its own distinct distortions (see Fajgelbaum and Gaubert (2024) for a detailed discussion). In our quantification for Germany, we match local public spending to local tax revenues. Since most social benefits and transfer payments to private households (e.g., non-employment payments, child-care benefits, pensions) are federally funded, we introduce a second, national portfolio. For realistic parameterisations, rent payments suffice to finance all non-employed compensation.

of non-employed workers:

$$L^g_{h|i} = \xi^g_{h|i} L^g_i = \Bigg[\underbrace{\left(\exp\left[B^g_{h|i}\right]\right)^{-1}}_{\text{Structural Barriers}} \underbrace{\left(\frac{I^g_{m|i}}{I^g_{h|i}}\right)^{1-\alpha} \left(\left[\frac{R_i}{L^\chi_i}\right]^{\rho^g}\right)^{\alpha}}_{\text{Spatial Policies}} \Bigg]^{-\epsilon^g} L^g_i. \tag{8}$$

Equation (8) shows that spatial policies influence participation through two channels: (1) the income ratio between market and home work ($I^g_{m|i}/I^g_{h|i}$), and (2) the provision of public goods R_i.[12] The elasticity of non-employment with respect to public goods is $\gamma^g \equiv \alpha\epsilon^g\rho^g$, which we estimated in reduced-form with an approach outlined in Section 2. These participation decisions, in turn, generate agglomeration and congestion spillovers: when workers enter the workforce, they increase local productivity, expand the tax base, and reduce the federal government's transfer obligations; however, they also increase public goods congestion and decrease home production. Individuals fail to internalize the impact of their participation decisions on other workers, which motivates the design of well-targeted spatial policies to address these distortions.

Spatial Sorting. Workers choose locations to maximise expected utility, accounting for spatial variation in public goods, real incomes, structural barriers, and amenities. In spatial equilibrium, it then holds that

$$L^g_i = \frac{(\bar{V}^g_i)^\theta}{\sum_{i\in J}(\bar{V}^g_i)^\theta} L^g, \tag{9}$$

where $\bar{V}^g_i = A^g_i \Lambda \left(I^g_{m|i}\right)^{1-\alpha} \cdot (R_i/L^\chi_i)^\alpha \left(1 + \xi^g_{h|i}/(\epsilon^g - 1)\right)$ is the expected indirect utility, incorporating the weighted utility of becoming employed or non-employed. Our Online Supplement **??** provides detailed model derivations, all market-clearing conditions and equilibrium properties for the interested reader.

3.7 Efficiency and Spatial Externalities

The competitive, spatial equilibrium described above is generally inefficient in the presence of spatial externalities (Fajgelbaum and Gaubert, 2020). Agents do not internalize the full social costs and benefits of their location choices. To characterize these inefficiencies in a spatial framework with endogenous LFP, we consider a social planner who maximizes aggregate welfare subject to resource and technological constraints in general equilibrium. These constraints include: (i) demand for intermediate and final goods must equal production in all locations; (ii) workers freely choose their locations; (iii) workers freely choose whether to join the labor force; and (iv) supply of mobile production inputs must equal their demand in production. See Appendix A.2 for details of the planner's problem set-up.

[12] Equation (8) can also be derived as the steady state of a regional search-and-matching model with frictional unemployment (Kline and Moretti, 2013). See Online Supplement B.3 for details and discussions.

Comparing the planner's solution to the competitive equilibrium reveals that the efficient spatial allocation of workers must satisfy the condition that the social marginal cost and benefit of allocating a worker to a location are equal.

Proposition 1 (Efficient Spatial Sorting)**.** *The efficient spatial allocation requires that for every location i, the social marginal cost of an additional worker equals the social marginal benefit:*

$$\underbrace{W_i^g}_{\text{opportunity cost}} + \underbrace{P_i C_i^g}_{\text{consumption cost}} = \underbrace{\left(1 - \xi_{h|i}^g\right) w_i^g}_{\text{marginal product}} + \underbrace{Ex_i^{NET}}_{\text{net externalities}} \tag{10}$$

where W_i^g is the shadow value of the worker's outside option and the value of market work, w_i^g, has to equal the social benefit of home market production in all places, $\tilde{W}_{m|i}^g$. The term Ex_i^{NET} captures the net spatial externalities:

$$Ex_i^{NET} \equiv \underbrace{Ex_i^{AGG}}_{\text{agglomeration}} + \underbrace{Ex_i^{CON}}_{\text{congestion}} + \underbrace{Ex_i^{LFP\text{-}Fiscal}}_{\text{labor supply fiscal externality}}$$

Proof. See Appendix A.2 for proof in the most general setting with multiple market sectors and frictional goods trade.

While the agglomeration ($Ex_i^{\text{AGG}} \equiv \zeta^g(1 - \xi_{h|i}^g)w_i^g$) and congestion ($Ex_i^{\text{CON}}$) terms are standard in the literature, our framework identifies an additional source of spatial inefficiency arising from the endogenous participation margin.

The Labor Supply Fiscal Externality. The third term in Proposition 1, designated as the labor supply fiscal externality, arises from the interaction between endogenous home production and the congestion of public goods. In Appendix A.2, this term is derived as follows:

$$Ex_i^{\text{LFP-Fiscal}} \equiv -\chi\gamma^g \xi_{h|i}^g \cdot \left(w_i^g - \frac{\bar{\mathcal{C}}}{(1-\alpha)(\epsilon^g - (1 - \xi_{h|i}^g))} \right) \tag{11}$$

where $\gamma^g \equiv \alpha\epsilon^g\rho^g$ represents the elasticity of labor supply with respect to the provision of public goods and $\bar{\mathcal{C}}$ the average private goods consumption.

This externality captures the failure of private migration and participation decisions to internalize the degradation of the local participation infrastructure. The mechanism is best illustrated by the dynamics in a high-wage metropolitan area such as Munich, where high structural barriers block a large pool of productive (female) workers from entering the market. In such a setting, an additional resident entering the labor market expands agglomeration benefits and contributes to the local government budgets, but also increases the utilization of capacity-constrained public goods, such as childcare facilities. This congestion raises the opportunity cost of market work for the incumbent population since access to high-quality childcare impedes labor force re-entry.

The spatial heterogeneity of labor force participation rates implies that the magnitude of the labor supply fiscal externality varies significantly across regions. The social planner values the reallocation of time toward home production based on the differential between the lost market wage and the social value of home production. As a result, the social cost of discouraging market work acts as a strong congestion force in high-productivity locations where wages are high. In contrast, the welfare impact is minimal in locations where the behavioral response to increased congestion, as reflected in the elasticity of labor supply to public goods, is low.

This heterogeneity suggests that policies aimed at maximizing aggregate welfare cannot rely solely on density targets. Instead, welfare-maximizing policy interventions address the specific composition of economic activity. Standard place-based literature often focuses on demand-side externalities. For instance, Bartik (2020) argues that hiring in distressed regions reduces social costs such as crime or fiscal transfers.[13] In contrast, this framework identifies a countervailing supply-side externality concentrated in productive regions. Private markets in high-wage cities tend to underprovide the infrastructure needed to enable participation. Therefore, optimal policy requires a Pigouvian provision of public goods. In the welfare-maximizing allocation, such interventions concentrate in productive locations with high market attachment, where the deviation between private and social returns to labor market entry is largest. In these locations, the demand for and the benefits from participation-enabling public goods are particularly high, while behavioral responses are minimized.

We provide a detailed analysis of the optimal policy instruments, specifically how tax rates and fiscal transfers should vary with local labor market conditions, in Section 5.1. There, we show that the optimal policy involves location-specific labor income taxes that target the spatial variation in labor supply elasticity, and a redistribution scheme that balances this novel labor supply fiscal externality with traditional arguments for spatial redistribution, namely spatial differences in agglomeration benefits, amenity congestion, and marginal utilities of consumption.

4 Quantification

To take our theoretical framework to the data, we quantify its key parameters for Germany, focusing on commuting zones (CZs) in 2014. While our stylized facts in Section 2 use districts to maximize statistical power for detecting within-state patterns, we shift to commuting zones for the structural model. This choice reflects three considerations. First, commuting zones are designed to approximate self-contained labor markets in which most residents live and work, making them the natural units for modeling the labor market equilibrium and spatial sorting. Second, the structural model requires matching wages

[13] Bartik (2020) posits that shifting resources from tax breaks to targeted business inputs, such as job training, improves cost-effectiveness and employment outcomes in distressed regions by addressing firm-level productivity constraints.

to local labor supply, which is conceptually cleaner when regions correspond to actual commuting patterns rather than administrative boundaries. Third, commuting zones align with the standard in the quantitative spatial economics literature, facilitating comparison with prior work (Caliendo et al., 2018; Redding and Rossi-Hansberg, 2017).

Our goal is to measure the forces governing the allocation of labor between the market and home sectors. This requires two steps: first, constructing a comprehensive dataset of regional economic conditions, including gender-specific wages and employment rates; and second, identifying how policy affects the market-versus-home trade-off.

4.1 A Multi-Sector Trade Framework for Quantification

The theoretical framework in Section 3 abstracts from sectoral heterogeneity and trade frictions to highlight the core participation mechanism. For quantification, we extend the model along three dimensions to better reflect the German economy. Full derivations are provided in Appendix A.1.

These extensions enrich the counterfactual analysis without altering the core mechanism: public goods substitute for home production, and the extent of this substitutability varies by gender and location. The sectoral structure allows us to match observed industry-by-gender employment patterns, while trade and input-output linkages ensure that policy interventions in one region have realistic spillover effects on others.

Multi-Sector Production. We disaggregate the economy into six market sectors $u \in M$, comprising agriculture, manufacturing, construction, tradable services, non-tradable services, and housing, following the classification in Caliendo et al. (2018). This sectoral structure captures two empirically important features. First, men and women sort differently across industries: women are overrepresented in services, while men dominate manufacturing and construction. Second, sectors differ in their tradability: manufactured goods flow freely across regions, while housing and personal services must be consumed locally. These sectoral differences generate spatial variation in the gender wage gap and in how local shocks propagate through the economy.

Inter-Regional Trade. Regional goods trade follows the Eaton-Kortum gravity framework (Eaton and Kortum, 2002). Trade flows depend on bilateral distance, with closer and more productive regions capturing larger market shares. This structure implies that each region's price level reflects its market access, defined as the ease of sourcing goods from productive suppliers. Capturing these trade linkages is essential for evaluating place-based policies: a fiscal transfer to one region alters its wages and prices, which then propagate to trading partners through changes in market access and input costs.

Input-Output Linkages. Sectors purchase intermediate inputs from one another, creating production networks that amplify local shocks. For example, an increase in construction sector productivity reduces housing costs, which lowers the cost of living and attracts

workers to that region. These workers then increase demand for local services, generating additional employment. We calibrate input-output shares using World Input-Output Tables (WIOD) to capture this general equilibrium feedback.

4.2 Data

Our quantification combines several data sources. Core labor market data are sourced from the Federal Institute for Research on Building, Urban Affairs, and Spatial Development (BBSR) and the Federal Employment Agency, providing detailed information on the working-age population, labor force participation, and unemployment rates by gender at the county level. We use these data to construct measures of "non-employment" as our empirical proxy for the share of the population engaged in the home production sector.

To capture sectoral composition and construct region-sector-specific wages by gender, we use the Sample of Integrated Labor Market Biographies (SIAB) from the Institute for Employment Research (IAB) to allocate total employment across different market sectors.[14] We apply an AKM earnings model (Abowd et al., 1999) to individual wages, addressing wage censoring issues using the imputation method proposed by Card et al. (2013). We then combine estimated fixed effects for each gender, region, and sector with national account data from the EU KLEMS Database to ensure consistency with aggregate wage measures.

Fiscal data on tax revenues and inter-regional transfers originate from German Statistical Offices (Statistisches Bundesamt, Destatis), and we construct a (novel) panel data set of local tax and inter-regional transfers following the methodology of Henkel et al. (2021). We allocate federal, state, and municipal tax revenues to the commuting zone level and calculate corresponding fiscal transfers within and between Federal states. We use regional price indices for non-tradable goods and real estate from Ahlfeldt et al. (2020) and Weinand and Auer (2020).[15]

For production structure and trade patterns, we combine several data sources. Gross output and value-added data come from EU KLEMS, and regional economic accounts are provided by the Statistical Office of the European Union (Eurostat). Input-output linkages are derived from World Input-Output Tables (WIOD). We measure trade flows using data from the Clearing House of Transport Data at the Institute of Transport Research of the German Aerospace Center (Schubert et al., 2014), which provides information on

[14] "Weakly anonymous Version of the Sample of Integrated labor Market Biographies (SIAB) - Version 7521 v1". Research Data Centre of the Federal Employment Agency (BA) at the Institute for Employment Research (IAB). DOI: 10.5164/IAB.SIAB7521.de.en.v1. Data access was provided on-site at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently, via remote data access. Our sample includes individuals aged 15-65 who are either employed or non-employed, excluding marginally employed, deceased, or emigrated workers. See Table C.1 in the Online Supplement for categorising six 'market sectors' based on the ISIC 4 classification of economic activities.

[15] To capture local cost-of-living differences for the non-tradable sectors, we use regional price indices for real estate (serving as a proxy for construction sector prices) and non-tradable service prices. The real estate price indices are based on microdata from the Immobilien Scout 24 platform, using the methodology in Ahlfeldt et al. (2020).

interregional trade between German districts. These flows are aggregated to match our commuting zone and sector-specific gross output data.

4.3 Calibration

Baseline Parameters. We calibrate the model to match key German economic indicators. Non-employment compensation is set to 62% of after-tax wages, reflecting Germany's current parental allowance for parents on leave with young children.[16] Production parameters match observed data: region-sector-specific labor shares $(1 - \kappa_{i,u})$ correspond to labor payments relative to value-added, and value-added shares $\delta_{i,u}$ match EU KLEMS and Eurostat data.

For agglomeration economies, we use gender-specific productivity spillover estimates from Ahlfeldt et al. (2020): $\zeta^M = 0.018$ and $\zeta^F = 0.032$, which fall well within the range of 0.01 to 0.06 documented in the literature (Rosenthal and Strange, 2004). Amenity spillovers are set to $\eta = 0.3$ for both genders, matching the average across skill groups in Diamond (2016). The elasticity of substitution between male and female workers is $\sigma^g = 2.5$ (Olivetti and Petrongolo, 2014).[17]

Trade parameters follow the gravity literature (Head and Mayer, 2014). We set the elasticity of substitution across regions at $\sigma = 5$ and model trade costs as $\tau_{ij} = dist_{ij}^{\zeta_u}$ with $\nu_u = 5$. Using the bilateral trade flow data, we estimate trade cost parameters $-\nu_u\zeta_u$ ranging from -1.43 to -2.14.

For public goods, we assume perfect rivalry ($\chi = 1$) and set the preference weight ($\alpha = 0.24$) and Fréchet shape parameter ($\theta = 2$) following Fajgelbaum et al. (2019) and German public finance data.[18] We calibrate expenditure shares to ensure aggregate goods market clearing. See Table C.2 in our Online Supplement for an overview of the complete parametrization.

Elasticity of Allocation between Market and Home Sectors. The parameter ϵ^g governs the substitution between market and home sectors. From equation (8), the elasticity of local labor supply to wage or income tax changes is:

$$\frac{\partial L^g_{m|i}}{\partial (I^g_{m|i}/I^g_{h|i})} \frac{(I^g_{m|i}/I^g_{h|i})}{L^g_{m|i}} \equiv \varepsilon^g_i = \left[(1-\alpha)\,\epsilon^g \xi^g_{h|i}\right] \left(1 - \xi^g_{h|i}\right)^{-1}. \tag{12}$$

We calibrate average elasticities to match meta-analyses for European countries and the US (Mui and Schoefer, 2025), setting $\varepsilon^M = 0.310$ and $\varepsilon^F = 0.465 = 1.5 * \varepsilon^M$. This 50% higher female elasticity reflects greater responsiveness to financial incentives, consistent

[16] While this paper focuses on non-employment rather than frictional unemployment, we also note that the first-tier unemployment benefit ('Arbeitslosengeld I') lies in a very similar vicinity.

[17] Estimates range from 1.2 to 2.7 in Mexico (Bhalotra and Fernández, 2018) and around 3 in the US (Acemoglu et al., 2004).

[18] With Cobb-Douglas preferences, α equals the public goods expenditure share, which should equal the share of aggregate public expenditure to total value added. Local public finance data for Germany suggests a similar value, which justifies our chosen value.

with the meta-analysis in Bargain and Peichl (2016).[19] Combined with our public goods preference parameter ($\alpha = 0.24$) and observed average non-employment rates by gender across labor markets, these elasticities imply Pareto shape parameters of $\{\epsilon^M = 1.58; \epsilon^F = 1.56\}$.

The Effect of Public Goods on the Market-vs-Home Choice. The Census shock (Section 2.1) identifies the composite elasticity $\hat{\gamma}^F = 0.013$: a one percent increase in local public goods reduces female non-employment by $(1.3/2.4 = 0.54)$ percent. We use these estimates to recover the structural preference parameter ρ^g, which governs how public goods enter the home versus market utility comparison:

$$\rho^g = \frac{(\hat{\gamma}^g / \Delta T)}{\alpha \cdot \epsilon^g \cdot \phi} \tag{13}$$

where $\alpha = 0.24$ is the public goods share, ϵ^g is the Pareto shape parameter (calibrated above), $\Delta T = 2.4$ is the average percentage increase in fiscal transfers, and $\phi = 0.65$ is the fiscal pass-through from revenues to public goods provision (Helm and Stuhler, 2024). Substituting our estimates yields structural elasticities of $\rho^F = 0.013/(1.56 \times 2.43 \times 0.24 \times 0.65) = 0.022$ for women and $\rho^M = 0.016$ for men.

This mapping from reduced form to structure is critical for the counterfactual exercises in Section 5. The Census shock identifies how local labor supply responds to public goods *on the margin*, but the counterfactuals require simulating *equilibrium* responses that account for general equilibrium feedbacks through wages, migration, and fiscal adjustment. The structural parameter ρ^g enters the individual participation decision (Equation 8), which then interacts with the full model, including agglomeration economies, congestion externalities, and fiscal multipliers, to generate aggregate predictions.

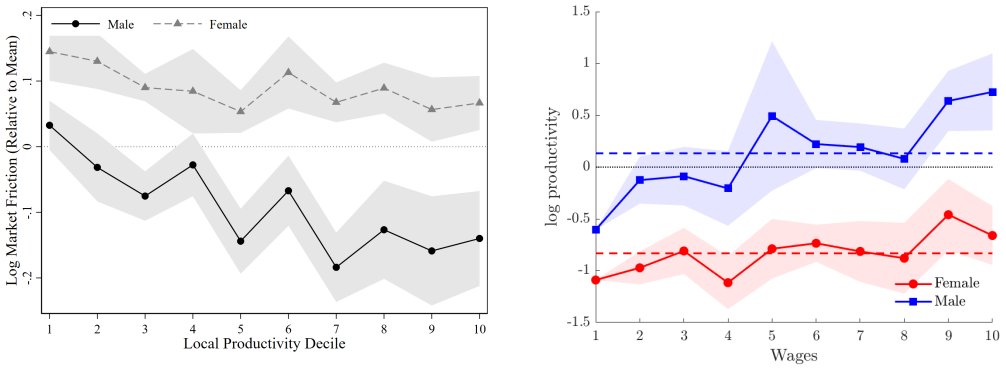
4.4 Recovering Spatial Fundamentals

We use the model structure, together with the calibrated and estimated parameters to recover the region- and gender-specific fundamentals that rationalize the observed data: structural barriers ($B^g_{h|i}$), market productivity ($\bar{Z}i^g$), supply of land and structure (H_i) and amenities, ($\bar{A}i^g$). In particular, these structural model fundamentals are inverted such that they perfectly and uniquely explain the observed labor market, public finance, trade, and price data, given a set of spatial policies $t_{s|i}, x^g_{s|i}, \iota_i$ for the year 2014. A full description of the inversion strategy and results is in Online Supplement C.3 for the interested reader.

This inversion reveals that the urban gender participation gap is driven by high male market productivity, combined with relatively high structural barriers to market entry for women in the largest cities. Figure 2 documents this finding: Panel (a) shows that male workers experience systematically lower structural barriers in high-wage cities (consistent with better labor market access), while female barriers remain elevated across the wage

[19] Bargain et al. (2014) also documents estimates for married women between 0.2 and 0.6.

distribution. Panel (b) confirms that productivity advantages rise with local wages for both genders, but the persistence of female barriers prevents these advantages from translating into comparable participation gains.



(a) The Gender-Spatial Wedge

(b) Productivity Advantages

Figure 2: Structural Barriers and Productivity Across Space

Notes: Panel (a) plots log structural barriers (centered at the global mean) for men and women across local productivity deciles, revealing the "Gender Participation Gap": male barriers decline in productive cities while female barriers remain constant. Panel (b) shows log productivity against wage deciles for both genders, confirming urban productivity advantages. Solid lines are male; dashed lines are female. Shaded areas are 95% confidence intervals.

Over-identification and Validation The structural barriers $B^g_{h|i}$ are model residuals recovered from the participation equation, controlling for wages and public goods. A natural concern is whether these residuals capture economically meaningful frictions rather than unobserved heterogeneity. We address this through two complementary validation exercises.

First, we regress recovered barriers on observable proxies for participation constraints using regional infrastructure data from the INKAR database, residualizing both outcomes and predictors on log wages and log population. Female barriers exhibit a strong positive correlation with long-term unemployment (a proxy for labor market mismatch and skill depreciation), indicating that search frictions are key predictors of participation barriers. Male barriers show a similar pattern.

Childcare enrollment rates show a *negative* correlation with female barriers: regions with higher childcare usage have lower structural barriers to female market entry. This cross-sectional association captures *equilibrium* differences in childcare utilization—regions with lower barriers have more women in the labor force who demand childcare. Importantly, our enrollment measure reflects take-up (demand realized), not capacity (supply available), so this correlation does not directly identify supply constraints. Online Supplement Figure **??** visualizes these gender-differential correlations.

Second, the heterogeneity analysis in Section 2.1 provides a distinct test. There, we

show that *marginal* fiscal shocks have larger employment effects in regions with initially *low* childcare enrollment (Table 1). This is not a contradiction: low enrollment can reflect either (i) low supply, creating scope for improvement when public investment arrives, or (ii) low demand from an already non-participating population. The fiscal shock identifies the supply channel—windfalls expand local public services, and the employment response is largest where such services were previously scarce.

The alignment between these two exercises supports our structural interpretation: barriers correlate with labor market frictions in levels, while fiscal shocks causally reduce barriers at the margin by relaxing supply constraints on participation-enabling infrastructure (Kleven et al., 2019; Le Barbanchon et al., 2021; Moreno-Maldonado, 2023).

5 Counterfactual Policy Analysis

5.1 Theoretical Predictions from the Quantitative Framework

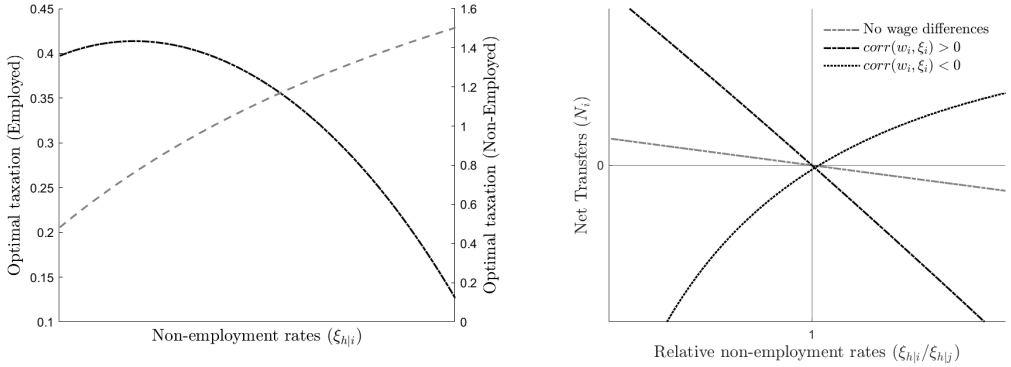
Before implementing counterfactual scenarios to highlight the role of labor force participation in spatial models, the following subsection provides intuition for how the competing pressures of the three spatial externalities shape the optimal design of place-based policy instruments. We present all technical proofs and the closed-form solutions for the optimized policies that maximize economy-wide welfare (tax rates, fiscal transfers, and wage subsidies) in Appendix A.2.2.

Optimal Taxation. In a single-sector (full-employment) model, uniform tax rates are optimal to avoid distorting migration incentives.[20] However, when labor force participation is endogenous ($\epsilon < \infty$ and $\xi_{h|i} > 0$), location acts as a *tag* for labor supply elasticity (Akerlof, 1978; Saez, 2002). Because the impact of structural barriers ($B_{h|i}$) differs across space, the elasticity of the tax base varies between regions. Optimal policy exploits this by setting location-specific tax rates. Panel (a) of Figure 3 plots the optimal tax rate on market workers ($\tilde{t}_{m|i}$) against the local non-employment rate ($\xi_{h|i}$), using the parameterization for Germany. The resulting inverse-U shape reveals the tension between two classic public finance principles applied to a spatial setting.

First, consider a region with low barriers and high market attachment (low $\xi_{h|i}$), such as a location with excellent childcare infrastructure (e.g., the East German city of Leipzig in our stylized example). Here, the labor supply elasticity is relatively low (see also Eq. (12)) and only a few productive workers are likely to leave market work following a tax increase. Applying a 'spatial Ramsey rule', the planner sets higher tax rates in those places to efficiently raise revenue for public goods, capitalizing on the inelastic tax base.

[20] Under full-employment ($\epsilon \to \infty$ and $\xi_{h|i} = 0$), the planner chooses a uniform tax rate $t_{m|i} = t_i = [1 + (1 - \alpha)\theta]^{-1}$ that declines with worker mobility and private goods preferences, consistent with the principle of preferably taxing inelastic bases (Keen and Konrad, 2013; Fajgelbaum and Gaubert, 2024; Helpman and Pines, 1980; Wildasin, 1987).

Second, consider female workers in regions with greater structural barriers (high $\xi_{h|i}$), such as Munich. Here, a large potential pool of productive individuals sits on the margin of the labor force, blocked by comparatively high entry costs, and the labor supply is highly elastic. In this context, the planner prescribes lower tax rates (or a targeted earned income credit). This effectively subsidizes the entry costs to market work. The logic is driven by a selection effect into market employment: reducing the tax wedge in high-barrier regions draws highly productive non-employed workers into the market, generating a double dividend of increased output and expanded fiscal capacity that outweighs the direct revenue loss from the lower rate. Within our model, the agglomeration and fiscal benefits would outweigh the social cost of reduced home-market production and higher congestion in these locations, and optimal tax rates would adjust to the spatial heterogeneity in labor supply elasticities.



(a) Taxation (b) Redistribution

Figure 3: Optimal Spatial Policies

Notes: These figures plot the optimal tax rates and net transfers against different levels of non-employment rates for two locations i, j, using parameter values used in the quantification for Germany ($\alpha = 0.24; \epsilon = 1.57$; $\theta = 2$; $1 - \gamma = 0.62$; $\kappa = 0.34$; $\zeta = 0.02$; $\rho_h = 0.019$; $\chi = 1$).
Panel (a) displays optimal tax rates for workers of different employment statuses as a function of non-employment rates, $\xi_{h|i}$. Panel (b) plots net transfers against relative non-employment rates, $\xi_{h|i}/\xi_{h|j}$, between places, under three scenarios: (a) equal wages across locations, $w_i = w_j$, (b) positive correlation between wages and non-employment, $corr(w_i, \xi_{h|i} > 0)$, where low-wage locations have high labor force participation; and (c) negative correlation, $corr(w_i, \xi_{h|i} < 0)$, where high-wage locations have high labor force participation.

Optimal Redistribution. The labor supply fiscal externality ($Ex_i^{\text{LFP-Fiscal}}$) fundamentally changes optimal redistribution. In the standard single-sector (full-employment) model, a social planner resolves the tension between allocating resources to low-wage locations, where the marginal utility of consumption is highest, and transferring resources to productive locations to maximize agglomeration. Congestion spillovers (Ex_i^{CON}) typically favor directing transfers *away* from dense clusters.

With endogenous LFP, the labor supply fiscal externality adds an additional layer. Its sign and magnitude depend on the correlation between local wages, w_i^g, and the local home

production share, $\xi^g_{h|i}$, and it amplifies or counteracts the effect of traditional agglomeration and congestion spillovers differently across places. To illustrate how the planner resolves these competing motives, we simulate the optimal net fiscal transfer (N_i) between two synthetic locations.[21] Panel (b) of Figure 3 plots these transfers against relative non-employment rates. To focus on the intuition behind results, consider three archetypal German cities: Munich (High Wage, Medium LFP), Leipzig (Low Wage, High LFP), and Bochum (Low Wage, Low LFP).

First, consider redistribution between Leipzig and Bochum (dashed line in Figure 3b). Both cities have similar, relatively low market wages. In the standard model without home production, there would thus be little rationale for redistribution of funds between these locations. However, Leipzig has a significantly higher female labor market attachment. Consequently, efficiency concerns prescribe net fiscal transfers from Bochum to Leipzig in the optimum. Two mechanisms operate. First, investments in public services, financed by fiscal transfers, incentivize increased migration into Leipzig at the margin. Since structural barriers are, furthermore, smaller in this location, demand for public services is higher and migrating workers are more likely to join the labor force. Thus they generate larger fiscal and agglomeration spillovers in Leipzig than they would in Bochum. Furthermore, the spatial Ramsey rule applies: because the labor supply elasticity is lower, increased public goods congestion from migrating workers yields only small behavioral responses to local female LFP, making Leipzig a more efficient recipient of public goods investment.

Next, consider Munich vs. Leipzig (dark black line). Munich has much higher wages but lower female labor force participation rates. Standard equity motives suggest redistribution from Munich to Leipzig, since the marginal utility of additional consumption is higher in the latter region. In our framework, this redistribution motive is reinforced: Leipzig's high labor force participation and demand for local public services makes it an efficient target for transfers, aligning equity and efficiency objectives and generating substantial transfers to the low-wage region with high labor market potential.

Finally, consider the most complex case: Munich vs. Bochum (dotted line). Munich has high wages, which typically implies a smaller marginal utility from added funds. However, Bochum has a very large home market sector (low LFP). In this comparison, the planner then faces a trade-off: equity favors Bochum (high consumption utility), but efficiency favors Munich (higher LFP and productivity).

As shown in our simulation, if the participation gap were sufficiently large, the optimal policy may actually direct net transfers *towards* the high-wage city with a large female labor market potential (Munich). This occurs because the social return to unlocking the

[21] The total change in resources (both private and public goods consumption) available to the average resident in a location i, relative to a scenario without spatial redistribution between locations. We use the calibration for Germany and vary local fundamentals to generate the mapped differences in non-employment rates between the two places, $\xi_{h|i}/\xi_{h|j}$. A positive N_i indicates a net recipient; a negative value means it is a net contributor. For the interested reader, the formal derivation of the net fiscal transfers is in Supplemental Appendix B.5. There, we also formally demonstrate how fiscal transfers can be calculated solely from structural parameters and observable wages, population, and participation rates.

marginal worker in a high-productivity, high-wage city, via childcare or infrastructure, outweighs the static utility gain of consumption transfers to a low-participation region. This finding highlights that, depending on the parametrization and initial differences in structural barriers, explicitly modelling the home production sector can even reverse the direction of optimal redistribution compared to standard models.

5.2 Counterfactual I: Welfare-Maximizing Spatial Policy

This section uses the quantified model to analyze how spatial policies that maximize aggregate welfare would reshape labor market outcomes in Germany. We investigate the effects on labor allocation between the market and home sectors across regions and demographic groups, quantify the aggregate welfare and output implications, and highlight the importance of the endogenous labor supply margin.

5.2.1 Implementation Strategy

We compute the counterfactual equilibrium that maximizes social welfare using an iterative algorithm. Starting from the 2014 baseline, we calculate the optimal policy adjustments– taxes, subsidies, and transfers– a social planner would choose, as described in detail in Proposition 2 of Appendix A.2.2. These policies alter the relative returns to market versus home work, inducing changes in labor allocation and location choices. Individual decisions, in turn, shift regional wages, prices, and externalities, requiring a new set of optimal policies. We iterate this process until the economy reaches a new spatial equilibrium where all markets clear and social welfare is maximised. To ensure we find a global, rather than local, welfare maximum, we use a global optimization approach based on Latin Hypercube Sampling with numerous initial starting values.[22] To isolate the contribution of the LFP channel, we solve the spatial model under two scenarios: first, in our most general framework with endogenous labor force participation, and second, in a special scenario where all workers are assumed to be in the labor force.

5.2.2 How Welfare-Maximizing Policy Differs from Current Policy

The counterfactual analysis reveals key differences between welfare-maximizing policy and Germany's current system in two dimensions: taxation and redistribution.

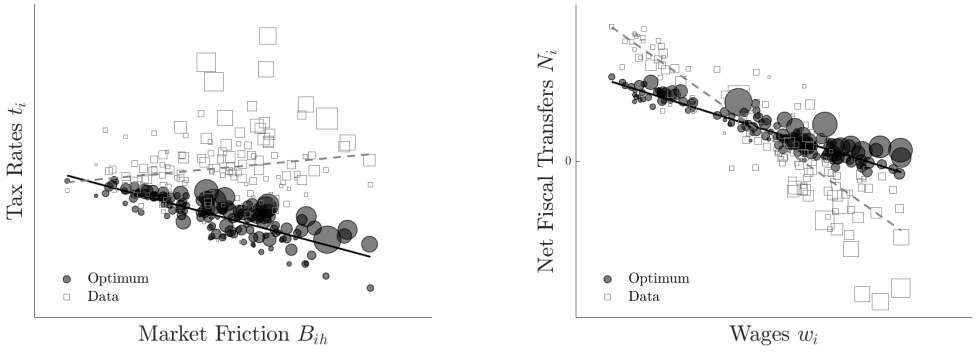
Taxation. The welfare-maximizing policy features lower taxes on market work in locations that currently have high non-employment (i.e., a large home production sector). As Panel (a) of Figure 4 shows, this reverses the existing pattern. The mechanism is that, in locations where labor supply is more elastic, tax cuts are a highly effective instrument

[22] Equilibria are unique based on structural parameters, fundamentals, and an initial set of fiscal policies. Our approach identifies N localised maxima by inverting fundamentals and parameters while varying the initial sets of spatial policies. These maxima result from implementing the optimal policies of Proposition 2 and remain consistent with a spatial equilibrium. For the interested reader, Online Supplement D.1 provides further details on this approach and the randomization strategy.

for enabling productive workers to move from home to market production. This effect is particularly strong for women. Conversely, tax rates are higher in areas with high market attachment, as this allows for revenue generation with minimal distortion along the sectoral margin.

Redistribution. Welfare-maximizing fiscal transfers are smaller and less correlated with local wages than in the current system (Figure 4, Panel b). This holds even in the full employment version of the model (see Online Supplement Figure D.4), but in the presence of endogenous LFP, the amount of redistribution is reduced further. The welfare-maximizing policy reduces transfers from high-wage to low-wage regions because the efficiency gains from incentivizing the market sector in productive and high-participation areas partially offset the equity motive for supporting consumption in low-wage areas.

This is a result of the empirical observation that wages and labor force participation correlate positively in the data, especially when comparing redistribution within West German regions (Case 3 discussed in Sub-section 5.1) or for male workers. In Supplemental Appendices D.3, we provide further details on this aspect for the interested reader. Consequently, we would overestimate the optimal level of redistribution if we did not account for the labor force participation channel.



(a) Taxation

(b) Redistribution

Figure 4: Optimal fiscal policies: Key Policy Changes

Notes: This figure highlights spatial fiscal policy for two different scenarios: (i) optimized policy instruments ("Optimum") according to Appendix Proposition 2 and (ii) the observed German public finance system in 2014 ("Data"). Panel (a) plots tax rates against inverted market frictions, while Panel (b) displays net fiscal transfers (see Definition 1 in the Online Supplement) against local wages. The size of the marker is proportional to local labor market size.

5.3 Local and Aggregate Effects

The optimal policy reallocates labor along two margins: spatially, through migration, and across sectors, through movements from home to market work or between market sectors within a location. The most significant changes occur in high-wage urban areas that

currently feature large gender participation gaps. These locations experience an influx of workers and a notable increase in the share of labor allocated to the market sector, particularly among women.[23]

The optimal policy regime differs fundamentally from both the current system and the predictions of conventional full-employment spatial models. The key distinction lies in how the planner manages the labor supply fiscal externality. In high-productivity urban areas where market output is valuable but participation is constrained by structural barriers, the optimal policy substitutes broad-based redistribution with targeted investments in participation-enabling infrastructure. This shift addresses the misallocation between market and home production directly at its source. In contrast, the current system's formula-based transfers are only weakly related to the social value of activating the local labor supply, whereas full-employment models cannot capture this margin at all. The planner's ability to target the dual spatial and sectoral margins simultaneously generates substantially larger welfare gains than either migration-based reallocation alone or non-optimized fiscal transfers.

Table 2 quantifies the aggregate effects. Under the welfare-maximizing policy, the aggregate labor force increases by approximately $400,000$ workers (Column 1). This expansion of the labor force, combined with changed spatial sorting, leads to substantial increases in real GDP (2.1%), local government fiscal capacity (6.4%), and aggregate welfare (2.7%). We apply a Shapley decomposition to determine each adjustment margin's contribution to the total gain in GDP. The extensive margin (new entrants to the labor market) accounts for over half of the increase in real output. In contrast, spatial reallocation of existing workers makes a negligible contribution. Endogenous price and wage adjustments account for the remaining gains, highlighting the role of general equilibrium effects in assessing policy effectiveness. These results underscore that the welfare and output gains are not merely about spatial reallocation but also about activating latent labor supply.

A key finding emerges when comparing the results to a benchmark full-employment model in which adjustment can occur only through migration (Column 2 of Table 2). The welfare gains in our two-sector model are almost 10 times larger (2.69% vs. 0.28%). This is because the planner can exploit a less costly adjustment margin: shifting existing residents from home to market work generates smaller increases in congestion (e.g., in housing markets) than attracting new migrants from other regions. The ability to activate this local labor supply channel, which is absent in standard frameworks, is therefore of first-order importance for realizing the full potential gains from place-based policy.

When labor supply is inelastic, place-based policy can only redistribute a fixed pool of workers across locations, generating limited aggregate gains because migration itself is costly. In contrast, when labor supply responds to local conditions, the planner can

[23]Online Supplement Figure D.1 illustrates these local adjustment patterns in detail, demonstrating that high-wage urban areas experience the largest increases in consumption possibilities, leading to both in-migration and higher labor force participation.

increase total market employment by reducing barriers that trap productive workers in the home sector. This activation channel dominates quantitatively because it creates new economic activity rather than merely reallocating existing activity.

The implication is that models without an extensive margin may systematically underestimate the potential welfare gains from spatial policies, particularly in contexts where participation gaps are large and responsive to policy intervention.

Table 2: Aggregate Effects of Optimal Spatial Policy

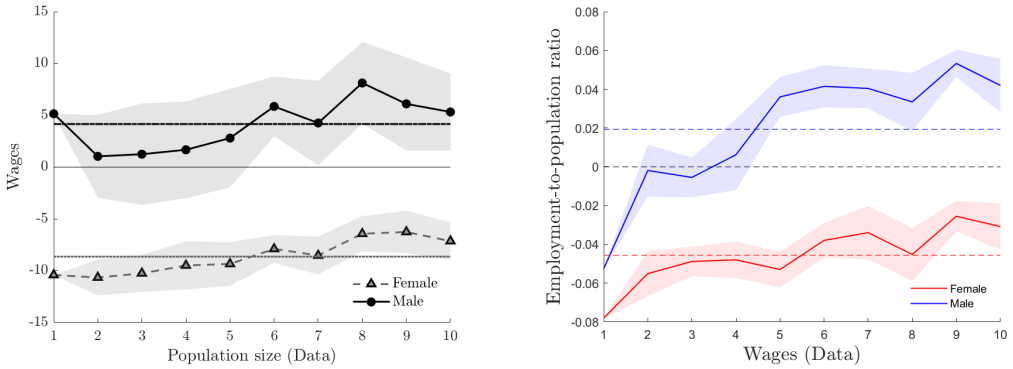
Component	**Model Specification**		**Share**
	Two-Sector (1)	**Full Employment** (2)	
Panel A: Aggregate Outcomes			
Welfare gain	+2.69%	+0.28%	—
Real GDP increase	+2.13%	−0.73%	—
Local fiscal capacity	+6.38%	+3.75%	—
Labor force expansion	+399,416	0	—
Panel B: Shapley Decomposition of Real GDP Gain (Full Model)			
Extensive margin (participation)	+1.11 pp	—	52%
Spatial reallocation (migration)	−0.17 pp	—	−8%
Price and wage adjustments	+1.19 pp	—	56%
Total	**+2.13** pp	—	**100**%

Notes: Panel A compares aggregate gains from welfare-maximizing policy under two model specifications: (1) the full model with endogenous labor force participation, and (2) a benchmark framework without LFP where all workers participate in the market sector. Panel B applies a Shapley decomposition to attribute the real GDP gain in the full model to three margins: (i) the extensive margin, capturing entry of non-employed individuals into market work; (ii) spatial reallocation, capturing migration of existing workers across locations; and (iii) endogenous price and wage adjustments. Shares are computed as the percentage of the total 2.13% GDP gain. The negative spatial contribution reflects composition effects as workers shift toward market sectors with lower average productivity weights.

As Figure 5 shows, optimizing spatial policies significantly reduces the "urban participation gap" by creating stronger incentives for market work in high-wage cities, where the social value of market production is highest. The optimized policies also lead to notable compression of regional variation in gender gaps in employment. While LFP rises in productive urban centers, it decreases slightly in areas where the social value of market work is lower. See Online Supplement Figure D.2 for the full spatial distributions.

5.4 Sensitivity Analysis

Our main findings are robust to a wide range of alternative parameter specifications for the main structural parameters. The results are qualitatively stable across variations in standard spatial parameters, such as agglomeration economies (ζ^g), worker mobility (θ), amenity congestion (η), and our newly estimated value of ρ^g. Higher worker mobility (column 4) and lower amenity congestion (column 3) generate slightly larger welfare gains



(a) Urban wage premium w/o Controls

(b) LFP vs Wages w/o Controls

Figure 5: Urban Premia and Gender Gaps under Optimal Policy

Notes: This figure shows the relationship between wages (Panel a) and LFP rates (Panel b) simulated by the model against labor market size and wage deciles for males and females in Germany. LFP rates are defined as local labor supply relative to the working-age population. The dotted lines represent the mean across all commuting zones (CZs). Two solid lines are plotted, one for each gender, representing the demeaned average of each variable within each bin. The shaded areas around each line represent the 95% confidence interval.

by enabling more efficient migration to productive locations. Decreasing the endogenous responses of LFP to local fiscal spending (ρ^g) implies smaller GDP and welfare gains since labor force increases would not predominantly occur in the most productive, urban centers of the economy, where funds would be redirected.

Table 3: Optimal Policies: Aggregate Effects

	(1) $\zeta^g = 0$	(2) $\eta = 0$	(3) $\theta^g = 3$	(4) $\rho^g = 0$	(5) In-cash transfer
Welfare gain	2.52	2.82	3.51	2.50	2.47
Real GDP increase	1.97	2.24	3.06	1.94	2.08
Local fiscal capacity	6.18	6.59	7.43	6.53	-0.38
Labor force participation	399,503	400,728	439,118	406,840	378,590

Notes: This table presents the nominal changes in the size of the labour force and percentage changes in aggregate outcomes–fiscal capacities (per capita), real GDP, and welfare. These variations result from counterfactual changes in spatial policies that implement optimal policies. We simulate counterfactual changes in 5 different scenarios where we vary the main structural parameters of the model: $\{\zeta^g, \eta, \theta^g, \rho^g\}$. Column (5) displays the aggregate effects of optimizing fiscal policies in a counterfactual scenario where in-cash wage subsidies substitute for local government transfers.

Across all specifications, the central conclusion remains: the optimal policy involves less spatial redistribution than the current system, but utilizes targeted fiscal instruments to incentivize labor allocation towards the market sector in the most populous areas with the largest gender employment gaps.

We also test the sensitivity to parameters governing the labor supply elasticity in the

Supplemental Appendix D.3. The welfare gains would be larger if the labor supply elasticity (ϵ^g) were higher, as this makes the LFP margin more responsive to policy. Assuming uniform labor supply responses across genders would substantially reduce the aggregate welfare gains, confirming that the heterogeneous nature of the home-versus-market trade-off, driven by heterogeneous labor supply elasticities, is a key driver of our results.

5.5 The Role of Structural Barriers

Equation (8) suggests that the gender gaps in non-employment rates are governed by group-specific differences in structural barriers, market income and how much they profit from local public goods in each location i. Since our quantification for Germany yields similar values of ϵ^g for all worker groups, we can decompose gender gaps in non-employment as follows:

$$\underbrace{\frac{(L^F_{h|i}/L^F_i)}{(L^M_{h|i}/L^M_i)}}_{\substack{\text{Group-specific}\\ \text{Non-Employment}}} = \Bigg[\underbrace{\frac{\exp[B^F_{h|i}]}{\exp[B^M_{h|i}]}}_{\substack{\text{Group-specific}\\ \text{Barrier}}} \underbrace{\left(\frac{(I^F_{m|i}/I^F_{h|i})}{(I^M_{m|i}/I^M_{h|i})}\right)^{\alpha-1}}_{\substack{\text{Group-specific}\\ \text{Compensation}}} \underbrace{\left(\frac{R_i}{L^\chi_i}\right)^{-\alpha(\rho^F-\rho^M)}}_{\substack{\text{Public Goods}\\ \text{as Substitute}}} \Bigg]^{\epsilon} \tag{14}$$

In the last counterfactual, we kept the structural barriers for all workers and locations fixed at their inverted value for the year 2014 and optimized the policy instruments (e.g. taxes, transfers, subsidies) to increase overall welfare in the economy – asking the question how fiscal policy can be adjusted to decrease inefficiencies in the economy.

The assumption that structural residuals are constant over time is reasonable for the short- to medium-run. Nonetheless, in the long run, we may expect these barriers to converge further across places and workers of different genders, as they have in the last decades (Goldin, 2014; Hsieh et al., 2019). In this counterfactual, we take a long-run perspective and ask to what extent female and male labor force participation would converge if the female-specific components of barriers to market employment were to converge to the level of male's in all places. As noted above, this implies convergence in some of Germany's largest and most productive areas, in particular. Specifically, starting from the inverted values, we simulate a gradual decrease in the group-specific differences in the structural barriers and sector-specific participation costs: $\exp[B^F_{h|i}] = g_s \cdot \exp[B^M_{h|i}] + (1-g_s) \cdot \exp[B^F_{h|i}]$, with $g_s \in [0,1]$. For this counterfactual, we fix spatial policy at its 2014 observed value and solve for a new long-run spatial equilibrium.

Figure 6 suggests that a complete convergence of structural barriers is associated with a convergence in the non-employment gap: while it currently sits at 37%, it would decrease to around 5%, with the remainder mainly attributed to gender-specific differences in market compensation. At the same time, around 1.7 million female workers would join one of the market sectors across all locations, which would increase the female labor force by around 9%. Note that optimizing spatial policy (Counterfactual I) in itself would already imply the same increase in the aggregate labor force (about 400,000) as a gender convergence of

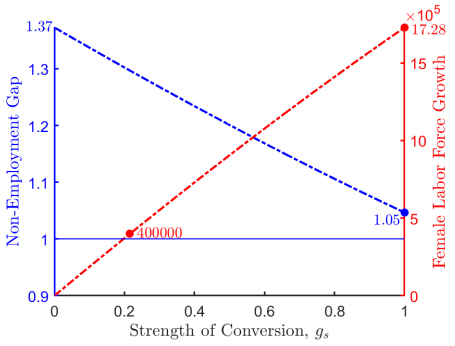


Figure 6: Conversion of Structural Barriers

Notes: This figure illustrates the counterfactual evolution of gender employment gaps as female structural barriers ($B^F_{h|i}$) converge toward male levels ($B^M_{h|i}$). The x-axis represents the degree of convergence (g_s), where 0 implies current barriers and 1 implies full convergence. The solid line tracks the reduction in the aggregate gender gap, while the dashed line shows the increase in total female employment.

structural barriers by around 20% from the 2014 level - highlighting the out-sized role of the optimal design of spatial policy to decrease aggregate inefficiencies.

5.6 Cash Subsidies vs. In-Kind Transfers

Fiscal policy affects labor force participation through two channels: transfers financing local public services and direct income subsidies. The German system employs both, but an alternative system could redirect inter-governmental transfers to households as wage subsidies. We evaluate whether in-kind provision (public services) yields larger welfare gains than budget-neutral cash transfers when labor supply is endogenous.

We implement this comparison by first computing the optimal policy, then progressively substituting local government transfers with equivalent cash payments to households until public expenditures return to observed 2014 levels. From the household perspective, this substitutes public for private consumption. For aggregate welfare, however, the two instruments differ if private consumption elicits different labor supply responses than public services.

Column (5) of Table 2 reports the results: welfare, GDP and labor force gains are substantially smaller under cash subsidies. Cash transfers raise income in both sectors, potentially dampening labor supply through a negative income effect. In-kind services such as childcare, by contrast, directly substitute for home production, lowering barriers to market entry. This distinction has important policy implications. In-kind transfers yield welfare gains approximately 10 % smaller than under the fully optimized policy, indicating that the composition of fiscal spending matters substantially for aggregate outcomes.

Two mechanisms drive this result. First, public services target the binding supply constraint, the opportunity cost of market work, enabling entry for individuals otherwise confined to home production.[24] Second, service provision can be geographically targeted

[24]The reliance on public rather than private provision reflects well-documented market failures. The classic public-goods literature establishes that services generating substantial social spillovers face system-

to high-productivity areas where social returns to participation are largest, whereas cash transfers raise reservation wages uniformly across locations. These findings reinforce the central insight that the welfare effects of place-based policies depend on location-specific barriers to market entry.

5.7 Policy Implications

The analysis yields several implications for the design of place-based policies. First, our analysis reveals pronounced spatial heterogeneity in returns to public investments, with childcare infrastructure and transportation networks yielding particularly high returns in high-wage urban areas with strong labor market attachment.

Second, place-based policies generate differential impacts across demographic groups, particularly for female labor force participation. Furthermore, policies aimed at reducing structural barriers may generate both aggregate efficiency gains and reductions in gender inequality, indicating that these objectives are more complementary than previously recognized.

Third, the aggregate welfare gains mask substantial regional redistribution. Our optimal policy reallocates some resources toward high-productivity urban centers, where the social returns to labor force participation are largest. This implies that some currently receiving regions—particularly those with low labor market attachment and limited growth potential—would see reduced transfers under the optimal scheme. Such redistribution faces well-known political economy constraints: Germany's constitutional mandate to ensure "equivalent living conditions" (Article 72 GG) reflects a political equilibrium that may resist reforms to the existing system. Incremental approaches that preserve broad regional support while targeting marginal investments at participation-enabling infrastructure may therefore be more feasible than wholesale reform. The analysis suggests that even partial movements toward the optimum could capture a meaningful share of the potential gains. The substantial magnitude of the estimated welfare gains indicates that mobilizing underutilized labor through place-based policies offers substantial returns for economies facing demographic transitions. As such, spatial policy serves not only as a tool for spatial redistribution, but also as a lever for increasing aggregate employment and decreasing female employment gaps, with possible applications to other developed economies experiencing similar demographic pressures as Germany.

atic under-provision when left to decentralized private actors (Samuelson, 1954). For childcare specifically, private markets face coordination problems and fail to internalize parental productivity gains, child human capital formation, and fiscal spillovers (Blau and Currie, 2006). Cross-country evidence confirms that public or heavily-subsidized systems achieve higher coverage and stronger maternal employment effects than private-market equilibria (Olivetti and Petrongolo, 2017; Gelbach, 2002).

6 Conclusion

This paper demonstrates that place-based policies influence not only where people work, but also whether they participate in the labor market. By incorporating an endogenous labor force participation margin within a quantitative spatial framework, we show that optimal spatial policy design encompasses two distinct allocation problems: the spatial sorting of workers across regions and the sectoral allocation between market and home production within regions.

Our analysis yields two primary contributions. Theoretically, we identify a labor supply fiscal externality that fundamentally alters the optimal policy calculus. When workers enter the labor market, they generate agglomeration economies and expand the tax base, but they also congest the public services that enable others to work. This externality varies systematically across locations and demographic groups, creating heterogeneous social returns to participation that shape optimal policy design.

Quantitatively, the application to German data provides causal evidence that public spending on services that substitute for home production directly influences the extensive margin of labor supply. Counterfactual simulations indicate that a policy regime optimized for this multi-sector economy generates substantial aggregate gains. Specifically, real GDP increases by 2.1% and welfare by 2.7%. These gains stem primarily from the reallocation of labor, particularly female labor, from the home sector to the market sector in high-productivity urban centers where the marginal product of labor is highest.

The central insight of this analysis is that spatial variation in labor force participation is a fundamental determinant of optimal spatial policy rather than a peripheral feature. In developed economies facing demographic pressures and skills shortages, the mobilization of underutilized labor represents an important policy margin. Our framework demonstrates that place-based policies can yield welfare gains overlooked by conventional full-employment models when they account for the gender-specific impact on labor force participation.

While the framework identifies substantial potential welfare gains, implementing a fully optimal policy entails practical challenges, including political resistance to regional redistribution and the data requirements for calibrating local elasticities. Nevertheless, the analysis provides a clear trajectory for policy reform. Incremental adjustments toward the optimal design, such as targeting public investment to specific barriers to market entry, could capture a significant share of the potential gains. Future research might extend this analysis to dynamic settings or explore the interaction of these mechanisms with family structure and dual-earner households (Calvo et al., 2024).

APPENDICES

A Theory Appendix

This appendix provides the formal derivation of the efficiency results from the social-planner setup presented in Section 3.7, as well as the optimal policy instruments that maximize welfare in the economy and are used in our first counterfactual in Section 5. While the main text focuses on a simplified single-sector model for clarity, the derivations here are based on a generalized framework that explicitly incorporates multiple market sectors, allows for firm heterogeneity, and accounts for frictional trade across sectors.

A.1 A Multi-Sector Trade Framework

In the extended model, workers choose both their location i and the market sector u from several tradable or non-tradable sectors, including the housing sector ($u \in M \subset S$). Workers consume a Cobb-Douglas aggregate of tradeable goods and non-tradeable services with elasticities β_u. As before, idiosyncratic home market productivity shocks determine workers' allocation between the market and home sectors. We denote the share of labor allocated to the home sector as $\xi^g_{h|i,u} \equiv L^g_{h|i,u}/L^g_{i,u}$, where $L^g_{i,u} \leq L^g_i$ is the potential local workforce in sector u and region i. Location and sector choices depend on region- and sector-specific real wages, public goods, amenities, and sector-specific market participation costs, $\exp\left[-\mu^g_{m|i,u}\right] \leq 1$. Region-specific, structural barriers, $\exp\left[\bar{B}^g_{h|i,u}\right] \varphi(\omega)$, condition on these choices, creating rich heterogeneity in the market-versus-home trade-off.

The production structure of intermediate goods features regional specialization and trade. Firms in location i and sector u combine labor $l_{i,u}$ and immobile factors $h_{i,u}$ (land and structures) as well as materials from other sectors u' under perfect competition and with a production function

$$y_{i,u}(z_{i,u}) = z_{i,u}\left[(h_{i,u})^{\kappa_{i,u}}(l_{i,u})^{1-\kappa_{i,u}}\right]^{\delta_{i,u}} \prod_{u' \imath M}\left[M_{i,uu'}\right]^{\delta_{i,uu'}}, \tag{A1}$$

where $z_{i,u}$ represents firm-specific productivity for each variety drawn from a Fréchet distribution. The cumulative distribution function of draws is given by $\phi_{i,u}(z) = \exp\{-z^{-\nu_u}\}$, where the shape parameter $\nu_u > 1$ governs the variance of efficiency draws and we allow fundamental labor productivity ($\bar{Z}^g_{i,u}$) to vary by market sector und location. $M_{i,uu'}$ are material inputs from sector u' used by sector u in region i. $\delta_{i,uu'}$ is the share of materials from u' in u's production, while we let $\delta_{i,u}$ denote the value-added share. Constant returns to scale imply $\sum_{u' \in S} \delta_{i,uu'} = 1 - \delta_{i,u}$. Firms minimize costs, such that the cost of inputs,

$\lambda_{i,u}(z_{i,u})$, is determined as

$$\lambda_{i,u}(z_{i,u}) = \frac{D_{i,u}}{z_{i,u}} \left(r_i^{\kappa_{i,u}} \left[\sum_{g \in G} \left(\frac{Z_{i,u}^g}{w_{i,u}^g} \right)^{\sigma^g - 1} \right]^{\frac{1-\kappa_{i,u}}{1-\sigma^g}} \right)^{\delta_{i,u}} \prod_{u' \in M} \left[P_{i,u'} \right]^{\delta_{i,uu'}}, \tag{A2}$$

where $D_{i,u} \equiv \left((\kappa_{i,u})^{\kappa_{i,u}} (1-\kappa_i)^{(1-\kappa_i)} \right)^{-\delta_{i,u}} \prod_{u' \in M} \left[\delta_{i,uu'} \right]^{-\delta_{i,uu'}}$. Trade flows between regions follow an Eaton-Kortum structure with iceberg costs τ_{ij}. The share of total expenditures in region i on intermediate goods from region j is

$$\pi_{ij} = \frac{X_{ij}}{X_i} = \frac{(\lambda_j \tau_{ij})^{-\nu}}{\sum_{n \in J} (\lambda_n \tau_{in})^{-\nu}}, \tag{A3}$$

where X_{ij} are bilateral expenditures, and X_i is gross output in i. Denoting as $\Gamma(.)$ the Gamma function yields regional price indices:

$$P_i = \Gamma \left(\frac{\nu + 1 - \sigma}{\nu} \right)^{\frac{1}{1-\sigma}} \left[\sum_{j \in J} (\lambda_j \tau_{ij})^{-\nu} \right]^{-\frac{1}{\nu}}, \tag{A4}$$

A.2 The Social Planner Problem

The social planner maximises the social welfare function, subject to non-negativity constraints for consumption and production choices, resource constraints, supply of productive inputs, workers' preferences, and mobility. The following equations detail these constraints.

- Social Welfare Function:

$$\mathcal{W} = \sum_{g \in G} \mu^g \mathcal{U} \left[\left(\sum_{u \in M} \sum_{i \in J} \left[A_i^g \exp\left[-\mu_{m|i,u}^g \right] \left(C_{m|i,u}^g \right)^{1-\alpha} \left(\frac{R_{m|i,u}^g}{\left(\sum_{g \in G} \sum_{u \in M} L_{i,u}^g \right)^{\chi}} \right)^{\alpha} \right. \right. \right.$$
$$\left. \left. \left. \left(1 + \frac{\left[\left(\frac{1}{\mathcal{B}_{s|i,u}^g} \right) \left(C_{m|i,u}^g / C_{h|i,u}^g \right)^{1-\alpha} \left(\left[\frac{R_{m|i,u}^g}{\left(\sum_{g \in G} \sum_{u \in M} L_{i,u}^g \right)^{\chi}} \right]^{\rho^g} \right)^{\alpha} \right]^{-\epsilon^g}}{\epsilon^g - 1} \right) \right]^{\theta} \right)^{\frac{1}{\theta}} \Gamma\left(\frac{\theta - 1}{\theta} \right) L^g \right]$$

- Preferences:

$$\prod_{u'=1}^{M} \left(C_{s,u'|i,u}^g \right)^{\beta_{u'}^C} = C_{s|i,u}^g \quad \text{and} \quad \prod_{u'=1}^{M} \left(R_{m,u'|i,u}^g \right)^{\beta_{u'}^R} = R_{m|i,u}^g.$$

- Final goods resource constraints:

$$Y_{i,u'} = \sum_{s \in h,m} \sum_{u \in M} \sum_{g \in G} \xi_{s|i,u}^g C_{s,u'|i,u}^g L_{i,u}^g + \sum_{u \in M} \sum_{g \in G} \left(\frac{L_{i,u}^g}{L_i} \right) R_{m,u'|i,u}^g + \sum_{u \in M} \int M_{i,uu'}(\mathbf{z_{u'}}) \, d\phi(\mathbf{z_{u'}})$$

where we let $Y_{i,u'} \equiv \left(\int \left(\sum_{j \in J} \tilde{y}_{ij,u'} \left(\mathbf{z_{u'}} \right) \right)^{\frac{\sigma-1}{\sigma}} d\phi \left(\mathbf{z_{u'}} \right) \right)^{\frac{\sigma}{\sigma-1}}$ denote the quantity produced of final goods in region-sector pair $\{i, u'\}$. The input of intermediate goods produced in region j and sector u', but consumed in i is $\tilde{y}_{ij,u'} \left(\mathbf{z_{u'}} \right)$.

- Intermediate goods resource constraints:

$$\left[\left(h_{i,u'} \left(z_{i,u'} \right) \right)^{\kappa_{i,u'}} \left(\left[\sum_{g \in G} \left(Z^g_{i,u'} L^g_{m|i,u'} \left(z_{i,u'} \right) \right)^{\frac{\sigma^g - 1}{\sigma^g}} \right]^{\frac{\sigma^g}{\sigma^g - 1}} \right)^{1-\kappa_{i,u'}} \right]^{\delta_{j,u'}} \prod_{u \in M} \left[M_{i,u'u} \left(z_{i,u'} \right) \right]^{\delta_{i,u'u}}$$
$$= \sum_{j \in J} \tau_{ji,u'} \tilde{y}_{ji,u'} \left(\mathbf{z_{u'}} \right)$$

- Supply of production inputs:

$$H_i = \sum_{u \in M} \int h_{i,u} \left(z_{i,u} \right) d\phi_i \left(z_{i,u} \right) \quad \text{and} \quad L^g_{m|i,u} = \int L_{m|i,u} \left(z_{i,u} \right) d\phi_i \left(z_{i,u} \right)$$

- Worker Sorting:

$$\frac{\left(\bar{V}^g_{i,u} \right)^\theta}{\sum_{u \in M} \sum_{i \in J} \left(\bar{V}^g_{i,u} \right)^\theta} L^g = L^g_{i,u}$$

- Local labor supply:

$$\left(1 - \left[\left(\frac{1}{\mathcal{B}^g_{s|i,u}} \right) \left(C^g_{m|i,u} / C^g_{h|i,u} \right)^{1-\alpha} \left(\left[\frac{R^g_{m|i,u}}{(\sum_{g \in G} \sum_{u \in M} L^g_{i,u})^\chi} \right]^{\rho^g} \right)^\alpha \right]^{-\epsilon^g} \right) L^g_{i,u} = L^g_{m|i,u}$$

A.2.1 Characterising Optimal Spatial Policies

In this section, we show how this set-up of the social planner problem allows us to characterise the socially optimal choices of consumption, production, population and employment.

1. Consumption of goods in different sectors:

$$\frac{\partial \mathcal{W}}{\partial C^g_{s,u'|i,u}} : \quad L^g_{s|i,u} P_{i,u'} = \beta^C_{u'} \frac{C^g_{s|i,u}}{C^g_{s,u'|i,u}} P^g_{s|i,u}, \tag{A5}$$

where $P_{i,u'}$ denotes the Lagrange multiplier corresponding to the final goods resource constraint. $P^g_{s|i,u}$ is the multiplier on private consumption aggregation. This

condition implies an ideal price index $P_i \equiv \frac{P^g_{s|i,u}}{L^g_{s|i,u}} = \prod_{u'=1}^{M} \left(P_{i,u'}/\beta^C_{u'}\right)^{\beta^C_{u'}}$.

$$\frac{\partial \mathcal{W}}{\partial R^g_{s,u'|i,u}}: \quad P_{i,u'}\frac{L^g_{i,u}}{L_i} = \beta^R_{u'}\frac{R^g_{s|i,u}}{R^g_{s,u'|i,u}}\tilde{P}_{s|i,u}, \tag{A6}$$

where $\tilde{P}_{s|i,u}$ is the Lagrange multiplier for the public good consumption aggregation, and we get an ideal price index for public goods: $P^R_i \equiv \tilde{P}_{s|i,u}\left(L_i/L^g_{i,u}\right) = \prod_{u'=1}^{M}\left(P_{i,u'}/\beta^R_{u'}\right)^{\beta^R_{u'}}$.

2. Local consumption of private and public goods:

$$\begin{aligned}\frac{\partial \mathcal{W}}{\partial C^g_{m|i,u}}: \quad & \underbrace{\frac{(1-\alpha)\,\mu^g \mathcal{U}'\left(\mathcal{V}^g\right)\mathcal{V}^g}{C^g_{m|i,u}}\left[\frac{\epsilon^g - 1}{\epsilon^g - 1 + \xi^g_{h|i,u}}\right]}_{\text{marginal utility of consumption (per capita)}} \\ & = P_i - \underbrace{\sum_{j\in J}\sum_{u'\in M} W^g_{j,u'}\Psi^g_{j,u'}/\left(1-\xi^g_{h|i,u}\right)}_{\text{sorting across region-sectors}} - \underbrace{\frac{\tilde{W}^g_{m|i,u}\left[(1-\alpha)\,\epsilon^g\right]\xi^g_{h|i,u}}{\left(1-\xi^g_{h|i,u}\right)C^g_{m|i,u}}}_{\text{selection along extensive margin}},\end{aligned} \tag{A7}$$

where $W^g_{j,u}$ and $\tilde{W}^g_{m|i,u}$ are the Lagrange multipliers on the regional and extensive labor supply constraints, respectively, $\mathcal{V}^g$ is the equalised indirect utility for each worker group, and the $\Psi^g_{j,u'}$ are given as:

$$\Psi^g_{j,u'} = \begin{cases} -\left(L^g_{j,u'}/L^g\right)\left(\frac{(1-\alpha)\theta}{C^g_{m|i,u}}\right)\left[\frac{(\epsilon^g-1)(1-\xi^g_{h|i,u})}{\epsilon^g-1+\xi^g_{h|i,u}}\right] & \text{if } \{i,u\} \neq \{j,u'\} \\ \left(1-\frac{L^g_{i,u}}{L^g}\right)\left(\frac{(1-\alpha)\theta}{C^g_{m|i,u}}\right)\left[\frac{(\epsilon^g-1)(1-\xi^g_{h|i,u})}{\epsilon^g-1+\xi^g_{h|i,u}}\right] & \text{if } \{i,u\} = \{j,u'\}. \end{cases}$$

$$\begin{aligned}\frac{\partial \mathcal{W}}{\partial C^g_{h|i,u}}: \quad & \underbrace{\frac{(1-\alpha)\,\mu^g \mathcal{U}'\left(\mathcal{V}^g\right)\mathcal{V}^g}{C^g_{h|i,u}}\left[\frac{\epsilon^g}{\epsilon^g - 1 + \xi^g_{h|i,u}}\right]}_{\text{marginal utility of consumption (p.c.)}} \\ & = P_i - \underbrace{\sum_{j\in J}\sum_{u'\in M} W^g_{j,u'}\Psi^g_{j,u',h}/\xi^g_{h|i,u}}_{\text{sorting across region-sectors}} + \underbrace{\frac{\tilde{W}^g_{m|i,u}\left[(1-\alpha)\,\epsilon^g\right]\xi^g_{h|i,u}}{\xi^g_{h|i,u}C^g_{h|i,u}}}_{\text{selection along extensive margin}},\end{aligned} \tag{A8}$$

where we denote as $\Psi^g_{j,u',h}$ the following components:

$$\Psi^g_{j,u',h} = \begin{cases} -\left(L^g_{j,u'}/L^g\right)\left(\frac{(1-\alpha)\theta}{C^g_{h|i,u}}\right)\left[\frac{\epsilon^g\xi^g_{h|i,u}}{\epsilon^g-1+\xi^g_{h|i,u}}\right] & \text{if } \{i,u\} \neq \{j,u'\} \\ \left(1-\frac{L^g_{i,u}}{L^g}\right)\left(\frac{(1-\alpha)\theta}{C^g_{h|i,u}}\right)\left[\frac{\epsilon^g\xi^g_{h|i,u}}{\epsilon^g-1+\xi^g_{h|i,u}}\right] & \text{if } \{i,u\} = \{j,u'\}. \end{cases}$$

$$\frac{\partial \mathcal{W}}{\partial R^g_{m|i,u}}: \quad \underbrace{\mu^g \mathcal{U}'\left(\mathcal{V}^g\right) \mathcal{V}^g / R^g_{m|i,u} \left[\alpha - \Upsilon^g_{i,u}\right]}_{\text{marginal utility of consumption}} \tag{A9}$$

$$= \frac{P^R_i}{L_i} - \underbrace{\sum_{j \in J} \sum_{u' \in M} W^g_{j,u} \Psi^{g,R}_{j,u'}}_{\text{sorting across region-sectors}} - \underbrace{\tilde{W}^g_{m|i,u} \left[\alpha \epsilon^g \rho^g\right] \xi^g_{h|i,u} / R^g_{m|i,u}}_{\text{selection along extensive margin}},$$

$$\Psi^{g,R}_{j,u'} = \begin{cases} -\left(L^g_{j,u'}/L^g\right)\left(\frac{\theta}{R^g_{m|i,u}}\right)\left[\alpha - \Upsilon^g_{i,u}\right] & \text{if } \{i,u\} \neq \{j,u'\} \\ \left(1 - \frac{L^g_{i,u}}{L^g}\right)\left(\frac{\theta}{R^g_{m|i,u}}\right)\left[\alpha - \Upsilon^g_{i,u}\right] & \text{if } \{i,u\} = \{j,u'\}. \end{cases}$$

with $\Upsilon^g_{i,u} \equiv \frac{\gamma^g \xi^g_{h|i,u}}{\epsilon - (1 - \xi^g_{h|i,u})}$ and $\gamma^g = \alpha \rho^g \epsilon^g$ is the spillover from public expenditure to local non-employment.

3. Production inputs:

$$\frac{\partial \mathcal{W}}{\partial L^g_{m|i,u}\left(z_{i,u}\right)}: \quad \tilde{\lambda}_{i,u}\left(z_{i,u}\right) \delta_{i,u} \left(1 - \kappa_{i,u}\right) \frac{\left(\frac{Z^g_{i,u}}{w^g_{i,u}}\right)^{\sigma^g - 1}}{\sum_{g \in G}\left(\frac{Z^g_{i,u}}{w^g_{i,u}}\right)^{\sigma^g - 1}} \frac{\sum_{j \in J} \tau_{ji,u} \tilde{y}_{ji,u}\left(z_{i,u}\right)}{L^g_{m|i,u}\left(z_{i,u}\right)}$$

$$= w^g_{i,u} d\phi\left(z_{i,u}\right) \tag{A10}$$

where $\tilde{\lambda}_{i,u}\left(z_{i,u}\right)$ and $w^g_{i,u}$ are the Lagrange multipliers on the intermediate goods constraint and resource constraint for local labor respectively. Also,

$$\frac{\partial \mathcal{W}}{\partial h_{i,u}\left(z_{i,u}\right)}: \quad \tilde{\lambda}_{i,u}\left(z_{i,u}\right) \delta_{i,u} \kappa_{i,u} \frac{\sum_{j \in J} \pi_{ji,u} \tilde{y}_{ji,u}\left(z_{i,u}\right)}{h_{i,u}\left(z_{i,u}\right)} = r_i d\phi\left(z_{i,u}\right), \tag{A11}$$

where we denote as r_i the Lagrange multiplier on the resource constraint for land and structures. Similarly, the materials input is derived as follows:

$$\frac{\partial \mathcal{W}}{\partial M_{i,uu'}\left(z_{i,u}\right)}: \quad \tilde{\lambda}_{i,u}\left(z_{i,u}\right) \delta_{i,uu'} \frac{\sum_{j \in J} \pi_{ji,u} \tilde{y}_{ji,u}\left(z_{i,u}\right)}{M_{i,uu'}\left(z_{i,u}\right)} = P_{i,u'} d\phi\left(z_{i,u}\right). \tag{A12}$$

Using the first-order conditions (A10) - (A12) in the intermediate goods resource constraint, we derive the optimal region-sector-specific unit cost index:

$$\tilde{\lambda}_{i,u}\left(z_{i,u}\right) \equiv \frac{\lambda_{i,u} d\phi(z_{i,u})}{z_{i,u}} = \frac{D_{i,u}}{z_{i,u}} \left(r_i^{\kappa_{i,u}} \left[\sum_{g \in G} \left(\frac{Z^g_{i,u}}{w^g_{i,u}}\right)^{\sigma^g - 1}\right]^{\frac{1 - \kappa_{i,u}}{1 - \sigma^g}} \right)^{\delta_{i,u}} \prod_{u' \in M} \left[P_{i,u'}\right]^{\delta_{i,uu'}} d\phi(z_{i,u}),$$

with $D_{i,u} \equiv \left(\delta_{i,u} \left(\kappa_{i,u}\right)^{\kappa_{i,u}} \left(1 - \kappa_{i,u}\right)^{(1 - \kappa_{i,u})}\right)^{-\delta_{i,u}} \prod_{u' \in M} \left(\delta_{i,uu'}\right)^{-\delta_{i,uu'}}$ a region-sector-specific constant. The social planner similarly optimizes with respect to intermediate

goods production and consumption in region-sector pair $\{i, u'\}$:

$$\frac{\partial \mathcal{W}}{\partial \tilde{y}_{ji,u'}\left(\mathbf{z_{u'}}\right)}: \begin{cases} \tilde{y}_{ji,u'}\left(\mathbf{z_{u'}}\right) > 0 \text{ if } & \tilde{\lambda}_{j,u}\left(z_{j,u}\right)\tau_{ij,u} = P_{i,u}\left(\frac{Y_{i,u}}{\tilde{y}_{ij,u'}(\mathbf{z_u})}\right)^{\frac{1}{\sigma}} d\phi\left(z_{j,u}\right) \\ \tilde{y}_{ji,u'}\left(\mathbf{z_{u'}}\right) = 0 \text{ if } & \tilde{\lambda}_{j,u}\left(z_{j,u}\right)\tau_{ij,u} > P_{i,u}\left(\frac{Y_{i,u}}{\tilde{y}_{ij,u'}(\mathbf{z_u})}\right)^{\frac{1}{\sigma}} d\phi\left(z_{j,u}\right) \end{cases}$$

This first-order condition can be re-written as $\tilde{y}_{i,u}\left(\mathbf{z_u}\right) = \left(p_{i,u}\left(\mathbf{z_u}\right)\right)^{-\sigma} P_{i,u}^{\sigma-1}\left(Y_{i,u}P_{i,u}\right)$, using the fact that prices equal unit costs under perfect competition and with $\tilde{\lambda}_{i,u}\left(z_{i,u}\right) \equiv p_{i,u}(z_{i,u})d\phi(z_{i,u})$ if producers choose minimal unit costs. It is easily seen that this first-order condition implies the same trade shares and price levels as in the competitive equilibrium.

4. Local labor force:

$$\frac{\partial \mathcal{W}}{\partial L_{m|i,u}^{g}}: \; w_{i,u}^{g} = \tilde{W}_{m|i,u}^{g}. \tag{A13}$$

5. Worker Allocation across space:

$$\begin{aligned} \frac{\partial \mathcal{W}}{\partial L_{i,u}^{g}}: \quad & \underbrace{W_{i,u}^{g}}_{\text{opportunity cost}} + \underbrace{\sum_{u' \in M} P_{i,u'}\left[\xi_{h|i,u}^{g} C_{h,u'|i,u}^{g} + \left(1-\xi_{h|i,u}^{g}\right) C_{m,u'|i,u}^{g}\right]}_{\text{consumption cost}} \\ = \; & \underbrace{\left(1-\xi_{h|i,u}^{g}\right)\tilde{W}_{m|i,u}^{g}}_{\text{marginal product of labor}} + \underbrace{Ex_{i}^{NET}}_{\text{net spatial externalities}}, \end{aligned} \tag{A14}$$

Spatial Externalities. Productivity, congestion and labor supply fiscal spillovers are derived as follows:

$$Ex_{i}^{AGG} = \sum_{u \in M}\sum_{g \in G} \zeta^{g}\left(1-\xi_{h|i,u}^{g}\right) w_{i,u}^{g}\left(\frac{L_{i,u}^{g}}{L_{i}}\right) \tag{A15}$$

$$Ex_{i}^{CON} = -\frac{1}{\sum_{g \in G}\sum_{u \in M} L_{i,u}^{g}} \sum_{g \in G}\left(\mu^{g}\mathcal{U}'\left(\mathcal{V}^{g}\right)\mathcal{V}^{g}\sum_{u \in M} L_{i,u}^{g}\left(\chi\alpha+\eta\right)\right)$$

Note that expected utility can be further expressed as (see Supplemental Appendix **??** for details and derivations)

$$\left(1-\alpha\right)\mu^{g}\mathcal{U}'\left(\mathcal{V}^{g}\right)\mathcal{V}^{g} = \frac{1}{L_{g}}\sum_{i \in J}\sum_{u \in M} L_{i,u}^{g}\left[P_{i}\sum_{s \in h,m}\xi_{s|i,u}^{g} C_{s|i,u}^{g}\right]$$

Using this equation in the definition of Ex_{i}^{CON} and the definition of average consumption $\bar{\mathcal{C}}$, we finally get:

$$Ex_{i}^{CON} = -\frac{\bar{\mathcal{C}}}{\left(1-\alpha\right)}\sum_{g \in G}\sum_{u \in M}\left(\frac{L_{i,u}^{g}}{L_{i}}\right)\left(\chi\alpha+\eta\right). \tag{A16}$$

Using the first-order condition (A13), labor supply fiscal spillovers are derived as

$$Ex_i^{LFP} = \chi \sum_{u \in M} \sum_{g \in G} \gamma^g \xi^g_{h|i,u} \left(\frac{L^g_{i,u}}{L_i} \right) \left(w^g_{i,u} - \frac{\bar{\mathcal{C}}}{(1-\alpha)(\epsilon^g - (1-\xi^g_{h|i}))} \right). \tag{A17}$$

Combining Equations (A14), (A15), (A17) and (A16), and applying it for the special case with $M = G = 1$, yields Equation (10) in the main paper and proves Proposition 1.

A.2.2 Optimal Spatial Policy

The following proposition characterises the optimal policy instruments (taxes, transfers and subsidies) that maximise welfare in the spatial economy.

Proposition 2. *The first-best allocation of economic activity is implemented by the following system of taxes, subsidies, and transfers.*

Optimal labor Income Tax. A location-status-specific tax, $\tilde{t}_{s|i}$ that targets participation margins:

$$1 - \tilde{t}^g_{s|i,u} = \begin{cases} \frac{(1-\alpha)\theta}{1+(1-\alpha)\theta} + (1-\alpha)\,\epsilon^g \xi^g_{h|i,u} \left(\frac{1}{1-\xi^g_{h|i,u}} - \frac{\theta}{[1+(1-\alpha)\theta]\left[\epsilon^g - \left(1-\xi^g_{h|i,u}\right)\right]} \right) & \text{if } s \in M, \\ \frac{1-\xi^g_{h|i,u}}{\xi^g_{h|i,u}} \left(\frac{(1-\alpha)\theta}{1+(1-\alpha)\theta} - (1 - \tilde{t}^g_{m|i,u}) \right) & \text{otherwise} \end{cases} \tag{A18}$$

Wage Subsidy. A location-status-specific subsidy, $\tilde{x}_{s|i}$, that corrects for local externalities:

$$\begin{aligned} \tilde{x}_{m|i,u} = & \left[\sum_{g \in G} L^g \left[\epsilon^g - \left(1 - \xi^g_{h|i,u}\right) \right] / (\epsilon^g - 1) \right]^{-1} \times \\ & \left[\sum_{g \in G} \sum_{j \in J} \sum_{u' \in M} \left(\frac{\left(1 - \xi^g_{h|i,u}\right) L^g_{j,u'} w^g_{i,u'}}{1 + (1-\alpha)\,\theta} + h_{j,u'} r_j - P^R_j R_j \right) \right. \\ & \left. + \sum_{g \in G} \frac{(1-\alpha)\,\theta L^g}{1 + (1-\alpha)\,\theta} \left(Ex_i^{NET} - \frac{1}{L^g} \sum_{j \in J} \sum_{u' \in M} L^g_{j,u'} Ex_j^{NET} \right) \right] \end{aligned} \tag{A19}$$

as well as

$$\tilde{x}_{h|i,u} = \tilde{x}_{m|i,u} * \frac{\sum_{g \in G} L^g \left[\epsilon^g - \left(1 - \xi^g_{h|i,u}\right) \right] / (\epsilon^g - 1)}{\sum_{g \in G} L^g \left[\epsilon^g - \left(1 - \xi^g_{h|i,u}\right) \right] / \epsilon^g} \tag{A20}$$

where we assume that additive wage subsidies do not differ by worker group as in the framework in the main part of the paper, such that $\tilde{x}^g_{s|i,u} = \tilde{x}_{s|i,u} \quad \forall g \in G$.

Optimal Fiscal Transfers. An inter-regional system of taxes and transfers that corrects for participation spillovers:

$$\frac{P_i^R \tilde{R}_i}{L_i} \sum_{g \in G} \sum_{u \in M} \frac{\left(\epsilon^g - 1 + \xi^g_{h|i,u}\right) L^g}{\left(\epsilon^g - 1 + \xi^g_{h|i,u}\left[1 - \epsilon^g \rho^g_{h,R}\right]\right)} = \frac{\alpha}{1-\alpha} \times M \times \tag{A21}$$

$$\left(\left[\sum_{g \in G} \frac{L^g \left[\epsilon^g - \left(1 - \xi^g_{h|i,u}\right)\right]}{\epsilon^g - 1} \cdot \tilde{x}_{m|i,u} \right] + \frac{(1-\alpha)\,\theta \sum_{g \in G} \sum_{u \in M} \left(1 - \xi^g_{h|i,u}\right) L^g w^g_{u|i,u}}{1 + (1-\alpha)\,\theta} \right.$$

$$\left. + \sum_{g \in G} \sum_{u \in M} L^g \,(1-\alpha)\, \epsilon^g \rho^g_{h,R} \xi^g_{h|i,u} w^g_{u|i,u} \left[\frac{\epsilon^g - 1 + \xi^g_{h|i,u}}{\epsilon^g - 1 + \xi^g_{h|i,u}\left[1 - \epsilon^g \rho^g_{h,R}\right]} \right] \right),$$

Public and Private Goods Consumption. The vector of optimal policy instruments $\{\tilde{x}_{s|i,u}, P_i^R \tilde{R}_i\}$ is given by the unique solution to the system of equations (A19) - (A21), while optimal tax rates $\tilde{t}^g_{s|i,u}$ are determined by equation (A18).

Implementation. This Appendix sketches the main steps necessary to derive the optimal taxes and transfers that implement the socially optimal levels of private and public good consumption by combining the planner's first-order conditions. Online Supplement B.4 displays all derivations and corresponding proofs in full.

1. Solve for the optimal private goods consumption of employed and non-employed workers in all regions, sectors and groups by combining (A7), (A8), (A13) and the planner's first-order condition on local population (A14).

2. Step 1 yields optimal private good consumption levels as a function of wages, employment rates and two policy instruments: region-specific tax rates, $\tilde{t}^g_{s|i,u}$ on local labor income as well as additive wage subsidies $\tilde{x}^g_{s|i,u}$.

3. Again applying the planner's first-order condition on local population (A14), all policy instruments can be expressed using solely information on observable variables at the regional level (e.g. wages, employment, rents and labor force participation rates), structural parameters and the optimal level of local public good provision.

4. Derive the optimal level of public good consumption, using equations (A9), (A13), the planner's first-order condition on local population (A14) as well as the solutions for private good consumption from step 2.

5. Again, using the general equilibrium structure of the framework, local public good levels can be expressed solely as a function of economic variables at the regional level (wages, rents, population, labor force participation rates) as well as structural parameters of the model.

References

Abowd, John M., Francis Kramarz, and David N. Margolis, "High Wage Workers and High Wage Firms," *Econometrica*, 1999, *67* (2), 251–333.

Acemoglu, Daron, David H. Autor, and David Lyle, "Women, War, and Wages: The Effect of Female Labor Supply on the Wage Structure at Midcentury," *Journal of Political Economy*, 2004, *112* (3), 497–551.

Agrawal, David R., Tidiane V. Ly, and Raphael Parchet, "Policy Competition in a Spatial Economy," *Working Paper*, 2025.

Ahlfeldt, Gabriel M., Fabian Bald, Duncan Roth, and Tobias Seidel, "Quality of Life in a Dynamic Spatial Model," *CESifo Working Papers*, 2020, *8767*.

Akerlof, George A, "The Economics of "Tagging" as Applied to the Optimal Income Tax, Welfare Programs, and Manpower Planning," *The American Economic Review*, 1978, *68* (1), 8–19.

Albanesi, Stefania and Claudia Olivetti, "Gender Roles and Medical Progress," *Journal of Political Economy*, 2016, *124* (3), 650–695.

Allen, Treb and Costas Arkolakis, "Trade and the topography of the spatial economy," *Quarterly Journal of Economics*, 2014, *129* (3), 1085–1139.

Austin, Benjamin, Edward Glaeser, and Lawrence Summers, "Jobs for the Heartland: Place-Based Policies in 21st-Century America," *Brookings Papers on Economic Activity*, 2018, pp. 151–255.

Baker, Michael, Jonathan Gruber, and Kevin Milligan, "Universal Child Care, Maternal Labor Supply, and Family Well-Being," *Journal of Political Economy*, 2008, *116* (4), 709–745.

Barbanchon, Thomas Le, Roland Rathelot, and Alexandra Roulet, "Gender Differences in Job Search: Trading off Commute Against Wage," *The Quarterly Journal of Economics*, 2021, *136* (1), 381–426.

Bargain, Olivier and Andreas Peichl, "Own-wage labor supply elasticities: variation across time and estimation methods," *IZA Journal of Labor Economics*, 2016, *5* (1), 10.

_ **, Kristian Orsini, and Andreas Peichl**, "Comparing Labor Supply Elasticities in Europe and the United States - New Results," *Journal of Human Resources*, 2014, *49* (3), 723–838.

Bartik, Timothy J., "Using Place-Based Jobs Policies to Help Distressed Communities," *Journal of Economic Perspectives*, 2020, *34* (3), 99–127.

Baum-Snow, Nathaniel, Matthew Freedman, and Ronni Pavan, "Why Has Urban Inequality Increased?," *American Economic Journal: Applied Economics*, 10 2018, *10* (4), 1–42.

Becker, Gary S., "A Theory of the Allocation of Time," *The Economic Journal*, 1965, *75* (299), 493–517.

Benhabib, Jess, Richard Rogerson, and Randall Wright, "Homework in Macroeconomics: Household Production and Aggregate Fluctuations," *Journal of Political Economy*, 1991, *99* (6), 1166–1187.

Berlinski, Samuel, Maria Marta Ferreyra, Luca Flabbi, and Juan David Martin, "Childcare Markets, Parental Labor Supply, and Child Development," *Journal of Political Economy*, 2024, *132* (6), 2113–2177.

Bhalotra, Sonia R. and Manuel Fernández, "The Distribution of the Gender Wage Gap," *IZA Discussion Paper*, 2018, *11640.*

Bick, Alexander, "The Quantitative Role of Child Care for Female Labor Force Participation and Fertility," *Journal of the European Economic Association*, 2016, *14* (3), 639–668.

Bilal, Adrien, "The Geography of Unemployment," *The Quarterly Journal of Economics*, 2023, *138* (3), 1507–1576.

Blau, David and Janet Currie, "Pre-School, Day Care, and After-School Care: Who's Minding the Kids?," in E. Hanushek and F. Welch, eds., *Handbook of the Economics of Education*, Vol. 2 2006, chapter 20, pp. 1163–1278.

Blouri, Yashar and Maximilian V. Ehrlich, "On the optimal design of place-based policies: A structural evaluation of EU regional transfers," *Journal of International Economics*, 7 2020, *125*, 103319.

Boelmann, Barbara, Anna Raute, and Uta Schönberg, "Wind of Change? Cultural Determinants of Maternal Labor Supply," *American Economic Journal: Applied Economics*, 2025, *2* (17), 41–74.

Caliendo, Lorenzo, Fernando Parro, Esteban Rossi-Hansberg, and Pierre Daniel Sarte, "The impact of regional and sectoral productivity changes on the U.S. economy," *Review of Economic Studies*, 2018, *85* (4), 2042–2096.

Calvo, Paula, Ilse Lindenlaub, and Ana Reynoso, "Marriage Market and Labor Market Sorting," *The Review of Economic Studies*, 2024, *91* (6), 3316–3361.

Card, David, Jörg Heining, and Patrick Kline, "Workplace Heterogeneity and the Rise of West German Wage Inequality," *The Quarterly Journal of Economics*, 2013, *128* (3), 967–1015.

Colas, Mark and Kevin Hutchinson, "Heterogeneous Workers and Federal Income Taxes in a Spatial Equilibrium," *American Economic Journal: Economic Policy*, 2021, *13* (2), 100–134.

Combes, Pierre-Philippe and Laurent Gobillon, "The Empirics of Agglomeration Economies," in Gilles Duranton, Vernon J. Henderson, and William C. Strange, eds., *Handbook of Regional and Urban Economics*, Elsevier B.V., 2015, chapter 5, pp. 247–348.

Cubas, German, Chinhui Juhn, and Pedro Silos, "Coordinated Work Schedules and the Gender Wage Gap," *The Economic Journal*, 2023, *133* (651), 1036–1066.

Dauth, Wolfgang, Sebastian Findeisen, Enrico Moretti, and Jens Suedekum, "Matching in Cities," *Journal of the European Economic Association*, 2022, *20* (4), 1478–1521.

Diamond, Rebecca, "The determinants and welfare implications of US Workers' diverging location choices by skill: 1980-2000," *American Economic Review*, 2016, *106* (3), 479–524.

Doepke, M. and M. Tertilt, "Families in Macroeconomics," *Handbook of Macroeconomics*, 2016, *2*, 1789–1891.

Eaton, Jonathan and Samuel Kortum, "Technology, geography, and trade," *Econometrica*, 2002, *70* (5), 1741–1779.

Ehrlich, Maximilian V. and Henry G. Overman, "Place-Based Policies and Spatial Disparities across European Cities," *Journal of Economic Perspectives*, 2020, *34* (3), 128–49.

Erosa, Andrés, Luisa Fuster, Gueorgui Kambourov, and Richard Rogerson, "Hours, Occupations, and Gender Differences in Labor Market Outcomes," *American Economic Journal: Macroeconomics*, 2022, *14* (3), 543–590.

Fajgelbaum, Pablo D. and Cecile Gaubert, "Optimal spatial policies, geography, and sorting," *Quarterly Journal of Economics*, 2020, *135* (2), 959–1036.

_ and _ , "Optimal Spatial Policies," *Working Paper*, 2024.

_ , Eduardo Morales, Juan Carlos Suárez Serrato, and Owen Zidar, "State Taxes and Spatial Misallocation," *Review of Economic Studies*, 2019, *86* (1), 333–376.

Gaubert, Cecile, Patrick M. Kline, and Danny Yagan, "Place-Based Redistribution," *NBER Working Paper*, 2021, *28337*.

Gelbach, Jonah B., "Public Schooling for Young Children and Maternal Labor Supply," *American Economic Review*, 2002, *92* (1), 307–322.

Glaeser, Edward L. and David C. Maré, "Cities and Skills," *Journal of Labor Economics*, 4 2001, *19* (2), 316–342.

Goldin, Claudia, "A grand gender convergence: Its last chapter," *American Economic Review*, 2014, *104* (4), 1091–1119.

Head, Keith and Thierry Mayer, "Gravity Equations: Workhorse,Toolkit, and Cookbook," in Gina Gopinath, Elhanan Helpman, and Kenneth Rogoff, eds., *Handbook of International Economics*, Vol. 4 2014, chapter 3, pp. 131–195.

Helm, Ines and Jan Stuhler, "The Dynamic Response of Municipal Budgets to Revenue Shocks," *American Economic Journal: Applied Economics*, 2024, *16* (4), 484–527.

Helpman, Elhanan and David Pines, "Optimal Public Investment and Dispersion Policy in a System of Open Cities," *The American Economic Review*, 1980, *70* (3), 507–514.

Henkel, Marcel, Tobias Seidel, and Jens Suedekum, "Fiscal Transfers in the Spatial Economy," *American Economic Journal: Economic Policy*, 2021, *13* (4), 433–468.

Hsieh, Chang-Tai, Erik Hurst, Charles I. Jones, and Peter J. Klenow, "The Allocation of Talent and U.S. Economic Growth," *Econometrica*, 2019, *87* (5), 1439–1474.

INKAR, "Indikatoren und Karten zur Raum- und Stadtentwicklung. INKAR. Ausgabe 2020.," Technical Report, Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) im Bundesamt für Bauwesen und Raumordnung (BBR), Bonn 2020.

Jessen, Jonas, Sophia Schmitz, and Felix Weinhardt, "Immigration, Female Labour Supply and Local Cultural Norms," *The Economic Journal*, 2023, *134* (659), 1146–1172.

Jung, Philip, Philipp Korfmann, and Edgar Preugschat, "Optimal regional labor market policies," *European Economic Review*, 2023, *152*, 104318.

Keen, Michael and Kai A. Konrad, "The theory of international tax competition and coordination," in Alan J. Auerbach, Raj Chetty, Martin Feldstein, and Emmanuel Saez, eds., *Handbook of Public Economics, Chapter 5*, Vol. 5, Elsevier, 2013, chapter 5, pp. 257–328.

Kleven, Henrik J., Camille Landais, Johanna Posch, Andreas Steinhauer, and Josef Zweimüller, "Child Penalties across Countries: Evidence and Explanations," *AEA Papers and Proceedings*, 2019, *109*, 122–126.

Kline, Patrick and Enrico Moretti, "Place Based Policies with Unemployment," *American Economic Review*, 2013, *103* (3), 238–43.

_ **and** _ , "People, Places, and Public Policy: Some Simple Welfare Economics of Local Economic Development Programs," *Annual Review of Economics*, 2014, *6*, 629–662.

Kuhn, Moritz, Iourii Manovskii, and Xincheng Qiu, "The Geography of Job Creation and Job Destruction," *NBER Working Paper*, 2021, (29399).

Moreno-Maldonado, Ana, "Mums and the City: Household Labour Supply and Location Choice," *SSRN Electronic Journal*, 2023.

Mui, Preston and Benjamin Schoefer, "Reservation Raises: The Aggregate Labor Supply Curve at the Extensive Margin," *The Review of Economic Studies*, 2025, *92* (1), 442–475.

Neumark, David and Helen Simpson, "Place-Based Policies," in Gilles Duranton, J. Vernon Henderson, and William C. Strange, eds., *Handbook of Regional and Urban Economics*, Vol. 5, Elsevier B.V., 2015, chapter 18, pp. 1197–1287.

Olivetti, Claudia and Barbara Petrongolo, "Gender Gaps across Countries and Skills: Demand, Supply and the Industry Structure," *Review of Economic Dynamics*, 2014, *17* (4), 842–859.

_ **and** _ , "The economic consequences of family policies: Lessons from a century of legislation in high-income countries," *Journal of Economic Perspectives*, 12 2017, *31* (1), 205–230.

Rambachan, Ashesh and Jonathan Roth, "A More Credible Approach to Parallel Trends," *Review of Economic Studies*, 9 2023, *90* (5), 2555–2591.

Redding, Stephen J. and Esteban Rossi-Hansberg, "Quantitative Spatial Economics," *Annual Review of Economics*, 2017, *9*, 21–58.

Roback, Jennifer, "Wages, Rents, and the Quality of Life," *Journal of Political Economy*, 1982, *90* (6), 1257–1278.

Rosenthal, Stuart S. and William C. Strange, "Evidence on the Nature and Sources of Agglomeration Economies," in J. Vernon Henderson and Jacques Francois Thisse, eds., *Handbook of Regional and Urban Economics*, Vol. 4 2004, chapter 49, pp. 2119–2171.

Rossi-Hansberg, Esteban, Pierre-Daniel Sarte, and Felipe Schwartzman, "Cognitive Hubs and Spatial Redistribution," *American Economic Journal: Macroeconomics*, 2025, (forthcoming).

Roy, Andrew D., "Some thoughts on the distribution of earnings,," *Oxford Economic Papers*, 1951, *3* (2), 135–146.

Saez, Emmanuel, "Optimal Income Transfer Programs: Intensive versus Extensive Labor Supply Responses," *The Quarterly Journal of Economics*, 2002, *117* (3), 1039–1073.

Samuelson, Paul A., "The Pure Theory of Public Expenditure," *The Review of Economics and Statistics*, 1954, *36* (4), 387–389.

Sant'Anna, Pedro H.C. and Jun Zhao, "Doubly robust difference-in-differences estimators," *Journal of Econometrics*, 2020, *219* (1), 101–122.

Schmutz, Benoît and Modibo Sidibé, "Frictional Labour Mobility ," *The Review of Economic Studies*, 2019, *86* (4), 1779–1826.

Schubert, Markus, Tobias Kluth, Gregor Nebauer, and Ralf Ratzenberger, "Verkehrsverflechtungsprognose 2030," *Schlussbericht. Bundesministerium für Verkehr und digitale Infrastruktur*, 2014.

Serrato, Juan C.S. and Philippe Wingender, "Estimating Local Fiscal Multipliers," *NBER Working Paper Series*, 2016, *22425*.

Vieira, Caterina Soto, "Home Production in the City," *Working Paper*, 2026.

Weinand, Sebastian and Ludwig von Auer, "Anatomy of regional price differentials : Evidence from micro price data," *Spatial Economic Analysis*, 2020, *15*, 413–440.

Wildasin, David E., "Chapter 29: Theoretical analysis of local public economics," *Handbook of Regional and Urban Economics*, 1 1987, *2*, 1131–1178.

Supplemental Appendix

A Empirical Supplement **1**

A.1 German Fiscal Federalism 1

A.2 The 2011 Census Shock 1

A.3 Balance Tests 3

A.4 Continuous Treatment Specification 3

B Theory Supplement **5**

B.1 Derivation of Expected Utility 5

B.2 Definition of Spatial Equilibrium 6

B.3 Alternative Micro-Foundation of Labor Force Participation 8

B.4 Additional Details on the Social Planner's Set Up 11

B.5 Derivation and Decomposition of Net Fiscal Transfers 14

C Quantification Details **16**

C.1 Classification of Market Sectors 16

C.2 Parameterization 16

C.3 Inversion Strategy 17

D Counterfactual Supplement **22**

D.1 Implementation Strategy 22

D.2 Counterfactual Equilibria 24

D.3 Additional Counterfactual Results 26

A Empirical Supplement

A.1 German Fiscal Federalism

Germany's existing fiscal redistribution scheme (*Finanzausgleich*) transfers nearly 10 % of nominal GDP between different government layers and regions. This system follows a formula-based approach, in which transfers are determined by the difference between a region's assessed fiscal needs and its fiscal capacity (local tax potential). While fiscal capacity varies with the local economic base, fiscal needs are mechanically tied to population size, typically calculated as a fixed per-capita target adjusted for specific municipal characteristics (Helm and Stuhler, 2024). Although transfers are not strictly proportional to population due to the capacity offset, this institutional link ensures that population updates generate exogenous variation in municipal budgets (see Appendix for details).

Figure A.1 presents two key correlations of this redistribution scheme. We hereby define net fiscal transfers as the change in consumption possibilities from redistribution. Panel (a) confirms a finding consistent with the system's design (Henkel et al., 2021): transfers flow from high-wage to low-wage regions. Panel (b), however, reveals a second, distinct pattern: controlling for wage differences, transfers also flow systematically to regions with lower LFP, indicating the fiscal system supports areas where a larger share of the population is engaged in the home sector. These place-based policies affect where people live and work. Redistributed funds support public amenities that increase local attractiveness (Tiebout, 1956) and help workers, especially women, join the labor force.

A.2 The 2011 Census Shock

In Germany, municipalities bear the primary responsibility for providing local public goods, including childcare. For instance, the 2008 "Kinderförderungsgesetz" (KiföG) mandated the expansion of childcare, heavily relying on fiscal transfers to fund it. In 2011, a nationwide Census revealed substantial deviations from official registry-based population projections used to calculate fiscal transfers. These unexpected revisions, ranging from -7.65% to $+3.43\%$, resulted in permanent changes to local fiscal budgets, unrelated to economic conditions. Helm and Stuhler (2024) show that such windfall increases to budgets translate into higher government expenditures, particularly in the short run. Supplement Figure A.2 shows the spatial distribution of the 2011 Census shock.

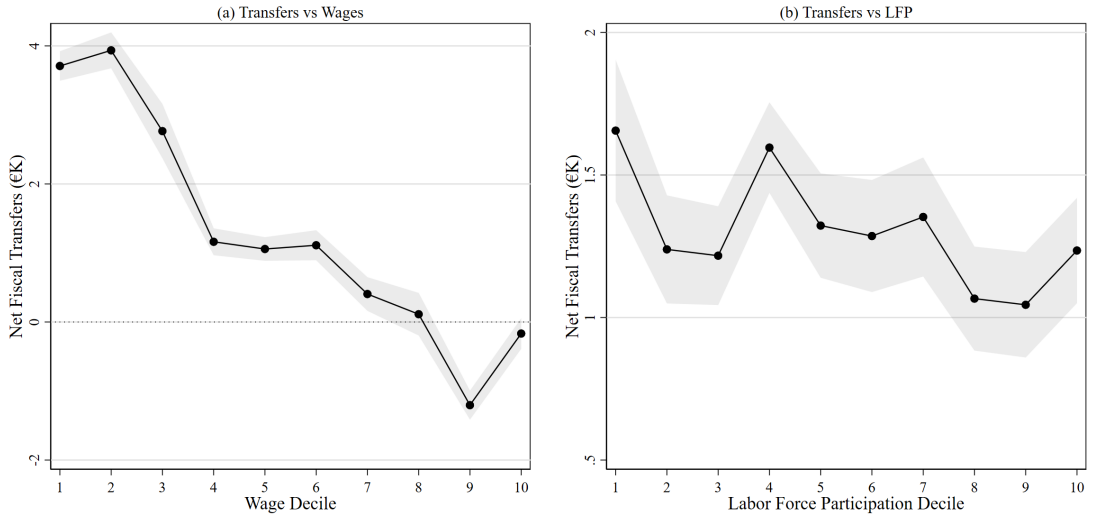


Figure A.1: Stylised Facts about the German Fiscal Redistribution Scheme

Notes: This figure displays binned scatter plots (10 bins) for German Commuting Zones (CZs) over the period 2008–2018. Variables are residualized on year fixed effects and additional controls. Panel (a) plots net fiscal transfers against regional wage deciles, controlling for population size and labor force participation. Panel (b) plots net fiscal transfers against labor force participation deciles, controlling for regional wages and population size. All estimates are weighted by population. Shaded areas indicate 95% confidence intervals for the bin means.

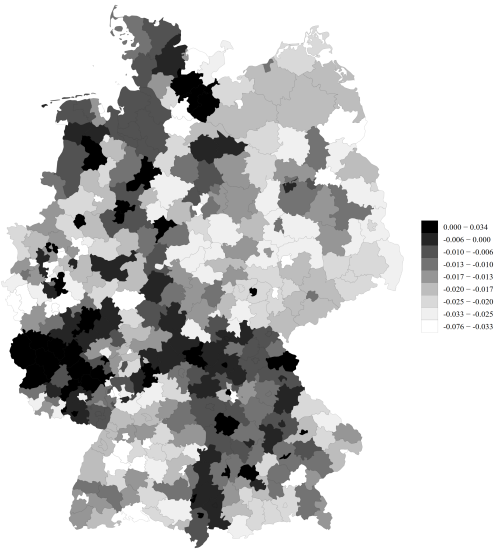


Figure A.2: Distribution of the 2011 Census shock

Note: The figure plots the spatial distribution of the 2011 Census Shock. The Census Shock is measured as the log difference between local population counts at the end of 2010 and the results of the 2011 Census in May 2011.

A.3 Balance Tests

We compare pre-treatment characteristics between regions experiencing above-mean Census revisions (treated) and those below the mean (control). As shown in Table A.1, treated regions show higher wages but lower population and initial fiscal transfers. Moreover, the dynamics of these variables in the pre-treatment period differ between groups. These systematic differences in both levels and pre-treatment dynamics motivate our use of augmented inverse probability weighting (AIPW).

Table A.1: Balance on Pre-treatment Characteristics

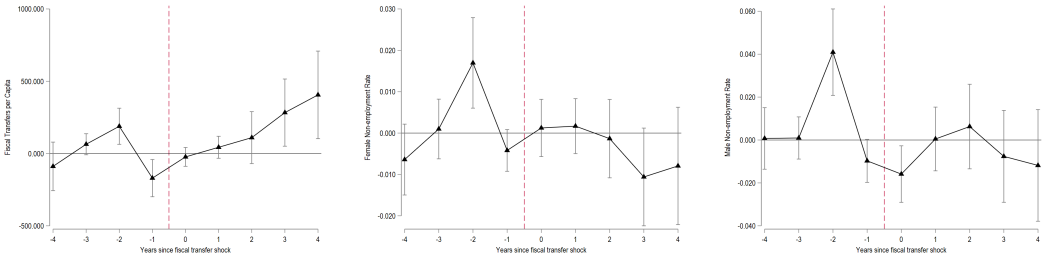
	Control	Treated	Difference	SE
GDP per capita	47 138.53	45 146.75	1991.78**	808.80
Working-age population	158 874.39	111 822.88	47 051.51***	6323.59
Wages	34 305.82	35 884.64	−1578.82***	195.08
Net wages	26 960.65	27 834.84	−874.19***	148.61
Net wages, female	28 930.87	29 777.91	−847.04***	145.06
Net wages, male	39 680.77	41 991.38	−2310.61***	255.46
Labor Force Participation rate	0.71	0.74	−0.03***	0.00
Employment rate	0.71	0.74	−0.03***	0.00
Employment rate, female	0.70	0.71	−0.01***	0.00
Employment rate, male	0.77	0.80	−0.03***	0.00
Non-employment rate, female	0.30	0.29	0.01***	0.00
Non-employment rate, male	0.23	0.20	0.03***	0.00
Fiscal transfers per capita	903.81	659.92	243.89**	121.78
Tax revenues per capita (before redistribution)	9717.25	9664.22	53.03	125.83
Tax revenues per capita (after redistribution)	10 621.05	10 324.14	296.92***	39.55
Gross expenditures per capita	3279.24	3185.93	93.31	72.36
Public debt per capita	2060.77	2378.80	−318.03***	74.87

Note: The table shows the balance of pre-treatment characteristics between control and treated groups. Means and standard errors (SE) are reported. Significant differences are indicated by ** (p ¡ 0.05) and *** (p ¡ 0.01).

Figure A.3 confirms the validity of the research design. Panel (a) shows that treated regions experienced a sustained increase in fiscal transfers following the Census revision, while pre-trends remain parallel. Panels (b) and (c) demonstrate that these transfer increases coincided with reductions in non-employment rates, particularly for women.

A.4 Continuous Treatment Specification

Table A.2 reports results using a continuous treatment specification, where we interact the Census shock intensity with a post-treatment indicator. This approach exploits the full variation in treatment intensity rather than dichotomizing regions into treated and control groups. The coefficient on the interaction term represents the effect of a one-unit increase in the Census shock on outcomes in the post-treatment period. Results are consistent with our main findings: fiscal transfer shocks significantly reduce female non-employment, with smaller and statistically insignificant effects for men.



(a) Transfers (b) Female Non-employment (c) Male Non-employment

Figure A.3: Event Study Estimates: Parallel Trends and Treatment Effects

Notes: This figure plots dynamic average treatment effects on the treated (ATT) from an augmented inverse probability weighting (AIPW) difference-in-differences estimator (Sant'Anna and Zhao, 2020). The outcome variables are fiscal transfers per capita (Panel a) and log non-employment rates for women (Panel b) and men (Panel c). Treatment is defined as an above-median population revision from the 2011 Census, with effects realized in 2013 due to the two-year lag in fiscal transfer calculations. The omitted reference period is $t = -1$ (2012). Vertical bars represent 95% confidence intervals. County and state-by-year fixed effects are included; controls comprise log net wages, population, and four lags of the outcome. Standard errors are clustered at the county level.

Table A.2: Continuous Treatment Effects of Census Shock

	(1) Transfers	(2) Female Non-emp.	(3) Male Non-emp.
Census Shock × Post	0.842***	-0.015**	-0.008
	(0.124)	(0.007)	(0.012)
Observations	4,400	4,400	4,400
Region FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Notes: This table reports difference-in-differences estimates using continuous treatment intensity. The Census Shock variable measures the per capita revision in population counts induced by the 2011 Census. Post equals one for years 2013 and later. All specifications include region and year fixed effects and control for log net wages and population. Standard errors (in parentheses) are clustered at the regional labor market level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B Theory Supplement

B.1 Derivation of Expected Utility

Given the definition of structural barriers, $\exp\left[B^g_{h|i,u}\right]\varphi(\omega)$, the expected amount of private home market production is determined as

$$\frac{1}{L^g_{h|i,u}}\int_1^\infty L^g_{h|i,u}\exp\left[B^g_{h|i,u}\right]\varphi\frac{\partial Q^g(\varphi)}{\partial\varphi}d\varphi=\exp\left[B^g_{h|i,u}\right]\int_1^\infty\varphi\frac{\partial Q^g(\varphi)}{\partial\varphi}d\varphi$$

where $Q^g(\varphi)$ is the cumulative distribution function of workers' individual home productivity draws. Only those workers whose individual draw is above a local cut-off $\tilde{\varphi}^g_{h|i,u}$ end up in the home market sector, such that the average level of private home market production can be re-written as

$$\bar{B}^g_{h|i,u}=\frac{\exp\left[B^g_{h|i,u}\right]}{1-Q^g\left(\tilde{\varphi}^g_{h|i,u}\right)}\int_{\tilde{\varphi}^g_{h|i,u}}^\infty\varphi dQ^g(\varphi),$$

with $L^g_{h|i,u}/L^g_{i,u}=1-Q^g\left(\tilde{\varphi}^g_{h|i,u}\right)$ the share of workers in the home market sector.

Assume now that the idiosyncratic component follows a Pareto distribution with the following group-specific cumulative distribution and density functions:

$$Q^g(\varphi)=1-\varphi^{-\epsilon^g}\quad\text{and}\quad\frac{\partial Q^g(\varphi)}{\partial\varphi}=\epsilon^g\varphi^{-\epsilon^g-1}$$

Substituting these functional forms into the expression above yields

$$\int_{\tilde{\varphi}^g_{h|i,u}}^\infty\varphi dQ^g(\varphi)=\int_{\tilde{\varphi}^g_{h|i,u}}^\infty\varphi\left(\frac{\partial Q^g(\varphi)}{\partial\varphi}\right)d\varphi=\epsilon^g\int_{\tilde{\varphi}^g_{h|i,u}}^\infty\varphi^{-\epsilon^g}d\varphi=\frac{\epsilon^g}{\epsilon^g-1}\left(\tilde{\varphi}^g_{h|i,u}\right)^{1-\epsilon^g}.$$

Comparing individual utility under either employment status yields the size of the local cutoff. Thus we get

$$\int_{\tilde{\varphi}^g_{h|i,u}}^\infty\varphi dQ^g(\varphi)=\frac{\epsilon^g}{\epsilon^g-1}\left(\left(\frac{1}{\mathcal{B}^g_{s|i,u}}\right)\left(\frac{I^g_{m|i,u}}{I^g_{h|i,u}}\right)^{1-\alpha}\left(\left[\frac{R_i}{L^\chi_i}\right]^{\rho^g}\right)^\alpha\right)^{1-\epsilon^g}.$$

Collecting terms, we arrive at

$$\begin{aligned}\bar{B}^g_{h|i,u}&=L^g_{i,u}/L^g_{h|i,u}\exp\left[B^g_{h|i,u}\right]\frac{\epsilon^g}{\epsilon^g-1}\left(\left(\frac{1}{\mathcal{B}^g_{s|i,u}}\right)\left(\frac{I^g_{m|i,u}}{I^g_{h|i,u}}\right)^{1-\alpha}\left(\left[\frac{R_i}{L^\chi_i}\right]^{\rho^g}\right)^\alpha\right)^{1-\epsilon^g}\\&=\frac{\epsilon^g}{(\epsilon^g-1)}\left(\mathcal{B}^g_{s|i,u}\right)^{\epsilon^g}\exp\left[-\mu^g_{m|i,u}\right]\left[\left(\frac{I^g_{m|i,u}}{I^g_{h|i,u}}\right)^{1-\alpha}\left(\left[\frac{R_i}{L^\chi_i}\right]^{\rho^g}\right)^\alpha\right]^{(1-\epsilon^g)}\frac{1}{L^g_{h|i,u}/L^g_{i,u}},\end{aligned}$$

Using this expression in the expression for expected market efficiency, we calculate expected indirect utility in region i and market sector u as follows:

$$\begin{aligned}\bar{V}_{i,u}^{g}(\omega) &= a_{i,u}^{g}(\omega)\left(\left(1-\xi_{h|i,u}^{g}\right)V_{m|i,u}^{g}+\xi_{h|i,u}^{g}V_{h|i,u}^{g}\right)\\ &= a_{i,u}^{g}(\omega)\,A_{i}^{g}\exp\left[-\mu_{m|i,u}^{g}\right]\left(\frac{I_{m|i,u}^{g}}{P_{i}}\right)^{1-\alpha}\left(\frac{R_{i}}{L_{i}^{\chi}}\right)^{\alpha}\left(1+\xi_{h|i,u}^{g}\left[\frac{\epsilon^{g}}{\epsilon^{g}-1}-1\right]\right)\\ &= a_{i,u}^{g}(\omega)\,V_{m|i,u}^{g}\left(1+\xi_{h|i,u}^{g}\left[\frac{\epsilon^{g}}{\epsilon^{g}-1}-1\right]\right).\end{aligned}$$

For the special case where $M=1$, we get the expression for indirect utilities in equation (9) of the main paper.

B.2 Definition of Spatial Equilibrium

In this Appendix, we detail the equilibrium of the quantitative framework. Given model primitives $\{\bar{A}_{i}^{g}, B_{h|i}^{g}, H_{i}, L^{g}, \bar{Z}_{i}^{g}, \Lambda\}$, a set of spatial policies and structural parameters, a general equilibrium of the economy is referenced by a vector of endogenous objects $\mathbf{V}=\{E_{i}, h_{i,u}, I_{s|i,u}^{g}, L_{i,u}^{g}, L_{s|i,u}^{g}, P_{i}, r_{i}, w_{i,u}^{g}, X_{i,u}, \lambda_{i,u}, \pi_{ij,u}\}$. These endogenous objects are jointly determined such that:

1. Workers optimally choose bundles of final goods from all markets given region-specific price indices for all market sectors and after-tax income;

2. Workers optimally sort into locations and market sectors, given after-tax income, public expenditure, local amenities and regional price levels:

$$L_{i,u}^{g}=\frac{\left(A_{i}^{g}\exp\left[-\mu_{m|i,u}^{g}\right]\left(\frac{I_{m|i,u}^{g}}{P_{i}}\right)^{1-\alpha}\left(\frac{R_{i}}{L_{i}^{\chi}}\right)^{\alpha}\left(1+\xi_{h|i,u}^{g}\left[\frac{\epsilon^{g}}{\epsilon^{g}-1}-1\right]\right)\right)^{\theta}}{\sum_{i\in J}\sum_{u\in M}\left(A_{i}^{g}\exp\left[-\mu_{m|i,u}^{g}\right]\left(\frac{I_{m|i,u}^{g}}{P_{i}}\right)^{1-\alpha}\left(\frac{R_{i}}{L_{i}^{\chi}}\right)^{\alpha}\left(1+\xi_{h|i,u}^{g}\left[\frac{\epsilon^{g}}{\epsilon^{g}-1}-1\right]\right)\right)^{\theta}}L^{g}$$

3. Workers decide on their labor force participation after their workplace decision:

$$L_{h|i,u}^{g}=\Bigg[\underbrace{\left(\exp\left[\mathcal{B}_{s|i,u}^{g}\right]\right)^{-1}}_{\text{Structural Barriers}}\underbrace{\left(\frac{I_{m|i}^{g}}{I_{h|i}^{g}}\right)^{1-\alpha}\left(\left[\frac{R_{i}}{L_{i}^{\chi}}\right]^{\rho^{g}}\right)^{\alpha}}_{\text{Spatial Policies}}\Bigg]^{-\epsilon^{g}}L_{i}^{g}.$$

4. Intermediate good producers demand materials, labor, as well as land and structures under unit costs in a Cobb-Douglas production function. These productive inputs are used to produce idiosyncratic intermediate good varieties.

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

6. Trade costs and unit costs determine optimal price indices

7. Final goods market clearing implies

$$\begin{aligned} X_{i,u} =& \beta_u^R \left[\left(\sum_{u' \in M} \sum_{g \in G} \left(t^g_{m|i,u'} + \iota_i \right) (1 - \xi^g_{h|i,u'}) w^g_{i,u'} L^g_{i,u'} \right) \right] \\ &+ \beta_u^C \left[\frac{L_i}{L} \left(\sum_{j \in J} \sum_{u' \in M} r_j h_{j,u'} - \sum_{g \in G} (1 - t^g_{h|i,u'}) \xi^g_{h|j,u'} w^g_{j,u'} L^g_{j,u'} \right) \right. \\ &\left. + \sum_{s \in h,m} \sum_{u' \in M} \sum_{g \in G} \left(1 - t^g_{s|i,u'} \right) \xi^g_{s|i,u'} w^g_{i,u'} L^g_{s|i,u'} \right] + \sum_{u' \in M} \delta_{i,u'u} \sum_{j \in J} \pi_{ji,u'} X_{j,u'} \end{aligned}$$

8. Intermediate goods market clearing is given as

$$(1 - \xi^g_{h|i,u}) w^g_{i,u} L^g_{i,u} = \delta_{i,u} (1 - \kappa_{i,u}) \frac{\left(\frac{Z^g_{i,u}}{w^g_{i,u}} \right)^{\sigma^g - 1}}{\sum_{g \in G} \left(\frac{Z^g_{i,u}}{w^g_{i,u}} \right)^{\sigma^g - 1}} \sum_{j \in J} \pi_{ji,u} X_{j,u},$$

where $\sum_{j \in J} \pi_{ji,u} X_{j,u}$ are expenditures in all locations j on goods produced in region i and sector u.

9. Market clearing for land and structures implies

$$h_{i,u} = \frac{\delta_{i,u} \kappa_{i,u}}{r_i} \sum_{j \in J} \pi_{ji,u} X_{j,u}.$$

Land and structures market clearing for all regions $i \in J$ and market sectors $u \in M$ ensures that demand for land and structures (9) equals the exogenous supply of land and structures $H_i = \sum_{u \in M} h_{i,u}$.

10. Demand for materials is given by

$$M_{i,uu'} = \frac{\delta_{i,uu'}}{P_{i,u'}} \sum_{j \in J} \pi_{ji,u} X_{j,u}.$$

11. The local governments' budget constraint reads

$$E_i = \sum_{u \in M} \sum_{g \in G} (t^g_{m|i,u} + \iota_i)(1 - \xi^g_{h|i,u}) w^g_{i,u} L^g_{i,u}$$

The system of equations is over-identified (by one equation in total), meaning there are more equations than unknowns. To solve this, we normalise the aggregate price level

in the economy and treat it as the numéraire in the system, e.g.

$$\sum_{i \in J} P_i L_i / L \equiv \bar{P} = 1.$$

This equation also pins down aggregate welfare in the economy.

B.3 Alternative Micro-Foundation of Labor Force Participation

This Online Supplement Section provides an alternative micro-foundation of the labor supply equation (Eq. (8) in the main paper), based on dynamic search-and-matching models of unemployment. This micro-foundation draws on previous work (Kline and Moretti, 2013) and allows us to connect our results to existing research on spatial sorting and frictional unemployment (Bilal, 2023; Schmutz and Sidibé, 2019).

Model Setup. We consider a similar setup as in the spatial equilibrium framework of Section 3 of the main paper. For tractability, we assume that workers and firms are homogeneous, exclude frictional trade, and suppress the subscripts for heterogeneous worker groups.

The economy has L individuals who can move freely across $i \in J$ regions, work in the market sector $m \in S$, or join the home market sector h. Each worker demands one unit of a non-tradable final good, with prices equal to marginal production costs ($P_i = \lambda_i$). Workers and firms are matched according to a constant-returns-to-scale matching function, $\mathcal{M}_i(L_{h|i}, O_i)$, where $L_{h|i}$ denotes unemployed workers, and O_i represents the open vacancies in labor market i. We assume a logarithmic utility function for all workers.

Unemployed workers derive utility from local amenities A_i, private goods, public goods, and the flow utility of unemployment $\tilde{B}_i$, including non-employment benefits, private home market production, and leisure value. The transition of workers to employment depends on the number of open vacancies and non-employed workers. Firms face costs related to posting job openings and hiring workers, including a sunk flow cost of k and a hiring cost of H_i. These costs and worker-firm match productivity (Z_i) influence job creation and posting dynamics. Immobile capitalists own firms. Workers and firms discount the future at a common rate r.

Value functions. In steady-state, the value of non-employment is

$$r J_{h|i} = \ln(\tilde{B}_i) + \ln(A_i) - (1-\alpha)\ln(P_i) + \alpha\,(1-\tilde{\rho}_h)\ln(R_i/L_i^{\chi}) + \upsilon_i q_i(\upsilon_i)\left(J_{m|i} - J_{h|i}\right),$$

where $\upsilon_i = \frac{O_i}{L_{h|i}}$ represents market tightness, and $q_i(\upsilon_i) = \frac{\mathcal{M}_i}{O_i}$ denotes the job finding rate. The steady-state value of market employment $J_{m|i}$ relates to

$$r J_{m|i} = (1-\alpha)\ln w_i + \ln A_i + \alpha \ln(R_i/L_i^{\chi}) - (1-\alpha)\ln(P_i) + o_i\left(J_{h|i} - J_{m|i}\right),$$

with w_i being workers' market wage and o_i representing an exogenous separation probability. Worker mobility ensures that the expected utility of being non-employed is equalized across the economy, resulting in $rJ_{h|i} = rJ_h = \mathcal{V}$ for all $i \in J$.[25]

In a steady state, firms and workers are matched with a certain probability, filling an open vacancy. The value of this filled vacancy $J_{F|i}$ satisfies

$$rJ_{F|i} = \ln(Z_i) - \ln(w_i) + o_i \left(J_{O|i} - J_{F|i}\right),$$

where $J_{O|i}$ is the steady-state value of opening a vacancy. Since firms incur costs of vacancy posting irrespective of obtaining a match, the value of opening vacancies is driven to zero by free firm entry and given by:

$$rJ_{O|i} = -k + q_i(\upsilon_i) \left(J_{F|i} - J_{O|i} - H_i\right).$$

In spatial equilibrium, worker reallocation across regions is determined by inflow and outflow rates, resulting in the local non-employment rate:

$$\xi_{h|i} = \frac{L_{h|i}}{L_i} = \frac{o_i}{o_i + \upsilon_i q_i(\upsilon_i)}.$$

In less tight markets, we can approximate the non-employment rate as follows:

$$\ln \xi_{h|i} \approx -\upsilon_i q_i(\upsilon_i)/o_i.$$

Equilibrium. Workers and firms bargain over the surplus generated by the match:

$$J_{m|i} - J_{h|i} = \frac{b}{1-b} \left(J_{F|i} - J_{O|i} - H_i\right),$$

with b the workers' Nash bargaining share of the surplus. Substituting the values for employment and unemployment as well as the value of matching in the previous expression, we get an expression for regional wages:

$$\ln w_i = \frac{1}{1-\alpha(1-b)} \left[b \left(\ln Z_i - (r+o_i) H_i\right) + (1-b) \left((1-\alpha) \ln P_i + \mathcal{V} - \ln A_i - \alpha \ln(R_i/L_i^{\chi})\right)\right].$$

Combining the steady-state values for vacancy posting and matches, the job creation side of the model requires that:

$$q_i(\upsilon_i) = \frac{k(o_i + r)}{\ln Z_i - \ln w_i - (o_i + r) H_i}.$$

After integrating the values of employment and non-employment, incorporating the job-finding rate, applying the wage expression, and substituting the market tightness ex-

[25] Alternatively, one could assume that the expected utility of being non-employed or employed must be equalized across locations as in our generalized framework in the main paper. Introducing this assumption will, however, not impact the main predictions from this Appendix.

pression, we obtain the following through algebraic manipulation:

$$\mathcal{V} + (1-\alpha)\ln P_i - \ln A_i = kv_i \frac{b}{1-b} + \tilde{B}_i + \alpha\,(1-\tilde{\rho}_h)\ln(R_i/L_i^{\chi}).$$

After substituting this equation into the wage expression, we arrive at the following expression:

$$\ln w_i = \frac{1}{1-\alpha(1-b)}\left[b\left(\ln Z_i - (r+o_i)\,H_i + kv_i\right) + (1-b)\left(\tilde{B}_i - \alpha\tilde{\rho}_h \ln(R_i/L_i^{\chi})\right)\right].$$

This equation illustrates how the wage is determined by the bargaining power (b), weighted average of match productivity (Z_i) net of hiring costs (H_i), and the necessary flow for workers to obtain the utility level $\mathcal{V}$. This utility level represents the flow utility of unemployment $\tilde{B}_i$ net of public goods provision (R_i/L_i^{χ}).

Leveraging the relationship between non-employment rates and labor market tightness, we derive an expression for the logarithm of non-employment rates as a function of the logarithm of wages, public goods, and exogenous components:

$$\begin{aligned}\ln \xi_{h|i} = &-\left(\frac{q_i(v_i)}{ko_i}\right)\left(\frac{1-\alpha(1-b)}{b}\ln w_i - \ln Z_i - \frac{(1-b)\alpha\tilde{\rho}_h}{b}\ln(R_i/L_i^{\chi})\right)\\ &+\frac{q_i(v_i)}{ko_i}\left(\frac{1-b}{b}\tilde{B}_i - (r+o_i)\,H_i\right).\end{aligned}$$

This simplified framework of frictional labor markets provides a micro-foundation for the labor force participation equation (8). Specifically, the wage elasticity of labor supply, ϵ, and the elasticity of extensive labor supply to public goods provision ρ in the main framework of our paper are thus related as follows:

$$\epsilon = \left(\frac{q_i(v_i)}{ko_i}\right)\frac{1-\alpha(1-b)}{b(1-\alpha)}; \quad \rho_h = \frac{(1-\alpha)(1-b)}{1-\alpha(1-b)}\tilde{\rho}.$$

They are functions of the job finding rate, the sunk cost of vacancy posting, the separation rate, and the workers' Nash bargaining share. The elasticity of labor supply ϵ increases with the local job-finding rate but decreases with the sunk cost of vacancy posting, the exogenous separation rate and the workers' Nash bargaining share. Furthermore, the utility value of non-employment, represented by $B_{h|i}$, increases with non-employment benefits, the value of leisure/non-employment, $\tilde{B}_i$, and productivity of worker-firm matches, Z_i (as a proxy for the job finding rate under perfect firm entry) but decreases with match costs, $(r+o_i)H_i$:

$$B_{h|i} = \frac{b(1-\alpha)}{1-\alpha(1-b)}\left(\left(\frac{1-b}{b}\right)\tilde{B}_i - (r+o_i)H_i + \ln Z_i\right).$$

B.4 Additional Details on the Social Planner's Set Up

This Supplement provides further details on how the first-order conditions of the social planner problem can be used to derive the optimal spatial policy instruments and prove Proposition 2 in the Appendix of the main paper. The first-order conditions we refer to in this online Supplement Section are all supplied in Appendix A.2.1 that accompanies the main paper. In this Supplement, we refer to their designation and numbering throughout.

The social planner maximises the social welfare function, subject to non-negativity constraints for consumption and production choices, resource constraints, supply of productive inputs, workers' preferences, and mobility:

$$\max \mathcal{W} = \sum_{g \in G} \mu^g \mathcal{U}(\bar{V}^g_{agg})$$

subject to:

- Resource constraints for final and intermediate goods.
- Supply of production inputs (labor, land).
- Worker sorting condition (equalized utility across locations).
- Local labor supply condition (endogenous participation margin).

See Appendix A.2 in the original manuscript for the full Lagrangian formulation.

Private Good Consumption We first derive workers' optimal private good consumption levels from the planner's problem. By using the first-order condition on the local labor force, equation (A13), we can re-write the first-order conditions on local consumption of both types of goods as follows:

$$\begin{aligned}
&(1-\alpha)\left[\frac{(\epsilon^g-1)\left(1-\xi^g_{h|i,u}\right)}{\epsilon^g-1+\xi^g_{h|i,u}}\right]\left(\mu^g\mathcal{U}'\left(\mathcal{V}^g\right)\mathcal{V}^g+\theta W^g_{i,u}-\theta\sum_{j\in J}\sum_{u'\in M}W^g_{j,u'}\left(\frac{L^g_{j,u'}}{L^g}\right)\right)\\
&=\left(1-\xi^g_{h|i,u}\right)P_iC^g_{m|i,u}-w^g_{i,u}\left[(1-\alpha)\,\epsilon^g\right]\xi^g_{h|i,u}.
\end{aligned}$$

$$\begin{aligned}
&(1-\alpha)\left[\frac{\epsilon^g\xi^g_{h|i,u}}{\epsilon^g-1+\xi^g_{h|i,u}}\right]\left(\mu^g\mathcal{U}'\left(\mathcal{V}^g\right)\mathcal{V}^g+\theta W^g_{i,u}-\theta\sum_{j\in J}\sum_{u'\in M}W^g_{j,u'}\left(\frac{L^g_{j,u'}}{L^g}\right)\right)\\
&=\xi^g_{h|i,u}P_iC^g_{h|i,u}+w^g_{i,u}\left[(1-\alpha)\,\epsilon^g\right]\xi^g_{h|i,u}.
\end{aligned}$$

Next, we substitute the first-order conditions on local population, Eq. (A14) into these new equations. This yields a system of three equations, which can be uniquely solved for the optimal consumption levels of employed workers solely as a function of the market wage and policy instruments $\{\tilde{t}^g_{s|i,u}, \tilde{x}^g_{s|i,u}\}$:

$$P_i\tilde{C}^g_{s|i,u}=\left(1-\tilde{t}^g_{s|i,u}\right)w^g_{i,u}+\tilde{x}^g_{s|i,u} \tag{B.1}$$

$$1-\tilde{t}^g_{s|i,u}=\begin{cases}\frac{(1-\alpha)\theta}{1+(1-\alpha)\theta}+(1-\alpha)\,\epsilon^g\xi^g_{h|i,u}\left(\frac{1}{1-\xi^g_{h|i,u}}-\frac{\theta}{[1+(1-\alpha)\theta]\left[\epsilon^g-\left(1-\xi^g_{h|i,u}\right)\right]}\right) & \text{if } s\in M,\\ \frac{1-\xi^g_{h|i,u}}{\xi^g_{h|i,u}}\left(\frac{(1-\alpha)\theta}{1+(1-\alpha)\theta}-(1-\tilde{t}^g_{m|i,u})\right) & \text{otherwise}\end{cases}$$

$$\tilde{x}^g_{s|i,u}=\begin{cases}\frac{(\epsilon^g-1)(1-\alpha)\left(\mu^g\mathcal{U}'(\mathcal{V}^g)\mathcal{V}^g-\theta\sum_{j\in J}\sum_{u'\in M}\frac{W^g_{j,u'}L^g_{j,u'}}{L^g}+\theta Ex^{NET}_i\right)}{[1+(1-\alpha)\theta]\left[\epsilon^g-\left(1-\xi^g_{h|i,u}\right)\right]} & \text{if } s\in M,\\ \frac{\epsilon^g}{\epsilon^g-1}\cdot\tilde{x}^g_{m|i,u} & \text{otherwise}\end{cases}$$

Private Goods Consumption Levels as a Function of Observables. We substitute the opportunity cost term $W^g_{i,u}$ once again, using the first-order condition on local population in the additive wage subsidy equations.

Note further that the weighted average of aggregate private good consumption is given as follows:

$$\sum_{i\in J}\sum_{u\in M}P_iL^g_{i,u}\sum_{s\in h,m}\xi^g_{s|i,u}C^g_{s|i,u}=\sum_{i\in J}\sum_{u\in M}\left[L^g_{i,u}w^g_{i,u}\sum_{s\in h,m}\xi^g_{s|i,u}\left(1-\tilde{t}^g_{s|i,u}\right)+L^g_{i,u}\sum_{s\in h,m}\xi^g_{s|i,u}\tilde{x}^g_{s|i,u}\right]$$

Plugging in the expressions for weighted additive wage subsidies and taxes yields

$$(1-\alpha)\,\mu^g\mathcal{U}'\left(\mathcal{V}^g\right)\mathcal{V}^g=\frac{1}{L_g}\sum_{i\in J}\sum_{u\in M}L^g_{i,u}\left[P_i\sum_{s\in h,m}\xi^g_{s|i,u}C^g_{s|i,u}\right]$$

Note further that total consumption expenditures (on private and public goods) in the economy have to equal total incomes from working and land rents such that

$$\begin{aligned}&\sum_{g\in G}\sum_{j\in J}\sum_{u'\in M}L^g_{j,u'}P_j\sum_{s\in h,m}\xi^g_{s|j,u'}C^g_{s|j,u'}+\sum_{j\in J}P^R_jR_j\\&=\sum_{g\in G}\sum_{j\in J}\sum_{u'\in M}L^g_{j,u'}\left(1-\xi^g_{h|j,u'}\right)w^g_{j,u'}+\sum_{j\in J}\sum_{u'\in M}h_{j,u'}r_j\end{aligned}$$

Substituting the expression for marginal utilities $(1-\alpha)\,\mu^g\mathcal{U}'\left(\mathcal{V}^g\right)\mathcal{V}^g$ into the expression for additive wage subsidies and using this last equation, finally yields:

$$\begin{aligned}\tilde{x}_{m|i,u}=&\frac{1}{\sum_{g\in G}L^g\left[\epsilon^g-\left(1-\xi^g_{h|i,u}\right)\right]/(\epsilon^g-1)}\times\\&\left[\sum_{g\in G}\sum_{j\in J}\sum_{u'\in M}\frac{\left(1-\xi^g_{h|i,u}\right)L^g_{j,u'}w^g_{i,u'}}{1+(1-\alpha)\,\theta}+\left(h_{j,u'}r_j-P^R_jR_j\right)\right.\\&\left.+\sum_{g\in G}\frac{(1-\alpha)\,\theta L^g}{1+(1-\alpha)\,\theta}\left(Ex^{NET}_i-\frac{1\,}{L^g}\sum_{j\in J}\sum_{u'\in M}L^g_{j,u'}Ex^{NET}_j\right)\right]\end{aligned}\tag{B.2}$$

as well as

$$\tilde{x}_{h|i,u} = \tilde{x}_{m|i,u} * \frac{\sum_{g\in G} L^g \left[\epsilon^g - \left(1 - \xi^g_{h|i,u}\right)\right] / (\epsilon^g - 1)}{\sum_{g\in G} L^g \left[\epsilon^g - \left(1 - \xi^g_{h|i,u}\right)\right] / \epsilon^g} \tag{B.3}$$

where we assume that additive wage subsidies do not differ by worker group as in the framework in the main part of the paper, such that $\tilde{x}^g_{s|i,u} = \tilde{x}_{s|i,u} \quad \forall g \in G$.

Given that tax rates are solely a function of observable labor force participation rates (see equation (A18)), optimal transfers to workers, $\tilde{x}_{s|i,u}$, are determined by a vector of variables at the regional level $\{h_{i,u}, L^g_{i,u}, r_i, w^g_{i,u}, \xi^g_{h|i,u}\}$, structural parameters $\{\alpha, \epsilon^g, \zeta^g, \theta, \rho^g, \chi\}$ and payments to local governments for public goods provision.

Public Good Provision. Next, given the optimised private goods consumption possibilities for all worker groups and the tax system, we derive optimal public goods provision. In the first step, we re-write the first-order conditions on local public good consumption (equation (A9)) as follows:

$$\begin{aligned}
&\left[\alpha - \Upsilon^g_{i,u}\right] \left(\mu^g \mathcal{U}' \left(\mathcal{V}^g\right) \mathcal{V}^g + \theta W^g_{i,u} - \theta \sum_{j\in J} \sum_{u'\in M} W^g_{j,u'} \left(\frac{L^g_{j,u'}}{L^g} \right) \right) \\
&= P^R_i \tilde{R}_i / L_i - \alpha \epsilon^g \rho^g \xi^g_{h|i,u} w^g_{i,u}.
\end{aligned}$$

Substituting in the first-order conditions on local population $L^g_{i,u}$, equation Eq. (A14), as well as the optimal consumption levels yields optimised public goods consumption as a function of private goods consumption. Substituting the expressions for the latter and again combining with the first-order condition on population, we derive optimised public goods consumption as follows:

$$\begin{aligned}
\frac{P^R_i \tilde{R}_i}{L_i} = &\left[\alpha - \Upsilon^g_{i,u}\right] \left(\frac{\mu^g \mathcal{U}' \left(\mathcal{V}^g\right) \mathcal{V}^g}{1 + (1-\alpha)\,\theta} + \frac{\theta E x^{NET}_i}{1 + (1-\alpha)\,\theta} - \theta \left(\frac{(1-\alpha)\,\theta \left(1 - \xi^g_{h|i,u}\right)}{1 + (1-\alpha)\,\theta} \right) w^g_{i,u} \right. \\
&+ \frac{\frac{\theta}{L^g} \sum_{j\in J} \sum_{u'\in M} L^g_{j,u'} \left[P_j \sum_{s\in h,m} \xi^g_{s|j,u'} C^g_{s|j,u'} - \left(1 - \xi^g_{h|j,u'}\right) w^g_{j,u'} - E x^{NET}_i \right]}{1 + (1-\alpha)\,\theta} \\
&\left. + \left(\theta \left(1 - \xi^g_{h|i,u}\right) + \epsilon^g \rho^g \xi^g_{h|i,u} \left[\frac{\epsilon^g - 1 + \xi^g_{h|i,u}}{\epsilon^g - 1 + \xi^g_{h|i,u} \left[1 - \epsilon^g \rho^g\right]} \right] \right) w^g_{i,u} \right)
\end{aligned}$$

Public Good Provision as a Function of Observables. At this point, we again make use of the fact that

$$\mu^g \mathcal{U}' \left(\mathcal{V}^g\right) \mathcal{V}^g = \frac{1}{(1-\alpha)\,L^g} \sum_{i\in J} \sum_{u\in M} L^g_{i,u} \left[P_i \sum_{s\in h,m} \xi^g_{s|i,u} C^g_{s|i,u} \right]$$

Plugging in and combining with the solutions for private goods consumption, we derive the optimal levels of local public good provision $\tilde{R}_i$ solely as a function of observable variables

at the region-gender-sector level (e.g. employment, wages, rents, labor force participation rates, price levels) as well as structural parameters and subsidies to workers:

$$\frac{P_i^R \tilde{R}_i}{L_i} \sum_{g \in G} \sum_{u \in M} \frac{\left(\epsilon^g - 1 + \xi^g_{h|i,u}\right) L^g}{\left(\epsilon^g - 1 + \xi^g_{h|i,u}\left[1 - \epsilon^g \rho^g_{h,R}\right]\right)} = \frac{\alpha}{1-\alpha}$$
$$\left(M \times \left[\sum_{g \in G} \frac{L^g \left[\epsilon^g - \left(1 - \xi^g_{h|i,u}\right)\right]}{\epsilon^g - 1} \cdot \tilde{x}_{m|i,u} \right] + \frac{(1-\alpha)\,\theta \sum_{g \in G} \sum_{u \in M} \left(1 - \xi^g_{h|i,u}\right) L^g w^g_{u|i,u}}{1 + (1-\alpha)\,\theta} \right.$$
$$\left. + \sum_{g \in G} \sum_{u \in M} L^g (1-\alpha)\, \epsilon^g \rho^g_{h,R} \xi^g_{h|i,u} w^g_{u|i,u} \left[\frac{\epsilon^g - 1 + \xi^g_{h|i,u}}{\epsilon^g - 1 + \xi^g_{h|i,u}\left[1 - \epsilon^g \rho^g_{h,R}\right]} \right] \right), \tag{B.4}$$

where we used the fact that aggregate expenditures on private and public goods consumption equals total labor and rent income in the economy and the definition of optimal subsidies to employed workers.

Public and Private Goods Consumption. Given our results from steps 1-3 and the definition of local externalities, the vector of optimal policy instruments $\{\tilde{x}_{s|i,u}, P_i^R \tilde{R}_i\}$ is given by the unique solution to the system of equations (A19) - (A21), while optimal tax rates $\tilde{t}^g_{s|i,u}$ are determined by equation (A18).

B.5 Derivation and Decomposition of Net Fiscal Transfers

The main text conceptually defines the net fiscal transfer, N_i, and uses it to interpret the redistribution simulations in Figure 3 (Panel b). This Supplement provides the formal derivation of N_i.

To calculate N_i, we conduct a thought experiment comparing a "before" redistribution benchmark with the "after" state under the optimal policies from Proposition 2. We hold prices and wages fixed to isolate the direct impact of the fiscal instruments.

To define the "before" redistribution benchmark we start from an initial allocation where there is no inter-regional redistribution. Local tax revenues fund local public goods: $E_i^{before} = t_{m|i}(1 - \xi_{h|i}) w_i L_i$, and any remaining rents are redistributed to local workers as lump-sum subsidies. Non-employed workers receive a fixed share $1 - o$ of local after-tax wage income, $(1 - t_{m|i})(1 - o) w_i$, as compensation financed from locally-occurring rents.

The planner then implements the optimal tax, subsidy, and transfer instruments ($\tilde{t}_{s|i}$, $\tilde{x}_{s|i}$, $\tilde{\iota}_i$) described in Proposition 2. These policies determine the new levels of private consumption ($\tilde{C}_{s|i}$) and public goods ($\tilde{E}_i$). We define the change in private consumption expenditures as $dP_i C_{s|i} \equiv (P_i C_{s|i})^{after} - (P_i C_{s|i})^{before}$, and the change in public goods expenditure as dE_i.

Definition 1. *The net fiscal transfer, N_i, measures the change in per capita consumption possibilities after the implementation of optimal policies:*

$$N_i = \sum_{s \in h,m} \xi_{s|i} dP_i C_{s|i} + d(E_i/L_i). \tag{B.5}$$

The following corollary provides the full analytical decomposition of N_i, linking it to local economic conditions. This decomposition relies on the definition of optimal policies in Proposition 2 and forms the basis for the simulations in the main text. For pedagogical purposes, we focuses on the simpler case with $G = M = 1$ when displaying net transfers in the following Corollary.

Corollary 1. *Assume there is one worker group and market sector in the economy (G=M=1). The net fiscal transfer to a location i is then given by:*

$$\begin{aligned} N_i = \Theta_{i,1} & \underbrace{\left(\sum_{j \in J} w_j L_j / L - w_i \right)}_{\text{relative market compensation}} + \Theta_{i,2} \underbrace{\left(\sum_{j \in J} \xi_{h|j} w_j L_j / L - \xi_{h|i} w_i \right)}_{\text{relative non-market compensation}} \\ - \Theta_{i,3} & \underbrace{\left(\sum_{j \in J} \Upsilon_j L_j / L - \Upsilon_i \right)}_{\text{relative participation sensitivity}} + \underbrace{\gamma \sum_{j \in J} \xi_{h|j} w_j L_j / L}_{\text{avg. non-market compensation}} \\ + \frac{1}{(1-\alpha)L} & \underbrace{\left[(1 - \Upsilon_i/\alpha) \sum_{j \in J} \alpha \left((1 - \xi_{h|j}) w_j L_j + r_j h_j \right) - (1 - \Upsilon_i) \sum_{j \in J} \tilde{E}_j \right]}_{\text{extended Samuelson rule}} \end{aligned} \tag{B.6}$$

where the weighting terms $\Theta_{i,1}, \Theta_{i,2}, \Theta_{i,3}$ are functions of the model's deep parameters:

$$\begin{aligned} \Theta_{i,1} &\equiv \frac{1 - [\alpha(1 - \Upsilon_i/\alpha) + \zeta(1 - \Upsilon_i)]\,\theta}{1 + (1-\alpha)\theta} \\ \Theta_{i,2} &\equiv -\Theta_{i,1} - \gamma \left(1 - \frac{[1 - \Upsilon_i]\,\theta\chi}{1 + (1-\alpha)\theta} \right) + (1-o)(1 - t_{m|i}) \\ \Theta_{i,3} &\equiv \frac{\chi\,[1 - \Upsilon_i]\,\theta \cdot \bar{\mathcal{C}}}{[1 + (1-\alpha)\theta](1-\alpha)} \quad \textit{with} \quad \Upsilon_i \equiv \frac{\gamma \xi_{h|i}}{\epsilon - (1 - \xi_{h|i})} \end{aligned}$$

Proof. Substituting the optimal policy expressions from Proposition 2 into the household and government budget constraints to find the "after" consumption levels, and then applying Definition B.5.

This decomposition provides the analytical basis for the simulations in Figure 3. The corollary translates the planner's problem's structural motives into coefficients on observable local characteristics. For instance, the "relative market compensation" term, with its coefficient $\Theta_{i,1}$, captures the net effect of the planner's underlying preference for the marginal utilities of consumption and the components of the spatial externalities (like

$Ex_i^{\text{LFP-Fiscal}}$) that are systematically correlated with local wages. As long as $\Theta_{i,1} > 0$, the planner redistributes towards locations with below-average wages. Similarly, the other terms capture how differences in local participation rates ($\xi_{h|i}$) drive transfers, bundling the effects of competing agglomeration and labor supply externalities. Finally, the Samuelson rule governs the optimal allocation of funds between private goods and public services.

C Quantification Details

C.1 Classification of Market Sectors

Table C.1: ISIC Revision 4 Sector Classification

Sector	ISIC Rev. 4	Description
1. Agriculture	A	Agriculture, Forestry and Fishing
2. Mining and Quarrying	B, D, E	Mining and Quarrying; Electricity, gas, steam and air conditioning supply; Water supply; sewerage, waste management and remediation activities
3. Manufacturing	C	Manufacturing
4. Wholesale/Retail Trade	G - J	Wholesale and retail trade; repair of motor vehicles and motorcycles; Transportation and Storage; Accommodation and food service activities; Information and communication
5. Construction	F	Construction
6. Non-tradable and Non-market Services	K - U	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

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, while sectors 5 and 6 are non-tradable sectors.

C.2 Parameterization

Table C.2 summarizes our parameterization for German commuting zones. We either take parameter values from the literature, calibrate them to our data or – where necessary– estimate them ourselves.

Table C.2: Parameter Values

Description	Parameter	Value	Origin	Approach
Preferences				
Endogenous amenities	η	0.30	Diamond, 2016	Set
Public goods weight	α	0.24	Average public spending to GDP ratio (c.f. Fajgelbaum et al., 2019; Henkel et al., 2021)	Cal.
Degree of rivalry in public services	χ	1.0	Fajgelbaum et al. (2019); Henkel et al. (2021)	Set
Migration elasticity	θ	2.0	Fajgelbaum et al. (2019)	Set
Wage elasticity	ϵ^g	[1.58.1.56]	Bargain and Peichl (2016)	Set
LFP elasticity w.r.t. public expenditure	ρ^g	$[0.01, 0.014]$	DID of fiscal transfer shocks	Est.
Production				
Agglomeration elasticity	ζ^g	$[0.018, 0.03]$	Ahlfeldt et al. (2020)	Set
Elasticity of substitution between males and females	σ^g	2.5	Olivetti and Petrongolo (2014)	Set
Elasticity of substitution of varieties	σ	5.0	Head and Mayer (2014)	Set
Trade elasticity	ν_u	5.0	Head and Mayer (2014)	Set
Labour share in production	$1 - \kappa_{i,u}$	$[0.08, 0.95]$	Wage income to value added ratio	Cal.
Share of value added	$\delta_{i,u}$	$[0.15, 1]$	Value added to gross output ratio	Cal.
Share of material inputs	$\delta_{i,uu'}$	$[0, 0.54]$	Input-Output Tables	Cal.
Expenditure share	β_u	$[0.001, 0.53]$	Aggregate goods market clearing	Fitted
Government				
Regional tax rate	t_i	$[0.22, 0.45]$	Tax revenue to GDP ratio	Cal.
Transfer rate	ρ_i	$[-0.15, 0.23]$	Net transfer to GDP ratio	Cal.

Notes: "Cal." indicates that the parameter is calibrated based on observable data outlined under "data", while "Set" indicates that the parameter is assigned a value based on theoretical considerations or literature. "Fitted" parameters match the model-consistent equations outlined under "source/target", while we estimate parameters indicated by "Est." ourselves. We identify parameter values following the estimation steps outlined in Appendix C.3.

C.3 Inversion Strategy

This appendix outlines our procedure for inverting the model's fundamentals from observed economic outcomes. The approach follows a sequential strategy that leverages the model's structure to recover unobserved productivity levels, amenity values, and structural barriers

that rationalize the observed spatial patterns in wages, employment, and migration across German labor markets:

1. **Derive model-consistent values $\delta_{i,u}$, $\delta_{i,uu'}$, $\kappa_{i,u}$** The parameters $\delta_{i,u}$ can be identified by the fraction of value added over gross regional output in each region-sector pair:

$$\delta_{i,u} = \frac{\sum_{g \in G}(1 - \xi_{h|i,u}) w^g_{i,u} L^g_{i,u} + r_i h_{i,u}}{\sum_{j \in J} \pi_{ji,u} X_{j,u}},$$

   Summing the demand for materials over all regions yields

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

   where we define as $\delta_{uu'}$ the share of economy-wide material inputs of goods from sector u' used in the production of goods from sector u. We observe material inputs in producing goods from each sector from the World Input-Output Tables (Timmer et al. (2015)). We assume then that in all regions, the value of materials $u' \in M$ used as inputs, relative to total material inputs, is constant:

$$\delta_{uu'} = \frac{\delta_{i,uu'}}{\sum_{u' \in M} \delta_{i,uu'}} \quad \forall i \in J \quad \text{and} \quad \delta_{i,uu'} = (1 - \delta_{i,u})\, \delta_{uu'}.$$

   We calibrate the share of value added accruing to workers as

$$1 - \kappa_{i,u} = \frac{\sum_{g \in G}(1 - \xi_{h|i,u}) w^g_{i,u} L^g_{i,u}}{\delta_{i,u} \sum_{j \in J} \pi_{ji,u} X_{j,u}}.$$

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

   Expenditures on land and structures are a fixed share of total wage expenditures:

$$r_i h_{i,u} = \frac{\kappa_{i,u}}{1 - \kappa_{i,u}} \sum_{g \in G} w^g_{i,u} L^g_{m|i,u}.$$

3. **Calculate model-consistent expenditure shares $\beta^C_{u'}$ and $\beta^R_{u'}$**

Aggregate goods markets clear for all sectors, which implies that

$$\begin{aligned}\sum_{i\in J} X_{i,u} =&\beta_u^R \left[\left(\sum_{i\in J}\sum_{g\in G}\sum_{u'\in M}\left(t^g_{m|i,u'}+\iota_i\right)\left(1-\xi^g_{h|i,u'}\right)w^g_{i,u'}L^g_{i,u'}\right)\right]\\ &+\beta_u^C\left[\sum_{i\in J}\frac{L_i}{L}\left(\sum_{j\in J}\sum_{u'\in M} r_j h_{j,u'}-\sum_{g\in G}(1-t^g_{h|i,u'})\xi^g_{h|j,u'}w^g_{j,u'}L^g_{j,u'}\right)\right.\\ &\left.+\sum_{i\in J}\sum_{s\in h,m}\sum_{u'\in M}\sum_{g\in G}\left(1-t^g_{s|i,u'}\right)\xi^g_{s|i,u'}w^g_{i,u'}L^g_{s|i,u'}\right]\\ &+\sum_{i\in J}\sum_{u'\in M}\frac{\delta_{i,u'u}}{\delta_{i,u'}\left(1-\kappa_{i,u'}\right)}\sum_{g\in G}(1-\xi^g_{h|i,u'})w^g_{i,u'}L^g_{i,u'}.\end{aligned}$$

With wage and employment data, as well as parameter values for ι_i and regional tax rates t_i, as well as $\delta_{i,u}$,$\kappa_{i,u}$ and $\delta_{i,uu'}$ obtained from identification step 1, we solve for model-consistent expenditure shares $\{\beta_u^C,\beta_u^R\}$.[26]

4. **Calculate total expenditures**
   Goods market clearing in all regions and sectors implies that,

$$\begin{aligned}X_{i,u} =&\beta_u^R \left[\left(\sum_{g\in G}\sum_{u'\in M}\left(t^g_{m|i,u'}+\iota_i\right)\left(1-\xi^g_{h|i,u'}\right)w^g_{i,u'}L^g_{i,u'}\right)\right]\\ &+\beta_u^C\left[\frac{L_i}{L}\left(\sum_{j\in J}\sum_{u'\in M} r_j h_{j,u'}-\sum_{g\in G}(1-t^g_{h|i,u'})\xi^g_{h|j,u'}w^g_{j,u'}L^g_{j,u'}\right)\right.\\ &\left.+\sum_{s\in h,m}\sum_{u'\in M}\sum_{g\in G}\left(1-t^g_{s|i,u'}\right)\xi^g_{s|i,u'}w^g_{i,u'}L^g_{s|i,u'}\right]\\ &+\sum_{u'\in M}\frac{\delta_{i,u'u}}{\delta_{i,u'}\left(1-\kappa_{i,u'}\right)}\sum_{g\in G}(1-\xi^g_{h|i,u'})w^g_{i,u'}L^g_{i,u'},\end{aligned}$$

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

5. **Calculate relative unit cost shares $\tilde{\lambda}_{i,u}$ for all tradable goods**
   Substituting the model-consistent expressions for trade shares as well as the calculated values for total expenditure into the equations for value-added, we get

$$\sum_{j\in J} X_{j,u}\frac{\left(\lambda_{i,u}\tau_{ji,u}\right)^{-\nu_u}}{\sum_{n\in J}\left(\lambda_{n,u}\tau_{jn,u}\right)^{-\nu_u}}=\frac{\sum_{g\in G} w^g_{i,u}L^g_{m|i,u}}{\delta_{i,u}\left(1-\kappa_{i,u}\right)}.$$

   For all pairs $\{i,u\}$ we solve for the relative unit costs $\tilde{\lambda}_{i,u}\equiv\frac{(\lambda_{i,u})^{\nu_u}}{\sum_{n\in J}(\lambda_{n,u})^{\nu_u}}$ that are

[26] We assume local governments do not consume housing but distribute expenditures like workers across the remaining sectors. This assumption allows us to better fit private expenditure to observable housing expenditure shares in Germany.

implied by the structure of trade flows.

6. **Compute sector-specific price levels for all tradable goods**
Substituting relative unit costs $\tilde{\lambda}_{j,u}$ we solve for the ideal cost indices $P_{i,u}$:

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

where $\sum_{n\in J} \left(\lambda_{n,u}\right)^{\nu_u}$ are sector-specific constants to be determined by normalisation. We choose a model-consistent normalisation on aggregate sector-specific cost indices: $P_u \equiv \sum_{i\in J} P_{i,u}\pi_{i,u} = 1$, that is, we define sector-specific cost aggregates as a weighted average of region-sector-specific costs and normalise them to unity. The weights $\pi_{i,u} = \frac{X_{i,u}}{\sum_{n\in J} X_{n,u}}$ are the share of total spending in sector u, that accrues to region-i expenditures. Applying the normalisation, we solve for the sector-specific constants and subsequently calculate ideal cost indices:

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

Unit costs in levels are therefore determined as

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

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

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

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 $\tau_{ij,u} \to \infty$ for all regions $j \neq i$, such that price levels simplify to $P_{i,nt} = \Gamma\left(\gamma_{nt}\right)^{\frac{1}{1-\sigma}} \lambda_{i,nt}$. Finally, we normalise aggregate price levels and unit costs to the numéraire such that $\sum_i P_i \equiv \bar{P} = 1$.

8. **Compute productivity as compensating differential to unit costs**
This step leverages the relationship between unit costs and productivity in spatial equilibrium. In high-wage locations, higher production costs must be offset by greater productivity to maintain firms' competitiveness in trade. The recovered productivity

values reveal systematic patterns across regions and gender groups that help explain observed spatial wage disparities. Group-specific labor demand can be re-written in terms of the aggregate wage sum:

$$\frac{w_{i,u}^g L_{m|i,u}^g}{\sum_{g\in G} w_{i,u}^g L_{m|i,u}^g} = \frac{\left(\frac{Z_{i,u}^g}{w_{i,u}^g}\right)^{\sigma^g-1}}{\sum_{g\in G}\left(\frac{Z_{i,u}^g}{w_{i,u}^g}\right)^{\sigma^g-1}}$$

Substituting relative productivity $\tilde{Z}_{i,u}^g \equiv \frac{Z_{i,u}^g}{\sum_{g\in G} Z_{i,u}^g}$ and applying the fact that relative productivity $\tilde{Z}_{i,u}^g$ sums to unity in all region-sector pairs allows identifying them solely in terms of observable average wages and market employment:

$$\tilde{Z}_{i,u}^g = \frac{\left(w_{i,u}^g\right)^{\frac{\sigma^g}{\sigma^g-1}}\left(L_{m|i,u}^g\right)^{\frac{1}{\sigma^g-1}}}{\sum_{g\in G}\left(w_{i,u}^g\right)^{\frac{\sigma^g}{\sigma^g-1}}\left(L_{m|i,u}^g\right)^{\frac{1}{\sigma^g-1}}}$$

Given unit cost estimates, higher local unit prices (e.g. wages, rent, intermediate goods prices) thus imply larger regional productivity in sector u:

$$Z_{i,u}^g = \tilde{Z}_{i,u}^g\left[\frac{D_{i,u}}{\lambda_{i,u}}\left(r_i^{\kappa_{i,u}}\left[\sum_{g\in G}\left(\frac{\tilde{Z}_{i,u}^g}{w_{i,u}^g}\right)^{\sigma^g-1}\right]^{\frac{1-\kappa_{i,u}}{1-\sigma^g}}\right)^{\delta_{i,u}}\prod_{u'\in M}\left[P_{i,u'}\right]^{\delta_{i,uu'}}\right]^{\frac{1}{\delta_{i,u}\left(1-\kappa_{i,u}\right)}}.$$

9. **Ensure goods market clearing in non-tradable sectors**
   Identification step 5 ensures goods market clearing in all regions and tradable sectors since unit costs are identified from model-consistent trade flows. In contrast, we use data on observable price levels in non-tradable sectors for quantification, which may not ensure goods market clearing in these sectors initially. We, therefore, gradually adjust the parameters $\delta_{i,u}, \delta_{i,uu'}$ across regions and non-tradable sectors such that they ensure goods market clearing also in non-tradable sectors. The loop works as follows:

   - Follow identification steps 1-8, given initial guesses for $\delta_{i,u}, \delta_{i,uu'}$ in all regions and sectors
   - Calculate trade flows implied by guesses of unit costs, $X_{i,u}$ and trade costs
   - Use guesses for unit costs and intermediate cost inputs to compute the total value of intermediate goods production
   - Evaluate whether local production equals total demand
   - Adjust the parameters $\delta_{i,u}, \delta_{i,uu'}$, re-do all the steps above until goods market clearing is ensured

10. **Compute preferences as compensating differentials to labor supply**
Given sector-specific unit cost levels as well as data on wages $w^g_{i,u}$, tax rates, public expenditure and employment rates, overall preference shifters $A^g_i \exp\left[-\mu^g_{m|i,u}\right]$ are recovered as the residual to observable labor supply:[27]

$$L^g_{i,u} = \frac{\left(\bar{V}^g_{i,u}\right)^\theta}{\sum_{u\in M}\sum_{i\in J}\left(\bar{V}^g_{i,u}\right)^\theta} L^g,$$

To split the two preference components, we regress the overall preference shifter on region-fixed effects for all worker groups to identify amenities and region-sector-specific participation costs separately. Thus $\bar{A}^g_i = A^g_i L_i^{-\zeta^g}$, with $A_1 = 1$ for both worker groups.

11. **Compute structural barriers**
Finally, we use the structural parameter estimates $\{\epsilon^g, \rho^g, \alpha\}$ and non-employment rates to recover the aggregate level $\mathcal{B}^g_{s|i,u}$, such that

$$\mathcal{B}^g_{s|i,u} = \left(\xi^g_{h|i,u}\right)^{\frac{1}{\epsilon^g}} \left(\frac{I^g_{m|i,u}}{I^g_{h|i,u}}\right)^{1-\alpha} \left(\left[\frac{R_i}{L_i^\chi}\right]^{\rho^g}\right)^{\alpha}.$$

Finally, we split preference shifters into participation costs and structural barriers, such that $\exp\left[B^g_{h|i,u}\right] = \mathcal{B}^g_{s|i,u} \exp\left[-\mu^g_{m|i,u}\right]$ and normalize all preference components.

D Counterfactual Supplement

This appendix provides technical details on our counterfactual implementation and additional results that complement Section 5 of the main paper. We explain our computational approach to finding welfare-maximizing spatial policies and document local effects that support our aggregate findings about the potential benefits of optimized redistribution.

D.1 Implementation Strategy

Global Optimization via Latin Hypercube Sampling. Conditional on the initial distribution of fiscal policies, counterfactual equilibria are unique as long as congestion forces outsize agglomeration forces. Yet, there may be multiple equilibria for different initial sets of policies. Since we are interested in the global maximum achievable for the German economy, we explore this potential multiplicity by varying the spatial distribution

[27] Since preference shifters are identified only up to scale, we normalize the first cell (J=1,G=1,M=1) to unity such that the preference terms in all other regions, sectors and groups are identified relative to this cell.

of initial policies. To do so efficiently in a high-dimensional policy space, we employ Latin Hypercube Sampling (LHS).

We generate $N = 1,000$ distinct sets of policies, $\mathcal{V}_0^P = \{\tilde{t}^g_{s|i,u}, \tilde{x}^g_{s|i,u}, \tilde{E}_i\}$, using a maximin Latin Hypercube design. Unlike simple Monte Carlo sampling, which can leave large gaps in the parameter space, LHS ensures that the sample is stratified across the entire range of each policy dimension. For a policy vector of dimension D, LHS divides the range of each variable into N equiprobable intervals and ensures that exactly one sample is drawn from each interval. This space-filling property is crucial to our analysis because the efficiency of the search for a global optimum depends on the domain's coverage. Stein (1987) shows that LHS reduces the variance of estimators compared to simple random sampling, with convergence rates approaching $O(N^{-1})$ rather than $O(N^{-1/2})$. Given the computational cost of solving the general equilibrium model, LHS enables robust exploration of the global welfare landscape with $N = 1,000$ points, providing coverage comparable to that of a significantly larger random sample.

Sampling strategy. A social planner chooses a vector of taxes, regional transfers and wage subsidies, $\mathcal{V}_0^P = \{\tilde{t}^g_{s|i,u}, \tilde{x}^g_{s|i,u}, \tilde{E}_i\}$ as a function of local wages, labor force participation, population and rents, such that they satisfy all general equilibrium conditions as detailed in the Appendix B.2 of the main paper. We generated this vector using LHS for our global optimization study, enabling us to evaluate $N = 1,000$ distinct initial equilibria. In the following, we provide details on the sampling procedure.

1. We sample tax rates for employed workers, $\tilde{t}^g_{m|i,u}$, from a Latin Hypercube design, scaled to the uniform bounds $(0, 1)$ for all places, sectors, and worker groups. We normalize simulated tax rates so that their average equals the data mean (around $t = 0.4$). This ensures that the aggregate share of public goods relative to private goods remains comparable to the observed value for 2014.

2. Non-employed workers receive a fraction $o^g_{i,u}$ of after-tax wage income. We sample this fraction from the LHS design (scaled to uniform bounds $(0, 1)$) for all places, sectors, and worker groups. Taxes on non-employed workers follow as $\tilde{t}^g_{h|i,u} = 1 - (1 - \tilde{t}^g_{m|i,u}) \cdot o^g_{i,u}$.

3. Calculate model-consistent rent income from all locations, net of non-employment payments:

$$\mathcal{K} = \sum_{i \in J} \sum_{u \in M} \sum_{g \in G} \left(\frac{\kappa_{i,u}}{1 - \kappa_{i,u}} \left(1 - \xi^g_{h|i,u}\right) w^g_{i,u} L^g_{i,u} - (1 - \tilde{t}^g_{h|i,u}) \xi^g_{h|i,u} w^g_{i,u} L^g_{i,u} \right)$$

4. Calculate aggregate government income that can be redistributed across local governments and workers:

$$E = \sum_{i \in J} \sum_{u \in M} \sum_{g \in G} \tilde{t}^g_{m|i,u} \left(1 - \xi^g_{h|i,u}\right) w^g_{i,u} L^g_{i,u} + \mathcal{K}$$

5. Calculate total funds available for public goods expenditure: $\alpha \cdot E$.[28]

6. Randomly allocate αE to different locations: $\tilde{E}_i = \frac{\text{share}_i^P}{\sum_{i \in J} \text{share}_i^P} \cdot \alpha E$, where[29]

$$\text{share}_i^P = \frac{\sum_{u \in M} \sum_{g \in G} L_{i,u}^g}{\sum_{i \in J} \sum_{u \in M} \sum_{g \in G} L_{i,u}^g} \cdot \tilde{\iota}_i; \quad \text{and} \quad \tilde{\iota}_i \sim U(0.1, 1.9)$$

7. Calculate total funds to be distributed as (additive) wage subsidies: $(1 - \alpha) \cdot E$

8. Sample wage subsidies across locations, sectors and worker types. First, we calculate the (sampled) shares of the total funds that accrue to all workers:

$$\text{share}_i^S = \frac{L_{i,u}^g}{\sum_{i \in J} \sum_{u \in M} \sum_{g \in G} L_{i,u}^g} \cdot \tilde{\iota}_{i,u,S}^g; \quad \text{and} \quad \tilde{\iota}_{i,u,S}^g \sim U(0.5, 1.5)$$

   Second, we determine the subsidies that accrue to all workers:

$$\tilde{x}_{u|i,u}^g = \frac{\text{share}_{i,u,S}^g}{\sum_{i \in J} \sum_{u \in M} \sum_{g \in G} \text{share}_{i,u,S}^g} \cdot (1 - \alpha) \cdot E / L_{i,u}^g$$

   Lastly, we normalize subsidies such the total amount of subsidies equals the funds used for private wage subsidies:

$$\tilde{x}_{u|i,u}^g = \frac{\tilde{x}_{i,u}^g}{\sum_{i \in J} \sum_{u \in M} \sum_{g \in G} \left(\tilde{x}_{i,u}^g L_{i,u}^g \right)} \cdot (1 - \alpha) \cdot E \quad \text{and} \quad \tilde{x}_{u|i,u}^g = \tilde{x}_{h|i,u}^g$$

This randomization strategy ensures we explore a broad range of potential equilibria, enabling us to identify policies that maximize global rather than merely local welfare. We can systematically compare welfare outcomes across alternative redistribution schemes by varying initial policy combinations while maintaining consistency with general equilibrium constraints.

D.2 Counterfactual Equilibria

When solving for the initial spatial equilibrium in each LHS iteration, we start from the observed equilibrium in 2014, apply the N sets of spatial policies, and compute the counterfactual values of all endogenous variables in the general equilibrium. In each iteration, we solve for new levels of wages, employment, and LFP rates and use them to adjust the (random) policies: we keep tax rates ($\tilde{t}_{s|i,u}^g$), random transfer rates ($\tilde{\iota}_i$) and subsidy shares ($\tilde{\iota}_{i,u,S}^g$) constant, but update public/ private funds, government expenditures and wage subsidies with the new wages, local employment and labor force participation rates.

[28] Note: Under Cobb-Douglas preferences α is the preferred ratio of public to private goods.

[29] Our choice of sampling of government transfers and wage subsidies incorporates three objectives: (i) ensures that there is at least some public good provision/wage subsidies in all locations initially, (ii) ensures that all funds are spent on public or private goods in either of the J locations and (iii) highly-populous locations get more funds for consumption of both goods.

A spatial equilibrium is found when all markets clear, the random policies are implemented, and the aggregate resource constraint is satisfied. The outcomes are N different spatial equilibria determined by (random) fiscal policies, exogenous characteristics of the German economy in 2014, and the same set of structural parameters.

Details on Implementation. In the following, we provide further details how inverted model fundamentals $\{\bar{A}_i^g, B_{h|i,u}^g, H_i, \bar{Z}_{i,u}^g\}$ and model parameters $\{\alpha, \epsilon^g, \zeta^g, \eta^g, \theta, \kappa_{i,u}, \nu_u, \rho^g, \sigma, \tau_{ij,u}, \chi\}$ can be combined with a counterfactual set of spatial policies $\{t_{s|i,u}^g, x_{s|i,u}^g, \iota_i\}$ to solve for a counterfactual set of endogenous variables $\mathbf{V} = \{E_i, h_{i,u}, I_{s|i,u}^g, L_{i,u}^g, L_{s|i,u}^g, P_{i,u}, r_i, w_{i,u}^g, X_{i,u}, \lambda_{i,u}, \pi_{ij,u}\}$. For computational quickness, we split the loop into two components: An inner loop and an outer loop that updates labor force participation rates. In Algorithm 1, we use pseudo-code to highlight the workings of the inner loop. We update labor force participation rates in the outer loop with the model-consistent endogenous variables determined in the inner loop. Particularly, we solve for non-employment rates (Eq. (8)) and use this to restart the inner loop with new inputs.

Local and Global Maxima. In this counterfactual, we search for the fiscal policies that maximize overall welfare and evaluate their aggregate economic impact. We start from the initial equilibria determined by the random fiscal policy sets. Next, we derive and implement the policy instruments according to Proposition 2 in the main paper and solve for a counterfactual general equilibrium. Since the optimal policies depend on endogenous variables, we re-adjust them in each iteration after solving for new values of these variables. Conditional on exogenous economic characteristics, structural parameters, and initial policies, we find $N = 1,000$ local welfare maxima induced by implementing the optimal tax, transfer, and subsidy rules.

From the set of local maxima, we pick the one that leads to the largest increase in overall welfare relative to the *baseline* German economy in 2014, using empirically observable tax and transfer rates.

Algorithm 1: Numerical solution algorithm - Inner Loop

Given values for primitives $\{\bar{A}_i^g, B_{h|i,u}^g, H_i, \bar{Z}_{i,u}^g\}$, first guess for $\xi_{h|i,u}^g$ and model parameters $\{\alpha, \epsilon^g, \zeta^g, \eta^g, \theta^g, \kappa_{i,u}, \nu_u, \rho_h^g, \sigma, \tau_{ij,u}, \chi\}$, define a counterfactual set of spatial policies $\{t_{s|i,u}^g, x_{s|i,u}^g, \iota_i\}$ that solve for a set of endogenous variables $\mathbf{V} = \{E_i, h_{i,u}, I_{s|i,u}^g, L_{i,u}^g, L_{s|i,u}^g, P_{i,u}, r_i, w_{i,u}^g, X_{i,u}, \lambda_{i,u}, \pi_{ij,u}\}$

Set convergence parameter $\kappa \in (0,1)$

Set precision rule to govern deviation between guesses and model solution.

Set maximum number of iterations to *maxiter* and *count* $= 1$

Guess values of $P_{i,u}$ $w_{i,u}^g$ and $L_{i,u}^g$

while *count* $<$ *maxiter* **do**

  Solve for aggregate expenditures, $\sum_{j\in J} \pi_{ji,u} X_{j,u}$, from labour demand condition.

  Use aggregate expenditures to solve for expenditures on materials, $M_{i,uu'}$, and rents, $\{r_i h_{i,u}, r_i\}$, from their respective market clearing conditions

  Solve for $X_{i,u}$ by using final goods market clearing.

  Solve for $\lambda_{i,u}$ from the definition of unit costs.

  Solve for new trade shares π_{ij}, using updated unit costs.

  Then compute new values of initial (or updated) guesses:

  Compute $P_{i,u}^{new}$ from updated unit costs. Normalise aggregate price level in the economy to $\sum_{i\in J} P_i^{new} L_i / L \equiv \bar{P} = 1$

  Compute $L_{i,u}^{g,new}$ from labour supply condition and using updated prices.

  Compute $w_{i,u}^{g,new}$ from labour demand condition and using updated levels of employment.

  Check deviation between guesses and model solution

$$target1 = round(abs(w_{i,u}^g - w_{i,u}^{g,new}), precision)$$
$$target2 = round(abs(L_{i,u}^g - L_{i,u}^{g,new}), precision)$$
$$target3 = round(abs(P_{i,u} - P_{i,u}^{new}), precision)$$

  if $target1 == 0$ & $target2 == 0$ & $target3 == 0$ **then**

    break;

  else

    Update initial guesses or updated values of $P_{i,u}$ $w_{i,u}^g$ and $L_{i,u}^g$:

$$w_{i,u}^{g,up} = \kappa w_{i,u}^g + (1-\kappa) w_{i,u}^{g,new}$$
$$L_{i,u}^{g,up} = \kappa L_{i,u}^g + (1-\kappa) L_{i,u}^{g,new}$$
$$P_{i,u}^{up} = \kappa P_{i,u} + (1-\kappa) P_{i,u}^{new}$$

    Use updated values and re-iterate

$$w_{i,u}^g = w_{i,u}^{g,up}, L_{i,u}^g = L_{i,u}^{g,up}, P_{i,u} = P_{i,u}^{up}$$

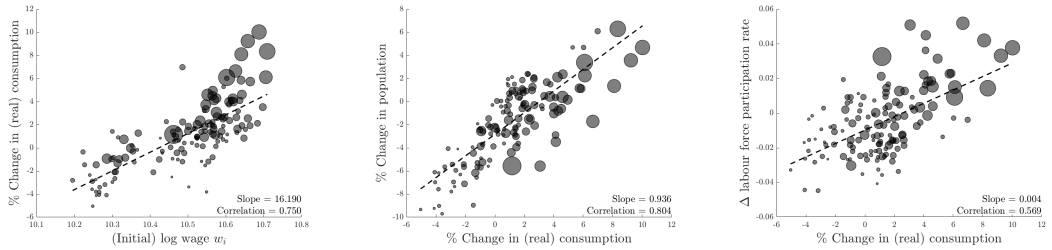
  Compute other endogenous variables (e.g. quantities) as needed.

Result: Equilibrium values of $\mathbf{V}$, given initial guess for $\xi_{h|i,u}^g$

D.3 Additional Counterfactual Results

Local Effects. Figure D.1 illustrates how optimized spatial policy affects different locations heterogeneously. Panel (a) reveals a positive relationship between local wages and increases in real consumption possibilities, with urban areas experiencing the largest gains. These consumption improvements generate two complementary effects: attracting workers from other regions (Panel b) and stimulating higher local labor force participation (Panel c). The latter effect operates through the mechanisms described in equation (8) in the

main paper, where reduced tax rates and enhanced public goods provision lower the opportunity cost of market employment. This participation response is particularly pronounced among female workers, due to their higher labor supply elasticities, thereby contributing significantly to the aggregate employment gains documented in the main text.



(a) Change in real consumption possibilities

(b) Population changes

(c) Changes in LFP rates

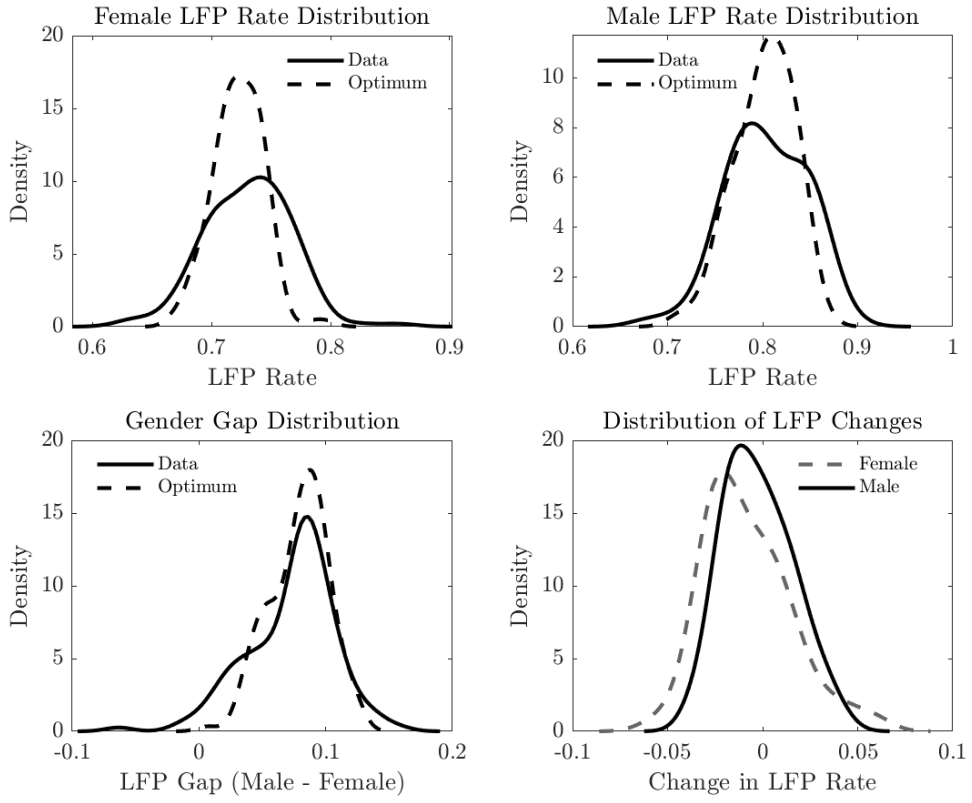
Figure D.1: Local Effects

Notes: This figure shows key local responses to optimized spatial policy. Panel (a) plots the change in real consumption possibilities (private + public goods) against local wages, demonstrating larger gains in high-wage locations. Panel (b) illustrates the resulting population changes, showing worker migration toward areas with improved consumption. Panel (c) displays changes in local labor force participation rates, which increase most in areas with the largest consumption improvements. Marker size is proportional to local labor market size in all panels. These patterns highlight the dual adjustment channels through which spatial policy affects local economies: worker reallocation across space and changes in employment rates within locations.

Spatial Distribution of Employment Effects Figure D.2 illustrates how the optimal policy reshapes regional labor force participation patterns. Female LFP rates (Panel a) become more concentrated under the optimal policy, with reduced regional variation. Male LFP rates (Panel b) also become more uniform, though the effect is less pronounced than for women. Panel (c) shows that while gender gaps persist, the optimal policy substantially narrows their regional variation, creating more consistent labor market conditions across Germany. Finally, Panel (d) reveals gender-specific responses to the policy changes, with some regions experiencing particularly strong increases in female labor force participation. This is consistent with our empirical finding that women show stronger employment responses to fiscal transfers.

Sectoral Dimension of Employment Effects. Our counterfactual analysis also reveals important sectoral dimensions within the market economy. Figure D.3 shows that under the optimal policy, female workers gain more employment in industries where women are traditionally underrepresented, such as Agriculture (+3.2%) and Wholesale/Retail (+2.8%), while seeing declining employment in Manufacturing (-1.7%). Male employment, by contrast, shows its largest gains in heavily female-dominated Service sectors (+1.4%) and declines in traditionally male sectors like Mining (-1.3%) and Manufacturing (-1.0%). This pattern suggests that optimized spatial policy reduces gender-based occu-

Figure D.2: Distribution: Baseline vs. Optimal Policy



Notes: This figure compares labor force participation (LFP) distributions under the baseline scenario and optimal spatial policy. Panel (a) shows kernel density estimates of female LFP rates across regions. Panel (b) presents the distribution of male LFP rates. Panel (c) displays the gender gap distribution (male minus female employment rates) under each scenario. Panel (d) illustrates the distribution of changes in LFP rates from baseline to optimal policy for both genders. All panels use kernel density estimation to visualize the full distribution of outcomes across labor markets in Germany.

pational segregation, facilitating female entry into previously male-dominated fields while encouraging male employment in service sectors.

Optimal Transfers and Redistribution. In Figure D.4, we compare the optimized level of redistribution across different versions of our framework. Panel (a) underscores that even in a model with full employment ("No LFP", $\epsilon^g \to \infty$), a social planner would redistribute fewer funds into low-wage locations compared to the observed transfer system given current labor market conditions and size of net externalities.

Yet, the correlation between net fiscal transfers and wages is stronger in this full-employment model version than in our general framework (Panel b), as indicated by the larger slope coefficient. This relates to the fact that local differences in LFP impact the size and distribution of spatial externalities. For the German parametrization, we find that labor supply fiscal externalities are positive in all locations, but smaller in places with a

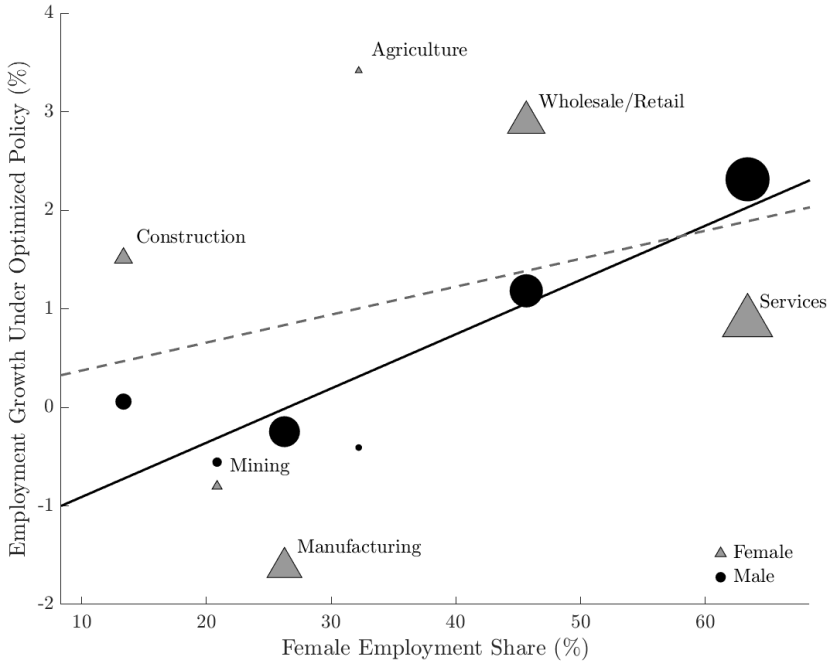


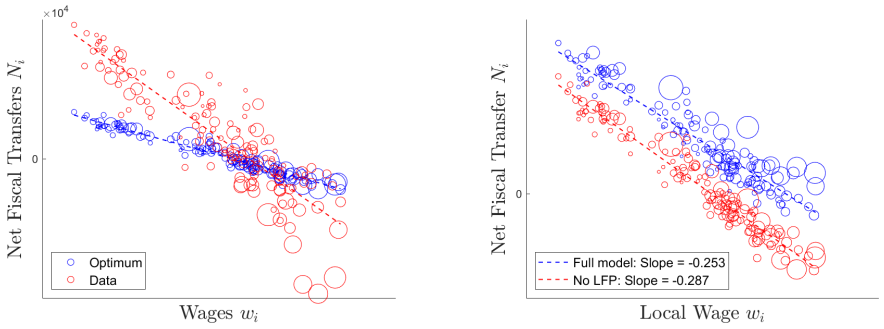
Figure D.3: Sectoral Employment Growth by Gender Under Optimized Policy

Notes: This figure shows the relationship between initial female employment share and employment growth under optimized spatial policy across economic sectors. Each point represents a sector, with point size proportional to total sector employment. Red points show female employment growth, while blue points show male employment growth. Dashed lines represent linear trends. The figure reveals that female employment gains are largest in sectors with lower initial female representation (Agriculture, Wholesale/Retail, Construction), while male employment grows most in female-dominated sectors (Services). This pattern suggests that optimal spatial policy reduces gender-based occupational segregation across sectors.

large share of workers in the market sector (Panel (a) of Figure D.5), which is in line with our theoretical discussions in Section 3.7. At the same time, agglomeration economies are higher in these places, so overall net spatial externalities are higher in places with higher labor force participation, making the efficiency channel of redistribution larger in places with high market attachment. Since wages and LFP rates are furthermore positively correlated across German labor markets, the planner redistributes even fewer funds once we account for the LFP channel. Abstracting from the LFP channel, one would, therefore, overestimate the optimal level of redistribution in Germany.

Sensitivity to Gender-specific Labor Supply Elasticities. We document sizable effects of implementing optimized spatial policies. The size of these effects is governed by gender-specific responses to fiscal policy.

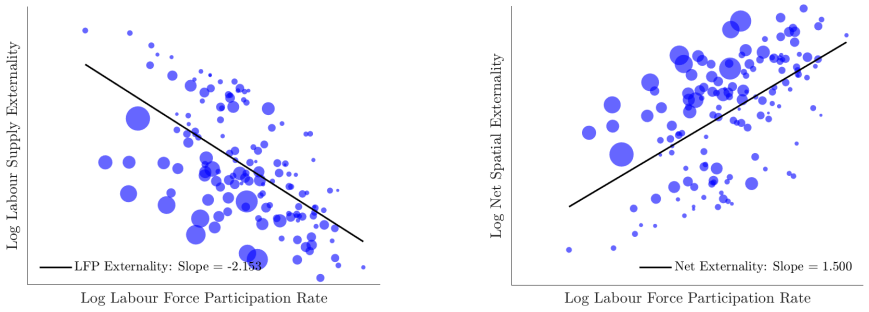
In Figure D.6, we explore the sensitivity of our counterfactual results to the gender-specific magnitude of labor supply elasticities. While the female elasticity is 50 % larger in our preferred parametrization (see Section 4), we also consider alternative values in this sensitivity analysis and highlight the aggregate implications. Starting from homogeneous



(a) Redistribution ("No LFP") (b) LFP vs No LFP

Figure D.4: Optimized Redistribution - Impact of LFP channel

Notes: Panel (a) of this Figure displays net fiscal transfers (see Definition 1) against local wages for two different scenarios: (i) optimized policy instruments when abstracting from the LFP channel ($\epsilon^g \to \infty$) and (ii) observed German public finance system in 2014 ("Data"). Panel (b) plots optimized net fiscal transfers (i) in our full model and (ii) in the "No LFP" scenario. The size of the marker is proportional to local labor market size.



(a) Redistribution ("No LFP") (b) LFP vs No LFP

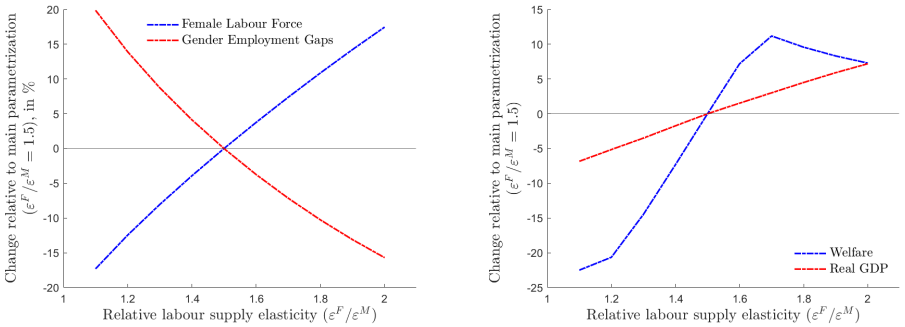
Figure D.5: Impact of LFP on net externalities

Notes: Panel (a) of this Figure displays labor supply externalities against local labor force participation rates, while Panel (b) plots the net spatial externalities (agglomeration externalities + labor supply externalities) against labor force participation rates. Note that congestion externalities do not directly depend on LFP rates. The size of the marker is proportional to local labor market size.

labor supply elasticities across workers of different genders ($\varepsilon^F/\varepsilon^M = 1$), we incrementally increase the gender-specific heterogeneity in employment responses to fiscal policy. We calculate the impact of an optimized spatial policy under different specifications by plotting four aggregate variables (female labor force, gender employment gaps, real GDP, and welfare) across heterogeneous values of labor supply elasticities. We normalize results relative to their impact in our most preferred parametrization ($\varepsilon^F/\varepsilon^M = 1.5$) and plot their (percentage) deviations.

Female employment growth is larger when the labor supply elasticity is larger, and thus the heterogeneity in responses to spatial policy is greater. This is also reflected in a

greater decrease in the employment gap. Indeed, if female elasticities were almost twice those of males, optimized spatial policies could close gaps in most places altogether. A large increase in the female labor force would also translate into higher growth in real GDP (Panel (b)). This also holds for changes in overall welfare, even though there are striking non-linearities with regard to the impact of ϵ. While welfare increases with the size of the economy, higher female labor force participation also affects congestion and selection into the home market sector. The latter two effects attenuate the impact of the former and give rise to the observable non-linearities.



(a) Female labor Force and Gender Gaps (b) Real GDP and Welfare

Figure D.6: Optimized Redistribution - Sensitivity to gender-specific labor supply elasticities

Notes: This Figure displays the differential impact of implementing optimized spatial policy for four variables (female labor force, gender employment gap, real GDP and welfare) and different values of the labor supply elasticity μ^g. All variable values are calculated as changes relative to our main parametrization, where $\mu^F/\mu^M = 1.5$ (see Section 4 in the main paper). The x-axis plots the relative difference in labor supply elasticities across workers of both genders. Panel (a) shows the changes in the (female) labor force (in %) and the shift in employment gaps in percentage points. Panel (b) plots percentage changes in real GDP and welfare.

References

Ahlfeldt, Gabriel M., Fabian Bald, Duncan Roth, and Tobias Seidel, "Quality of Life in a Dynamic Spatial Model," *CESifo Working Papers*, 2020, *8767.*

Bargain, Olivier and Andreas Peichl, "Own-wage labor supply elasticities: variation across time and estimation methods," *IZA Journal of Labor Economics*, 2016, *5* (1), 10.

Bilal, Adrien, "The Geography of Unemployment," *The Quarterly Journal of Economics*, 2023, *138* (3), 1507–1576.

Diamond, Rebecca, "The determinants and welfare implications of US Workers' diverging location choices by skill: 1980-2000," *American Economic Review*, 2016, *106* (3), 479–524.

Fajgelbaum, Pablo D., Eduardo Morales, Juan Carlos Suárez Serrato, and Owen Zidar, "State Taxes and Spatial Misallocation," *Review of Economic Studies*, 2019, *86* (1), 333–376.

Head, Keith and Thierry Mayer, "Gravity Equations: Workhorse,Toolkit, and Cookbook," in Gina Gopinath, Elhanan Helpman, and Kenneth Rogoff, eds., *Handbook of International Economics*, Vol. 4 2014, chapter 3, pp. 131–195.

Helm, Ines and Jan Stuhler, "The Dynamic Response of Municipal Budgets to Revenue Shocks," *American Economic Journal: Applied Economics*, 2024, *16* (4), 484–527.

Henkel, Marcel, Tobias Seidel, and Jens Suedekum, "Fiscal Transfers in the Spatial Economy," *American Economic Journal: Economic Policy*, 2021, *13* (4), 433–468.

Kline, Patrick and Enrico Moretti, "Place Based Policies with Unemployment," *American Economic Review*, 2013, *103* (3), 238–43.

Olivetti, Claudia and Barbara Petrongolo, "Gender Gaps across Countries and Skills: Demand, Supply and the Industry Structure," *Review of Economic Dynamics*, 2014, *17* (4), 842–859.

Sant'Anna, Pedro H.C. and Jun Zhao, "Doubly robust difference-in-differences estimators," *Journal of Econometrics*, 2020, *219* (1), 101–122.

Schmutz, Benoît and Modibo Sidibé, "Frictional Labour Mobility ," *The Review of Economic Studies*, 2019, *86* (4), 1779–1826.

Stein, Michael, "Large Sample Properties of Simulations Using Latin Hypercube Sampling," *Technometrics*, 5 1987, *29* (2), 143–151.

Tiebout, Charles M., "A Pure Theory of Local Expenditures," *Journal of Political Economy*, 1956, *64* (5), 416–424.

Timmer, Marcel P., Erik Dietzenbacher, Bart Los, Robert Stehrer, and Gaaitzen J. de Vries, "An Illustrated User Guide to the World Input-Output Database: The Case of Global Automotive Production," *Review of International Economics*, 8 2015, *23* (3), 575–605.