Place-Based Science Funding, Brain Drain, and the Geography of Innovation: Evidence from China

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Extended Abstract

The spatial concentration of scientific talent is a defining feature of modern innovation systems. High-skilled researchers and inventors increasingly cluster in a small number of leading regions, where dense knowledge networks, specialized labor markets, advanced laboratories, and abundant research funding raise individual productivity and generate agglomeration economies. Yet the same forces that make leading regions productive may weaken the scientific capacity of lagging regions. When researchers leave less-developed places, origin regions may lose not only individual human capital, but also collaborators, mentoring capacity, laboratory routines, and the cumulative know-how embedded in local research teams.

Whether such outflows constitute a brain drain, however, is theoretically ambiguous. Talent mobility may increase aggregate innovation by reallocating researchers to more productive environments. Migrants may also benefit their origin regions through collaboration, knowledge diffusion, or return migration. Conversely, persistent outflows may erode local research ecosystems and reinforce spatial inequality in innovation. This ambiguity is central to the economics of talent: the private and aggregate gains from mobility may coexist with local losses at the origin.

This paper studies whether public research funding can alter the geography of scientific talent without directly restricting mobility. The policy question is important because governments generally cannot, and should not, prevent scientists from moving. They may instead attempt to make lagging regions more attractive places to conduct research by improving local funding, equipment, laboratory conditions, and research opportunities. Whether such interventions generate new innovation or simply reallocate talent and inventive activity across space remains an open empirical question.

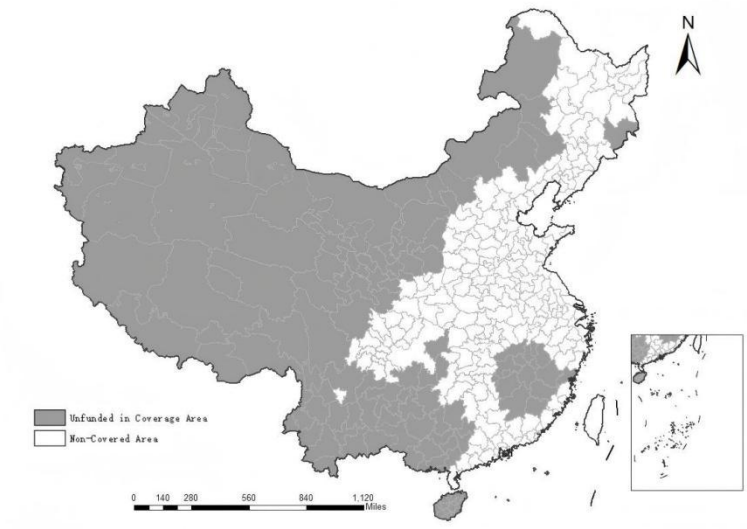
We examine this issue using China's Regional Science Fund Program, administered by the National Natural Science Foundation of China. The program is one of China's major place-based research funding initiatives. It targets regions with weaker scientific

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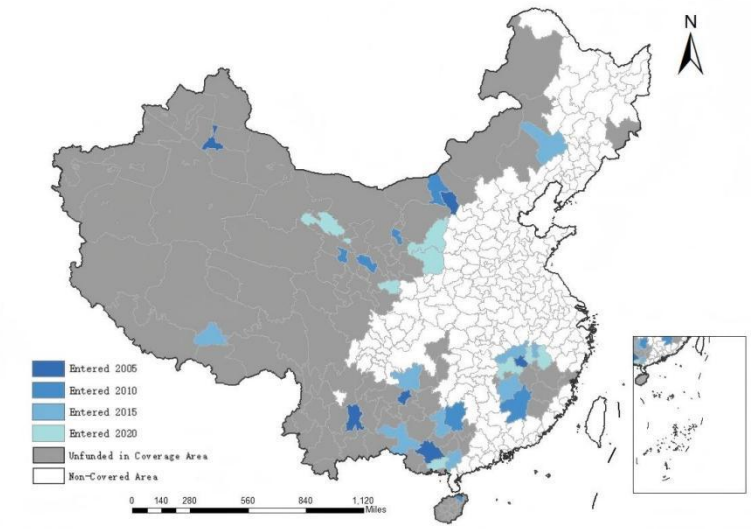
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foundations and more limited access to research resources. Unlike standard competitive grant programs that allocate funds primarily on scientific excellence, the Regional Science Fund has an explicit regional-development objective: strengthening local research capacity in places outside China's leading innovation centers. The program expanded substantially over time, making it large enough to plausibly affect research environments, team formation, and the mobility decisions of scientific workers. This setting is therefore well suited for studying whether place-based science funding can reduce brain drain and whether local retention translates into greater local innovation.

We assemble a new city-year panel combining project-level data on Regional Science Fund grants, city-level invention patent records, and inventor mobility histories spanning multiple decades. The final analysis covers 295 prefecture-level cities over the period 2000-2024. Figure 1 illustrates the geographic coverage of the program and the staggered timing at which cities first accumulate substantial support. Panel A shows that the program covers regions that are geographically and economically distinct from China's main coastal innovation centers. Panel B shows variation across cities in the year when cumulative Regional Science Fund support first reaches RMB 10 million. This staggered timing forms the basis of our empirical design.



(a) Spatial Distribution of Regional Science Fund Coverage



(b) Spatial Distribution of Regions First Reaching the RMB 10 Million Funding Threshold

Figure 1. Spatial Coverage of the Regional Science Fund and Staggered Treatment Timing

***Notes*:** Panel (a) maps the prefecture-city coverage of China's Regional Science Fund Program. Panel (b) shows the first year in which each city's cumulative Regional Science Fund support exceeds RMB 10 million. This threshold defines the treatment event in the staggered difference-in-differences analysis.

Our empirical design exploits staggered variation in the timing at which cities first receive a substantial level of Regional Science Fund support. Specifically, we define treatment as the first year in which a city's cumulative Regional Science Fund grants exceed RMB 10 million. This threshold captures a meaningful expansion in local research resources, rather than the receipt of a small or isolated grant. We estimate dynamic treatment effects using a staggered difference-in-differences framework with city and year fixed effects, clustering standard errors at the city level. Our baseline estimates use the Callaway and Sant'Anna estimator to address concerns associated with heterogeneous treatment effects under staggered adoption.

Figure 2 summarizes the baseline treatment effects. Treated cities experience both a significant reduction in regional talent outflows and a significant increase in innovation output. This finding suggests that research funding affects the spatial allocation of scientific talent. Improved local funding appears to make lagging regions more viable locations for scientific work, and local innovation rises when talent outflows fall.

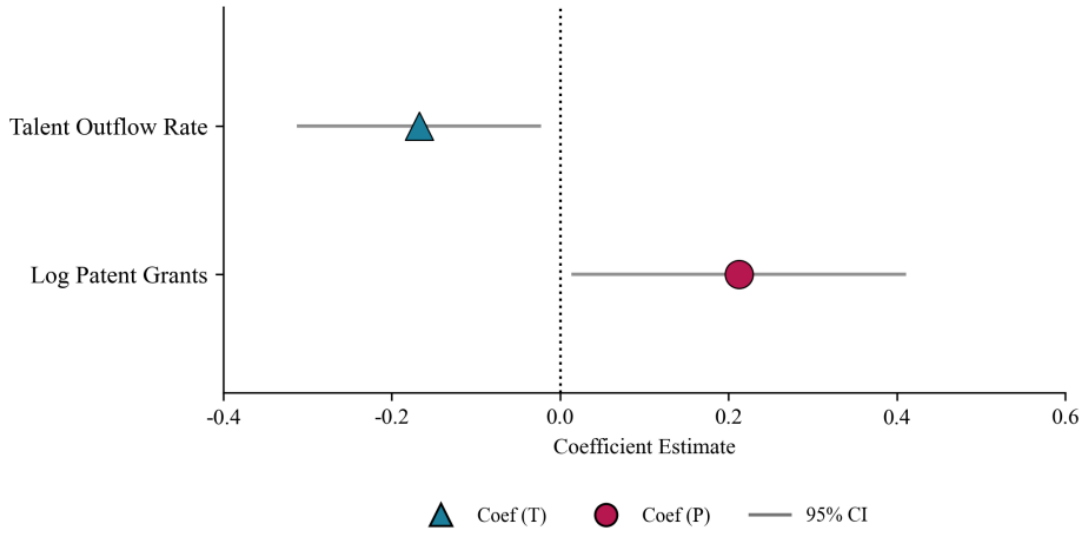


Figure 2. Effects of Place-Based Science Funding on Talent Outflows and Innovation

Notes: This figure reports the estimated effects of first reaching the RMB 10 million Regional Science Fund threshold on regional talent outflows and invention patent output. Estimates are obtained from a staggered difference-in-differences design with city and year fixed effects. Standard errors are clustered at the city level.

We then explore sectoral heterogeneities. If Regional Science Fund support works mainly by improving academic research conditions, its effects should be strongest in universities and public research institutes rather than in firms or government-affiliated organizations. Figure 3 shows exactly this pattern. The innovation response is concentrated in universities, research institutions, and industry-academia-research collaborations. The estimated effects for enterprises and government organizations are positive but statistically weaker. This pattern is consistent with the institutional design of the program, which primarily strengthens the academic and public research system rather than directly subsidizing firm-level commercialization. Figure 3 explicitly separates universities, research institutions, industry-academia-research collaborations, enterprises, and government organizations, and shows that the statistically stronger responses are concentrated in the academic sector.

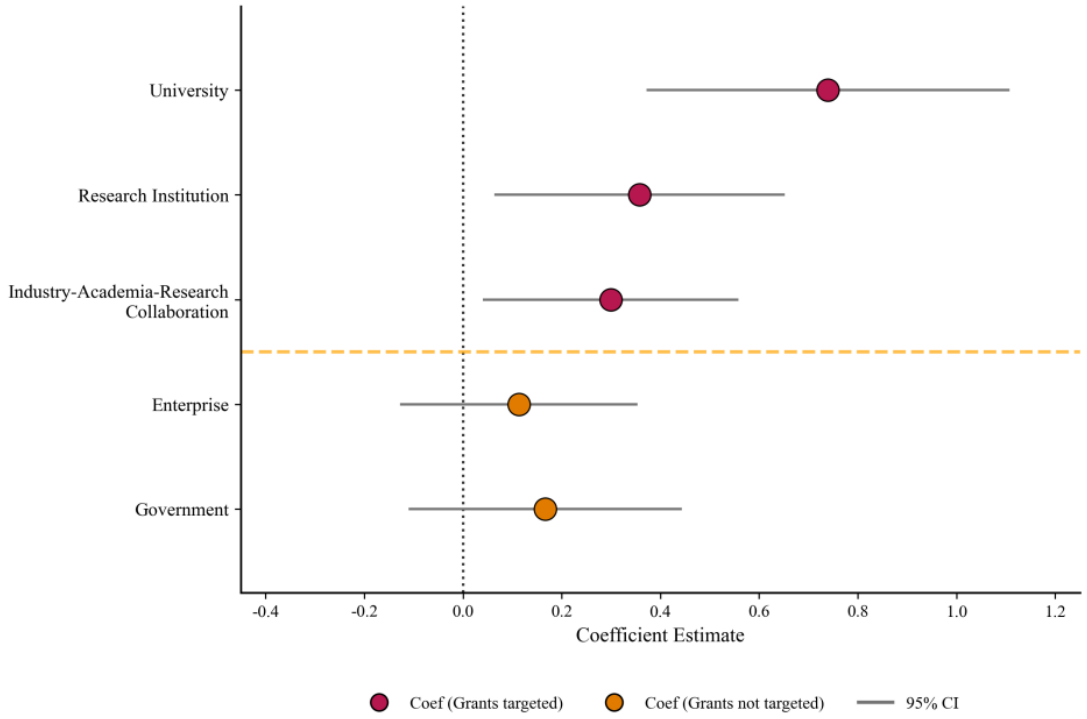


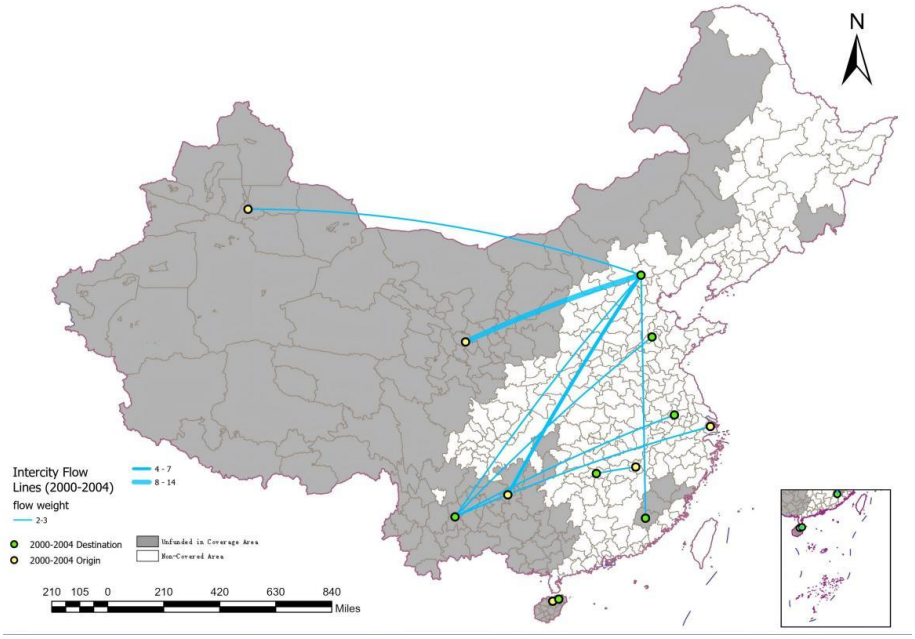
Figure 3. Innovation Effects by Sector

Notes: This figure reports heterogeneous effects on invention patent output by organizational sector. The academic sector includes universities, public research institutes, and industry-academia-research collaborations. The enterprise and government sectors show smaller and statistically weaker responses.

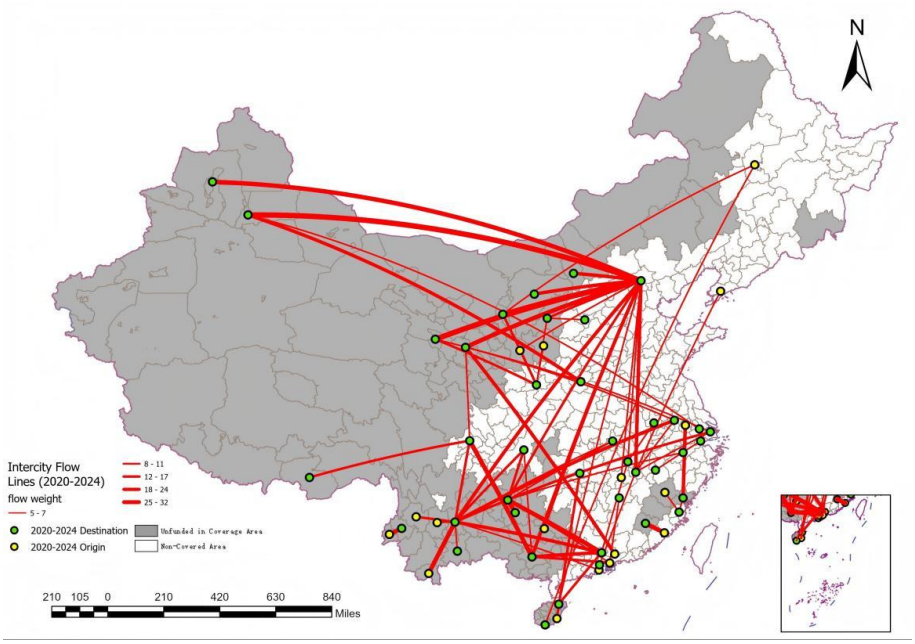
To interpret why talent retention matters for local innovation, we construct a longitudinal inventor database from patent records and identify migration events across cities and organizations. This allows us to examine the innovation consequences of mobility at the inventor and collaborator level. Preliminary inventor-level evidence points to a key trade-off. Inventors become more productive after relocating, consistent with the view that mobility can move talent toward more productive environments. Their patent output increases after relocation. At the same time, collaborators who remain in the origin location experience declines in innovative output after a co-inventor departs, with their patent output falling. These patterns suggest that talent mobility may generate gains for movers and destinations while imposing losses on origin-region research teams.

Figure 4 visualizes the changing network of intercity talent mobility within Regional Science Fund areas. The comparison between 2000-2004 and 2020-2024 reveals two important patterns. First, inventor mobility networks became substantially denser and geographically broader over time, suggesting that the scientific labor market became more spatially integrated. Second, the position of Regional Science Fund target regions within this network changed markedly. In 2000-2004, these regions appear mainly as

talent-origin locations, with major mobility links pointing outward. By 2020-2024, a nontrivial subset had also become talent destinations, receiving inventors from other cities. This descriptive pattern is not causal, but it is consistent with a broader improvement in the research conditions and talent attractiveness of historically lagging regions over the past two decades. This changing mobility structure strengthens the motivation for our analysis. If lagging regions increasingly participate in national scientific labor markets, place-based research funding may affect not only whether local researchers leave, but also whether these regions can become viable nodes of innovation. Figure 4 identifies migration events based on changes in an inventor's primary city of inventive activity and compares intercity mobility networks between 2000-2004 and 2020-2024.



(a) Intercity Talent Mobility Network, 2000–2004



(b) Intercity Talent Mobility Network, 2020–2024

Figure 4: The Expanding Geography of Inventor Mobility

Notes: This figure visualizes intercity inventor mobility within Regional Science Fund areas. Migration events are identified from changes in an inventor's primary city of inventive activity. Panel (a) shows mobility links during 2000–2004, and Panel (b) shows mobility links during 2020–2024. Link width is proportional to the intensity of inventor flows between city pairs. For visual clarity, only flows in the top 10 percent of the mobility distribution are shown.

A central interpretation issue is whether the policy generates additional local innovation multipliers or primarily reallocates talent and inventive activity across space. The current evidence points more strongly to the latter. The proportional increase in local patenting is close to the proportional decline in talent outflows. Moreover, the innovation gains appear concentrated in the sectors directly affected by the funding program. We therefore interpret the results as evidence that place-based science funding can retain talent and raise local inventive output, but we do not yet find strong evidence of sizable additional agglomeration effects beyond the retained inventive activity itself. This distinction is important: local gains from talent retention are economically meaningful, but they should not automatically be interpreted as net aggregate innovation creation.

The paper contributes to three literatures. First, it contributes to the economics of talent by shifting attention from the formation and productivity of high-skilled individuals to the geography of their deployment. Existing work has emphasized that talent is highly

productive in dense innovation clusters. We study whether policy can change where talent is retained and how this affects local inventive activity. Second, the paper contributes to the literature on agglomeration and regional inequality in innovation. Our evidence suggests that lagging regions can improve local research output through targeted science funding, but the local gains appear to operate mainly through talent retention rather than through large additional local innovation multipliers. Third, the paper contributes to the literature on place-based policy. Unlike many place-based interventions that rely on infrastructure, tax incentives, industrial subsidies, or relocation programs, the policy studied here operates through scientific research funding. This allows us to examine a distinct policy margin: whether strengthening local research environments can affect the location choices of scientific workers.

The broader implication is that place-based science funding can reduce brain drain and increase local innovation, but its aggregate welfare consequences are not obvious. From the perspective of treated regions, the program appears successful: it reduces talent outflows and raises inventive output. From the perspective of the national innovation system, however, the key question is whether these gains represent net innovation creation or spatial reallocation. If retained researchers would have been substantially more productive in leading regions, the policy may trade off aggregate efficiency for regional equity. If improved local research conditions allow scientists to remain productive while preserving local collaboration networks, the policy may reduce regional inequality at limited aggregate cost. Our ongoing work will quantify this trade-off by comparing local innovation gains, foregone productivity from reduced mobility, and changes in collaborative spillovers across regions.

This paper uses China's Regional Science Fund Program as a large-scale empirical setting to study a general problem in the economics of talent: how public policy shapes not only the development of human capital, but also the geography of its deployment. The findings suggest that research funding can be an effective retention instrument for lagging regions. They also caution that local innovation gains should not automatically be interpreted as aggregate innovation creation. Distinguishing between new innovation and spatial reallocation is essential for designing talent and science policies that balance innovation efficiency with regional inclusion.