Universities in Space

Aleksandr Gevorkian[*,†,‡] Christoph Hedtrich[‡]

UCLA Anderson University of Edinburgh

Job Market Paper

November 14th, 2026

Click here for the latest version

Abstract

Countries around the world have debated whether college expansion – often seen as a form of place-based policy – should target less or more favored regions. This paper studies how the supply of higher education shapes the spatial distribution of economic activity and aggregate income. We develop a dynamic spatial general equilibrium model in which universities embody a technology for human capital accumulation and provide access to local labor markets. We quantify the framework using rich administrative and open-source data from Sweden, a country that underwent a large spatial expansion of colleges in the late 1970s. Empirically, we find that programs in dense and productive metro areas have worse quality fundamentals, which are partly offset by better peer composition due to sorting. In model-based counterfactuals, reallocating college supply to expand geographic access reduces total output. In selective fields of study, college attendance and expected earnings rise among lower- and middle-ability students near expanding campuses. We also find that concentrating educational opportunities in highly productive metro areas can raise overall college attainment while reducing aggregate human capital.

[*]I am indebted to Pablo Fajgelbaum for his continuous encouragement. I also thank Hugo Hopenhayn, Jon Vogel, Nico Voigtländer, and Romain Wacziarg for their advice and support. I especially thank Levi Crews for his insights. I thank Simon Fuchs for discussing the paper at the 20th North American Meeting of the Urban Economics Association. This research benefited from financial support from the Center for Global Management at UCLA Anderson. All errors are my own. Contact: aleksandr.gevorkian.phd@anderson.ucla.edu.

[†]Visiting Researcher, Uppsala University.

[‡]This work uses confidential microdata from Statistics Sweden (SCB), accessed through the MONA system and Uppsala University. The views expressed are the authors' own and do not necessarily reflect those of Statistics Sweden.

1 Introduction

Human capital accounts for a large share of cross-country income differences, and location determines the opportunities to acquire it. Geography matters for access to education and jobs, and for higher education, access partly depends on the spatial distribution of universities. Countries around the world have been debating the extent to which university expansion – often seen as a form of place-based policy – should target less or more favored regions. Recent examples of increased supply in the periphery include the U.S. junior-college expansion in the 1920s (Bleemer and Quincy, 2026).[1] Local provision is oftentimes coupled with people-based educational policies and admission practices that explicitly favor local applicants.[2]

Designing a university system involves trade-offs. Bringing universities to peripheral areas may expand the local supply of skill and promote development, at the cost of losing benefits from concentrating talent elsewhere. First, if mobility is costly for the young, university location has an important effect on individual decisions about whether and where to study. If there are frictions to moving after graduation, returns to a degree partly reflect the campus's access to high-wage regions. Second, universities contribute to human capital formation by bringing students together. How much students learn depends on their own ability and on whom they learn from. Whether this generates a trade-off between broader access and aggregate output depends on the technology of human capital formation and mobility frictions across different stages of the life cycle.

Given this trade-off, this paper studies the role of the supply of higher education in shaping the spatial distribution of economic activity and aggregate income. We develop a dynamic spatial equilibrium framework where universities produce an educational service whose quality is shaped by program characteristics and peer composition. That quality in turn determines how much human capital a student of given ability acquires and brings to the labor market. We estimate the model using rich administrative and hand-collected data from Sweden – a country that recently underwent a large spatial expansion of colleges – where we can track individuals from their home regions through college and into labor markets. Using the framework, we evaluate the aggregate and distributional consequences of alternative allocations of college seats and assess the effectiveness of people-based educational policies.

In the model, universities jointly provide education and access to field-specific labor markets. Both benefits are local due to gravity costs, and the returns to education are endogenous due to peer effects. We embed these forces in an overlapping-generations spatial equilibrium framework, where individuals of heterogeneous ability and parental wealth sort across space into college,

[1] France's Université 2000 plan expanded provision in the 1990s (Nimier-David, 2023). Sweden's 1977 reform established regional colleges (SOU, 2007). Between 2007 and 2015, Argentina established sixteen new national universities in peripheral regions, with explicit objectives to widen access and boost local economic activity (Secretaría de Educación, 2024; Argentina, 2009). In 1988, the UC Regents approved a San Joaquin Valley campus, subsequently sited at Merced, to enhance access in a traditionally underserved region (UC Merced, 2003).

[2] In 2018, oversubscribed Paris university programs favored local applicants (Fabre, 2026, p. 16). In 2017, the University of California adopted an 18% cap on nonresident undergraduate enrollment at five campuses (University of California, 2017). North Carolina, Florida, and UT Austin also restrict nonresident enrollment (UNC System, 2026; Florida Board of Governors, 2025; UT Austin, 2016).

accumulate skills and savings, and then sort into labor markets, where a new generation inherits part of the accumulated skills and assets. College programs vary in quality and have limited seats, and ability-based admission thresholds adjust to clear the market for higher education. Reallocating capacity changes admission cutoffs and access to programs, with further effects on learning through student composition. In steady state, the spatial distribution of population, skills, admission rates, college attendance, and human capital accumulation is endogenously determined as a function of the spatial distribution of colleges.

The two main takeaways from the paper are as follows. First, empirically we show that, in Sweden, local productivity, peer composition, and program characteristics have different geographies: programs in dense and productive labor markets have worse fundamentals but enroll students whose composition is beneficial for the learning of everyone attending. Second, in model-based counterfactuals we find that reallocating supply toward underserved regions in Sweden lowers aggregate output. This is mostly due to a reduction in the total human capital produced in the donor programs. The losses are both on the extensive margin – enrollment in productive metro areas shrinks more than it expands in the periphery – and on the intensive margin: in the presence of peer effects and complementarities between own ability and overall college quality, human capital accumulation falls. Imperfect mobility – a strong feature of the data that we estimate – pulls students at these expanding campuses towards unproductive local markets, exacerbating losses even further. Nevertheless, lower- and middle-ability students near expanding campuses gain college access and expected earnings. We also assess the effects of an alternative supply of college opportunities, where seats are instead concentrated in productive labor markets, and contrast these effects with those of people-based educational subsidies.

To demonstrate the implications of the geography of colleges for welfare, we use a simplified version of the quantitative framework, under a parameterization consistent with our estimates. First, imperfect mobility at both stages jointly determines the extensive margin of college attainment: if campuses are far from productive centers, or mobility is relatively more costly for the young, students at the periphery may not pursue higher education. If moving after school and after college is costly, a utilitarian planner brings educational opportunities closer to the productive center (CBD). Similarly, when the young are relatively mobile, it is optimal to locate the university close to the CBD, and squarely in the CBD under perfect mobility when young. Changes in attendance also alter composition and therefore learning spillovers. The planner can raise welfare by moving the campus toward the productive center even though some low-ability students cease to attend: improved peer quality and workplace productivity outweigh the participation loss. A further increase in student moving costs can instead induce an outward jump that expands attendance and raises quality. The optimal location hence need not vary monotonically with student moving costs, and learning spillovers can generate discontinuous changes in policy.

In Section 2, we present the quantitative framework. The model embeds sequential discrete choices of college attendance and post-college labor market location into a dynamic spatial general equilibrium setup. The economy consists of regions populated by overlapping

generations of dynasties. High-school graduates differ in ability, parental wealth, and home region, and make forward-looking decisions about whether to attend college, which colleges and fields to choose, and how much to save, subject to mobility costs. These forward-looking decisions incorporate, in expectation, the later choice of where to work after graduation. Crucially, for the young, their choice sets vary with individual ability and are pinned down by ability-based admission cutoffs that adjust in equilibrium to clear the market for university seats. Human capital accumulation depends jointly on students' own ability and program quality, which itself is shaped by the composition of students due to peer effects. Graduates then choose among regions that differ in productivity and field-specific labor demand, subject to mobility frictions. Across generations, parents leave bequests to children who grow up where their parents work, and parents' human capital shapes the ability of their offspring. The geography of higher education thus shapes both the current allocation of talent and the resources and opportunities inherited by subsequent cohorts.

In Section 3, we describe our environment and data. Sweden is a particularly well-suited context for three reasons. First, the supply of university program seats is set at the national level by the central government rather than by local authorities. Second, higher education is tuition-free for domestic students, so prices do not ration seats while local housing costs shape access. Third, successive reorganizations and expansions have extended college supply beyond the historical university sites. The 1977 Higher Education Reform established twelve regional colleges across sixteen municipalities, including three former university branches (SOU, 2007; Bergh et al., 2024). Substantial enrollment growth followed in the late 1980s and 1990s: enrollment nearly doubled between 1985 and 1998, with more than half of the increase at newer institutions (Andersson et al., 2004). Our baseline sample covers high-school cohorts from 2000 to 2010 and their choices of fields of study at 41 universities.

In Section 4, we discuss quantification. We first estimate program-cohort value added from earnings differences within field-region-year cells, allowing returns to quality to vary with ability. Identification rests on selection on observables and the assumption that, within a field, the human-capital gain from program quality is independent of the local labor market in which graduates work. We then estimate the learning technology. We identify the strength and curvature of peer effects from variation in enrolled students' ability distributions, controlling for permanent university and field differences and common cohort effects. Our identifying assumption is that, given these controls, unobserved institutional-quality differences are mean-independent of peer composition. Our findings reject a model with mean peer effects and instead imply that learning responds more strongly to proportional changes in the ability of weaker peers than to the same changes among stronger peers. That is, holding program characteristics and mean student ability fixed, program quality is lower when student ability is more dispersed. We also find complementarities, albeit mild, between students' own ability and the overall composite quality of college programs.

Together, our estimates suggest that, in Sweden, college attainment and college quality are distributed differently across space. Specifically, the productive, densely populated metropolitan

areas of Stockholm, Göteborg, and Malmö–Lund account for 55–80% of students in selective fields. Program quality follows the opposite pattern: within a field, the programs that add the most to a given student's earnings tend to be located in smaller, less productive labor markets. However, this pattern reflects permanent differences across universities rather than sorting. In selective fields such as Engineering and ICT, student composition favors programs located in dense metropolitan areas and offsets part of the permanent gap. Overall, holding workplace fixed, moving from the 10th to the 90th percentile of composite program quality raises predicted earnings by about 26% for a student of median ability.

We use our individual data on college and workplace choices to estimate migration frictions and taste heterogeneity, allowing both to vary across stages of the life cycle. Using variation in choices by ability, parental resources, and location, we identify sensitivity to differences in program quality and to differences in labor-market returns. We find evidence of gravity in post-college migration and a home bias toward the home region. Using a standard inversion argument, we recover local productivity shifters that vary at the field-region-sector level. We also estimate the CES elasticity of substitution across fields and use links between children and their parental households to inform ability transmission across generations.

We then embed the previous estimates into the general equilibrium framework, which endogenously determines the joint distribution of population, skills, and employment by field. Starting from the 2005 baseline, we conduct separate reallocations in Engineering, Business and Economics, and Law. We transfer seats from programs outside the three highest-productivity regions to existing programs there, keeping national capacity fixed in every field. We then solve for new stationary equilibria, allowing admission cutoffs, peer quality, wages, rents, and the distribution of ability, resources, and population to adjust.

First, a pure redistribution of seats toward productive labor markets can increase college attainment while decreasing human capital and aggregate output. These responses highlight the role of the spatial *distribution* of college supply beyond its aggregate capacity. The decline in human capital reflects differences in program fundamentals, changes in enrollment, and adjustments in student composition. In Engineering, the closing programs have stronger permanent learning fundamentals than the expanding programs. Lower admission cutoffs at recipients also weaken peer quality, reducing the human capital accumulated by students who would attend under either allocation. Holding peers fixed reduces the Engineering tradable-output loss from 0.98 to 0.60 percent.

Even when aggregate college attainment changes little, the policy substantially redistributes educational opportunities across home regions. In Engineering, attendance rises in the recipient metros and falls in the northeast, regardless of where students attend. Imperfect mobility links the earnings premium from attending a particular college to labor demand for graduates in nearby labor markets. Campus labor markets attract their graduates, raising recipients' share of aggregate college human capital by 1.21 percentage points. Removing the campus-to-workplace moving cost reduces this increase to 0.11 percentage points and slightly increases the tradable-output loss. Moving frictions help retain graduates near the productive labor markets to which

seats are reallocated, while also affecting their educational choices.

The distributional effects differ across ability groups, home regions, and fields of study. In Engineering, lower- and middle-ability students near expanding campuses gain attendance and expected earnings as lower admission cutoffs open programs previously unavailable to them. High-ability students gain less from relaxed cutoffs and can lose from weaker peer quality; those in the far northeast lose both attendance and earnings as nearby programs close. Comparisons across fields jointly depend on initial program quality and labor demand, not least the tradability of field services. In Business and Economics, high-ability students in the far northeast gain earnings despite lower attendance, unlike their counterparts in Engineering and Law.

In the increased-access counterfactual, we reallocate the same number of seats toward existing campuses in regions with relatively few seats compared with the number of nearby high-school graduates without a college degree. This brings college opportunities closer to students but shifts college supply toward less productive labor markets. Aggregate output again falls. College attainment falls in Engineering and Business and Economics, as recipients do not fill enough additional seats to replace enrollment lost elsewhere, while remaining essentially unchanged in Law. Compared with concentration, Engineering produces fewer graduates but more human capital per graduate, leaving a smaller loss of human capital in the field. In Business and Economics, the larger enrollment decline instead leads to a greater human-capital loss.

Relation to the literature. We contribute to an expanding literature that studies how human capital accumulation shapes the spatial distribution of economic activity (Bilal and Rossi-Hansberg, 2021; Eckert and Kleineberg, 2024; Aguilar, 2026; Desmet et al., 2026; Fogli et al., 2026). The role of local spillovers in knowledge accumulation and diffusion has long been recognized (Davis and Dingel, 2019), but only recently has quantitative work examined their implications for aggregate outcomes and growth (Desmet and Rossi-Hansberg, 2014; Desmet et al., 2018). In particular, Crews (2023) and Lhuillier (2026) study how cities and their skill composition affect learning and, through it, aggregate human capital and productivity. Crews (2023) argues that in the case of the U.S., spatial policies that further concentrate skilled workers in large cities raise growth. Our paper focuses specifically on universities as a means of skill acquisition. In this respect, it is closest to contemporaneous work by Wright (2025). The latter explores the implications of decentralization and market power in the U.S. state college system. Our paper instead examines how the geographic supply of higher education shapes the long-run distribution of population and skills, as well as the resulting inequality. We endogenize the joint distribution of ability, wealth, and origin, making universities and educational policies consequential across generations. We also identify and estimate a generalized learning technology directly from individual earnings and variation in peer composition, allowing the data to determine how ability interacts with university quality and how different parts of the peer-ability distribution contribute to human capital formation. We introduce field-specific labor demand that varies across regions and between tradable and nontradable activities, allowing the returns to education and the effects of reallocating the geographic supply of university seats to depend on the tradability of graduates' occupational services.

Second, we also contribute to the literature on higher education and intergenerational mobility (Chetty et al., 2020; Capelle and Matsuda, 2026). We complement this work by making college-field choices forward-looking with respect to subsequent workplace opportunities, allowing university geography to affect the ability and resources that the next generation inherits.

Third, we contribute to the literature that evaluates the aggregate and distributional effects of education policies in general equilibrium (Abbott et al., 2019; Alon et al., 2024; Akcigit et al., 2025; Fujimoto et al., 2025; Daruich, 2026; Smeets et al., 2026). This work spans all the stages of education, from early childhood development programs (Daruich, 2026) and free secondary schooling (Fujimoto et al., 2025) to college financial aid and student-debt relief (Abbott et al., 2019; Alon et al., 2024) and subsidies for postgraduate education that shape the supply of innovative talent (Akcigit et al., 2025). Unlike these studies, we assess how people-based education policies affect the spatial distribution of economic activity. A noteworthy contemporaneous work is Smeets et al. (2026), which nests the choice of field of study within a broader labor supply framework. Its focus is on how educational policy shapes the aggregate economy's response to shocks that alter the relative values of fields of study. We augment their environment with college choice over universities and fields of study and field-specific labor demand that varies across local labor markets and between tradables and nontradables. We also incorporate institutional quality and family background, which shape equilibrium sorting into college programs. In doing so, we complement the literature on the role of colleges for intergenerational mobility (Chetty et al., 2020; Capelle and Matsuda, 2026).

Fourth, we contribute to the growing literature on college value added and on the role of peers in higher education. For the former, the closest work is by Mountjoy and Hickman (2021), who estimate the value added of Texas public universities by comparing students within the same admission portfolios, and Mountjoy (2026), who uses admission cutoffs at these universities to measure the private and social returns to enrolling marginal applicants. Our empirical approach also uncovers credible university-field-specific measures of quality for the universe of programs in a tuition-free national system, where admission is driven by academic achievement. Relative to these papers, we provide a model-based framework for measuring the components of returns to higher education. On peers, existing research on higher education typically studies a single program, major, or school (Booij et al., 2017; Feld and Zölitz, 2017; Bianchi, 2020; Golsteyn et al., 2021; Fischer et al., 2025; Isphording et al., 2026; Hampole et al., 2026). Most of these papers measure effects on grades and other academic outcomes; exceptions that examine labor-market income or career trajectories include Bianchi (2020), Fischer et al. (2025), and Hampole et al. (2026). To our knowledge, we are the first to estimate generalized peer effects in the context of the higher education premium, drawing on variation across universities and the full range of fields of study. Our specification allows peer composition to matter beyond its mean and variance, letting the data determine which parts of the ability distribution contribute most to earnings.

Finally, we extend the literature on trade in services (Eilat and Einav, 2004; Lipsey, 2009;

Eaton and Kortum, 2019; Muñoz, 2022) to higher education. Closest in spirit is the work of Dingel et al. (2026), who study how regional scale economies and patient travel shape access to medical services under administered prices. Their benchmark model features returns to scale external to individual providers; they estimate these scale effects and compare subsidies to local production with subsidies to patient travel. Two features distinguish our setting from their framework. First, instead of scale effects, we quantify the compositional spillovers that determine service quality. Second, consumption changes the evolution of individuals' states through human capital accumulation and affects the ability and resources of the next generation. These effects require a dynamic spatial framework, which this paper develops.

The remainder of the paper is organized as follows. Section 2 presents the model and discusses its implications. Section 3 describes our context, the Swedish institutional setting, and the data. Section 4 explains the quantification. Section 5 presents the policy counterfactuals. The final section concludes.

2 Theoretical Framework

2.1 Model

In this section, we develop a dynamic spatial equilibrium model with overlapping generations and human capital accumulation. Time subscripts denote calendar dates; cohort t enters the economy when young at date t.

The economy consists of a finite set of regions $\mathcal{N}$, with $N \equiv |\mathcal{N}|$ elements. We use r when referring to a young agent's home region and n when referring to an old agent's workplace region, but both belong to the same set $\mathcal{N}$. Time is discrete and runs forever: $t = 0, 1, 2, \ldots$. An individual lives for two periods, young at t and old at $t+1$; hence, at every date t, the young cohort t coexists with the old cohort $t-1$. Each region produces a differentiated tradable variety and a local nontradable service. Regional tradable varieties are assembled à la Armington into a freely traded final good, whose price is the numeraire. Each region additionally supplies dwelling services through separate young and old housing markets. Individuals cannot write debt contracts with each other, but can borrow from or lend to the rest of the world at the exogenous risk-free gross return R from t to $t+1$.

Colleges. A college option is a university-field pair $k = (u, f) \in \mathcal{K} \subseteq \mathcal{U} \times \mathcal{F}$, where $\mathcal{U}$ is the set of universities, $\mathcal{F}$ the set of fields, and $\mathcal{K}$ the set of programs offered; $u(k)$ and $f(k)$ denote the two components. Not attending college is the outside option $k = 0$, available to everyone, with the convention $f(0) = 0$: non-college labor is "field 0". Each university is endowed with a campus, which we model as a location $\ell(u) \in \mathcal{N}$; several universities may share a location. We write $\ell(k) \equiv \ell(u(k))$ and set $\ell(0) \equiv r$ for a young agent from home region r who does not attend college.

Prices and wages. Every price is a lowercase p carrying a superscript for the market and a subscript for the location: p_n^{T} is the price of region n's tradable variety, p_n^{NT} the price of its local

services, $p_n^{\mathbf{o}}$ the price of old housing, and $p_n^{\mathbf{y}}$ the price of young housing in region n. Wages per efficiency unit of labor are $\bar{w}_{fn}$ for $f \in \mathcal{F} \cup \{0\}$, so that $\bar{w}_{0n}$ is the non-college wage in region n.

Consumption. The old consume the tradable good, local services, and housing; the young consume the tradable good and housing only. We write $c^{\mathbf{y}}$ and $d^{\mathbf{y}}$ for the young bundle, $\mathbf{c^o} \equiv (c_{\mathrm{T}}^{\mathbf{o}}, c_{\mathrm{NT}}^{\mathbf{o}})$ and $d^{\mathbf{o}}$ for the old one, and collect the Cobb-Douglas price indices implied by the preferences below in

$$\Pi_\ell^{\mathbf{y}} \equiv \left(p_\ell^{\mathbf{y}}\right)^{1-\alpha_{\mathbf{y}}}, \qquad \Pi_n^{\mathbf{o}} \equiv \left(p_n^{\mathrm{NT}}\right)^{\alpha_{\mathbf{o}}(1-\gamma)} \left(p_n^{\mathbf{o}}\right)^{1-\alpha_{\mathbf{o}}},$$

where $\alpha_{\mathbf{y}}, \alpha_{\mathbf{o}} \in (0,1)$ are the nonhousing expenditure shares when young and when old (for the young, this is the tradable share), and $\gamma \in (0,1)$ is the tradable share within the old's nonhousing consumption, the remainder falling on local services. The price p_n^{NT} is the shadow resource price of the local service bundle, which includes individually consumed services whether purchased directly or provided in kind.

Since students consume no local services, the only price they face while in college is the young housing rent $p_\ell^{\mathbf{y}}$ in the campus region.

2.1.1 Dynasties: Timing and Choices

In each period t and each region r, a mass $N_{r,t}$ of young individuals enters the economy with state vector (z, a, r), where z is high-school ability and $a \in \mathbf{R}_+$ is the parental transfer interpreted as initial wealth. Ability has fixed population support $\mathcal{Z} = [z_{\min}, z_{\max}]$, with $0 \leq z_{\min} < z_{\max} < \infty$. We refer to r as the *home region* or *high-school location* and use the two terms interchangeably. Conditional on residing in region r, the joint CDF of (z, a) is denoted by $F_{r,t}(z, a)$; when time subscripts are suppressed, we write F_r.

At date t, the old cohort $t-1$ enters with education, human capital and saving determined at $t-1$. Its workplace choices and transfers determine the home regions and initial wealth of the young cohort t. The latter takes its own state as given when choosing education and saving. The lifetime sequence for a member of cohort t is:

(i) at t, a young agent with state (z, a, r) draws college-specific preference shocks ϵ_k and decides whether to stay unskilled ($k = 0$) or attend a program k from the eligibility set $\mathcal{K}_t(z)$. She also chooses consumption of the tradable final good $c_t^{\mathbf{y}}$, young housing services $d_t^{\mathbf{y}}$, and a risk-free asset position b_t;

(ii) attendance at t generates human capital $h_t(z, k)$ from that cohort's program quality q_{kt};

(iii) at $t+1$, while still in the region of her college, the now-old agent draws workplace preference shocks ϵ_n and chooses a region $n \in \mathcal{N}$ in which to supply human capital. She consumes the tradable final good, local nontradable services and old housing, and leaves a transfer a'_{t+1} out of income $Rb_t + \bar{w}_{f(k)n,t+1} h_t(z, k)$;

(iv) her child enters the young cohort $t+1$ in region n, with ability $z' \sim G(\cdot \mid h_t(z, k))$ and

initial wealth a'_{t+1}.

Under full-information rational expectations, the young correctly anticipate the prices they face when old.

2.1.2 Problem of the Young

We now elaborate on the problem of the young. Young households at date t choose among the programs available to them, $\mathcal{K}_t(z) \subseteq \mathcal{K} \cup \{0\}$. This choice set depends on how a student's high-school ability z ranks against that of other applicants: she is eligible for program k only if z clears its admission cutoff $\bar{z}_{kt}$, which, as we show in Section 2.1.4, is itself an equilibrium object. The choice set is therefore individual-specific but always nonempty: not attending college, $k = 0$, is available to everyone as an outside option.

Let ϵ_k be an idiosyncratic preference shock for option k, i.i.d. across options and individuals with scale $\sigma^{\mathbf{y}}$. The young observe their preference shocks before choosing. They are forward-looking and take as given the old-age continuation value $V^{\mathbf{o}}_{t+1}(h, b, k, r)$, characterized below, which depends on the human capital h acquired at k, the asset position b, the chosen option k, and the home region r. Throughout the household problems we fix the young state (z, a, r) and, once an object has been introduced with its full argument list, suppress the arguments that are held fixed. For each option k, write $h_{kt} \equiv h_t(z, k)$ for the human capital it delivers (specified below) and, for a given asset choice b,

$$
\begin{aligned}
I_{kn,t+1}(b) &\equiv I_{n,t+1}(h_{kt}, b, k) = R\, b + \bar{w}_{f(k)n,t+1}\, h_{kt}, \\
\mu^{\mathbf{o}}_{kn,t+1}(b) &\equiv \mu^{\mathbf{o}}_{t+1}(n \mid h_{kt}, b, k, r), \\
V^{\mathbf{o}}_{k,t+1}(b) &\equiv V^{\mathbf{o}}_{t+1}(h_{kt}, b, k, r),
\end{aligned}
$$

for income, workplace choice and continuation value at $t+1$. Young households face housing prices at t and anticipate old-age wages and prices at $t+1$. A young agent solves

$$
V^{\mathbf{y}}_t(z, a, r) = \mathbb{E}_{\epsilon}\Big[\max_{k \in \mathcal{K}_t(z)} \big\{ v^{\mathbf{y}}_{k,t} + \sigma^{\mathbf{y}} \epsilon_k \big\}\Big],
$$

where the option-specific value $v^{\mathbf{y}}_{k,t} \equiv v^{\mathbf{y}}_t(k;\, z, a, r)$ is

$$
v^{\mathbf{y}}_{k,t} \equiv \max_{c^{\mathbf{y}},\, d^{\mathbf{y}},\, b} \left\{ \log \frac{A^{\mathbf{y}}_k}{\tau^{\mathbf{y}}_{rk}} + \alpha_{\mathbf{y}} \log c^{\mathbf{y}} + (1 - \alpha_{\mathbf{y}}) \log d^{\mathbf{y}} + V^{\mathbf{o}}_{k,t+1}(b) \right\}
$$

subject to the budget constraint

$$
c^{\mathbf{y}} + p^{\mathbf{y}}_{\ell(k),t}\, d^{\mathbf{y}} + b \le a, \qquad b \in \mathcal{B}_{kt} \equiv \big\{ b < a :\ I_{kn,t+1}(b) > 0 \text{ for all } n \in \mathcal{N} \big\}.
$$

The amenity $A^{\mathbf{y}}_k > 0$ captures characteristics of option k that are common across students (e.g., quality of campus life, offered amenities); it shifts college demand but does not affect human

capital acquisition. The friction $\tau^{\mathbf{y}}_{rk} \geq 1$ is denominated in utility terms and depends on k only through the campus location $\ell(k)$. Note that even though universities are tuition-free, attending college incurs a flow cost of housing services while enrolled, $p^{\mathbf{y}}_{\ell(k),t} d^{\mathbf{y}}$.

We assume that the idiosyncratic preference shocks follow a T1EV distribution.

Saving and indirect utility. Due to Cobb-Douglas preferences, we can rewrite the option-specific value as

$$v^{\mathbf{y}}_{k,t} = \max_{b \in \mathcal{B}_{kt}} \Big\{ \log \frac{A^{\mathbf{y}}_k}{\tau^{\mathbf{y}}_{rk}} + \log \frac{a-b}{\Pi^{\mathbf{y}}_{\ell(k),t}} + V^{\mathbf{o}}_{k,t+1}(b) \Big\} + \text{const.}$$

We assume $\sigma^{\mathbf{o}} > 1 + \beta$, which guarantees a unique interior saving choice (Appendix A.4). The maximizer $b^*_{kt} \equiv b^*_t(z, a, k, r)$ solves

$$\frac{1}{a - b^*_{kt}} = (1+\beta)\, R \sum_{n \in \mathcal{N}} \frac{\mu^{\mathbf{o}}_{kn,t+1}(b^*_{kt})}{I_{kn,t+1}(b^*_{kt})}.$$

The right-hand side is the expected marginal value of wealth when old, taken over the endogenous workplace probabilities; the factor $1 + \beta$ appears because an extra unit of old-age income finances both consumption and the transfer. Evaluated at the optimal saving, we drop the argument, $I_{kn,t+1} \equiv I_{kn,t+1}(b^*_{kt})$ and $\mu^{\mathbf{o}}_{kn,t+1} \equiv \mu^{\mathbf{o}}_{kn,t+1}(b^*_{kt})$; where the dependence on the young state has to be displayed, as in the aggregation below, we write $\mu^{\mathbf{o}}_{t+1}(n \mid k; z, a, r)$ for the latter.

College choice and expected utility. The college choice probability $\mu^{\mathbf{y}}_{k,t} \equiv \mu^{\mathbf{y}}_t(k \mid z, a, r)$ and the ex-ante expected utility over the distribution of taste draws take standard logit form:

$$\mu^{\mathbf{y}}_{k,t} = \frac{\exp\left(\frac{v^{\mathbf{y}}_{k,t}}{\sigma^{\mathbf{y}}}\right)}{\sum_{j \in \mathcal{K}_t(z)} \exp\left(\frac{v^{\mathbf{y}}_{j,t}}{\sigma^{\mathbf{y}}}\right)}, \qquad V^{\mathbf{y}}_t = \sigma^{\mathbf{y}} \log \left(\sum_{j \in \mathcal{K}_t(z)} \exp\left(\frac{v^{\mathbf{y}}_{j,t}}{\sigma^{\mathbf{y}}}\right) \right).$$

The outside option is available to everyone, so the denominator and the young value remain well defined. Appendix A.1 gives the choice-specific utility in closed form:

$$\exp\left(v^{\mathbf{y}}_{k,t}\right) \propto \frac{A^{\mathbf{y}}_k}{\tau^{\mathbf{y}}_{rk}} \frac{a - b^*_{kt}}{\Pi^{\mathbf{y}}_{\ell(k),t}} \left[\sum_{m \in \mathcal{N}} \left(\frac{A^{\mathbf{o}}_{km}}{\tau^{\mathbf{o}}_{km|r}} \frac{I^{1+\beta}_{km,t+1}}{\Pi^{\mathbf{o}}_{m,t+1}} \right)^{1/\sigma^{\mathbf{o}}} \right]^{\sigma^{\mathbf{o}}}.$$

University Human Capital Formation. Universities are a means of human capital accumulation: a member of cohort t who attends option k supplies $h(z, q_{kt})$ efficiency units of field-$f(k)$ labor at date $t+1$. We assume that attending program k generates human capital h according to a general learning technology that depends on the student's own ability z and program-cohort quality $q_{kt} \in \mathbb{R}^+$:

$$\log h(z, q_{kt}) = \theta_z \log z + \theta_q \log q_{kt} + \theta_{zq} \log q_{kt} \cdot \log z.$$

Given q_{kt}, $\theta_{zq} > 0$ means that student ability and college quality are complements: high-ability students benefit more from quality. Equivalently, the return to college quality is increasing in student ability. If $\theta_{zq} = 0$, the technology is log-additive and quality shifts human capital proportionally for all students. If $\theta_{zq} < 0$, ability and quality are substitutes, so quality improvements matter relatively more for lower-ability students.

We assume that college quality is a Cobb-Douglas aggregator of three components:

$$\log q_{kt} = \log \bar{q}_k + \theta_x \log x_{kt} + \frac{1-\theta_x}{\xi} \log \mathbb{E}_{F^*_{kt}}(z^\xi). \tag{1}$$

Here, $\bar{q}_k > 0$ is a TFP-like time-invariant scalar measure of university quality (e.g., reputation); x_{kt} represents quality-enhancing inputs such as faculty quality (Epple et al., 2006); and F^*_{kt} is the within-college ability distribution among enrolled students. The peer-composition term uses the within-college ability moment

$$\mathbb{E}_{F^*_{kt}}(z^\xi) \equiv \int z^\xi \, dF^*_{kt}(z).$$

A few remarks are in order. First, we allow either sign of ξ, with $\xi \neq 0$ in the displayed expression and strictly positive ability. The parameter governs the sensitivity of peer quality to the tails of the within-college ability distribution. When $\xi = 1$, the term is the log arithmetic mean of peer ability. As $\xi \to 0$ from either side, it converges to the mean log ability, $\int \log z \, dF^*_{kt}(z)$. Negative values give greater weight to low-ability peers; at $\xi = -1$, the term is the log harmonic mean. As $\xi \to \infty$, it approaches the log of the maximum enrolled ability, while as $\xi \to -\infty$, it approaches the log of the minimum. These limits are well defined on the positive bounded college eligibility support, even when population ability has a zero lower endpoint.

Second, the weights on x_{kt} and the peer-composition component impose constant returns in quality production: college quality has a permanent component $\bar{q}_k$, while inputs and peer composition determine the time-varying component of q_{kt}.

No College. For the outside option $k = 0$, we write

$$h(z, 0) \equiv h_0(z),$$

with h_0 strictly increasing: non-college human capital depends on ability alone.

2.1.3 Problem of the Old

At date t, an old household from cohort $t-1$ enters with state (h, b, k, r), where h is human capital acquired at $t-1$, b is the asset position chosen at $t-1$, k is the college attended, and r is the home region. Conditional on this state, the household chooses a workplace region and allocates old-age income between current consumption and the transfer received by her child in the young cohort t.

Given (h, b, k, r), total income in workplace region n is asset income plus labor income at the

wage per efficiency unit of the agent's field,

$$I_{nt}(h, b, k) \equiv R\, b + \bar{w}_{f(k)nt}\, h,$$

where $f(0) = 0$ selects the non-college wage. The state (h, b, k, r) is fixed throughout this subsection, so we write I_{nt} for $I_{nt}(h, b, k)$ and drop the state from the objects introduced below in the same way.

As in the case of the young, preference heterogeneity and mobility frictions bring gravity to workplace choice. The amenity $A^{\mathbf{o}}_{kn}$ captures characteristics of workplace region n that are common across workers; it varies with k only through schooling status, taking one value for college graduates ($k \neq 0$) and another for non-college workers ($k = 0$). The friction $\tau^{\mathbf{o}}_{kn|r} \geq 1$ is denominated in utility terms and depends on the campus location $\ell(k)$ and the home region r. Both are primitives.

Let ϵ_n be an idiosyncratic preference shock for workplace region n that is i.i.d. T1EV across locations and individuals with scale $\sigma^{\mathbf{o}}$. The old household has a *warm-glow* bequest motive: she derives utility $\beta \log(a')$ from leaving a transfer $a' \geq 0$ to the next generation, where $\beta > 0$ governs the strength of the bequest motive. The old household solves

$$V^{\mathbf{o}}_t(h, b, k, r) = \mathbb{E}_\epsilon\Big[\max_{n \in \mathcal{N}} \big\{ v^{\mathbf{o}}_{nt} + \sigma^{\mathbf{o}} \epsilon_n \big\}\Big],$$

where the destination-specific value $v^{\mathbf{o}}_{nt} \equiv v^{\mathbf{o}}_t(n;\, h, b, k, r)$ is

$$v^{\mathbf{o}}_{nt} \equiv \max_{\mathbf{c}^{\mathbf{o}},\, d^{\mathbf{o}},\, a'} \left\{ \log \frac{A^{\mathbf{o}}_{kn}}{\tau^{\mathbf{o}}_{kn|r}} + \alpha_{\mathbf{o}} \big[\gamma \log c^{\mathbf{o}}_{\mathrm{T}} + (1-\gamma) \log c^{\mathbf{o}}_{\mathrm{NT}} \big] + (1 - \alpha_{\mathbf{o}}) \log d^{\mathbf{o}} + \beta \log a' \right\}$$

subject to

$$c^{\mathbf{o}}_{\mathrm{T}} + p^{\mathrm{NT}}_{nt}\, c^{\mathbf{o}}_{\mathrm{NT}} + p^{\mathbf{o}}_{nt}\, d^{\mathbf{o}} + a' \leq I_{nt}, \qquad a' \in [0, I_{nt}].$$

Bequests and indirect utility. The Cobb-Douglas exponents sum to $1 + \beta$, so old-age income is split in constant shares across the three goods and the transfer (Appendix A.1). The optimal bequest and destination-specific value take a simple form:

$$a'^{*}_{nt} = \frac{\beta}{1+\beta}\, I_{nt}, \qquad v^{\mathbf{o}}_{nt} = \log \frac{A^{\mathbf{o}}_{kn}}{\tau^{\mathbf{o}}_{kn|r}} + \log \frac{I^{1+\beta}_{nt}}{\Pi^{\mathbf{o}}_{nt}} + \text{const},$$

where the constant term is common to workplaces. The transfer is paid and received at date t; warm glow introduces no continuation value for the child.

Workplace choice and continuation value. With T1EV shocks of scale $\sigma^{\mathbf{o}}$, the workplace choice

probability $\mu^{\mathbf{o}}_{nt} \equiv \mu^{\mathbf{o}}_t(n \mid h, b, k, r)$ and the continuation value take the familiar logit form:

$$\mu^{\mathbf{o}}_{nt} = \frac{\exp\left(\frac{v^{\mathbf{o}}_{nt}}{\sigma^{\mathbf{o}}}\right)}{\sum_{m\in\mathcal{N}} \exp\left(\frac{v^{\mathbf{o}}_{mt}}{\sigma^{\mathbf{o}}}\right)}, \qquad V^{\mathbf{o}}_t = \sigma^{\mathbf{o}} \log\left(\sum_{m\in\mathcal{N}} \left[\frac{A^{\mathbf{o}}_{km}}{\tau^{\mathbf{o}}_{km|r}} \frac{I^{1+\beta}_{mt}}{\Pi^{\mathbf{o}}_{mt}}\right]^{1/\sigma^{\mathbf{o}}}\right) + \text{const.}$$

Warm glow has two immediate implications: the transfer inherits the destination-specificity of old-age income, and workplace choice is log-linear in income with elasticity $1+\beta$, since a higher-income destination finances both consumption and a larger transfer.

To see how imperfect mobility and human capital accumulation jointly shape demand for education, consider an asset-poor individual who receives no parental bequest, $a = 0$. For two eligible programs k, k' in the same field, optimal borrowing gives the following log-odds decomposition:[3]

$$\sigma^{\mathbf{y}} \log \frac{\mu^{\mathbf{y}}_k}{\mu^{\mathbf{y}}_{k'}} = \underbrace{\log \frac{A^{\mathbf{y}}_k \tau^{\mathbf{y}}_{rk'} \Pi^{\mathbf{y}}_{\ell(k')}}{A^{\mathbf{y}}_{k'} \tau^{\mathbf{y}}_{rk} \Pi^{\mathbf{y}}_{\ell(k)}}}_{\text{attendance}} + \underbrace{(2+\beta) \log \frac{h_k}{h_{k'}}}_{\text{human capital}} + \underbrace{(2+\beta) \log \frac{\mathcal{W}^{\star}_{f(k),\ell(k)}}{\mathcal{W}^{\star}_{f(k'),\ell(k')}}}_{\text{wage access}} + \underbrace{\sigma^{\mathbf{o}} \log \frac{\mathsf{UMA}^{c}_{\ell(k)}}{\mathsf{UMA}^{c}_{\ell(k')}}}_{\text{workplace amenities and costs}}.$$

The last two terms measure returns to campus geography. Conditional on field, origin and the equilibrium environment, both are independent of ability z: at $a = 0$, optimal borrowing scales with human capital, so Rb^*_k/h_k does not vary with z. Among eligible programs, ability therefore changes these log-odds only through $h_k/h_{k'}$; campus geography shifts their level.

2.1.4 Market for Higher Education

A program $k = (u, f) \in \mathcal{K}$ is characterized by its quality q_{kt}, its capacity Q_k, and the campus location $\ell(u)$ of the university offering it. All programs share a fixed higher-education eligibility threshold z_{elig}, with $z_{\min} < z_{\text{elig}} < z_{\max}$.[4] The threshold applies only to college entry: individuals below it remain in the population and choose the non-college option. Each program carries an endogenous admission cutoff $\bar{z}_{kt} \geq z_{\text{elig}}$ that determines eligibility:

$$\mathcal{K}_t(z) \equiv \{k \in \mathcal{K} \cup \{0\} : z \geq \bar{z}_{kt}\},$$

with $\bar{z}_{0t} \equiv z_{\min}$, so the outside option is available to all agents; $K \equiv |\mathcal{K}|$. Realized enrollment of the young cohort t is

$$E_{kt} \equiv \sum_r N_{rt} \iint \mu^{\mathbf{y}}_t(k \mid z, a, r)\, dF_{rt}(z, a), \qquad k \in \mathcal{K},$$

[3] We suppress dates and the fixed home region r. $\sigma^{\mathbf{o}} > 1 + \beta$ is sufficient for a unique interior optimum.

[4] This threshold summarizes basic eligibility requirements for higher education, such as a high-school diploma, a minimum GPA, and language proficiency.

with a complementary slackness condition:

$$0 \leq \bar{z}_{kt} - z_{\text{elig}} \;\perp\; Q_k - E_{kt} \geq 0, \qquad k \in \mathcal{K}.$$

Thus a selective program with $\bar{z}_{kt} > z_{\text{elig}}$ fills its capacity, $E_{kt} = Q_k$. If capacity exceeds enrollment when the cutoff is at z_{elig}, the program admits from its full eligible support, $\bar{z}_{kt} = z_{\text{elig}}$, and the unused capacity remains slack. Agents with $z < z_{\text{elig}}$ are ineligible for every college in every equilibrium.

The peer distribution F^*_{kt} is a probability CDF on $[z_{\text{elig}}, z_{\max}]$ and solves the following equation:[5]

$$E_{kt} F^*_{kt}(z) = \sum_r N_{rt} \iint \mathbf{1}\{\tilde{z} \leq z\}\, \mu^{\mathbf{y}}_t(k \mid \tilde{z}, \tilde{a}, r)\, dF_{rt}(\tilde{z}, \tilde{a}).$$

With positive amenities and taste scales, an offered program has positive enrollment whenever a positive mass of students is eligible.

2.1.5 Production: Final Good and Regional Varieties

Let $s \in \mathcal{S} \equiv \{\text{T}, \text{NT}\}$ denote the tradable (T) or nontradable (NT) sector. Each region produces a tradable variety $Y_{\text{T}n}$. A competitive final-good firm combines these regional varieties according to

$$Y = \left(\sum_{n \in \mathcal{N}} Y_{\text{T}n}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}},$$

where $\eta > 1$ is the elasticity of substitution across regional tradable varieties. The final-good price index is normalized to one:

$$P = \left(\sum_{n \in \mathcal{N}} \left(p^{\text{T}}_n\right)^{1-\eta} \right)^{\frac{1}{1-\eta}} = 1.$$

Regional nontradable output $Y_{\text{NT}n}$ is absorbed only in region n and has local price p^{NT}_n.

Within each sector-region cell, college labor is a CES aggregate across fields:

$$H^{\text{c}}_{sn} = \left[\sum_{f \in \mathcal{F}} \omega_{sfn}^{1/\rho_f} \left(H^{\text{c}}_{fsn}\right)^{\frac{\rho_f - 1}{\rho_f}} \right]^{\frac{\rho_f}{\rho_f - 1}},$$

where $\rho_f > 1$ is the elasticity of substitution across fields and the sector-region-specific distribution weights satisfy $\omega_{sfn} > 0$ and $\sum_f \omega_{sfn} = 1$. The normalization holds separately for every sector-region pair. The weights are constant over time and allow relative field demand to differ across both sectors and regions.

[5] If $E_{kt} = 0$, set $F^*_{kt} = F^\circ$, uniform on $[z_{\text{elig}}, z_{\max}]$, to define q_{kt} and $h_t(z,k) = h(z, q_{kt})$; $h_t(z,0) = h_0(z)$.

Sectoral output is produced using the field aggregate and non-college labor:

$$Y_{sn} = \Omega_{sn}\left[(\Omega^{\mathrm{c}}_{sn}H^{\mathrm{c}}_{sn})^{\frac{\rho-1}{\rho}} + (H^{\mathrm{nc}}_{sn})^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}}, \qquad s \in \{\mathrm{T},\mathrm{NT}\},$$

where $\rho > 1$ is the elasticity of substitution between the college composite and non-college labor. We normalize $\Omega_{\mathrm{NT}n} \equiv 1$.

There is one competitive labor market per field $f \in \mathcal{F} \cup \{0\}$ in each region, so sectoral employment satisfies

$$H^{\mathrm{c}}_{fn} = H^{\mathrm{c}}_{f\mathrm{T}n} + H^{\mathrm{c}}_{f\mathrm{NT}n}, \qquad H^{\mathrm{nc}}_{n} = H^{\mathrm{nc}}_{\mathrm{T}n} + H^{\mathrm{nc}}_{\mathrm{NT}n}.$$

The field wage $\bar{w}_{fn}$ and the non-college wage $\bar{w}_{0n}$ do not carry a sector subscript. The final-good demand system, sectoral factor demands, cross-sector wage equalization, and zero-profit conditions are collected in Appendix A.3.

Labor Supply. Restoring time subscripts, workers at date $t \geq 1$ belong to cohort $t-1$. Write $\mu^{\mathbf{o}}_t(n \mid k; z, a, r) \equiv \mu^{\mathbf{o}}_t(n \mid h_{t-1}(z,k), b^*_{t-1}(z,a,k,r), k, r)$ for its workplace probability at the inherited education and saving choices. Aggregate efficiency-unit supplies are

$$H^{\mathrm{nc}}_{nt} = \sum_r N_{r,t-1} \iint h_{t-1}(z,0)\, \mu^{\mathbf{y}}_{t-1}(0 \mid z,a,r)\, \mu^{\mathbf{o}}_t(n \mid 0; z,a,r)\, dF_{r,t-1}(z,a),$$
$$H^{\mathrm{c}}_{fnt} = \sum_r N_{r,t-1} \iint \sum_{k \in \mathcal{K}} \mathbf{1}\{f(k) = f\}\, h_{t-1}(z,k)\, \mu^{\mathbf{y}}_{t-1}(k \mid z,a,r)\, \mu^{\mathbf{o}}_t(n \mid k; z,a,r)\, dF_{r,t-1}(z,a).$$

These are accounting identities that demonstrate how individual choices shape aggregate variables.

2.1.6 Housing Markets

Dwellings are owned by absentee landlords who consume all of their rental income in the rest of the world.

Young Housing. Students rent housing in their campus region, while young agents who do not attend college rent in their home region. Within each region, they share a housing market with isoelastic supply:

$$D^{\mathbf{y}}_{nt} = \bar{D}^{\mathbf{y}}_{nt}\left(p^{\mathbf{y}}_{nt}\right)^{\psi}, \qquad n \in \mathcal{N}.$$

Old Housing. The old rent housing where they work. College and non-college workers share a housing market, separate from that of the young, with supply

$$D^{\mathbf{o}}_{nt} = \bar{D}^{\mathbf{o}}_{nt}\left(p^{\mathbf{o}}_{nt}\right)^{\psi}, \qquad n \in \mathcal{N}.$$

The two markets share a supply elasticity $\psi \geq 0$, constant across regions and time. The supply shifters $\bar{D}^{\mathbf{y}}_{nt}$ and $\bar{D}^{\mathbf{o}}_{nt}$ may vary by region and date. In each market, rents adjust to equate supply

with household demand.

Consumption Goods. The tradable composite is the numeraire. Its market clears when

$$Y_t = \int_{i:\,\text{young at } t} c^{\mathbf{y}}_{i,t}\, di + \int_{i:\,\text{old at } t} c^{\mathbf{o}}_{\mathrm{T},i,t}\, di + NX_t,$$

where NX_t denotes net exports. Let B_t be aggregate saving chosen by the young cohort t, so the old cohort $t-1$ receives RB_{t-1}. Combining household budgets with firm zero-profit conditions and local-service market clearing gives

$$NX_t = \sum_{n\in\mathcal{N}} p^{\mathbf{y}}_{nt} D^{\mathbf{y}}_{nt} + \sum_{n\in\mathcal{N}} p^{\mathbf{o}}_{nt} D^{\mathbf{o}}_{nt} + B_t - RB_{t-1}, \qquad B_t \equiv \int_{i:\,\text{young at } t} b^{*}_{i,t}\, di.$$

Transfers paid by the old at t are received by the young at t and cancel in this aggregate budget. In a stationary equilibrium,

$$NX = \sum_{n\in\mathcal{N}} p^{\mathbf{y}}_{n} D^{\mathbf{y}}_{n} + \sum_{n\in\mathcal{N}} p^{\mathbf{o}}_{n} D^{\mathbf{o}}_{n} - (R-1)\, B, \qquad B_t = B_{t-1} = B,$$

the rents paid to landlords net of the interest earned on the economy's asset position. Each local-service market clears separately:

$$Y_{\mathrm{NT}nt} = \int_{i:\,\text{old in } n \text{ at } t} c^{\mathbf{o}}_{\mathrm{NT},i,t}\, di.$$

Students do not enter this market, so a campus affects the local service sector only through the workers its graduates supply to the region.

2.1.7 Intergenerational Transmission and the Law of Motion

Child ability depends on parental human capital through a transmission technology common across regions. Conditional on $h > 0$,[6]

$$\log z' = \kappa \log h + \nu, \qquad \kappa \geq 0. \tag{2}$$

Workplace location determines the child's home region but does not shift the ability technology conditional on parental human capital. Under warm glow, the parent internalizes neither channel, so the inherited pair (z', a'^{*}) is a by-product of her own workplace choice. Each old household has one child at the date when she works and leaves the transfer. For $t \geq 1$, a parent working at t entered young at $t-1$. If her initial state was $(\tilde{z}, \tilde{a}, r)$ and she attended k,

[6] The innovation follows a $\mathcal{N}(0, \sigma_\nu^2)$ law, $\sigma_\nu > 0$, conditioned on $z' \in \mathcal{Z}$. Appendix A.7 gives the truncation bounds and conditional CDF $G(z' \mid h)$.

write $\tilde{h} \equiv h_{t-1}(\tilde{z}, k)$ and $\tilde{b} \equiv b^*_{t-1}(\tilde{z}, \tilde{a}, k, r)$. Her child's state enters the date-t distribution:

$$N_{n,t}F_{n,t}(z,a) = \sum_r N_{r,t-1} \iint \sum_{k \in \mathcal{K}_{t-1}(\tilde{z})} \mu^{\mathbf{y}}_{t-1}(k \mid \tilde{z}, \tilde{a}, r)\, \mu^{\mathbf{o}}_t(n \mid \tilde{h}, \tilde{b}, k, r) \\ \times G(z \mid \tilde{h}) \mathbf{1}\Big\{ \tfrac{\beta}{1+\beta}\, I_{nt}(\tilde{h}, \tilde{b}, k) \le a \Big\}\, dF_{r,t-1}(\tilde{z}, \tilde{a}),$$

with $N_{n,t}$ given by the same expression without the last two factors. At date zero, education and saving are given for each initially old household. Denoting these households by i and integrating with their population weights gives

$$N_{n,0}F_{n,0}(z,a) = \int_{i:\,\text{old at } 0} \mu^{\mathbf{o}}_0(n \mid h_i, b_i, k_i, r_i)\, G(z \mid h_i)\, \mathbf{1}\Big\{ \tfrac{\beta}{1+\beta} I_{n0}(h_i, b_i, k_i) \le a \Big\}\, di.$$

2.1.8 Sequential Competitive Equilibrium

Definition. Given parameters Θ, exogenous housing-supply paths, the set of regions $\mathcal{N}$, the set of universities $\mathcal{U}$ with campus locations $\{\ell(u)\}_{u \in \mathcal{U}}$, the set of programs $\mathcal{K}$ with fundamentals $\{\bar{q}_k, Q_k\}_{k \in \mathcal{K}}$, the common higher-education eligibility threshold z_{elig}, and a given feasible distribution of education, human capital, saving, and home regions of the initially old, a **sequential competitive equilibrium** is a sequence $\{\mathcal{E}_t\}_{t=0}^{\infty}$, where each $\mathcal{E}_t$ consists of:

(i) Household Block. Value functions $V^{\mathbf{y}}_t$ and $V^{\mathbf{o}}_t$ on the feasible state spaces defined above; decision rules for college $\mu^{\mathbf{y}}_t(\cdot \mid z, a, r)$ and workplace $\mu^{\mathbf{o}}_t(\cdot \mid h, b, k, r)$; policies $c^{\mathbf{y}}_t, d^{\mathbf{y}}_t, b_t$ for the young cohort t and $\mathbf{c}^{\mathbf{o}}_t, d^{\mathbf{o}}_t, a'_t$ for the old cohort $t-1$.

(ii) Market Block. Admission cutoff vector $\bar{\mathbf{z}}_t = (\bar{z}_{kt})_{k \in \mathcal{K}} \in [z_{\text{elig}}, z_{\max}]^K$; within-program ability distributions $\{F^*_{kt}\}_{k \in \mathcal{K}}$ and qualities $\{q_{kt}\}_{k \in \mathcal{K}}$ for the attending cohort t; young regional populations and state distributions $\{N_{rt}, F_{rt}\}_{r \in \mathcal{N}}$, each F_{rt} a joint CDF on $[z_{\min}, z_{\max}] \times \mathbf{R}_+$; wages per efficiency unit $\{\bar{w}_{fnt}\}_{f \in \mathcal{F} \cup \{0\},\, n \in \mathcal{N}}$, goods prices $\{p^s_{nt}\}_{s \in \mathcal{S},\, n \in \mathcal{N}}$, young housing prices $\{p^{\mathbf{y}}_{nt}\}_{n \in \mathcal{N}}$, and old housing prices $\{p^{\mathbf{o}}_{nt}\}_{n \in \mathcal{N}}$; production and sectoral employment allocations.

such that:

(a) Household optimality. At every date t, the young optimize given current admission cutoffs, peer qualities and young rents, and the correctly anticipated continuation value $V^{\mathbf{o}}_{t+1}$. The old optimize at current wages and prices, taking their inherited education, human capital and saving as given.

(b) University Market Clearing and Consistency. For each program k and date t, enrollment E_{kt} does not exceed capacity, the cutoff floor and unused capacity satisfy complementary slackness, and F^*_{kt} obeys the mass-form consistency identity above. At zero enrollment, it equals the fixed common reference CDF F°. Quality q_{kt} equals the quality aggregator evaluated at F^*_{kt} and the supplied inputs.

(c) Labor Market Clearing. At date t, demand across the two sectors equals the field-specific and non-college supplies of the old cohort $t-1$, with its inherited human capital and current workplace choices.

(d) Housing Market Clearing. In every region, young housing clears against the demand of cohort t and old housing against the demand of cohort $t-1$ at date t.

(e) Production and Goods Market Clearing. The final-good firm and sectoral producers optimize as described in Appendix A.3 and earn zero profits. Each local nontradable-service market and the aggregate tradable-good market clear, with $P_t = 1$ and net exports satisfying the aggregate budget identity above.

(f) Evolution of Joint Distribution over Individual States. The young cohort's education and saving determine the old state of that cohort one date later. At each date, the old cohort's workplace choices, transfers and ability transmission generate the young cohort's regional masses and joint state distributions. These relations start from the given states of the initially old and the date-zero young population they generate.

With time-invariant exogenous fundamentals, a **stationary** equilibrium has time-invariant equilibrium objects and satisfies the fixed-point condition for the law of motion in *(f)*, so in particular $N_{r,t+1} = N_{r,t}$ and $F_{r,t+1} = F_{r,t}$ for all $r \in \mathcal{N}$.

Model Takeaways. The framework brings together forward-looking decisions to acquire human capital through university choice and subsequent workplace migration. A central implication is that university fundamentals (permanent quality, inputs, capacity, and campus location) shape the spatial allocation of talent, operating through selection and sorting. Naturally, any reallocation of university spots changes both the contemporaneous allocation of talent and the state of the economy faced by the next generation. One would expect that the direct gains from higher quality or expanded capacity may be mitigated by endogenous price responses, altered sorting patterns, and changes in dynastic resources. Section 2.1.9 isolates the conditional college-sorting margins analytically.

2.1.9 Implications from the Model: Sorting

For a given parameterization, our model yields several implications for sorting patterns. As such, at given equilibrium prices and admission cutoffs, a log-supermodular learning technology, $\theta_{zq} > 0$ (which we later verify in the data, as shown in Section 4.5.1), generates the following conditional results.

Proposition 2.1 (Sorting into college). *Suppress dates and assume $\sigma^{\mathbf{o}} > 1 + \beta$, $\sigma^{\mathbf{y}} > 0$, $\theta_{zq} > 0$, and $h_z, h_q > 0$ on the relevant domain.*

(i) For programs k, k' in the same field with $q_k > q_{k'}$ and $\tau^{\mathbf{o}}_{kn|r} = \tau^{\mathbf{o}}_{k'n|r}$ for every workplace n, ability raises relative demand for quality at given (a, r), while parental transfers reduce it at given (z, r):

$$\frac{\partial}{\partial z} \log \frac{\mu^{\mathbf{y}}_k}{\mu^{\mathbf{y}}_{k'}} > 0, \qquad \frac{\partial}{\partial a} \log \frac{\mu^{\mathbf{y}}_k}{\mu^{\mathbf{y}}_{k'}} < 0.$$

(ii) Higher quality q_k raises relative demand for program k, but less for children receiving larger parental transfers:

$$\frac{\partial}{\partial q_k} \log \frac{\mu^{\mathbf{y}}_k}{\mu^{\mathbf{y}}_{k'}} > 0, \qquad \frac{\partial^2}{\partial a \, \partial q_k} \log \frac{\mu^{\mathbf{y}}_k}{\mu^{\mathbf{y}}_{k'}} < 0.$$

Proof. See Appendix A.4.

In partial equilibrium, parental transfers crowd out demand for higher quality by lowering the marginal utility of the educational earnings premium a program provides.[7] Students with more parental resources therefore place greater relative weight on amenities and proximity when choosing college. Under warm glow, parents do not internalize how their transfers affect these educational choices.

2.1.10 Equilibrium Uniqueness

Establishing a global sufficient condition for uniqueness in the full model is beyond the scope of this paper. In an online appendix, we characterize a simplified static environment with one tradable production sector that retains heterogeneous programs, endogenous peers and admission cutoffs, bilateral mobility frictions, and regional labor and housing markets. For this environment, we give primitive sufficient conditions for existence and for global uniqueness, with uniqueness requiring sufficiently weak feedback between enrollment, peer composition, wages, and rents.

Numerically, we solve the model from a broad range of initial guesses. In ongoing work, we explore homotopy methods to trace equilibrium branches as parameters vary and search systematically for additional equilibria.

2.2 Campus Location and Learning: A Linear-City Illustration

To shed light on the key forces of the model, we use a considerably simplified version of the framework developed so far. Our goal is to illustrate how mobility frictions and learning jointly shape aggregate welfare and the optimal location of a university.

[7] This trade-off mirrors the U.S. evidence in Boar and Lashkari (2021): children of higher-income parents are significantly more likely to work in occupations offering better nonpecuniary attributes.

2.2.1 Population, Learning, and Workplaces

A cohort of mass one has home regions r uniformly distributed on $[0,1]$. At every r, shares $N_L = 1 - N_H$ and $N_H \in (0,1)$ have abilities $0 < z_L < z_H$, respectively. This trivially implies $\mathbb{E}[z] = N_L z_L + N_H z_H$ and $\mathrm{Var}(z) = N_L N_H (z_H - z_L)^2$.

We abstract from dynamics, intergenerational links, and preference heterogeneity in both college and workplace choices, setting $\sigma^{\mathbf{y}} = \sigma^{\mathbf{o}} = 0$.

One college program k operates at campus location $\ell(k) \in [0,1]$. We assume $Q_k > 1$, so capacity accommodates all possible demand. A student of ability z acquires

$$h(z, q_k) = z q_k, \qquad q_k = \left(\mathbb{E}_{F_k^*}[z^{-1}] \right)^{-1}. \tag{3}$$

Here F_k^* is the distribution of ability among attendees. Quality is their harmonic mean ability: this is the $\xi = -1$, $\theta_x = 0$ specialization of peer quality in the main model. Learning has $\theta_z = \theta_q = 1$ and $\theta_{zq} = 0$, so ability and quality are complements in levels.

To clarify our main point, we fix wages and abstract from general equilibrium forces in local labor markets. Specifically, the wage per efficiency unit at workplace $n \in [0,1]$ is $\bar{w} - \chi n$, with $\bar{w} > \chi > 0$. A graduate chooses n to maximize

$$v_n^{\mathbf{o}}(z;k) = (\bar{w} - \chi n) h(z, q_k) - \tau^{\mathbf{o}} |n - \ell(k)|. \tag{4}$$

Moving when young costs $\tau^{\mathbf{y}} |r - \ell(k)|$; moving after college costs $\tau^{\mathbf{o}} |n - \ell(k)|$. Here the nonnegative scalar coefficients $\tau^{\mathbf{y}}$ and $\tau^{\mathbf{o}}$ measure real moving costs per unit of distance, in the same units as earnings. With linear utility, we normalize the fixed outside payoff to zero without loss of generality, measuring college surplus relative to nonattendance. College charges no tuition.

Taking quality as given, the young choose to attend university if and only if

$$v_k^{\mathbf{y}}(z, r) = \max_{n \in [0,1]} v_n^{\mathbf{o}}(z;k) - \tau^{\mathbf{y}} |r - \ell(k)| \geq 0. \tag{5}$$

Although nonattendance by a high type implies nonattendance by a low type from the same r, high-type graduates may still work at the CBD ($n = 0$) while gravity keeps low-type graduates at the campus ($n = \ell(k)$).

2.2.2 College Attendance and Equilibrium

Following the notation in the main text, let E_{Lk} and E_{Hk} denote the masses of low- and high-ability students who enroll. For $i \in \{L, H\}$,

$$E_{ik} = N_i \int_0^1 \mathbf{1}\{v_k^{\mathbf{y}}(z_i, r) \geq 0\} \, dr, \qquad E_k = E_{Lk} + E_{Hk}. \tag{6}$$

Equilibrium consistency requires

$$q_k = \frac{E_{Lk} + E_{Hk}}{E_{Lk}/z_L + E_{Hk}/z_H}. \tag{7}$$

2.2.3 Welfare and the Extensive Margin

Define the aggregate surplus of ability group i as

$$W_i(\ell(k)) = N_i \int_0^1 \max\{0, v_k^{\mathbf{y}}(z_i, r)\}\, dr, \qquad i \in \{L, H\}. \tag{8}$$

The planner chooses location to maximize

$$W(\ell(k)) = W_L(\ell(k)) + W_H(\ell(k)), \qquad \ell^*(k) \in \arg\max_{\ell(k)\in[0,1]} W(\ell(k)). \tag{9}$$

Conditional on graduates working at the productive center, an outward move saves $\tau^{\mathbf{y}}$ per unit of distance when young for students living to the right of campus, but adds $\tau^{\mathbf{o}}$ after graduation. Students to the left face higher costs at both stages. Post-college moving costs therefore affect college demand even when every graduate ultimately works at 0.

To clarify the exposition, we focus on gravity in workplace choice for high types, and therefore for low types too.[8] Since every graduate works at the campus, writing $\ell = \ell(k)$, college surplus becomes

$$v_k^{\mathbf{y}}(z, r) = (\bar{w} - \chi\ell) z q_k - \tau^{\mathbf{y}} |r - \ell|.$$

Old moving costs determine this workplace regime but are not paid within it. At every campus location, the attendance equilibrium is unique, with $1/\mathbb{E}[z^{-1}] \leq q_k \leq \mathbb{E}[z]$. Reflecting a campus toward the CBD preserves the distribution of distances to students and raises workplace productivity, so an optimal campus lies in $[0, 1/2]$. For an initial campus in $(0, 1/2)$, away from changes in whether a type attends from either city endpoint, the first-order welfare effect of a reallocation is

$$\frac{dW}{d\ell} = \sum_{i\in\{L,H\}} N_i \int_{\{r: v_k^{\mathbf{y}}(z_i, r)\geq 0\}} \left[\tau^{\mathbf{y}} \operatorname{sgn}(r - \ell) - \chi z_i q_k + (\bar{w} - \chi\ell) z_i \frac{dq_k}{d\ell}\right] dr. \tag{10}$$

The first term represents savings in young moving costs for students to the right of campus, net of the additional costs for those to its left. The second is the direct effect of worse local labor markets on earnings. Learning spillovers introduce a third effect through the change in equilibrium quality, which the planner takes into account. Marginal entrants and leavers have zero private surplus; their first-order contribution comes through their effect on the learning of existing students.

[8] A sufficient condition, valid at every campus location, is $\tau^{\mathbf{o}} > \chi z_H^2$.

Two limiting cases admit a global characterization; proofs are in Appendix A.6. If $0 < \tau^{y} \leq \bar{w} z_L / \mathbb{E}[z^{-1}]$, both types attend from every r for any campus in $[0, 1/2]$, so quality is fixed at $q_k = 1/\mathbb{E}[z^{-1}]$. Then

$$\frac{dW}{d\ell} = \tau^{y}(1 - 2\ell) - \chi \frac{\mathbb{E}[z]}{\mathbb{E}[z^{-1}]}, \qquad \ell^*(k) = \max\left\{0, \frac{1}{2} - \frac{\chi \mathbb{E}[z]}{2\tau^{y}\mathbb{E}[z^{-1}]}\right\}. \tag{11}$$

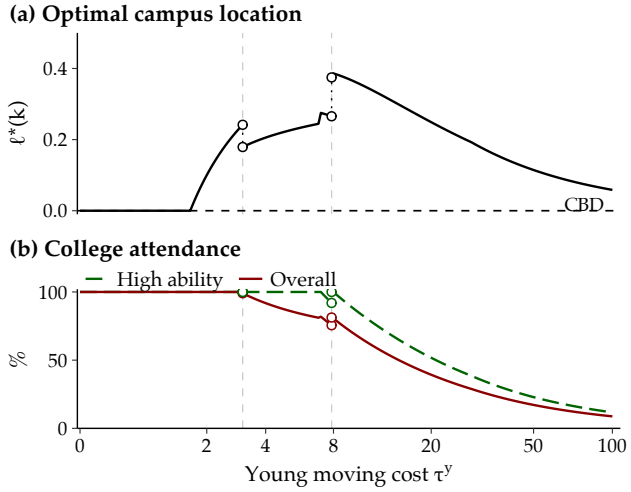
Within this range, the campus is at the CBD when $\tau^{y} \leq \chi \mathbb{E}[z]/\mathbb{E}[z^{-1}]$; it is also at the CBD when $\tau^{y} = 0$. Above this threshold, while full attendance persists, it moves outward to reduce young moving costs.

For sufficiently large τ^{y}, the global optimum instead makes a high type from $r = 0$ just willing to attend. At this campus, $q_k = \mathbb{E}[z]$: attendance is proportional to ability, so selection raises harmonic peer quality to the population arithmetic mean. Immediately to its right, neither type attends from either city endpoint: quality is unchanged, and moving outward lowers workplace earnings. On this branch,

$$\frac{dW}{d\ell} = -\frac{2\chi(\bar{w} - \chi\ell)}{\tau^{y}} q_k^2 \mathbb{E}[z^2] < 0, \qquad \ell^*(k) = \frac{\bar{w} z_H q_k}{\tau^{y} + \chi z_H q_k}. \tag{12}$$

A positive share of each type does not attend, disproportionately more among low types. As

Figure 1: Optimal location and attendance



Notes: Both types stay at campus. Open circles mark equal-welfare optima; dotted connectors indicate jumps. Young moving costs use $\log(1 + \tau^{y})$ spacing. Parameters are in Appendix A.6.

young moving costs rise further, the planner locates the university closer to the CBD: bounded learning gains cannot compensate for arbitrarily costly travel to university.

For intermediate moving costs, changes in who attends affect learning and hence the welfare ranking of campuses. Figure 1 shows the optimal location for a particular parameterization, detailed in Appendix A.6.

Two remarks are in order. At the first jump, the planner moves the campus toward the productive center, accepting lower attendance in exchange for better peer quality and higher workplace productivity.

At the second jump, the campus instead moves outward: attendance rises for both types, proportionately more for high types, so quality also rises. As young moving costs rise near this jump, peer quality improves at the farther of the two competing locations and deteriorates at the nearer one, favoring the outward move. As costs rise further, the campus briefly moves farther out before turning back toward the CBD.

The analysis developed in this section demonstrates that, even in a simplified geography, mobility frictions and learning spillovers can make the optimal campus location nonmonotonic and even discontinuous. This highlights the need to discipline the model with data, to which we turn in the next sections.

3 Higher Education in Sweden: Context and Reform

We describe our data sources in Section 3.1, the Swedish higher-education system in Section 3.2, the 1977 reform and subsequent expansion in Section 3.3, and spatial variation in attainment, skill premia, and rents in Section 3.4.

3.1 Data Sources

We use Swedish administrative and archival registers and combine them with hand-collected data on university programs and regional housing markets. The key dataset for our model tracks individuals from their childhood households through the schooling system until retirement. Crucially, it records high-school academic achievement, which is central to college admission.

Administrative registers. We observe ninth-grade and high-school grades, high-school programs and tracks, and residence at graduation, and link graduates to university records reporting the institution, field, and year of each degree. The degree records begin in 1985. Statistics Sweden's LISA register provides annual earnings, employment, education, and residence from 1990 onward, while RAMS links workers to their establishments. These links let us follow individuals from their home region to college and subsequent workplaces, including those who do not complete a college degree. The multigenerational register connects children to their parents, whose own records supply parental earnings, education, and residence.

University and housing data. We assemble university financial statements and statistics on enrollment, degrees, and applicants from the Swedish Higher Education Authority (UKÄ), and supplement them with publication and citation records from OpenAlex. For regional housing markets, we collect municipality-level cooperative-apartment and small-house sale prices from *Boendebarometer*, together with rents from Statistics Sweden's rent survey. We retain sale prices and rents as separate series; the rent survey excludes dedicated student housing.

Admissions records. The centralized admissions archive, beginning with the autumn 1977 admissions round, records applicants' ranked choices of programs and institutions, merit scores, and admission outcomes. It therefore reports which alternatives students applied to and which offers they received. Older records require digitization and harmonization before linkage to the administrative panel, as we discuss in Appendix C alongside source coverage and record linkage.

3.2 Higher Education in Sweden

Swedish higher education combines national financing with geographically dispersed provision. The system includes established research universities, regional university colleges (*högskolor*), and specialized institutions. Although tuition is zero for domestic students, they are responsible for covering their living expenses. Eligible students can finance these expenses through public grants and optional student loans administered by the Swedish Board of Student Finance (CSN).[9]

Under the current system, applicants submit a ranked list of up to twelve choices for an autumn or spring term through the national admissions portal. A choice may be a degree program or a freestanding course (Antagning.se, n.d.). Applicants must meet general and program-specific entry requirements; eligible applicants then compete for places on merit, including grades or the Swedish Scholastic Aptitude Test. Offers are processed in the order applicants rank their choices, subject to a limit on credits accepted in a term (University Admissions, n.d.). The application rules are detailed in Appendix C.2.

Teaching and research have also followed different geographic paths. The regional colleges initially focused on undergraduate education, while research and doctoral training remained concentrated at established universities.

3.3 The 1977 Reform and Subsequent Expansion

Following the parliamentary decision in 1975, the Higher Education Reform took effect on 1 July 1977 (Government of Sweden, 1977). It established twelve regional colleges across sixteen municipalities, including the former university branches in Karlstad, Växjö, and Örebro (SOU, 2007; Bergh et al., 2024). The reform incorporated teacher training, nursing, technical, and other post-secondary programs into the higher-education sector, often by combining existing provision within a regional college. Its stated aim was to widen geographic and social access to higher education (SOU, 2007). We describe the institutions and changes in the coverage of higher-education statistics in greater detail in Appendix C.4.

Location of the regional colleges. Most receiving towns already hosted teacher-training, nursing, technical, military, naval, or other public facilities (Andersson et al., 2004, 2009). Among the later openings, Karlskrona-Ronneby, established in 1989, is the documented exception where local economic distress after a shipyard closure influenced the site decision (Andersson et al.,

[9] See CSN (n.d.) for eligibility and payment rules. Student loans became increasingly common during the 2010s: among student-aid recipients across all education levels, the share taking loans rose from 66.9% in 2011 to 72.3% in 2019 (CSN, 2020).

2004, 2009; Bergh et al., 2024). This history helps explain the institutional geography, but does not establish that later allocations of students and research resources were independent of local economic conditions.

Expansion from the late 1980s. Our data confirm the expansion of higher education documented by Andersson et al. (2004), with college attainment increasing among high-school cohorts graduating from 1985 onward. Student numbers nearly doubled between 1985 and 1998, from 161,091 to 306,767, with more than half of the increase at newer institutions (Andersson et al., 2004, pp. 377–378). Research employment also grew, although it remained much more concentrated at the established universities (Andersson et al., 2004, 2009). The opening or reorganization of a college in 1977 and its later growth in teaching and research are therefore distinct changes.

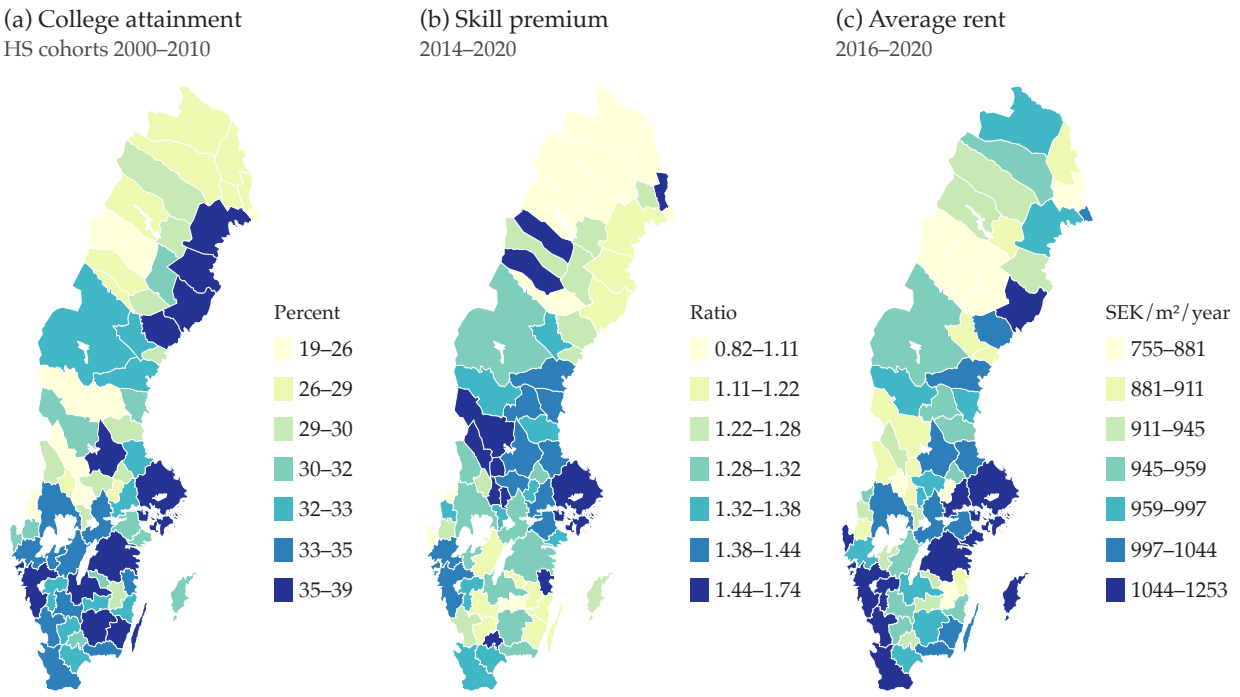
Funding and institutional status. Further reforms changed how the regional system operated. In 1993, institutions gained greater discretion over program offerings and enrollment, and teaching finance became tied to students and completed credits, subject to funding ceilings (Bergh et al., 2024, p. 20). From 1997, smaller and medium-sized colleges received increased permanent research resources (Government of Sweden, 1996). Karlstad, Växjö, and Örebro gained university status on 1 January 1999 (Government of Sweden, 1998, p. 104). Together, these changes distinguish the initial geographic reorganization from the subsequent expansion of capacity and research.

3.4 Spatial Variation in Attainment, Skill Premia, and Rents

Figure 2 shows substantial spatial variation in education, labor markets, and housing costs across Sweden's 72 functional analysis (FA) regions. Among high-school cohorts graduating in 2000–2010, the share obtaining a college degree by 2021 ranges from 19% to 39% across home regions. The estimated college-to-noncollege wage ratio per efficiency unit ranges from 0.82 to 1.74, indicating that the relative price of college skills also differs markedly across regional labor markets. Average annual apartment rents range from SEK 755 to SEK 1,253 per square meter,[10] making housing roughly two-thirds more expensive in the highest-rent region than in the lowest.

[10]For a 60-square-meter one-bedroom apartment, these rents imply approximately US$425–705 per month in nominal 2016–2020 dollars. We use the mean of the annual exchange rates over that period, SEK 8.89 per US dollar (Board of Governors of the Federal Reserve System, 2026). The floor area matches the 2014 national mean for two rooms and a kitchen (Statistics Sweden, 2015).

Figure 2: Spatial variation in college attainment, skill premia, and rents



Notes: All panels cover 72 FA regions; colors show seven regional-quantile bins, with a separate scale for each measure. Panel (a): share of the 2000–2010 high-school cohorts with a qualifying college degree by 2021, assigned to high-school home region regardless of subsequent study, work, or residence. Panel (b): ratio of estimated college to noncollege wages per efficiency unit, pooled over 2014–2020. Panel (c): mean of available annual population-weighted rental-apartment rents over 2016–2020, in SEK per square meter per year. Sources: Swedish administrative registers and Statistics Sweden's rent survey (*Hyror i bostadslägenheter*).

4 Quantification

In Section 4.1, we describe our data sources, explain how the primitives of the model are mapped to the data, and provide some descriptive statistics of our baseline sample. Section 4.2 discusses how we choose a handful of parameters to match aggregate expenditure moments from Statistics Sweden. In Section 4.3, we explain the estimation and identification of program quality and the learning technology. Section 4.4 discusses college choice, labor supply, and the inversion that recovers local amenities, productivities, and housing supply. We then present the corresponding estimation results in Section 4.5.

4.1 Economic Environment

Spatial units. We map home regions r and workplace regions n to Sweden's functional analysis regions (FA regions), which group municipalities into local labor markets. Each university is assigned to the region containing its campus, $\ell(u)$. We aggregate finer geographic records

to this level and measure bilateral distances between population-weighted regional centroids. Appendix C.5 describes the geographic crosswalk and the coverage of each estimation sample.

Levels and fields of education. We classify degrees with the Swedish Standard Classification of Education (SUN 2020). Statistics Sweden assigns its level and field codes to every degree in the register and publishes correspondence keys to the ISCED 2011 levels and ISCED-F 2013 fields (Statistics Sweden, 2020; UNESCO Institute for Statistics, 2012, 2015). College graduates hold a university or university-college degree of at least three years (ISCED levels 6 and 7); all other individuals form the non-college group. Unlike Smeets et al. (2026), who take the decision to enter college as given, we treat this group as the outside option $k = 0$ in college choice. Our fields follow ISCED-F 2013, aggregated into ten groups. Where Smeets et al. (2026) split health programs by degree type, we separate medicine from the remaining health programs, which are mostly nursing; pooling them would combine programs with very different admission cutoffs and labor markets. Law, teacher training, and social work are separate fields. Table 6 lists the ten fields and their codes; Appendix C.5 documents the degree definitions and detailed field reassignments.

Students, programs, and cohorts. In the model, we define a program $k = (u, f)$ as a university-field pair. Likewise, in the data, the institution and field of an individual's first college degree identify her college choice. We use the number of graduates to measure program enrollment. Individuals without a college degree, including dropouts, are classified as non-college ($k = 0$). High-school grade ranks measure z, and a fixed fraction of parents' mid-career earnings measures initial resources a. Counts and the joint distribution of observables inform N_{rt} and $F_{rt}(z, a)$. Enrolled students supply the peer distribution F^*_{kt} and the lower-tail grade moments used to approximate admission cutoffs. Appendix C.5 records the degree definition, resource scaling, cohort timing, eligibility construction, and capacity inputs.

Occupational Tradability. In the model, the labor market is region-field specific, meaning that, conditional on employment, workers get the same wage in the tradable and nontradable sectors. In the data, we observe the occupation of the job and use its offshorability to assign workers to sectors: activities that can be supplied away from the customer enter the tradable sector, while activities tied to the place of consumption enter local services. This follows the occupational approach to tradability in Burstein et al. (2020), based on professional assessments of offshorability (Blinder and Krueger, 2013). Swedish occupation codes are linked through international concordances to the released tradable/nontradable classification. Where those links give conflicting assignments, the crosswalk uses the underlying survey evidence. Field of education determines the type of college labor f; occupation determines its sector s. Appendix C.7 gives the crosswalk and the allocation of records with missing occupations.

Baseline sample. Our baseline sample consists of high-school cohorts graduating from 2000 to 2010. It contains 785,680 individuals, including those without a college degree, and covers 29 regions and 222 university-field programs at 41 universities, grouped into ten fields. We link high-school grades and residence to parental earnings and to workplaces and annual labor earnings

nine to eleven years after high-school graduation. Appendix C.5 gives the variable definitions and observation windows.

4.2 Externally Set and Calibrated Parameters

First, we set the warm-glow weight, housing supply elasticity, and elasticities of substitution in the Armington aggregator and in college/non-college production to values commonly used in the literature. Second, we calibrate a subset of parameters to match moments that are unavailable in the microdata but reported in aggregate administrative statistics.

Housing expenditure shares: $\alpha_{\mathbf{y}}$ and $\alpha_{\mathbf{o}}$. We set housing shares to 0.37 for the young and 0.30 for the old, giving $\alpha_{\mathbf{y}} = 0.63$ and $\alpha_{\mathbf{o}} = 0.70$. Both values come from the same calibration to Statistics Sweden (SCB) household expenditure data; the old-age value rounds the average all-household housing share in the 2006–2009 surveys. Appendix C.6 documents the expenditure measures.

Tradable consumption share: γ. We calibrate the tradable share of the old's nonhousing consumption from Swedish actual individual consumption in 2001–2003. This measure includes household purchases and individual services supplied by government and nonprofit institutions, including health care and education. We classify expenditures into tradables, local services, and housing, then divide tradable expenditure by total nonhousing expenditure. Pooling expenditure levels across the three years gives $\gamma = 0.499$ (Statistics Sweden, 2026; Eurostat, 2026). The category assignments and accounting are reported in Appendix C.6.

Externally set: β, R, ρ, η, and ψ. The warm-glow weight β and the gross return R govern transfers and saving; the current estimation uses $\beta = 0.3$ and $R = 1$. The elasticity of substitution between college and non-college labor is $\rho = 4.95$, estimated by Olovsson et al. (2025) from Swedish population registers for 2002–2018, comparing college graduates with workers who have at most a high-school education. Applying this national estimate to both sectoral nests is a maintained assumption. Swedish estimates lie above the conventional US range of 1.4–2 (Acemoglu and Autor, 2011); Edin and Holmlund (1995) obtain 2.9 for university relative to high-school graduates. We use 1.5 and 2.9 as sensitivity values. The elasticity across regional tradables is $\eta = 4$, the value used by Monte et al. (2018) and in line with the estimates of Broda and Weinstein (2006). The housing supply elasticity is $\psi = 1.38$, the long-run estimate for Sweden in Caldera Sánchez and Johansson (2011); the more recent estimate of 2.01 in Cavalleri et al. (2019) serves as a sensitivity value. Both estimates measure the long-run response of residential investment to real house prices, whereas ψ is the elasticity of housing services supplied with respect to their price in each segment. We borrow the Swedish value as a long-run supply benchmark and summarize our findings in terms of the parameter estimates in Table 1.

Table 1: Externally set and calibrated parameters

Parameter	Interpretation	Value	Source
$\alpha_{\mathbf{y}}$	Young nonhousing share	0.63	SCB household budgets
$\alpha_{\mathbf{o}}$	Old nonhousing share	0.70	SCB household budgets
γ	Tradables in old nonhousing consumption	0.499	AIC, 2001–2003
β	Warm-glow weight	0.30	Working calibration
R	Gross return on saving	1.00	Working calibration
ρ	Substitution: college/non-college	4.95	Olovsson et al. (2025)
η	Substitution: regional tradables	4	Monte et al. (2018)
ψ	Housing supply elasticity	1.38	Caldera Sánchez and Johansson (2011)

Notes: Housing shares are $1-\alpha_{\mathbf{y}}$ and $1-\alpha_{\mathbf{o}}$. Actual individual consumption (AIC) includes household, nonprofit, and government individual consumption. Appendix C.6 documents the expenditure calibration. The working values of β and R are those used in the current choice estimation. Sensitivity values are $\rho \in \{1.5, 2.9\}$ and $\psi = 2.01$ (Edin and Holmlund, 1995; Cavalleri et al., 2019).

4.3 Program Quality and the Learning Technology

In what follows, we first discuss how we recover a model-consistent measure of college quality. We then use that measure to estimate the learning technology that governs human capital accumulation while in college.

Program Quality, Returns to Quality and Ability. We use our parametric specification of the learning technology to obtain the wage equation implied by the model. For worker i from program $k_i = (u_i, f_i)$ and cohort τ_i, labor earnings in region n and calendar year t satisfy

$$\log w_{int} = \log \bar{w}_{f(k_i)nt} + \theta_z \log z_i + \left(\theta_q + \theta_{zq} \log z_i\right) \log q_{k_i\tau_i}, \qquad k_i \neq 0. \tag{13}$$

We use annual earnings nine to eleven years after high-school graduation to estimate its parameters. We absorb $\log \bar{w}_{fnt}$ into field-region-year effects δ_{fnt} and define program-cohort value added $\pi_{k\tau} \equiv \theta_q \log q_{k\tau}$. Our estimating equation therefore takes the following form:

$$\log w_{int} = \delta_{f(k_i)nt} + \pi_{k_i\tau_i} + \left(\theta_z + \frac{\theta_{zq}}{\theta_q}\pi_{k_i\tau_i}\right) \log \tilde{z}_i + e_{it}, \qquad k_i \neq 0. \tag{14}$$

In (14), i denotes college graduates, $k = (u, f)$ programs, n workplace regions, τ high-school cohorts, and t calendar years in which earnings are measured. We fix each graduate's program k_i, defined by the first college degree, and high-school cohort τ_i, grouped into two-year bands; the workplace n is observed in each earnings year. Ability is measured by $\tilde{z}_i$, the graduate's percentile rank in the grade distribution of her high-school cohort. The field-workplace-year effect $\delta_{fnt} = \log \bar{w}_{fnt}$ is the log wage per efficiency unit of field-f labor in region n. The program-cohort effect $\pi_{k\tau}$ is the earnings value added of program k for cohort τ, relative to the average program. For a graduate with grade rank $\tilde{z}$, the program's contribution to log earnings is $\pi_{k\tau}\left(1 + (\theta_{zq}/\theta_q)\log \tilde{z}\right)$. The coefficients of interest are $\pi_{k\tau}$, θ_z, and θ_{zq}/θ_q: θ_z is the return to ability at a program of

average value added, and θ_{zq}/θ_q measures how the return to ability rises with value added, or equivalently how the return to value added rises with ability. It is positive when ability and quality are complements.

We estimate (14) by nonlinear least squares, profiling over θ_{zq}/θ_q; at each value of the ratio, the equation is linear in the fixed effects and θ_z. A separate non-college equation estimates $h_0(z) = z^{\theta_z^0}$ and $\bar{w}_{0nt}$. Our identification argument is twofold. First, conditional on pre-college academic ability and field, students attending different universities have the same mean unobserved earnings potential at each possible workplace. Second, conditional on pre-college performance and the university program attended, the unobserved earnings component at each destination is mean independent of workplace choice. Together, these assumptions ensure that earnings differences among graduates with the same grades within a field-workplace-year cell identify relative program value added. See Appendix C.8 for details.

University Learning Technology. Combining our learning specification in (1) with the wage-equation effect $\pi_{k\tau} = \theta_q \log q_{k\tau}$, we obtain the estimating equation:

$$\widehat{\pi}_{k\tau} = \bar{\pi}_k + \delta_\tau + \theta_q\theta_x \log x_{k\tau} + \frac{\theta_q(1-\theta_x)}{\xi} \log \widehat{\mathbb{E}}_{F^*_{k\tau}}(z^\xi) + e_{k\tau}, \tag{15}$$

where $\bar{\pi}_k \equiv \theta_q \log \bar{q}_k$, δ_τ absorbs common cohort effects, and the hat on the peer moment denotes its empirical counterpart. We estimate (15) by weighted nonlinear least squares, using the precision of each wage-step estimate as its weight and profiling over ξ. We find that $\theta_x = 0$. Within-program changes in enrolled students' grades then link changes in $\widehat{\pi}_{k\tau}$ to peer quality. Its coefficient gives θ_q; changes in the shape of the grade distribution determine ξ. Multiplying the wage-step estimate of θ_{zq}/θ_q by $\widehat{\theta}_q$ gives $\widehat{\theta}_{zq}$. The permanent component yields $\bar{q}_k = \exp(\bar{\pi}_k/\theta_q)$, and the fitted peer term supplies cohort-specific quality for the choice model. Appendix C.8 gives further estimation details.

4.4 College Choice, Labor Supply, and Local Fundamentals

We next estimate a set of structural parameters that govern college and workplace choice by two-step maximum likelihood. In doing so, we also recover college-field-level amenities and workplace amenities. We then explain how we obtain estimates of productivity shifters, along with the across-field elasticity of substitution ρ_f and intergenerational transmission of ability.

For a college graduate, the utility cost of workplace n depends on its distance from both the campus and the home region. A non-college worker faces a home-to-workplace cost. We parameterize these frictions in kilometers as

$$\log \tau^{\mathbf{o}}_{kn|r} = \begin{cases} \lambda^{\mathrm{c}}_1 d_{\ell(u)n} + \lambda^{\mathrm{c}}_2 d_{rn}, & k = (u,f), \\ \lambda^{\mathrm{nc}}_2 d_{rn}, & k = 0, \end{cases} \qquad \log \tau^{\mathbf{y}}_{rk} = \lambda^{\mathbf{y}} d_{r\ell(u)}. \tag{16}$$

For an agent with state (h, b, k, r), utility from choosing location n can be rewritten as:

$$v^{\mathbf{o}}_{nt}(h, b, k, r) = B_{g(k),nt} - \log \tau^{\mathbf{o}}_{kn|r} + (1 + \beta) \log\Big(Rb + \bar{w}_{f(k)nt} h\Big). \tag{17}$$

We let workplace amenity $B_{g,nt}$ vary by two broad groups, college and non-college, denoted by $g(k) \in \{\text{c}, \text{nc}\}$. This destination-time effect combines workplace amenities with old housing and local-service prices. We estimate the parameter vector by maximum likelihood:

$$\widehat{\vartheta}^{\mathbf{o}} \in \arg\max_{\vartheta^{\mathbf{o}}} \sum_i \log \mu^{\mathbf{o}}(n_i \mid h_i, b^*_i(\vartheta^{\mathbf{o}}), k_i, r_i; \vartheta^{\mathbf{o}}). \tag{18}$$

We solve for saving b^*_i at each trial parameter vector, nesting the household problem inside likelihood maximization (Rust, 1987). Conditional on education and origin, differences in destination choices by field and resources inform the income response and $\sigma^{\mathbf{o}}$; differences by campus and home location discipline the two mobility costs. Destination shares recover $B_{g,nt}$ relative to the reference workplace.

Similarly, for the young with state (z, a, r), we can write the utility of choosing college program $k = (u, f)$ as:

$$v^{\mathbf{y}}_{k,t} = \log A_u + \log A_f - \lambda^{\mathbf{y}} d_{r\ell(u)} + \log(a - b^*_{k,t}) - (1 - \alpha_{\mathbf{y}}) \log p^{\mathbf{y}}_{\ell(u),t} + V^{\mathbf{o}}_{k,t+1}(b^*_{k,t}). \tag{19}$$

Holding the workplace estimates fixed, we solve for saving and the continuation value for each eligible alternative and choose $\lambda^{\mathbf{y}}$, $\sigma^{\mathbf{y}}$, A_u, and A_f to maximize

$$\widehat{\vartheta}^{\mathbf{y}} \in \arg\max_{\vartheta^{\mathbf{y}}} \sum_i \log \mu^{\mathbf{y}}\Big(k_i \mid z_i, a_i, r_i; \vartheta^{\mathbf{y}}, \widehat{\vartheta}^{\mathbf{o}}\Big). \tag{20}$$

Choices across origins identify the distance cost, while differences by ability and parental resources discipline the response to consumption and earnings gains. See Appendix C.10 for details.

4.4.1 Recovering Local Fundamentals

As is standard in quantitative spatial economics (e.g., Ahlfeldt et al., 2015), we recover local productivities and housing-supply shifters from the equilibrium conditions, conditional on the estimated parameters and normalizations. We take as given the estimated field elasticity ρ_f, the calibrated elasticities (ρ, η, ψ), estimated wages, sectoral efficiency-unit labor inputs and wage bills, model-implied housing expenditure, and observed housing prices. Given the field weights, we recover the remaining unknowns one at a time. With positive wages, labor inputs, expenditure, and prices, the normalizations $P_t = 1$ and $\Omega_{\text{NT}nt} \equiv 1$ yield unique closed-form solutions for college-augmenting productivity Ω^{c}_{snt}, tradable productivity $\Omega_{\text{T}nt}$, goods prices, and the housing-supply shifters $\bar{D}^{\mathbf{y}}_{nt}$ and $\bar{D}^{\mathbf{o}}_{nt}$. For illustration, the producers' field-level first-

order conditions and the normalization $\sum_f \omega_{sfn} = 1$ imply

$$\omega_{sfn} = \frac{\bar{w}_{fnt}^{\rho_f} H_{fsnt}^{c}}{\sum_{f' \in \mathcal{F}} \bar{w}_{f'nt}^{\rho_f} H_{f'snt}^{c}} \qquad \text{for every } t. \tag{21}$$

The time-invariant field weights are overidentified across dates; we estimate them from the pooled moment condition in (29). Appendix C.12 sets out the production recursion, and Appendix C.13 the housing inversion.

4.4.2 Substitution Across Fields

We estimate the CES elasticity of substitution across fields from the response of field wages to efficiency-unit supplies. The first-order conditions imply

$$\log \widehat{\bar{w}}_{fnt} = \delta_{sfn} + \delta_{snt} - \frac{1}{\rho_f} \log H_{fsnt}^{c} + e_{fsnt}, \tag{22}$$

where sector-field-region effects absorb permanent relative field demand and sector-region-year effects absorb common demand shifts. The OLS estimate is $\widehat{\rho}_f = 6.89$ (s.e. 0.40). See Appendix C.9 for the input construction, estimation details, and recovery of field-demand weights.

4.4.3 Intergenerational Transmission

We discipline the parameter κ in (2) by running the following regression on linked parent-child records:

$$\log \text{grade}_i = \kappa \log \text{parent_earn}_i + \delta_{r_i} + \delta_{t_i^{\mathbf{y}}} + e_i, \tag{23}$$

where parental earnings are measured at mid-career, δ_{r_i} absorbs home-region level differences, and $\delta_{t_i^{\mathbf{y}}}$ is an effect for the high-school graduation year $t_i^{\mathbf{y}}$. Within these cells, parental earnings proxy parental human capital.

4.5 Estimation Results

Table 1 reports the calibration, and Table 4 in Appendix B reports structural parameter estimates and the calibration used in the counterfactuals. Figure 13 in Appendix B.4 maps college attainment by high-school origin, regional skill premia, the college share of incumbent workers, and rents.

4.5.1 Learning and Program Quality

Returns to ability, proxied by high-school performance, are higher for college graduates than for non-college workers. Program quality also raises earnings. That is, a 10% increase in program quality raises earnings by 2.5% at median ability, holding field and workplace fixed. Ability

and quality are mild complements: moving from grade rank 0.50 to 0.90 raises earnings by 8.2% and 9.8% at the within-field 10th and 90th percentiles of fitted program quality, respectively, compared with 2.8% for non-college workers. The college comparisons average equally across the ten fields for the 2004–05 high-school cohort.

Our baseline specification controls for university, field, and cohort effects and finds $\widehat{\theta}_q = 0.279$ (s.e. 0.066) and $\widehat{\xi} = -0.459$ (s.e. 0.129). The peer aggregator thus lies between the geometric mean ($\xi \to 0$) and the harmonic mean ($\xi = -1$). The elasticity of the ξ-power mean of enrolled ability with respect to the ability of students at z is proportional to z^{ξ}. Note that with $\widehat{\xi} < 0$, this weight falls with ability: raising the ability of students at grade rank 0.25 by 1% raises peer quality about 1.7 times as much as raising that of an equal number of students at rank 0.75. Any $\xi < 1$ favors weaker students for equal increases in rank; only a negative ξ does so for equal proportional increases. Since $\theta_x = 0$, the power mean enters quality one-for-one, so a 10% increase in it raises earnings at median ability by 2.5%. Our main takeaway in interpreting the point estimates is that peer quality is tied to the bottom of the enrolled distribution. A marginal student raises peer quality if and only if her ability exceeds the program's ξ-power mean, which lies below its mean ability. Holding fixed which students enroll, combining them into fewer programs lowers the enrollment-weighted mean of the log peer-composition term when $\xi < 0$, and raises it when $\xi > 0$, unless the programs being combined have the same power mean.

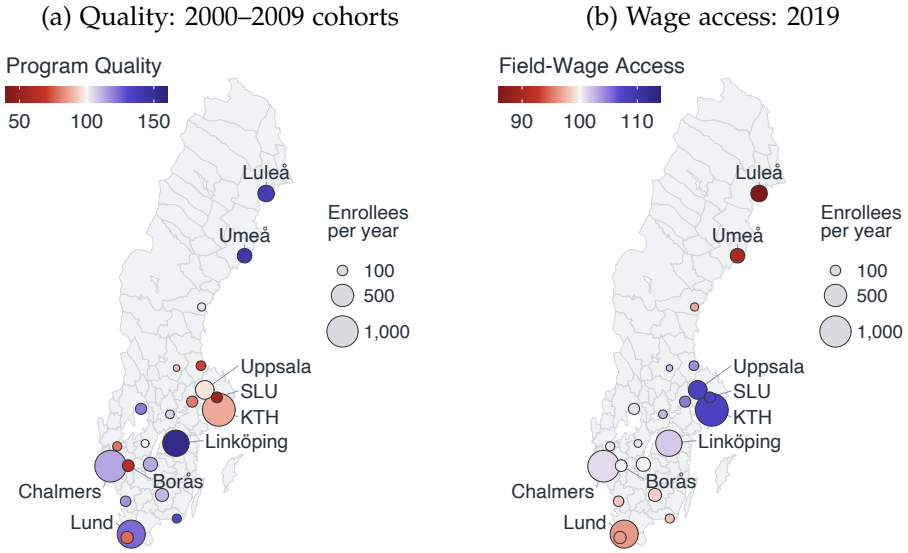
4.5.2 Program Quality, Market Access, and Spatial Incidence

Program quality is widely dispersed within fields, so students with the same pre-college achievement can acquire different amounts of human capital depending on where they study. We find that moving from the 10th to the 90th percentile of fitted program quality raises earnings by approximately 26% for a student of median ability, holding field and workplace fixed. This comparison averages equally across the ten fields for the 2004–05 high-school cohort. The earnings differences capture variation in learning across programs, holding fixed the wage paid for the resulting human capital. Figure 3, panel (a), illustrates the dispersion in program quality for Engineering.

Programs with higher measured quality tend to be located in regions where the same skills command lower wages. This relationship holds in nine of the ten fields: our quality measure is negatively correlated with the campus region's wage per efficiency unit. Larger labor markets also tend to host programs with lower fitted value added. Regional productivity and field-specific demand determine these wages jointly with skill supply. The estimated geography therefore creates a tension between where students acquire more human capital and where that human capital earns a higher return.

Migration frictions make this geographic separation consequential. Our estimates imply gravity in workplace choice toward both the university campus and the home region. Other things equal, graduates are more likely to work near these locations, and forward-looking

Figure 3: Engineering program quality and wage access



Notes: Both panels show 22 Engineering programs in 19 campus regions. Panel (a) averages log fitted quality equally across the five two-year high-school cohort bands from 2000–2001 to 2008–2009. Panel (b) shows wage access $\mathcal{W}_{f,\ell(k)}(0)$ from (25), evaluated at zero asset shift using 2019 workplace conditions and equal home-to-workplace distances across destinations. Each measure has an equal-program geometric mean of 100. Colors use separate linear scales; circle areas represent average annual enrollment, with the same program sizes in both panels.

students give those destinations greater weight when evaluating a degree.[11] Students attending a high-quality program in a lower-wage region can therefore face a tradeoff: they acquire more human capital, but reaching the labor markets where their skills command the highest return is costly. The value of the degree depends on the interaction between its learning opportunities and the field-specific labor markets accessible from its location. Figure 3, panel (b), maps the wages accessible from each Engineering campus; the rank correlation between program quality and wage access is -0.50.

The broader university market-access (UMA) measure also incorporates program-specific human capital and optimal saving. The value of the additional human capital produced by a high-quality program can be partly offset by less favorable opportunities to employ it after graduation. In Engineering, program quality and UMA are negatively correlated at the benchmark student state, even after allowing human capital and optimal saving to vary across programs.[12] This interaction also affects spatial incidence: the returns to learning depend on where graduates subsequently work, while the value of workplace opportunities differs across fields and students' origins. University provision thus influences both how much human capital students acquire and where they use it.

[11] Holding income, other destination characteristics, and the other distance fixed, an additional 100 kilometers from campus lowers graduates' conditional workplace-choice odds by approximately 45%; an additional 100 kilometers from home lowers them by approximately 50%.

[12] The rank correlation is -0.32, holding ability and parental resources fixed and home-to-workplace distance equal across destinations.

5 Counterfactuals

We use the estimated model to quantify the role higher education plays in shaping the long-term spatial distribution of economic activity. We consider a series of counterfactual scenarios in which aggregate capacity within a field is held fixed, while the geographic distribution of college slots differs. In the first counterfactual, which we dub *regional concentration*, we concentrate seats in the three most productive regions already offering the field. In the second, which we refer to as *increased access*, we reallocate the same number of seats toward existing campuses in regions with relatively few seats compared with the number of nearby high-school graduates without a college degree. By construction, both exercises hold fixed the aggregate and field-specific capacity of seats supplied by the planner.

We conduct both exercises separately for Engineering, Business and Economics, and Law, starting from the same 2005 baseline. In the baseline sample, these fields together account for 35% of college enrollment[13] and 44% of the college-educated wage bill in 2015. Each experiment reallocates capacity in one field and leaves every other field's capacity unchanged. We solve for a new stationary equilibrium, allowing all endogenous objects to adjust in equilibrium. In doing so, we compare steady states across two policy regimes.[14]

Policy specifications. Under concentration, we rank local labor markets by field-specific workplace productivity, retain programs in the top three, and transfer all other programs' seats to them in proportion to initial capacity. To bring out the mechanisms of interest, we weight tradable and nontradable productivity using each field's national allocation of efficiency units across the two sectors.[15] Recipient selection is robust to alternative sectoral weights, including equal weights and a ranking based on tradable productivity alone. All three fields select Stockholm, Göteborg, and Malmö–Lund. The policy reallocates 37.3%, 45.2%, and 21.5% of national capacity in Engineering, Business and Economics, and Law, respectively. Figure 4 illustrates our allocation rule.

Under increased access, we compare each existing campus region's capacity with a benchmark proportional to the nearby population of high-school graduates without a college degree, giving less weight to more distant origins. We expand regions below this benchmark in proportion to their initial shortfalls and reduce capacity elsewhere in proportion to initial supply. The policy transfers the same shares of national field capacity as concentration while retaining every program; see Figure 7. Table 8 in Appendix D describes both allocation rules in further detail.

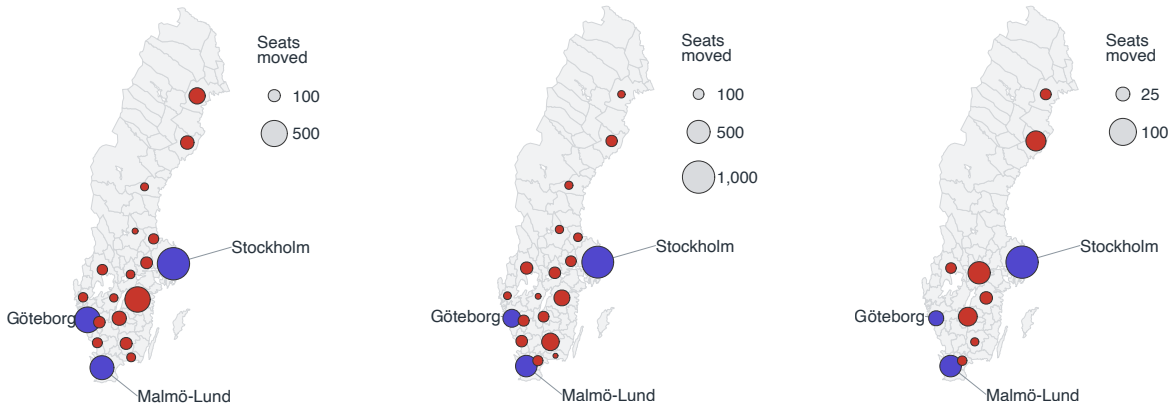
[13] Engineering, Business and Economics, and Law account for 16.98%, 14.20%, and 4.14% of college enrollment in the data, respectively. Their corresponding shares in the model baseline are 17.46%, 14.80%, and 4.38%.

[14] In ongoing work, we study the transition.

[15] The ranking uses $\left(\Omega_{\mathrm{T}n}\Omega^{\mathrm{c}}_{\mathrm{T}n}\omega^{1/(\rho_f-1)}_{\mathrm{T}fn}\right)^{s_f}\left(\Omega^{\mathrm{c}}_{\mathrm{NT}n}\omega^{1/(\rho_f-1)}_{\mathrm{NT}fn}\right)^{1-s_f}$, where the fixed 2015 data shares s_f are 0.615 for Engineering, 0.678 for Business and Economics, and 0.240 for Law.

Figure 4: Regional concentration of university seats

(a) Engineering (b) Business and Economics (c) Law



Notes: Each panel shows a separate reallocation of a fixed national supply of seats in the indicated field. Purple circles mark added seats; red circles mark removed seats. Circle area represents the number of seats moved, with a separate size key in each panel. See Table 8 in Appendix D for details.

5.1 Regional concentration

We begin by examining the ramifications of the policy for aggregate variables (Table 2). First, despite aggregate capacity in each field being held fixed at its baseline value, overall college attainment can increase, as in Engineering, decrease, as in Business and Economics, or remain essentially unchanged, as in Law. This response at the extensive margin of skill acquisition highlights the role of the spatial *distribution* of college program supply, in contrast to the aggregate capacity or expenditure more commonly emphasized in the literature. Despite the increase in college attainment in Engineering, human capital produced in that field falls by 10.36%. Human capital produced in Business and Economics and Law also falls under their respective reallocations.

The decline in human capital – aggregate and per enrolled student – reflects differences in program fundamentals, changes in the size of the enrolled population, and adjustments in student composition. First, human capital per enrolled graduate changes mechanically with the quality of the program attended. Donor and recipient programs differ in exogenous characteristics, including permanent quality, amenities, and campus location. In Engineering, the closing programs have stronger permanent learning fundamentals than the expanding programs.[16] The size of the enrolled population also changes: Engineering enrollment rises by 0.73%, but human capital per graduate falls by 11.01%, leaving 10.36% fewer Engineering efficiency units. Finally, changes in admission cutoffs alter who enrolls and how students are distributed across programs. This affects both the ability of those acquiring a degree and the peer environment in which they accumulate their human capital.

[16] At ability rank 0.75, evaluating learning using only the permanent component of quality gives a 12.4% donor advantage, with programs weighted by baseline enrollment.

Table 2: Effects of concentrating university seats

	Engineering	Business and Economics	Law
A. Economy-wide outcomes			
Tradable output (%)	−0.98	−0.50	−0.14
Local-service output (%)	−0.86	−0.47	−0.17
College attainment (pp)	+0.033	−0.239	−0.002
College human capital (%)	−1.79	−1.76	−0.57
Recipients' share of college human capital (pp)	+1.21	+1.05	+0.41
B. Outcomes in the reallocated field (%)			
Enrollment	+0.73	−5.08	0.00
Human capital per graduate	−11.01	−8.39	−7.05
Total human capital	−10.36	−13.04	−7.05
Human capital per graduate, peers fixed	−6.47	−2.73	−4.13
C. Tradable output under alternative assumptions (%)			
Peer quality held at baseline	−0.60	−0.17	−0.09
No campus-to-workplace moving cost	−1.00	−0.57	−0.14
No campus-to-workplace cost, peers fixed	−0.64	−0.26	−0.09

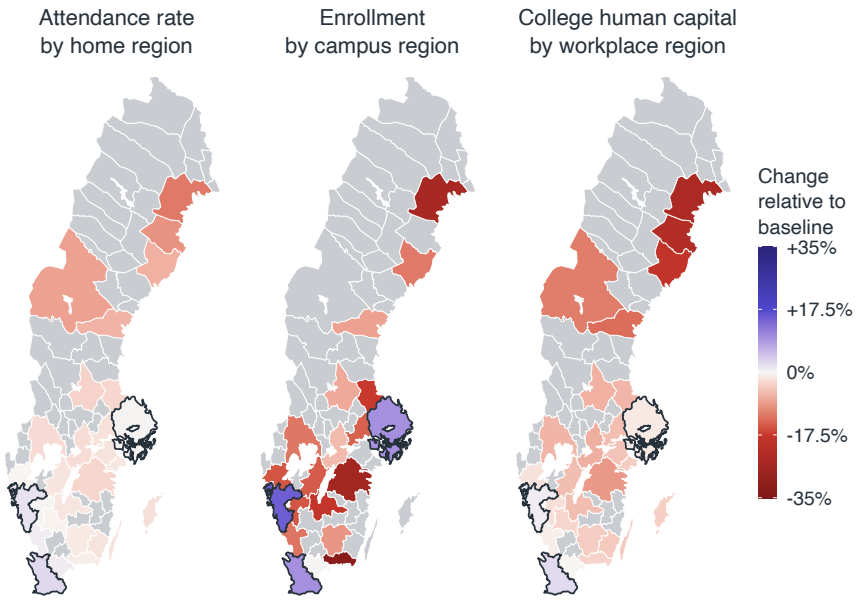
Notes: Columns are independent reallocations. Panel A covers all fields. Attainment is the college share of a fixed national cohort. Local-service quantities are valued at baseline regional prices. College human capital sums efficiency units in the maintained learning normalization. Panel B covers the affected field; the Law enrollment change is zero to numerical precision. Holding peers fixed freezes each surviving program's additive peer contribution at its matching baseline and resolves all other endogenous objects. Removing campus-to-workplace costs sets only $\lambda_1^c = 0$; home-related frictions remain. Each specification is compared with its own baseline. Percentage-point changes are marked pp.

The peer contrast shows the importance of this compositional adjustment. Expanding selective programs lowers their admission cutoffs, admitting students who were previously ineligible. Under the estimated learning technology, the resulting deterioration in peer quality lowers human capital at a given ability, including for students who would attend under either allocation. Holding each surviving program's peer contribution at its baseline value reduces the Engineering human-capital loss from 10.36% to 5.65% and the tradable-output loss from 0.98% to 0.60%. The change in attainment is small in comparison. Endogenous learning thus amplifies the effects of reallocating seats across programs with different fundamentals.[17]

Even in scenarios with mild aggregate college attainment responses, the policy substantially redistributes educational opportunities across home regions. Figure 5 distinguishes where students come from, where they study, and where their skills are employed. Its left panel measures college attendance by home region, regardless of the location or field of study. In the Engineering experiment, this rate rises in all three recipient metros, by 2.78% in Malmö–Lund and 1.80% in Göteborg, while falling by 11.83% in Luleå and 9.43% in Skellefteå. These are

[17]The peer contrast compares complete equilibrium responses. It retains changes in student selection, program assignment, prices, and the stationary population; it does not isolate the learning effect on a fixed group of students.

Figure 5: Where skills are acquired, produced, and used: Engineering



Notes: Percentage changes from the Engineering seat reallocation. All panels cover college education in every field. Left: the share of young people from each home region attending college anywhere. Middle: enrollment at campuses in each region. Right: college human capital supplied at workplaces in each region. Regional attendance rates use each equilibrium's own young population. Outlines mark Stockholm, Göteborg, and Malmö–Lund. Gray denotes regions outside the model; the middle panel also shades regions without a campus. The three panels share a color scale.

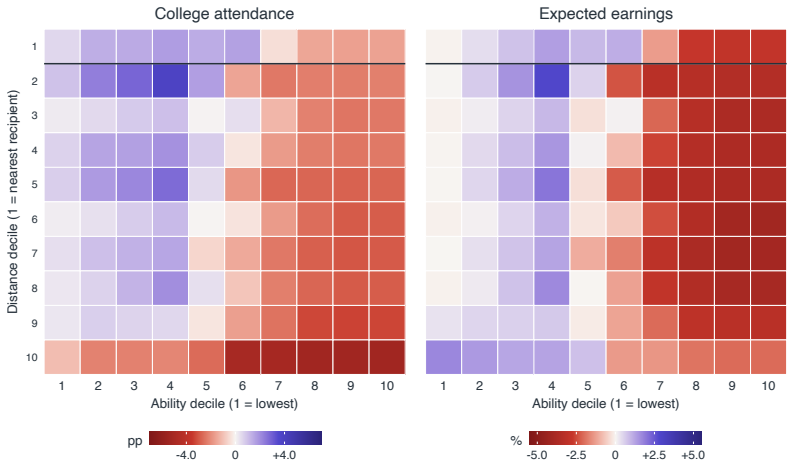
relative changes in regional attendance rates. Concentrating provision expands opportunities near the recipients while removing local options for students in the northeast, even though national field capacity is unchanged.

Consider now the role of imperfect mobility, which links the earnings premium from attending a particular college to labor demand for graduates in that field in nearby labor markets. Campus labor markets attract their graduates, raising the recipient metros' share of aggregate college human capital by 1.21 percentage points in the Engineering experiment. The right panel of Figure 5 shows the corresponding concentration of skills: workplace college human capital rises in Malmö–Lund and Göteborg and falls sharply in the northeast. The policy brings education to productive labor markets, where campus attachment tends to retain graduates. When we remove the campus-to-workplace moving cost, the increase in recipients' share is only 0.11 percentage points and the tradable-output loss is slightly larger, 1.00% rather than 0.98%. This comparison is consistent with campus attachment cushioning output losses: removing it makes working away from the recipients, including in less productive regions, less costly. It also changes educational choices: Engineering attainment no longer rises, and the aggregate college-human-capital loss increases from 1.79% to 1.96%.[18]

We now focus on the distributional effects of the policy, again considering only steady-state comparisons. Each equilibrium is characterized by a joint distribution of ability and parental

[18] We set only $\lambda_1^c = 0$; home-related moving costs remain.

Figure 6: Distributional effects of regional concentration: Engineering



Notes: Effects of the Engineering seat reallocation. Left: change in college attendance probability, in percentage points. Right: percentage change in expected earnings. Baseline ability-decile boundaries and type masses are held fixed; parental-resource groups and home regions are pooled using baseline population weights. Distance deciles group home regions by distance to the nearest recipient, from 1 (nearest) to 10 (farthest); the first decile contains Stockholm, Göteborg, and Malmö–Lund.

transfers across home regions. Figure 6 summarizes the model's predictions across ability deciles and deciles of distance to the nearest recipient.

On average, lower- and middle-ability students, in deciles 1–5, gain attendance and expected labor earnings in the recipient metros. Lower admission cutoffs open programs that were previously unavailable to them, and campus proximity limits the cost of taking up these places. In the far northeast, expected earnings for this group also rise, even though attendance falls. Equilibrium changes in wages and workplace opportunities can therefore benefit groups whose access to college contracts.

High-ability students, in deciles 8–10, are generally the most affected. In the far northeast, closing nearby programs removes attractive options for students who were already eligible, and both attendance and expected earnings fall. High-ability students from the recipient metros also lose expected earnings. These losses are consistent with limited gains from relaxed admission thresholds and weaker peer quality, which reduces learning for students who would already have attended the expanding programs. Their outcomes illustrate why additional seats near a student's home need not raise her return to education: the policy changes the quality of the available programs as well as access to them.

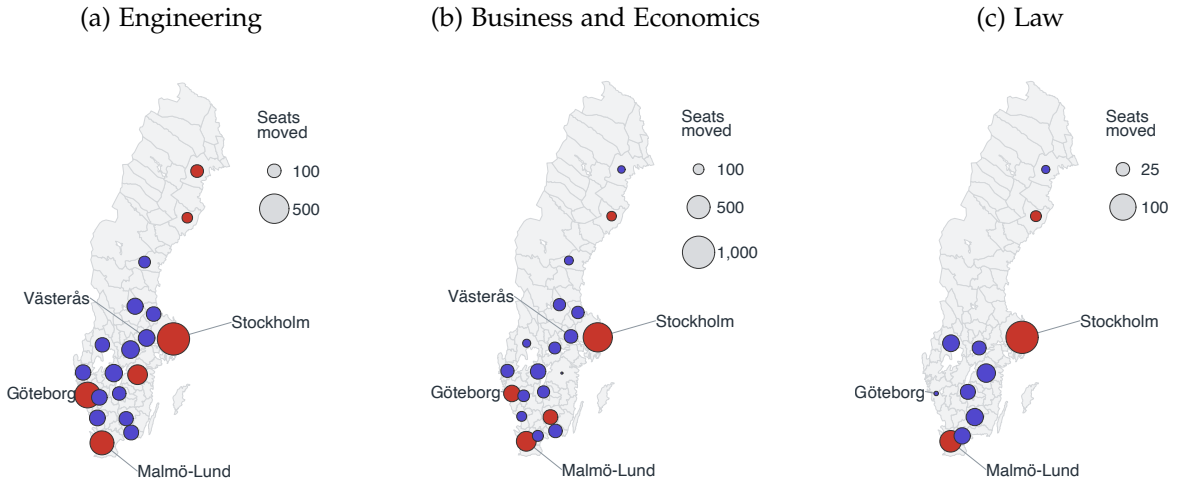
For Business and Economics and Law, the relative importance of the mechanisms discussed above varies. Business and Economics loses both enrollment and human capital per graduate, whereas Law loses human capital with virtually unchanged enrollment. Engineering's larger initial donor learning advantage and the response of peers contribute to its greater tradable-output loss. Sectoral exposure also matters: Engineering and Business and Economics account for larger cost shares in tradables, while Law is relatively more intensive in local services.

In Law, local-service output falls by 0.17%, compared with 0.14% for tradables. In Business and Economics, the fall in attainment expands non-college labor supply and cushions the production loss; the supporting labor-input accounting appears in Table 9 in Appendix D. Earnings incidence likewise differs: high-ability students in the far northeast gain earnings in the Business experiment despite lower attendance, unlike their counterparts in Engineering and Law. Comparisons across fields thus jointly depend on initial program quality, the amount of capacity moved, and labor demand forces, not least the tradability of field services.

5.2 Increased access

Figure 7 illustrates the allocation of seats under increased access. As in regional concentration, aggregate capacity in each field is held fixed at its baseline value.

Figure 7: Reallocation of university seats under increased access



Notes: Each panel shows a separate reallocation of a fixed national supply of seats. Purple circles mark added seats; red circles mark removed seats. Circle area represents the number of seats moved, with a separate size key in each panel. Every program remains open. Allocation rules are described in Table 8.

We begin by examining the ramifications of the policy for aggregate variables (Table 3). Overall college attainment falls in Engineering and Business and Economics, while remaining essentially unchanged in Law. This reallocation of college supply therefore need not raise aggregate attainment. Human capital produced in Engineering falls by 8.62%, and the decline is larger in Business and Economics. In Law, human capital produced in the field rises slightly.

Changes in human capital – aggregate and per enrolled student – again reflect differences in program fundamentals, changes in the size of the enrolled population, and adjustments in student composition. First, human capital per enrolled graduate changes mechanically with the quality of the program attended. In Engineering, the expanding programs have stronger permanent learning fundamentals than the contracting programs, on average. The size of the enrolled population also changes: recipients do not fill enough additional seats to replace

Table 3: Effects of reallocating university seats under increased access

	Engineering	Business and Economics	Law
A. Economy-wide outcomes			
Tradable output (%)	−0.415	−0.896	−0.004
Local-service output (%)	−0.294	−0.637	−0.015
College attainment (pp)	−0.357	−0.982	0.000
College human capital (%)	−1.42	−3.56	+0.04
Recipients' share of college human capital (pp)	+0.45	+0.53	+0.32
B. Outcomes in the reallocated field (%)			
Enrollment	−6.52	−21.17	−0.002
Human capital per graduate	−2.25	−5.46	+0.57
Total human capital	−8.62	−25.47	+0.57
Human capital per graduate, peers fixed	+1.49	−1.82	+1.55
C. Tradable output under alternative assumptions (%)			
Peer quality held at baseline	−0.117	−0.763	+0.022
No campus-to-workplace moving cost	−0.295	−0.776	+0.001
No campus-to-workplace cost, peers fixed	+0.005	−0.621	+0.026

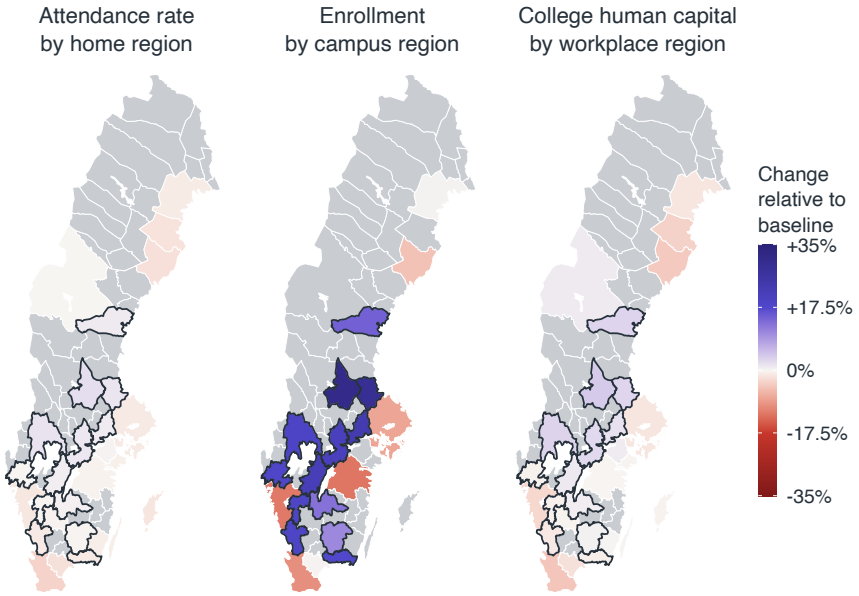
Notes: Definitions and matching baselines are the same as in Table 2. Recipient regions differ across fields and from concentration. All programs remain available.

enrollment lost at donors, and Engineering enrollment falls by 6.52%. Some expanding programs reach the common eligibility threshold and leave seats unfilled. Finally, changes in admission cutoffs alter who enrolls and how students are distributed across programs, changing the peer environment in which they accumulate their human capital.

The peer contrast shows the importance of this compositional adjustment. Expanding Engineering programs lower admission cutoffs and peer quality. At contracting programs, peer quality rises. Since these programs remain open, students who continue to attend benefit from the improvement in their peer environment. These gains partly offset the deterioration at recipients, but human capital per graduate still falls by 2.25%. Holding each program's peer contribution at its baseline value instead raises human capital per graduate by 1.49%, reduces the Engineering human-capital loss from 8.62% to 4.81%, and reduces the tradable-output loss from 0.41% to 0.12%. Compared with regional concentration, increased access produces fewer Engineering graduates but more human capital per graduate, leaving a smaller decline in human capital produced in the field.

The policy also redistributes educational opportunities across home regions. Figure 8 distinguishes where students come from, where they study, and where their skills are employed. Its left panel measures college attendance by home region, regardless of the location or field of study. In the Engineering experiment, this rate rises by 2.18% in Falun–Borlänge and 1.76% in Karlstad, while falling by 3.27% in Malmö–Lund and 2.01% in Umeå. These are relative changes

Figure 8: Where skills are acquired, produced, and used under increased access: Engineering



Notes: Percentage changes from the Engineering seat reallocation. All panels cover college education in every field. Left: the share of young people from each home region attending college anywhere. Middle: enrollment at campuses in each region. Right: college human capital supplied at workplaces in each region. Regional attendance rates use each equilibrium's own young population. Outlines mark recipient regions. Gray denotes regions outside the model; the middle panel also shades regions without a campus.

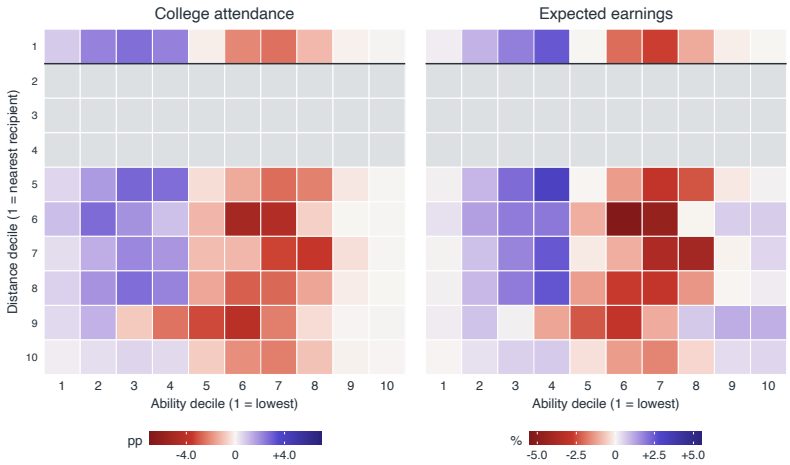
in regional attendance rates. The reallocation expands opportunities near recipient campuses while reducing them near programs that lose seats.

Consider now the role of imperfect mobility, which links the earnings premium from attending a particular college to labor demand for graduates in that field in nearby labor markets. Campus labor markets attract their graduates, raising recipients' share of aggregate college human capital by 0.45 percentage points in the Engineering experiment. The right panel of Figure 8 shows the corresponding spatial changes: workplace college human capital rises in Falun–Borlänge and Karlstad and falls in Malmö–Lund and Umeå. When we remove the campus-to-workplace moving cost, the increase in recipients' share is only 0.04 percentage points. In this case, however, the tradable-output loss falls from 0.41% to 0.30%. Educational choices also adjust: the aggregate attainment loss falls from 0.36 to 0.28 percentage points, and the aggregate college-human-capital loss falls from 1.42% to 1.07%. Imperfect mobility thus shapes both where graduates work and how much human capital they acquire, with different implications under the two allocation rules.

We now focus on the distributional effects of the policy, again considering only steady-state comparisons. Figure 9 summarizes the model's predictions across ability deciles and deciles of distance to the nearest recipient.

On average, lower- and middle-ability students, in deciles 1–5, gain attendance and expected labor earnings in recipient regions. Lower admission cutoffs open programs that were previously

Figure 9: Distributional effects of increased access: Engineering



Notes: Effects of the Engineering seat reallocation. Left: change in college attendance probability, in percentage points. Right: percentage change in expected earnings. Baseline ability-decile boundaries and type masses are held fixed; parental-resource groups and home regions are pooled using baseline population weights. Distance deciles group home regions by distance to the nearest recipient, from 1 (nearest) to 10 (farthest). Equal distances stay together, and all recipient regions enter the first group. Gray rows contain no home regions.

unavailable to them, and campus proximity limits the cost of taking up these places. Attendance and expected earnings also rise for this group in the regions farthest from a recipient. Gains in access therefore extend beyond the regions in which capacity expands, since students can attend programs elsewhere.

High-ability students, in deciles 8–10, lose attendance and expected earnings in recipient regions, on average. Students in deciles 6–7 experience larger losses there. These losses are consistent with limited gains from relaxed admission thresholds and weaker peer quality at expanding programs. Additional seats near a student's home need not raise her return to education. In the regions farthest from a recipient, high-ability students also lose attendance, but their expected earnings rise. As under regional concentration, equilibrium changes in wages and workplace opportunities can benefit groups whose access to college contracts.

For Business and Economics and Law, the relative importance of the mechanisms discussed above varies. Business and Economics loses both enrollment and human capital per graduate. Its larger enrollment decline leaves a greater loss of human capital than under regional concentration, even though human capital per graduate falls by less. The fall in attainment expands non-college labor supply and cushions the production loss; Table 10 in Appendix D reports the supporting labor-input accounting. Law has virtually unchanged enrollment and a small increase in human capital per graduate, yet tradable output remains nearly unchanged and local-service output falls slightly. The distributional effects also differ: in Business and Economics, lower- and middle-ability students in recipient regions gain attendance but lose expected earnings, whereas high-ability students in Law gain both. Figures 16 and 17 in Appendix D report the spatial and distributional changes in these fields. Comparisons across

fields thus jointly depend on initial program quality, the amount of capacity moved, and labor demand forces, not least the tradability of field services.

6 Conclusion

In this paper, we develop a dynamic spatial general equilibrium model in which university programs shape the long-run spatial distribution of population and skill. The composition of peers in college matters for human capital accumulation, making college quality endogenous, while education and migration choices shape the ability and resources inherited by subsequent generations. We quantify the model using Swedish administrative, archival, and open-source data. We reject mean peer effects and find that program quality is particularly sensitive to the lower tail of the ability distribution. Higher-quality programs tend to be located in lower-wage regions, so learning opportunities and access to productive labor markets need not coincide.

Using the quantified model, we evaluate geographic reallocations of university seats, holding national capacity fixed within each field. We show that aggregate college attainment can rise or fall despite unchanged capacity. Concentrating seats in the most productive regions lowers college human capital and output, with weaker peer quality amplifying the losses. The effects differ across students and regions: in Engineering, lower- and middle-ability students near expanding campuses gain attendance and expected earnings. Bringing college opportunities closer to more students instead shifts provision toward less productive labor markets.

In ongoing work, we use and extend this framework on two fronts. First, we study optimal spatial policy, both theoretically and quantitatively, in an economy undergoing demographic transformation and facing exogenous changes in demand for its educational services. Second, motivated by empirical evidence on the agglomeration of skills and industries, we study how a planner can combine education policies with the geographic provision of higher education to coordinate the economy on a particular equilibrium in settings with both static and dynamic multiplicity.

References

Abbott, Brant, Gallipoli, Giovanni, Meghir, Costas, and Violante, Giovanni L. (2019). "Education Policy and Intergenerational Transfers in Equilibrium". *Journal of Political Economy* 127.6, pp. 2569–2624.

Acemoglu, Daron and Autor, David (2011). "Skills, Tasks and Technologies: Implications for Employment and Earnings". In Ashenfelter, Orley and Card, David, editors, *Handbook of Labor Economics*, volume 4B. Elsevier, pp. 1043–1171.

Aguilar, Elena (2026). "Credit Constraints, Learning, and Spatial Misallocation". Working paper.

Ahlfeldt, Gabriel M., Redding, Stephen J., Sturm, Daniel M., and Wolf, Nikolaus (2015). "The Economics of Density: Evidence from the Berlin Wall". *Econometrica* 83.6, pp. 2127–2189.

Akcigit, Ufuk, Pearce, Jeremy, and Prato, Marta (2025). "Tapping into talent: Coupling education and innovation policies for economic growth". *Review of Economic Studies* 92.2, pp. 696–736.

Alon, Titan, Cox, Natalie, and Kim, Minki (2024). "Debt, Human Capital, and the Allocation of Talent". Working paper.

Andersson, Roland, Quigley, John M., and Wilhelmsson, Mats (2004). "University decentralization as regional policy: The Swedish experiment". *Journal of Economic Geography* 4.4, pp. 371–388.

Andersson, Roland, Quigley, John M., and Wilhelmsson, Mats (2009). "Urbanization, productivity, and innovation: Evidence from investment in higher education". *Journal of Urban Economics* 66.1, pp. 2–15.

Antagning.se (n.d.). "Så anmäler du dig". URL https://www.antagning.se/sv/anmal-dig-sa-har/tva-vagar-till-webbanmalan/sa-anmaler-du-dig/. Accessed September 2026.

Argentina (2009). "Ley 26.575: Creación de la Universidad Nacional de Moreno". Honorable Congreso de la Nación Argentina. URL https://www.argentina.gob.ar/normativa/nacional/ley-26575-162426/texto.

Bergh, Andreas, Hällerfors, Henrik, Tåg, Joacim, and Åstebro, Thomas (2024). "Demokratisering och decentralisering av högskolan: En utvärdering av 1977 års svenska högskoleexpansion". Technical report, SNS Förlag.

Bianchi, Nicola (2020). "The Indirect Effects of Educational Expansions: Evidence from a Large Enrollment Increase in University Majors". *Journal of Labor Economics* 38.3, pp. 767–804.

Bilal, Adrien and Rossi-Hansberg, Esteban (2021). "Location as an Asset". *Econometrica* 89.5, pp. 2459–2495.

Bleemer, Zachary and Quincy, Sarah (2026). "Junior Colleges and Local Development". Working paper.

Blinder, Alan S. and Krueger, Alan B. (2013). "Alternative Measures of Offshorability: A Survey Approach". *Journal of Labor Economics* 31.S1, pp. S97–S128.

Boar, Corina and Lashkari, Danial (2021). "Occupational Choice and the Intergenerational Mobility of Welfare". Working Paper 29381, National Bureau of Economic Research. Revised May 2025.

Board of Governors of the Federal Reserve System (2026). "Swedish Kronor to U.S. Dollar Spot Exchange Rate [AEXSDUS]". FRED, Federal Reserve Bank of St. Louis. URL https://fred.stlouisfed.org/series/AEXSDUS. Annual averages; 2016–2020 observations. Accessed November 1, 2026.

Booij, Adam S., Leuven, Edwin, and Oosterbeek, Hessel (2017). "Ability Peer Effects in University: Evidence from a Randomized Experiment". *Review of Economic Studies* 84.2, pp. 547–578.

Broda, Christian and Weinstein, David E. (2006). "Globalization and the Gains from Variety". *Quarterly Journal of Economics* 121.2, pp. 541–585.

Burstein, Ariel, Hanson, Gordon, Tian, Lin, and Vogel, Jonathan (2020). "Tradability and the Labor-Market Impact of Immigration: Theory and Evidence From the United States". *Econometrica* 88.3, pp. 1071–1112.

Caldera Sánchez, Aida and Johansson, Åsa (2011). "The Price Responsiveness of Housing Supply in OECD Countries". OECD Economics Department Working Papers 837, OECD Publishing, Paris.

Capelle, Damien and Matsuda, Kazushige (2026). "The Great Gatsby Goes to College: Tuition, Inequality and Intergenerational Mobility". Working paper, May 9.

Cavalleri, Maria Chiara, Cournède, Boris, and Özsöğüt, Ezgi (2019). "How Responsive Are Housing Markets in the OECD? National Level Estimates". OECD Economics Department Working Papers 1589, OECD Publishing, Paris.

Chetty, Raj, Friedman, John N., Saez, Emmanuel, Turner, Nicholas, and Yagan, Danny (2020). "Income Segregation and Intergenerational Mobility Across Colleges in the United States". *The Quarterly Journal of Economics* 135.3, pp. 1567–1633.

Crews, Levi Garrett (2023). "A dynamic spatial knowledge economy".

CSN (2020). "Allt fler studerande väljer att ta studielån". URL https://www.csn.se/om-csn/press/pressmeddelanden/2020-04-21-allt-fler-studerande-valjer-att-ta-studielan.html. Press release, April 21.

CSN (n.d.). "Student grants and loans for studies in Sweden". URL https://www.csn.se/languages/english/student-grants-and-loans-for-studies-in-sweden.html. Accessed November 1, 2026.

Daruich, Diego (2026). "The Macroeconomic Consequences of Early Childhood Development Policies". *Journal of Political Economy* 134.7, pp. 2023–2073.

Davis, Donald R. and Dingel, Jonathan I. (2019). "A Spatial Knowledge Economy". *American Economic Review* 109.1, pp. 153–170.

Desmet, Klaus and Rossi-Hansberg, Esteban (2014). "Spatial Development". *American Economic Review* 104.4, pp. 1211–1243.

Desmet, Klaus, Nagy, Dávid Krisztián, and Rossi-Hansberg, Esteban (2018). "The Geography of Development". *Journal of Political Economy* 126.3, pp. 903–983.

Desmet, Klaus, Nagy, Dávid Krisztián, and Rossi-Hansberg, Esteban (2026). "Human Capital Accumulation Across Space". Working Paper 2634, Federal Reserve Bank of Dallas.

Dingel, Jonathan I., Gottlieb, Joshua D., Lozinski, Maya, and Mourot, Pauline (2026). "Market Size and Trade in Medical Services". Working Paper 31030, National Bureau of Economic Research.

Eaton, Jonathan and Kortum, Samuel (2019). "Trade in Goods and Trade in Services". In Ing, Lili Yan and Yu, Miaojie, editors, *World Trade Evolution: Growth, Productivity, and Employment*. Routledge, pp. 82–125.

Eckert, Fabian and Kleineberg, Tatjana (2024). "The Geography of Opportunity: Education, Work, and Intergenerational Mobility Across US Counties". Working paper.

Edin, Per-Anders and Holmlund, Bertil (1995). "The Swedish Wage Structure: The Rise and Fall of Solidarity Wage Policy?". In Freeman, Richard B. and Katz, Lawrence F., editors, *Differences and Changes in Wage Structures*. University of Chicago Press, Chicago, pp. 307–344.

Eilat, Yair and Einav, Liran (2004). "Determinants of International Tourism: A Three-Dimensional Panel Data Analysis". *Applied Economics* 36.12, pp. 1315–1327.

Epple, Dennis, Romano, Richard, and Sieg, Holger (2006). "Admission, tuition, and financial aid policies in the market for higher education". *Econometrica* 74.4, pp. 885–928.

Eurostat (2026). "National Accounts and Actual Individual Consumption". URL https://ec.europa.eu/eurostat/databrowser/view/nama_10_gdp/default/table. Datasets nama_10_gdp, prc_ppp_ind, and prc_ppp_ind_1. Data accessed August 29, 2026.

Fabre, Anaïs (2026). "The Geography of Higher Education and Spatial Inequalities". *The Review of Economic Studies*. Accepted for publication.

Feld, Jan and Zölitz, Ulf (2017). "Understanding Peer Effects: On the Nature, Estimation, and Channels of Peer Effects". *Journal of Labor Economics* 35.2, pp. 387–428.

Fischer, Alexander, Gorshkov, Andrei, Sandoy, Tróndur M., and Walldorf, Jeanette (2025). "Peers, Heirs, and Careers: Labor Market Effects of Alumni Networks". Working paper, January 2025.

Florida Board of Governors (2025). "Limitation on Non-Resident Student Enrollment". Regulation 7.006. URL https://www.flbog.edu/wp-content/uploads/2025/11/7.006-Limitation-on-Non-Res-Student-Enroll_2025-1.pdf.

Fogli, Alessandra, Guerrieri, Veronica, Ponder, Mark, and Prato, Marta (2026). "The End of the American Dream? Inequality and Segregation in US Cities". *Journal of Political Economy* 134.4, pp. 1110–1158.

Fujimoto, Junichi, Lagakos, David, and VanVuren, Mitchell (2025). "Macroeconomic Effects of 'Free' Secondary Schooling in the Developing World". *American Economic Journal: Macroeconomics*. Forthcoming.

Golsteyn, Bart H. H., Non, Arjan, and Zölitz, Ulf (2021). "The Impact of Peer Personality on Academic Achievement". *Journal of Political Economy* 129.4, pp. 1052–1099.

Government of Sweden (1977). "Om utbildning och forskning inom högskolan m.m.". Proposition 1976/77:59. URL https://www.riksdagen.se/sv/dokument-och-lagar/dokument/proposition/om-utbildning-och-forskning-inom-hogskolan-m-m_g00359/.

Government of Sweden (1996). "Budgetpropositionen för 1997, utgiftsområde 16: Utbildning och universitetsforskning". Proposition 1996/97:1. URL https://www.regeringen.se/contentassets/d8908af93ba74dcfa2ed9d69ebb978b6/utgiftsomrade-16b-utbildning-och-universitetsforskning-forts/.

Government of Sweden (1998). "Budgetpropositionen för 1999, utgiftsområde 16: Utbildning och universitetsforskning". Proposition 1998/99:1. URL https://www.riksdagen.se/sv/dokument-och-lagar/dokument/proposition/budgetpropositionen-for-1999_GM031D2/html/.

Hampole, Menaka, Truffa, Francesca, and Wong, Ashley (2026). "Peer Effects and the Gender Gap in Corporate Leadership: Evidence from MBA Students". *Quarterly Journal of Economics* 141.3, pp. 2499–2554.

Isphording, Ingo E., Thieme, Albert, and Zölitz, Ulf (2026). "The Value of a Peer". Working paper, July 2026.

Lhuillier, Hugo (2026). "Should I Stay or Should I Grow? How Cities Affect Human Capital". Working paper.

Lipsey, Robert E. (2009). "Measuring International Trade in Services". In Reinsdorf, Marshall and Slaughter, Matthew J., editors, *International Trade in Services and Intangibles in the Era of Globalization*. University of Chicago Press, pp. 27–70.

Monte, Ferdinando, Redding, Stephen J., and Rossi-Hansberg, Esteban (2018). "Commuting, Migration, and Local Employment Elasticities". *American Economic Review* 108.12, pp. 3855–3890.

Mountjoy, Jack (2026). "Marginal Returns to Public Universities". *The Quarterly Journal of Economics* 141.1, pp. 429–497.

Mountjoy, Jack and Hickman, Brent R. (2021). "The returns to college(s): Relative value-added and match effects in higher education". Technical report, National Bureau of Economic Research.

Muñoz, Mathilde (2022). "Trading Non-Tradables: The Implications of Europe's Job Posting Policy". Working paper.

Nimier-David, Elio (2023). "Local Human Capital and Firm Creation: Evidence from the Massification of Higher Education in France". Working paper.

Olovsson, Conny, Walentin, Karl, and Westermark, Andreas (2025). "Dynamic Macroeconomic Implications of Immigration". *Journal of Monetary Economics* 151, p. 103747.

Rust, John (1987). "Optimal Replacement of GMC Bus Engines: An Empirical Model of Harold Zurcher". *Econometrica* 55.5, pp. 999–1033.

Secretaría de Educación (2024). "Listado de instituciones universitarias integrantes del Sistema Universitario Nacional". Dirección Nacional de Gestión Universitaria. URL https://www.argentina.gob.ar/sites/default/files/2024_m12_-_instituciones_universitarias_1.pdf.

Smeets, Valerie, Tian, Lin, and Traiberman, Sharon (2026). "Field Choice, Skill Specificity, and Labor Market Disruptions". *The Review of Economic Studies*. Accepted for publication.

SOU (2007). "Resurser för kvalitet". Technical Report 2007:81, Statens offentliga utredningar.

Statistics Sweden (2015). "Antal hyresrättslägenheter, årshyra, bostadsyta efter region, nybyggår/värdeår, årsintervall och lägenhetstyp. År 2003–2014". URL https://www.statistikdatabasen.scb.se/goto/sv/ssd/Bhudef1ny. Table Bhudef1ny. Updated October 1, 2015; accessed November 1, 2026.

Statistics Sweden (2020). "SUN 2020: Svensk utbildningsnomenklatur [Swedish Standard Classification of Education], Version 1.1". Statistics Sweden, Örebro. URL https://www.scb.se/sun.

Statistics Sweden (2026). "National Accounts: Household Consumption by Purpose and Government Consumption by Function". URL https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__NR__NR0103__NR0103E/NR0103ENS2010T03NAN/. Tables NR0103ENS2010T03NAN and NR0103ENS2010T05NA. Data accessed August 29, 2026.

UC Merced (2003). "Going Vertical at First UC Campus in Four Decades". Newsroom, October 7. URL https://news.ucmerced.edu/news/2003/going-vertical-first-uc-campus-four-decades.

UNC System (2026). "Policy on Nonresident Undergraduate Enrollment". The UNC Policy Manual, Section 700.1.3. URL https://www.northcarolina.edu/apps/policy/doc.php?id=789.

UNESCO Institute for Statistics (2012). *International Standard Classification of Education: ISCED 2011*. UNESCO Institute for Statistics, Montreal.

UNESCO Institute for Statistics (2015). "International Standard Classification of Education: Fields of Education and Training 2013 (ISCED-F 2013), Detailed Field Descriptions". UNESCO Institute for Statistics, Montreal.

University Admissions (n.d.). "Selection process: Bachelor's". URL https://www.universityadmissions.se/en/selection-and-admissions-results/selection-process-bachelors/. Accessed September 2026.

University of California (2017). "UC Board of Regents Approves Policy on Nonresident Student Enrollment". URL https://www.universityofcalifornia.edu/press-room/uc-board-regents-approves-policy-nonresident-student-enrollment.

UT Austin (2016). "Undergraduate Admission". General Information 2016–2017. URL https://catalog.utexas.edu/archive/2016-17/general-information/admission/undergraduate-admission/.

Wright, Jacob (2025). "On the Spatial Distribution of Colleges". Working paper.

Appendix

Appendix A Theory

Appendix A.1 Household Intratemporal Problems and Indirect Utilities

At each stage, the household solves a Cobb-Douglas allocation problem. We omit additive constants common across alternatives, since they do not affect choices. We also omit dates: cohort t chooses its young bundle and education at t, then receives income and consumes its old bundle at $t+1$. Program quality refers to t, and the continuation value to $t+1$.

Young. Given (z, a, r), an option k and an asset choice b, the household solves

$$\max_{c^{\mathbf{y}},\, d^{\mathbf{y}}} \ \alpha_{\mathbf{y}} \log c^{\mathbf{y}} + (1-\alpha_{\mathbf{y}}) \log d^{\mathbf{y}} \quad \text{s.t.} \quad c^{\mathbf{y}} + p^{\mathbf{y}}_{\ell(k)} d^{\mathbf{y}} = a - b.$$

The exponents sum to one, so expenditures are constant shares of $a-b$:

$$c^{\mathbf{y}} = \alpha_{\mathbf{y}}\,(a-b), \qquad p^{\mathbf{y}}_{\ell(k)} d^{\mathbf{y}} = (1-\alpha_{\mathbf{y}})(a-b).$$

Substituting these demands into utility gives $\log\big[(a-b)/\Pi^{\mathbf{y}}_{\ell(k)}\big]$, with $\Pi^{\mathbf{y}}_{\ell} = (p^{\mathbf{y}}_{\ell})^{1-\alpha_{\mathbf{y}}}$.

Old. Given (h, b, k, r) and a workplace n, the household allocates income across three goods and a parental transfer:

$$\max_{\mathbf{c^o},\, d^{\mathbf{o}},\, a'} \ \alpha_{\mathbf{o}} \big[\gamma \log c^{\mathbf{o}}_{\mathrm{T}} + (1-\gamma) \log c^{\mathbf{o}}_{\mathrm{NT}}\big] + (1-\alpha_{\mathbf{o}}) \log d^{\mathbf{o}} + \beta \log a'$$

subject to $c^{\mathbf{o}}_{\mathrm{T}} + p^{\mathrm{NT}}_n c^{\mathbf{o}}_{\mathrm{NT}} + p^{\mathbf{o}}_n d^{\mathbf{o}} + a' = I_n$. The exponents now sum to $1+\beta$, so every share carries $1/(1+\beta)$:

$$c^{\mathbf{o}}_{\mathrm{T}} = \frac{\alpha_{\mathbf{o}}\gamma}{1+\beta} I_n, \quad p^{\mathrm{NT}}_n c^{\mathbf{o}}_{\mathrm{NT}} = \frac{\alpha_{\mathbf{o}}(1-\gamma)}{1+\beta} I_n, \quad p^{\mathbf{o}}_n d^{\mathbf{o}} = \frac{1-\alpha_{\mathbf{o}}}{1+\beta} I_n, \quad a'^{*} = \frac{\beta}{1+\beta} I_n.$$

Substituting these demands into utility gives a coefficient of $1+\beta$ on $\log I_n$ and the price index $\Pi^{\mathbf{o}}_n$, as in $v^{\mathbf{o}}_n$ in the main text. Taking the T1EV log-sum over workplaces gives $V^{\mathbf{o}}$.

Exponentiated young value. Evaluate $v^{\mathbf{y}}_k$ at b^*_k and exponentiate:

$$\exp\big(v^{\mathbf{y}}_k\big) \propto \frac{A^{\mathbf{y}}_k}{\tau^{\mathbf{y}}_{rk}} \frac{a - b^*_k}{\Pi^{\mathbf{y}}_{\ell(k)}} \exp\big(V^{\mathbf{o}}_k(b^*_k)\big).$$

The log-sum formula for $V^{\mathbf{o}}$ gives

$$\exp\big(V^{\mathbf{o}}_k(b^*_k)\big) \propto \left[\sum_{m \in \mathcal{N}} \left(\frac{A^{\mathbf{o}}_{km}}{\tau^{\mathbf{o}}_{km|r}} \frac{I^{1+\beta}_{km}}{\Pi^{\mathbf{o}}_m}\right)^{1/\sigma^{\mathbf{o}}}\right]^{\sigma^{\mathbf{o}}}.$$

Appendix A.1.1 Program-Closure Extension

The baseline sets every program's choice multiplier to one. For counterfactuals that close programs while retaining their identifiers, introduce $\varpi_{kt} \geq 0$, with $\varpi_{0t} = 1$ for the outside option. For $\varpi_{kt} > 0$, add $\log \varpi_{kt}$ to the baseline option-specific value $v^{\mathbf{y}}_{k,t}$; this additive constant does not change conditional saving. The corresponding choice probabilities and expected utility are

$$\mu^{\mathbf{y}}_t(k \mid z, a, r; \varpi) = \frac{\varpi_{kt}^{1/\sigma^{\mathbf{y}}} \exp(v^{\mathbf{y}}_{k,t}/\sigma^{\mathbf{y}})}{\sum_{j \in \mathcal{K}_t(z)} \varpi_{jt}^{1/\sigma^{\mathbf{y}}} \exp(v^{\mathbf{y}}_{j,t}/\sigma^{\mathbf{y}})},$$

$$V^{\mathbf{y}}_t(z, a, r; \varpi) = \sigma^{\mathbf{y}} \log \left[\sum_{j \in \mathcal{K}_t(z)} \varpi_{jt}^{1/\sigma^{\mathbf{y}}} \exp(v^{\mathbf{y}}_{j,t}/\sigma^{\mathbf{y}}) \right].$$

Setting $\varpi_{kt} = 0$ closes program k: its choice weight is zero, without evaluating $\log 0$. The outside option keeps the denominator positive. For an empty program, assign the reference peer distribution F° defined in Section 2.1.4; its quality affects no choice when its multiplier is zero. The multiplier sequence is supplied with the policy, and the remaining equilibrium conditions are unchanged. At $\varpi_{kt} = 1$ for every option, these expressions reduce to the baseline.

Appendix A.2 Education Demand when $a = 0$

As in the main text, we omit time subscripts. Consider college programs for which an optimal saving choice exists. Old-age amenities vary only with schooling status, and workplace frictions depend on the program only through its campus location and origin. Thus nonpecuniary workplace access for a college graduate is

$$\mathsf{UMA}^{\mathsf{c}}_{\ell(k)}(r) \equiv \sum_{n \in \mathcal{N}} \left(\frac{A^{\mathbf{o}}_{kn}}{\tau^{\mathbf{o}}_{kn|r} \Pi^{\mathbf{o}}_n} \right)^{1/\sigma^{\mathbf{o}}}. \tag{24}$$

This measure aggregates workplace amenities and living costs net of mobility frictions, excluding earnings. For normalized assets $v \equiv Rb/h_k > -\min_n \bar{w}_{f(k)n}$, define the asset-shifted wage-access measure

$$\mathcal{W}_{f(k),\ell(k)}(v; r) \equiv \left[\frac{\sum_{n \in \mathcal{N}} \left(\frac{A^{\mathbf{o}}_{kn}}{\tau^{\mathbf{o}}_{kn|r} \Pi^{\mathbf{o}}_n} \right)^{1/\sigma^{\mathbf{o}}} (\bar{w}_{f(k)n} + v)^{(1+\beta)/\sigma^{\mathbf{o}}}}{\mathsf{UMA}^{\mathsf{c}}_{\ell(k)}(r)} \right]^{\sigma^{\mathbf{o}}/(1+\beta)}. \tag{25}$$

It is a power mean of asset-adjusted field wages, with weights proportional to the nonpecuniary terms in (24). Factoring $I_{kn}(b) = h_k(\bar{w}_{f(k)n} + v)$ out of the continuation value gives

$$V^{\mathbf{o}}_k(b) = (1+\beta) \log h_k + (1+\beta) \log \mathcal{W}_{f(k),\ell(k)}(v; r) + \sigma^{\mathbf{o}} \log \mathsf{UMA}^{\mathsf{c}}_{\ell(k)}(r) + \text{const.}$$

Section 4.5.2 evaluates a broader measure of continuation value at a benchmark student state, incorporating earnings as well as $\mathsf{UMA}^{\mathsf{c}}$.

At $a = 0$, feasibility requires $-\min_n \bar{w}_{f(k)n} < v < 0$, and young expenditure is $-b =$

$(-v)h_k/R$. Optimizing borrowing gives the wage-access measure

$$\mathcal{W}^{\star}_{f(k),\ell(k)}(r) \equiv \left[\max_{-\min_n \bar{w}_{f(k)n}<v<0} \left\{(-v)\left[\mathcal{W}_{f(k),\ell(k)}(v;r)\right]^{1+\beta}\right\}\right]^{1/(2+\beta)}. \tag{26}$$

Substitution into the young problem yields

$$\begin{aligned} v^{\mathbf{y}}_k = \log \frac{A^{\mathbf{y}}_k}{\tau^{\mathbf{y}}_{rk}\Pi^{\mathbf{y}}_{\ell(k)}} + (2+\beta)\log h_k + (2+\beta)\log \mathcal{W}^{\star}_{f(k),\ell(k)}(r) \\ + \sigma^{\mathbf{o}} \log \mathsf{UMA}^{\mathrm{c}}_{\ell(k)}(r) - \log R + \text{const.} \end{aligned}$$

The coefficient $2+\beta$ combines the unit elasticity of young expenditure and the $1+\beta$ elasticity of old-age income. Subtracting across programs gives the log-odds decomposition in the body. The maximizing normalized asset position Rb^*_k/h_k depends on the field wage schedule and campus-specific access from r, but not on h_k or ability. Hence both access measures are independent of z, conditional on field, origin and the equilibrium environment. They need not move independently: destination-specific changes in amenities, living costs or mobility frictions affect both nonpecuniary access and the weights in the wage-access measure.

Appendix A.3 Production Demand and Factor Prices

The final-good firm minimizes the cost of obtaining Y from the regional tradable varieties. Its conditional demand and price index are

$$Y_{\mathrm{T}n} = \left(\frac{p^{\mathrm{T}}_n}{P}\right)^{-\eta} Y = \left(p^{\mathrm{T}}_n\right)^{-\eta} Y, \qquad P = \left(\sum_m \left(p^{\mathrm{T}}_m\right)^{1-\eta}\right)^{\frac{1}{1-\eta}} = 1.$$

For $s \in \{\mathrm{T}, \mathrm{NT}\}$, differentiating the sectoral college-labor aggregate with respect to field-f employment gives

$$\frac{\partial H^{\mathrm{c}}_{sn}}{\partial H^{\mathrm{c}}_{fsn}} = \omega^{1/\rho_f}_{sfn}\left(\frac{H^{\mathrm{c}}_{sn}}{H^{\mathrm{c}}_{fsn}}\right)^{1/\rho_f}.$$

The sectoral producer hires labor until its marginal revenue product equals the wage. For every field that supplies labor to sector s,

$$\bar{w}_{fn} = p^{\mathrm{s}}_n \frac{\partial Y_{sn}}{\partial H^{\mathrm{c}}_{sn}} \omega^{1/\rho_f}_{sfn}\left(\frac{H^{\mathrm{c}}_{sn}}{H^{\mathrm{c}}_{fsn}}\right)^{1/\rho_f}, \qquad \bar{w}_{0n} = p^{\mathrm{s}}_n \frac{\partial Y_{sn}}{\partial H^{\mathrm{nc}}_{sn}}.$$

Consequently, relative field wages within a sector satisfy

$$\frac{\bar{w}_{fn}}{\bar{w}_{f'n}} = \left(\frac{\omega_{sfn}}{\omega_{sf'n}}\right)^{1/\rho_f}\left(\frac{H^{\mathrm{c}}_{f'sn}}{H^{\mathrm{c}}_{fsn}}\right)^{1/\rho_f}.$$

Because workers of a given field can work in either sector within region n, an interior

allocation equalizes the two sectoral values of their marginal product:

$$p_n^{\mathrm{T}} \frac{\partial Y_{\mathrm{T}n}}{\partial H^{\mathrm{c}}_{f\mathrm{T}n}} = p_n^{\mathrm{NT}} \frac{\partial Y_{\mathrm{NT}n}}{\partial H^{\mathrm{c}}_{f\mathrm{NT}n}} = \bar{w}_{fn}.$$

The analogous condition for non-college labor is

$$p_n^{\mathrm{T}} \frac{\partial Y_{\mathrm{T}n}}{\partial H^{\mathrm{nc}}_{\mathrm{T}n}} = p_n^{\mathrm{NT}} \frac{\partial Y_{\mathrm{NT}n}}{\partial H^{\mathrm{nc}}_{\mathrm{NT}n}} = \bar{w}_{0n}.$$

At a corner, the value of the marginal product in the inactive sector is weakly below the common wage. Constant returns imply zero profits in each sector-region cell:

$$p_n^s Y_{sn} = \sum_{f \in \mathcal{F}} \bar{w}_{fn} H^{\mathrm{c}}_{fsn} + \bar{w}_{0n} H^{\mathrm{nc}}_{sn}.$$

Appendix A.4 Proof of Proposition 2.1

Let $\mathbb{E}_k$ denote expectation over workplace choices with probabilities $\mu^{\mathbf{o}}_{kn}(b)$, where $I_{kn}(b) = Rb + \bar{w}_{f(k)n} h_k$ and $h_k = h(z, q_k)$. The derivative of the conditional saving objective is

$$\Gamma(b; z, a, k, r) = -\frac{1}{a-b} + (1+\beta) R\, \mathbb{E}_k[I_{kn}^{-1}], \qquad -\frac{h_k}{R} \min_n \bar{w}_{f(k)n} < b < a.$$

Differentiating incomes and workplace probabilities gives

$$\Gamma_b = -\frac{1}{(a-b)^2} - (1+\beta) R^2 \left[\left(1 - \frac{1+\beta}{\sigma^{\mathbf{o}}} \right) \mathbb{E}_k[I_{kn}^{-2}] + \frac{1+\beta}{\sigma^{\mathbf{o}}} \left(\mathbb{E}_k[I_{kn}^{-1}] \right)^2 \right] < 0,$$

$$\Gamma_{q_k} = -(1+\beta) R\, h_q(z, q_k) \left[\left(1 - \frac{1+\beta}{\sigma^{\mathbf{o}}} \right) \mathbb{E}_k \left[\frac{\bar{w}_{f(k)n}}{I_{kn}^2} \right] + \frac{1+\beta}{\sigma^{\mathbf{o}}} \mathbb{E}_k[I_{kn}^{-1}] \mathbb{E}_k \left[\frac{\bar{w}_{f(k)n}}{I_{kn}} \right] \right] < 0.$$

At the upper feasible endpoint, $\Gamma \to -\infty$; at the lower endpoint, $\Gamma \to +\infty$, since $(1+\beta)/\sigma^{\mathbf{o}} < 1$ makes the minimum-income contributions to the marginal continuation value diverge. Thus the saving optimum is unique and interior, and $\partial_{q_k} b_k^* = -\Gamma_{q_k} / \Gamma_b < 0$.

At the saving optimum for program k, the logit formula and envelope theorem give

$$\sigma^{\mathbf{y}} \log \frac{\mu_k^{\mathbf{y}}}{\mu_{k'}^{\mathbf{y}}} = v_k^{\mathbf{y}} - v_{k'}^{\mathbf{y}}, \qquad \partial_a v_k^{\mathbf{y}} = \frac{1}{a - b_k^*}, \qquad \partial_z v_k^{\mathbf{y}} = \varsigma_k\, \partial_z \log h_k,$$

$$\varsigma_k \equiv (1+\beta) \mathbb{E}_k \left[\frac{\bar{w}_{f(k)n} h_k}{I_{kn}} \right] = (1+\beta) - \frac{b_k^*}{a - b_k^*} > 0.$$

The saving first-order condition gives the last equality. In part (i), programs k and k' share field wages, workplace amenities and workplace frictions, so their saving choices differ only through quality. Hence $q_k > q_{k'}$ implies $b_k^* < b_{k'}^*$ and $\varsigma_k \geq \varsigma_{k'}$, since $\partial_b[(1+\beta) - b/(a-b)] = -a/(a-b)^2 \leq 0$. Log-supermodularity gives

$$\partial_z \log h_k = \frac{\theta_z + \theta_{zq} \log q_k}{z} > \frac{\theta_z + \theta_{zq} \log q_{k'}}{z} = \partial_z \log h_{k'} > 0.$$

These inequalities imply $\partial_z v_k^{\mathbf{y}} > \partial_z v_{k'}^{\mathbf{y}}$, while $b_k^* < b_{k'}^*$ implies $\partial_a v_k^{\mathbf{y}} < \partial_a v_{k'}^{\mathbf{y}}$. The logit formula then proves part (i). At $a = 0$, both ς terms equal $2 + \beta$, so the ability comparison remains strict.

For part (ii), raising q_k changes $v_k^{\mathbf{y}}$ and leaves $v_{k'}^{\mathbf{y}}$ unchanged. The envelope theorem gives

$$\partial_{q_k} v_k^{\mathbf{y}} = \varsigma_k \frac{h_q(z, q_k)}{h_k} > 0, \qquad \partial_a \partial_{q_k} v_k^{\mathbf{y}} = \frac{\partial_{q_k} b_k^*}{(a - b_k^*)^2} < 0.$$

Dividing by $\sigma^{\mathbf{y}} > 0$ proves part (ii). At $a = 0$, we take derivatives with respect to parental transfers from the right. ■

Appendix A.5 Work at the CBD

Proposition (Unique equilibrium)**.** *Suppose $0 < \tau^{\mathbf{o}} < \chi z_L / \mathbb{E}[z^{-1}]$. At every campus location and every $\tau^{\mathbf{y}} > 0$, there is exactly one equilibrium quality in $[1/\mathbb{E}[z^{-1}], z_H)$. At $\tau^{\mathbf{y}} = 0$, all agents attend and $q_k = 1/\mathbb{E}[z^{-1}]$.*

Proof. Attendance is nondecreasing in ability, so $q_k \geq 1/\mathbb{E}[z^{-1}]$. The restriction implies $\chi z q_k > \tau^{\mathbf{o}}$ for both types. Workplace surplus therefore decreases on either side of campus, and both types work at $n = 0$.

Fix $\ell(k)$ and $\tau^{\mathbf{y}} > 0$. For $q \in [1/\mathbb{E}[z^{-1}], z_H]$, net college returns are positive and the attendance rate is

$$m_z(q) = \min\left\{\frac{\bar{w} z q - \tau^{\mathbf{o}} \ell(k)}{\tau^{\mathbf{y}}}, \ell(k)\right\} + \min\left\{\frac{\bar{w} z q - \tau^{\mathbf{o}} \ell(k)}{\tau^{\mathbf{y}}}, 1 - \ell(k)\right\}.$$

At differentiable points, both m_z and $m_z - q m_z'$ are nondecreasing in z, as follows from the displayed minima. If high-type attendance has elasticity above one, low-type attendance has at least as large an elasticity. Otherwise, the elasticity difference is at most one because attendance is nondecreasing in quality. Thus

$$q \frac{d}{dq} \log \frac{m_{z_H}(q)}{m_{z_L}(q)} \leq 1.$$

Let $\widetilde{q}(q) = \mathbb{E}[m_z]/\mathbb{E}[m_z/z]$ be the implied harmonic peer quality. Direct differentiation gives

$$\frac{q \widetilde{q}'(q)}{\widetilde{q}(q)} = \frac{(\widetilde{q} - z_L)(z_H - \widetilde{q})}{\widetilde{q}(z_H - z_L)} \, q \frac{d}{dq} \log \frac{m_{z_H}}{m_{z_L}} < 1,$$

since the prefactor lies in $[0, 1)$. Hence $\widetilde{q}(q)/q$ strictly decreases, including across clipping points by continuity. At $q = 1/\mathbb{E}[z^{-1}]$, higher-ability attendance is weakly larger, so $\widetilde{q}(q) \geq q$. At $q = z_H$, positive low-type attendance gives $\widetilde{q}(q) < q$. There is therefore exactly one fixed point. At $\tau^{\mathbf{y}} = 0$, both types have positive surplus everywhere, so everyone attends and $q_k = 1/\mathbb{E}[z^{-1}]$. ■

Appendix A.6 Campus Location when Graduates Stay

This appendix establishes the results in Section 2.2 for $\xi = -1$ and $h(z, q) = zq$, under $\tau^{\mathbf{o}} > \chi z_H^2$. All graduates stay at the campus, so old moving costs are not paid. Write $\ell = \ell(k)$. For $\tau^{\mathbf{y}} > 0$, the attendance rate of type z is

$$m_z(\ell, q) = \min\left\{\frac{(\bar{w} - \chi \ell) z q}{\tau^{\mathbf{y}}}, \ell\right\} + \min\left\{\frac{(\bar{w} - \chi \ell) z q}{\tau^{\mathbf{y}}}, 1 - \ell\right\}, \qquad q = \frac{\mathbb{E}[m_z]}{\mathbb{E}[m_z/z]}.$$

Expectations below refer to the fixed population distribution of ability.

Unique equilibrium and the relevant location interval. For a trial quality q, let $\widetilde{q}(\ell, q) = \mathbb{E}[m_z]/\mathbb{E}[m_z/z]$ be harmonic mean ability among attendees. Attendance increases with ability, while m_z/z is nonincreasing, so

$$\frac{1}{\mathbb{E}[z^{-1}]} \leq \widetilde{q}(\ell, q) \leq \mathbb{E}[z].$$

At differentiable points, concavity of attendance in q gives $0 \leq \partial \log m_z / \partial \log q \leq 1$. Hence

$$\frac{q\,\partial_q \widetilde{q}}{\widetilde{q}} = \frac{(\widetilde{q} - z_L)(z_H - \widetilde{q})}{\widetilde{q}(z_H - z_L)} \frac{\partial}{\partial \log q} \log \frac{m_{z_H}}{m_{z_L}} < 1.$$

Thus $\widetilde{q}(\ell, q)/q$ decreases in q. The endpoint bounds and continuity give a unique fixed point, including where an attendance interval reaches a city endpoint. At $\tau^{\mathbf{y}} = 0$, everyone attends and $q_k = 1/\mathbb{E}[z^{-1}]$. More generally, full attendance at a fixed campus occurs if and only if

$$\tau^{\mathbf{y}} \max\{\ell, 1-\ell\} \leq \frac{(\bar{w} - \chi\ell) z_L}{\mathbb{E}[z^{-1}]}.$$

Attendance depends on workplace productivity and quality through their product $(\bar{w} - \chi\ell)q$. The same elasticity bound implies that higher workplace productivity, holding student distances fixed, raises this product in equilibrium and hence individual surplus. Sites ℓ and $1-\ell$ have identical distance distributions; the former has higher productivity when $\ell < 1/2$. Hence

$$W(\ell) > W(1-\ell) \qquad (0 \leq \ell < 1/2).$$

Every global optimum belongs to $[0, 1/2]$.

Low young moving costs.

If $0 < \tau^{\mathbf{y}} \leq \bar{w} z_L / \mathbb{E}[z^{-1}]$, the unique global optimum is

$$\boxed{\ell^*(k) = \max\left\{0, \frac{1}{2} - \frac{\chi \mathbb{E}[z]}{2\tau^{\mathbf{y}} \mathbb{E}[z^{-1}]}\right\}.}$$

At $\tau^{\mathbf{y}} = 0$, it is 0. To prove the positive-cost result, reflection dominance restricts the search to $[0, 1/2]$. At quality $1/\mathbb{E}[z^{-1}]$, full attendance there requires $(\bar{w} - \chi\ell) z_L / \mathbb{E}[z^{-1}] \geq \tau^{\mathbf{y}}(1-\ell)$. The difference is affine and nonnegative at both endpoints under the stated restriction and $\bar{w} > \chi$. Thus quality is $1/\mathbb{E}[z^{-1}]$, and the claimed location maximizes the concave quadratic

$$W(\ell) = (\bar{w} - \chi\ell) \frac{\mathbb{E}[z]}{\mathbb{E}[z^{-1}]} - \tau^{\mathbf{y}}(\ell^2 - \ell + \tfrac{1}{2}).$$

Local welfare effects. Within a fixed attendance pattern, $1 - \partial_q \widetilde{q} > 0$ at equilibrium, so quality is differentiable by the implicit function theorem. At an interior campus, differentiating each group's integrated surplus gives (10). Terms from moving attendance boundaries vanish because surplus equals zero there. The point $r = \ell$ has zero measure. When an attendance boundary reaches a city endpoint, the same calculation applies from either side, using the corresponding one-sided quality derivative.

High young moving costs. When both attendance intervals lie inside the city, $m_z = 2(\bar{w} -$

$\chi\ell)zq/\tau^{\mathbf{y}}$. Harmonic consistency gives $q = \mathbb{E}[z]$, and integration yields

$$W(\ell) = \frac{(\bar{w} - \chi\ell)^2}{\tau^{\mathbf{y}}}\mathbb{E}[z]^2\mathbb{E}[z^2].$$

Its derivative is the first expression in (12). We next give a finite sufficient condition under which the second expression is the unique global optimum.

For this proof, write $\mu = \mathbb{E}[z]$, $m_2 = \mathbb{E}[z^2]$, $H = z_H\mu$, $e_H = \bar{w}H/(\tau^{\mathbf{y}} + \chi H)$. Quality and truncation bounds imply

$$W(\ell) \leq \frac{(\bar{w} - \chi\ell)^2\mu^2 m_2}{\tau^{\mathbf{y}}}.$$

If $\tau^{\mathbf{y}} \geq (2\bar{w} - \chi)H$, then $e_H \leq 1/2$. At e_H both attendance intervals are inside the city and this bound is attained. Every $\ell > e_H$ is strictly dominated because $\chi > 0$. For $\ell \in [0, e_H]$, the far endpoint cannot bind: the maximum of $\ell + (\bar{w} - \chi\ell)H/\tau^{\mathbf{y}}$ on this interval is $2e_H \leq 1$.

For the remaining locations to the left of e_H, partition by which attendance intervals reach the city boundary. In one regime, peer quality is no higher than at e_H and integrated surplus is strictly lower. In the other, the fall in peer quality as the campus moves inward offsets the gain in workplace productivity when $\tau^{\mathbf{y}}$ is sufficiently large. These comparisons give a finite threshold above which e_H is the unique global optimum.

Parameterization. Figure 1 uses $z_L = 1$, $z_H = 2$, $N_H = 1/2$, $\bar{w} = 2$, $\chi = 0.8$, $\xi = -1$, $\theta_q = 1$, and $\tau^{\mathbf{o}} = 4$.

The old moving cost exceeds $\chi z_H^2 = 3.2$, so both types stay at every campus. Full-attendance quality is $4/3$; when neither type attends from either city endpoint, quality is $3/2$.

For each value of young moving costs, the numerical solution compares all feasible smooth stationary points, attendance-pattern boundaries, and the endpoints 0 and $1/2$. On branches with varying quality, harmonic consistency makes ℓ a rational function of q, reducing stationary and boundary conditions to polynomial equations. Constant-quality branches are optimized directly. Evaluating all feasible candidates gives welfare ties at $\tau^{\mathbf{y}} \simeq 3.09662$ and 7.85581, with respective pairs of optimal locations $(0.24165, 0.17910)$ and $(0.26556, 0.37482)$. Independent direct searches over the full city verify these comparisons.

Appendix A.7 Intergenerational Transmission

The transmission law in (2) conditions an underlying Gaussian innovation on the fixed population support $\mathcal{Z} = [z_{\min}, z_{\max}]$. For parental human capital $h > 0$, define

$$L(h) = \frac{\log z_{\min} - \kappa \log h}{\sigma_\nu}, \qquad U(h) = \frac{\log z_{\max} - \kappa \log h}{\sigma_\nu},$$

where $\kappa \geq 0$, $\sigma_\nu > 0$, and $\log z_{\min} = -\infty$ when $z_{\min} = 0$. The conditional innovation law is

$$\nu \mid h \sim \mathrm{TN}_{[\sigma_\nu L(h), \sigma_\nu U(h)]}(0, \sigma_\nu^2),$$

where TN denotes a normal law conditioned on the stated interval. Writing Φ for the standard normal CDF, the child-ability CDF at $z_{\min} < z < z_{\max}$ is

$$G(z \mid h) = \frac{\Phi((\log z - \kappa \log h)/\sigma_\nu) - \Phi(L(h))}{\Phi(U(h)) - \Phi(L(h))}, \tag{27}$$

with $G(z \mid h) = 0$ for $z \leq z_{\min}$ and $G(z \mid h) = 1$ for $z \geq z_{\max}$.

The innovation bounds depend on parental human capital so that the offspring support remains $\mathcal{Z}$. Truncation conditions the draw on this interval; it creates no endpoint atoms. A zero lower endpoint permits arbitrarily low positive ability without an atom at zero. Human capital must be positive almost surely on the population distribution. The population support is fixed independently of the common higher-education eligibility threshold z_{elig}.

The parameters κ and σ_ν govern the underlying Gaussian location and scale; after truncation, the conditional innovation need not have zero mean or variance σ_ν^2. The conditional normalization also enters the estimation likelihood in Appendix C.11.

Appendix B Empirical Findings

Appendix B.1 Structural Parameters

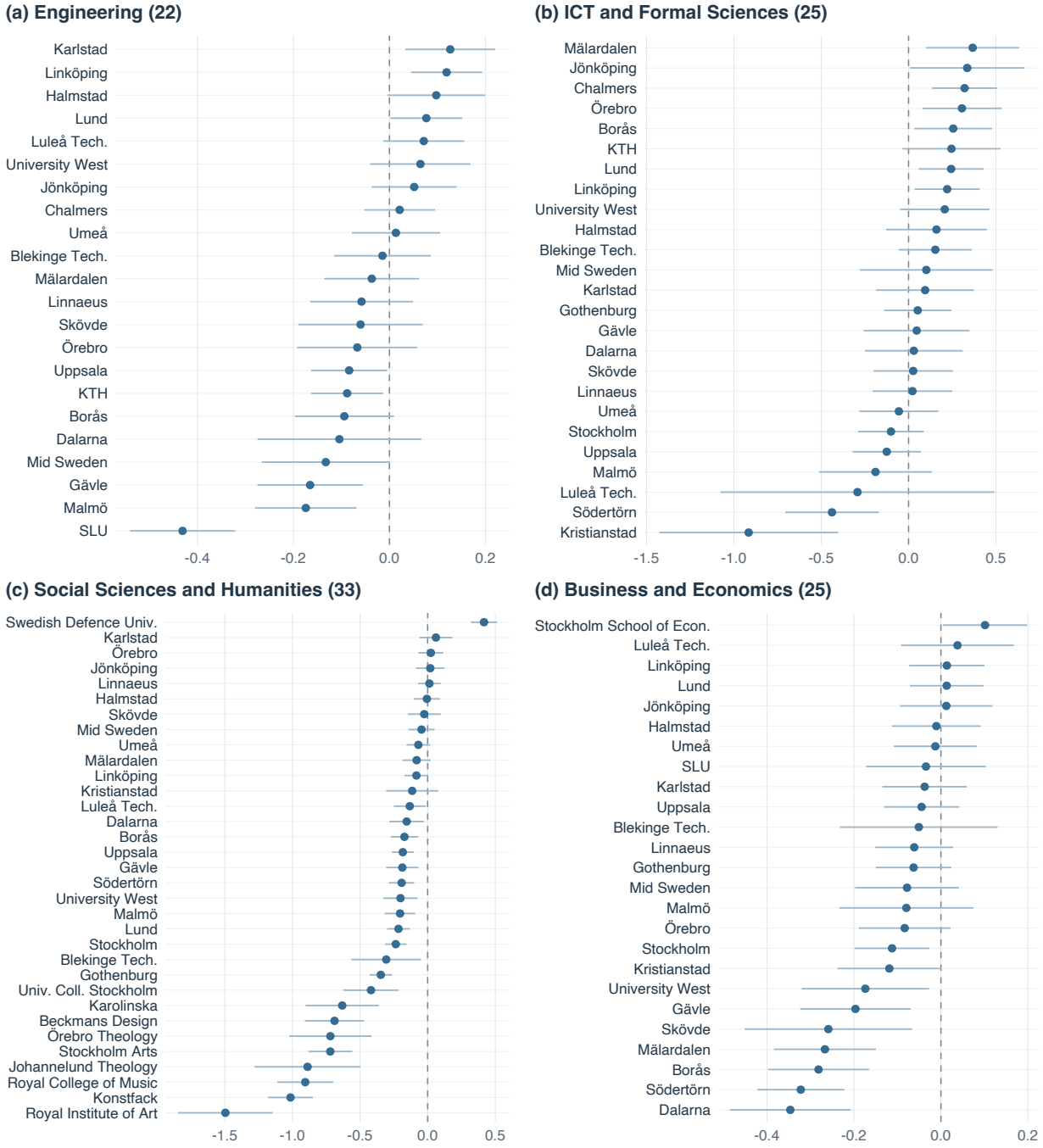
Table 4: Structural parameter estimates and counterfactual calibration

Parameter	Interpretation	Value
(a) Human capital and program quality		
θ_z	Ability elasticity, college	0.159
θ_z^0	Ability elasticity, non-college	0.047
θ_{zq}/θ_q	Complementarity relative to quality return	0.103
θ_q	Return to program quality	0.279
ξ	Curvature of the peer aggregator	-0.459
θ_{zq}	Ability-quality complementarity	0.029
θ_x	Institutional-input weight (fixed)	0.000
(b) Workplace preferences		
$\sigma^{\mathbf{o}}$	Workplace taste dispersion	1.488
λ_1^{c}	Campus-to-workplace distance	0.00888
λ_2^{c}	Home-to-workplace distance, college	0.01028
λ_2^{nc}	Home-to-workplace distance, non-college	0.02210
(c) College preferences		
$\sigma^{\mathbf{y}}$	College taste dispersion	15.442
$\lambda^{\mathbf{y}}$	Home-to-campus distance	0.08702
$\sigma^{\mathbf{y}}/\lambda^{\mathbf{y}}$	Scale/distance ratio (km)	177.454
(d) Production and intergenerational transmission		
ρ_f	Substitution across fields	6.89
κ	Intergenerational transmission elasticity (provisional)	0.050
σ_ν	Gaussian scale before truncation (provisional)	1.000

Appendix B.2 Program Quality and Wage Access

Within the 2000–2009 high-school cohort window, Figure 10 reports first-step program value-added estimates and their 95% confidence intervals for the 2004–2005 band. Figure 11 maps fitted program quality pooled over all five two-year bands in the window. Both figures cover Engineering, ICT and Formal Sciences, Social Sciences and Humanities, and Business and Economics. Figure 12 maps field wage access under 2019 workplace conditions for the same programs as Figure 11.

Figure 10: Program value added by field, 2004–2005 high-school cohorts

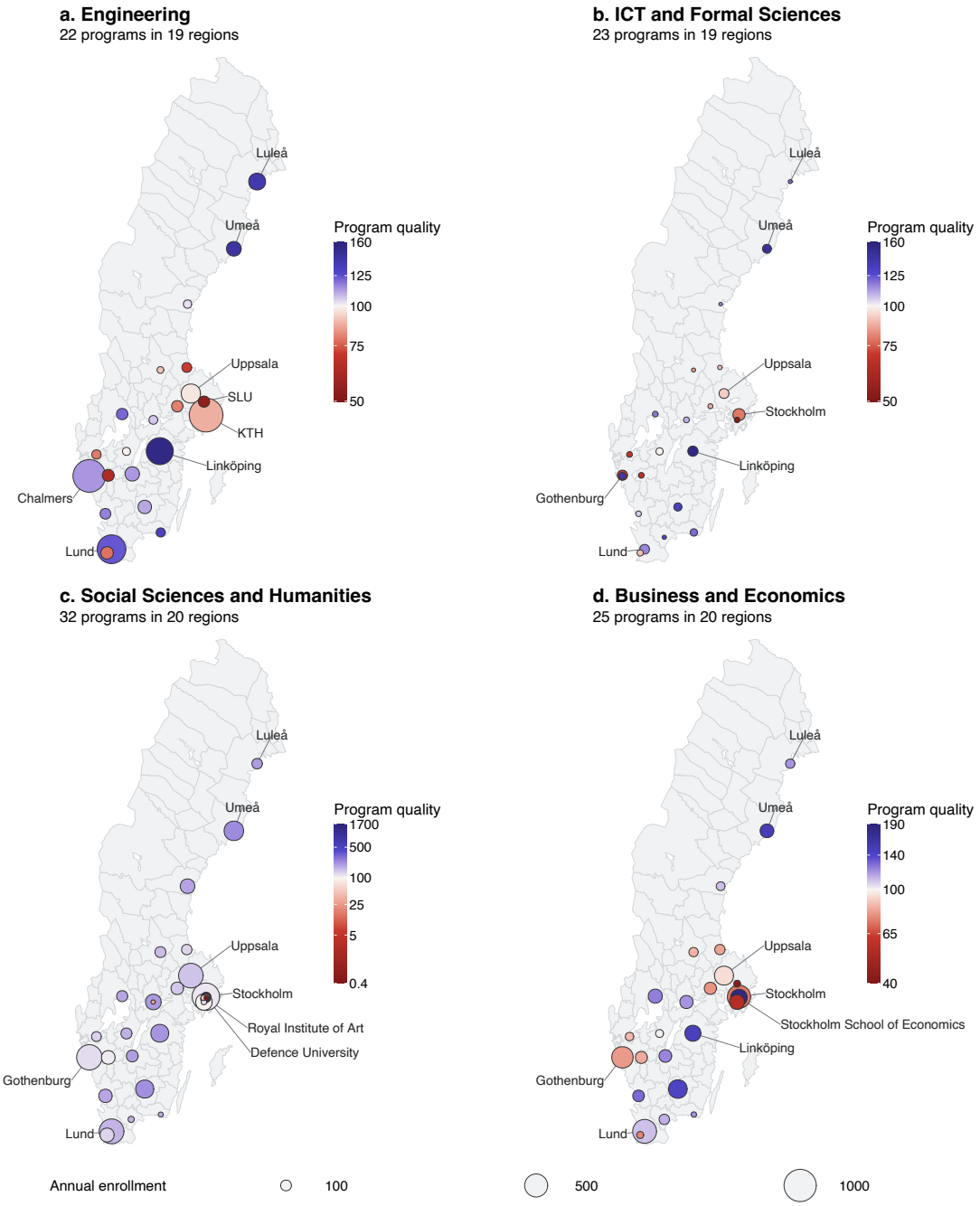


Notes: The displayed 2004–2005 band lies within the 2000–2009 analysis window. Dots show first-step estimates; bars are the estimate ± 1.96 times its exported standard error. Let $\mathcal{C}_1$ contain all college program-cohort cells in the full first-step sample (1990–2011 high-school cohorts), and let n_{js} count earnings observations in cell (j, s). The common value-added definition and normalization are

$$\left(\pi_{k\tau} = \theta_q \log q_{k\tau}, \qquad \frac{\sum_{(j,s)\in\mathcal{C}_1} n_{js} \widehat{\pi}_{js}}{\sum_{(j,s)\in\mathcal{C}_1} n_{js}} = 0 \right).$$

Figure 11: University quality across space by field, 2000–2009 high-school cohorts

Within-field measure of fitted program quality $\widehat{q}_{k\tau}$ entering the structural wage equation (13).

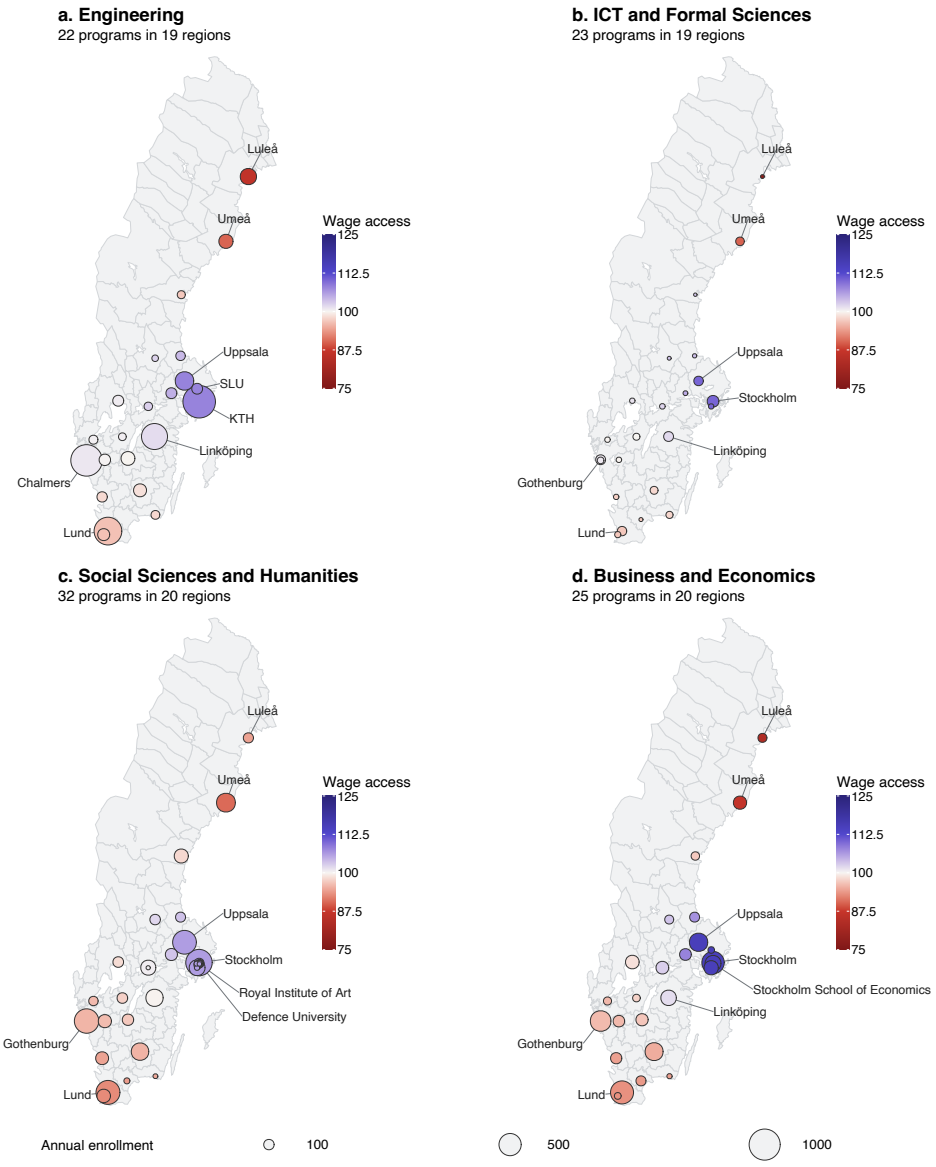


Notes: Colors show fitted structural program quality, including permanent, peer, and cohort components; color scales are logarithmic and differ across panels. Programs must be observed in all five two-year bands, $\mathcal{T} = \{2000, 2002, 2004, 2006, 2008\}$. Circle area is proportional to average annual enrollment over the same 2000–2009 window. For the displayed programs $\mathcal{K}_f^*$ in each field, the equal-program geometric mean of the quality measure is 100:

$$\log q_k^{\text{pool}} = \frac{1}{5} \sum_{\tau \in \mathcal{T}} \log \widehat{q}_{k\tau}, \qquad q_k^{\text{norm}} = 100 \exp\left(\log q_k^{\text{pool}} - \frac{1}{|\mathcal{K}_f^*|} \sum_{j \in \mathcal{K}_f^*} \log q_j^{\text{pool}} \right).$$

Figure 12: Wage access across space by field, 2019

Access to field-f wages per efficiency unit from campus ℓ: $\mathcal{W}^0_{f\ell} \equiv \mathcal{W}_{f\ell}(0)$ in (25).



Notes: Field wage access is a weighted power mean of wages per efficiency unit, evaluated at zero asset shift:

$$\mathcal{W}^0_{f\ell} = \left[\sum_{n\in\mathcal{D}} \zeta_{n|\ell}\, \bar{w}_{fn,2019}^{(1+\beta)/\sigma^{\mathbf{o}}}\right]^{\sigma^{\mathbf{o}}/(1+\beta)}, \qquad \zeta_{n|\ell} = \frac{\exp\left[(B_{\mathrm{c},n,2019} - \lambda_1^{\mathrm{c}} d_{\ell n})/\sigma^{\mathbf{o}}\right]}{\sum_{m\in\mathcal{D}} \exp\left[(B_{\mathrm{c},m,2019} - \lambda_1^{\mathrm{c}} d_{\ell m})/\sigma^{\mathbf{o}}\right]}.$$

Here, $\mathcal{D}$ contains the 29 retained workplaces, and $B_{\mathrm{c},n,2019}$ includes workplace amenities and living costs. Home-to-workplace distance is held constant across destinations, so its cost cancels from the weights. We use 2019 wages and destination effects for the 2009 high-school cohort. Program support and circle areas match Figure 11, using the 2000–2009 cohorts. All panels share a linear color scale. Within each field, the displayed measure has equal-program geometric mean 100:

$$\mathcal{W}^{\mathrm{norm}}_k = 100 \exp\left[\log \mathcal{W}^0_{f,\ell(k)} - \frac{1}{|\mathcal{K}^*_f|}\sum_{j\in\mathcal{K}^*_f} \log \mathcal{W}^0_{f,\ell(j)}\right], \qquad k \in \mathcal{K}^*_f.$$

Appendix B.3 Intergenerational Transmission

Each column includes graduation-year effects and uses log high-school grades and log parental earnings. Column (2) supplies the proxy estimate reported in the main text.

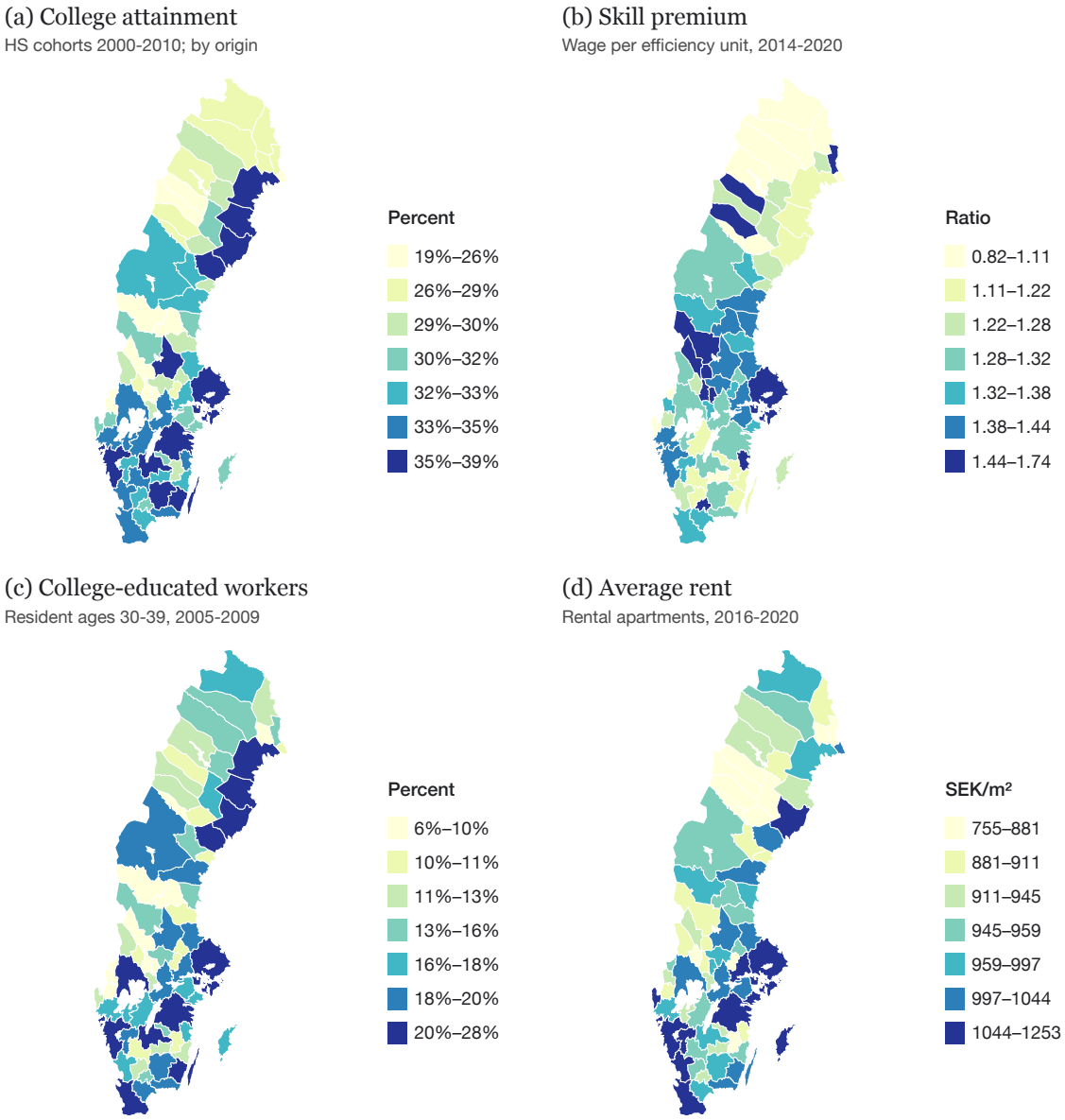
Table 5: Intergenerational transmission: preliminary proxy regressions

	(1)	(2)	(3)	(4)
Log parental earnings	0.042	0.041	0.040	0.031
	(0.0009)	(0.0009)	(0.0008)	(0.0005)
Graduation-year effects	Yes	Yes	Yes	Yes
Geographic effects	None	Labor market	Municipality	DeSO
Observations	2,179,507	2,178,466	2,178,466	2,179,507

Notes: Dependent variable: log high-school grade. Values and parenthesized standard errors are retained from the preliminary draft table and await the updated estimation export.

Appendix B.4 Spatial Patterns in Education and Labor Markets

Figure 13: Education and labor markets across Sweden



Notes: All maps cover 72 FA regions. Panel (a): share of the 2000–2010 high-school cohorts with a qualifying college degree by 2021, pooling counts by high-school home region. Panel (b): college/noncollege wage per efficiency unit, 2014–2020. Panel (c): bachelor-or-higher share of employed residents aged 30–39, 2005–2009. Panel (d): mean annual rental-apartment rent per square meter, 2016–2020. Sources: Swedish administrative registers and Statistics Sweden's rent survey (*Hyror i bostadslägenheter*).

Appendix C Data and Quantification Details

This appendix documents the data sources, construction of model inputs, estimating equations, and recovery of local fundamentals.

Appendix C.1 Sources and Record Linkage

Our data draw, among other sources, on individual registers, archival admissions records, and university- and municipality-level public series. Coverage differs across sources; the availability of a register from a given year does not imply that all variables are observed for every cohort in that year.

Employment and family records. The Longitudinal Integration Database for Health Insurance and Labour Market Studies (LISA), maintained by Statistics Sweden, records employment, employers, earnings, education, and municipality of residence annually from 1990 onward. The Register-Based Activity Statistics (RAMS) provides worker-establishment links and establishment characteristics. Personal identifiers connect these records to the education registers and to the multigenerational register (*Flergenerationsregistret*). The latter records biological and adoptive parent links. Parental earnings, education, and residence are attached through the parents' own register records.

Education records. The university register reports institution, field, credits earned, and degree completion. The school registers contain ninth-grade and upper-secondary grades and school identifiers. Grading-system changes create breaks in comparability across cohorts; the final sample documentation must specify the grade scale and harmonization used. Observing a parent-child link does not ensure that both generations have the required schooling and earnings records.

Admissions archive. Historical centralized admissions records begin with the autumn 1977 admissions round. The recorded fields include ranked program-institution choices, merit scores, and admission, waitlist, or rejection outcomes. Older records are available as images. Digitization, applicant identifiers, program codes, and admission-round definitions must be reconciled before these records can be combined with observed enrollment. The final construction record must distinguish the rounds available in the archive from those successfully digitized and linked.

Appendix C.2 Current Admissions Process

For autumn and spring applications on Antagning.se, applicants may list up to twelve degree programs, freestanding courses, or a mixture of both. They search by title or code, add choices to one application, and rank them before the deadline (Antagning.se, n.d.). Each choice carries general eligibility requirements and, where applicable, program- or course-specific subject requirements. Eligible applicants compete within the relevant selection groups on merit, including upper-secondary grades and the Swedish Scholastic Aptitude Test. The admissions system processes choices in priority order, subject to a maximum of 45 credits per term; admission to a higher-ranked program or course can remove lower-ranked choices once that limit is reached (University Admissions, n.d.). The Swedish terms are *grundläggande behörighet* for general eligibility and *särskild behörighet* for specific eligibility. These are current rules; the historical admissions archive requires separate documentation of the rules in each cohort.

University statistics. UKÄ's public series include income statements by activity, enrollment

headcounts, registered students by field and level, degrees, and first-choice applicants. The financial series used in the draft begins in 1999. OpenAlex supplies publications, citations, and co-authorship information matched to institutions. Institutional identifiers must distinguish reorganizations and mergers from changes in the underlying activity; university-level records also need to be distinguished from campus-level locations.

Housing series. *Boendebarometer* supplies cooperative-apartment (*bostadsrätt*) and small-house transaction prices, expressed per square meter at the municipality level, from 2000 onward. Statistics Sweden's *Hyror i bostadslägenheter* reports rents per square meter for rental dwellings, with municipality-level coverage from 2016 and coarser geographic coverage back to 2003. Available breakdowns include dwelling size, building year, and metropolitan district. Dedicated student housing is excluded from the rent survey. Sale prices and rents have different units and coverage and are retained as distinct series.

Appendix C.3 Sample Construction

The source inventory above does not define a common estimation sample. Entry cohorts, years of earnings observation, parental observation windows, and the availability of linked admissions and housing records determine the supported sample for each exercise. A final sample description must report these windows, the treatment of missing records, and the number of observations retained at each linkage and restriction.

Appendix C.4 Historical Detail on the Higher-Education Reforms

Institutional counts. The twelve regional colleges formed in 1977 were Borås, Eskilstuna/Västerås, Falun/Borlänge, Gävle/Sandviken, Jönköping, Kalmar, Karlstad, Kristianstad, Sundsvall/Härnösand, Växjö, Örebro, and Östersund (SOU, 2007, p. 69). Together they covered sixteen municipalities (Bergh et al., 2024, p. 33). Karlstad, Växjö, and Örebro had previously operated as university branches (Bergh et al., 2024, p. 19). Halmstad and Skövde were established in 1983 and are excluded from the later evaluation's treatment and comparison samples (Bergh et al., 2024, pp. 32–34).[19]

Decision and implementation. The parliamentary decision was public in 1975, and the reorganization took effect on 1 July 1977 (Government of Sweden, 1977). Existing teacher-training, nursing, engineering, military, naval, and other facilities contributed to the choice of locations (Andersson et al., 2004). In the municipalities classified by Andersson et al. (2004) as newer-institution locations, population grew by 4.9% between 1968 and 1976, compared with −4.3% in established-institution municipalities and 6.3% elsewhere. This classification includes later openings; the descriptive comparisons do not constitute a test of parallel trends for the 1977 colleges.

Changes in the definition of higher education. The 1977 reorganization incorporated vocational and other post-secondary provision into the higher-education sector. The broader definition brought approximately 46,000 existing students into higher-education statistics (SOU, 2007, p. 70). Technical extension years and nursing programs were among the activities reclassified as short college programs (Bergh et al., 2024, pp. 19–20, 40). Enrollment or degree series spanning the

[19] Andersson et al. (2004, p. 372) report eleven new institutions, fourteen status changes, and thirty-six institutions in twenty-six municipalities. Their later grouping includes post-1977 openings; it does not reconcile these totals with the government's twelve-college list.

reform therefore require a consistent definition before increases can be interpreted as additional provision. The first implementation years also differed in admissions arrangements: remaining open-admission provision was abolished in 1979 (Bergh et al., 2024, p. 19). These features qualify comparisons that treat 1977 as an immediate, uniform capacity change.

Teaching and research resources. University research positions increased from 6,091 in 1985 to 18,737 in 1998. Positions at the newer institutions grew sevenfold from a small base, reaching about 6% of the national total in 1998 (Andersson et al., 2004). By 2001, the newer institutions held about one eighth of university research positions (Andersson et al., 2009). The two shares come from different studies and are not a single series; the later one postdates the 1997 increase in research resources and the 1999 university charters described below. The resource expansion from the late 1980s, the 1993 change in teaching finance, and the extension of research resources from 1997 are separate from the original opening or status changes. Smaller and medium-sized colleges were allocated increased permanent research resources from 1997 (Government of Sweden, 1996); Karlstad, Växjö, and Örebro received university status on 1 January 1999 (Government of Sweden, 1998, p. 104).

Appendix C.5 Geography and Model Inputs

Spatial units. The estimation uses functional analysis (FA) regions. Municipality-to-FA and small-area crosswalks place residence, universities, and establishments on this common geography. The national crosswalk contains 72 regions; the current choice export covers 29, whereas the preliminary field-demand regression uses all 72. Each estimation block uses its documented support. FA regions, rather than the separately defined LA regions, are the units in the current construction. The crosswalk vintage and the treatment of boundary changes remain to be documented.

Population-weighted centroids use 2018 DeSO population counts. Bilateral distances are Euclidean distances in kilometers between these centroids, with a one-kilometer floor. The home region is residence at high-school graduation. The workplace region is the modal workplace in years nine through eleven after graduation; ties are resolved in favor of the most recent observation. University locations determine $\ell(u)$. Institutions with several campuses require the institution-to-campus assignment used in constructing the choice set.

Cohorts, ability, and resources. The current choice export covers the 2000–2010 high-school graduation cohorts and contains 785,680 individuals, 41 universities, ten fields, and 222 university-field pairs. High-school graduation marks the young decision; old-age prices are evaluated ten years later. Annual earnings in years nine through eleven supply the wage observations. These conventions align the observed life cycle with the model's two periods.

Ability is measured by a positive high-school grade percentile, floored at 10^{-6} before taking logs. Initial resources are $a_i = 0.15\,\text{parent_earn}_i$. For each parent, the earnings measure averages positive labor earnings at ages 40–50; the mother's and father's measures are then added. Adoptive-parent links take precedence where available. This is an earnings-based resource proxy. Counts by origin and cohort and the empirical joint distribution of (z_i, a_i) construct N_{rt} and F_{rt} on the selected population support. Population weights, rather than efficiency-unit weights, enter household aggregation.

Degrees and fields. The degree register records each degree's awarding institution, year, and SUN 2020 level and field codes. A college degree has level code 536, 537, 546, 547, 556, or 557: general or vocationally oriented university and university-college programs of three, four, and five or more years. Statistics Sweden maps the three-year codes to ISCED 2011 level 6 and the

longer codes to level 7. The level code records the length of a program, not whether it builds on an earlier degree. The four- and five-year codes therefore contain first degrees from programs that students enter directly from high school, including medicine, engineering (*civilingenjör*), and five-year subject-teacher training. Two-year university degrees (codes 526 and 527, ISCED level 5), post-secondary vocational programs outside universities, and credits accumulated without a degree carry other level codes and do not count as college degrees. For each individual, the realized program is the institution and field of the earliest college degree; ties within a year are broken by the lower level code. Institution codes are made time-consistent by assigning merged institutions to their successor; for example, degrees from Kalmar and Växjö are assigned to Linnaeus University. Since the register records degrees rather than enrollment, program counts, peer moments, and cutoff proxies are computed over graduates.

Table 6 gives the field classification. Each field is defined by SUN 2020 codes; the ISCED-F 2013 equivalents follow Statistics Sweden's correspondence key. The reassigned detailed fields keep the content of each field comparable across the universities that offer it. Economics is grouped with business rather than the other social sciences. Education science without a teaching qualification is separated from teacher training. Transport and protective-services programs join engineering, and sport science and occupational health join health. In the current estimates, Medicine follows SUN 2020 code 721, which combines physician training (721a) with other medical degrees (721x), including general degrees in biomedicine and clinical medicine. The field therefore also includes programs at universities that do not train physicians; the revised estimation restricts Medicine to 721a.

Programs, cutoffs, and capacities. The realized program defines $k = (u, f)$; individuals without a college degree define $k = 0$. Positive enrollment support determines the offered set. A university-field pair enters the choice set only if at least 30 sample members hold its degree; smaller pairs and the individuals who chose them are excluded from the estimation sample rather than assigned to $k = 0$. The current choice construction approximates a program's cutoff by the tenth percentile of enrolled students' grades. The observed choice is retained when this grade rule would otherwise exclude it, accommodating admission routes outside the grade proxy. These cutoffs are constructed from enrollment; the archival application and offer records described in Appendix C.1 are a separate source.

Observed enrollment supplies Q_k when the admission constraint binds above the cutoff floor. For a program at the floor, the capacity input is the available number of seats, with enrollment satisfying the capacity inequality. The final capacity file must therefore distinguish selective-program counts from seat inputs for programs at the floor. The fixed higher-education eligibility threshold z_{elig} is common to all programs and distinct from the population lower bound $z_{\min}$. An observed program admission cutoff may exceed it when seats are scarce. The enrolled grade distribution supplies the peer moments in (15).

Housing prices. The current implementation forms a regional price index by taking the arithmetic mean of the population-weighted cooperative-apartment and small-house price series from *Boendebarometer*. The young and old blocks use this index at their respective observation dates. The index is a sale-price proxy for the model's housing price; the recovered supply shifters are correspondingly expressed in index units. The SCB rental series remains a distinct source.

Initial conditions. For a transition, the initial data record the education, human capital, saving, and home regions of the old generation already present when the reform begins. Workplace choice, transfers, and ability transmission then generate the first young generation. The empirical distributions used in estimation provide the initialization targets; implementing the transition requires a dated, population-scaled initial-state file consistent with this law of motion. This

Table 6: Classification of fields of study

Field	SUN 2020	ISCED-F 2013	Programs	Content
Education	14 exc. 142	011 exc. 0111	25	Teacher training
Social Sciences and Humanities	142, 21, 22, 31 exc. 314, 32, 86 exc. 861	0111, 02, 031 exc. 0311, 032, 103 exc. 1032	34	Arts, humanities, languages, social and behavioral sciences, journalism, education science, military and defense; reference field
Business and Economics	314, 34, 81 exc. 813, 85 exc. 851	0311, 041, 101 exc. 1014, 102 exc. 1022	25	Business and administration, economics, hospitality and tourism
Law	38	042	13	Law
Life and Natural Sciences	42, 442, 443, 449, 62	051, 052, 0531, 0532, 0539, 08 exc. 084	17	Biology, environmental and earth sciences, chemistry, agriculture and forestry
ICT and Formal Sciences	440, 441, 46, 48	0530, 0533, 054, 061	27	Computing, mathematics, statistics, physics
Engineering	52, 54, 58, 84, 861	071–073, 104, 1032	23	Engineering, manufacturing, architecture and construction, transport, protective services
Health	64, 72 exc. 721, 813, 851	084, 091 exc. 0912, 1014, 1022	28	Nursing, dentistry, pharmacy, therapy, medical diagnostics, veterinary medicine, sport science
Medicine	721	0912	10	Physician training (721a); in the current estimates also biomedicine and other non-physician medical degrees (721x)
Social Work	76	092	20	Social work, child and youth services
Total			222	

Notes: SUN 2020 field codes are two-digit groups or three-digit fields; ISCED-F 2013 codes are two-digit broad, three-digit narrow, or four-digit detailed fields. "exc." removes codes assigned to another row. ISCED-F equivalents follow Statistics Sweden's SUN 2020 correspondence key (Statistics Sweden, 2020); the unspecified natural-science code 0500 follows its SUN group (420 and 429 to Life and Natural Sciences, 460 and 469 to ICT and Formal Sciences). The "Programs" column reports the number of university-field pairs in the baseline choice set, which retains pairs with at least 30 graduates in the 2000–2010 cohorts. The Medicine count includes programs at universities that do not train physicians (see text). No college degree in the sample carries the unknown field code (SUN 999).

remaining input is distinct from the estimated behavioral parameters.

Appendix C.6 Consumption Calibration

The old housing share of 0.30 rounds the mean of the all-household shares in the 2006–2009 SCB household expenditure surveys: 28.9, 29.3, 29.2, and 29.5 percent. The young housing share of 0.37 comes from the same calibration exercise. Thus $\alpha_{\mathbf{y}} = 0.63$ and $\alpha_{\mathbf{o}} = 0.70$; the young consume tradables and housing, while the old also consume local services.

For γ, actual individual consumption combines household final consumption, nonprofit institutions' individual consumption, and government individual consumption. The construction uses SCB household expenditures by COICOP purpose, government expenditures by COFOG function, and Eurostat national-account and actual-individual-consumption aggregates (Statistics Sweden, 2026; Eurostat, 2026). Housing includes actual and imputed rents and associated housing expenditures. Tradables include physical products and remotely supplied services; local services include education, health care, care services, and other activities supplied at the place of consumption. Government medical products enter tradables, while individual medical services enter local services. Collective government consumption is outside the individual-consumption aggregate.

Let J_t^{T}, J_t^{NT}, and J_t^{H} denote nominal expenditure on tradables, local services, and housing. The calibration pools expenditure levels:

$$\widehat{\gamma} = \frac{\sum_{t=2001}^{2003} J_t^{\mathrm{T}}}{\sum_{t=2001}^{2003} (J_t^{\mathrm{T}} + J_t^{\mathrm{NT}})} = 0.498994. \tag{28}$$

The pooled shares of total AIC are 0.403225 for tradables, 0.404851 for local services, and 0.191924 for housing. The AIC housing share is part of this national accounting decomposition; age-specific housing demand uses the separately calibrated $\alpha_{\mathbf{y}}$ and $\alpha_{\mathbf{o}}$.

Table 7: Tradable share of nonhousing consumption

Consumption aggregate	Years	$J^{\mathrm{T}}/(J^{\mathrm{T}} + J^{\mathrm{NT}})$
Actual individual consumption: baseline	2001–2003	0.499
Household final consumption	2001–2003	0.761
Actual individual consumption	2021–2023	0.454

Notes: Ratios use pooled nominal expenditure. Household final consumption covers household purchases; AIC additionally includes individual services financed by government and nonprofit institutions. Sources: SCB national accounts and Eurostat; construction and category assignments are archived with the consumption-calibration output.

Appendix C.7 Occupations and Sector Assignment

The occupational classification measures whether an activity can be supplied away from the customer. The public release associated with Burstein et al. (2020) provides a binary assignment for 50 occupation groups. We use that released assignment as a category indicator, retaining its distinction between tradable and nontradable work.

The concordance links SSYK96 to SSYK2012, ISCO08, US occupational classifications, and the released occupation groups. It retains all admissible links. A unique assignment, or agreement among the supported links, supplies the sector indicator. Conflicting or weak links are resolved

using the professional-coder assessments in the offshorability survey of Blinder and Krueger (2013). After deduplicating respondents and removing uncoded responses, the fallback classifies an occupation as tradable when the weighted share of ratings in categories four and five is at least one half. It proceeds from four-digit to successively broader ISCO groups, then to the available Swedish parent group. The threshold applies to the survey share; the released binary categories retain their original assignments.

Records with missing occupations receive fractional sector allocations from the efficiency-unit-weighted shares among classified workers in the same taxonomy, schooling, field, region, and year. Successively broader donor cells use field-year, field, schooling, and cross-taxonomy schooling groups; the terminal fallback assigns the record to local services. Donor shares use originally classified records. These fractional assignments preserve the worker's total earnings and efficiency units when constructing sector aggregates.

Appendix C.8 Human Capital and Quality

We use τ for high-school cohorts and t for calendar years in which earnings are measured. The wage step estimates field-region-calendar-year effects and university-field-cohort value added jointly with the ability coefficients in (14). The current implementation profiles over θ_{zq}/θ_q, uses two-year high-school-cohort bands, and imposes one restriction on the program-cohort effects: their mean across college cells, weighted by the number of person-year earnings observations, is zero. The return to ability θ_z is then the return at a program of average quality. One restriction suffices because θ_z is common across fields: shifting the effects of every program in field f by a constant, and the field's wage effects by the opposite amount, changes that field's earnings gradient in grade by $-(\theta_{zq}/\theta_q)$ times the shift. The division of field-level earnings differences between wages per efficiency unit and program effects is therefore identified only through the ability-quality interaction; with $\theta_{zq} = 0$ it would require one restriction per field. The same normalization is retained across fields when constructing production inputs. The non-college equation uses its own ability elasticity θ_z^0.

Write the sample peer moment of program k and cohort τ as

$$\widehat{\mathbb{E}}_{F^*_{k\tau}}(z^\xi) = \frac{1}{E_{k\tau}} \sum_{i:k_i=k,\tau_i=\tau} z_i^\xi,$$

where the sum runs over the $E_{k\tau}$ enrolled students observed in the cell. As $\xi \to 0$, $\xi^{-1} \log \widehat{\mathbb{E}}_{F^*_{k\tau}}(z^\xi)$ converges to their mean log ability. The quality regression is

$$\widehat{\pi}_{k\tau} = \bar{\pi}_k + \delta_\tau + \theta_q \theta_x \log x_{k\tau} + \frac{\theta_q(1-\theta_x)}{\xi} \log \widehat{\mathbb{E}}_{F^*_{k\tau}}(z^\xi) + e_{k\tau}.$$

Weights are the inverse estimated variances of the wage-step value-added estimates. In the current peer-only specification, $\theta_x = 0$ and $\bar{\pi}_k$ consists of an intercept, university effects, and field effects; the coefficient on the peer term is then θ_q itself. In the input-augmented specification, θ_q is the sum of the input and peer coefficients and θ_x is the input coefficient's share of that sum; expenditure per student must be matched to the relevant university-field-cohort cell before estimating that specification.

Permanent quality is $\bar{q}_k = \exp(\bar{\pi}_k/\theta_q)$ under the common normalization. Model quality is evaluated from this permanent component and the observed input and peer moments. Cohort effects absorb common dated shifts in the quality regression and are held fixed when evaluating

the corresponding baseline cohort. The complementarity parameter is the wage-step ratio multiplied by θ_q. Bootstrap inference for these derived objects re-estimates both steps in each replication.

Appendix C.9 Field Demand and Production Inputs

For an individual with annual earnings w_{it}, the production construction uses $\widehat{h}_{it} = w_{it}/\widehat{\bar{w}}_{fnt}$. Summing these earnings-based units with occupational sector weights yields H^{c}_{fsnt} and H^{nc}_{snt}. The corresponding wage bills use the same records and weights. This construction incorporates observed annual labor earnings; human capital predicted solely by the learning equation is a separate, model-based measure.

We estimate (22) by OLS, giving each retained aggregate cell equal weight. Sector-field-region effects absorb the time-invariant relative field weights, and sector-region-year effects absorb the common demand for college labor. The coefficient on log efficiency units is $-1/\rho_f$, identified from changes over time in relative field supplies within sector-region pairs, provided the remaining variation is orthogonal to e_{fsnt}. Cells with zero efficiency units are excluded from the log regression, and singleton fixed-effect groups are removed recursively.

An alternative specification with sector-field effects instead of sector-field-region effects, imposing field weights common across regions, gives 10.3670 (s.e. 0.8909) on 21,222 cells. The September 7 estimates of 6.9068 with regional weights and 10.3443 with common weights are earlier results from the previous input release. Neither OLS specification uses an excluded supply instrument.

The planned two-stage least-squares regression uses the sector-field-region and sector-region-year effects in (22). After partialing them out, the instrument vector Z_{fsnt} must shift field supply and satisfy

$$\mathbb{E}[Z_{fsnt}e_{fsnt}] = 0, \qquad \operatorname{Cov}(Z_{fsnt}, \log H^{c}_{fsnt} \mid \delta_{sfn}, \delta_{snt}) \neq 0$$

for at least one excluded instrument. The intended instruments are supply-side shifters. Their precise construction and the first-stage results accompany the IV estimates, which are in progress.

Both wages and efficiency units are generated objects. Since the latter divide earnings by the former, wage-estimation error enters both sides of (22). Regional fixed effects absorb permanent field-specific distortions, but do not remove time-varying errors in skill prices, sample composition, or occupational allocation. OLS therefore requires orthogonality of the residualized input to the composite regression error; joint inference must also account for the wage estimation.

Field-demand weights. The producers' first-order conditions imply (21). Time-invariant weights require the right-hand side to coincide across dates. Each additional date therefore provides overidentifying restrictions on relative field demand within a sector-region pair.

In the data, replacing wages and efficiency units in (21) with their empirical counterparts, denoted with hats, generates annual implied weights that may vary over time. Holding $\rho_f = \widehat{\rho}_f$ fixed, we estimate the permanent weights under the identifying moment condition

$$\mathbb{E}\left[\widehat{\bar{w}}^{\rho_f}_{fnt}\widehat{H}^{c}_{fsnt} - \omega_{sfn}\sum_{f'\in\mathcal{F}}\widehat{\bar{w}}^{\rho_f}_{f'nt}\widehat{H}^{c}_{f'snt}\right] = 0. \tag{29}$$

The expectation is conditional on the sector-region pair and the supplied elasticity. This condition restricts errors in the generated inputs and residual field-demand variation; it is an empirical

identifying assumption rather than a consequence of the exact identity alone.

Setting the time-sample analog of (29) to zero over a common set of years $\mathcal{T}_{sn}$ with positive inputs and observed wages for every field gives

$$\widehat{\omega}_{sfn} = \frac{\sum_{t\in\mathcal{T}_{sn}} (\widehat{\widetilde{w}}_{fnt})^{\widehat{\rho}_f} \widehat{H}^{c}_{fsnt}}{\sum_{f'\in\mathcal{F}} \sum_{t\in\mathcal{T}_{sn}} (\widehat{\widetilde{w}}_{f'nt})^{\widehat{\rho}_f} \widehat{H}^{c}_{f'snt}}. \tag{30}$$

The weights sum to one over fields within each sector-region pair; observations from different regions are not pooled. Under the exact CES conditions, any common set of years yields the same weights. With noisy inputs, (30) matches the time-averaged level moments rather than every annual first-order condition, and annual deviations from constant implied weights provide a specification check. The construction requires wages and efficiency units from the same wage estimation and normalization. The preliminary OLS elasticity can be used as a fixed input to this inversion, but the resulting weights are conditional on that value.

Missing or sampled-zero field inputs cannot be treated as evidence of a zero structural weight under the maintained positive-weight CES. A field never observed with positive input has no identified positive weight. The pooled formula uses the same supported years for all fields within a sector-region pair.

Appendix C.10 Choice Estimation

Workplace choice uses field-specific wage schedules, human capital, initial resources, and the saving choice implied by each trial parameter vector. The distance functions and choice values appear in (16)–(19). Workplace destination effects differ between college and non-college workers. The first likelihood sums log workplace probabilities at the observed destination; the second sums log college probabilities over the observed eligible choices, holding the first-step estimates fixed. Saving and the workplace continuation value are recomputed for each college alternative.

The destination effect $B_{g,nt}$ absorbs both local price terms. Write $A^{\mathbf{o}}_{gn} \equiv A^{\mathbf{o}}_{kn}$ for any program with $g(k) = g$, using the model's restriction that workplace amenities vary with education only through schooling status. Its relationship to the primitive amenity is

$$B_{g,nt} = \log A^{\mathbf{o}}_{gn} - (1-\alpha_{\mathbf{o}}) \log p^{\mathbf{o}}_{nt} - \alpha_{\mathbf{o}}(1-\gamma) \log p^{\mathrm{NT}}_{nt}.$$

Old housing prices are observed, and local-service prices come from the production inversion in Appendix C.12. We recover workplace amenities by schooling group and region by adding both price terms back, using price differences relative to Stockholm, the reference destination for the estimated effects. If housing prices enter the choice value explicitly, the estimated effect is $B_{g,nt} + (1-\alpha_{\mathbf{o}}) \log p^{\mathbf{o}}_{nt}$, so only the service-price term is added back. Dated effects yield dated recovered amenities; a fixed-date equilibrium uses the corresponding baseline cross-section.

Young amenities have the multiplicative form $A^{\mathbf{y}}_k = A_u A_f$. Young housing prices enter the choice value at their calibrated expenditure share, including the home-region price for the outside option. The outside-option amenity is normalized to one, and a reference field fixes the university-field decomposition. The current reference field is Social Sciences and Humanities. The taste scales are estimated in the same utility units as consumption and the warm-glow term.

For $k = (u, f)$, let $W_{k,t} \equiv \log(a - b^*_{k,t}) - (1-\alpha_{\mathbf{y}}) \log p^{\mathbf{y}}_{\ell(u),t} + V^{\mathbf{o}}_{k,t+1}(b^*_{k,t})$ denote the known payoff component computed conditional on the accepted workplace estimates and other fixed

inputs. The young choice value satisfies

$$\frac{v^{\mathrm{y}}_{k,t}}{\sigma^{\mathrm{y}}} = \frac{\log A_u}{\sigma^{\mathrm{y}}} + \frac{\log A_f}{\sigma^{\mathrm{y}}} - \frac{\lambda^{\mathrm{y}}}{\sigma^{\mathrm{y}}} d_{r\ell(u)} + \frac{1}{\sigma^{\mathrm{y}}} W_{k,t}.$$

With the coefficient on young log expenditure normalized to one, the coefficient on $W_{k,t}$ identifies $1/\sigma^{\mathrm{y}}$, allowing recovery of the unscaled amenity and distance parameters. Identification requires variation in payoff differences across eligible alternatives that is not absorbed by the amenity effects and distance terms. For the program-closure extension in Appendix A.1.1, add $\log \varpi_{kt}$ to this component for positive multipliers and assign zero choice weight to closed programs.

Stage-specific BHHH/outer-product standard errors condition on the inputs held fixed in that stage. Joint inference requires resampling the data and re-estimating the wage, quality, workplace, and college blocks. Table 4 reports the available estimates and the calibration used in the counterfactuals; joint inference remains pending.

Appendix C.11 Intergenerational Transmission

The model's transition kernel uses child ability and parental human capital on their structural scales and conditions on the fixed population interval $[z_{\min}, z_{\max}]$. An interior observation contributes the log-likelihood

$$\mathcal{L}_i(\kappa, \sigma_v) = -\log \sigma_v + \log \phi\left(\frac{\log z_i - \kappa \log h_i}{\sigma_v}\right) - \log\left[\Phi(U(h_i)) - \Phi(L(h_i))\right],$$

where L and U are defined in Appendix A.7. Estimation imposes $\kappa \geq 0$ and $\sigma_v > 0$. The truncation normalization varies with h_i and with both parameters; ordinary regression residual dispersion is therefore not the structural Gaussian scale. Observed endpoint grades or flooring require an explicit observation rule, such as interval probabilities under G, rather than invented endpoint atoms in the latent ability law. The proxy estimates remain labeled as such until the structural scale conversion, observation rule, and truncated likelihood have been implemented.

Appendix C.12 Recovering Technology from Wages and Employment

We start from individual earnings, schooling, occupation, workplace, and year. The wage estimation gives field wages $\bar{w}_{fnt}$ and the non-college wage $\bar{w}_{0nt}$, common to both sectors. We divide earnings by these wages and aggregate by occupational sector to obtain efficiency-unit inputs H^{c}_{fsnt} and H^{nc}_{snt}, as in Appendix C.9. We then recover technologies and goods prices from these inputs and sector wage bills. We omit time and region subscripts when all quantities refer to the same date and region.

Recovered objects. The skill-premium condition recovers college-augmenting productivity, and zero profit recovers the composite $p^s\Omega_s$. Armington demand separates tradable prices from tradable productivity. For local services, $\Omega_{\mathrm{NT}nt} = 1$ fixes units and makes the composite the local-service price.

Step 1: field weights. Conditional on ρ_f, positive field inputs and wages, and their efficiency-unit normalization, the relative-wage conditions in Appendix A.3 and $\sum_f \omega_{sfn} = 1$ give (21). Time-invariant weights require the right-hand side to be the same at every date. We pool over years within each sector-region pair, as in (30). Given these weights, the CES aggregator in the main text gives H^{c}_{snt}. Below, we retain n on the weights and omit the common region and time

subscripts on the inputs.

Step 2: college-augmenting technology. The field first-order condition reads $\bar{w}_f = p^s\,\partial Y_s/\partial H^{\mathrm{c}}_s \cdot \omega_{sfn}^{1/\rho_f}(H^{\mathrm{c}}_s/H^{\mathrm{c}}_{fs})^{1/\rho_f}$ for every f. Multiply each condition by H^{c}_{fs}, sum over fields, and use the CES aggregator to obtain

$$\sum_f \bar{w}_f H^{\mathrm{c}}_{fs} = p^s\,\frac{\partial Y_s}{\partial H^{\mathrm{c}}_s}\,(H^{\mathrm{c}}_s)^{\frac{1}{\rho_f}}\sum_f \omega_{sfn}^{1/\rho_f}(H^{\mathrm{c}}_{fs})^{\frac{\rho_f-1}{\rho_f}} = p^s\,\frac{\partial Y_s}{\partial H^{\mathrm{c}}_s}\,H^{\mathrm{c}}_s.$$

With $\partial Y_s/\partial H^{\mathrm{c}}_s = \Omega_s^{\frac{\rho-1}{\rho}} Y_s^{\frac{1}{\rho}}(\Omega^{\mathrm{c}}_s)^{\frac{\rho-1}{\rho}}(H^{\mathrm{c}}_s)^{-\frac{1}{\rho}}$ and $\partial Y_s/\partial H^{\mathrm{nc}}_s = \Omega_s^{\frac{\rho-1}{\rho}} Y_s^{\frac{1}{\rho}}(H^{\mathrm{nc}}_s)^{-\frac{1}{\rho}}$, dividing by the non-college condition $\bar{w}_0 H^{\mathrm{nc}}_s = p^s\,\partial Y_s/\partial H^{\mathrm{nc}}_s \cdot H^{\mathrm{nc}}_s$ removes both p^s and Ω_s:

$$\frac{\sum_f \bar{w}_f H^{\mathrm{c}}_{fs}}{\bar{w}_0 H^{\mathrm{nc}}_s} = \left(\frac{\Omega^{\mathrm{c}}_s H^{\mathrm{c}}_s}{H^{\mathrm{nc}}_s}\right)^{\frac{\rho-1}{\rho}}. \tag{31}$$

The ratio of the college to the non-college wage bill in a sector equals the effective-input ratio raised to $(\rho-1)/\rho$. Given ρ, this identifies $\Omega^{\mathrm{c}}_{snt}$ cell by cell from wage-bill shares and employment.

Step 3: the price-productivity product. Zero profit says revenue equals the wage bill. Substituting the production function,

$$p^{\mathrm{s}}_{nt}\,\Omega_{snt} = \frac{\sum_f \bar{w}_{fnt} H^{\mathrm{c}}_{fsnt} + \bar{w}_{0nt} H^{\mathrm{nc}}_{snt}}{\left[(\Omega^{\mathrm{c}}_{snt} H^{\mathrm{c}}_{snt})^{\frac{\rho-1}{\rho}} + (H^{\mathrm{nc}}_{snt})^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}}}, \tag{32}$$

the wage bill per unit of the effective-input aggregate. The next two steps separate this recovered price-productivity composite using goods demand and the local-service normalization.

Step 4: tradables. The final-good firm's demand, $Y_{\mathrm{T}nt} = (p^{\mathrm{T}}_{nt})^{-\eta} Y_t$, gives revenue $p^{\mathrm{T}}_{nt} Y_{\mathrm{T}nt} = (p^{\mathrm{T}}_{nt})^{1-\eta} Y_t$. Summing over regions and using $P_t = 1$ yields $\sum_n p^{\mathrm{T}}_{nt} Y_{\mathrm{T}nt} = Y_t$, so

$$\left(p^{\mathrm{T}}_{nt}\right)^{1-\eta} = \frac{\sum_f \bar{w}_{fnt} H^{\mathrm{c}}_{f\mathrm{T}nt} + \bar{w}_{0nt} H^{\mathrm{nc}}_{\mathrm{T}nt}}{\sum_m \left(\sum_f \bar{w}_{fmt} H^{\mathrm{c}}_{f\mathrm{T}mt} + \bar{w}_{0mt} H^{\mathrm{nc}}_{\mathrm{T}mt}\right)}: \tag{33}$$

a region's share of the national tradable wage bill determines its tradable price. Zero profit equates revenue with the wage bill. Given p^{T}_{nt}, (32) gives $\Omega_{\mathrm{T}nt}$.

Step 5: local services. With $\Omega_{\mathrm{NT}nt} \equiv 1$, (32) at $s = \mathrm{NT}$ is the local-service price itself,

$$p^{\mathrm{NT}}_{nt} = \frac{\sum_f \bar{w}_{fnt} H^{\mathrm{c}}_{f\mathrm{NT}nt} + \bar{w}_{0nt} H^{\mathrm{nc}}_{\mathrm{NT}nt}}{\left[(\Omega^{\mathrm{c}}_{\mathrm{NT}nt} H^{\mathrm{c}}_{\mathrm{NT}nt})^{\frac{\rho-1}{\rho}} + (H^{\mathrm{nc}}_{\mathrm{NT}nt})^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}}},$$

a function of local wages and $\Omega^{\mathrm{c}}_{\mathrm{NT}nt}$ alone. Destination-time effects in the workplace-choice block absorb its level; counterfactual changes in this price enter $\Pi^{\mathbf{o}}_n$.

Two remarks. First, at a single date, freely varying regional weights can match relative field demands within each sector-region pair conditional on ρ_f. Holding those weights fixed across dates restricts changes in relative field wages and inputs. With noisy inputs, pooled weights need not satisfy every annual field condition exactly. Equation (31) then recovers technology

from the aggregate wage-bill moment; the estimation must also report field-level residuals. The cross-sector equalization conditions of Appendix A.3 require the same $\bar{w}_{fnt}$ to clear both sectoral demands. Second, local-service clearing with Cobb-Douglas demand requires the nontradable wage bill in n to equal $\frac{\alpha_{\mathbf{o}}(1-\gamma)}{1+\beta}$ times the income of the old residing there. Given the calibrated shares, this condition provides a check on the occupational sector allocation. We do not impose it; the industry-based robustness allocation requires the same check.

Appendix C.13 Baseline Housing Supply Inversion

We recover housing-supply shifters from observed prices and model-implied expenditure. Let di carry population weights and $t_i^{\mathbf{y}}$ and $t_i^{\mathbf{o}}$ denote individual i's young and old observation dates, with $t_i^{\mathbf{o}} = t_i^{\mathbf{y}} + 1$ in the model and corresponding calendar years in the data. At the estimated demand parameters, we compute saving $b^*_{ik,t_i^{\mathbf{y}}}$ and human capital $h_i(k)$ for each eligible program, using quality at $t_i^{\mathbf{y}}$. Fitted housing expenditure is

$$J^{\mathbf{y}}_{nt} = (1-\alpha_{\mathbf{y}}) \int_{i:\, t_i^{\mathbf{y}}=t} \sum_{k\in\mathcal{K}_t(z_i)} \mathbf{1}\{\ell_i(k)=n\}\mu^{\mathbf{y}}_{i,t}(k)(a_i - b^*_{ik,t})\, di,$$

$$J^{\mathbf{o}}_{nt} = \frac{1-\alpha_{\mathbf{o}}}{1+\beta} \int_{i:\, t_i^{\mathbf{o}}=t} \sum_{k\in\mathcal{K}_{t_i^{\mathbf{y}}}(z_i)} \mu^{\mathbf{y}}_{i,t_i^{\mathbf{y}}}(k)\mu^{\mathbf{o}}_{i,t}(n \mid k) \left[R b^*_{ik,t_i^{\mathbf{y}}} + \bar{w}_{f(k)nt} h_i(k)\right] di,$$

where $\ell_i(0) = r_i$ and $\ell_i(k) = \ell(k)$ for college options. Young housing thus includes local students and non-college households. Old expenditure includes both schooling groups and combines cohort-specific college choices and saving with current workplace probabilities and wages. Each stage enters its own observation year.

At positive prices, market clearing and the supply schedule for segment $s \in \{\mathbf{y}, \mathbf{o}\}$ imply

$$\bar{D}^s_{nt}(\psi) = \frac{J^s_{nt}}{(p^s_{nt})^{1+\psi}}.$$

Prices and expenditure must use consistent units and population scaling; Appendix C.5 documents the inputs. A property-sale-price proxy yields shifters in proxy units. Zero expenditure implies zero supply and does not identify a log shifter; we leave missing cells unfilled. The recovered shifters describe the baseline at the chosen ψ. Counterfactual prices require a new market-clearing solution.

Appendix D Counterfactual Policy Details

Table 8: Rules for reallocating university seats

	(1) Concentration	(2) Access
Regions that expand	Three highest-productivity regions already offering the field.	Regions below the capacity benchmark based on distance-weighted non-attainment catchments.
Allocation of added seats	Proportional to recipients' initial program capacities.	Proportional to regions' initial shortfalls; initial program shares preserved within each region.
Regions that contract	All other programs in the field close.	Other regions offering the field lose seats in proportion to initial capacity.
National capacity	Fixed in each field.	Fixed in each field.
Engineering	1,675 seats (37.3%).	Same transfer.
Business and Economics	1,701 seats (45.2%).	Same transfer.
Law	236 seats (21.5%).	Same transfer.

Notes: Columns describe policy rules; rows are separate field experiments. Initial national capacity is 4,496 in Engineering, 3,761 in Business and Economics, and 1,096 in Law. Concentration recipients are Stockholm, Göteborg, and Malmö–Lund in all three experiments. Access uses all 27 home regions to construct catchments over existing campus regions.

Appendix D.1 Increased access: allocation of seats

The access exercise directs capacity toward existing campuses serving relatively many high-school graduates without a college degree. We construct a catchment for each campus region using all 27 home regions, including those without a program in the field. Each origin's non-attainers are allocated across distinct campus regions with weights proportional to $\exp[-(\lambda^{y}/\sigma^{y})d_{rn}]$, normalized to sum to one within the origin. The estimated distance coefficient gives a decay length of 177.45 kilometers. The weights use neither ability nor endogenous enrollment; they determine the capacity allocation while students retain their national choice sets.

Let M_r be the fixed number of 2005 high-school graduates from origin r without a qualifying degree by 2021, and let M_{fn} denote the resulting catchment population for campus region n in field f. For initial capacity Q^0_{fn} and the set $\mathcal{N}_f$ of existing campus regions, the benchmark is

$$Q^*_{fn} = Q_f \frac{M_{fn}}{\sum_{r\in\mathcal{N}} M_r}, \qquad Q_f = \sum_{n\in\mathcal{N}_f} Q^0_{fn}. \tag{34}$$

The denominator is 56,659 in all three fields. With $\mathcal{R}_f = \{n \in \mathcal{N}_f : Q^0_{fn} < Q^*_{fn}\}$ and transferred capacity D_f, the rule is

$$Q^{\text{access}}_{fn} = \begin{cases} Q^0_{fn} + D_f \dfrac{Q^*_{fn} - Q^0_{fn}}{\sum_{m\in\mathcal{R}_f}(Q^*_{fm} - Q^0_{fm})}, & n \in \mathcal{R}_f, \\ Q^0_{fn} - D_f \dfrac{Q^0_{fn}}{\sum_{m\in\mathcal{N}_f\setminus\mathcal{R}_f} Q^0_{fm}}, & n \notin \mathcal{R}_f. \end{cases} \tag{35}$$

Programs retain their initial capacity shares within each region. We match concentration's transfers of 1,675, 1,701, and 236 seats. The rule expands 13 Engineering, 15 Business and Economics, and 8 Law campus regions, leaving every program open. Contracting regions hold 3,606, 2,456, and 807 seats, respectively. Additions are proportional to initial shortfalls and are not capped at the benchmark; only Business and Economics overshoots its aggregate initial shortfall. The capacity plans are fixed across the four peer and mobility specifications.

Appendix D.2 Labor-Input Accounting under Concentration

Table 9 values changes in tradable labor inputs at baseline regional wages and reconciles their contributions with the finite change in output. Engineering's small non-college offset contrasts with the larger offset in Business and Economics, where lower college attainment expands non-college labor supply. These entries describe the inputs employed in tradables, rather than changes in national skill supplies alone.

Table 9: Labor-input accounting for tradable output

	Engineering	Business and Economics	Law
Reallocated field	−1.135	−0.928	−0.146
Other college fields	+0.185	+0.190	+0.022
Non-college labor	+0.030	+0.278	−0.008
Nonlinear remainder	−0.056	−0.045	−0.009
Tradable output change	−0.976	−0.504	−0.141

Notes: Entries are percentage points of baseline tradable output. Labor-input changes refer only to employment in tradables and are valued at the baseline regional wage per efficiency unit.

Appendix D.3 Labor-Input Accounting under Increased Access

Table 10 reports the corresponding labor-input accounting for increased access. Lower college attainment expands non-college labor supply in Engineering and Business and Economics, partly offsetting the fall in college human capital. In Law, the small increase in national field human capital coexists with a decline in local-service output and virtually unchanged tradable output.

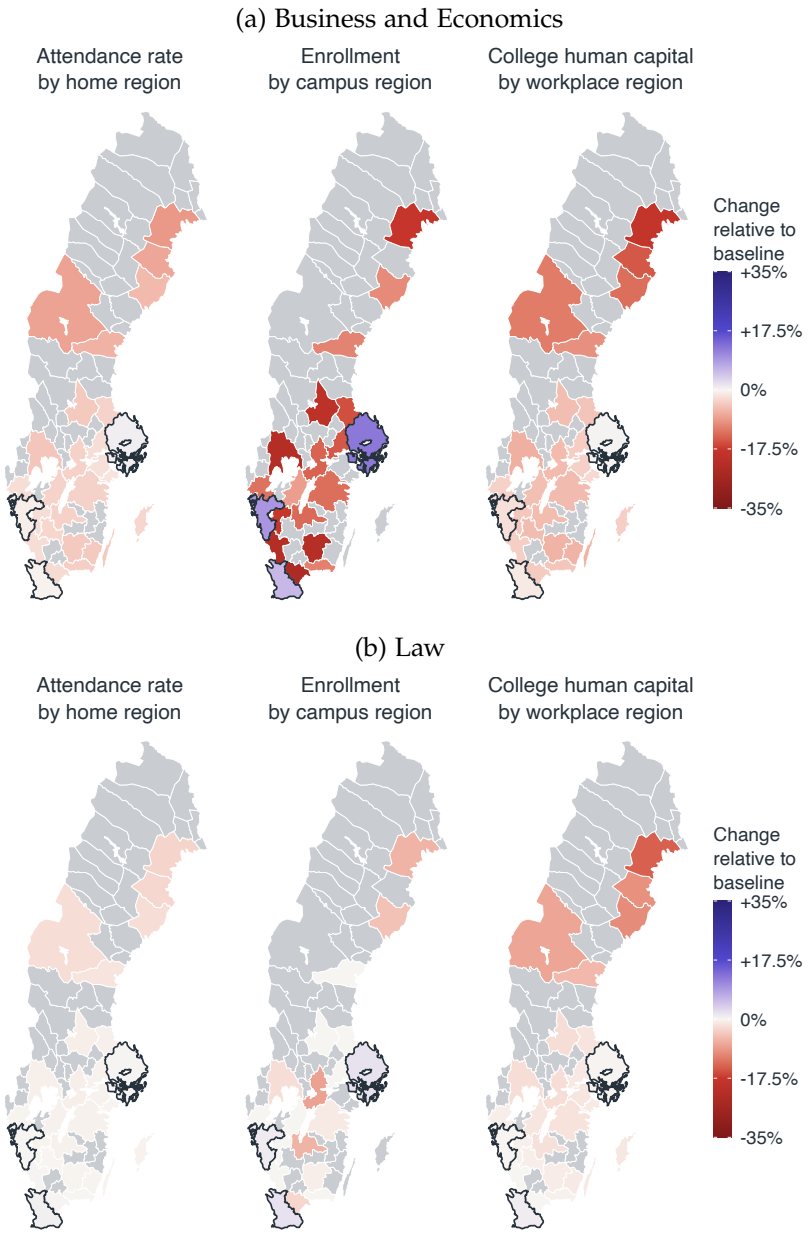
Table 10: Labor-input accounting for tradable output: access

	Engineering	Business and Economics	Law
Reallocated field: national tradable input	−0.962	−2.170	+0.027
Reallocated field: regional allocation	−0.004	−0.026	−0.010
Other college fields	+0.176	+0.332	−0.013
Non-college labor	+0.389	+1.024	−0.006
Nonlinear remainder	−0.014	−0.057	−0.002
Tradable output change	−0.415	−0.896	−0.004

Notes: Percentage points of baseline tradable output. The first two rows split the affected field's initial-wage contribution using its baseline tradable-employment-weighted national wage. Regional allocation includes differential regional entry and exit; it does not isolate migration. Other definitions follow Table 9.

Appendix D.4 Additional Concentration Results

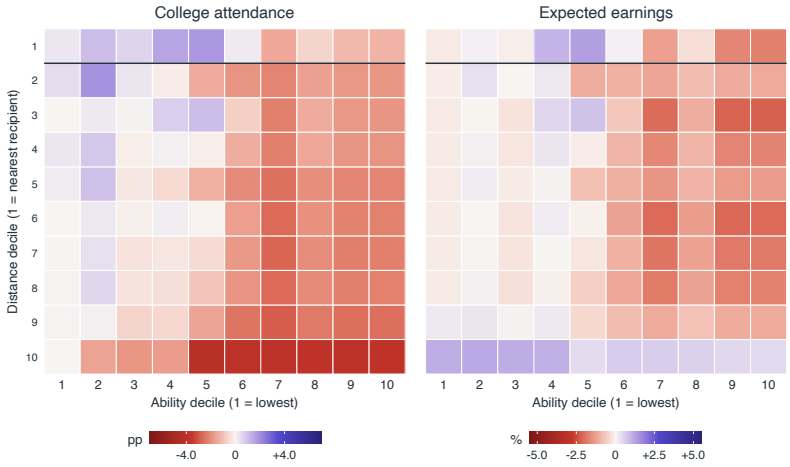
Figure 14: Spatial effects of regional concentration: additional fields



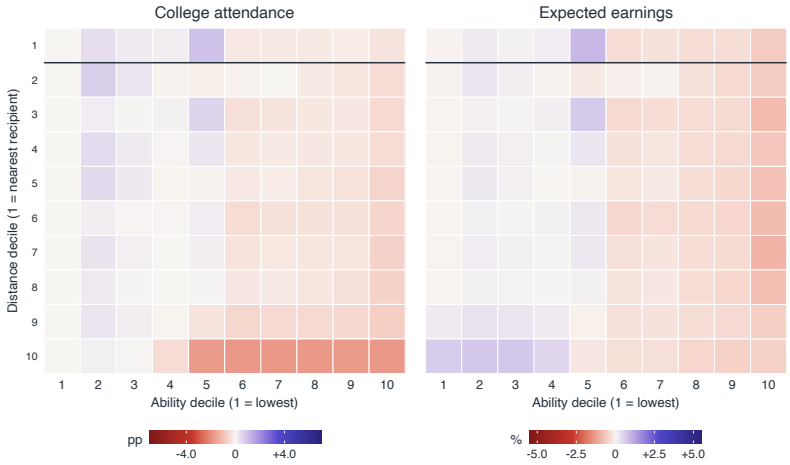
Notes: Each row is a separate field reallocation; all maps cover college education in every field. Panels show percentage changes in attendance rates by home region, enrollment by campus region, and college human capital by workplace region. Home attendance counts college anywhere and uses each equilibrium's regional young population.

Figure 15: Distributional effects of regional concentration: additional fields

(a) Business and Economics



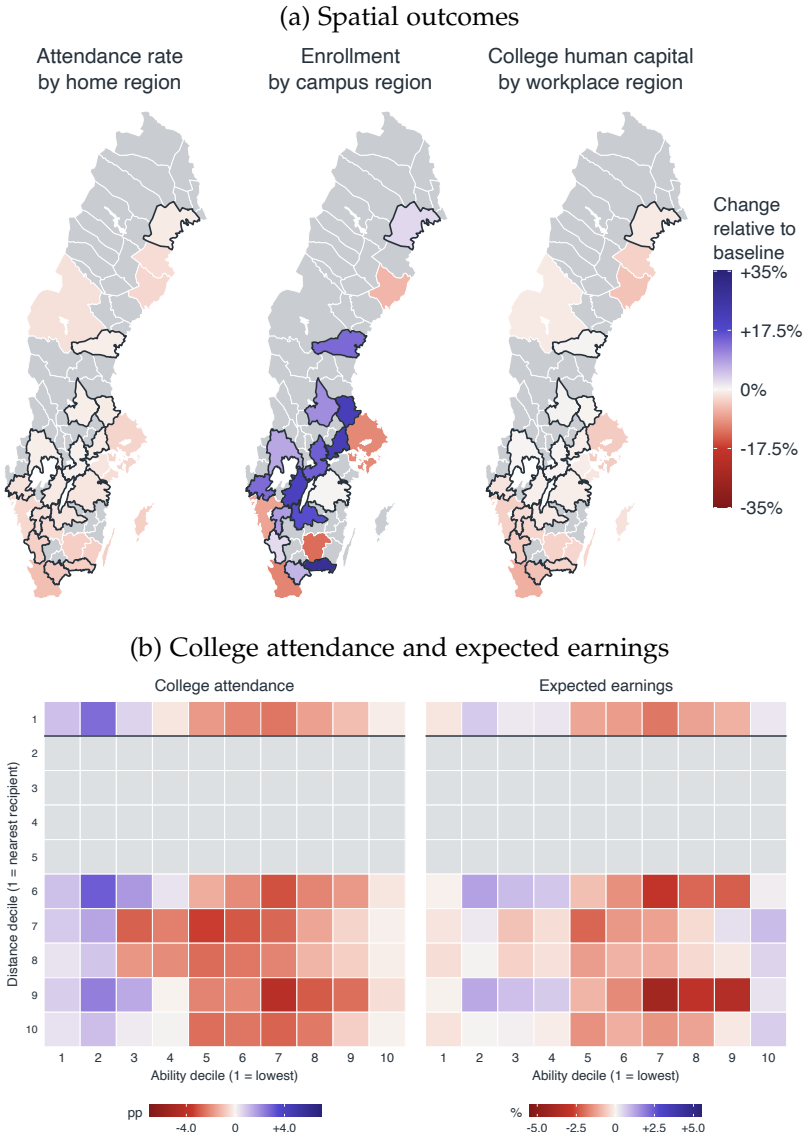
(b) Law



Notes: Each row is a separate field reallocation. Left: changes in college attendance probabilities, in percentage points. Right: percentage changes in expected earnings. Baseline ability-decile boundaries and type masses are held fixed; parental-resource groups and home regions are pooled using baseline population weights. Distance deciles run from 1 (nearest recipient) to 10 (farthest). The first group contains Stockholm, Göteborg, and Malmö–Lund. Color scales are common across fields for each outcome.

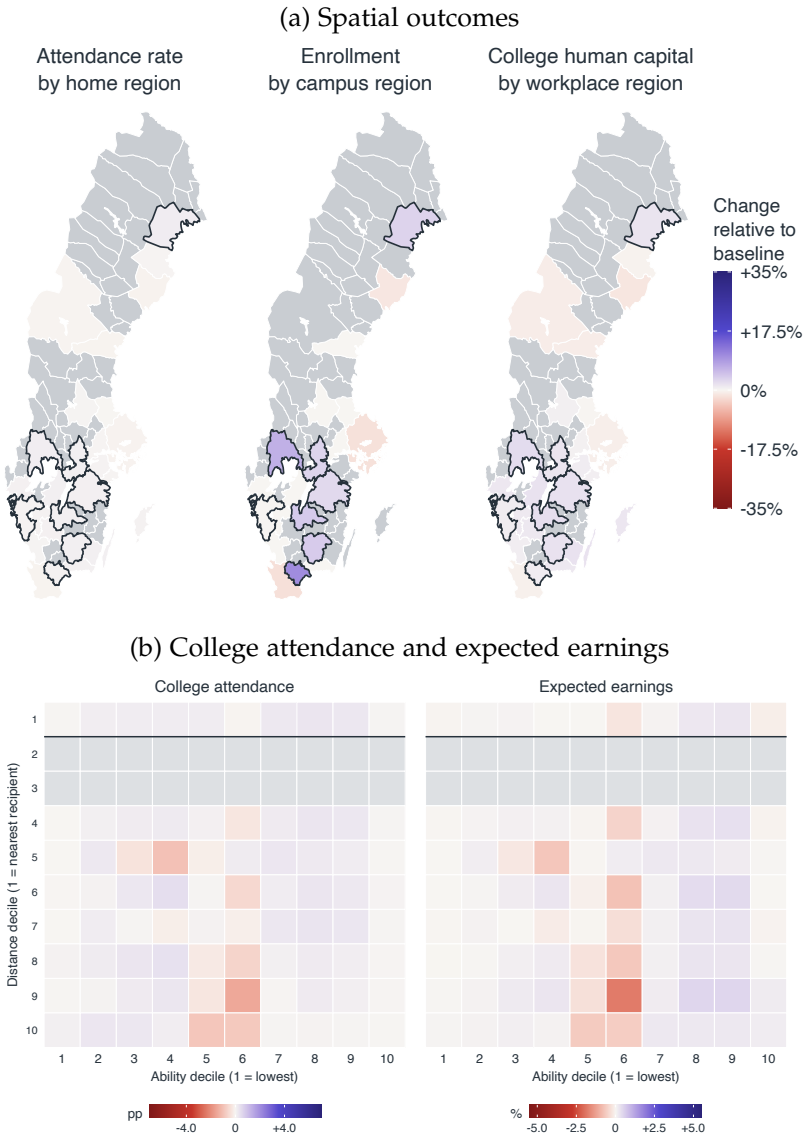
Appendix D.5 Additional Access Results

Figure 16: Spatial and distributional effects of increased access: Business and Economics



Notes: Separate reallocation in Business and Economics. Panel (a) covers college education in every field. Maps show percentage changes in attendance rates by home region, enrollment by campus region, and college human capital by workplace region. Home attendance counts college anywhere and uses each equilibrium's regional young population. Panel (b) shows changes in college attendance probabilities, in percentage points (left), and percentage changes in expected earnings (right). Baseline ability-decile boundaries and type masses are held fixed; parental-resource groups and home regions are pooled using baseline population weights. Distance deciles run from 1 (nearest recipient) to 10 (farthest). The first group contains all recipient regions. Gray rows contain no home regions. Color scales are common across fields for each outcome.

Figure 17: Spatial and distributional effects of increased access: Law



Notes: Separate reallocation in Law. Panel (a) covers college education in every field. Maps show percentage changes in attendance rates by home region, enrollment by campus region, and college human capital by workplace region. Home attendance counts college anywhere and uses each equilibrium's regional young population. Panel (b) shows changes in college attendance probabilities, in percentage points (left), and percentage changes in expected earnings (right). Baseline ability-decile boundaries and type masses are held fixed; parental-resource groups and home regions are pooled using baseline population weights. Distance deciles run from 1 (nearest recipient) to 10 (farthest). The first group contains all recipient regions. Gray rows contain no home regions. Color scales are common across fields for each outcome.