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Local Industrial Policy and Sectoral Hubs†

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Production in the United States is concentrated in space with some cities acting as major hubs for particular activities. This concentration has been interpreted as evidence of external local effects that in turn can provide a basis for industrial policy.

We study the desirability of such policies in an extension of the quantitative spatial model developed in Rossi-Hansberg, Sarte, and Schwartzman (2020). The model comprises 382 US cities, and production is differentiated into 22 industry groups. Cities trade but are subject to trade costs that increase with distance. Individuals work in two types of occupations, cognitive nonroutine (CNR) and others (non-CNR), and can choose where to live. The equilibrium allocation is suboptimal because individual workers influence the productivity of other workers in their occupation. We quantify the model to match the observed US spatial distribution of industrial employment and wages. We then ask whether a constrained optimal allocation reinforces the spatial concentration of activities observed in the baseline equilibrium.

The results described in this paper derive from new industry-specific estimates of local productive externalities. A social planner, therefore, will choose to concentrate workers in cities that specialize in industries where those workers have the largest productivity spillovers. Thus, for example, we find spillovers from CNR workers to other CNR workers to be largest in sectors that make up professional and other services. Given that those sectors are themselves very intensive in the use of CNR labor, the services they provide are optimally concentrated in a small number of coastal cities that then become national hubs for those services.

The quantitative model further highlights how the formation of these hubs depends on trade costs. While professional services are relatively easy to trade, health and education are subject to much larger costs. Therefore, the planning solution involves the formation of a larger number of local health and education hubs away from the coasts, with inland medium-sized cities such as Minneapolis or Denver increasing their output relative to smaller cities.

Our findings do not suggest the formation of many hubs in manufacturing or sectors associated with low-skilled services comprising accommodation, transportation, and wholesale trade. Rather, the prescription that emerges from the analysis is to spread out those activities over a large number of small cities.

I. Model

We now sketch a model of spatial equilibrium with trade frictions, sectoral heterogeneity, and local externalities. We present some key features of, and differences from, Rossi-Hansberg, Sarte, and Schwartzman (2020) but refer the reader to that paper for further details.

The economy consists of N cities (indexed n). It is populated by individuals characterized by their occupation (indexed k) and a vector $\mathbf{a} = \{a_1, \ldots, a_N\}$ governing their preferences for where to live. Individuals choose in which city to live, n, and a consumption basket, C_n^k, to maximize their utility, $U^k\left(C_n^{kj}, \mathbf{a}, n\right) = A_n^k a_n C_n^k$; $C_n^k \equiv \prod_j \left(C_n^{kj}\right)^{\alpha^j}$, where A_n^k is a common amenities component experienced by households with occupation k in city n, and C_n^k is an aggregate of sector-specific consumption, C_n^{kj}. Individuals are subject to the budget constraint $\sum_j P_n^j C_n^{kj} = w_n^k + \chi^k$, where w_n^k is wages received in occupation k in city n, and χ^k is a dividend from a portfolio of land and structures received by workers in occupation k.

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Households choose where to live freely. We assume that a_n is drawn from a Fréchet distribution with shape parameter ν. One can then show that the fraction of households in occupation k that chooses to live in city n satisfies $L_n^k/L^k = \left(A_n^k C_n^k\right)^{\nu} / \left(\sum_{n'}\left(A_{n'}^k C_{n'}^k\right)^{\nu}\right)$.

The production side of the economy extends Caliendo et al. (2018) to an environment with different types of labor and local externalities. In each city, there are J final goods producers who use a continuum of sector-specific intermediate varieties as inputs. Each of those varieties can be produced in all cities. These producers use labor, structures, and final goods ("materials") as inputs.

Trade between cities is subject to iceberg transportation costs. Intermediate input producers are competitive so that final goods producers purchase from the city with the lowest input costs. They then sell the final good within their own city to households and as materials to intermediate goods producers.

Local unit costs in industry j and city n satisfy

$$x_n^j \propto \left(\sum_{k=1}^{K}\left(w_n^k/\lambda_n^{kj}\right)^{1-\varepsilon}\right)^{\frac{\gamma_n^j}{1-\varepsilon}} \prod_{j'=1}^{J}\left(P_n^{j'}\right)^{\gamma_n^{j'j}}.$$

A key assumption in the model is that labor productivity is influenced by external effects stemming from the local composition of labor. In particular, the productivity of occupation k in industry j in city n is given by

$$(1) \qquad \lambda_n^{kj} = \hat{\lambda}_n^{kj}\left(\frac{L_n^k}{L_n}\right)^{\tau^{R,kj}} \left(L_n\right)^{\tau^{L,j}},$$

where $\hat{\lambda}_n^{kj}$ is an exogenous component of local productivity. This formulation allows externalities to be industry specific. Hence, for example, a worker employed in professional services may benefit from a high concentration of CNR workers in a given city to a greater degree than a worker employed in, say, accommodation. To keep the specification parsimonious, we assume that standard agglomeration externalities are common to all occupations so that $\tau^{L,j}$ is not indexed by k.

In this setting, local prices, (P_n^j), summarize local consumer market access to individual sectors (Redding 2020). Changes in these prices can then be decomposed into two components, one determined by local unit costs and another tied to the number of traded varieties (i.e., $1-\pi_{nn}^j$), that is, $\Delta \ln\left(P_n^j\right) = \Delta \ln\left(x_n^j\right) - \theta^{-1}\Delta \ln(\pi_{nn}^j)$, where θ is the shape parameter of the Fréchet distribution from which the productivities of individual varieties are drawn. Note that increases in trade (i.e., lower π_{nn}) naturally translate into greater market access.

Local unit costs in turn reflect the prices of inputs (labor and materials) and productivity. Up to a first-order log-linear approximation,

$$(2) \; \Delta \ln x_n^j \simeq \gamma_n^j \sum_k \frac{w_n^k L_n^{kj}}{\sum_n w_n^k L_n^{kj}}\left(\Delta \ln w_n^k - \Delta \ln \lambda_n^{kj}\right) + \sum_{j'} \gamma_n^{j'j}\, \Delta \ln P_n^{j}.$$

II. Planning Problem

We compare observed equilibrium allocations with those emerging from a constrained planner's choice. In particular, we assume that the planner allows workers in each occupation to move freely across cities. Under this assumption and the Fréchet distribution characterizing preferences over location, the average utility of a worker in occupation k is proportional to $\left(\sum_n\left(A_n^k C_n^k\right)^{\nu}\right)^{1/\nu}$. The planner maximizes a weighted sum of those averages, with weights selected so that everyone obtains the same welfare gains.

Proposition 1 in Rossi-Hansberg, Sarte, and Schwartzman (2020) establishes that whenever the problem is concave, the optimal allocation can be implemented by a set of personal taxes and subsidies, t_L and Δ_n^k, and transfers, R^k, to individual workers such that $P_n C_n^k = \left(1-t_L\right) \times \left(w_n^k + \Delta_n^k\right) + \chi^k + R^k$, where

$$\Delta_n^k = \sum_{k'j} \frac{w_n^{k'} L_n^{k'j}}{L_n^k} \frac{\partial \ln \lambda_n^{k'j}}{\partial \ln L_n^k},$$

$t_L = 1/\left(1+\nu\right)$, and R^k satisfies budget balance. Implementing the optimal allocation involves an income tax term, t^L, that incentivizes individuals to stay in cities where they experience the highest amenities; an occupation-specific lump-sum transfer, R^k, that the planner uses to redistribute gains between occupations; and an occupation-city subsidy term, Δ_n^k, that compensates workers for the external effects they generate.

Table 1—Externality Parameters

Industry group	τ^R (CNR)	τ^R (NCNR)	τ^L
Health and education (HE)	0.63 (0.05)	0.44 (0.14)	0.20 (0.01)
Professional and other services (PS)	1.22 (0.08)	0.71 (0.14)	0.39 (0.01)
Manufacturing (M)	1.23 (0.13)	1.28 (0.21)	0.51 (0.01)
Accommodation, trade, and transportation (ATT)	0.80 (0.10)	0.54 (0.14)	0.37 (0.01)

Notes: Parameter estimates using 2SLS, with controls and instruments as described in the text. Standard errors (in parentheses) are clustered at the city level. The first-stage *F*-tests for the MIIVs are all above 10. See text for how industry groups are defined.

Fajgelbaum and Gaubert (2020) present a similar result, though a key difference here is that the wedge term, Δ_n^k, depends on the local composition of industries: the planner chooses to incentivize workers to move to cities dominated by industries where their occupational type enjoys the highest spillovers.

More generally, Δ_n^k is a function of endogenously determined wages and industry-level employment so that details of the underlying model matter for optimal allocations. Specifically, wages and the occupational makeup of a city are themselves a function of its industrial composition and vice versa. Depending on the strength of externalities, this interaction can lead to the formation of occupational and industrial clusters under the optimal allocation. Congestion forces—in the form of limited land supply, imperfect substitutability between worker types, and trade costs—ensure that those clusters do not become degenerate.

III. Model Inversion and Estimation

The equilibrium allocation depends on amenity (A_n^k) and productivity (λ_n^{kj}) parameters. These can be recovered through a "model inversion" where—given data on wages, employment, and input-output linkages and calibration of trade costs and elasticity parameters—one can find values for (endogenously determined) productivity and amenities that imply the observed data as an equilibrium. We invert the model using data from two broad occupational groups (CNR and non-CNR) and 22 industry groups. See Rossi-Hansberg, Sarte, and Schwartzman (2020) for further details of definitions, data, and implementation of the model inversion.

Given the measures of productivity recovered by the model inversion, λ_n^{kj}, we then estimate the degree of local externalities. Specifically, we estimate equation (1). We parametrize $\widehat{\lambda}_n^{kj}$ with occupation-industry dummies, dummies for nine census divisions, and measures of local climate, which we introduce as controls.

One challenge in estimating equation (1) is the potential for reverse causality from productivity to the composition of the local labor force. We address this challenge by using a set of model-implied instrumental variables (MIIV). Thus, we first obtain counterfactual allocations by setting productivity in different occupations and industries, λ_n^{kj}, to their cross-city averages. The resulting allocation, therefore, is now independent of city-specific productivity shocks and solely a function of local amenities and geography. This allows us to use the allocations implied by the counterfactual as model-implied instruments.

We run the regression separately for four industry groups encompassing the 20 tradable industries in our classification: (i) health and education (HE); (ii) professional and other services (PS, including professional and business services, finance and insurance, communications, and others); (iii) manufacturing (M); and (iv) accommodation, wholesale trade, and transportation (ATT). We set externalities in nontradable sectors (retail, utilities and construction, and real estate) to zero.

Table 1 presents our findings. Our estimates follow a pattern similar to that in Rossi-Hansberg, Sarte, and Schwartzman (2020): while overall agglomeration economies matter, workers benefit most from being close to other workers of the same occupational type. In addition, with one exception, occupational spillovers are largest among workers in CNR occupations.

The table also reveals differences in the externality coefficients for individual industries. Spillovers from proximity to CNRs are most pronounced for PS but are comparatively muted in HE. The sector group in which spillovers

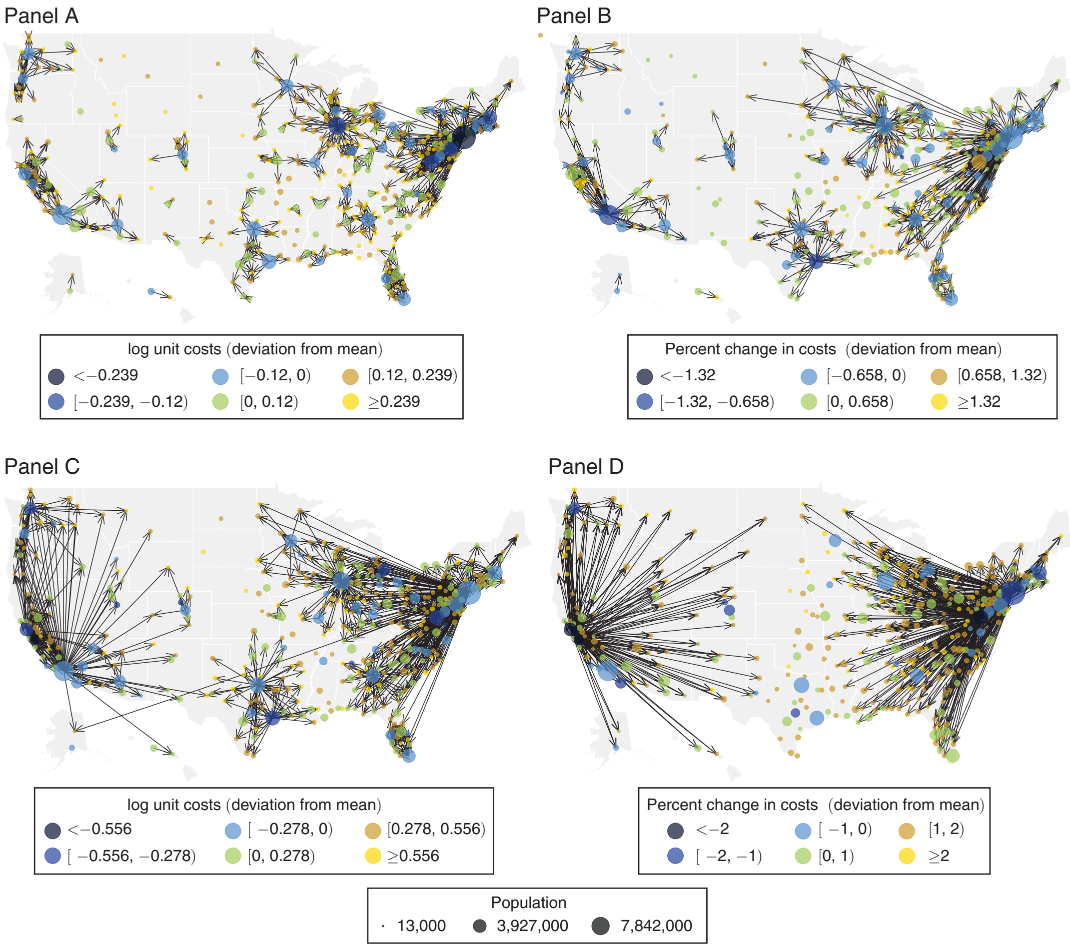

Figure 1. Trade Flows

Note: Panel A—HE: $\pi_{nn'} > 5$ percent; panel B—HE: $\pi_{nn'}^{opt} - \pi_{nn'} > 0.25$ percent; panel C—PS: $\pi_{nn'} > 5$ percent; panel D—PS: $\pi_{nn'}^{opt} - \pi_{nn'} > 1$ percent.

are comparable for CNR and non-CNRs is M, which is intensive in non-CNR workers.

Those estimates suggest the possibility of optimal sectoral hubs. For example, the concentration of CNR workers promotes the development of PS, which in turn attracts more CNR workers. We describe the nature of such hubs next.

IV. Sectoral Hubs

We now describe the ways in which optimal policy alters the geography of sectors. We start by noting that the general pattern of occupational reallocation falls largely in line with that found by Rossi-Hansberg, Sarte, and Schwartzman (2020). The planner chooses to build "cognitive hubs" concentrating CNR workers in larger cities. The planner also chooses to increase the relative size of smaller cities.

The maps in Figure 1 show the pattern of trade flows for the two CNR-intensive sector groups: HE and PS. The left-hand panels show the trade flows consistent with the 2011–2015 data used in the model inversion. The arrows indicate flows that have as their destination any city that spends more than 5 percent of its expenditures on either sectoral group from the origin city. The colors in the dots represent local unit production costs in those industries.

Panel A shows equilibrium trade flows for HE. Those tend to be mainly local, where large CNR-abundant cities constitute local hubs with low unit costs that serve smaller surrounding cities. Panel B shows that under the optimal policy, unit costs fall in most of these larger cities that then expand their service to neighboring places.

Panels C and D provide the same analysis for trade in PS, where trade costs are smaller than in HE. In equilibrium, large cities are even more dominant in the production of those services reaching beyond their immediate neighborhood. The optimal allocation concentrates production along the coasts further.

The changes shown in Figure 1 reflect changes in the price of goods and services (or market access) in different cities. Thus, we now describe how optimal policy affects these prices. We decompose price changes into different components.

Panel A of Figure 2 shows the decomposition of price changes in HE implied by the optimal policy. Those generally decline in larger cities and increase in smaller cities, largely following changes in unit costs. These changes in unit costs are partially offset by the variety effect, with large low-cost cities concentrating more of their expenditures in HE at home, while imports in small high-cost cities increase. Panel B shows the breakdown of unit costs in equation (2). For the most part, declines in HE unit costs take place together with increases in TFP (appearing as a negative decline). This result arises as the planner increases the concentration of CNR workers in larger cities. TFP increases are partially offset by wage increases. The major exceptions are San Jose; Washington, DC; and San Francisco, in which wage increases outweigh TFP increases, thus leading to a net rise in unit costs.

Panels C and D show the same decomposition for PS. While the price of HE increases in some cities and declines in others, the price of PS declines for all cities. Among smaller cities, the increase in traded varieties more than offsets higher unit costs. As with HE, lower unit costs in PS under the optimal policy are driven by TFP increases, though partially offset by higher wages. The three large cities with increases in HE prices (Washington, DC; San Francisco; and San Jose) now appear as the ones with the largest fall in unit costs. Those cities become so specialized in PS that the resulting increase in CNR wages crowds out HE.

Finally, panels E and F in Figure 2 show the same decomposition for M (ATT looks qualitatively similar). Here the pattern is reversed. Prices decline the most in smaller cities. However, as with PS, prices fall everywhere under the optimal policy, as a rise in trade more than offsets unit-cost increases in larger cities including New York and Washington, DC. Moreover, wages and TFP now affect unit costs in the same direction. The notable exception is San Jose, where the computer industry experiences a large gain in productivity.

M is the one sector where intersectoral linkages play a significant role. In particular, the optimal allocation implies an overall reduction in input prices that lower M costs across the country. The optimal policy does not lead to the formation of hubs in M, where some key cities become major sources of M goods for the rest of the country. Rather, it is one that spreads out M production across a wide range of smaller cities. While this implies more specialization in M, those cities are for the most part too small to become major M hubs. As noted previously, a similar pattern is also mostly true for ATT.

V. Conclusion

Individuals benefit from interactions with their neighbors and coworkers. In service sectors, these interactions are more valuable across workers in CNR occupations and are particularly large in PS. Thus, in industries that produce services that are easily tradable, the large sectoral hubs that have emerged since the 1980s (Eckert, Ganapati, and Walsh 2020) are not only desirable but should be encouraged and reinforced. Hubs in less tradable services, like HE, should also be encouraged but remain smaller and more local. The rest of the economy should balance these tendencies and revitalize the traditional M towns. With the right incentives, sectoral hubs can yield shared gains for everyone.

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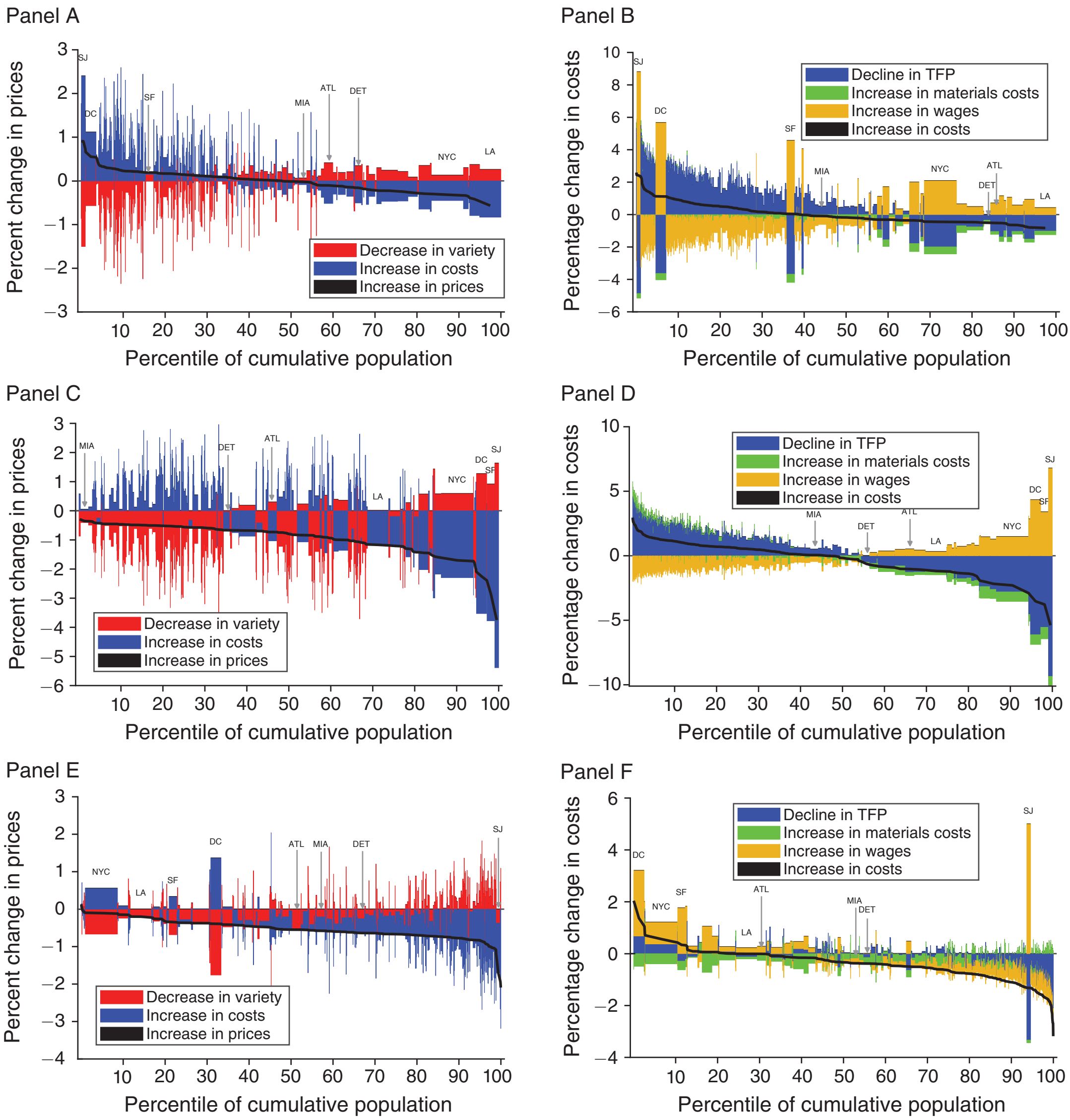

FIGURE 2. PRICE AND UNIT-COST DECOMPOSITION FOR HE, PS, AND M

Note: Panel A: decomposition of changes in prices in HE by city; panel B: decomposition of changes in costs in HE by city; panel C: decomposition of changes in prices in PS by city; panel D: decomposition of changes in costs in PS by city; panel E: decomposition of changes in prices in M by city; panel F: decomposition of changes in costs in M by city.

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