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State incentives for innovation, star scientists and jobs: Evidence from biotech

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ABSTRACT

We evaluate the effects of state-provided financial incentives for biotech companies, which are part of a growing trend of placed-based policies designed to spur innovation clusters. We estimate that the adoption of subsidies for biotech employers by a state raises the number of star biotech scientists in that state by about 15% over a three year period. A 10% decline in the user cost of capital induced by an increase in R&D tax incentives raises the number of stars by 22%. Most of the gains are due to the relocation of star scientist to adopting states, with limited effect on the productivity of incumbent scientists already in the state. The gains are concentrated among private sector inventors. We uncover little effect of subsidies on academic researchers, consistent with the fact that their incentives are unaffected. Our estimates indicate that the effect on overall employment in the biotech sector is of comparable magnitude to that on star scientists. Consistent with a model where workers are fairly mobile across states, we find limited effects on salaries in the industry. We uncover large effects on employment in the non-traded sector due to a sizable multiplier effect, with the largest impact on employment in construction and retail. Finally, we find mixed evidence of a displacement effect on states that are geographically close, or states that economically close as measured by migration flows.

1. Introduction

There is growing empirical evidence that agglomeration of economic activity generates significant economies of scale at the local level. This evidence raises both normative questions, concerning whether government intervention is socially optimal from a national or global perspective, and positive questions about whether such intervention, even if desirable, is effective. Can firms' location decisions be influenced by government incentives and, if so, should national or local governments provide incentives to firms to cluster in particular locations?

These questions have led to growing interest among economists on the effect of place-based economic policies. Place-based economic policies are development strategies intended to foster economic activity in a city or a region. These policies are widespread both in the US and in the rest of the world.[1] Indeed, it is rare for a large production or research facility to open today in the US without the provision of some form of subsidy from the relevant local government (Greenstone and Moretti, 2004; Greenstone et al., 2010).

An increasingly common type of place-based policy is state-provided subsidies for "high-tech" and life-science firms designed to spur innovation-based clusters. Urban economists have long suspected that innovative industries like high-tech and life-science are characterized by significant localized agglomeration economies. For example, the distribution of the bio-technology industry is heavily clustered spatially, with a large fraction of the industry employment concentrated in Boston/Cambridge, the San Francisco Bay area, San Diego, New Jersey, Raleigh-Durham and the

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[1] Bartik's (1991) seminal book on place-based economic policies provides a comprehensive taxonomy and discussion of the different types of policies. In the US, state and local governments spend $80 billion per year on these policies (Story, 2013), while the federal government spends $15 billion (GAO, 2012). Examples of location-based policies typically adopted by local and state governments include direct subsidies and/or tax incentives for local firms, subsidized loans, industrial parks, technology transfer programs, export assistance and export financing, the provision of infrastructure, and workforce training.

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Washington, DC area. This concentration is consistent with the existence of strong localized agglomeration externalities.[2]

Because local governments often aim at creating and fostering self-sustaining clusters of life-science research, a growing number of them have introduced incentives that specifically target the biotech industry. As of 2010, 11 states provide some type of incentive for biotech firms, and their generosity appears to be growing. In addition, over the past two decades, general R&D tax credits offered by US states have become increasingly important. These credits are not specific to biotech, but given the importance of R&D for the industry they are likely to disproportionally benefit the biotech sector. As of 2010, 34 states provide a broad-based tax credit on R&D, and the average effective credit rate has grown approximately fourfold over this period to equal half the value of the federal effective credit rate. In many states, the state tax credit is considerably more generous than the federal credit (Wilson, 2009).

Yet, despite the growing importance of these incentives, their effects are not well understood.[3] In this paper, we investigate the effects of state-provided biotech incentives on the local biotech industry and the broader state economy. We construct a rich state-level panel data set combining data on biotech-specific incentives and general R&D tax credits with data on various outcomes measuring biotech activity in a given state and year. Our outcome measures consist of the number of "star scientists" (defined below), employment, wages, establishments and patents – each specific to the biotech sector – for the period 1990–2010. We also estimate models where the outcome variables measure employment in the non-traded sector outside biotech. Using this data set, we identify the effect of biotech incentives and the R&D user cost off of the variation within each state over time.

We find significant effects both of the biotech specific subsidies and the general R&D tax credits on biotech star scientists, defined as those patenters whose patent count over the previous ten years is in the top 5% of patenters nationally.[4] The adoption of biotech subsidies raises the number of star scientists in a state by 15% relative to states' pre-adoption baseline. This is important because of the existing evidence on the important role played by the localization of star scientists on the localization and survival of US biotech clusters (Zucker et al., 1998).

Notably, most of the gains in star scientists are due to the relocation of star scientists to adopting states, with limited effect on the prolificacy of incumbent scientists already in the state. In addition, we find that the gains are concentrated among private sector inventors, both corporate and individual. We uncover little effects of subsidies on academic researchers, consistent with the fact that incentives for universities – which are mostly non-profit – are unaffected by the subsidies.

The effect of incentives on employment is not limited to top scientists, but it extends to other parts of the biotech workforce. We uncover significant effects on total employment in the Pharmaceutical and Medicine Manufacturing industry (16% gain); the Pharmaceutical Preparation Manufacturing industry (31% gain); and the scientific R&D industry (18% gain). Because the effect for all workers is generally similar to the effect for stars, we infer that the incentives do not alter the ratio of stars in the workforce.[5]

Consistent with a model where workers are fairly mobile across states, we find limited effects on average salaries in these three industries. While we do not have a direct measure of start-up creation, we find that the number of biotech-related establishments also increases following incentive adoption. On the other hand, we find limited effects on patents following the subsidy, possibly because it takes time for biotech research to come to fruition.

We cannot rule out the possibility that the adoption of subsidies is correlated with unobserved trends in the vitality of the local economy in general or the local innovation sector in particular. However, we fail to find an effect of biotech subsidies and R&D credits on employment in fields different from biotech. Triple difference models that include other sectors largely confirm our estimates for the employment effects.

Consistent with the presence of a local employment multiplier effect (Moretti, 2011), we do uncover an indirect effect on the local non-traded sector, including retail, construction and real estate. It appears that by increasing employment in biotech, the incentives indirectly increase employment in local services, like construction and retail, whose demand reflect the strength of the local economy.

In additional specifications, we test whether the provision of biotech-specific tax credits increases biotech employment at the expense of nearby states. We find mixed evidence of an effect on states that are geographically close, or states that are economically close as measured by worker migratory flows. If there is displacement, it is likely to be national in scope.

Finally, we provide some partial, illustrative and indirect evidence on whether there is a first mover advantage in providing incentives. In the presence of agglomeration economies and large fixed costs, the initially positive effect of the subsidy on the biotech industry of an early adopting state should be long lasting, as biotech activity keeps agglomerating in the state even after other states have matched the subsidy. On the other hand, in the absence of significant agglomeration economies and large fixed costs, the initially positive effect experienced by an early adopter will not last after competing away any relative advantage. In this case, local biotech activity will revert to the long run equilibrium level that existed before the provision of any subsidies. Empirically, we find limited evidence of a first-mover advantage for biotech incentives, although data limitations preclude us from drawing definitive conclusions.

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* imply that biotech subsidies are a good use of taxpayer money. Finding that the provision of tax incentives by a state results in an increase in biotech R&D activity in that state does *not* necessarily suggests the existence of a market failure, nor does it imply that the provision of tax incentives is an *efficient* use of public funds. In this paper we have little to contribute to the question of local efficiency of place based policies. Efficiency of these policies from the point of view of the nation as a whole is even harder to address and is outside the scope of this paper.[6]

[2] The hypothesis of agglomeration economies dates back at least to Marshall (1920) who discussed how they could be generated by a variety of mechanisms, including localized knowledge spillovers, thick labor markets for specialized workers, and localized supply chains.

[3] Economists have long cautioned that due to the complex nature of the market failures at work it is unclear what cluster policies should do in practice and how they should do it (Duranton, 2011). A number of recent empirical studies have sought to assess the effectiveness of state-wide incentives. Examples include, but are not limited to, Faulk (2002), Bartik and Erickcek (2010), Bartik and Eberts (2012), Chirinko and Wilson (2008, 2010), Wilson (2009), Head et al. (1999), and Duranton et al. (2011). Overall, the empirical evidence on the effect of tax incentives on local labor markets is still limited and more work is needed to understand how in practice these subsidies contribute to economic development.

[4] We follow the literature in using the term "star scientists," though it should be noted that patenters include institutions such as universities and corporations in addition to individuals. Specifically, in our biotech patent database, individuals account for 70.9% of patents, universities account for 5.6%, and other institutions (mostly corporations) account for 23.5% of patents.

[5] The Pharmaceutical Preparation Manufacturing industry is an exception.

[6] See Kline and Moretti (2013) for a discussion.