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Innovation and Incentives: Evidence from Biotech

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Financial incentives from state governments are part of a growing trend of policies designed to spur innovation clusters in specific regions. Biotechnology industry clusters in particular have benefited from these subsidies, which have boosted the number of star biotech scientists in those states by roughly 15%. Likewise, the number of biotech jobs overall has grown in states that offered incentives, although they have had little impact on salaries. Incentives have also spilled over to generate sizable effects in local service sectors.

In recent decades, more state and local governments have adopted policies to foster economic activity in their regions. Indeed, it is rare for a large U.S. research facility or new industry to open its doors without local governments providing some form of subsidy.

Yet, despite the growing importance of these incentives, their effects on state economies are not well understood. In this *Economic Letter*, we investigate the effects of state-provided incentives on local biotechnology industry clusters and the broader state economy. Our findings suggest that incentives appear to encourage growth in the states that offer them. State subsidies help attract star scientists and increase local jobs, although there is little overall effect on regional salaries. By spurring clusters of innovative industries, these states reap further benefits from economic growth spilling over to other local service sectors. Of course, for state policymakers these benefits must be weighed against the cost of the subsidies—that is, the benefits of spending those funds differently—which is outside the scope of our analysis.

The shape of state incentives

Many states have turned to an increasingly common economic policy, offering financial incentives to spur innovation-based clusters of high-tech and life-science businesses. Local policymakers find such clusters desirable as a way to generate what economists call "agglomeration economies." This term refers to the local economic value generated by having many businesses and industries close to each other that are engaged in complementary activities. One example of an agglomeration economy is Silicon Valley, where information technology firms are heavily concentrated and often provide services and ideas to each other. Similarly, the biotechnology industry, "biotech" for short, is heavily clustered: a large fraction of the industry's jobs are concentrated in Boston/Cambridge, the San Francisco Bay area, San Diego, New Jersey, Raleigh-Durham, and the Washington, DC area. This concentration is consistent with strong formal and informal linkages among the biotech companies in each of these areas.

As of 2010, 11 states provided some type of incentive for biotech firms, and the generosity of these plans appears to be growing. In addition, over the past two decades, tax credits offered by states for general research and development (R&D) have become increasingly important. As of 2010, 34 states provided a broad-based tax credit on R&D, and the average effective credit rate approximately quadrupled over this

period to around 6%, which is about half the value of the effective federal R&D credit rate. In several states, in fact, the state credit is actually more generous than the federal credit.

Analyzing state incentives

To investigate these trends, we gathered a rich data set on biotech-specific incentives and general R&D tax credits, combined with information on economic activity in a given state and year for both the biotech sector and the state overall. We use this data to first explore the kinds of incentives state governments provide that benefit biotech companies. We then estimate the economic effects of these incentives and report the results of our empirical analysis.

We focused our analysis on two types of state-specific incentives for innovation: R&D tax credits and biotech-specific subsidies. The former provide a credit against a business's income taxes that is proportional to its expenditures on qualified R&D. These credits are not specific to biotech R&D or biotech companies; however, since R&D costs are disproportionately important to biotech companies, it is obviously a significant cost shifter for the industry.

In addition to generic R&D tax credits, states have adopted a variety of specific fiscal incentives to attract biotech activity. These include tax credits on investment or job creation by biotech companies, sales and use tax exemptions for purchasing equipment used in biotech activity, low-interest loans to biotech start-ups, and lump sum grants to biotech companies. This wide variety makes it difficult to quantify and compare the financial values of these different incentives, so we simply assess the average economic effects from a state having a biotech-specific incentive versus not having one.

Measuring biotech activity

To evaluate the effects of incentives for biotech, we compiled data on a host of measures of state economic activity in the sector.

First, we look at biotech patenting. We use data on patents to identify the location of "star" biotech scientists and to measure biotech innovation in a state. We define star biotech inventors in a given year as those who are in the top 5% in the nation for the number of biotech patents they have received over the past 10 years. In other words, stars are exceptionally prolific patenters in the biotech field. The 5% cutoff is arbitrary, but using other percentages does not affect our empirical results.

In addition to these measures of biotech innovation, we look at employment, wages, and number of establishments in the biotech sector. While we can precisely assign patents to the biotech field, the same is not true for official labor market and establishment data. We consider three different industries as potentially reflecting biotech activity: pharmaceutical and medicine manufacturing; pharmaceutical preparation manufacturing; and research and development in the physical, engineering, and life sciences. None of these industries perfectly captures the biotech sector, as each of them excludes parts of biotech and includes parts of other sectors. However, there is enough overlap with biotech that any economically significant impact of subsidies on biotech should show up as an impact in one or more of these three industries.

Impact of incentives on biotech activity

Turning to the empirical results, we find that both biotech-specific subsidies and general R&D tax credits in a given state significantly increase the number of biotech star scientists residing there. The adoption of

biotech subsidies raises the number of star scientists in a state by 15% relative to that state's pre-adoption number of stars. We find a similar effect from the adoption of R&D credits. These findings are important because of the role star scientists play on the local development and survival of U.S. biotech clusters. In addition, we find that most of the increase in the number of stars is due to their relocation to states that adopt incentives. Meanwhile, subsidies have only a limited effect on the productivity, measured by patenting, of incumbent scientists already in the state. We also find that the increase in star scientists happening after a state adopts a biotech incentive is entirely due to an increase in private/for-profit sector scientists, with no detectable increase in academic scientists.

As for overall biotech employment, we find that the effect of biotech-specific incentives is not limited to top scientists but it extends to other parts of the biotech workforce. We see significant effects on total employment in all three industries in our data, that is, the two pharmaceutical-related industry groups and the scientific R&D industry. The size of the incentives' effect on total biotech employment is generally similar to its effect on the number of star scientists. This suggests that the incentives do not alter the share of stars in a state's biotech workforce.

We find that biotech-specific and R&D incentives on average have limited effects on salaries in the three industries we study. This is consistent with the notion that workers are fairly mobile across states. If a state's incentives led to significantly higher local biotech salaries, then some biotech workers would be likely to relocate to that state, increasing local labor supply and driving salaries back down. While we do not have a direct measure of biotech start-ups, we find that the number of biotech-related business establishments also increases after a state adopts incentives. On the other hand, we find limited effects on the total number of biotech patents in a state following the adoption of an incentive, possibly because it takes time for biotech research to come to fruition.

Finally, consistent with positive effects spilling over to other parts of the local economy, we find that incentives have an indirect effect on the local nontraded sector, including retail, construction, and real estate. That is, by increasing employment in biotech, incentives appear to indirectly boost employment in local services, like construction and retail, whose demand reflects the strength of the local economy.

In further analysis, we tested whether the increased biotech activity in a state resulting from incentives might come at the expense of nearby states. We found little evidence that incentives produced any such "beggar thy neighbor" effects for states that are geographically close or for those that are economically close as measured by the flows of worker migration. Thus, if incentives in one state cause reduced biotech activity in any other states, the reduction is likely to be national in scope.

Conclusions

States forgo billions of dollars in tax revenue to attract economic activity—especially activity perceived to be high-tech or innovative—even though little is known about how these incentives affect the local economy. In this *Letter*, we examined how effective these policies are at attracting jobs in the biotech sector. We found that, after states adopted incentives, they experienced significant increases in the number of star scientists, the total number of biotech workers, and the number of establishments, but limited effects on salaries and patents. We also uncovered significant spillover effects from biotech incentives to employment in other sectors that provide services in the local economy such as retail and construction.

In terms of policy implications, it is important to keep in mind that our finding that biotech subsidies are successful at attracting star scientists and at raising local biotech employment do *not* necessarily imply that the subsidies are economically justified. The economic benefits to a state of providing these incentives must be weighed against their fiscal costs—for instance, the loss of tax revenues and resulting loss of public services. Our research suggests that state incentives are successful at increasing the number of jobs inside the state. Nevertheless, our results do not suggest that the social benefit—either for that state or for the nation as a whole—is larger than the cost to taxpayers, nor that incentives for innovation are the most effective way to increase jobs in a state.

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Reference

Moretti, Enrico, and Daniel J. Wilson. 2014. "State Incentives for Innovation, Star Scientists and Jobs: Evidence from Biotech." *Journal of Urban Economics* 79(1, January), pp. 20–38.

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