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Effects of Licensing Reform on Firm Innovation

Evidence from India

Murat Seker

The World Bank
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Enterprise Analysis Unit
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Abstract

The regulatory environment in a country can affect firm performance. This study investigates the impact of a particular regulation, namely license requirements for certain firm activities, on the innovation performance of Indian firms. First it presents a model of firm and industry evolution that explains the dynamics of multi-product firms. Then, using a firm level panel data set, it shows that removal of license requirements led to roughly 5 percentage points faster innovation rates where innovation is measured as introduction of new product varieties that had not existed in the market. The results are robust to inclusion of controls for the other policy reforms that occurred during the period of licensing reform.

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Effects of Licensing Reform on Firm Innovation: Evidence from India

By Murat Seker[*]
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Finance and Private Sector Development Vice-Presidency
World Bank

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[*] Correspondence: 1818 H Street NW MSN F4K-411 Washington DC, 20433. E-mail: mseker@worldbank.org.

I. Introduction

Since the seminal works of Grossman and Helpman (1991) and Aghion and Howitt (1992), many studies have found technological innovation to be the main determinant of growth. There are structural factors like human and physical capital levels that affect innovation performances of firms. The regulatory environment and investment climate in a country also play important roles for the success of technology adoption strategies and innovative efforts. This study provides an empirical analysis of how regulatory environment affects innovation. It focuses on a particular product market regulation that was reformed in India in mid 1980s and then again in early 1990s and shows how this reform affected introduction of new product varieties in formal manufacturing sector.

There are a number of papers that investigate the relationship between different aspects of regulatory environment, investment climate, and innovation. Aghion et al. (2009) focus on liberalization of foreign firm entry to U.K. market and find that technologically advanced entry by foreign firms has a positive effect on innovation in sectors that are initially close to technological frontier. In another study Aghion et al. (2005) use a sequence of competition policy reforms to investigate how product market competition level affects innovation performances. They find that an inverted U-shape relationship between product market competition and innovation outcomes. In a recent work Goldberg et al (2010b) relate international trade to innovation. They show that liberalization of tariff rates which led to imports of new intermediate goods that were not available in the market before increased the rate at which firms introduce new products to the market.

Following this literature, I analyze the effects of India's licensing reform on firms' innovation performances. Before the reform all firms were required to obtain a license to establish a new factory, significantly expand capacity, start a new product line, or change location. Delicensing reform meant freedom from constraints on output, inputs, technology usage, and location choice as well as easier entry into delicensed industries. Freedom from these constraints allowed firms to take advantage of economies of scale, more efficient input combinations, and newer technologies. Furthermore, greater domestic competition as a result of free entry into delicensed industries provided firms with incentives to innovate, increase productivity, and improve product quality.

Most of the existing studies on innovation use patenting activity/citations, total factor productivity (TFP), and data from innovation surveys.[2] R&D expenditures which are sometimes used to measure innovation intensity should be considered only as an input factor for innovation process. TFP measures have the well known problem that they are biased in the presence of imperfectly competitive product markets. Moreover there is a general problem with interpreting TFP findings as they usually use revenue data which makes it difficult to identify the effects of policy reforms on physical efficiency separately from its the effects on firm markups, product quality, and in the case of multiproduct firms the range of products produced by the firm (see Foster et al. (2008) and Katayama et al. (2009)). The patent data provides a better measure of innovation compared to TFP or innovation survey data but it usually has low data coverage. Moreover in developing countries the patenting mechanism usually does not work efficiently and thus provide a very limited picture of overall innovation activities. The innovation measure I use in this paper is introduction of new products to the market. This information is

[2] An example of these surveys is Community Innovation Surveys (CIS) which is developed by European Commission for member countries of European Union.

available for a large number of firms over a six year period. The use of such direct measure of innovation activities differentiates this study from most of the existing work with firm-level datasets.

There are several studies that analyze the effects of licensing reform in Indian economy. In one of these studies Aghion et al. (2008) analyze how the effects of this reform on firm revenues varies across states with differing restrictiveness of labor regulations. My analysis differs from their work in two main aspects. I use a firm level panel dataset whereas their data is at industry level. Hence the policy question I investigate is how the reform affects firm dynamics rather than industry dynamics. Their focus is on revenues whereas mine is on innovation and growth. In another study Chari (2010) focuses on the effects of the licensing reform on total factor productivity. Using the same dataset as Aghion et al. (2008) he focuses on the licensing reform in 1985. Lack of a panel dataset prevents to perform a firm-level productivity analysis using a production function estimation method. It also prevents to observe the heterogeneity in firms' responses to the policy change. Using the same dataset as Aghion et al. (2008), Chamarbagwala and Sharma (2010) analyze the effect of licensing reform on skill upgrading where they measure skill upgrading as employment and wage bill shares of white-collar workers. None of these studies can analyze growth at firm level as the data they use is a repeated cross-section of firms.

Removal of the distortive regulations can have significant contribution to firm performance. The analysis of Hsieh and Klenow (2009) on within-industry dispersion in factor productivities in China and India show that the removal of plant-level distortions could result in as much as a 30% improvement in aggregate productivity. Chari (2010) shows that the licensing reform in India improved productivity by 22%. In this study, I show that the licensing reform increased innovation rate by five percentage points. The empirical analysis presented in the paper is supported by a dynamic model of innovation. The model explains the mechanism how a group of multi-product firms evolve and how licensing reform can impact innovation. The model extends a stylized model of innovation and industry evolution presented by Klette and Kortum (2004). In their model, a firm is defined as a collection of products and firms grow by introducing new products. Through the model, they explain various stylized facts that relate R&D, productivity, patenting, and firm growth. Seker (2009) extends their model by introducing exogenous heterogeneity in firms' efficiency levels which allows him to have rich firm dynamics.

The rest of the paper is structured as follows. In the next section I present the analytical model to explain the dynamics of firm and industry evolution. Then I explain the data and the various policy reforms that were implemented in India. In section four, I present descriptive analysis of the licensing reform, the empirical model, and discuss the estimation results. I finish with some concluding remarks.

II. Model

I introduce a dynamic and analytically tractable model of firm evolution to be able to explain the relationship between the licensing reform and innovation performances of firms. The model is replicated from Seker (2009) which follows from Klette and Kortum (2004). Klette and Kortum (2004) present a stylized model with a simple interpretation of innovation and industry evolution. Seker and Rodriguez (2011) extend Seker (2009) further to explain the relationship between innovation and the use of imported intermediate goods. Their model shows how trade liberalization in India contributed to introduction of new product varieties. Goldberg et al. (2010b) present another study that includes a

theoretical framework to explain the relationship between trade liberalization and product scope growth. However the framework they introduce does not explain firm evolution. The model presented here aims to uncover the mechanism through which removing the license requirements in industries influence innovation.

The economy consists of a large number of monopolistically competitive firms. Each firm can produce multiple products (where each product is a different variety). Consumption of the composite good *Y* is determined by a CES production function as described in equation 1

$$Y = \left(\int_{j \in J} y(j)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}}, \qquad (1)$$

where *j* is an index over varieties chosen from a set *J* and σ >1 is the elasticity of substitution between different varieties. Producers are distinguished only by their efficiency levels, indexed by φ >0. The solution of firm's optimization problem follows from Melitz (2003). Under monopolistic competition, producers with same efficiency levels charge the same price and make the same profit for each product they produce. Profit maximization problem for any product yields revenue and profit given in equation 2

$$r(\varphi) = \left(\frac{p(\varphi)}{P} \right)^{1-\sigma} E \quad and \quad \pi(\varphi) = \frac{r(\varphi)}{\sigma}, \qquad (2)$$

where p(φ) is the price charged by the firm, *P* is aggregate price index and *E* is aggregate expenditure of the composite good (*E=PY*).

The number of varieties produced by a firm *n* determines its portfolio. This portfolio increases by innovating new products and it decreases by destruction of existing products. To succeed in innovation, the producer invests in research and development (R&D), denoted by *R*. This investment determines the Poisson arrival rate $I = \lambda n$ of new varieties where λ is the innovation rate. In addition to R&D investment, the innovation process also depends on the existing stock of knowledge capital. The knowledge capital stands for all skills, techniques, and know-how that firms use in their attempts to innovate. A simple way to incorporate the knowledge capital into the model is by using the number of products that firm currently produces *n*. The innovation function is characterized as strictly concave in R&D, strictly increasing and homogeneous of degree one in both R&D and *n*.[3] The innovation function is formalized in equation 3

$$\begin{aligned} &\mathrm{I} = \mathrm{F}(\mathrm{R}, \mathrm{n}) \\ &\lambda \mathrm{n} = R^{\alpha} n^{1-\alpha} \ \ where\ 0 < \alpha < 1 \\ &R = \lambda^{1/\alpha} n = c(\lambda) n. \end{aligned} \qquad (3)$$

As a result of the monopolistic competition in the final goods sector, each product is being produced by a single firm. Firms face a Poisson hazard rate μn of losing any of their products. Luttmer (2011) introduces a similar hazard rate of exit. He assumes that producer of a differentiated commodity needs a blueprint to produce and these blueprints depreciate in a one-hoss-shay fashion. It can also be explained as a simple way of incorporating the idea that products get obsolete and firms stop producing them. The hazard rate of μ is same for all firms and each firm takes it as given. However its value is

[3] See Klette and Kortum (2004) for a detailed discussion of the innovation function introduced here.

determined by aggregate creation in the economy by incumbent firms and new entrants. Firms exit when all of their products are destroyed. There is no re-entering once exit occurs.

Based on this setup, dynamics of firm evolution in a stationary equilibrium is modeled as follows. A firm of efficiency type φ, with a current flow of profits $\pi(\varphi)n$, faces a Poisson hazard μn of losing a product. By spending in R&D, it influences the Poisson hazard *I* of becoming a firm with n+1 products. The firm chooses optimal amount of R&D to maximize its expected present value $V_\varphi(n)$. Bellman equation for firm's dynamic optimization problem is presented below

$$rV_\varphi(n) = \max_{\lambda>0}\left(\pi(\varphi)n - wc(\lambda)n + \lambda n\left[V_\varphi(n+1) - V_\varphi(n)\right] - \mu n\left[V_\varphi(n) - V_\varphi(n-1)\right]\right),$$

where *r* is the interest rate and *w* is wage rate. The value function is linear in *n* which allows us to get an analytically tractable solution to the problem. The solution of this problem which is reproduced in equation 4 is derived in Seker (2009). Lentz and Mortensen (2008) solve the equilibrium for a slightly different setup. In the equilibrium condition presented in equation 4 optimal amount of innovation rate λ is determined by setting marginal cost of innovation equal to marginal benefit

$$\underbrace{wc'(\lambda)}_{marginal\,cost} = \underbrace{\frac{\pi(\varphi) - wc(\lambda)}{r+\mu-\lambda}}_{marginal\,benefit}. \qquad (4)$$

Firms with high values of λ introduce new products at a faster rate and they grow faster. Analyzing equation 4, we see that higher profit levels shift up marginal benefit of innovation and lead to higher innovation rates (by increasing λ)[4]. In equation 2, profit level increases in efficiency level. Thus efficient firms innovate at a faster rate. Lower cost of R&D decreases marginal cost and increases marginal benefit of innovation and also results in higher values of λ.

The model allows for entry. From a constant potential pool of entrants, successful ones enter the economy as a result of introducing a new variety. Firms discover their efficiency types immediately after they enter. Entrants face the same innovation cost function as incumbent firms. Although entering and exiting firms contribute to reallocation of resources and aggregate innovation in an economy, Prowess database does not allow us to analyze their dynamics. Firms can exit and re-enter the database. Since it is not possible to identify new entrants and actual exiting firms, the empirical analysis does not discuss the contribution of entrants and exiting firms to aggregate innovation. Goldberg et al. (2010b) also use the Prowess database and provide a similar discussion regarding to entering and exiting firms.

III. Data and Policy Reforms in India

Data Description

Firm level data used in the analysis is obtained from Prowess Database which is constructed by Centre for Monitoring the Indian Economy (CMIE) in India. This dataset has advantages over the Annual Survey of Industries (ASI) which is the India's manufacturing census. ASI is constructed from a repeated cross section of firms whereas Prowess database includes a panel of firms. The panel feature allows us to tract firms over time. It is also among the few databases that records annual information on firms' product

[4] A formal proof of this relationship is presented in Klette and Kortum (2004).

mix. Hence product creation and destruction can be tracked at firm level. This unique feature of the data allows me to evaluate the relationship between firms' adjustment of their product lines and policy changes.

There are several innovation strategies that firms can follow. They can introduce process innovation by significantly improving their production processes or they can introduce product innovation by introducing a new product variety that they did not produce before. Studies like Bertschek (1995), Parisi et al. (2006), and Fritsch and Meschede (2001) highlight the differences between these two innovation strategies. The model introduced in this study and the data from Prowess are appropriate for analyzing product innovation strategy which will be measured by the change in product mix of firms.[5]

The database contains information on income statements and balance sheets of relatively large Indian firms from 1989 to 1995. This dataset is well suited for the particular purpose of the study as large firms contribute more to aggregate product creation compared to small firms. As discussed in Goldberg et al. (2010b) the dataset is not well suited to analyze entry and exit dynamics because firms are not obliged to report to the data collecting agency. Prowess database accounts for 60% to 70% of the economic activity in the organized industrial sector. The panel is unbalanced and the number of firms included in the data increases from 752 in 1989 to 2293 in 1995.

In the data product level information is available for around 85% of the firms in manufacturing sector. Products are defined according to CMIE's internal product classification. Goldberg et al. (2010a) present a detailed description of the data, product classification, and product mix change. They identify 1,886 products linked to 108 four digit 1998 version of National Industrial Classification (NIC) industries in manufacturing sector and they find that products that can be mapped to four or five digit NIC codes account for 99 percent of total output. They also show that the number of products classified in India is quite comparable to the number found in Bernard et al. (2006) for US manufacturing sector.

The Prowess database has been used in a series of papers by Goldberg et al. (2010a, 2010b), Chari and Gupta (2008), and Krishna and Mitra (1998) among many others. From this database I use the number of products owned by a firm, total sales, and an indicator for firms that spent on R&D. Descriptive statistics for these variables are presented in Table 1. An average firm has 1.9 products and average product growth rate in the economy is 6%. The data shows that average product addition is more frequent than product dropping. A discussion of this high product creation is presented in Goldberg et al. (2010a). Finally 9% of the firms in the data invested in R&D. The table also shows the overall variation, over time variation for each firm (within), and variation between firms (between) for each variable. Between firm variation is higher than within firm variation for the number of products which is expected due to short time period. For product growth, there is reasonable variation in both over time and between firms. Multi-product firms make around 45% of the firm population in the data. An average multi-product firm owns around 3 products and these firms make around 80% of total sales. A descriptive analysis of evolution of multi-product and single product firms is presented in Table 2. The table shows the percentage of firms that showed various product evolution patterns annually, over

[5] The model can be easily expanded to include process innovation by adding a quality attribute to the products innovated and firms can be allowed to invest in both quality improvement and product innovation. An older version of Seker (2009) which is available upon request provides such a setup.

three and five year periods for 1989-1995 period. Goldberg et al. (2010a) present the same table for 1989-2003 period. The results presented in Table 2 are quite similar to those presented in their study. Firms do not change their product mix too often annually. This is not surprising because it requires relatively high investment (the R&D cost) to introduce a new product to the market. Percentage of firms that change their product mix increases over longer time periods. Over five year around 40% of firms add or drop a product. Adding new products is much more common among Indian firms than dropping existing products and it is more common among multi-product firms than single-product firms. This evidence is in accordance with the model. Firms with multiple products have higher knowledge capital which makes them more likely to add new products (recall that innovation function is given as $I = \lambda n$).

Economic Reforms in India

I complement the data from Prowess with several other data sources to investigate whether the economic reforms that took place in India affected innovation. Starting from 1980s, India liberalized its economy by dismantling government controls over industries and opened up to trade. One of these reforms is on product market regulations. Up until 1985, Industries Act of 1951 brought all key industries in the registered manufacturing sector under central government control through industrial licensing. Under this act firms were required to get a license to establish a new factory, significantly expand capacity, start a new product line, or change location. The granting of the licenses was subject to heavy bureaucracy. Moreover firms were discouraged to pursue investment projects because each project would require multiple licenses. In 1985 after Rajiv Gandhi's rise to the power, a group of the industries were delicensed. Later in 1991 India went through a balance of payment crisis which resulted in a Stand-By arrangement with IMF in August 1991. In this period IMF requested macroeconomic stabilization policies and structural reforms. As a part of the structural reforms licenses were removed for another group of industries. A number of industries were retained from the licensing reform due to security and strategic concerns, social reasons, hazardous nature of the products, and to elitist consumption.[6]

Aghion et al. (2008) and Chari (2009) provide a detailed discussion of this reform and list the industries that were delicensed and when they were delicensed. Delicensing reforms were mostly unanticipated.[7] I use the data on licensing reform compiled by Aghion et al. (2008). They use various issues of Handbook of Industrial Policy and Statistics, press notes, and notifications issued by the federal government to code when different industries were exempted from industrial licensing. In Table 3, I present the percentage of firms that belong to a 4-digit NIC industry that has been delicensed. In 1989 around 40% of the firms belonged to an industry that was delicensed on or before 1988. In 1992, the share of delicensed firms more than doubles.

India had several other major market reforms. One of these reforms was on international trade. Average tariff rates and non-tariff barriers were among the most restrictive in Asia towards the end of 1980s. Topalova and Khandelwal (2011) show that there has been radical changes in economic policies during 1990s and this has led to a continuous decline in average tariff rates from 97% in 1989 to 46% in

[6] There were also some industries that were delicensed in different years than 1985 and 1991 such as manufacture of domestic appliances, n.e.c which was delicensed in 1993.
[7] Aghion et al. (2008) provide a discussion of this conclusion.

1995. They also show that there were significant decreases in the share of products that are subject to quantitative restrictions which went down from 87% in 1987 to 45% in 1994. Goldberg et al. (2010b) explain that the tariff liberalization up until 1997 was unanticipated, not targeted toward specific industries, and they were free of political economy pressures. I obtain the data on tariff rates at four digit industry level from Topalova and Khandelwal (2011). They construct a database of annual tariff rates at 6-digit level according to Indian Trade Classification Harmonized System Code based on various publications of the Ministry of Finance. Then they match the products at 6-digit with 4-digit NIC codes using the concordance by Debroy and Santhanam (1993) to calculate average industry level tariffs. These industry-level output tariffs are combined with input-output transaction table from 1993-1994 to calculate the input tariffs. Controlling for input tariff rates is particularly important because Goldberg et al. (2010b) find that reduction of input tariff rates significantly increased innovation capacities of firms. Hence, the relationship between licensing reform and innovation can be biased if the effect of tariff reform is not controlled for.

Indian government also reduced the barriers to foreign direct investment in a group of industries after the balance of payments crisis in 1991. The reform allowed majority ownership rights to foreign firms. As a result of this reform, total foreign direct investment in India increased from around 250 million dollars in 1989 to around 2200 million dollars according to the numbers in UNCTAD's FDI database. I use the data compiled by Topalova and Khandelwal (2011) which is a 4-digit industry level, time varying measure of openness to foreign direct investment. They obtain the data from the publications of Handbook of Industrial Statistics. The FDI measure takes a value of zero before 1991 in all industries when FDI was strictly controlled. After that year it shows the percentage of the industry that is opened to FDI. Foreign held companies are usually better at technology adoption and they are more innovative than domestic firms. They can get easier access to technology, capital resources, and R&D facilities of the parent company which facilitate innovation and growth. Seker (2011), Criscuolo et al. (2010), and Almeida and Fernandes (2008) provide empirical evidence on the relationship between FDI and innovation. There are also studies like Haddad and Harrison (1993) and Sinha (1993) that find a positive impact of foreign ownership on firms' productivity levels.

India is a federal democracy and industrial relations fall under the joint jurisdiction of central and state governments in the constitution. Labor regulations are affected by both jurisdictions. Key central legislation is the Industrial Disputes Act of 1947 which sets out the conciliation, arbitration, and adjudication procedures to be followed in the case of an industrial dispute. Although all states have the same starting labor regulations, they have diverged from one another over time. Besley and Burgess (2004) divide states into three groups: pro-worker, pro-employer, and neutral. A state has a pro-worker labor regulation if the legislations benefitted workers compared to employers. They show that states which had pro-worker labor regulations experienced lower output, employment, investment, and productivity in registered or formal manufacturing sector. In the Prowess database some firms provided information on the geographic location of their headquarters. Following Besley and Burgess (2004) I set a dummy equal to one if the firm is located in a state that has pro-worker labor regulations. I analyze whether the relationship between licensing reform and innovation varied with the labor regulations in the states.

The trade liberalization, FDI reform, and variation in labor regulations across states can affect innovation performances of firms. In the empirical analysis I test whether the licensing reform increased

innovation capacities of firms controlling for all these changes as well as firm specific factors that affect their evolution.

IV. Empirical Analysis

Based on the motivation provided by the analytical model, the empirical analysis measures the impact of the licensing reform on the change in product mix of firms. The impact of reform can be incorporated in the model in several ways. Restuccia and Rogerson (2008) analyze the effects of policy distortions on firm performance where they formalize these distortions as output tax. They find that distortions in firms' profits can lead to sizeable decreases in productivity. A similar interpretation is also used in Hsieh and Klenow (2009). They introduce a tax on output for firms that face government restrictions on size or that face high transportation costs. Interpreting policy distortion as an output tax can be applied in the model presented above. Being required to provide a license to increase capacity or start a new product line firms have to deal with government officials which is likely to take time and it is costly. This distortion can be considered as a tax on firm's profit or revenue. License requirement prevents firms from responding quickly to the changes in market conditions and lead to loss of competitiveness.

An alternative way to model licensing requirement is introducing it as a tax on innovation costs particularly because one of the activities that require license is starting a new product line. Such a license requirement would provide disincentive to invest in R&D which will result in reduction of innovative effort. In the model, representation of the distortion caused by license requirement either as a tax on profit or on R&D investment is analogous to each other. In the first order condition presented in equation 4, if this distortion is represented as a tax $\tau_R > 0$ on R&D investment we get the condition in equation 5,

$$(1+\tau_R)c'(\lambda) = \frac{\pi(\varphi) - (1+\tau_R)wc(\lambda)}{r+\mu-\lambda} \quad . \tag{5}$$

In this equation, higher distortion in innovation cost simultaneously increases the marginal cost and decreases the marginal benefit of innovation which results in a lower level of λ. If we divide both sides of the equation by $(1+\tau_R)$ we get the result in equation 6

$$c'(\lambda) = \frac{\frac{\pi(\varphi)}{(1+\tau_R)} - wc(\lambda)}{r+\mu-\lambda} \quad . \tag{6}$$

In this equation since $1/(1+\tau_R) < 1$, it is equivalent to a tax on profit or revenue level $((1-\tau_\pi) = 1/(1+\tau_R))$. Note that from equation 2, revenue and profit levels only differ by σ and a tax on either one has the same impact on innovation rate λ. In either representation of licensing requirements, we see that it increases the opportunity cost of investing in R&D and results in lower innovation performance.

For the empirical analysis, first I present a descriptive analysis of whether innovation performances of firms in industries which were delicensed before 1989 differed from the rest of the firms. I set a dummy variable to one if the industry was delicensed before 1989. Since this indicator variable does not change over time, fixed effects estimation methods are not applicable. I apply pooled ordinary least squares method (OLS) and random effects panel method to analyze the relationship

between innovation performances of firms and licensing reform. Pooled OLS method is appropriate when in addition to standard assumptions of OLS method; homoskedasticity and no-serial correlation assumptions over time dimension are satisfied. However in panel datasets, the standard errors are likely to be correlated across firms and over time. Hence they are not independent and identically distributed. This problem can be alleviated by correcting the standard errors by clustering over firms. Failure to control for this error correlation might lead to underestimation of standard errors.

Innovation outcome is measured as a change in product mix over a year which is computed as $\dot{n}_{it} = (n_{it} - n_{it-1}) / n_{it-1}$. The main variable of interest is the indicator variable that represents the industries that were delicensed before 1989 (*Delicen89*). In addition, I include log of firm's past sales (*log(Sales)*) as a determinant of its innovation success. The empirical evidence presented in Cohen and Klepper (1996) show that larger firms are more innovative than small ones. In the innovation function described in equation 3, number of products reflected knowledge capital stock that is accumulated through the firm's past innovation successes and more knowledge leads to more innovation. In the models of Seker (2009) and Klette and Kortum (2004) number of products was used as a proxy for knowledge capital in order to get an analytically tractable solution. In reality sales can serve as a better proxy for knowledge capital than the number of products as it contains information on both the number of different varieties produced and the quality of the products. Moreover, there are many firms in the data with single products, yet they differ significantly in their sales. Hence it is more informative to assume that those firms differ in their knowledge capital.

The other determinant of innovation is R&D investment (*R&D*) which is represented as a dummy variable that is set to one if the firm invested in R&D between period *t-1* and *t*. There are many studies in industrialized countries that show the positive links between R&D, innovation, and productivity such as Griffith et al. (2004), Griffith et al. (2006), Parisi et al. (2006), and OECD (2009). Finally, I include year dummies from 1991 to 1995 to control for the year effects. Although data is available from 1989 to 1995, first year is eliminated when computing growth rates.

Product growth rates of firms can be affected by the other policy reforms that took place in India. The importance of trade and FDI liberalization policies were discussed in the previous section. Goldberg et al. (2010b) and Topalova and Khandelwal (2011) show how reductions in tariff rates increased introduction of new varieties and improved productivity. To control for the effects of trade reforms, I include tariff rates at industry level (*Tariff*). Topalova and Khandelwal (2011) show that certain industry groups like basic goods, capital goods, and intermediate goods sectors had substantial reduction in non-tariff barriers. I include a dummy variable set to one for firms that belong to any of these industry groups (*Industry*). Finally, studies like Seker (2011) and Almeida and Fernandes (2008) show that exporting firms are more innovative than non-trading firms. I include a control for export oriented industries (*Export*) to capture this effect. The specification used to estimate product growth rate of firms is presented in equation 7 where subscript *i* and *t* represent firm and year respectively. In the equation γ_t controls for the year fixed effects and ε is the error term.

$$\dot{n}_{it} = \beta_0 + \beta_1 Delicen89 + \beta_2 Log(Sales)_{it-1} + \beta_3 R\&D_{it} + \beta_4 Tariff_{t-1} + \beta_5 Industry + \beta_6 Export + \gamma_t + \varepsilon_{it} \quad (7)$$

The estimation results with the pooled OLS method are presented in the first four columns of Table 4. The first column shows annual change in product mix. Firms in industries that were delicensed before 1989 are more innovative than the firms in the remaining industries. They increase their product mix at a rate 1.3 percentage points faster than the rest of the firms. Size and R&D investment significantly increase product creation rate. Higher tariff rates decrease the rate of product growth; however the coefficient of this variable is not significant. The industries that had large decrease in non-tariff barriers also have higher product growth rates. The second column in the table repeats the estimation in column one restricting the sample to firms that were in the sample from 1989 to 1995. Since the Prowess data is not balanced and sample size increases from 1989 to 1995, the estimation results could be biased as successful firms are more likely to survive and innovate compared to inefficient firms who are more likely to exit. The results are similar and the impact of licensing reform on innovation is only slightly higher.

Introduction of new varieties to the economy shows a sporadic behavior. As Table 2 showed there are many firms that have zero product growth rates annually. In the third column, I compute product growth rate over a three year period instead of two years. With this definition of product growth rate, firms in delicensed industries grow at 1.8 percentage points faster than firms that are in licensed industries. Although standard errors are clustered at firm level and the estimation equation includes year dummies, serial correlation can still be a concern. To alleviate this concern in the fourth column I include only the data from 1991. The first year that product growth can be computed is 1990 but the sample size is larger in 1991. Although a large group of industries were delicensed towards the end of 1991, the effects of the reform on these firms would not be seen right away. Hence *Delicen89* will still be able to capture the difference in innovation performance between firms that were delicensed before and after 1989. The estimation result confirms the significant positive relationship between delicensing and innovation. In this column since only one year of data is used, standard errors cannot be clustered at firm level. Hence robust standard errors are presented at 4-digit industry level.[8] The magnitude of the coefficient of delicensing indicator is higher when the sample is restricted to 1989-1994 rather than 1989-1995 period. This probably due to shorter period for firms that were delicensed at the end of 1991 to reach to the innovation performance levels of those firms that were delicensed before 1989.

The fifth and sixth columns analyze the relationship between probability of adding a product and the licensing reform. The fifth specification uses pooled probit model for which the estimation equation is given in equation 8

$$\Pr(z_{it}=1)=\Pr(\beta_1 Delicen89_i+\beta_2 Log(Sales)_{it-1}+\beta_3 R\&D_{it}+\beta_4 Tariff_{t-1}+\beta_5 Industry+\beta_6 Export+\gamma_t+\varepsilon_{it}>0) \quad (8)$$

where z_{it} is a discrete random variable equal to one if the *i*th firm at period *t* introduced any new product. Licensing reform increases probability of innovation by around two percent. Column six applies panel probit model which has the advantage over pooled probit model by correcting the panel complication that observations are correlated over time for a given individual. By allowing correlation

[8] The results are quite similar if the clustering of standard errors is made at 2-digit industry-year level.

over *i* and *t*, panel method leads to efficiency gains.[9] The table shows that this correction does not significantly improve the results from the fifth column. In the bottom of the table, I present the likelihood ratio test statistic which provides evidence on the existence of random effect in the model.

The last two columns apply random effects method to the product growth rates. As discussed in the previous paragraph random effects estimators allow over time correlation for each firm and leads to efficiency gains. This method is applied only when innovation is measured over three years.[10] The result from the random effects model yields a similar result to the pooled OLS method presented in column one. Contribution of licensing reform to product growth is 0.4 percentage points higher in random effects model than the result from pooled OLS method. Last column repeats the estimation in column seven for firms that were in the panel from 1989 to 1995. In the bottom of the table, I present Breusch and Pagan (1980)'s likelihood ratio test statistic for product growth which provide evidence on the existence of random effects for the results presented in column seven and eight.

Dynamic Model Estimation

In the descriptive analysis performed in the previous section, although the inclusion of additional controls, clustering standard errors, and the use of panel estimation methods alleviate the endogeneity problem, they do not completely solve it. First of all the main determinant of innovation, sales is endogenous to innovation decision. For a firm with *n* products, total sales is computed as summation of revenues from each product $Sales_{it} = \sum_{j=1}^{n_{it}} sale_{ijt}$. Hence number of products created this period will affect total sales of the future periods. This effect makes the specification dynamic. The common methods of dealing with firm-specific effects like within-group or difference estimators might not be appropriate given the dynamic nature of the regression. The advantage of the methods applied in the previous section was that I could identify the coefficient of an indicator variable that does not vary over time. Industries were delicensed at various years and some of them were never delicensed. I introduce a new indicator variable denoted as *Delicen* which is zero until the industry is delicensed and changes to one after delicensing. Using this continuous variable, I apply a variation of Arellano-Bond (1991) generalized method of moments (GMM) method for dynamic panels. With this method, I can control for the biases that are due to unobserved firm-specific effect such as efficiency level- φ and the endogeneity of firm sales. These estimators are based on differencing regressions to control for unobserved effects and using appropriate lags of explanatory variables and dependent variable as instruments. It is important to note that within estimator is inconsistent once lagged regressors are introduced to the model because the within model has the first regressor that is correlated with the error term.

I present two-step GMM (Two-step GMM) estimator where optimal weighting matrix is computed in the first step which is then used in the second step. This estimator is more efficient than the two-stages least square-2SLS (one-step) estimator in overidentified models. The GMM estimator which is based on the differenced model can have statistical shortcomings. Blundell and Bond (1998)

[9] Random effect method is used in panel probit model and standard errors are not clustered for this specification.
[10] When growth rates are computed over two years, share of individual effect in overall variation (the interclass correlation) was ignorable which means random effects method is not appropriate. On the other hand when growth rates are computed over three years, the interclass correlation is around 0.22.

and Alonso and Arellano (1999) show that when the explanatory variables are persistent over time, lagged levels of these variables are weak instruments for the regression equation in differences. Instrument weakness could lead to inefficient and biased coefficient estimates. To reduce these possible biases and imprecision, I follow the method developed by Arellano and Bover (1995) and Blundell and Bond (1998) and use system GMM (GMM-SYS) estimator which combines the regression equation in differences and the regression equation in levels into one system. In this method, twice lagged values of output and endogenous inputs as well as the difference of other inputs are used as instruments in the differenced equation and lagged first difference of these variables are used as instruments in the level equation. In this way I can control for the persistent part of the unobserved firm efficiency without throwing away the information contained in the levels. Results with GMM-SYS estimation are reported in two-step. The standard errors presented in all estimations are robust to general heteroskedasticity.

In the estimations I use the lag values of sales and the three policy reform measures: output tariff *OTariff*, input tariff *ITariff*, and foreign direct investment *FDI*. If the delicensing reform across industries and over time is correlated with the process of tariff reduction and openness to FDI, then the empirical strategy could erroneously attribute the impact of these other reforms to delicensing reform. I also include R&D dummy that is set to one if the firm invested in R&D between period *t-1* and *t*. In the estimations sales is treated as an endogenous variable as it is correlated with the error term. R&D is also treated as endogenous as it is related to the number of products as presented in equation 3.[11] The specification is presented in equation 9,

$$\dot{n}_{it} = \beta_0 + \beta_1 Delicen_{it-1} + \beta_2 Log(Sales)_{it-1} + \beta_3 R\&D_{it} + \beta_4 OTariff_{t-1} + \beta_5 ITariff_{t-1} + \beta_6 FDI_{t-1} + \gamma_t + \mu_i + \varepsilon_{it} \quad (9)$$

The estimation results are presented in Table 5. The first column shows the results from Two-step GMM estimation. Delicensing reform increases product creation rate by around 5 percentage points. The second column applies GMM-SYS method which yields similar results to two-step method. In the third column, I use a limited set of moment condition for the endogenous sales and R&D indicator. I include lag sales and R&D indicator as contemporaneous regressors and include at most two additional lags as instruments. Although in theory the potential set of instruments spans all sufficiently lagged observations, when too many instruments are included the asymptotic theory would provide a poor finite-sample approximation to the distribution of the estimator. Following Arellano and Bond (1998), I use a restricted set of moment conditions in order to avoid overfitting bias. This restriction slightly decreases the impact of the licensing reform but it does not distort the significance of the reform.

The way product growth rate is defined can be sensitive to outliers. I use two alternative growth measures. In one of them I use log difference $\dot{n}_{it} = \log(n_{it}) - \log(n_{it-1})$ and in another one I use the method applied by Davis and Haltiwanger (1992) $\dot{n}_{it} = (n_{it} - n_{it-1})/((n_{it} + n_{it-1})/2)$. The results are quite similar when either measure is used to compute product growth rate. The coefficient of delicensing indicator is significant and it is around 3.7 percent with these alternative measures of product growth.

The fourth column replaces time-varying delicensing dummy variable with the percentage of products in the four digit industry level that are licensed (an industry is fully delicensed when this

[11] Treating R&D as an exogenous variable does not make a significant difference in the estimation results which could be due to small number of firms that invest in R&D.

percentage goes to zero). One percent decrease in the share of products that are licensed increase product creation rate by six percent. The last column of the table shows how licensing reform affected the total number of varieties produced by firms. It uses log number of products as the dependent variable and applies the same GMM-SYS method. The result shows that the reform increased product scope by around 3 percent.

In the estimations, coefficients of tariff rates and FDI indicator are not significant. However Goldberg et al. (2010b) find significant increase in product growth rate caused by the reduction in input tariffs. My analysis differs from their study in several ways. In their model input tariff rates are used as instruments for a conventional price index and a variety index. They show that both indices affect product growth. According to their model lower tariffs lead to lower prices of inputs which result in increased imported varieties. Higher use of varieties is associated with an expansion of firm scope. In the estimations of product growth they do not control for the licensing reform. Moreover the model presented in their study does not show the dynamics of product growth.

FDI reform is another factor that can affect innovation performances of firms. It can reduce the cost of innovation by increasing R&D capacity or lowering capital and transactions costs. Using the Prowess database, Vishwasrao and Bosshardt (2001) find that foreign ownership is among the variables that impact a firm's probability of adoption new technology. However they do not use the detailed product information as their measure of technology adoption. The estimation results presented in Table 5 include all these factors and thus provide a more complete set of controls of policy reforms during the time period included in the analysis. Among the three major reform areas, licensing reform is the only one that significantly increases product creation rates.

At the bottom of the table I present Sargan tests of over-identifying restrictions to test the validity of instruments. For consistent estimation, the error term should be serially uncorrelated. In the GMM estimator this depends on the absence of second-order serial correlation in the residuals of the first differenced specification. The table also presents these test results. The Sargan test has an asymptotic χ^2- distribution under the null hypothesis that these moment conditions are valid.[12] In all specifications the null hypothesis is not rejected at conventional 5 percent level. If the error terms are serially uncorrelated, we expect to reject the test at order one but not at higher orders. This hypothesis holds in all specifications presented in the table. The null hypothesis that $Cov(\Delta\varepsilon_{it}, \Delta\varepsilon_{it-1})=0$ is rejected (i.e. there is no serial correlation between differenced residuals at order one) but cannot reject at order two $Cov(\Delta\varepsilon_{it}, \Delta\varepsilon_{it-2})=0$.

Robustness Tests

The economic reforms that took place around 1991 did not affect all industries in the same magnitude. Share of products that were opened to FDI and tariff rate reductions were not homogenous across industries. I include tariff rates and FDI reform variable in the estimations to control for the potential effects of these reforms on innovation. GMM-System estimation method controls for industries that observed too high or too low changes in these variables by including their over time differences as instruments. Among the firms that had tariff reductions or FDI liberalization, the ones with the highest

[12] The distribution of Sargan test is known only when the errors are independently and identically distributed. Thus this test is valid only when it is applied to the specifications with standard errors computed without the robust option.

reduction are more likely to increase their innovative capacities. I exclude firms that belong to industries that had the highest benefit from these reforms as a robustness test. The results with sub-samples are presented in Table 6. In the first column I exclude 4-digit industries that had more than half of the industry liberalized in FDI by 1995. In the second column I exclude the top quartile of industries that had the highest drops in output tariff rates between 1989 and 1995. In the third column I exclude top quartile of industries that had the highest drops in input tariffs for the same time period. In all three columns licensing reform significantly increases innovation performances of firms which provide further support that the relationship between licensing reforms and innovation is not affected by these other reforms.

In his survey on technology diffusion, Keller (2004) summarizes theoretical and empirical literature on how imports provide knowledge and technology transfer in a macroeconomic perspective. Using micro-level data from developing countries Almeida and Fernandes (2008) and Seker (2011) provide evidence on importing and exporting firms being more innovative. Criscuolo et al. (2010) reach a similar conclusion on the contribution of exporting on innovation for British firms. In the fourth and fifth columns of Table 6, I exclude export oriented and import oriented industries respectively. The coefficient of licensing reform indicator continues to be significant. Another test with sub-samples is with employee income levels. Industries with high wage payments are likely to employ more skilled workers and produce more knowledge embodied products. This could facilitate the innovation activities in these industries. In the last column I exclude the top quartile of the industries with the highest wage payments.[13] Some of the industries went through multiple reforms and the sub-sample used in each column of the table could include overlapping industries which could affect the results. Although there are industries that have been included in multiple groups, their numbers are not large with a possible exception of industries with highest input and output tariff drops. 50 percent of firms that belong to industries in the top quartile of input tariff drop also exist in industries that are in the top quartile of output tariff drop. The overlap of industries among other groups is much smaller.

In India, there are institutional differences across states on labor regulations. These differences can affect the relationship between licensing reform and innovation. Besley and Burgess (2004) show that pro-worker labor regulations in Indian states resulted in lower output, employment, investment, and productivity in formal manufacturing sector. Following their work, Aghion et al. (2008) find that when licensing reform occurred, industries in states with pro-worker regulations experienced less increase in output and employment relative to pro-employer states. These differences across states can affect firms' innovative performances. Aghion et al. (2008) use a dataset at industry level obtained from ASI which prevents them from analyzing the dynamics of firm evolution. To see the effects of labor regulations on innovation performances of firms, I include an interaction term between the licensing reform indicator and a dummy variable which is set to one for pro-worker states. The result is presented in the first column of Table 7. In this specification interaction term is treated as endogenous in addition to *Log(Sales)* and R&D variables. The result is in accordance with that of Aghion et al. (2008) although their dependent variable is log of sales where here it is product growth rate. In pro-worker states, the contribution of licensing reform on firm innovation rates is almost six percent less compared to pro-employer states. Regulations that favor worker rights hinder job flows in firms by raising the costs of

[13] The wage data is from 1987 Annual Survey of Industries database.

hiring and firing workers. This makes production more costly and results in lower operating profits. Lower profits would reduce innovation rates λ according to the first order condition presented in equation 4.

Indian states also show variation in access to external finance. Financial development can be an important facilitator for innovation by allowing firms to spare more resources for investments in R&D. I define a state as financially developed if the average state credit level per capita is above median. The second column of Table 7 shows the result for financial development. Licensing reform has a larger benefit on firms that are located in states that are financially under developed. This finding could be interpreted as follows. Easier access to finance helps to reduce the financial burden on firms caused by license requirements. Thus the states that did not have sufficient financial development might have underperformed in innovation activities due to license requirements. When these requirements were removed, the effect on innovation performance was higher in these states.

Aghion et al. (2008) can only show the impact of licensing reform on firm sales through its differential effect on states with varying levels of labor regulations. They show in Table 2 of their study that without the interaction terms, licensing reform does not have any impact on sales. According to the model presented here, license requirement can directly affect innovation performance and thus sales. The ASI database they use might not reveal this direct relationship as it is not appropriate to for analyzing dynamics of firm evolution. I test the direct relationship between licensing reform, Log(Sales), and sales growth using the data from Prowess. Sales growth is computed below using the formula presented in Davis and Haltiwanger (1992),

$$\text{Sales Growth}_{t-1,t}=(\text{Sales}_t-\text{Sales}_{t-1})/((\text{Sales}_t+\text{Sales}_{t-1})/2.$$

Sales values vary a lot across firms and outliers can be a much serious concern than product growth and this formula is robust to outliers. I also computed sales growth as log difference of sales levels which provided quite similar results.

The results are presented in Table 8. The table shows that unlike in Aghion et al. (2008) licensing reform significantly increases both sales and sales growth. The licensing reform increases sales by 3.4 percent. Although the estimation method and the controls used in this study differs from those used in Aghion et al. (2008), magnitude of the coefficient is quite close to 3.1 percent increase obtained in their study. However the coefficient in their estimation is not significant. Licensing reform has also a significant impact on sales growth by leading to a 5 percent increase. This value is close to the impact of the reform on product growth rate which could mean that the reform mainly affected product growth rate rather than the growth in revenues generated from existing products. To further support this hypothesis, I computed total unit sale values of every product and then computed the growth rate of this value. Replacing total sales growth with the growth of unit product sales yields an insignificant coefficient on licensing reform. This supports the argument that the reform mainly contributed to product creation rate rather than a growth in sales of each product.

V. Conclusion

This study investigates the impact of regulatory environment on the success of firms' innovative efforts. Using data from Indian manufacturing sector, it focuses on a particular reform on license requirements of firms. This reform liberalized product markets in introducing new products, increasing capacities, and

establishing new plants. The analysis shows that the reform significantly increased the rate at which firms introduce new product varieties to the market. In the estimation exercise, system GMM method is applied which is the appropriate model to use in dynamic panel models and it alleviates the endogeneity problem with removing firm fixed effects. In addition to the licensing reform, India had several major economic reforms on liberalizing trade and allowing foreign ownership. The relationship between licensing reform and innovation is robust to inclusion of controls for these reforms.

The empirical evidence on the impact of licensing reform on innovation is supported with a structural model. The model is analytically tractable and it presents how distortions in firms' operations affect their decisions to invest in R&D and pursue innovative activities. License requirements decrease firms' profits which lead to a reduction in marginal benefit of innovation and lower product creation rates.

Innovation activities have been accepted as the engine of growth. This study shows the importance of regulatory environment to prosper in innovation activities which has an important policy implication. In order to fully benefit from investments in human capital and physical capital to achieve sustainable growth and increased welfare, a favorable investment climate is required. The inefficiencies in investment climate will leave the efforts to improve the economy and increase innovation incomplete.

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VII. Appendix

Table 1 Descriptive Statistics of Variables

Variable		Mean	Std. Dev.		Number of Observations
# of Products	Overall	1.9	1.7	N	9812
	Between		1.3	n	2445
	Within		0.5		
Prod Growth	Overall	0.06	0.29	N	7127
	Between		0.19	n	1997
	Within		0.25		
Add Product	Overall	0.10	0.29	N	7127
	Between		0.20	n	1997
	Within		0.24		
Drop Product	Overall	0.03	0.17	N	7127
	Between		0.09	n	1997
	Within		0.14		
Log(Sales)	Overall	3.5	1.6	N	9806
	Between		1.7	n	2442
	Within		0.4		
R&D	Overall	0.09	0.28	N	9350
	Between		0.19	n	2402
	Within		0.22		

Note: N: Total number of observations; n: Number of firms; Data covers 1989-1995 period. Between component measures variation between firms; Within component measures variation over time.

Table 2 Evolution of Firms' Product Scopes (% of firms)

	All Firms				Multi-Product Firms				Singe-Product Firms			
	Stay	Add	Drop	Add& Drop	Stay	Add	Drop	Add& Drop	Stay	Add	Drop	Add& Drop
Annual	88.2	8.9	2.3	0.6	82.4	11.5	5.0	1.2	93.2	6.7	-	0.2
Three year	74.0	20.6	3.4	2.0	64.9	24.4	7.1	3.6	82.1	17.2	-	0.7
Five year	62.4	30.7	4.1	2.8	52.1	34.7	8.5	4.7	72.0	26.9	-	1.1

Table shows firm evolution annually, over three and five year periods separately for all firms, multi-product firms, and single-product firms. Product addition is defined as a firm starting to produce a product that was not produced before. Product dropping is stopping production of a product that was previously produced.

Table 3 Percentage of Firms that are in Delicensed Industries

Year	% Delicensed	# of Firms
1989	0.43	682
1990	0.45	875
1991	0.46	1059
1992	0.89	1153
1993	0.89	1334
1994	0.91	1720
1995	0.92	2079

Table 4 Analysis of Industries Delicensed before 1989

	OLS	OLS	OLS	OLS	Probit	Panel Probit	Random Effect	Random Effect
	Annual Growth	Annual Growth	Three- Yr Growth	Only 1991	Add Product	Add Product	Two- Yr Growth	Two- Yr Growth
Delicen89	0.013	0.019	0.018	0.037	0.021	0.018	0.017	0.023
	(0.007)*	(0.011)*	(0.009)*	(0.017)**	(0.008)**	(0.008)**	(0.010)*	(0.013)*
$Log(Sales)_{t-1}$	0.006	0.007	0.007	0.012	0.017	0.015	0.008	0.003
	(0.003)*	(0.005)	(0.003)**	(0.005)**	(0.003)***	(0.002)***	(0.003)**	(0.004)
R&D	0.032	0.020	0.034	0.028	0.021	0.018	0.028	0.032
	(0.017)*	(0.020)	(0.015)**	(0.055)	(0.013)	(0.012)	(0.015)*	(0.019)*
$Tariff_{t-1}$	-0.002	0.010	0.021	-0.036	0.005	0.004	0.008	0.022
	(0.016)	(0.021)	(0.021)	(0.024)	(0.017)	(0.014)	(0.023)	(0.026)
Industry	0.019	0.020	0.015	-0.023	0.025	0.022	0.012	0.023
	(0.007)***	(0.010)**	(0.009)	(0.016)	(0.008)***	(0.007)***	(0.009)	(0.013)*
Export-Orient	-0.013	0.003	0.006	0.015	-0.010	-0.011	-0.001	0.023
	(0.009)	(0.015)	(0.015)	(0.032)	(0.012)	(0.011)	(0.015)	(0.022)
Survivors 89-95		Yes						Yes
Observations	6,220	3,014	4,422	794	6,220	6,220	4,422	2,519
Likelihood						0.000		
B-P Test							0.000	0.000
# of Firms							1,331	514

In all estimation results except OLS for *Only 1991* and panel probit methods, robust standard errors clustered at firm level are presented in parentheses. In OLS for *Only 1991* standard errors are clustered at 4-digit industry level. All regressions include controls for year fixed effects. Coefficients of the probit regressions show the marginal effects at mean values. *** p<0.01, ** p<0.05, * p<0.1.

Table 5 Innovation and Licensing Reform

	Two-Step GMM	GMM-SYS	GMM-SYS	GMM-SYS	GMM-SYS
$Log(Sales)_{it-1}$	0.098	0.002	0.021	0.012	0.028
	(0.080)	(0.016)	(0.023)	(0.021)	(0.014)**
$Delicen_{t-1}$	0.053	0.052	0.044		0.029
	(0.026)**	(0.025)**	(0.026)*		(0.016)*
$R\&D_{it}$	-0.009	-0.022	-0.074	-0.022	-0.019
	(0.054)	(0.030)	(0.050)	(0.034)	(0.026)
$OTariff_{t-1}$	-0.021	-0.053	-0.046	-0.069	-0.016
	(0.072)	(0.069)	(0.069)	(0.072)	(0.034)
$ITariff_{t-1}$	0.213	0.159	0.064	0.024	-0.082
	(0.232)	(0.204)	(0.217)	(0.205)	(0.141)
FDI_{t-1}	-0.011	-0.012	-0.003	-0.010	0.007
	(0.031)	(0.031)	(0.033)	(0.028)	(0.018)
$\%License_{t-1}$				-0.061	
				(0.037)*	
Observations	3,036	4,422	4,422	4840	6,220
Specification Tests					
Sargan	0.64	0.76	0.78	0.86	0.17
1^{st} Serial Corr.	0.00	0.00	0.00	0.00	0.00
2^{nd} Serial Corr.	0.40	0.59	0.58	0.16	0.80

In all columns robust standard errors are presented in parentheses. Log(Sales) and R&D are treated as endogenous variables. Column (I) shows Two-Step GMM results, (II) shows GMM-SYS results with two-step estimation, (III) repeats the estimation in column (II) with restricting the lags for the endogenous variables to two periods, (IV) replaces Delicen dummy with percent of products in the 4-digit industry that are licensed (%Licensed), (V) dependent variable is log number of products. All results include year dummies. *** p<0.01, ** p<0.05, * p<0.1.

Table 6 Tests with Sub-samples

	FDI	OTariff	Itariff	Export	Import	Wage
$Log(Sales)_{it-1}$	0.009	-0.033	-0.004	0.004	-0.006	-0.015
	(0.055)	(0.022)	(0.014)	(0.071)	(0.014)	(0.039)
$Delicen_{t-1}$	0.070	0.066	0.066	0.053	0.048	0.071
	(0.033)**	(0.029)**	(0.033)**	(0.027)**	(0.026)*	(0.042)*
$R\&D_{it}$	-0.010	0.007	-0.034	-0.026	-0.035	0.076
	(0.172)	(0.048)	(0.028)	(0.153)	(0.027)	(0.149)
$OTariff_{t-1}$	0.006	-0.061	0.032	-0.072	0.018	-0.174
	(0.072)	(0.085)	(0.056)	(0.075)	(0.060)	(0.138)
$ITariff_{t-1}$	-0.011	0.227	-0.192	0.210	-0.003	0.231
	(0.661)	(0.210)	(0.247)	(0.212)	(0.201)	(0.463)
FDI_{t-1}	0.097	0.007	0.012	-0.031	0.005	-0.090
	(0.169)	(0.034)	(0.037)	(0.035)	(0.031)	(0.066)
Observations	1,925	3,399	3,012	4,116	3,544	1,869

In all columns two-step GMM-SYS method is applied and robust standard errors are presented. Column (I) excludes industries that had least 50% of the industry opened to FDI by 1995, (II) excludes top 25% of industries that had the highest drop in output tariff rates between 1989 and 1995, (III) excludes top 25% of industries that had the highest drop in input tariff rates between 1989 and 1995, (IV) excludes export oriented industries, (V) excludes import oriented industries, (VI) excludes top 25% of the industries with the highest wage payments. All estimations include year dummies. *** p<0.01, ** p<0.05, * p<0.1.

Table 7 Controlling for across-state variation

	Labor Reg	Fin Develop
$Log(Sales)_{it-1}$	0.010	0.008
	(0.017)	(0.016)
$Delicen_{t-1}$	0.058	0.113
	(0.039)	(0.072)
$Delicen_{t-1}$*LaborReg	-0.057	
	(0.029)**	
$Delicen_{t-1}$*FinDevelop		-0.119
		(0.072)*
$R\&D_{it}$	-0.009	0.003
	(0.017)	(0.030)
$OTariff_{t-1}$	-0.077	-0.049
	(0.039)	(0.067)
$ITariff_{t-1}$	-0.005	-0.080
	(0.220)	(0.164)
FDI_{t-1}	0.018	0.016
	(0.032)	(0.031)
Observations	2,891	3,086

In both columns two-step GMM-SYS method is applied and robust standard errors are presented. Both estimations include year dummies. Column (I) interacts delicensing dummy with a dummy set to one for firms that are located in pro-worker states, (II) interacts delicensing dummy with a dummy set to one for firms that are located in states that have above average state credit per capita. *** p<0.01, ** p<0.05, * p<0.1.

Table 8 Licensing Reform and Firm Sales

	Log(Sales)	Sales Growth
$Log(Sales)_{it-1}$	0.534	-0.124
	(0.060)***	(0.084)
$Delicen_{t-1}$	0.034	0.052
	(0.021)*	(0.021)**
$OTariff_{t-1}$	0.080	0.075
	(0.043)*	(0.053)
$ITariff_{t-1}$	-0.370	-0.579
	(0.249)	(0.268)**
FDI_{t-1}	0.031	0.034
	(0.030)	(0.028)
Observations	6,455	4,554

In both columns two-step GMM-SYS method is applied and robust standard errors are presented. Both estimations include year dummies. In column (I) dependent variable is log(Sales), in column (II) dependent variable is annual growth rate of sales. *** p<0.01, ** p<0.05, * p<0.1.