

Firm Heterogeneity, Trade Liberalization, and Duration of Trade and Production: The Case of India

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Abstract: We use a firm level dataset for India to investigate the duration of exports and production at the firm level. The median duration of exporting is 4 years and 7 years for production. We estimate a Cox proportional hazard model finding that age, group association, foreign ownership, being in manufacturing, tariff rates, and the number of products produced all reduce the hazard of both importing and exporting. Sales, research and development expenses, profit after tax have no effect on either the hazard of exporting, while R&D decreases the hazard of production. Once we account for firm productivity, trade liberalization measured by changes in tariffs improves both the hazard of exporting and the hazard of production.

1. Introduction

Trade liberalization has led to significant changes in the structure and composition of trade in many developing countries. Over the last three decades, many developing countries have undertaken substantial economic reforms, especially in the area of trade liberalization.¹ Given the number of trade liberalization episodes and their importance, much effort has gone to examine the effects of trade liberalization both empirically and theoretically. Several studies have documented the impact of trade liberalization through greater competition, economies of scale and scope, access to greater variety and increased productivity, and linked firm productivity and trade, to name but a few avenues of research.² In this paper we contribute to the trade liberalization literature by investigating the effects trade liberalization has on duration of trade and production. We do so by studying the effects of trade liberalization in India.

India embarked on a sudden and unexpected course of trade liberalization in 1991. It was brought about by macroeconomic imbalances and the subsequent Stand-By Arrangement with the IMF (Topalova 2004). Several aspects of Indian trade liberalization and its effect on firms have been examined in the literature. Topalova (2004) finds Indian private firms have become more productive with their productivity growth rate increasing, while there were no improvements for government-owned or foreign firms. Goldberg, Khandelwal, Pavcnik, and Topalova (2008a) find that the availability of cheaper imported inputs has resulted in an increase in the new products produced by Indian firms, resulting in potentially large gains from trade. They find the main contribution of liberalization was to provide access to new imported inputs rather than making existing ones cheaper. Goldberg, Khandelwal, Pavcnik, and Topalova (2008b) examine multiproduct firms during this period finding little evidence of the “creative destruction” – Indian firms exhibit little product churning, unlike U.S. firms (Bernard, Redding, Schott 2006). Our paper extends the understanding of the effects of Indian trade liberalization on

¹ Li (2004) has documented trade liberalization episodes in 45 countries between 1970 and 1995. Wu and Zeng (2008) examine trade liberalization between 1970 and 2004 and conclude that the period 1985–1995 seems to be the “opening-up decade” for developing countries. 20 out of the 39 countries in their sample experienced multiple episodes of liberalization.

² For example, Edwards (1993, 1998); Sachs and Warner (1995); Harrison (1996); Frankel and Romer (1999); Srinivasan and Bhagwati (2001); Panagariya (2002); Broda and Weinstein (2006); Kasahara and Lephram (2008); Melitz and Ottaviano (2008); Melitz (2003).

the duration of trading relationships of Indian firms as well as on the duration of production at the product level.

The study of duration of trade – how long trade relationships between countries last without interruption – has recently attracted attention of trade economists. Besedeš and Prusa (2006a, 2006b) were the first to investigate duration of trade using U.S. import data at the product level finding that trade relationships are surprisingly short, with the median duration between two and four years. Duration differs systematically not just across countries (developed countries have longer relationships), but also across types of goods, with differentiated goods traded in longer relationships than homogeneous goods. The prevalent short duration of U.S. import relationships is consistent with a search model of trade following Rauch and Watson (2003) as shown by Besedeš (2008). Several papers have shown that the prevalence of short relationships is a universal characteristic across many countries. Besedeš and Prusa (2007) show duration of exports at the industry level is equally short in a sample of 46 developed and developing countries. Nitsch (2009) shows duration of German imports at the product level has many of the same characteristics as duration of U.S. imports. Volpe and Carballo (2008) and Görg, Kneller, and Muraközy (2008) show duration of trade at the firm product level is equally short.

We examine the effect of trade liberalization on duration of trade and production between 1989 and 2007 using the PROWESS dataset. A particular advantage of this data set is that it allows us to observe exports of Indian firms not only of goods, but also of services as well as deemed exports. On the import side we observe total imports of firms, as well as import of raw materials, stores and spares, finished goods, and capital goods. While we do not observe the markets where exports are sold or the source of imports, the fine gradation of both into different types of products enables us to examine new dimensions of firm level duration of trade. While there are no data on exports and imports of individual products, the dataset provides information on the specific products produced by Indian firms every year, thus enabling us to examine duration of production at the firm product level.

2. Motivation

International trade has long been perceived as an important source of economic growth, though a clear empirical link has not been established. Rodriguez and Rodrik (2000) and Estevadeordal and Taylor (2008) are but two examples espousing opposite views on the relationship between trade and economic growth. We are interested in investigating the relationship between trade liberalization and the ability of firms to sustainably participate in international markets by exporting their output. If trade liberalization has a positive effect on duration of exports, it would provide for a mechanism linking trade liberalization and economic growth by way of higher exports.

Developing countries in particular have been encouraged over time to pursue export oriented development strategies for several reasons. One is the perceived connection between trade and economic growth, while the other one is that many developing countries have a high concentration of exports in a few industries, often involving primary products rather than manufactured goods. A successful export oriented development strategy would target creation of successful manufacturing industries to decrease the reliance on primary products and would as a result encourage diversification of a country's export portfolio. Hausmann and Rodrik (2003) compare the share of exports to the U.S. taken up by the top 25 products exported by developed and developing countries, finding large differences. For example, some 40% of Germany's exports are concentrated in the top 25 products it exports to the U.S. while for Honduras the relevant figure is larger than 80%. Hausmann and Rodrik (2003) argue high concentration of exports in a few products is a consequence of the inability of developing countries to discover what they are successful in producing and exporting the resulting output. The main difficulty lies in the inability of firms which make the discovery and capitalize on it as copycats quickly move in to capture the resulting economic gains. Thus, in the absence of proper domestic policy, there will be too little investment ex ante and too much production diversification ex post. Hausmann and Rodrik (2003) argue their model explains the Latin American import-substituting industrialization experience, while the successful developers of East Asia, such as South Korea, pursued the appropriate policies avoid the pitfalls of insufficient economic discoveries.

The lack of export discovery and the inability to maintain them has been highlighted in recent empirical research. Using Mexican firm level data Iacovone and Javorcik (2008) show most

export discoveries occur in products other firms are already exporting. Using more aggregated data Besedeš and Prusa (2007) show that one of the main factors accounting for differences in aggregate export growth between successful and unsuccessful developing countries is not the lack of export discoveries on the part of the unsuccessful developers, but their inability to sustain them, i.e., much shorter duration of exports. They find that both successful and unsuccessful developing countries form new trade relationships equally successfully, and in some cases unsuccessful ones form more new relationship, but the main difference is in the duration of new trade relationships. A key policy question then becomes what can be done to improve not just export discoveries, but also how to sustain them once they are made.

Trade liberalization is a potential policy tool which can provide for better export performance both in terms of discoveries and duration. The basic argument revolves around the consequences of trade liberalization on firms. Trade liberalization increases the competition firms face by reducing market access costs to foreign firms. As a result, domestic firms must become more productive in order to survive the new import competition. This is precisely the consequence of Indian trade liberalization highlighted by Topalova (2004). On the input side, trade liberalization can have two effects. It can make existing domestic and foreign inputs cheaper by increasing competition and it can provide access to previously unavailable inputs. Goldberg, Khandelwal, Pavcnik, and Topalova (2008a) find the latter effect to be much more significant in India resulting in firms producing new products, thus leading to new economic discoveries.

The link between trade liberalization and productivity has been investigated by Eaton and Kortum (2002), Bernard, Eaton, Jensen, and Kortum (2003), Melitz (2003), and Yeaple (2005). The Melitz (2003) model in particular has received much attention recently in investigations examining various aspects of firm heterogeneity. The model illustrates that trade liberalization increases aggregate productivity by forcing the least productive firms to leave the industry. The link between trade liberalization and trade duration has not been established theoretically but the mechanisms can be investigated through the scope of the Melitz model. The model predicts trade liberalization results in a redistribution of market share and profits in favor of more productive firms. More productive firms are the ones that are more likely to export as well. Thus, trade liberalization may promote export duration by increasing the likelihood that more productive

firms will exceed the productivity cutoff point need to export and may enable firms to maintain their productivity above the required threshold over a longer period of time, thus increasing their export duration. Certainly the finding that productivity increased as a result of Indian trade liberalization (Topalova 2004) speaks to potential relevance of this link.

Another channel through which trade liberalization may affect duration of trade is in models of uncertainty and its role in formation of trade relationships. Rauch and Watson (2003) build a model where uncertainty about a potential partner's ability to successfully deliver a large order results in some trade relationships starting large, some starting small, and some never being consummated. The matched partner's marginal cost of production plays a critical role in determining whether a relationship commences and whether it commences with a large initial purchase. Those that commence with large initial purchases are more likely to be of long duration. While Rauch and Watson (2003) do not examine the effect of trade liberalization its likely effect would be to reduce the marginal cost either by providing access to cheaper inputs or by increasing productivity. Both of these effects have been found to be the consequence of India's trade liberalization. Thus, one could expect that duration of exports of Indian firms could increase in response to trade liberalization.

3. Data

Data are assembled from a variety of sources. The main source of firm level data is the PROWESS database from the Center for Monitoring the Indian Economy (CMIE). The database covers some 20,000 medium and large Indian firms. It covers all firms traded on India's major stock exchanges and several others including the central public sector enterprises. The database covers most of the organized industrial activities, banking, and organized financial and other services sectors. Firms covered by Prowess account for 75% of all corporate taxes and over 95% of excise duty. Data on income, sales, capital, investment, imports, exports, firm ownership details, location, and product details are available. Of particular interest to us is the availability of trade data for Indian firms. On the export side we observe exports of final goods, exports of services, and deemed exports, exports which go through state trading houses. On the import side we observe imports of raw materials, stores and spares, capital goods, and finished goods. For

the purpose of our analysis we will define imports of raw materials and imports of stores and spares as imports of inputs.

There are a total of 18,580 firms in the data set, though not all firms are observed in every year. Almost 55 percent of the firms are observed for five years or less, while 10 percent are observed for fourteen years or more with 327 observed in every single year. Of the 18,580 observed firms, 7,097 firms are observed to have exported for at least one year, while 7,595 are observed to have imported for at least one year. Of these firms, 5,725 are observe both to import and export, while 1,372 are exporters only and 1,870 are importers only. The remaining 9,613 firms never import or export. We take the annually observed data and convert them to spell data conducive to survival analysis. We examine the number of years each firms has continuously participated in international markets either as an exporter or an importer.

Firms in our dataset account for between 20% and 43% of total Indian exports and between 29% and 62% of total imports in any given year (see Table 1). Sales account for 29% to 56% and firm income accounts for 34% to 67% of Indian GDP. In Table 2 we examine the distribution of the age of firms by the nature of their participation in international trade. All categories are dominated by firms less than 20 years in existence as of 2006. Some 64% of the exporters and 63% of the importers have been in existence for less than 20 years or incorporated after 1986. Approximately 47% of firms that are engaged in both exporting and importing are less than 20 years old. Among the purely domestic firms, about 61% are less than 20 years of age.

Table 3 examines group affiliation of firms by analyzing the size of the group. Larger groups have access to more resources and hence group affiliation with larger groups may facilitate trading relationships of longer duration. Firms without group affiliation account for 81% of firms that only export, 77% of firms that only import and 69% of firms which engage in both exports and imports.

The data provide no information on either the number of products a firm trades or the destination for exports or the source of imports. However, there is detailed information on the production of each product within each firm. We use this information to examine the effect trade liberalization

has had on duration of production. Detailed production data is available for 8,779 firms of which 2,098 are purely domestic in their activity, 642 only export, 1,360 only import, and 4,679 both import and export.

We use two variables to capture the effects of Indian trade liberalization. Data on tariff rates at the 6-digit HS level are compiled from three sources. Tariffs for 1989 to 2001 come from Topalova (2007), tariffs for 2002 and 2006 come from the World Trade Organization, while tariffs for 2004, 2005, and 2007 come from WITS. Since each firm is classified according to the 4-digit 2004 National Industrial Classification of India, we concord the tariff rates at the 6-digit HS level to the 4-digit NIC 2004 level. In cases where there are several HS categories belonging to the same NIC category, tariff rates were averaged. As we do not have the 2003 tariff rates at the HS level, those tariff rates are imputed once tariffs are calculated for 4-digit NIC industries. Using the input-output table for India provided by the World Bank's Trade, Production and Protection 1976-2004 database we compute the tariff each industry faces if it were to use only imported inputs.

Indian trade liberalization was sudden and fast. Trade liberalization started in 1991 when the average tariff rate stood at 76.5%. By 1997 it fell to 28.3%. Thereafter the average tariff hovered around 30% until 2004 when it started decreasing again reaching 17.3% in 2007 (see Figure 1).

In addition to liberalization of trade practices, several other industrial policies were liberalized in India in the 1980s and 1990s. One of them is the dismantling of the License Raj, a system of controls introduced in 1951 governing entry and production activity in the registered manufacturing sector. Aghion, Burgess, Redding, and Zilibotti (2008) examine the effects of dismantling the system of licenses finding that Indian states with pro-employer labor market institutions grew more quickly than those with pro-worker labor market institutions. The delicensing took place in several waves. The first was in 1985 and before our sample starts. However, the second big wave occurred in 1991 with several smaller ones following in subsequent years. To measure the effect of delicensing we use the variable created by Aghion, Burgess, Redding, and Zilibotti (2008) and extend it to cover the years missing from their dataset (1997 and beyond).

4. Duration of Trade and Production

We begin by characterizing duration of trade and production nonparametrically by estimating survival functions using the Kaplan-Meier product-limit estimator. In Table 4 we present summary statistics on duration of exports and production, while in Figures 2 and 3 we plot the Kaplan-Meier estimated survival function.

The median duration of an exporting spell is 4 years. There are a total of 7,094 exporting firms which export in 11,659 spells. We can broadly identify three main industries, minerals and raw materials, manufacturing, and services. Differences in duration of exporting across the type of industry are small. Manufacturing firms have a 5 year median survival, while those in raw materials and services have a one year shorter median duration. The similarity in duration of exporting is obvious from the upper right hand panel of Figure 2. Survival functions for the three industries are not very different. Manufacturing firms do have the highest probability of survival throughout.

We can identify three types of exporting activities, goods, services, and deemed exports. Firms participating in all three types have the longest duration, with median duration at 6 years. They also have much higher probability of survival than firm engaged in other combinations (lower left panel of Figure 2). Firms exporting both goods and services have the next best duration with median duration at 5 years and somewhat lower probability of survival. Firms exporting goods only or services only are virtually indistinguishable.

In the lower right panel of Figure 2 we present survival functions for firms of different ownership structures: whether they are affiliated with a group and whether they are Indian owned (these are not all mutually exclusive). Firms with a group affiliation have a somewhat longer duration and higher survival probability than non affiliated firms. Foreign owned firms do have a significantly longer duration than Indian owned firms with a 2 year longer median duration (six years versus four years).

On the production side there are a total of 29,729 subjects with 44,477 spells. It is important to note that a subject in production data is not a firm, but a firm-product pair. Median duration of producing a product is 7 years, three years longer than duration of exporting. There are somewhat larger differences in duration of production across the three broadly defined industries, as seen in the upper right hand panel of Figure 3, particularly in spells which last more than seven years.

When analyzing duration of production we divide firms based on their participation in international trade. There are firms which neither import nor export, as well as those that engage in both. In addition, there are firms which are exporters only and those that are importers only. Estimated survival functions for these types of firms are presented in the lower left hand panel of Figure 3. While there are differences across firms based on their participation in international trade, those differences are not large. Exporting firms have the longest duration and highest probability of survival than firms selling their output only domestically. Firms participating in both imports and exports have the longest duration (median of eight years) and highest probability of survival.

Differences in duration of production based on the ownership structure of firms are similar to the equivalent differences in export duration. Firms without a group affiliation have a somewhat shorter duration, while foreign owned firms produce their products in longer spells. We next turn to examining the effects of trade liberalization on duration of exports and production.

5. Effect of Trade Liberalization

To evaluate the effect trade liberalization on duration of exports and production we use the Cox semiparametric proportional hazard model. The model postulates the form of the hazard function as $h(t, \mathbf{x}, \boldsymbol{\theta}) = h_0(t)e^{\mathbf{x}'\boldsymbol{\theta}}$, where $h_0(t)$ is the baseline hazard, which is left unspecified and is not estimated, \mathbf{x} denotes the vector of covariates, and $\boldsymbol{\theta}$ is the vector of coefficients to be estimated. All coefficients are presented as hazard ratios implying that a ratio greater than one indicates that the increase in the independent variable increases the hazard. We will refer to variables having a positive impact on the hazard to be those for which an increase in the variable reduces the hazard.

5.1 Exports

We group our independent variables in two groups: firm specific and industry specific. Age of the firm is calculated using the year of incorporation provided by Prowess³ and is calculated as the difference from the current year. A firm incorporated in 1980 is nine years old in 1989, but 19 in 1999. Older firms may have an advantage in both exporting and production due to experience they may have accumulated. Domestic sales reflect the amount of sales a firm made in the domestic market. It is measured in millions of U.S. dollars. Larger firms may have an advantage in duration due to their sheer size. Research and development expenses are measured in millions of U.S. dollars. R&D may have a positive impact on duration as it signals that a firm is dedicated to improving its products. Group dummy captures the effect of firms with a group affiliation, while the foreign dummy captures the effect of foreign ownership. Government dummy captures the effect of government ownership (state or federal). First year exports capture the existence of any possible advantage of having an exporting spell start large, as identified in country-product level data by Besedeš (2008) and as hypothesized by Rauch and Watson (2003). Export incentives reflect whether the firm received any incentives from the government and are measured in millions of U.S. dollars. We include dummies for the type of export activity a firm engages in. We also include a variable counting the number of locations a firm operates as well as the number of products it produces. We include a dummy for firms which engage in imports. We also include a measure of a firm's productivity.

Several variables can only be computed at the industry level. While the tariff rates are available at the 6-digit HS product level, firms in our dataset are classified according to the 4-digit NIC classification. Since this is a classification of industrial activities and at the 4-digit level there are about 1,000 categories, there are more than one firm in at least some of the 4-digit categories. We concord the HS level tariffs to the 4-digit NIC level. We also include the percentage change in the tariff rate. The level of the tariff rate then captures the cross sectional differences in tariff rates, while the change in the tariff rate captures the effect of trade liberalization through lower tariff rates. We include the corresponding measures of input tariffs faced by firms. The input-

³ For some firms age will underestimate the true age as Prowess reports the latest instance of incorporation. If the firm merged with another, went through bankruptcy, or experienced any other significant restructuring, Prowess will report only the latest instance of such change as the year of incorporation.

output matrix is measured at the 3 digit ISIC level which is concorded to the 4-digit NIC classification. Since tariff rates are defined only for the minerals and raw materials and manufacturing industries, our regressions do not reflect the impact of trade liberalization on the service industry. The delicense variable is defined at the industry level and captures the effect of liberalizing industrial policy.

We explore several different specifications in Table 5. We do so as some of the variables have many missing values resulting in more restricted samples as more variables are used. In the first column we use the most restricted set of covariates which allows us to examine the largest sample possible. We only use firm and industry characteristics and do not use any of the liberalization variables resulting in a sample of 7,853 spells out of a total of 11,659 export spells. The age of the firm has a small positive impact on the hazard in the sense that age reduces hazard. Older firms face a somewhat lower hazard in exporting. Domestic sales have no impact on the hazard of exporting and neither do R&D expenses. Profits after taxes reduce exporting hazard.

Firms engaging in different types of exporting activities have very different hazards of exporting. Relative to firms exporting only goods, those that export goods and use deemed exports have a 14% lower hazard, while those exporting goods and services have a 30% lower hazard. Firms exporting goods and services and using deemed exports have a 44% lower hazard. First year exports have a small impact on the hazard, with \$1 million of initial exports reducing hazard by one percent. Firms receiving export incentives face a higher hazard of exporting. There are no significant differences between manufacturing firms and those producing minerals and raw materials. There are no significant differences across firms with and without a group affiliation. Foreign owned firms face a 20% lower hazard, while government operated firms face a 33% higher hazard. Importers face a much lower hazard of exporting, 35% lower.

In the second column we add two variables, one capturing the number of locations a firm operates and one capturing the number of products a firm produces. Both reduce the hazard, with one additional location reducing it by some 5% and one additional product reducing it by 2%. The only difference in other variables is that differences across the types of export activities

firms engage in are somewhat attenuated with deemed exports along with exports of goods creating no significant difference any more.

In the third column we add the four tariff variables. Output tariff has a small positive effect decreasing hazard by some 0.4% for each percentage point of the tariff. The input tariff also has a positive effect decreasing hazard by almost 2% for each percentage point. The two tariffs have a potentially confounding effect in that higher tariffs result in lower hazard. One should keep in mind that these two variables capture the level of the tariff and as such reflect cross-sectional differences rather than time series effects. The positive effect of the output tariff than indicates that at any point in time, firms whose output received greater protection in the form of tariffs will face a lower exporting hazard. The input tariff effect is more perplexing as it indicates that industries whose inputs are subject to higher tariffs will face a lower exporting hazard as well. The availability of cheaper or newly imported inputs does not have a beneficial effect on duration of exporting. While the percentage change in input tariff has a large effect indicating a 5% decrease for each percentage point of the tariff change, neither it nor the equivalent output tariff change measure are estimated significantly. Of changes in other coefficients there are no longer any differences between foreign and Indian owned firms and firms with a group affiliation face a 20% higher hazard.

In column 4 we add two more variables, one measuring firm productivity in the first year of exporting and one reflecting delicensing. This results in the smallest sample of just 1,228 spells, or slightly more than 10 percent of the total. Firms with higher productivity when they start exporting face a lower hazard, though the effect is small. The delicensed industries face a lower hazard, though the estimate is not significant. Trade liberalization variables now look more along the lines of what one might expect. The output tariff, while still indicating more protected industries face lower exporting hazard, is no longer significant. The input tariff now indicates that firms whose imported inputs are assessed a higher tariff will face a higher exporting hazard. This indicates that availability of new and cheaper inputs can indeed improve export duration. The change in the output tariff now has a large negative effect. This variable is defined such that negative values indicate a decrease in the tariff rate. Thus, a one percentage point decrease in the output tariff rate decreases the hazard of exporting by 19%, a rather large effect. The change in

the input tariff is indicating that it too will decrease hazard when input tariff is reduced, however, the coefficient is not estimated with any statistical significance. There are no significant differences in other coefficients.

5.2 Production

In Table 6 we present estimates for the production hazard. We follow a similar progression in terms of inclusion of explanatory variables, though we are using some different variables due to the differences in the two datasets. The first column examines the effect of firm characteristics on duration of production. It reflects 27,986 spells from a total of 44,477. Age of a firm increase the hazard of production, though the effect is rather small, 0.048% for each year of age. Sales in the first year of the production spell have no effect nor does profit after tax. Unlike the hazard of exporting, R&D expenses have a large effect on the hazard of production reducing it by 5% for every \$1 million spent, indicating innovating firms tend to produce in longer spells.

Manufacturing firms have a much lower hazard of production, by 20%. Firms affiliated with a group have an 8% lower hazard, while foreign owned firms have a 10% lower hazard, though the latter coefficient is only marginally significant. Government operated firms face an almost 50% higher hazard. Unlike for the hazard of exporting, importers face a much higher hazard of production. Importers face a 35% higher hazard, almost exactly opposite of the effect of importing on the hazard of exporting.

In the second column we again add the number of location and number of products variables. Both reduce the hazard, though the number of locations is not significant. Group affiliation and foreign ownership no longer create significant differences in the hazard of production and importers no longer face significantly higher hazard.

In column 3 we examine the effect of trade liberalization. The output tariff is not significantly estimated, though it again indicates a positive effect on the hazard rate. A one percentage point higher input tariff decreases production hazard by some 3%. Changes in either tariff variable have no effect on the hazard of production. The only significant change in other coefficients involves the ownership structure. Group affiliated firm face a 22% higher hazard, while foreign owned firms face a 24% higher hazard, a complete change in sign for both variables.

In column 4, we include productivity in the first year of production and the delicense dummy. Delicensing results in a significant restructuring of production indicated by the large coefficient. Firms in delicensed industries face a 77% higher hazard of production. Productivity in the first year has no effect. The level of the output tariff has no effect again, while the sign of the input tariff changes. A one percentage point increase in the input tariff increases the hazard by 5% indicating that firms with more heavily restricted access to imported goods face a higher hazard of production. The change in the output tariff has no impact again, while the change in the input tariff has an effect. An increase in the input tariff of one percentage point decreases hazard by some one percent.

6. Conclusion

In this paper we examine the effects of the Indian trade liberalization since the 1990s on duration of exporting and production of Indian firms. On the exporting side, we find that tariff changes have had a beneficial impact on duration of exports only once we account for firm productivity. Otherwise, the only effect we can identify is that of higher input tariffs decreasing the hazard of exporting. We also find that firms exporting goods and services and those exporting goods and services and using deemed exports have a lower hazard than those exporting goods only. Export incentives have no impact on how long firms export. Group affiliation offers no advantage, while foreign owned firms face a lower hazard. Firms operating more locations and producing more products face a lower hazard of exporting. Firms with higher productivity when they begin to export face a lower hazard.

On the production side, trade liberalization has had an impact only through the input tariff, while the output tariff has had no effect on the hazard of production. Once we account for productivity, the hazard of production decreases with higher input tariffs. Firms investing more in R&D tend to produce their product over longer spells. Sales and profits after tax have no effect.

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Table 1 - Share of firms in Indian economy

Year	Share in total exports	Share in total imports	Share of income in GDP	Share of sales in GDP
1989	20%	39%	40%	38%
1990	28%	38%	41%	38%
1991	31%	53%	53%	47%
1992	37%	57%	58%	50%
1993	26%	44%	45%	38%
1994	33%	39%	46%	39%
1995	21%	29%	34%	29%
1996	40%	55%	58%	49%
1997	38%	62%	58%	48%
1998	42%	55%	60%	50%
1999	36%	44%	55%	46%
2000	34%	53%	61%	50%
2001	43%	59%	67%	56%
2002	22%	30%	46%	40%
2003	38%	44%	59%	49%
2004	41%	40%	61%	52%
2005	42%	44%	61%	53%
2006	39%	46%	63%	54%
2007	35%	44%	56%	47%

Table 2 - Distribution of firms by Age and Trade Status

Age of Firm	Domestic Firms		Exporters		Importers		Importers and Exporters	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
above 50 years	1,233	12.89	146	10.67	156	8.36	713	12.47
30 to less than 50 years	570	5.96	111	8.11	178	9.54	1,014	17.74
20 to less than 30 years	1,918	20.06	237	17.32	359	19.25	1,301	22.76
10 to less than 20 years	3,649	38.16	541	39.55	778	41.72	1,936	33.87
less than 10 years	2,193	22.93	333	24.34	394	21.13	752	13.16
Total	9,563	100	1,368	100	1,865	100	5,716	100

Table 3 - Distribution of group size and trade status

Group Size	Domestic Firms		Exporters		Importers		Importers and Exporters	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Not Part of a Group	7,615	80.47	1,078	81.11	1,389	77.3	3,779	69.35
>= 2 and < 25	1,558	16.46	211	15.88	353	19.64	1,492	27.38
>= 25 and < 50	238	2.52	32	2.41	37	2.06	104	1.91
>= 50 and < 75	7	0.07	3	0.23	5	0.28	22	0.4
>= 75 and < 100	40	0.42	5	0.38	10	0.56	49	0.9
> 100	5	0.05			3	0.17	3	0.06
Total	9,463	100	1,329	100	1,797	100	5,449	100

Table 4 - Descriptive Statistics on Survival

	Subjects	Spells	Spells per Subject	Survival time		
				25%	Median	75%
Exports	7,094	11,659	1.64	2	4	8
Industry type						
Minerals and Raw materials	1,566	2,618	1.67	2	4	7
Manufacturing	3,587	6,132	1.71	2	5	8
Services	1,941	2,909	1.50	2	4	7
Export activity						
Goods only	4,422	7,065	1.60	2	4	6
Services only	1,033	1,368	1.32	2	4	6
Deemed exports	16	18	1.13	1	2	4
Goods and services	1,299	2,637	2.03	3	5	11
Goods and deemed exports	187	398	2.13	2	5	7
All three	132	267	2.02	3	6	18
Group affiliation						
No affiliation	4,619	7,191	1.56	2	4	7
Affiliated	2,475	4,468	1.81	2	5	9
Ownership						
Indian	6,541	10,781	1.65	2	4	7
Foreign	553	878	1.59	3	6	13
Imports	7,592	12,991	1.71	2	5	9
Industry type						
Minerals and Raw materials	1,556	2,778	1.79	2	4	6
Manufacturing	4,287	7,568	1.77	2	5	11
Services	1,749	2,645	1.51	2	4	7
Import activity						
Finished goods only	328	404	1.23	2	3	6
Inputs only	1,932	2,843	1.47	2	3	6
Capital goods only	803	1,002	1.25	1	2	5
Finished and input goods	278	505	1.82	2	4	7
Finished an capital goods	131	203	1.55	2	4	9
Inputs and capital goods	3,090	5,954	1.93	2	5	10
All three	1,030	2,080	2.02	3	6	13
Group affiliation						
No affiliation	4,944	8,053	1.63	2	4	8
Affiliated	2,648	4,938	1.86	2	5	10
Ownership						
Indian	7,053	12,113	1.72	2	5	8
Foreign	539	878	1.63	3	6	>19
Production	29,729	44,477	1.50	4	7	>19
Industry type						
Minerals and Raw materials	5,110	8,032	1.57	4	6	>19
Manufacturing	14,685	22,541	1.53	4	8	>19
Services	2,303	3,408	1.48	4	7	>19
Production activity						
Domestic only	4,096	5,451	1.33	4	6	12
Exports only	1,560	2,148	1.38	4	7	>19
Imports only	3,535	5,045	1.43	3	6	15
Exports and Imports	20,538	31,833	1.55	4	8	>19
Group affiliation						
No affiliation	12,187	18,407	1.51	4	7	>19
Affiliated	9,911	15,574	1.57	5	9	>19
Ownership						
Indian	20,175	31,211	1.55	4	7	>19
Foreign	1,923	2,770	1.44	5	12	>19

Table 5 - Cox proportional hazard estimates for exports

	(1)	(2)	(3)	(4)
Age	0.99945	0.99966	0.99955	1.00042
	0.022	0.382	0.188	0.439
Sales without exports	0.99997	1.00010	1.00024	1.00062
	0.886	0.617	0.157	0.308
R&D expenses	0.99265	0.99843	0.97641	0.96690
	0.707	0.926	0.336	0.394
Profit after tax	0.99560	0.99731	0.99700	0.99597
	0.018	0.307	0.163	0.303
Goods and services exports	0.70516	0.68412	0.75845	0.84091
	0.000	0.000	0.000	0.056
Goods and deemed exports	0.86672	0.91901	0.95740	1.11700
	0.080	0.441	0.680	0.379
All three	0.56272	0.61867	0.63638	0.60281
	0.000	0.001	0.003	0.031
First year exports	0.99034	0.99320	0.99096	0.99258
	0.007	0.086	0.044	0.199
Export incentives	1.02659	1.01752	1.00732	1.03423
	0.038	0.282	0.710	0.226
Manufacturing industry	1.03342	1.06076	0.94127	1.15609
	0.371	0.264	0.269	0.066
Group affiliaton	1.03677	1.07011	1.21352	1.00992
	0.307	0.177	0.000	0.888
Foreign ownership	0.79808	0.79656	0.86142	0.98046
	0.002	0.029	0.132	0.877
Importer	0.65847	0.62771	0.63152	0.62560
	0.000	0.000	0.000	0.000
Government operated	1.33798	1.30338	1.45096	
	0.001	0.041	0.007	
Number of locations		0.94687	0.96919	0.94036
		0.021	0.171	0.144
Number of products		0.98096	0.98531	0.99379
		0.011	0.038	0.466
Output tariff			0.99665	0.99736
			0.061	0.211
Pct change in output tariff			1.00280	1.19326
			0.978	0.001
Input tariff			0.98288	1.02767
			0.000	0.000
Pct change in input tariff			0.95330	1.06823
			0.816	0.882
First year productivity				0.99776
				0.000
Delicense				0.84442
				0.461
Observations	24877	13218	12548	3212
No. Subjects	7853	3796	3567	1228
Robust p values in parentheses				

Table 6 - Cox proportional hazard estimates for production

	(1)	(2)	(3)	(4)
Age	1.00048	1.00059	1.00039	1.00121
	0.000	0.000	0.002	0.000
First year sales	0.99957	0.99962	0.99983	0.99991
	0.162	0.277	0.436	0.611
R&D expenses	0.95299	0.96006	0.95764	1.00000
	0.000	0.002	0.000	1.000
Profit after tax	1.00034	1.00039	0.99983	1.00035
	0.295	0.184	0.652	0.207
Manufacturing industry	0.80369	0.89263	0.86689	1.13067
	0.000	0.028	0.006	0.115
Group affiliated	0.91897	0.96553	1.22446	1.10144
	0.023	0.487	0.000	0.149
Foreign ownership	0.89035	0.98358	1.24144	1.52148
	0.072	0.828	0.002	0.000
Government	1.49934	1.56797	1.77210	
	0.000	0.000	0.000	
Importer	1.35687	1.08254	1.08717	0.82092
	0.000	0.474	0.459	0.272
Fiscal benefits	0.99635	0.99686	0.99772	1.00295
	0.008	0.021	0.026	0.012
Number of locations		0.99000	1.00322	0.92018
		0.550	0.858	0.013
Number of products		0.97860	0.97941	1.00389
		0.000	0.000	0.382
Output tariff			0.99737	1.00220
			0.186	0.201
Pct change in output tariff			1.00091	0.99990
			0.347	0.959
Input tariff			0.96594	1.05813
			0.000	0.000
Pct change in input tariff			1.00018	0.98687
			0.930	0.000
First year productivity				1.00260
				0.628
Delicense				1.77363
				0.001
Observations	646122	429762	420555	93876
No. Subjects	27986	15522	14846	4993
Robust p values in parentheses				

Table 1 - Share of firms in Indian economy

Year	Share in total exports	Share in total imports	Share of income in GDP	Share of sales in GDP
1989	20%	39%	40%	38%
1990	28%	38%	41%	38%
1991	31%	53%	53%	47%
1992	37%	57%	58%	50%
1993	26%	44%	45%	38%
1994	33%	39%	46%	39%
1995	21%	29%	34%	29%
1996	40%	55%	58%	49%
1997	38%	62%	58%	48%
1998	42%	55%	60%	50%
1999	36%	44%	55%	46%
2000	34%	53%	61%	50%
2001	43%	59%	67%	56%
2002	22%	30%	46%	40%
2003	38%	44%	59%	49%
2004	41%	40%	61%	52%
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2006	39%	46%	63%	54%
2007	35%	44%	56%	47%

Table 2 - Distribution of firms by Age and Trade Status

Age of Firm	Domestic Firms		Exporters		Importers		Importers and Exporters	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
above 50 years	1,233	12.89	146	10.67	156	8.36	713	12.47
30 to less than 50 years	570	5.96	111	8.11	178	9.54	1,014	17.74
20 to less than 30 years	1,918	20.06	237	17.32	359	19.25	1,301	22.76
10 to less than 20 years	3,649	38.16	541	39.55	778	41.72	1,936	33.87
less than 10 years	2,193	22.93	333	24.34	394	21.13	752	13.16
Total	9,563	100	1,368	100	1,865	100	5,716	100

Table 3 - Distribution of group size and trade status

Group Size	Domestic Firms		Exporters		Importers		Importers and Exporters	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Not Part of a Group	7,615	80.47	1,078	81.11	1,389	77.3	3,779	69.35
>= 2 and < 25	1,558	16.46	211	15.88	353	19.64	1,492	27.38
>= 25 and < 50	238	2.52	32	2.41	37	2.06	104	1.91
>= 50 and < 75	7	0.07	3	0.23	5	0.28	22	0.4
>= 75 and < 100	40	0.42	5	0.38	10	0.56	49	0.9
> 100	5	0.05			3	0.17	3	0.06
Total	9,463	100	1,329	100	1,797	100	5,449	100

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Services	1,941	2,909	1.50	2	4	7
Export activity						
Goods only	4,422	7,065	1.60	2	4	6
Services only	1,033	1,368	1.32	2	4	6
Deemed exports	16	18	1.13	1	2	4
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All three	132	267	2.02	3	6	18
Group affiliation						
No affiliation	4,619	7,191	1.56	2	4	7
Affiliated	2,475	4,468	1.81	2	5	9
Ownership						
Indian	6,541	10,781	1.65	2	4	7
Foreign	553	878	1.59	3	6	13
Imports	7,592	12,991	1.71	2	5	9
Industry type						
Minerals and Raw materials	1,556	2,778	1.79	2	4	6
Manufacturing	4,287	7,568	1.77	2	5	11
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Import activity						
Finished goods only	328	404	1.23	2	3	6
Inputs only	1,932	2,843	1.47	2	3	6
Capital goods only	803	1,002	1.25	1	2	5
Finished and input goods	278	505	1.82	2	4	7
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Inputs and capital goods	3,090	5,954	1.93	2	5	10
All three	1,030	2,080	2.02	3	6	13
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No affiliation	4,944	8,053	1.63	2	4	8
Affiliated	2,648	4,938	1.86	2	5	10
Ownership						
Indian	7,053	12,113	1.72	2	5	8
Foreign	539	878	1.63	3	6	>19
Production	29,729	44,477	1.50	4	7	>19
Industry type						
Minerals and Raw materials	5,110	8,032	1.57	4	6	>19
Manufacturing	14,685	22,541	1.53	4	8	>19
Services	2,303	3,408	1.48	4	7	>19
Production activity						
Domestic only	4,096	5,451	1.33	4	6	12
Exports only	1,560	2,148	1.38	4	7	>19
Imports only	3,535	5,045	1.43	3	6	15
Exports and Imports	20,538	31,833	1.55	4	8	>19
Group affiliation						
No affiliation	12,187	18,407	1.51	4	7	>19
Affiliated	9,911	15,574	1.57	5	9	>19
Ownership						
Indian	20,175	31,211	1.55	4	7	>19
Foreign	1,923	2,770	1.44	5	12	>19

Table 5 - Cox proportional hazard estimates for exports

	(1)	(2)	(3)	(4)
Age	0.99945	0.99966	0.99955	1.00042
	0.022	0.382	0.188	0.439
Sales without exports	0.99997	1.00010	1.00024	1.00062
	0.886	0.617	0.157	0.308
R&D expenses	0.99265	0.99843	0.97641	0.96690
	0.707	0.926	0.336	0.394
Profit after tax	0.99560	0.99731	0.99700	0.99597
	0.018	0.307	0.163	0.303
Goods and services exports	0.70516	0.68412	0.75845	0.84091
	0.000	0.000	0.000	0.056
Goods and deemed exports	0.86672	0.91901	0.95740	1.11700
	0.080	0.441	0.680	0.379
All three	0.56272	0.61867	0.63638	0.60281
	0.000	0.001	0.003	0.031
First year exports	0.99034	0.99320	0.99096	0.99258
	0.007	0.086	0.044	0.199
Export incentives	1.02659	1.01752	1.00732	1.03423
	0.038	0.282	0.710	0.226
Manufacturing industry	1.03342	1.06076	0.94127	1.15609
	0.371	0.264	0.269	0.066
Group affiliaton	1.03677	1.07011	1.21352	1.00992
	0.307	0.177	0.000	0.888
Foreign ownership	0.79808	0.79656	0.86142	0.98046
	0.002	0.029	0.132	0.877
Importer	0.65847	0.62771	0.63152	0.62560
	0.000	0.000	0.000	0.000
Government operated	1.33798	1.30338	1.45096	
	0.001	0.041	0.007	
Number of locations		0.94687	0.96919	0.94036
		0.021	0.171	0.144
Number of products		0.98096	0.98531	0.99379
		0.011	0.038	0.466
Output tariff			0.99665	0.99736
			0.061	0.211
Pct change in output tariff			1.00280	1.19326
			0.978	0.001
Input tariff			0.98288	1.02767
			0.000	0.000
Pct change in input tariff			0.95330	1.06823
			0.816	0.882
First year productivity				0.99776
				0.000
Delicense				0.84442
				0.461
Observations	24877	13218	12548	3212
No. Subjects	7853	3796	3567	1228
Robust p values in parentheses				

Table 6 - Cox proportional hazard estimates for production

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	0.162	0.277	0.436	0.611
R&D expenses	0.95299	0.96006	0.95764	1.00000
	0.000	0.002	0.000	1.000
Profit after tax	1.00034	1.00039	0.99983	1.00035
	0.295	0.184	0.652	0.207
Manufacturing industry	0.80369	0.89263	0.86689	1.13067
	0.000	0.028	0.006	0.115
Group affiliated	0.91897	0.96553	1.22446	1.10144
	0.023	0.487	0.000	0.149
Foreign ownership	0.89035	0.98358	1.24144	1.52148
	0.072	0.828	0.002	0.000
Government	1.49934	1.56797	1.77210	
	0.000	0.000	0.000	
Importer	1.35687	1.08254	1.08717	0.82092
	0.000	0.474	0.459	0.272
Fiscal benefits	0.99635	0.99686	0.99772	1.00295
	0.008	0.021	0.026	0.012
Number of locations		0.99000	1.00322	0.92018
		0.550	0.858	0.013
Number of products		0.97860	0.97941	1.00389
		0.000	0.000	0.382
Output tariff			0.99737	1.00220
			0.186	0.201
Pct change in output tariff			1.00091	0.99990
			0.347	0.959
Input tariff			0.96594	1.05813
			0.000	0.000
Pct change in input tariff			1.00018	0.98687
			0.930	0.000
First year productivity				1.00260
				0.628
Delicense				1.77363
				0.001
Observations	646122	429762	420555	93876
No. Subjects	27986	15522	14846	4993
Robust p values in parentheses				

Figure 1 – Input and Output Tariff Rates

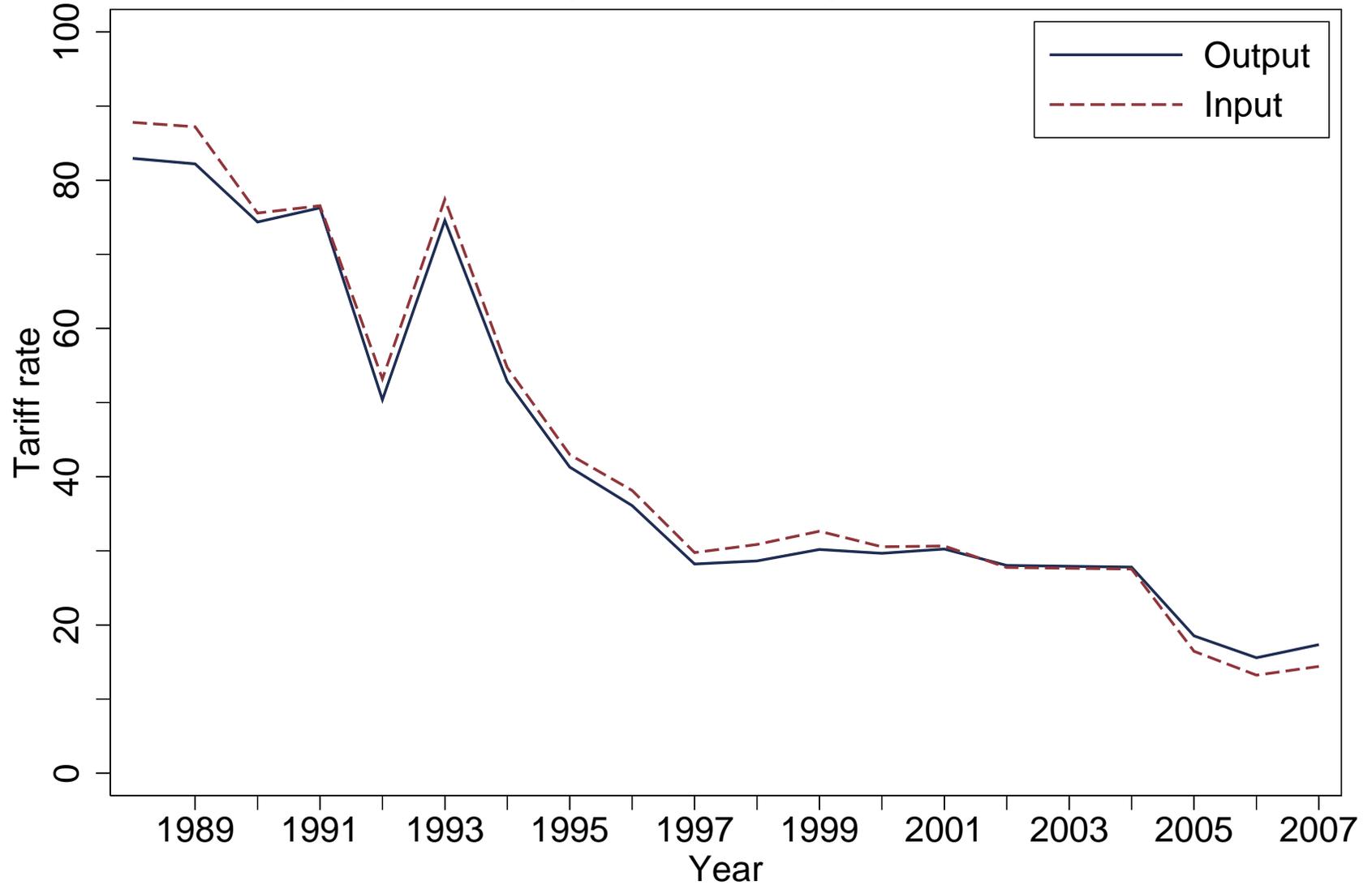


Figure 2 – Export Survival

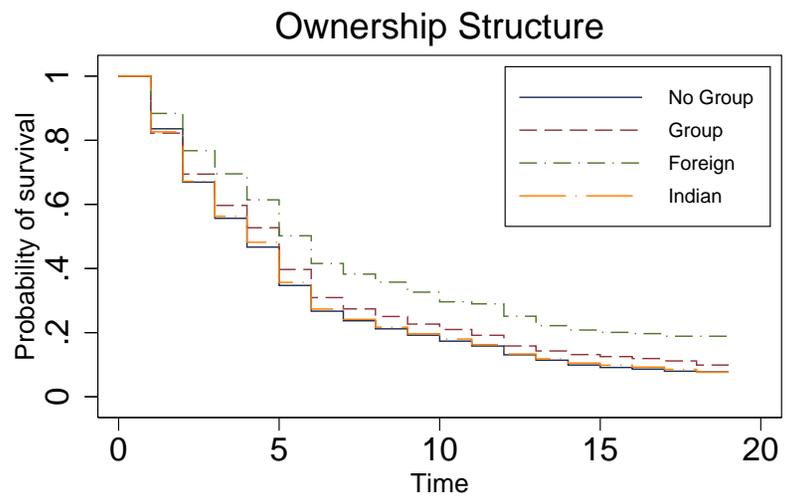
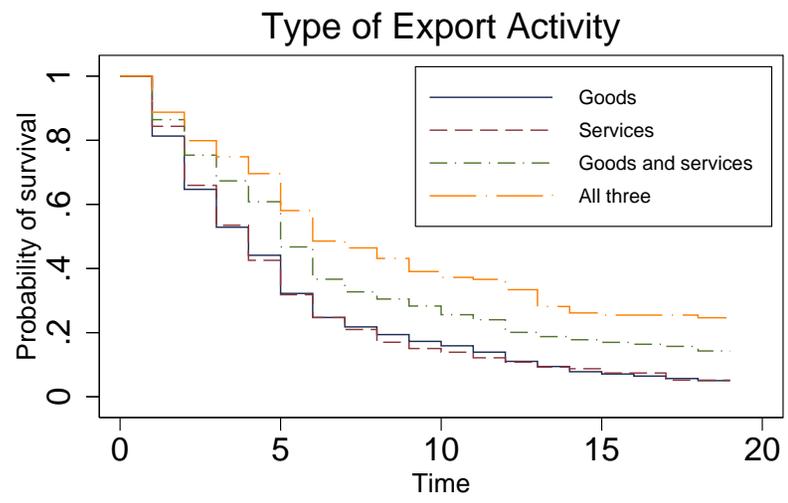
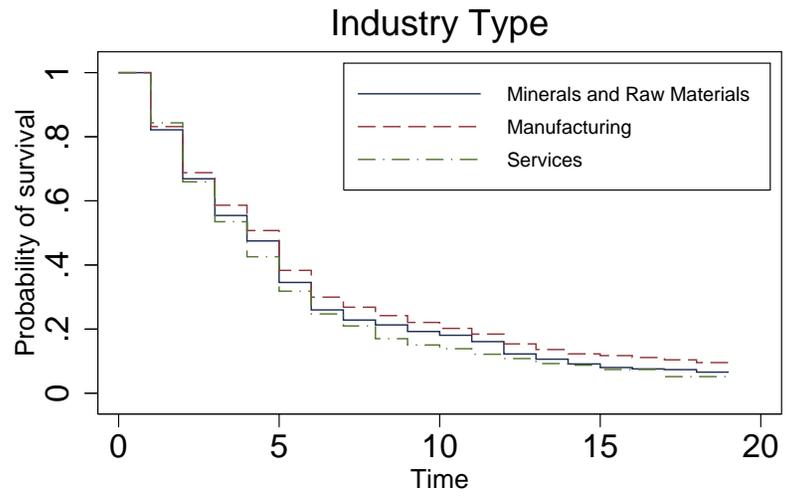
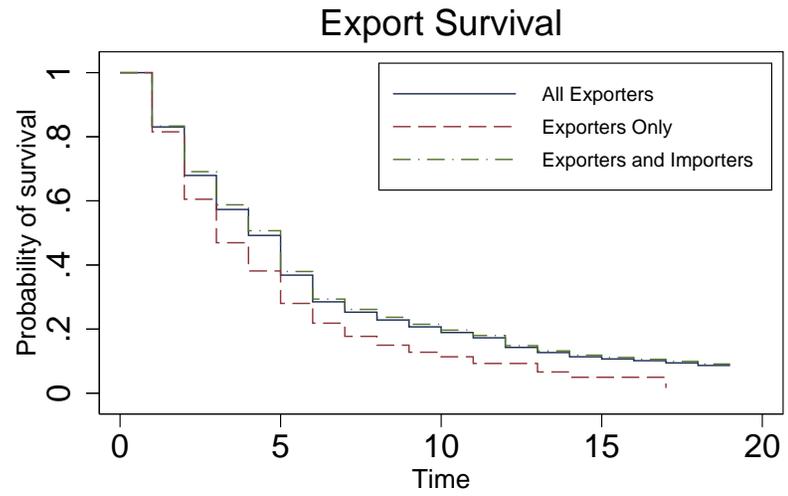


Figure 3 – Production Survival

