Industrial Policy and Competition*

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Abstract

This paper argues that sectoral policy aimed at targeting production activities to one particular sector, can enhance growth and efficiency if it is made competition-friendly. First, we develop a model in which two firms can operate either in the same (higher growth) sector or in different sectors. To escape competition, firms can either innovate vertically or differentiate by choosing a different sector from their competitor By forcing firms to operate in the same sector, sectoral policy induces them to innovate "vertically" rather than differentiate in order to escape competition with the other firm. The model predicts that sectoral targeting enhances average growth and productivity more when competition is more intense within a sector and when competition is preserved by policy. In the second part of the paper, we test these predictions using a panel of medium and large Chinese enterprises for the period 1998 through 2007. Our empirical results suggest that if subsidies are allocated to competitive sectors (as measured by the Lerner index) or allocated in such a way as to preserve or increase competition, then the net impacts of subsidies, tax holidays, and tariffs on total factor productivity levels or growth become positive and significant. We address the potential endogeneity of targeting and competition by using variations in targeting across Chinese cities that are exogenous to the individual firm.

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1 Introduction

In the aftermath of WWII, several developing countries opted for policies aimed at promoting new infant industries or at protecting local traditional activities from competition by products from more advanced countries. Thus many Latin

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American countries advocated import substitution policies, whereby local industries would more fully benefit from domestic demand. East Asian countries like Korea or Japan favored export promotion, which in turn was achieved partly through tariffs and non-tariff barriers and partly through maintaining undervalued exchange rates. For at least two or three decades after WWII, these policies were commonly referred to as "industrial policy", and they were largely noncontroversial as both groups of countries were growing at fast rates.

The economic slowdown in the 70s in Latin America and Japan in the late 90s generated a growing skepticism about the role of industrial policy in the process of economic development. On the empirical front, the debate was launched by Krueger and Tuncer (1982) who analyzed the effects of industrial policy in Turkey in the 60s, and "show" that firms or industries not protected by tariff measures were characterized by higher productivity in growth rates than protected industries.[1] On the theoretical front, the provision by domestic governments of subsidies or trade protection targeted to particular firms or industries, has come under disrepute among academics mainly on the ground that it prevents competition and allows governments to pick winners (and, more rarely, to name losers) in a discretionary fashion, thereby increasing the scope for capture of governments by vested interests. This argument appears to have won over traditional counteracting considerations, in particular those based upon the infant industry idea (e.g.,see Greenwald and Stiglitz (2006)).[2] This disrepute has affected not only the selection and promotion of national champions – what could be termed industrial policy in the narrow sense - but also any kind of public intervention going beyond horizontal supply-side policies with the aim to influence sectoral developments and the composition of aggregate output. A first argument against industrial policy and the infant industry argument, is that governments are not particularly good at picking winners, and providing them with an excuse to subsidize particular firms or sectors might end up favouring the emergence of industrial lobbies.

Yet, new considerations have emerged over the recent period, which invite us to revisit the issue. First, climate change and the increasing awareness of the fact that without government intervention aimed at encouraging clean production and clean innovation, global warming will intensify and generate negative

[1] However, see Harrison (1994) who shows that their results are not robust to rigorous statistical analysis.

[2] For an overview of infant-industry models and empirical evidence, see Harrison and Rodriguez-Clare (2010). The infant-industry argument could be summarized as follows. Consider a local economy that includes both a traditional sector (especially agriculture) and an industry in its infancy. Production costs in industry are initially high, but "learning by doing" decrease these costs over time, even faster as the volume of activity in this area is high. In addition, increased productivity which is a consequence of this learning by doing phase has positive spillovers on the rest of the economy, ie it increases the potential rate of growth also in the traditional sector. In this case, a total and instantaneous liberalization of international trade can be detrimental to the growth of the local economy, as it might inhibit the activity of the local industry whose production costs are initially high: what will happen in this case is that the local demand for industrial products will turn to foreign importers. It means that learning by doing in the local industry will be slowed itself, which will reduce the externalities of growth from this sector towards the traditional sector.

externalities (droughts, deforestations, migrations, conflicts) worldwide. Beyond the pricing of this externality through cap-and-trade systems or carbon taxation, many governments have engaged in targeted intervention to encourage the development of alternative technologies in the production (e.g.,from renewables) or the use (e.g. by efficient housing) of energy. Second, the recent financial crisis has prompted several governments, including the US, to provide support to particular industries (e.g., the automobile or green sectors). Also, an increasing number of scholars (in particular in the US) are denouncing the danger of laissez-faire policies that lead developed countries to specialize in upstream R&D and in services while outsourcing all manufacturing tasks to developing countries where unskilled labor costs are lower. They point to the fact that countries like Germany or Japan have better managed to maintain intermediate manufacturing segments through pursuing more active industrial policies, and that this in turn has allowed them to benefit more from outsourcing the other, less human capital-intensive segments.

In this paper we argue that the debate on industrial policy should no longer be "existential", i.e.,about whether sectoral policies should be precluded altogether or not, but rather on how such policies should be designed and governed so as to foster growth and welfare. Our focus is on the relationship between productivity (or productivity growth) and the extent to which sectoral policy is competition-friendly. In the first part of the paper we develop a theoretical framework in which two firms may choose either to operate in the same "higher-growth" sector (we refer to this as the choice to *focus* on the same technology) or they may choose to operate in different sectors, including in "lower-growth" sectors in order to reduce the intensity of competition among them (we refer to this as the choice to *diversify*). When firms focus on the same high-growth sector they generate more innovation and growth for two reasons: first, because the size of innovations, and therefore the post-innovation rents, are higher in a higher-growth sector; second, because when the two firms choose to operate in the same sector they compete more intensely, which in turn induces both firms to invest more in innovation in order to escape competition with the rival firm (see Aghion et al (2005)). The more intense competition within a sector, the more firms innovate if they operate in the same sector. At the same time, more intense competition within sectors may induce firms to choose diversity as an alternative way to avoid competition. This is where industrial policy comes into play: by inducing the two firms to operate in the same sector, the government induces firms to innovate "vertically" rather than differentiate "horizontally" in order to escape competition with the other firm. The more intense within-sector competition, the more growth-enhancing it is to induce both firms to operate in the same "high-growth" sector. In other words, there is a complementarity between product market competition and sectoral policy aimed at fostering innovation and growth: such policy must target competitive sectors and/or induce competition within the sector by not targeting a single firm within the sector but rather all firms in the sector.

In the second part of the paper we put this prediction to test using detailed micro data. We use a panel of medium and large Chinese enterprises for the period 1998 through 2007. Our measures of industrial policy are: (1) subsidies or tax holidays, allocated at the firm level, and (2) trade tariffs, which are determined at the sector level. We then look at the extent to which firm-level productivity or productivity growth) is affected by the dispersion of subsidies or tax holidays across firms in a sector, and also by the extent to which subsidies or tariffs are targeting sectors with higher initial levels of competition.

Our results suggest that if subsidies are allocated to competitive sectors (as measured by the Lerner index) or allocated in such a way as to preserve or increase competition (i.e if they are more dispersed across firms in the sector), then the net impacts of subsidies on productivity or productivity growth become positive and significant. In other words, targeting can have beneficial effects depending on both the degree of competition in the targeted sector and on how the targeting is done.

Most closely related to our analysis in this paper is Nunn and Trefler (2010). Using cross-country industry-level panel data, they analyze whether, as suggested by the argument of "infant industry", the growth of productivity in a country is positively affected by the measure in which tariff protection is biased in favor of activities and sectors that are "skill-intensive", that is to say, use more intensely skilled workers. They find a significant positive correlation between productivity growth and the "skill bias" due to tariff protection. As the authors point out though, such a correlation does not necessarily mean there is causality between skill-bias due to protection and productivity growth: the two variables may themselves be the result of a third factor, such as the quality of institutions in countries considered. However, Nunn and Trefler show that at least 25% of the correlation corresponds to a causal effect. Overall, their analysis suggests that adequately designed (here, skill-intensive) targeting may actually enhance growth, not only in the sector which is being subsidized, but in other sectors as well.[3]

The paper is organized as follows. Section 2 presents our model of the complementarity between competition and sectoral policy. Section 3 presents the empirical analysis and discusses endogeneity issues. Section 4 concludes. Finally, the Appendix develops extensions of the model in Section 2.

2 Theory

2.1 Basic setup

2.1.1 Preferences and production

We consider a two-period model of an economy producing two goods, denoted by A and B. Denote the quantity consumed on each good by x^A and x^B.

[3]The issue remains whether industrial policy comes at the cost of a lowering of competition, e.g., between high and low skill intensive sectors or within a high skill sector. As we show in this paper, industrial policy in the form of targeting may in fact take the form of enhancing competition in a sector and serves the dual role of increasing consumer surplus and growth (see Appendix A).

The representative consumer has income $2E$ and utility $\log(x^A)+\log(x^B)$ when consuming x^A and x^B. This means that, if the price of good i is p^i, demand for good i will be $x^i = E/p^i$.

The production can be done by one of two 'big' firms $1, 2$, or by 'fringe firms'. Fringe firms act competitively and have a constant marginal cost of production of c_f whereas firms $j = 1, 2$ have an initial marginal cost of c, where $E > c_f \geq c$. The assumption $c_f \geq c$ reflects the cost advantage of firms $1, 2$ with respect to the fringe and the assumption $E > c$ insures that equilibrium quantities can be greater than 1. Marginal costs are firm-specific and are independent of the technology in which production is undertaken.

2.1.2 Innovation

For simplicity, we assume that only firms $1, 2$ can innovate. Innovation reduces production costs, but the size of the cost reduction is different between the two sectors A and B. Without loss of generality, we assume that in sector A, innovations reduce production costs from c to $c/\gamma_A = c/(\gamma+\delta)$ whereas in sector B they reduce costs from c to $c/\gamma_B = c/(\gamma - \delta)$, where $\gamma - \delta > 1$ or $\delta < \gamma - 1$.

We also make the simple assumption that, with equal probability, each firm can be chosen to be the potential innovator. To innovate with probability q this firm must incur effort cost $q^2/2$. This is like saying that each firm has an exogenous probability of getting a patentable idea, which then has to be turned into cost reduction thanks to effort exerted by the firm.

2.1.3 Competition

We assume Bertrand competition within each sector unless the two leading firms choose the same sector and collude within that sector. Let φ be the probability of the two leading firms colluding in the same sector when they have the same cost, and let us assume that when colluding the two firms behave as a joint monopoly taking the fringe cost c_f as given. In this case, the expected profit of each leading firm with cost $c < c_f$ is $\varphi \frac{1}{2} \frac{c_f - c}{c_f} E$ since when collusion fails firms compete Bertrand.

2.1.4 Laissez-faire versus targeting

While under laissez-faire, firms choose the technology on which they want to produce (A or B), a planner may impose (or induce via tax/subsidies) such technology choices. Laissez-faire can lead to *diversification* (different technology choices by the two firms) or *focus* (same choice, be it A or B), while *targeting* is planner-enforced focus. We restrict attention to the case where there is perfect information about γ_i. Under laissez-faire, firms will choose either to diversity or to focus. Under focus, both firms choose the better technology A. Under diversity, one firm (call it firm 1) chooses A and the other (call it firm 2) chooses B (this is a coordination game and which firm ends up with technology A is random). Diversity is stable if the firm ending up with technology B does not want switch to technology A; if it does then we are back to a focus configuration.

We shall first compare between equilibrium innovation rates under diversity and under focus respectively. This will tell us about whether diversity or focus maximizes the rate of innovation (our proxy for growth in this model). Then, we shall derive conditions under which diversity arises under laissez-faire. We show for sufficiently high degree of competition within sectors, focus is always growth-maximizing whereas there exists $\delta^L > 0$ such that diversity is privately optimal if $\delta \leq \delta^L$. In the Appendix we compare the laissez-faire choice between diversity and focus with the social optimum, and we also briefly discuss what happens under imperfect information about γ_i.

2.2 Equilibrium profits and innovation intensities

2.2.1 Diversity

Under diversity, firm 1 is on technology A and firm 2 is on technology B and both firms enjoy a cost advantage over their competitors. Let e denote the representative consumer's expense on technology A, p_1 the price charged by firm 1 and c_f the limit price imposed by the competitive fringe.

The representative consumer purchases x_1^A, x_f^A in order to maximize $\log(x_1^A + x_f^A)$ subject to $p_1 x_1^A + c_f x_f^A \leq e$. The solution leads to $x_1^A > 0$ only if $p_1 \leq c_f$. The consumer spends e and since firm 1's profit is $e - c_1 x_1^A$, firm 1 indeed chooses the highest price (hence the lowest quantity x_1^A) consistent with $p_1 \leq c_f$, that is $p_1 = c_f$. It follows that $x^A = x_1^A$ and therefore $x^A = e/c_f$.

The problem is symmetric on the other technology and since the representative consumer has total income $2E$ she will spend E on each technology, yielding $x^A = x^B = E/c_f$.

If the firm is not a potential innovator (which happens with probability 1/2), its profit is equal to:

$$\pi^{D_0} = \frac{c_f - c}{c_f} E.$$

If the firm on technology i is chosen to be a potential innovator, it will get a profit margin of $c_f - \frac{c}{\gamma_i}$ if it innovates and a profit margin of $c_f - c$ if it does not. Hence, the ex ante expected payoff of the firm conditional on being chosen to be a potential innovator and upon choosing innovation intensity q, is equal to:

$$\pi = q\left(c_f - \frac{c}{\gamma_i}\right)x^i + (1-q)(c_f - c)x^i - \frac{1}{2}q^2$$

or

$$\pi = q\frac{\gamma_i - 1}{\gamma_i} c x^i + (c_f - c)x^i - \frac{1}{2}q^2.$$

Using $x^i = E/c_f$, the optimal probability of innovation under diversity q_i^D and the corresponding ex ante equilibrium profit $\pi_i^{D_1}$ when chosen to be a potential innovator, are respectively given by:

$$q_i^D = \frac{\gamma_i - 1}{\gamma_i}\frac{c}{c_f}E$$

and

$$\pi_i^{D_1} = \frac{1}{2}\left(\frac{\gamma_i - 1}{\gamma_i}\right)^2\left(\frac{c}{c_f}\right)^2 E^2 + \frac{c_f - c}{c_f}E.$$

Overall, the ex ante expected payoff from diversifying on technology i is

$$\pi_i^D = \frac{1}{2}(\pi^{D_0} + \pi_i^{D_1}),$$

that is:

$$\pi_i^D = \frac{1}{4}\left(\frac{\gamma_i - 1}{\gamma_i}\right)^2\left(\frac{c}{c_f}\right)^2 E^2 + \frac{c_f - c}{c_f}E. \tag{1}$$

We shall denote by $\pi^D(\delta)$ the profit under diversity for the firm on technology A, that is, with cost reduction $\gamma_A = \gamma + \delta$, and by $\pi^D(-\delta)$ the profit under diversity for the firm on technology B, that is, with cost reduction $\gamma_B = \gamma - \delta$. Similarly, we denote by $q^D(\delta)$ and $q^D(-\delta)$ the innovation intensities under diversity for firms on the good technology A and the bad technology B respectively.

2.2.2 Focus

Consider first the case with full Bertrand competition within each sector (A or B). If both leading firms decide to locate in the same sector, it is optimal for them to choose the sector with higher growth potential, i.e sector A. Under focus, the next best competitor for firm 1 is firm 2 rather than the fringe, so the equilibrium price is always equal to c which is lower than c_f by assumption. Hence, in this case, $x^A = E/c$ while $x^B = E/c_f$ since the consumer buys from the fringe in sector B.

If firm 1 is chosen to be a potential innovator, its expected profit is equal to:

$$\pi^{F_1} = q\left(c - \frac{c}{\gamma + \delta}\right)\frac{E}{c} - \frac{1}{2}q^2.$$

It follows that the optimal probability of innovation is equal to:

$$q^F = \frac{\gamma + \delta - 1}{\gamma + \delta}E.$$

If the firm is not chosen to be a potential innovator, its profit is zero since it has necessarily a (weakly) higher cost than its next best competitor. Hence the expected profit of each firm under focus is

$$\pi^F = \frac{1}{4}\left(\frac{\gamma + \delta - 1}{\gamma + \delta}\right)^2 E^2. \tag{2}$$

Now, let us depart from pure Bertrand competition and instead assume that two firms with the same cost within the same sector collude with probability φ and thereby can sustain a price of c_f, but still compete Bertrand with probability $(1-\varphi)$. In this case, the expected profit of a non-innovating firm with cost c is $\varphi\frac{1}{2}\frac{c_f-c}{c_f}E$.

The ex ante expected payoff of a firm called upon to innovate under focus, is then equal to:

$$q\frac{\gamma+\delta-1}{\gamma+\delta}E+(1-q)\varphi\frac{1}{2}\frac{c_f-c}{c_f}E-\frac{1}{2}q^2$$

and therefore the profit maximizing innovation intensity is:

$$q^F(\varphi)=\left(\frac{\gamma+\delta-1}{\gamma+\delta}-\frac{\varphi}{2}\frac{c_f-c}{c_f}\right)E.$$

In particular, as φ decreases, that is as the competitiveness of the sector increases, innovation increases. This captures an "escape competition" effect: the more intense within-sector competition, the higher the firms' incentives to innovate to escape competition.

Overall, the corresponding ex ante equilibrium payoff of a firm that chooses to focus, is given by:

$$\pi^F(\varphi)=\frac{1}{4}\left[\frac{\gamma+\delta-1}{\gamma+\delta}-\frac{\varphi}{2}\frac{c_f-c}{c_f}\right]^2E^2+\frac{\varphi}{4}\frac{c_f-c}{c_f}E \tag{3}$$

2.2.3 Growth-maximizing choice between diversity and focus

Focus is the growth-maximizing strategy whenever

$$q^F(\varphi)>q^D(\delta)$$

or equivalently

$$2q^F(\varphi)>q^D(\delta)+q^D(-\delta)=\left(\frac{\gamma+\delta-1}{\gamma+\delta}+\frac{\gamma-\delta-1}{\gamma-\delta}\right)\frac{c}{c_f}E.$$

This condition is more likely to be satisfied the lower φ, i.e.,the more intense the degree of within-sector competition, and it always holds for φ sufficiently small.

2.2.4 Laissez-faire choice between diversity and focus

Despite the lower cost reduction from innovating in sector B than in sector A, the firm that diversifies on B may prefer to stick to this sector because diversity shields it from competition: even if it does not innovate, the diversified firm obtains a positive profit equal to $\pi^{D_0}>0$.

Comparing the ex ante equilibrium profits $\pi^D(-\delta)$ and $\pi^F(\varphi)$ under diversity and focus, diversity is an equilibrium outcome under laissez-faire whenever:

$$\pi^D(-\delta) > \pi^F(\varphi)$$

or equivalently:

$$(\frac{c_f - c}{c_f})(1 - \frac{\varphi}{4}) \geq \frac{1}{4}E\left[\left(\frac{\gamma+\delta-1}{\gamma+\delta} - \frac{\varphi}{2}\frac{c_f - c}{c_f}\right)^2 - \left(\frac{\gamma-\delta-1}{\gamma-\delta}\right)^2\left(\frac{c}{c_f}\right)^2\right], \tag{4}$$

where the LHS captures the competitive benefit of diversity whereas the RHS captures the innovation disadvantage of technology B. The RHS is increasing in δ, and therefore there exists a cutoff value δ^L above which diversity cannot be an equilibrium outcome, leading to the following:

Proposition 1 *There exists a unique cutoff value δ^L such that diversity is chosen under laissez-faire if, and only if, $\delta \leq \delta^L$. This cutoff is decreasing in E and in φ.*

In particular, the lower φ, i.e.,the more intense within-sector competition, the higher the cutoff δ^L, i.e., the higher firms' incentives to diversify. On the other hand, we have seen before that for sufficiently small φ focus is always growth maximizing, and the more so the lower φ. This in turn yields one of our main empirical predictions, namely that government intervention to induce several (in our model, two) firms instead of one firm to focus on the same activity, is more growth-enhancing the higher the degree of (ex post) within-sector product market competition. Our analysis also suggests that government intervention aimed at focusing on a particular sector, is more likely to be growth-enhancing if it preserves or increases competition, which, in our model, amounts to subsidizing entry on an equal footing between the two firms rather than providing a wedge to one firm (for example by subsidizing entry in sector A for only one firm, not the other).

3 Empirical analysis

3.1 Basic approach

The theory developed in the previous section suggests that targeting is more likely to be growth-enhancing when competition is more intense within a sector or when competition is preserved by sectoral policy. To test these predictions, we need measures of targeting, competition, and outcomes. We propose to measure outcomes using total factor productivity (TFP). [4]

[4] The reader may be concerned that our model is about growth whereas TFP level is our right hand side variable. However, as we explain below, our regressions will control for fixed effects, and therefore speak to the relationship between sectoral subsidies and TFP growth.

To capture targeting, we consider three types of policy instruments: subsidies, tax holidays, and tariffs. Both subsidies and tax holidays are allocated at the firm level, while tariffs are set at the national level. Our data for tariffs are available at the 2 or 3 digit level. One significant advantage of using tariffs as a measure of industrial policy is that they are set nationally and are exogenous with respect to a particular region or a particular firm. However, since tariffs do not vary across firms, we cannot use measures of policy dispersion within a sector to test whether tariffs are set in a way that preserves competition. For tariffs, all we can do is test whether the imposition of tariffs in more competitive sectors is more likely to result in higher firm performance. To measure competition, we will compute a Lerner index at the sector level, which in turn measures the importance of markups (i.e of the difference between prices and marginal costs) relative to the firm's total value added.

A main empirical challenge is to capture the notion of subsidies or tax holidays being allocated in a way that preserves or increases competition. We first consider the sectoral dispersion of subsidies or tax holidays as a measure of their degree of "competitiveness". As an (inverse) measure of sectoral dispersion, we use the Herfindahl index constructed using the share of subsidies (or tax holidays) each firm in a given sector receives relative to the total subsidies awarded to the sector. We thus derive a measure of concentration, $Herf\_subsidy$, where:

$$Herf\_subsidy_{jt} = \sum_{i \in j} \left(\frac{Subsidy_{ijt}}{Sum\_subsidy_{jt}} \right)^2 \tag{5}$$

We then do the same thing for tax holidays, and obtain a measure of concentration, $Herf\_tax$, where:

$$Herf\_tax_{jt} = \sum_{i \in j} \left(\frac{TaxHoliday_{ijt}}{Sum\_TaxHoliday_{jt}} \right)^2 \tag{6}$$

The amount of tax holiday granted to any firm i is simply the quantity of tax revenues that the firm saves by qualifying for the tax holiday. During the time period of our analysis, corporate tax rates were at 15 percent. Consequently, the amount of the tax holiday is equal to profits times $(.15 - x)$, where x is the actual tax rate paid by the firm. As with standard Herfindahl indices, a smaller number indicates a higher degree of dispersion of subsidies or tax holidays, or a more equitable (and competition-preserving) allocation of those across firms in the sector. We then take the inverse of these Herfindhal indexes to capture the degree of sectoral dispersion of the tax holidays or subsidies. The inverse of our $Herf\_subsidy$ term we call $CompHerf\_subsidy$. The inverse of our $Herf\_tax$ term we call $CompHerf\_tax$.To the extent that greater dispersion of subsidies within a sector induces greater focus by encouraging more firms to innovate within a specific sector, we would expect the coefficient on that variable in the productivity regression to be positive.

If we were to regress firm-level measures of total factor productivity (TFP) on these sectoral dispersion measures, such an approach could raise potential endogeneity issues. For example, if governments favor large and more successful firms in the allocation process, then a firm that accounts for a large share of total tax holidays or subsidies within a sector might also exhibit higher TFP. These would lead our estimation procedure to reflect spurious relationships between state support and performance. A similar possibility exists if the government tends to support weaker enterprises, which would bias the coefficient in the opposite direction.

To address the potential endogeneity of our policy instruments, we calculate them separately for each firm and exclude the firm's own subsidies or tax holidays in estimating the $Herf\_subsidy$ and $Herf\_tax$ indexes. This means that in calculating the inverse of the Herf_subsidy, we exclude firm i's subsidy in both the numerator and the denominator. For the inverse of the Herf_tax, we do the same exclusion. Consequently, this sector-level measure is completely exogenous with respect to firm i's performance. We also employ an alternative approach to address potential endogeneity concerns, which we describe later.

The basic estimating equation can then be written as follows:

$$\ln TFP_{ijt} = \beta_1 Z_{ijt} + \beta_2 S_{jt} + \beta_3 CompHerf_{ijt} + +\alpha_i + \alpha_t + \epsilon_{ijt}, \qquad (7)$$

where Z is a vector of firm-level controls including state and foreign equity ownership at the firm level, S includes sector-level controls, such as tariffs or the degree of (initial) competition in the sector or the degree of foreign penetration in the sector as well as upstream and downstream, and $CompHerf_{ijt}$ measures the extent of sectoral dispersion in subsidies and/or tax holidays. The specification includes firm fixed effects α_i as well as time fixed effects α_t. Our conjecture is that $\beta_3 > 0$, i.e that more dispersed sectoral subsidies (or tax holidays) are more TFP enhancing.

3.2 Data and alternative estimation strategies

The dataset employed in this paper was collected by the Chinese National Bureau of Statistics. The Statistical Bureau conducts an annual survey of industrial plants, which includes manufacturing firms as well as firms that produce and supply electricity, gas, and water. It is firm-level based, including all state-owned enterprises (SOEs), regardless of size, and non-state-owned firms (non-SOEs) with annual sales of more than 5 million yuan. We use a ten-year unbalanced panel dataset, from 1998 to 2007. The number of firms per year varies from a low of $162,033$ in 1999 to a high of $336,768$ in 2007. The sampling strategy is the same throughout the sample period (all firms that are state-owned or have sales of more than 5 million yuan are selected into the sample).

The original dataset includes $2,226,104$ observations and contains identifiers that can be used to track firms over time. Since the study focuses on manufacturing firms, we eliminate non-manufacturing observations. The sample size is further reduced by deleting missing values, as well as observations with negative or zero values for output, number of employees, capital, and the inputs, leaving a sample size of $1,842,786$. Due to incompleteness of information on official output price indices, three sectors are dropped from the sample[5]. This reduces the sample size to $1,545,626$.

The dataset contains information on output, fixed assets, total workforce, total wages, intermediate input costs, public ownership, foreign investment, Hong Kong-Taiwan-Macau investment, sales revenue, and export sales. Because domestically owned, foreign, and publicly owned enterprises behave quite differently, for this paper we restrict the sample to firms that have zero foreign ownership and are not classified as state owned enterprises. In the dataset, $1,069,563$ observations meet the criterion[6].

To control for the effects of trade policies, we have created a time series of tariffs, obtained from the World Integrated Trading Solution (WITS), maintained by the World Bank. We aggregated tariffs to the same level of aggregation as the foreign investment data, using output for 2003 as weights. We also created forward and backward tariffs, to correspond with our vertical FDI measures. During the sample period, average tariffs fell nearly 9 percentage points, which is a significant change over a short time period. While the average level of tariffs during this period, which spans the years before and after WTO accession, was nearly 13 percent, this average masks significant heterogeneity across sectors, with a high of 41 percent in grain mill products and a low of 4 percent in railroad equipment.

The earlier literature on production function estimation shows that the use of OLS is inappropriate when estimating productivity, since this method treats labor, capital and other input variables as exogenous. As Griliches and Mairesse (1995) argue, inputs should be considered endogenous since they are chosen by a firm based on its productivity. Firm-level fixed effects will not solve the problem, because time-varying productivity shocks can affect a firm's input decisions.

Using OLS will therefore bias the estimations of coefficients on the input variables. To solve the simultaneity problem in estimating a production function, we employ the procedure suggested by Olley and Pakes (1996) (henceforth OP), which uses investment as a proxy for unobserved productivity shocks. OP address the endogeneity problem as follows. Let us consider the following Cobb-Douglas production function in logs:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \omega_{it} + \epsilon_{it}, \tag{8}$$

where y_{it}, k_{it}, l_{it}, m_{it} denote the log of output, capital, labor, and materials, respectively; ω_{it} is firm i's productivity, and ϵ_{it} is the error term (or a shock to

[5]They are the following sectors: processing food from agricultural products; printing, reproduction of recording media; and general purpose machinery.

[6]Actually, the international criterion used to distinguish domestic and foreign-invested firms is 10%, that is, the share of subscribed capital owned by foreign investors is equal to or less than 10%. In the earlier version of the paper, we tested whether the results are sensitive to using zero, 10%, and 25% foreign ownership. Our results show that between the zero and 10% thresholds, the magnitude and the significance levels of the estimated coefficients remain close, which makes us comfortable using the more restrictive sample of domestic firms for which the foreign capital share is zero. The results based on the 25% criterion exhibit small differences, but the results are generally robust to the choice of definition for foreign versus domestic ownership.

productivity). The key difference between ω_{it} and ϵ_{it} is that ω_{it} affects firms' input demand whereas ϵ_{it} does not. OP also make timing assumptions regarding the input variables. Labor and materials are free variables whereas capital is assumed to be a fixed factor and subject to an investment process. Specifically, at the beginning of every period, the investment level a firm decides together with the current capital value determines the capital stock at the beginning of the nest period, i.e.

$$k_{it+1} = (1-\sigma)k_{it} + i_{it} \tag{9}$$

The key innovation of the OP estimation is to use firms' observable characteristics to model a monotonic function of a firm's productivity. Since the investment decision depends on both productivity and capital, OP formulate investment as follows,

$$i_{it} = i_{it}(\omega_{it}, k_{it}) \tag{10}$$

Given that this investment function is strictly monotonic in ω_{it} , it can be inverted to obtain

$$\omega_{it} = f_t^{-1}(i_{it}, k_{it}) \tag{11}$$

Substituting this into the production function, we get the following,

$$\begin{aligned} y_{it} = \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + f_t^{-1}(i_{it}, k_{it}) + \epsilon_{it} = \\ = \beta_l l_{it} + \beta_m m_{it} + \phi_t(i_{it}, k_{it}) + \epsilon_{it} \end{aligned} \tag{12}$$

In the first stage of OP estimation, the consistent estimates of coefficients on labor and materials as well as the estimate of a nonparametric term (ϕ_t) are obtained. The second step of OP identifies the coefficient on capital through two important assumptions. One is the first-order Markov assumption of productivity, ω_{it} and the timing assumption about k_{it}. The first-order Markov assumption decomposes ω_{it} into its conditional expectation at time $t-1$, $E[\omega_{it}|\omega_{it-1}]$, and a deviation from that expectation, ζ_{it}, which is often referred to the "innovation" component of the productivity measure. These two assumptions allow us to construct an orthogonal relationship between capital and the innovation component in productivity, which is used to identify the coefficient on capital.

The biggest disadvantage of applying the OP procedure is that many firms report zero or negative investment. To address this problem, we also explore the robustness of our results to using the Levinsohn Petrin (2003) approach. Both approaches involve a two-stage estimation procedure when using TFP as the dependent variable. The first step is to use OP or LP to obtain unbiased coefficients on input variables and then calculate TFP (as the residual from the production function). The second step is to regress TFP on firm-level controls, sector-level controls, and our targeting measures.

Moulton showed that in the case of regressions performed on micro units that also include aggregated market (in this case industry) variables, the standard errors from OLS will be underestimated. As Moulton demonstrated, failing to take account of this serious downward bias in the estimated errors results in spurious findings of the statistical significance for the aggregate variable of interest. To address this issue, the standard errors in the paper are clustered for all observations in the same industry.

3.3 Baseline results

We begin with the baseline estimates from (7). The critical parameter is the coefficient β_3. Table 1 reports the coefficient estimates. The dependent variable is the log of TFP, using the OP method as outlined above. As indicated earlier, all specifications include both time and firm fixed effects. The subsidy and tax holiday variables are our measures of "targeting", and the corresponding CompHerfindahl index(es). Summary statistics for all the variables, including sample means and standard deviations, are reported in Appendix Tables A1 and A2.

As mentioned earlier, the sector level controls include input and output tariffs, the Lerner index as a measure of sector level competition, and sector-level measures of foreign presence. The Lerner index is defined as the ratio of operating profits less capital costs to sales. We first aggregate operating profits, capital costs, and sales at the industry-level. Under perfect competition, there should be no excess profits above capital costs, so the Lerner Index should equal zero and the competition measure should equal 1. A value of 1 indicates perfect competition while values below 1 suggest some degree of market power. For more discussion of the measures of foreign presence, which include measures for horizontal ("horizontal") and vertical ("backward" and "forward") foreign exposure, see Du, Harrison, and Jefferson (2011).

To the extent that greater dispersion of subsidies within a sector induces greater focus by encouraging more firms to innovate within a specific sector, we would expect the coefficient on $CompHerf\_subsidy$ to be positive. This is precisely what we obtain in the first two columns of Table 1, which show positive and significant coefficients on $CompHerf\_subsidy$. The coefficient estimates in column (2) indicate that a one standard deviation increase in the variable leads to an increase in TFP of 1.4 percentage points.

The next two columns of Table 1 look at the correlation between firm level TFP and our measure for the dispersion of tax holidays $CompHerf\_tax$. The coefficient is statistically significant and positive, indicating that greater dispersion of tax holidays increases productivity. The coefficient estimate, which varies from .00834 to .00856, indicates that a one standard deviation increase in the variable leads to an increase in TFP of roughly the same magnitude, 1.4 percentage points. In the last two columns, we combine our measures of dispersion of subsidies and tax holidays to create one term, by adding at the firm level the total amount of incentives due to subsidies and tax breaks. The coefficient estimate on the combined term is also statistically significant and positive. The coefficient in column (5) indicates that a one standard deviation increase in the variable leads to an increase in TFP of 1.7 percentage points. In light of the fact that average growth rates of TFP in industrial countries rarely exceed 2 percentage points annually, and that aggregate average TFP in manufacturing in China during this period was around 5 percentage points annually, an increase in TFP of 1.7 percentage points is economically significant. Achieving this outcome would not require additional resources, only a different allocation of those resources to make them more competition-friendly.

While not reported here, the results presented in Table 1 are robust to transforming the equations into differences and thus estimating the impact of changes in dispersion on TFP growth. It should not be surprising that the results are robust to taking first differences, as all the specifications in Table 1 include firm and year fixed effects.

One possible source of endogeneity bias might be if poorer performers drop out over time, leading to a spurious positive correlation between our measures of sectoral dispersion and productivity performance. To address this issue, in Table 2 we replicate the above analysis, but using only new firms and survivors. We also re-estimate our sector level measures of dispersion of income tax holidays and subsidies. While the sample size is 25 percent smaller than before, the coefficient estimates remain significant and of very similar magnitude. For the $CompHerf\_subsidy$, the coefficient estimates actually increase in size. The coefficient estimates in columns (1) and (2) in Table 2 suggest that a one standard deviation increase in this dispersion measure would be associated with a 1.6 percentage point increase in TFP.

In Tables 1 and 2, we also controlled for the size of the individual firm-level subsidy, $ratio\_subsidy$, and for the amount of the tax break, $taxbreak$. Our measure $ratio\_subsidy$ is defined as the amount of the subsidy divided by firm sales, whereas the tax break is defined as a zero-one variable indicating whether the firm paid taxes at a lower rate than the statutory corporate tax rate. We also include a control, dummy, which indicates whether zero or negative profits were reported. The coefficient on the subsidy variable alone is negative and significant in Tables 1 and 2, while the coefficient on the tax break is positive and significant. It is difficult to assign a causal interpretation to these firm-level variables, as they could simply indicate that subsidies are given to weaker enterprises and tax breaks are given to stronger enterprises.

In Table 3 we add an additional control for firm size, the log of (real) sales. Across all specifications reported in Table 3, the coefficients on the dispersion of sectoral policies remain significant and similar in magnitude. The coefficient on the firm-level subsidy term shifts from negative and significant to nearly zero in magnitude and statistically insignificant. This suggests that the negative and significant coefficient on firm-level subsidies in the previous tables was driven by the denominator and not the numerator. The coefficient on state ownership becomes negative and significant, indicating that after controlling for size state owned enterprises exhibit poorer productivity performance.

The results in Tables 1 through 3 suggest that preserving competition through a more equitable targeting policy is associated with superior performance, as measured by productivity. We addressed the potential endogeneity of targeting by excluding a firm's own subsidies or tax holidays when estimating the impact of sectoral dispersion of subsidies or tax holidays on that firm's TFP.

3.4 Addressing endogeneity: an alternative specification

In this part, we propose an alternative approach to understanding the importance of competition and focus in making industrial policy work. In particular, we test whether a pattern of subsidies focused on more competitive sectors, using the correlation between competition across different industrial sectors at the beginning of the sample period and current period targeting measures, explains differential success of industrial policies. We then introduce an alternative targeting measure, tariffs, which also helps address the endogeneity concerns at the firm level because they are set nationally.

We begin by measuring the pattern of subsidies at the city-year level, using a method developed by Nunn and Trefler (2006). To test whether subsidies are more effective when introduced in conjunction with competition, we propose to measure the correlation of subsidies with competition and then to see whether the strength of that correlation raises firm performance. To measure whether subsidies are biased towards more competitive sectors in city r in year t , we calculate the correlation between the industry-city level initial degree of competition and current (period t) subsidies in sector j and city r :

$$\Omega_{rt,subs} = Corr(SUBSIDY_{rjt}, COMPETITION_{rj0}) \tag{13}$$

Since subsidies vary over time, we thus obtain a time-varying change in the correlation between initial levels of competition and the patterns of interventions. We then explore whether higher correlations between subsidies and competition, as measured by Ω_{rt}, are associated with better performance. As an illustration, if in Shanghai the largest amount of subsidies are allocated to sectors with low markups and small or zero subsidies are given to sectors with high markups in the year 2003, then for Shanghai in 2003 this correlation coefficient will be close to unity.

To further address the issue of endogeneity of subsidies, we redo the analysis using an instrument of industrial policy which does not vary across firms. The instrument we use is tariffs, which protect all firms in a particular sector. Consequently, we redo the estimation, but replacing subsidies with tariffs and replacing the correlation between initial competition and subsidies with the correlation between initial competition and current period tariffs. At the city level, the correlation between that city's degree of competition at the beginning of the sample period and current period tariffs should be strictly exogenous, as the level of competition is predetermined and tariffs are set at the national, not the city, level. Our new correlation measure is now defined as:

$$\Omega_{rt,tariffs} = Corr(TARIFF_{jt}, COMPETITION_{rj0}) \tag{14}$$

Total factor productivity is computed using both OLS with fixed effects and Olley & Pakes 1996 (OP). The firm-level estimation equation is as follows:

$$\begin{aligned} lnTFP_{ijrt} = \alpha_0 + \alpha_1 X_{ijrt} + a_3 COMP_{jt} + \\ + a_4 \Omega_{rt,subs} + a_5 \Omega_{rt,tariffs} + f_i + D_t + \epsilon_{ijt}, \end{aligned} \tag{15}$$

where TFP_{ijrt} is total factor productivity in firm i in industry j located in city r in year t; X_{ijrt} includes sector and firm level controls such as the share of the firms' total equity owned by the state; f_i is the firm fixed effect and D_t represents year dummies.

The coefficient α_4 on the correlation between subsidies and competition indicates the extent to which targeting at the city level via subsidies is more efficient in more competitive industries, as measured by the initial degree of competition at the beginning of the sample period. Similarly, the coefficient α_5 measures the impact of the correlation between tariffs and competition in the sector. A positive and significant coefficient indicates that tariffs should have a more beneficial impact on productivity when there is more domestic competition.

The results in Table 4 show positive and significant coefficients on the correlations between subsidies or tariffs and competition. The coefficient estimate on the correlation between subsidies and initial competition $\Omega_{rt,subs}$ at the city level in column (1), .09, indicates that if the correlation between subsidies and competition at the city level was perfect (100 percent), then productivity would be 9 percent higher. Based on the sample means, a one standard deviation increase in the city-industry correlation would increase TFP by .8 percentage points for firms in that city and industry.

Columns (3) and (4) add the correlation between tariffs and competition $\Omega_{rt,tariffs}$ as right-hand side variable, whereas column (2) looks at the effect of this latter interaction alone. We find that both interaction terms are positively and significantly correlated with firm productivity, and the coefficient on the interaction between subsidy and competition remains of the same magnitude once we introduce the interaction between tariffs and competition. The coefficient on this latter interaction indicates that if the correlation between tariffs and competition at the city level was 100 percent, then productivity would be almost 5 percentage points higher.

Overall, the evidence in Table 4 suggests that instruments such as tariffs and subsidies have systemically been associated with improved productivity performance when combined with high initial levels of competition, as measured by the Lerner index. Since tariffs are set at the national level, and the correlation between subsidies and competition is measured at the city level, these correlation variables are independent of firm-level behavior and can be considered to be exogenous. One interesting question to ask is how much actual tariff and subsidy levels at the city-industry level were in fact correlated with actual competition levels. The summary statistics in Table A-1 suggest that in fact the Chinese government did not set tariff or subsidy levels higher in cities or industries where competition was more intense. The average correlation coefficient between tariffs and the Lerner measure is .019, suggesting almost zero correlation between tariffs and competition. The correlation with subsidies is higher, at 0.14. While the evidence suggests that performance was higher when policy instruments were introduced in conjunction with greater competition, the actual pattern of policies do not suggest that this is what the Chinese actually did. One interpretation is that there is enormous scope for improved performance outcomes associated with industrial policy if it is introduced in a way that preserves competition in the future.

In Table 5, we run the same specification as in Table 4 but we divide the sample into four groups based on the percentiles of the $Herf\_subsidy$ index. More precisely, we compare the results from the second quartile, where subsidies are more dispersed, with those from the fourth quartile, which represents sectors where subsidies are concentrated on fewer enterprises. The results are quite different between these two quartiles. Column (1) indicates that the positive impact of the correlations between subsidies and competition both at the city and firm level are significant in the second quartile of the distribution. In this case, the correlation coefficient is 0.139, indicating that a perfect correlation between subsidies and competition at the city-level would increase productivity by 13.9 percentage points. Column (2) indicates instead that for the fourth quartile, i.e when subsidies are more concentrated, there is no significant positive of impact of the correlation between subsidies and competition at either the city or firm level. In column (1), the net impact of the correlation between subsidies and competition is positive when there is perfect competition, with a one standard deviation increase in the level of the subsidies-competition correlation leading to an increase in productivity of 1.2 percentage points.

Summarizing the results in Tables 1 through 5, we find consistent evidence that different sectoral policy instruments–including tariffs, subsidies, and tax holidays–are associated with higher total factor productivity when introduced in a way which is more competition-friendly.

4 Conclusion

In this paper we have argued that sectoral state aids tend to foster productivity, productivity growth, and product innovation to a larger extent when policy targets more competitive sectors and when it is not concentrated on one or a small number of firms in the sector. A main implication from our analysis is that the debate on industrial policy should no longer be for or against the wisdom of such a policy. As it turns out, sectoral policies are being implemented in one form or another by a large number of countries worldwide, starting with China as a prominent example. Rather, the issue should be on *how* to design and govern sectoral policies in order to make them more competition-friendly and therefore more growth-enhancing. Our analysis suggests that proper selection criteria together with good guidelines for governing sectoral support can make a significant difference in terms of growth and innovation performance.

Yet the issue remains of how to minimize the scope for influence activities by sectoral interests when a sectoral state aid policy is to be implemented. One answer is that the less concentrated and more competition-compatible the allocation of state aid to a sector, the less firms in that sector will lobby for that aid as they will anticipate lower profits from it. In other words, political economy considerations should reinforce the interaction between competition and the efficiency of sectoral state aid. A comprehensive analysis of the optimal governance of sectoral policies still awaits further research.

One question which might arise is how this approach can work when there are significant economies of scale. We tested the framework in the context of the Chinese domestic market, which is large enough to allow producers to exploit scale economies in most industrial sectors. In a smaller economy, the question of how to encourage more focus and rivalry while allowing firms to reap the cost gains from exploiting scale economies would have more relevance. In that context, competition could be preserved by exposing firms to international rivalry. It is not surprising that smaller economies like South Korea were able to exploit the benefits of competition by forcing firms that received targeted support to compete on global markets. Further research exploring the implementation of industrial policy under increasing returns remains an avenue for future research.

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A Appendix 1: Theory

A.1 Social Optimum

In this first part of the Appendix we assume full Bertrand competition within sectors, and then compare the laissez-faire choice between diversity and focus with the choice that maximizes social welfare, not just innovation intensity or growth.

Suppose that a social planner could impose targeting, i.e force the two firms to focus on the same sector. The social benefit from targeting sector A is to achieve a larger cost reduction from innovation and also a lower price for consumers. On the other hand, in sector B, the good is provided at a higher marginal cost (by the fringe) than under diversity.

In sector B, consumers have the same total surplus of $\log(E/c_f) - E$ but the good is provided at cost $c_f E/c_f = E$ while the cost of provision under diversity, denoted by $C_B^D(\delta)$, is obviously the revenue of the firm, E, minus its profit, $\pi_B^D(\delta)$. Hence targeting leads a loss of $\pi_B^D(\delta)$ in sector B.

In sector A, consumers gain a surplus of $\log(E/c) - \log(E/c_f) = \log(c_f) - \log(c)$, which is a direct effect of increased product market competition. Moreover, there is also a change in the total cost of production. Indeed, under diversity the cost of production, denoted by $C_A^D(\delta)$, is $E - \pi_A^D(\delta)$, whereas under focus the total cost is $E - 2\pi^F(\delta)$. Hence targeting yields a net gain of $\log(c_f) - \log(c) + 2\pi^F(\delta) - \pi_A^D(\delta)$.

Consequently, targeting is socially beneficial when:

$$\log(c_f) - \log(c) \geq \pi_A^D(\delta) + \pi_B^D(\delta) - 2\pi^F(\delta).$$

Let $\Delta(\delta) \equiv \pi_A^D(\delta) + \pi_B^D(\delta) - 2\pi^F(\delta)$. From our analysis in Section 2, we know that $\Delta(\delta^L) > 0$: firm 2 is indifferent between diversity and targeting but firm 1 strictly prefers diversity to targeting. Under diversity and focus, the price to consumers in sector B is equal to c; however, under focus there is a higher probability that firms achieve lower costs and because total welfare is decreasing in price, it is the case that the above condition holds at δ^L.

We show now that $\Delta(\delta)$ is a decreasing function of δ implying the existence of a cutoff $\delta^S < \delta^L$ such that social welfare is greater under focus if and only if $\geq \delta_S$. To see this, let $g_+ \equiv \frac{\gamma+\delta-1}{\gamma+\delta}$ and $g_- \equiv \frac{\gamma-\delta-1}{\gamma-\delta}$ Direct differentiation yields

$$\Delta'(\delta) \propto \frac{2}{(\gamma+\delta)^2} g_+ \left[\left(\frac{c}{c_f}\right)^2 - 2 \right] - \frac{2}{(\gamma-\delta)^2} g_- \left(\frac{c}{c_f}\right)^2$$

which is negative since $c < c_f$.

Note that we can have $\delta^S > 0$ only if targeting is *not* socially beneficial at $\delta = 0$, that is when:

$$\begin{aligned}\log(c_f) - \log(c) &< 2\frac{c_f - c}{c_f} E + \frac{1}{2}\left(\frac{\gamma-1}{\gamma}\right)^2 \left(\left(\frac{c}{c_f}\right)^2 - 1 \right) E^2 \\ &= \frac{c_f - c}{c_f} E \left\{ 2 - \frac{1}{2}\frac{c_f + c}{c_f}\left(\frac{\gamma-1}{\gamma}\right)^2 E \right\}.\end{aligned}$$

By the intermediate value theorem, there exists $\tilde{c} \in (c, c_f)$ such that $\log(c_f) - \log(c) = (c_f - c)/\tilde{c}$. Let $g \equiv (\gamma - 1)/\gamma$ be the cost improvement when $\delta = 0$. The condition becomes:

$$M(E) = \frac{1}{2}\frac{c_f + c}{c_f} g^2 E^2 - 2E + \frac{c_f}{\tilde{c}} < 0.$$

If $g^2 > \tilde{c}/(c_f + c)$ this condition cannot be satisfied and therefore $\delta^S = 0$. However if $g^2 < \tilde{c}/(c_f + c)$, the condition is satisfied only for E between the two roots of the quadratic equation $M(E) = 0$.[7]

We summarize our findings in the following proposition.

Proposition 2 *1. There exists $\delta^S < \delta^L$ such that targeting is socially optimal if, and only if, δ is greater than δ^S.*

2. *Letting $g = \frac{\gamma-1}{\gamma}$, $\delta^S = 0$ when $g^2 \geq \frac{1}{2}\frac{\tilde{c}}{c_f+c}$.*

3. *When $g^2 < \frac{\tilde{c}}{c_f+c}$, there exist E_0, E_1 with $E_0 < E_1$ such that $\delta^S > 0$ only if the market size $E \in [E_0, E_1]$; for $E < E_0$ or $E > E_1$, $\delta^S = 0$*

[7] The roots are $E_0 = 2c_f \frac{1-\sqrt{1-\frac{c_f+c}{2\tilde{c}}g^2}}{c_f+c}$, $E_1 = 2c_f \frac{1-\sqrt{1+\frac{c_f+c}{2\tilde{c}}g^2}}{c_f+c}$.

These results are quite intuitive. First, ceteris paribus, for small values of δ, targeting has a low social benefit (in terms of higher competition and innovation) relative to the cost reduction on technology B achieved thanks to diversity. There may however be room for a targeting policy for higher δ's: the desire to relax price competition by choosing diversity leads the big firms not to focus enough.

Second, with perfect information, (innovation-reducing) diversity is welfare-decreasing if γ, and thus the potential cost decrease from innovation, is high enough. In this case, laissez-faire conflicts with social optimal for all values of δ less than δ^L, and we can 'safely' go for targeting: it is either welfare-increasing (for $\delta < \delta^L$) or irrelevant (for $\delta \geq \delta^L$).

Third, for smaller values of γ, there exists a intermediate region for market size E, where diversity may be socially optimal for some values of δ. If market size (E) is large, targeting is desirable.

A.2 Imperfect Information

Our assumption of perfect information is obviously extreme. Below we consider two possibilities. One where the firms know the sector in which the cost reduction possibilities are greater but the planner does not. The other case is where neither the firms nor the planner know the identity of the sector with the greater cost reduction. It turns out that the first case is equivalent to the case of perfect information if the planner can use mechanisms. For the second case, the laissez-faire outcome looks very different from the one under perfect information since it is now for high values of δ that diversity emerges. The possibility of conflict between the firms and the planner are still present and there is value for a targeting policy.

A.2.1 Only the planner has imperfect information

If the planner has imperfect information about which sector involves the higher cost reduction but the firms (or at least one of them) have perfect information about it, then as long as δ is known by the planner, the perfect information outcome can be replicated.

For $\delta \geq \delta^S$, letting the firm diversify is socially optimal and the planner will not intervene. When $\delta < \delta^S$, the planner would like to impose targeting *on the better sector*, but it does not know which one it is. However, conditional on being obliged to focus, firms 1 and 2 prefer to do it on the better sector, so that a planner can simply impose targeting to firms $1, 2$ and let them locate subject to this constraint.

If in addition the planner does not have information about the value of δ, since the parties have correlated information revelation mechanisms can be used to extract this information from the parties. The design of the optimal mechanism is beyond the scope of this paper however.

A.2.2 All parties have imperfect information

When neither the firms nor the planner have information about which sector entails the higher cost reduction under innovation, there may be a coordination failure both under laissez-faire and under intervention.

We consider the case where firms locate without knowing whether the market they have chosen allows for a cost reduction of $\gamma + \delta$ or $\gamma - \delta$ but, upon being called to innovate, they learn which cost reduction can be generated. This interpretation facilitates comparison with the perfect-information case.

Assume first diversity. Then total industry profit is the same as before since firms make the same decisions when they are chosen to innovate.

Under focus, since at the time the sector is chosen firms do not know which is the beter one, focus yields with probability 1/2 the level of profit $\pi^F(\delta)$ and with probability 1/2 the same level of profit but with $\gamma + \delta$ replaced by $\gamma - \delta$, that is, $\frac{1}{2}(\pi^F(\delta) + \pi^F(-\delta))$.

By revealed preferences in the perfect information case, we have $\pi^D(\delta) > \pi^F(\delta)$ since a firm under diversity could have chosen to set the same price and use the same innovation intensity as under focus. A similar argument shows that $\pi^D(-\delta) > \pi^F(-\delta)$, therefore:

$$(\pi^D(\delta) + \pi^D(-\delta))/2 > (\pi^F(\delta) + \pi^F(-\delta))/2$$

and firms prefer to diversity rather than to focus for any value of δ.

Proposition A1 *Under imperfect information, the laissez-faire outcome is for firms to diversify for any value of δ and γ.*

Let us now turn to intervention. Diversity brings the same social value as under perfect information. With targeting on the better sector (sector A), the social benefit is the same as under perfect information; but the social benefit is much lower than under perfect information when targeting the worse sector (sector B). When there is focus, the total cost is in fact $\frac{1}{2}(2E - \pi^F(\delta) - \pi^F(-\delta))$ and therefore targeting is socially optimal when:

$$\log(c_f) - \log(c) \geq \pi^D(\delta) + \pi^D(-\delta) - (\pi^F(\delta) + \pi^F(-\delta)).$$

The RHS is the difference in industry profit between diversity and focus, which is positive by Proposition A1. Using the expressions for the profit functions, we have:

$$\pi^D(\delta) + \pi^D(-\delta) - (\pi^F(\delta) + \pi^F(-\delta))$$
$$= \frac{1}{4}\left[\left(\frac{\gamma+\delta-1}{\gamma+\delta}\right)^2 + \left(\frac{\gamma-\delta-1}{\gamma-\delta}\right)^2\right]\left(\left(\frac{c}{c_f}\right)^2 - 1\right)E^2 + 2\frac{c_f - c}{c_f}E.$$

The term in brackets is decreasing in δ; since $c < c_f$, the coefficient of E^2 is negative and therefore the expression is *increasing* in δ. This is in sharp contrast with the perfect information case since the difference in industry profit between diversity and focus was *decreasing* in δ in that case. In the perfect information case, focusing on sector A led to a decreasing opportunity cost since, as δ increases, the value of being located in (the "better") sector A decreases. Under imperfect information though, focusing makes it as likely to be competiting in either sector A or B. Since firms prefer not to face competition as δ increases, firms value diversity more.

A necessary condition for targeting to be socially optimal is that $\log(c_f) - \log(c)$ be greater than the minimum difference in profits, which arises at $\delta = 0$, i.e when both sectors involve the same cost reduction when innovating. Using the same reasoning as in the perfect information case for deriving condition (**??**), if $\tilde{c}$ solves $\log(c_f) - \log(c) = (c_f - c)/\tilde{c}$ this necessary condition when $\delta = 0$ as (recall that $g \equiv (\gamma - 1)/\gamma$) becomes:

$$\frac{c_f + c}{c_f} g^2 E^2 - 2E + \frac{c_f}{\tilde{c}} > 0$$

which is the same condition as that under perfect information. Therefore when g^2 is larger than $\tilde{c}/(c_f + c)$, targeting is optimal when $\delta = 0$ and when g^2 is smaller than this value, targeting is optimal when E is smaller than E_0 or larger than E_1.

If focus is optimal at $\delta = 0$, by continuity there exists $\delta^* > 0$ such that focus is socially optimal for all δ less than δ^*.

Proposition A2

1. *If $g^2 > \frac{\tilde{c}}{c_f + c}$, there exists $\delta^* > 0$ such that targeting is socially optimal for all $\delta < \delta^*$.*
2. *If $g^2 < \frac{\tilde{c}}{c_f + c}$, and $E < E_0$ or $E > E_1$, there exists $\delta^{**} > 0$ such that targeting is socially optimal for all $\delta < \delta^{**}$.*
3. *If $g^2 < \frac{\tilde{c}}{c_f + c}$, and $E \in [E_0, E_1]$ targeting is not an optimal policy for all values of δ.*

Because targeting under imperfect information yields a smaller surplus than under perfect information while diversity brings the same benefit, it must be the case that focus is less often socially optimal, and therefore δ^* is strictly smaller than the cutoff δ^S in Proposition 2.

Finally, one can show that $\delta^* > \delta^{**}$, so that, as in the perfect information case, the range of δ's for which targeting is socially optimal, is bigger when the growth rate g is high than when it is low. To prove that claim, it suffices to note that if:

$$\Delta\Pi = \pi^D(\delta) + \pi^D(-\delta) - (\pi^F(\delta) + \pi^F(-\delta)),$$

we have:

$$\frac{\partial \Delta\Pi}{\partial \delta} > 0; \frac{\partial \Delta\Pi}{\partial \gamma} < 0.$$

To see this, note that:

$$\begin{aligned} \Delta\Pi &\approx -\left[\left(\frac{\gamma + \delta - 1}{\gamma + \delta} \right)^2 + \left(\frac{\gamma - \delta - 1}{\gamma - \delta} \right)^2 \right] \\ &\equiv -F(\delta, \gamma), \end{aligned}$$

where:
$$\frac{\partial F}{\partial \delta} = \frac{1}{(\gamma+\delta)^2} - \frac{1}{(\gamma+\delta)^3} - \frac{1}{(\gamma-\delta)^2} + \frac{1}{(\gamma+\delta)^3} < 0$$
and:
$$\frac{\partial F}{\partial \gamma} = \left(1 - \frac{1}{\gamma+\delta}\right)\frac{1}{(\gamma+\delta)^2} + \left(1 - \frac{1}{\gamma-\delta}\right)\frac{1}{(\gamma-\delta)^2} > 0.$$

A.3 Dynamic welfare under focus versus diversity

Consider a dynamic extension of the model where the social planner seeks to maximize intertemporal utility

$$U = \sum_{t=1}^{\infty}(1+r)^{-t}\left[\log x_t^A + \log x_t^B\right],$$

although private consumers and entrepreneurs live for one period only. Moreover, assume that, due to knowledge spillovers, after one period all firms multiply their initial productivity by the same $\widetilde{\gamma} \in \{\gamma+\delta, \gamma-\delta\}$ as the innovative firm. Then a social planner who wants to maximize intertemporal utility, will take into account not only the static welfare analyzed above, but also the average growth rates respectively under diversity and under focus.

The growth rates of utility under diversity and focus, are respectively given by:

$$G^D = \left[\frac{1}{2}\left(1 - \frac{1}{\gamma+\delta}\right)\log(\gamma+\delta) + \frac{1}{2}\left(1 - \frac{1}{\gamma-\delta}\right)\log(\gamma-\delta)\right]\frac{c}{c_f}E$$

and
$$G^F = \left(1 - \frac{1}{\gamma+\delta}\right)\log(\gamma+\delta)E.$$

We clearly have
$$G^F > G^D,$$

as a results of two effects that play in the same direction: (i) focus increases the expected size of innovation (always equal to $\log(\gamma+\delta)$ under focus, but sometimes equal to $\log(\gamma-\delta)$ under diversity); (ii) focus increases the expected frequency of innovation both because innovation under focus induces bigger cost reduction under focus (under diversity cost is sometimes reduced by factor $(\gamma-\delta)$) and because under focus there is more incentive to innovate in order to escape competition (term $\frac{c}{c_f}$ in the expression for G^D). This immediately establishes:

Proposition A3 *There exists a cut-off value $\delta^S(r) < \delta^S$, increasing in r, such that focus maximizes dynamic welfare whenever $\delta > \delta^S(r)$.*

B Appendix 2: Tables

Table 1

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: lnTFP (Olley-Pakes)					
stateshare	-0.00102	-0.00133	-0.00176	-0.00205	-0.00142	-0.00172
	(0.00326)	(0.00325)	(0.00321)	(0.00320)	(0.00316)	(0.00315)
horizontal	0.349***	0.225**	0.353***	0.243**	0.351***	0.247***
	(0.0731)	(0.0939)	(0.0710)	(0.0918)	(0.0710)	(0.0907)
ratio_subsidy	-0.199***	-0.198***	-0.216***	-0.215***	-0.218***	-0.217***
	(0.0324)	(0.0320)	(0.0325)	(0.0320)	(0.0339)	(0.0334)
comp_herfsubsidy	0.0169***	0.0164***				
	(0.00605)	(0.00615)				
comp_herftax			0.00856***	0.00834***		
			(0.00305)	(0.00304)		
comp_herftotal					0.00935**	0.00908**
					(0.00381)	(0.00380)
competition_lerner	0.440	0.419	0.492	0.482	0.451	0.446
	(0.536)	(0.536)	(0.524)	(0.525)	(0.525)	(0.526)
dummy			-0.0498***	-0.0501***	-0.0654***	-0.0653***
			(0.00569)	(0.00575)	(0.00168)	(0.00167)
taxbreak			0.00247**	0.00255***	0.00246**	0.00253***
			(0.000947)	(0.000943)	(0.000931)	(0.000928)
backward		0.724***		0.704***		0.690**
		(0.263)		(0.259)		(0.260)
forward		0.0665		0.0492		0.0428
		(0.0896)		(0.0893)		(0.0909)
lnTariff	-0.0352**	-0.0375**	-0.0378**	-0.0415**	-0.0387***	-0.0428***
	(0.0142)	(0.0160)	(0.0144)	(0.0161)	(0.0143)	(0.0160)
lnbwTariff	-0.0192	-0.0295	-0.0221	-0.0330	-0.0208	-0.0319
	(0.0175)	(0.0202)	(0.0190)	(0.0218)	(0.0193)	(0.0221)
lnfwTariff	-0.00785	-0.00592	-0.00709	-0.00475	-0.00774	-0.00527
	(0.00676)	(0.00744)	(0.00687)	(0.00750)	(0.00688)	(0.00750)
Constant	1.558***	1.567***	1.518***	1.519***	1.554***	1.552***
	(0.514)	(0.511)	(0.506)	(0.503)	(0.506)	(0.504)
Observations	1,069,563	1,069,563	1,069,563	1,069,563	1,069,563	1,069,563
R-squared	0.173	0.174	0.179	0.180	0.180	0.180

Notes: Robust clustered standard errors are presented in parentheses. The dependent variable is lnTFP (estimated by Olley-Pakes method), the estimation procedure is indeed two-stage. In the first stage, we use the OP regression method to obtain estimates for the input coefficients and then calculate lnTFP (the residual from the production function). In the second stage, we regress lnTFP on the remaining controls. *Comp_herfsubsidy* (or *comp_herftax* is constructed using the share of subsidies (or tax holidays) a firm receives relative to the total subsidies awarded to one industry. *Comp_herftotal* identifies an index that sums up the effect of subsidies and tax. *Dummy* is defined as 1 if a firm has negative or zero profits or pays negative income tax for a specific year. *Taxbreak* identifies firms that receive 20% income tax rate or below. *Stateshare*, *ratio_subsidy* (subsidy/sales), *dummy*, and *taxbreak* are at firm-level, while all other controls are at industry-level. Each regression includes firm fixed effect and year dummies.

*significant at 10 percent level
**significant at 5 percent level
***significant at 1 percent level

Table 2 New Panel (Retaining only Survivors and New Entrants)

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: lnTFP (Olley-Pakes)					
stateshare	-0.000474	-0.00103	-0.00194	-0.00248	-0.00152	-0.00207
	(0.00461)	(0.00457)	(0.00441)	(0.00438)	(0.00446)	(0.00443)
horizontal	0.382***	0.253**	0.387***	0.272**	0.385***	0.274***
	(0.0809)	(0.105)	(0.0791)	(0.103)	(0.0794)	(0.102)
ratio_subsidy	-0.210***	-0.207***	-0.222***	-0.220***	-0.225***	-0.223***
	(0.0434)	(0.0431)	(0.0406)	(0.0404)	(0.0430)	(0.0427)
comp_herfsubsidy	0.0191***	0.0188**				
	(0.00696)	(0.00706)				
comp_herftax			0.00763**	0.00743**		
			(0.00358)	(0.00356)		
comp_herftotal					0.00788*	0.00762*
					(0.00424)	(0.00425)
competition_lerner	0.612	0.595	0.648	0.642	0.616	0.615
	(0.587)	(0.588)	(0.581)	(0.583)	(0.580)	(0.582)
dummy			-0.0417***	-0.0419***	-0.0552***	-0.0551***
			(0.00599)	(0.00605)	(0.00178)	(0.00177)
taxbreak			0.00513***	0.00522***	0.00513***	0.00521***
			(0.00107)	(0.00107)	(0.00105)	(0.00105)
backward		0.763**		0.734**		0.723**
		(0.287)		(0.278)		(0.278)
forward		0.0631		0.0469		0.0423
		(0.0957)		(0.0948)		(0.0961)
lnTariff	-0.0400**	-0.0433**	-0.0409**	-0.0453**	-0.0426**	-0.0472**
	(0.0156)	(0.0180)	(0.0161)	(0.0185)	(0.0164)	(0.0190)
lnbwTariff	-0.0225	-0.0324	-0.0268	-0.0371	-0.0260	-0.0364
	(0.0205)	(0.0229)	(0.0221)	(0.0247)	(0.0227)	(0.0252)
lnfwTariff	-0.00503	-0.00303	-0.00491	-0.00262	-0.00505	-0.00269
	(0.00738)	(0.00808)	(0.00785)	(0.00852)	(0.00781)	(0.00849)
Constant	0.930	0.947	0.909	0.919	0.945	0.952
	(0.580)	(0.578)	(0.577)	(0.574)	(0.576)	(0.573)
Observations	726,854	726,854	726,870	726,870	726,870	726,870
R-squared	0.210	0.211	0.215	0.215	0.215	0.215

Notes: Robust clustered standard errors are presented in parentheses. Table 2 has the same structure as in Table 1 but only difference is the sample. In Table 2, to address potential selection issues, we only keep new firms and survivors. Each regression includes firm fixed effect and year dummies.

*significant at 10 percent level

**significant at 5 percent level

***significant at 1 percent level

Table 3 Controlling for Firm Size using the log of sales

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: lnTFP (Olley-Pakes)					
stateshare	-0.00974***	-0.0100***	-0.0101***	-0.0104***	-0.00982***	-0.0101***
	(0.00305)	(0.00305)	(0.00313)	(0.00313)	(0.00303)	(0.00303)
horizontal	0.377***	0.287***	0.377***	0.296***	0.376***	0.304***
	(0.0705)	(0.0899)	(0.0687)	(0.0883)	(0.0684)	(0.0870)
ratio_subsidy	-0.00779	-0.00667	-0.00799	-0.00712	-0.0106	-0.00985
	(0.0333)	(0.0324)	(0.0309)	(0.0303)	(0.0333)	(0.0327)
comp_herfsubsidy	0.0181***	0.0178**				
	(0.00659)	(0.00668)				
comp_herftax			0.00785**	0.00782**		
			(0.00318)	(0.00321)		
comp_herftotal					0.00998**	0.00996**
					(0.00407)	(0.00408)
competition_lerner	0.795	0.802	0.818	0.833	0.768	0.790
	(0.578)	(0.580)	(0.564)	(0.567)	(0.566)	(0.567)
ln_sales	0.164***	0.164***	0.163***	0.163***	0.163***	0.163***
	(0.00204)	(0.00202)	(0.00202)	(0.00200)	(0.00201)	(0.00199)
dummy			0.00409	0.00406	-0.0102***	-0.0101***
			(0.00539)	(0.00551)	(0.00135)	(0.00134)
taxbreak			0.00680***	0.00687***	0.00678***	0.00685***
			(0.000807)	(0.000801)	(0.000797)	(0.000791)
lnTariff	-0.0334**	-0.0391**	-0.0356**	-0.0423**	-0.0371**	-0.0446**
	(0.0160)	(0.0183)	(0.0163)	(0.0185)	(0.0160)	(0.0183)
lnbwTariff	-0.0292	-0.0410*	-0.0328	-0.0451*	-0.0312	-0.0437*
	(0.0204)	(0.0230)	(0.0215)	(0.0244)	(0.0222)	(0.0251)
lnfwTariff	-0.00854	-0.00564	-0.00766	-0.00447	-0.00848	-0.00508
	(0.00702)	(0.00757)	(0.00709)	(0.00762)	(0.00712)	(0.00763)
backward		0.665**		0.655**		0.632**
		(0.256)		(0.250)		(0.252)
forward		0.0243		0.0120		0.00156
		(0.0936)		(0.0933)		(0.0956)
Constant	-0.491	-0.500	-0.494	-0.509	-0.454	-0.474
	(0.545)	(0.544)	(0.537)	(0.536)	(0.537)	(0.535)
Observations	1,069,563	1,069,563	1,069,563	1,069,563	1,069,563	1,069,563
R-squared	0.290	0.291	0.291	0.291	0.291	0.292

Notes: Robust clustered standard errors are presented in parentheses. Table 3 has the same structure as in Table 1 but we add one more control, firm-level log of industrial sales. Each regression includes firm fixed effect and year dummies.

*significant at 10 percent level
**significant at 5 percent level
***significant at 1 percent level

Table 4 City-Industry Correlations Between Policy Instruments and Competition

VARIABLES	(1) TFP_OP	(2) TFP_OP	(3) TFP_olsFE	(4) TFP_OP
cor_subsidy_lerner	0.0923***		0.102***	0.0950***
	(0.0164)		(0.0162)	(0.0161)
cor_tariff_lerner		0.0407**	0.0464**	0.0480**
		(0.0201)	(0.0198)	(0.0199)
stateshare	-0.00349	-0.00395	-0.000873	-0.00344
	(0.00345)	(0.00341)	(0.00339)	(0.00345)
horizontal	0.181*	0.180*	0.179*	0.181*
	(0.0908)	(0.0912)	(0.0918)	(0.0908)
backward	0.760***	0.760***	0.763***	0.758***
	(0.265)	(0.265)	(0.268)	(0.264)
forward	0.0923	0.0928	0.0946	0.0925
	(0.0872)	(0.0871)	(0.0875)	(0.0872)
ratio_subsidy	-0.184***		-0.184***	-0.184***
	(0.0291)		(0.0292)	(0.0291)
competition_lerner	-0.261**	-0.288**	-0.270**	-0.259**
	(0.115)	(0.118)	(0.115)	(0.115)
lnTariff	-0.0384**	-0.0384**	-0.0387**	-0.0382**
	(0.0171)	(0.0170)	(0.0167)	(0.0171)
lnbwTariff	-0.0354*	-0.0358*	-0.0345	-0.0357*
	(0.0207)	(0.0207)	(0.0207)	(0.0207)
lnfwTariff	-0.00549	-0.00541	-0.00529	-0.00554
	(0.00737)	(0.00742)	(0.00742)	(0.00739)
Constant	1.912***	1.958***	2.107***	1.912***
	(0.107)	(0.111)	(0.108)	(0.107)
Observations	1,052,360	1,052,360	1,052,360	1,052,360
R-squared	0.176	0.176	0.191	0.176

Notes: Robust clustered standard errors are presented in parentheses. The dependent variable is lnTFP (estimated by Olley-Pakes method), the estimation procedure is indeed two-stage. In the first stage, we use the OP regression method to obtain estimates for the input coefficients and then calculate lnTFP (the residual from the production function). In the second stage, we regress lnTFP on the remaining controls. Each regression includes firm fixed effect and year dummies. *State share* is defined as the proportion of the firm's state assets to its total equity. *Horizontal* captures the intra-industry FDI spillover while *backward* and *forward* represent inter-industry FDI spillovers. *Ratio_subsidy* is defined as the share of subsidies to industrial sales. *Cor_subsidy_lerner* is constructed by the correlation between the industry-city level initial degree of competition (represented by lerner index) and current period of subsidies in sector j and city r. Each regression includes firm fixed effect and year dummies. *Cor_tariff_lerner* is constructed in the same way, use current period of tariff instead of subsidies. To note, when constructing interaction terms, *competition_lerner* is re-constructed at industry-city level.

*significant at 10 percent level
**significant at 5 percent level
***significant at 1 percent level

Table 5 Retaining only the Second and Fourth Quartiles

VARIABLES	(1) TFP_OP	(2) TFP_OP
	Second Quartile	Fourth Quartile
cor_subsidy_lerner	0.139***	0.0583
	(0.0358)	(0.0389)
cor_tariff_lerner	-0.0315	0.0357
	(0.0422)	(0.0436)
stateshare	-0.0132*	-0.00234
	(0.00737)	(0.00944)
Observations	265,516	245,645
R-squared	0.186	0.137

Notes: Robust clustered standard errors are presented in parentheses. Controls included in Table 4 are included in estimation but not reported here. In Table 5, we reproduce the results in Table 4 but divide the sample into four groups based on the percentiles of the *Herf_subsidy*. Here, we present the results based on the second and the fourth quartile. Each regression includes firm fixed effects and year dummies.

*significant at 10 percent level
**significant at 5 percent level
***significant at 1 percent level

Table A-1Summary Statistics

Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
	Full Sample			New Panel		
TFP_OP	1,069,563	1.765	0.336	726,870	1.715	0.323
TFP_olsFE	1,069,563	1.965	0.341	726,870	1.986	0.330
stateshare	1,069,563	0.022	0.130	726,870	0.016	0.111
horizontal	1,069,563	0.240	0.130	726,870	0.246	0.130
ratio_subsidy	1,069,563	0.003	0.016	726,870	0.003	0.016
comp_herfsubsidy	1,069,563	0.747	0.865	726,870	0.708	0.797
comp_herftax	1,069,563	1.638	1.661	726,870	1.723	1.762
comp_herf_total	1,069,563	2.127	1.840	726,870	2.131	1.889
competition_lerner (industry-level)	1,069,563	0.974	0.019	726,870	0.970	0.019
ln_sales	1,069,563	9.891	1.161	726,870	10.051	1.145
backward	1,069,563	0.074	0.041	726,870	0.077	0.041
forward	1,069,563	0.098	0.148	726,870	0.104	0.157
lnTariff	1,069,563	2.382	0.475	726,870	2.305	0.449
lnbwTariff	1,069,563	1.970	0.412	726,870	1.904	0.385
lnfwTariff	1,069,563	2.064	0.644	726,870	2.019	0.605
cor_tariff_lerner	1,052,360	0.019	0.141			
cor_subsidy_lerner	1,052,360	0.142	0.085			
Competition_lerner (province-industry level)	1,052,360	0.973	0.027			

Notes: The right panel of the table is based on the full sample while the left panel of the table is based on the sample of new firms and survivors. *State share* is defined as the proportion of the firm's state assets to its total equity. *Horizontal* captures the intra-industry FDI spillover while *backward* and *forward* represent inter-industry FDI spillovers. *Ratio_subsidy* is defined as the share of subsidies to industrial sales. *Comp_herfsubsidy* (or *comp_herftax* is constructed using the share of subsidies (or tax holidays) a firm receives relative to the total subsidies awarded to one industry. *Comp_herftotal* identifies an index that sums up the effect of subsidies and tax. *cor_subsidy_lerner* is constructed by the correlation between the industry-city level initial degree of competition (represented by lerner index) and current period of subsidies in sector j and city r. Each regression includes firm fixed effect and year dummies. *Cor_tariff_lerner* is constructed in the same way, use current period of tariff instead of subsidies. To note, when constructing interaction terms, *competition_lerner* is re-constructed at industry-city level.

Table A-2 Summary Statistics (the second and the fourth quartile)

Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
	Second Quartile			Fourth Quartile		
TFP_OP	265,654	1.767	0.314	246,039	1.767	0.365
stateshare	265,654	0.023	0.132	246,039	0.023	0.133
horizontal	265,654	0.244	0.098	246,039	0.252	0.170
ratio_subsidy	265,654	0.003	0.015	246,039	0.003	0.016
Competition_lerner (province-industry level)	265,654	0.968	0.026	246,039	0.972	0.033
backward	265,654	0.077	0.033	246,039	0.081	0.065
forward	265,654	0.094	0.121	246,039	0.070	0.121
cor_tariff_lerner	265,654	0.019	0.140	246,039	0.017	0.144
cor_subsidy_lerner	265,654	0.140	0.085	246,039	0.142	0.085
lnTariff	265,654	2.343	0.463	246,039	2.376	0.544
lnbwTariff	265,654	1.951	0.413	246,039	2.050	0.344
lnfwTariff	265,516	2.112	0.527	245,645	1.842	0.826

Notes: Table A-2 reproduces results in Table A-1 using the second and the fourth quartile of full sample.