

Environmental Standards and Trade: Evidence from a Natural Experiment*

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September 19, 2014

Abstract

Exploiting a natural experiment involving the imposition of technical regulations on the Indian leather and textile industries, I use a firm-level dataset to study the trade, adaptation and discontinuity effects and how they vary by firm size. I find (a) evidence of a signalling effect – regulation significantly increases the exports of a firm through the use of new technology and high quality imported raw materials; (b) this gain is highest for the upper-middle and big size cohort of the firm distribution, i.e., in the 3rd and 4th quartile; (c) use of high-quality raw materials (both imported and domestic) and productivity significantly account for low exit probabilities of a firm; and (d) evidence of spillover effects, i.e., product innovation in case of the upstream (chemical) firms.

Keywords: Regulation, Azo-dyes, Leather and Textile firms, Exports, Raw Materials, Technology Transfer, R&D

JEL: F1, O3, K2

*The paper was previously circulated as “Environmental Standards: Evidence from Indian Textile and Leather Industries”. I am indebted to Richard Baldwin, Nicolas Berman for their continuous support and guidance. Comments from Bernard Hoekman, Jean-Louis Arcand, Marcelo Olareaga, Reshad Ahsan, Sourfel Girma, Charles Mason, Anthony Heyes, Bernard Sinclair-Desgagne, Chad Bown, Cgalar Ozden, M. Scott Taylor, Brian R. Copeland, Martina Bozzola, Taiji Furusawa, Kalina Manova, Anthony Venables, T.Zylicz, Micheal Henry, Robert Elliot, Matthew Cole, Gabriel Ahlfedlt also helped in improving the paper substantially. I would also like to thank the seminar participants in the 5th FIW Conference, Vienna; 11th GEP Conference, Nottingham; 1st PhD Workshop in Environmental Economics and Policy, Ottawa; Internal Research Seminar, Development Economics-Trade and Integration Group, World Bank; ZEW Summer workshop on Trade and Environment, ZEW; Brown Bag Seminar, Graduate Institute; University of Adelaide; IIM, Indore; 4th Villars workshop on International Trade; Birla Institute of Technology and Sciences, Pilani; University of Oxford; 30th European Association of Law and Economics, Warsaw; University of Birmingham; 3rd IO Workshop: Theory, Empirics and Experiments; 3rd International Conference: Industrial Organization and Spatial Economics; ETSG 2014, LMU Munich; IIT Kanpur; IIM, Bangalore for their thoughtful insights and comments. I acknowledge financial support from the Swiss National Foundation (FNS). Lastly, I would like to thank Reshad Ahsan and Debashis Chakraborty for sharing the data with me. The usual disclaimer applies.

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1 Introduction

The increase in stringent environmental regulation costs in terms of “regulatory protectionism” (Baldwin, 2000) that firms must pay in order to access foreign markets, has the potential to impact the trade flows both at the intensive and extensive margins. A report from UNCTAD (UNCTAD, 2005) quotes a study by International Trade Commission (ITC) in 2002 that found 40 per cent of exports from less developed countries were subject to non-tariff barriers, including standards. The issue also assumed importance in the light of the fact that the past decade has seen a global proliferation of environmental and health related standards, along with the rise in trade in environmentally sensitive goods (Chaturvedi and Nagpal, 2002). The background and the political economy in regard to the environment-related standards have been well documented by Jha (2005). The Indian leather and textile industry in the 1990s witnessed such sudden exogenous regulatory shocks both from the importing countries and the domestic regulatory authority. This paper uses one such unique natural experiment to make an useful contribution to this emerging literature about the effect of the exogenous shocks, herewith in terms of trade-related environmental regulations, on firm-level exports. The paper’s key empirical finding is that the legislations significantly helped the leather and textile firms to earn higher revenue from exports through investment in high quality imported raw materials and technology.

With the production technologies that generate some of most polluting chemical effluents, both leather and textile sectors emerged as a battlefield for dramatic regulatory shifts with the processing technologies being under greater scrutiny by the governments and consumer advocacy groups in the industrial economies. The banning of one of the most widely used chemicals in the production of leather and textile goods, ‘Azo-dyes’, by the German regulatory authorities in July 1994 is one such exogenous regulatory shock on Indian leather and textile firms. A Ministry of Environment and Forests (MoEF), Govt. of India legislation in March 1997 matches this foreign regulation by extending its scope to the domestic market. It is only applicable to the exporters before. The MoEF also banned both the domestic production and import of this chemical. This domestic regulation can also be argued as exogenous, as it is merely an extension of the foreign regulation and is not put into effect due to some firm-level developments. The main purpose of the domestic regulation is to effectively and inclusively enforce the previous regulation. In other words, the foreign regulation is directed only to the ones, which sell in those markets, i.e., the exporters, whereas the domestic regulation caters to the entire set of firms operating in these two industries. Also, by completely banning the production of the chemical, the government on one hand not only reduced the cost of its own enforcement, but made the industries themselves to be the chief ‘enforcers’ of the bans (Tewari and Pillai, 2005). These sudden regulatory shocks imposed by the global and domestic

authorities unleashed a debate on how the leather and textile processing firms could possibly comply with this stringent environmental/technical standard without compromising on their competitiveness. This does not mean that these industries (leather and/or the textile) are not hit by any foreign regulation before. In 1989, Germany imposed the first trade-related technical regulation, banning the use of PCPs (Pentachlorophenol) particularly in the leather products. It does not per se have any direct effect on the textile sector. It is a narrow product-related ban and involved elimination of only a single chemical for which the substitutes are locally available. On the other hand, the ‘Azo-dyes’ ban is a broader and disastrous regulation, which affects multiple sectors and also the substitutes are not readily available.

The fundamental issue regarding environmental regulations or for any such technical regulation, is to resolve the presumed trade-off (between compliance and competitiveness) involving the process of adjustment by the firms. Triggered by the 1994 foreign regulation and to prevent the cascading effect of the ban on the economy, two significant event takes place simultaneously in order to facilitate Indian leather and textile firms in their process of adjustment: (1) Govt. of India immediately slashing the import duties of the improved high-quality substitutable chemicals from 150-200 per cent to its base rate, 20 per cent; and (2) the stakeholder associations (state-sponsored industrial bodies) jointly with the German regulatory authorities and the domestic suppliers of the banned input (the chemical firms) unleashing a process of innovation to develop the new chemical/input and providing direct technical support to the leather and textile firms in the process of adaptation. However, the reactions may well vary due to the size (financial, technological, human resource capacity etc.) of the firm. The reason for this immediate and efficient action primarily by the stakeholder associations of these industrial categories is due to the importance of these sectors both in terms of their contribution to the domestic economy and international trade earnings. India is one of the main exporters of leather and textile products in the global market and both the industries employ a very high proportion of the domestic labour force. The textile industry is one of the largest employers in India, second only to agriculture, accounts for about 16 per cent of India’s total exports and 3.04 per cent of the global trade in textiles (Ministry of Textiles, Govt. of India, 2008). The total leather exports is US\$ 2.4 billion, third only to China and Italy, ranks eighth in export earnings within the country and holds a share of around 5.16 per cent of the world trade. It is also a major employer, providing employment to about 2.5 million people (Council of Leather Exports, 2008). Also, given the fact that Germany represents a large share of the export market for Indian leather and textile goods, the product-related bans created a political space for the Indian government to be involved. In terms of the importance of these sectors among its buyers/importers, the Indo-German Chamber of Commerce highlighted that Germany was the single largest importer of Indian leather

and textile products in the 1990s. For example, textiles alone made up around 76 per cent of all consumer good exports from India to Germany (IKB Deutsche Industriebank, 1994). So, even the buyers would not want any interruptions in the supply chain in the sense that they are interested in raising the capacity of the firms to supply clean, high-quality products according to the demand of the customers through direct technical assistance.

Therefore, given the high export intensity of these sectors over the years, it is worth examining this important issue of the effect of the ban of a critical input in the production process of the leather and textile products on firm-level trade, adaptation and exit effects. While there is some literature on how these Indian leather and textile firms have coped with those customary quality and environmental norms, much of the existing research remains either at the qualitative or policy level. This paper tries to fill this gap by explicitly looking into these sector-specific regulations in order to quantify the effect on the trade earnings of the firms. To the best of my knowledge, this is the first paper which addresses the effects of the ‘Azo-dye’ ban at the micro-level using firm performance measure. The imposition of these international and domestic regulations respectively by Germany and the MoEF, Govt. of India arguably provides a good source of a natural experiment in terms of exogenous shocks, as they are mainly demand-driven. This paper contributes to this growing but small firm-level literature about the effects of environmental regulations on firm dynamics. I use a firm-level panel dataset containing direct measures on total sales, exports, imports of raw materials, expenditure on usage of domestic raw materials, research and development (R&D) expenditure, royalty payments for technical knowhow, capital, labour, intermediate goods, expenses on plant and machinery, etc. to test the trade, adaptation and discontinuity effects of these particular regulations for the years 1990-2002. The effects of environment-related barriers on developing countries’ exports have been penned down heavily in terms of qualitative case studies approach (Chakraborty, 2001; Mehta, 2005; Chakraborty, 2009), but neither the empirical nor the theoretical investigations in terms of assessing the effects of environmental regulations or Non-Tariff Barriers (NTBs) at the micro level are very substantive.

My results are clear and robust. I estimate the impact of the regulations on three important firm-level characteristics – export earnings, import of raw materials and technology transfer. I find strong evidence of a signalling effect. The regulations forced the leather and textile firms to use high quality substitutable inputs and improved technology in their production process, which helped them to earn significantly higher revenue from exports, more so in case of the 1994 German regulation. In other words, I find that the use of new substitutable input and upgraded technology led to the production of improved, high-quality and cleaner end-products carrying a quality signal and helping the leather and textile firms to reap significant gains from their export flows/international

trade. Next, I examine the factors which may pose a credible threat on the continuity of a firm’s activity—either to sell domestically or export—as a result of these regulations. My non-linear estimates demonstrate that the use of new raw materials (both imported and domestic) and productivity significantly explains the exit decision of a firm. Higher expenditure on high-quality raw material entails low exit probabilities. I also divide the firms by size to test for the amount of heterogeneity involved in the effects. I find that the gains from trade is highest and significant for the firms belonging to the 3rd and 4th quartile of the firm-size distribution as a result of investments in technology and improved raw materials, respectively. In terms of the heterogeneous survival probabilities, I find evidence in support of the sorting effect by the 1994 regulation – the German regulation negatively affects the operation of only the small firms. In case of the domestic regulation, the effect is significant across all size cohorts. I also check for possible spillover or upstream effects. The results show strong evidence of product innovation for the upstream (chemical) firms, i.e., the suppliers of the input (banned) to the textile and leather firms.

The rest of the paper is organized as follows. Section 2 gives some contextual background to the paper. Section 3 describes the data with some preliminary analysis. The direct effect of the regulations on firm-level export flows and adaptation cost has been estimated in Section 4. Section 5 estimates the survival probabilities of the firms. Section 6 confirms the amount of heterogeneity involved in the effect of the bans. I check for the upstream effects in Section 7. Section 8 does some sensitivity analysis, while Section 9 concludes.

2 Background

2.1 Regulatory Changes

Markets in the OECD countries are getting ‘green’ (German Development Institute, 1994). Consumers and governments consider the environmental threats seriously and demand industries to act accordingly. They are effectively using their purchasing power to influence governments and legislatures to introduce new regulations, which produce eco-friendly products. These regulations carry a technical standard or label affecting not only the products themselves but also the production process. These technical standards, such as product certification standards, labelling requirements commonly encompass a well-defined protocol based on a laboratory test procedure, which ascertains specific criteria that have a direct bearing on the quality of a product. The ban on ‘Azo-dyes’ is one such regulation.

Azo dye is a colouring substance used in the dyeing process. Azo dyes—a group of synthetic dyes made from benzidine, toluidine and similar organic chemical—account for ap-

proximately 70 per cent of all organic dyes produced in the world. Some azo dyes, through chemical breakdown form chemical substances called aromatic amines (arylamines). This have been proven to be or are suspected of being carcinogenic. The use of azo dyes and pigments is banned through introducing a legislation into the federal parliament of Germany in 1992. However, following complaints from the concerned industrial bodies, the bill is changed and a general exception is proposed for pigments (ERM, 1998). Germany's Federal Institute for Occupational Safety and Health in September 1993 issued a technical ruling that benzidine and certain other carcinogenic azo dyes should not be used (Woodward and Clarke, 1997). On July 15 1994, by an amendment to Germany's Consumer Goods Ordinance¹, the Parliament passed legislation completely banning the use of certain of 'Azo-dyes' in consumer products, which have the potential of coming into close and prolonged contact with the skin. The amendment of §16 of the "German Consumer Goods Regulation" states that the food and consumer goods as defined in §5 article 1 number 6 of the law may not be produced, imported, or sold after a certain period of time if they contain azo dye, since they can generate one of the forbidden azo-radicals listed in amendment 1 number 7 of this regulation. This amendment is called the 'Azo-dyes' ban. According to this regulation, nothing that is dyed with azo-colourant is allowed to reach the market in Germany. This law applies to domestic products as well as foreign ones. Germany, once the world centre of azo dyes production, became the first country to ban their use (OECD, 2006a), followed by The Netherlands, Austria and Norway. In 1999 the European Union (E.U.) diffused the ban across all its Member States by circulating a draft Directive. The ban on azo dye has been an acceptable measure within the GATT as well, since according to Article XX it is implemented to protect human health. Furthermore, the ban also does not discriminate against the origin of products. It applies equally to domestic and foreign products.

Following this legislation, a draft notification proposing imposition of prohibition on the handling of azo dyes is published via a notification by the MoEF, Govt. of India in March 1997 (MoEF, 1997). It completely banned the import and production of this chemical. The MoEF, Govt. of India regulation applies to all the firms in operation, while the German ban is targeted only to the exporters. Therefore, the leather and textile firms cannot even sell their products treated with 'Azo-dyes' even in the Indian domestic market. By completely banning the production of the chemicals, the government effectively redirected the flow of adjustment – the onus is now not only on the leather and textile firms, but also on the chemical input enterprises.

A report by Organisation of Economic Co-operation and Development (OECD) in 2006 reports that the effects of the European legislation on azo dyes is perhaps felt

¹"Zweite Verordnung zur Aenderung der Bedarfsgegenstandeverordnung", *Bundesgesetzblatt – Teil 1*, nr. 46 of 28 July 1994, pp. 1670-1671.

most acutely in India, which has a considerable large dye-making capacity and also a large textile and leather industry dependent on those dyes. Around 25-70 per cent of the items treated with azo dyes are exported to the E.U. with Germany as one of its main markets. Also, only five/six countries² in the E.U. consume around 35-40 per cent of total leather and textile exports from India. Therefore, facing a potential large loss from the export earnings and complaints by the concerned industrial bodies (leather and textile industrial associations) about the unavailability of the substitutable inputs (chemicals) or expensive alternatives, the Govt. of India reduces the import tariffs of the substitutable raw materials by around one-tenth. In addition, the respective state-sponsored industrial associations and the suppliers of the banned input—the chemical firms—starts a process of innovation of developing a suitable alternative. Aware of the inadequate testing facilities and difficulties in obtaining alternative technologies, the Indo-German Export Promotion Project (IGEP), a joint trade-promotion programme between the Ministry of Commerce, Govt. of India and the Ministry of Economic Co-operation and Development in Germany played a vital role in providing Indian leather and textile manufactures with information on the regulation and offering technical assistance aiming at better understanding and adopting the regulations. Further technical assistance is provided by multilateral development-assistance organisations and private companies. The special focus of the assistance has been on the medium-sized manufacturing and exporting firms in the private sector. The Netherlands also provided technical assistance by organising a series of workshops aimed at preventing the European azo dye regulation from becoming a trade barrier to developing country exporters (OECD, 1997).

2.2 Literature Review

This paper mainly relates to the literature regarding the impact of regulations, especially environmental regulations, on firm performance. The existing literature is concentrated mainly on two different kinds of effects: (a) signalling or the demand-side effect, which operates through either the use of high-quality input substitution or the technology upgradation/spillover effect, and the (b) cost or the supply-side effect. The former set of literature argues that a successful adoption of a technical standard may act as a label or a quality indicator, thereby giving a signal to the consumers that the product concerned is of higher quality. This may increase the effective demand by relieving consumers' concerns about the quality of the product (Porter and Van der Linde, 1995; Thilmany and Barrett, 1997; Ganslandt and Markusen, 2001; Mohr, 2002; Farzin, 2003; Greaker, 2006; Andre et al. 2009). On the other hand, the cost-side literature portrays that by raising adaptation costs, higher technical standards raise overall production costs of the polluting firms, rendering them uncompetitive and driving them out of the industry (Conrad and

²Austria, Belgium, France, Germany, Netherlands, Norway

Wang, 1993; Requate, 1997; Lahiri and Ono, 2007; Sengupta, 2010). My result comes closest to that of Greaker (2006) and Andre et al. (2009). Both the papers argue that exports or sales of a firm could increase in the post-regulation period even when there is an increase in adaptation cost. I present a simple mechanism where an environmental regulation can increase exports for a firm—to which the regulation is directed to—through support from actors in the upstream sector.

Consider the case of a downstream (leather and textile) firm, D_f . D_f produces one single product using a crucial input and exports all (or a significant portion of) its output to a fixed world price. The production and export of the product is a function of the supply of the input and support from the upstream sector (U_f). U_f consists of chemical firms (from which the leather and textile firms buy their input) and state-level industry associations (which helps them with technical consultations and support for exporting activities). In other words, D_f relies on U_f for the supply of that particular input and successful production and export of the product. Now, the government or some regulatory authority (German regulatory authorities or the Govt. of India) introduces a stringent environment regulation, where the D_f is required to use a new improved input in its production process as a substitute to the previous input in order to continue export or production. As a result, the upstream sector helps the D_f through various measures, such as investing in R&D for the development of the new input, easy procurement and adaptation through reduction of import duties and use of upgraded technology to successfully adapt the new input and produce. However, since R&D involves a cost, U_f cannot set price equal to marginal cost without generating negative profits in this stage. On the other hand, as for the adaptation cost of the D_f , it depends on the shift of the supply curve of the new input. Since the regulation resulted from the demand side, the trade competitiveness of D_f (the leather and textile firms) improves as a end result due to the higher willingness-to-pay for improved quality of goods (Ganslandt and Markusen, 2001).

Empirically, the effect of environmental regulations has been explored in several dimensions: (1) productivity (Gollop and Roberts, 1983; Gray, 1987; Berman and Bui, 2001; Dutta and Narayanan, 2005; Fleishman et al. 2009; Greenstone et al. 2010); (2) plant exit (Biorn et al. 1998; Yin et al. 2007; Nene et al. 2010); (3) trade volumes (Swann et al. 1996; Chen et al. 2008; Rodrigue and Soumonni, 2011); (4) product choice (Lipscomb, 2008); (5) plant or establishment birth and size (Dean et al. 2000; Millimet, 2003; List et al. 2003); and (6) innovation activity (Jaffe and Palmer, 1997; Kneller and Manderson, 2010). The literature is mostly mixed. Some studies find positive effects on exports, while some others see the opposite. Though there is some amount of literature available on the effects of environmental regulation on the dynamics of industries or firms, the lion's share focuses on the effect of state- or national-level regulation, which could

be endogenous to the performance of the industries or firms concerned. The significant value addition of this paper to this existing literature is that I am able to identify an important natural experiment in terms of trade-related environmental regulation which is completely exogenous, and estimate its effect on important firm-level choice variables of the targeted industries, i.e., the Indian leather and textile firms.

3 Data

3.1 Firm-level Data - PROWESS

The current study uses firm-level data from PROWESS database published by the Centre for Monitoring Indian Economy (CMIE). It contains information primarily from income statements and balance sheets of the companies. The database covers large companies, companies listed on the major stock exchanges (this includes all the publicly traded firms) and also many small enterprises. Data for big companies is worked out from balance sheets while CMIE periodically surveys smaller companies for their data. The database does not cover the unorganized sector. The firms in the sample comprises 60 to 70 per cent of the economic activity in the organised industrial sector in India and encompasses 75 per cent of corporate taxes and 95 per cent of excise duty collected by the Govt. of India (Goldberg et al. 2010).

PROWESS has some significant advantages over other datasets documenting India's manufacturing sector: (1) it is a panel of firms, which enables us to see firm performance over time; (2) secondly, the database records detailed product-level information at firm level; and (3) finally, the dataset perfectly suits my period of concern, i.e., 1990-2002. PROWESS, therefore, is particularly well-suited for understanding how these leather and textile firms adjusted their production function over time in response to both the domestic and international regulations. All the variables are measured in Indian Rupees (INR) Millions. The advantages of this dataset allows me to examine the behavioural changes in the firms as a result of the imposition of the regulations by Germany in 1994 and followed by the MoEF, Govt. of India in 1997. A balanced panel over the period 1990 to 2002 is used for estimation purposes.

3.2 Preliminary Analysis

This section previews the empirical strategy. **Figure 1** plots total leather and textile exports at the firm-level for the years 1990 to 2002. The figure clearly portrays that the export revenues start to increase significantly in the post-1994 period, i.e., post-German regulation timeframe. **Figure 2** plots import of raw materials and royalty

payments for technical knowhow (proxy for technology transfer) at the firm-level. Both these variables show significant upward spikes in the post-1994 regulation period. In particular, import of raw materials display a significant upward jump in the year 1995, whereas, for the technology transfer, the same phenomenon gets repeated, but for the year 1996. I also plot the same graph separately for the two different sectors (not reported). The increase is more in case of the textile firms. Next, I look at the behaviour of a few important firm-level indicators in the pre- and post-regulation periods with respect to both the notification. The one that is issued by the German regulatory authorities in 1994 and MoEF, Govt. of India circular in 1997 in **Table 1**. I divide 1990-1994 as the pre-regulation and 1995-2002 as the post-regulation period in case of 1994 regulation, whereas, in case of 1997 regulation, the same is 1990-1997 and 1998-2002, respectively. I calculate the average values—expenditures/earnings—across all the leather and textile firms for total sales, export earnings, import of raw materials, expenditure on account of domestic raw materials, royalty payments for technical knowhow (proxy for technology transfer), investments on account of R&D and expenditure on plant and machinery. The values in **Table 1** are corrected for inflation using sector-specific wholesale price index (WPI) number.

An average leather and textile firm earns more revenue from selling (both total sales and exports) in both the post-regulation period. The increase in sales may be either due to an increase in price or quantity. Since the PROWESS database does not provide any information on either price or quantity at the firm level, therefore, it is difficult to conclude regarding the exact reason for the increase in the firms' earnings. However, I utilise the customs level database (INDIA TRADES/UN COMTRADE) to investigate the exact reason behind the increase in the export revenues. The unit-price level data at the HS³ 6-digit level confirms that the increase in unit price increase led to more revenues in the post-regulation period. A firm spends close to double on account of import of raw materials in the post-regulations period. Expenditure on use of domestic raw materials also increased, but not very significantly. This could be due to the simultaneous cross-cutting effect of drop in the usage of the banned input and then the consequent increase of the new input supplied by the chemical firms. A leather and textile firm spends significantly more on account of royalty payments toward transfer of technology in the post-regulation period, but only in case of the 1994 regulation. Investments on account of R&D seem to increase in the after-period of 1997 MoEF regulation. The expenditure on account of plant and machinery also increased significantly in the post-regulation period. Use of new raw materials may require some changes in the production process, which led to an increase in the investment towards plant and machinery.

³Harmonised System

4 Effect of the Regulations

4.1 Empirical Strategy

Following the basic statistical analysis, I now evaluate the effect of the bans on three of the most important firm-level characteristics by estimating linear regressions of the fixed-effects type specification:

$$\ln(x_{ijt}) = \beta Post_t + \delta Post_{jt} * ltd_{ijt} + firmcontrols + \theta_i + \nu_t + \epsilon_{ijt}$$

The dependent or left-hand side variable, x_{ijt} , is either the exports or import of raw materials or technology transfer of a leather and textile firm. $Post_{jt}$ is a year dummy variable measuring the environmental regulations. It takes a value 1 for the years following the environmental regulations, if $j = Leather$ and $Textile$. $Post_{jt}$ is a vector of two different dummies, $ban94$ and $ban97$. In particular, $ban94$ would take value 1 for the years 1995-2002, whereas, $ban97$ would do the same for the years 1998-2002. These dummies measure the effect of different regulations separately. Since, the main variable of interest is a year dummy, it will be difficult to distinguish between the ‘treatment’ and the ‘time’ effects unless I use a control group in my estimation. In order to untangle the true effect of the regulation dummies, I need to include a group which is exogenous to the shock or treatment and its behavioural pattern is correlated with that of the treated one. For this purpose, I use the entire manufacturing sector less the chemical as the control group. I acknowledge the fact that this is not the perfect control group that I could use in this estimation. However, given the circumstances, this is the best that I can come up with use since all the other manufacturing sectors are impacted by some of the macro reforms (e.g., by simultaneous tariff and FDI liberalisation that happened in the 1990s) in the same way as leather and textiles. Using any other sector, say from the services, would definitely be more exogenous to the shock relative to the manufacturing sector, but the behavioural pattern of any services sector is completely different from that of manufacturing and may bias the results. **Figure 3** plots total exports by firms belonging to all other manufacturing sectors (manufacturing sector less chemical, leather and textile) over the same time period, i.e., the period of analysis. The figure clearly supports my conjecture – with a small difference. I do not find any sudden increase in the export earnings of other manufacturing sectors right after 1994. ltd is a dummy variable, which takes a value 1 for a firm if a firm is located in the leather and textile sector of the dataset. My main coefficient of interest is δ . δ measures the effect of any of the regulation ($ban94$ or $ban97$) on firm-level outcomes given that a firm belongs to the leather and textile sector in comparison to sectors which potentially has the same characteristics as the treated sectors, but exogenous to the regulation. $firmcontrols$ includes size of the firm, age, age squared, indicator for domestic or foreign ownership. I

use total assets of a firm as its size indicator. θ_i and ν_t are firm and year fixed effects, respectively. I cluster my standard errors at the firm level.

While estimating the above equation, I also carefully control for other simultaneous events or trade policies which could affect the outcomes. Those, if not, may confound the estimates. Three important events took place during the same time frame as my period of analysis which may affect the results: (a) first, India becoming a member of World Trade Organization (WTO) in the year 1994; (b) partial phasing out of the Agreement of Textiles and Clothing (ATC) as a continuation of the the Multi-Fibre Agreement (MFA) from 1995 onwards⁴; and (c) in March 1998, the European Commission (EC) requested India to procure export licenses in order to export raw hides and skins. Also, as a result of the membership of WTO in 1994, India experienced depreciation in bilateral exchange rate, which could also affect the results. The presence of the year fixed effects in the regression equation will categorically control for the effect of all these particular events.

Apart from these significant developments which may affect the operational pattern of the leather and textile sectors, there are also a number of anti-dumping duties that have been imposed by European Union (E.U.), United States of America (U.S.) and other countries on the different textile sector products of India. The presence of firm fixed effects should take care of any such effect. However, I take the following two steps to categorically control for this in my estimation: (a) I carefully match the information of the anti-dumping duties imposed at the product line (HS six-digit level) using the Global Antidumping Database (GAD)⁵ to the firm-level dataset using Debroy and Santhanam

⁴The Multifibre Arrangement (MFA) on Textile and Clothing (T&C) institutionalized quotas on cotton textiles and apparel products by countries like the United States and the United Kingdom against Asian textile exporters in 1974. The motivation behind the arrangement was for developed countries to seek a more systematic mechanism to deal with the continued growth of textile and clothing exports from large Asian countries. The MFA quotas were negotiated on four main MFA ‘groups’ of products spanning Yarn, Fabric, Made-Ups and Clothing. Protection from textile and apparel imports extended over a 20 year period, until 1994 and the signing of the Agreement on Textile and Clothing (ATC) under the Uruguay Round of negotiations under the World Trade Organization, after which the process of phasing down these import quotas began. The final phase down of the MFA/ATC (hereinafter MFA) quotas occurred in 2005, when all quotas under this arrangement were abolished. For labour-abundant countries like India and China with a comparative advantage in labour-intensive products, the MFA quotas were binding on clothing and textile exports. India, for example, exhibited a quota fill rate of 87 per cent, next to only China and Bangladesh, who both exhibit a quota fill rate of 88 per cent. So, the policy change, was not of any substantial importance, which could have affected its exports very significantly. Existing research on MFA also does not show any unambiguous or conclusive evidence of the post-MFA effect on the international trade flows of the textile sector of India. Further, most of the studies argue that there was almost no immediate effect of the MFA-phase out and the actual effect started to show from the post-2002 or post-2005 period. Others are of the opinion that MFA phase out crowds out international market share of India’s exports due to surge in China’s export flows. In order to specifically control for the yearwise phasing out of the quotas, I interact industry and year fixed effects in my sensitivity analysis table and the primary result continue to hold (discussed in detail in Section 8).

⁵<http://econ.worldbank.org/ttbd/>
<http://econ.worldbank.org/ttbd/gad/>

(1993) concordance table, (b) I construct a dummy variable, which takes a value 1, when an antidumping duty is imposed on a particular category of the textile sector in a particular year. The results do not change even when I use this additional control. The presence of firm-level fixed effects will also control for the information received by the firms about the bans, the network effects (with the state-level stakeholder agencies, which were the primary receiver of the information about the regulations) and the assistance the firms got from institutions like the Central Leather Research Institute (CLRI) or the Bombay Textile Research Association (BTRA) etc. Controlling for all these other policy effects will help produce true and exact estimates of the regulations.

4.2 Results

Table 2 summarizes the effect of two different bans (*ban94* and *ban97*) on firm-level exports – both the regulations have significant positive impact, more so in case of the 1994 German regulation. Columns (1) - (4) estimate the effect of *ban94*, whereas, columns (5) - (8) use *ban97* as the variable of interest. Column (1) regress natural logarithm of total exports of leather and textile firm plus one on the interaction between *ban94* and *ltd* controlling for the size, age and ownership of a firm. I do not use either firm or year fixed effects. The coefficient of interest demonstrates that the 1994 German regulation significantly increases the export earnings of a leather and textile firm at 1 per cent level of significance in comparison to all other manufacturing sectors. Columns (2) and (3) introduce firm fixed effects (which will absorb any unobserved heterogeneity among firms) and both firm and year fixed effects (which will absorb any other policy shock), respectively. The regression outcome stays the same as column (1).

Column (4) uses average treatment effect (ATE) methodology to estimate the effect of the German regulation. For this estimation, I use the leather and the textile exporters as the ‘treated’ and the exporters of the other manufacturing sectors less the chemical as the ‘control’ group. In order to carry out the estimation, I also balance the observables across the ‘treated’ and ‘control’ group. The estimate clearly shows that the 1994 German regulation has a positive and significant effect on the gains from international trade by the leather and textile firms. The point estimates are higher than that of the OLS results. The export market regulation significantly helps the leather and textile firms to earn more from their trade flows. Columns (5) - (8) estimate the effect of the notification issued by MoEF, Govt. of India in 1997 (*ban97*) on exports. I continue to find the same effect as of the 1994 German regulation. However, the magnitude of the effect is significantly less than that of the 1994 German regulation.

To corroborate my findings, I check the trend of the total amount of leather and textile exports from India. I find that the value of exports from 1991-92 to 1998-99 went up from

INR 30360 Million to INR 64360 Million and INR 154836 Million to INR 401715 Million for leather and textile goods, respectively. My results are strikingly similar to that of Swann et al. (1996) and Moenius (2005) even though they use different time periods and different datasets. They use counts of standards to find that British exports are positively correlated with national standards. It also draws support from the central premise of the Porter and Van der Linde (1995) hypothesis that environmental regulations sometime have a positive effect on the competitiveness of the firms through regulation-induced innovation.

There could also be other effects, which may influence my results, such as simultaneous increase in the world income. I include natural logarithm of world income as one of my independent variables to see if the effect of ‘Azo-dyes’ ban vanishes. I find no such evidence. More importantly, there could also be a trade diversion effect: (a) Indian leather and textile exports increased for other destinations except for the E.U. in the post-regulation period resulting in an increase in total exports. I check the exports of the leather and textile products following UN ComTrade database, at the HS six-digit level, and I find no such evidence in support. **Figure 4** plots total exports of Indian leather and textile goods to the World and the E.U. over 1990-2002. The figure fails to point out any evidence to accept the alternative hypothesis. Exports continued to increase in the post-regulation period; and (b) simultaneous decrease in exports from the other major leather and textile exporters, such as Bangladesh, Pakistan, Vietnam, etc. to these major importers of the E.U., which may force these countries to buy more of Indian products. I also check the trend of the exports of leather and textile products for these countries to the E.U. in the post-regulation period. The trend does not seem to support my conjecture.

The main reason that could be responsible for such an increase in exports of a textile and leather firm is the nature of these regulations. They are purely demand-driven and binding. The economic rationale behind this phenomenon can be explained as follows: the introduction of either of these new regulations allowed for the production of a new and more environmental friendly variant. Since, environmental friendly products are more costly to produce, in any unregulated market many firms would like to avoid the foray from ‘green’ production. But, in this case of a binding regulated market, the firms are bound to adopt the high quality input as suggested in order to maintain their operations in both the international and domestic markets. And, since the regulations came from the demand-side, the firms benefit from the consumers’ willingness-to-pay higher prices for a high-quality good and none would run the risk of being exploited by their competitors. This is called the signalling effect. The adoption of a high-quality input gives a clear signal to the consumers about its quality, which lead to higher earnings from trade. Further, this quick adoption of the newly improved chemical due to various

local and regional agencies, public and private, helped the firms to lower their cost of adjustment, generate ongoing learning and diffuse widely across the value chain. The standards could have also reduced the transaction costs by increasing the transparency of products and components, through flow of information between producers and consumers regarding the inherent characteristics and quality of products that can help in fetching good prices for the exporting establishments (David and Greenstein, 1990; Jones and Hudson, 1996). Another important reason, which may have helped the exporters to gain from exports, is the reduction in uncertainty in quality as a result of the compliance with the environmental/technical standard. As Tewari and Pillai (2005) reports, an official from Council of Leather Exports (CLE) points out that it became a fashion to show that a leather and textile product is Azo-dye free, since it signals better quality and yields higher price.

The principal objective of these regulations is to ban a widely used chemical (which is supposedly harmful) in the production process of leather and textile products and substitute it with some improved quality input. This process of substitution entails a firm to adjust its production process either using a different set of inputs (replacing the banned chemical) and/or technical upgradation. Using a different set of inputs (of high-quality) or new upgraded technology may have encouraged this growth in exports in the post-regulation period. However, this process of substitution may have helped the firms to gain higher export earnings, but they could also add to a firm's production cost. The literature on trade and environment points out that the cost of compliance is one of the main reasons that makes it difficult for firms to comply with stringent environmental standards without comprising their competitiveness. The idea is: mandatory regulations impose economic/production costs on firms, which undermine industrial competitiveness and reduce net exports (Chaturvedi and Nagpal, 2003). On the other hand, studies also point out how the firms could earn more revenue in the post-regulation period despite increase in cost. Mohr (2002) and Greaker (2006) discusses how tough environmental policies push a firm to invest in new pollution abatement techniques resulting in an increase in final output. Rodrigue and Soumonni (2011) also finds support for the fact that environmental investment encourages growth in exports for the Indonesian wood products industry. The literature on technical barriers to trade also highlights that external or foreign standards are more stringent and impede trade because developing countries generally lack the scientific expertise and technical infrastructure to comply with the new stringent standards (Chaturvedi and Nagpal, 2003). However, the assumed trade-off may not materialise if a firm invest in high quality inputs or process, which bears a positive effect on the quality of final product, thereby increasing its aggregate sales. Therefore, the adaptation cost involved in the process of adjustment could also be affected as a result of the regulations. As pointed out before, two significant events

followed the regulation relating to the process of compliance: (1) substantial reduction of import duties on the substitutable inputs and (2) technical assistance by multiple stakeholders (the upstream sector) in order to adapt the new input in the production process.

I test the effect of the regulations on two important variables related to the process of compliance – import of raw materials and royalty payments for technical knowhow at the firm-level in **Table 3**. I use these variables as the measures for ‘adjustment support’. The Govt. of India reduces the import duties substantially on the substitutable chemicals in order to enable the leather and textile firms to easily procure the new inputs (chemicals). This policy should affect the import bill of the firms. Since the information on the exact tariff lines (on which the tariff duties have been reduced) is not available, I use information on the import of raw materials by the firms as a proxy for the government-aid effect in columns (1) - (4). The results show that both the regulations have significant and positive impact on the import of raw materials by the leather and textile firms at 1 per cent level. Based on a field-level survey in Chennai and Kanpur for leather firms and Mumbai and Surat for textile firms, a report from The Energy and Resources Institute (TERI) (2005) also points out that the firms’ experienced an increase in their adaptation cost (through using of imported high-quality materials) in the process of substitution of the banned chemical. Surveying a handful number of leather firms in Chennai, Tewari (2001) also documents similar evidence of significant increase in their cost of substituting the newly improved chemical. The effect continues to be larger in case of the foreign regulation. OECD reports (2006a, 2006b) on the effect of ‘Azo-dye’ ban also reports of increase in the adaptation cost for the leather and textile firms.

Another obvious consequence of the regulations is supposedly the increased usage of raw materials (the new substitutable ones) from domestic sources. The 1994 German regulation though primarily targeted to the leather and textile industries also inadvertently affects the chemical industry as well. They are the primary suppliers of the input (which is banned) to the leather and textile firms. As a result, firm-level expenditure on raw materials (from domestic sources) reduces as a result of the drop in demand for the banned input. This targeting of the input producers unleashes a process of innovation by the chemical firms. They start to diffuse the new dyes as widely as possible among their potential clients and offered technical assistance to small and medium-sized firms as well (Tewari and Pillai, 2005). The innovation of the new chemical (or input) and the subsequent supply to the leather and textile firms would again induce a rise in the raw material expenditure for its users, i.e., the leather and textile firms. The simultaneous decrease (after the ban) and the consequent increase (after the product innovation by the chemical firms) should cross-cut each other having no aggregate effect. In particular, I should not find any significant effect of the regulations on the use of raw materials from

domestic sources. My result supports my conjecture (results not reported). According to a OECD study (2006a), one consequence of this change is the improvement in the general environmental performance of India's leather and textile industries. Two years following the ban, only 1 out of 129 samples failed the 'Azo-dyes' test compared to nearly all in 1994 (Tewari, 2001).

Case studies by OECD (2006a, 2006b) on the effect of the 'Azo-dyes' ban on the leather and textile industries also point out evidence of technology transfer from Germany in collaboration with industry associations (CLRI and BTRA) and Govt. of India. I use the royalty payments made by the firms on account of technical knowhow as a proxy for the technology transfer in order to use upgraded production process. Columns (5) - (8) regress natural logarithm of royalty payments by firms plus one on the interaction term of the respective regulation and sectoral (leather and textile) dummies. I fail to find any significant effect of either of the regulations on the transfer of technology at the aggregate level. I also use investments by the leather and textile firms towards R&D and sum of expenditure on R&D and technology transfer. I still do not find any significant result. The reasons could be many. But, the most important one could be that the transfer of technology concentrates in only one section and not the entire size distribution of firms. I explore this in later part of my paper.

Finally, to check whether the policy action taken by the Govt. of India to lower the tariff on imports of the regulation conforming chemicals (inputs) have some effect on the export earnings, I interact the natural logarithm of import of raw materials with my main variable of interest – the interaction term, $Post * ltd$. I find significant evidence of higher returns of using imported raw materials on export earnings by the leather and textile firms (results not reported), more so in case of the export regulation. Using the high-quality substitutable inputs as suggested by the German regulatory authorities renders some quality signalling to the final consumers and this catapulted into a positive impact on the exports. Since imports are clearly endogenous to exports, I use the average import of raw materials for the first four years of the period of analysis, i.e., of 1990-1993 (i.e., the years before the reform) and then interact with the respective regulation dummies to test my hypothesis. I do the same exercise for expenditure on the use of domestic raw materials and technology transfer. I find some evidence of increased returns using raw materials from domestic sources, but only in case of the domestic regulation. I continue to find no evidence of technology transfer helping the firms to earn more from their trade flows in aggregate.

5 Survival Probabilities

5.1 Empirical Strategy

As trade cost goes down, the chance of survival of a firm increases, thereby enabling new firms to enter the market. I test the opposite. The regulations could impose an additional cost on the operation on the firms (in terms of complying with the regulations) and this could lower their survival chances or exit the market (Melitz, 2003). Since, the decision to exit is a discrete variable, which by definition equals 0 or 1, the conditional probit model with a discrete binary endogenous dependent variable is appropriate. Hence the discontinuing probability of a firm i operating in industry j at time t is:

$$\Pr(X_{ijt} = 0 \mid X_{ijt-1} > 0) = 1 \text{ if } \beta(\text{Post}_{jt} * \text{ltd}_{ijt} * Z_{ijt}) + \mu_j + \nu_t + \epsilon_{ijt} = 0 \\ = 0 \text{ otherwise}$$

where, Z_{ijt} is a vector of control variables including import of raw materials, expenditure on raw materials used from domestic sources, technology adoption, productivity of a firm, expenditure on plant and machinery and capital employed. All the variables are used in their natural logarithmic form. The dependent variable is the discontinuing decision of a firm, which I denote as 1 if (a) the export of a firm equals zero for the years 1995 or 1996 for the ‘Azo-dyes’ ban; and (b) the domestic sales equal zero for the years 1998 or 1999 for the MoEF, Govt. of India regulation, conditional on the fact that exports or domestic sales are positive on or before the year of the ban. Since, the exit decision is taken at the firm-level, I use a full set of industry (μ_j) dummies. I also include a battery of year fixed effects (ν_t). I continue to cluster the standard errors at the firm level. The coefficients are estimated by maximum likelihood procedure. I report marginal effects. I continue to use the entire manufacturing sector less the chemical as the control group in the estimation. All the estimations include the double interaction and the individual terms. To check if the dependent variable is capturing the right effect and not any just general trend, I additionally perform another estimation (results not reported). I take any random year as the potential year of exit and run the same set of regressions to see if the factors, which significantly affect the operation decision of a firm as result of the regulation, stays the same. I do not find any such evidence.

While estimating the binary equation above, one issue which could influence my results is the problem of attrition bias. This is not much of a problem in case of the export market, as the exit rates are very low, i.e., around 8-9 per cent and secondly, I clearly observe the firms who stop exporting in the years following the foreign regulation. But, as for the domestic regulation, it is difficult to comment whether the firm is actually

exiting the market or just the sample. For example, a firm might become too small due to the regulation and does not report their values or may even do a product switching. Nonetheless, the results would still portray a true and clear picture about the effects of the technical regulations on the dynamics of the Indian leather and textile industries, as I focus on the firms, which survive the aftermath of these purely exogenous shocks.

5.2 Results

A regulation can affect an establishment for a variety of reasons:- impact on the choice of technology, production scale, investment behaviour, changes in revenues and costs (e.g., due to acquisition of more capital), choice of inputs, etc. These changes in a firm's structure due to compliance with a regulation could act as potential barriers, thereby decreasing their chance of survival. Biorn et al. (1998) studies the correlation between environmental regulations and plant exit for three manufacturing sectors in Norway in order to find that firm characteristics play an important role in the exit probability of a firm. Therefore, following the imposition of these binding environmental regulations—both international and domestic—I raise the following important concern: do these environmental regulations (acting as a trigger) significantly impact the exit decision of the firms, through different choice variables?

Table 4 discusses the results from the conditional probit estimation. Columns (1) - (6) estimate the survival probabilities of a firm as a result of German regulation in 1994. Column (1) regress the exit decision of a firm on the interaction of the natural logarithm of import of raw materials and $Post * ltd$. The result shows that use of imported raw materials significantly affects the exit decision of a firm. The estimate is significant at 1 per cent level. In particular, higher expenditure towards import of raw materials entails low exit probability. In other words, the estimates indicate that at the mean, a surviving firm spent 0.15-2.17 per cent more in comparison to a non-survivor on account of imported raw materials. It does so in order to comply with the 1994 regulation and to continue its operation in the international market. Since the export-market regulation is completely demand-driven, a firm which does not use the new substitutable chemicals faces a rejection in the testing procedure leading to return of the shipments. This forces a firm to discontinue its operation from the export market. Column (2) additionally introduces the amount of technology adopted by a new firm. I define technology adoption as the sum of expenditure on R&D and royalty payments for technical knowhow. I fail to find any significant effect of the technology adoption by a leather and textile firm on its exit decision. My primary result continues to hold. I take a step further to separate the components of technology adoption and run separate regressions. I fail to find any significant effect of the components affecting the exit decision.

Column (3) examines whether productivity of a firm has any effect on the exit decision. I do not find any such evidence. As the results demonstrate, my initial result continues to hold at 1 per cent level of significance. Change in the input mix may also induce changes in the production process. This could force firms to make alterations in the capital employed and expenditure towards machinery used for production. In order to account for these changes, columns (4) and (5) introduce expenditure on account of plant and machinery and capital employed (another size indicator). I continue to find no significant evidence of any other factor except for the import of raw materials on the exit decision of the firms. In column (6), I substitute import of raw materials with expenditure on use of domestic raw materials controlling for the technology adoption of the firms and the level of productivity. I do not find any effect of the use of the domestic raw materials. However, I find higher adoption of technology and higher productive firms entail low exit probabilities.

I repeat the same exercise in columns (7) - (12) in response to the 1997 MoEF, Govt. of India notification. Column (7) uses the same regression as of column (1) with the dependent variable taking the value 1 if a firm's domestic sales is zero in the year 1998 or 1999. I do not find any significant of the imported raw materials on the exit decision as a result of the domestic regulation. Columns (8) - (12) do the same set of estimations as (1) - (6) but by substituting expenditure on imported raw materials with domestic raw materials. I find some evidence of higher expenditure on raw materials from domestic sources implying lower exit probabilities. In addition, the results also demonstrate that higher productive firms have lower probabilities of exit.

6 Heterogeneity

6.1 Empirical Strategy

This section aims to test whether the effect of the regulations is heterogeneous. I test the effect of the regulations on the size distributions of the firms. In order to do so, I divide the entire sample of firms into four different quartiles, according to the total assets of a firm. I consider total assets as the size indicator of the firms. The different size categories of firms are indicated by a dummy variable. For example, if the total assets of a particular firm fall below the 25th percentile of the total assets of the industry, then that firm belongs to the first quartile and the variable would indicate 1 for that particular firm, and zero otherwise. Likewise, if a firm's total assets fall between 25th percentile to 50th percentile, 50th percentile to 75th percentile and above 75th percentile, the firm belongs to the categories of second, third and fourth quartile, respectively. I interact different quartile dummies with the respective regulation and leather and textile sector dummies

in order to measure the effect of an environmental regulation on that particular quartile of firms. I estimate the effects on the different quartiles of the firms in two separate ways:

(a) I estimate the impact of the regulations for the four different quartiles on the three important firm-level outcomes – exports, import of raw materials and royalty payments on technical knowhow using the following equation:

$$\ln(x_{ijt}) = \beta^r \sum_{r=1}^4 (Post_{jt} * ltd_{ijt} * Q_{it}^r) + \varphi^r \sum_{r=1}^4 Q_{it}^r + \gamma(Post_{jt} * ltd_{ijt}) + firmcontrols + \theta_i + \nu_t + \epsilon_{ijt}$$

where r indexes each of the four different quartiles of the size distribution and Q_{it}^r are dummy variables taking the value of 1 when firm i belongs to quartile r .

(b) secondly, I investigate the direct impact of the regulations on the discontinuing decisions of the firms across different quartiles:

$$\Pr(X_{ijt} = 0 \mid X_{ijt-1} > 0) = 1 \text{ if} \\ \beta^r \sum_{r=1}^4 (Post_{jt} * ltd_{ijt} * Q_{it}^r) + \varphi^r \sum_{r=1}^4 Q_{it}^r + \gamma(Post_{jt} * ltd_{ijt}) + \mu_j + \nu_t + \epsilon_{ijt} = 0 \\ = 0 \text{ otherwise}$$

The dependent variable used in the estimating equation above is same as in Section 5. I use the entire manufacturing sector minus the chemical as the control group in all the estimations above. Firms could change their position (quartiles) over the period of operation and this may endogenize my estimates. To control for this, I run the above regressions by using the average rank of the firms over all the years of my dataset, 1990-2002. To test for the robustness, I also use the rank of the firms in the base period of the analysis, i.e., 1990. But, the results do not change. For both type of estimations, I continue to cluster the standard errors at the firm level.

6.2 Results

6.2.1 Effect of the Regulations

Table 5 estimates the effect of both the 1994 German and 1997 MoEF, Govt. of India regulation on export earnings, import of raw materials and technology transfer by varying firms according to their size distribution. Columns (1) and (2) regress the natural logarithm of exports plus one on the interactions of the four different quartile dummies

with *Post * ltd.* The results demonstrate that the effect of the regulations is indeed heterogeneous⁶. The increase in export earnings as a result of the regulations is concentrated only on the upper-middle and big firms of the size distribution, i.e., the 3rd and 4th quartile of firms. Big exporters enjoy considerable advantages in their economies of scale. This helped them to comply with the regulations using the new high-quality inputs and/or upgraded production process, thereby earning more revenue from exports. On the other hand, the results show that the firms belonging to the 2nd quartile experiences a significant decline in their export earnings, but only in case of the domestic regulation.

Next, in columns (3) and (4), I use the import of raw materials as the dependent variable. I find that the regulations significantly increases the import of high-quality raw materials for the big leather and textile firms, i.e., only for firms, which belong to the 4th quartile. The estimates are significant at 1 per cent level. Drawing reference from my earlier result in columns (1) and (2), it can be argued that this use of high-quality imported substitutable raw materials helps the firms of 4th quartile to achieve higher growth in exports in the post-regulation phase through quality signal in their products. Lastly, I use natural logarithm of royalty payments on account of technical knowhow as the dependent variable in columns (5) and (6). As the result demonstrates, the effect of the regulations on the technology transfer is positive and significant for the firms belonging to the upper-middle size cohort of the firm size distribution, i.e., the firms of the 3rd quartile. This result regarding the transfer of technology concentrating on the upper-middle size cohort of firms as a result of some exogenous trade-related shock is outstandingly similar to the benchmark result of Bustos (2010), even though she uses a completely different context and dataset. However, both Yeaple (2005) and Bustos (2010) points out that a reduction in trade cost increases the use of the most advanced technology by the firms who export. The findings I present are similar in one sense but quite the opposite in the other – in this case, increase in trade cost forces the firms to use new technology. Tewari and Pillai (2005) points out that in the adjustment process, there is significant evidence of technical transfer from the standard-imposing country, which is Germany, to India. The IGEP made a significant role in providing the firms with adequate help to adapt to changes in the technical and environmental standard put forwarded by the regulations. Additionally, the Netherlands also provided technical assistance. Between October 1996 and January 1997, Centre for the Promotion of Imports from Developing Countries (CBI) in the Netherlands, together with a Dutch independent consultancy, CREM, jointly organised a series of workshops, which aimed at preventing the azo dye legislation from becoming a trade barrier to developing country exporters (OECD, 1997). The United Nations Industrial Organisation (UNIDO) also has been one of the most pro-active intergovernmental organisations in providing technical

⁶The probability that the coefficients for four different quartiles being equal is zero.

assistance to leather industries (OECD, 2006b). As a continuation of the significant technical assistance at the firm-level, a new, internationally certified testing centres, such as Asia’s first ISO-17025 certified testing and certification laboratories is established in 2001. It could result in important spillover gains for both the industries. These findings recommend that the involvement of the state—both Germany and India—made a crucial difference to the degree and speed of compliance.

To check whether the adoption of the new technology did actually result in the increase in gains from trade by the upper-middle size cohort of firms, I regress the natural logarithm of exports on the interaction of the quartile, sectoral and regulation dummies ($Post_{jt} * ltd_{ijt} * Q_{it}^r$) with the natural log of payments towards technical knowhow. The result points out that the technology transfer for the 3rd quartile of firms in the post-regulation period is indeed the most important and significant reason behind the increase in exports for this set of firms (results not reported).

6.2.2 Effect of the Regulations on the Exit Decision

Columns (1) and (2) of **Table 6** display the direct effect of the regulations, export and domestic respectively, on the survival probabilities of the leather and textile firms of different sizes. I do this in order to find out the heterogeneity in the survival probabilities of the firms. I investigate the required effect by using a conditional probit regression with a full set of industry and year fixed effects. My variables of interest are the interaction terms of four different quartile dummies with $Post * ltd$. The coefficients of these interaction terms measure the variance in the effect of the regulations on different sizes of the leather and textile firms. The results from column (1) suggest that the export regulation of 1994 has lead to a sorting effect. In other words, the negative impact of the regulation is significant only in case of the firms belonging to the 1st quartile. These are typically the small firms, hit the hardest by the foreign regulation forcing them to stop exporting and exit the market. Field-level reports by TERI (2005) also suggest severe impact of the ban on small enterprises. The regulation acts as an insurmountable trade barrier, which results in great loss of export markets for the small exporting firms. Many problems, such as poor understanding of environmental issues, asymmetric information on international regulations, not enough access to import of high quality raw materials or new domestically produced input, limited technical knowhow etc. may have played a role in the exit decision of the small firms.

In the post-regulation period, many German or E.U. importers of leather and textiles goods demand that the suppliers should certify their products to be azo-colourant free. And, in India, since many firms are located in semi-urban areas, they do not have any access to these testing laboratories. Also, these firms have very limited technical knowledge

and not willing to change their ways of production even if the information transfer issues are solved. This left with no choice for German importers but to opt to buy from the large firms instead. This led the gains from trade to be concentrated only on the big firms. On the other hand, the gains also got amplified as a result of the use of high-quality imported raw materials and technical upgradation by the upper-middle and big firms of the size distribution. This process of upgradation also helped the upper-middle and big firms to survive in the export market and retain their international competitiveness. Another important factor that could have a role in the adjustment process of the small firms is the difficulty in detecting exactly where the new chemicals should enter the value chain mainly due to their decentralised character.

This particular result about the sorting effect draws support from the finding of Pavcnik (2002), where she argues that the drop in tariffs help to reallocate resources from the small firms to the big firms. I find the exact result, but not in case of a fall in trade cost, but for a rise in some kind of trade cost. To check whether the result regarding the sorting effect is true, i.e., there is a reshuffling of resources from the small to the large firms, I do the following simple exercise using Pavcnik (2002) and Olley and Pakes (1996). First, I compute aggregate industry-level productivity measures for each year. Next, I decompose the productivity measure into two parts – the unweighted aggregate productivity measure (\bar{pr}_t) and the total covariance between a firm’s share of the industry output and its productivity ($(s_{it} - \bar{s}_t)(pr_{it} - \bar{pr}_t)$) by the following equation:

$$\omega_t = \sum_i s_{it}pr_{it} = \bar{pr}_t + \sum_i (s_{it} - \bar{s}_t)(pr_{it} - \bar{pr}_t)$$

where the bar over a variable denotes a mean over all the firms in a given year. The covariance is the contribution to the aggregate weighted productivity resulting from the reallocation of resources across firms of different productivity levels. If the covariance is positive, it means that there is a reallocation of resources towards the big or the efficient firms. I find the covariance term to be positive following the year of the export regulation (results not reported). I also computed it for the exporters. The result stays the same – the covariance term is positive and increasing in the post-regulation period.

I now shift my attention to the domestic regulation. Column (2) regress the exit decision of a firm from the domestic market as a result of the 1997 MoEF, Govt. of India regulation on different size categories of firms. I find that all the size quartiles of firms are significantly affected. Unlike my previous result, the effect increases with the firm size – the big firms are more affected than the small firms. But, this does not say whether the firms actually exits the market or stops producing the product. Lipscomb (2008) reports evidence of product-switching by firms as a result of state-level environmental

enforcement in India. Secondly, the big firms are usually the exporters who already have adjusted themselves in response to the foreign regulation. Therefore, the firms of the 3rd or the 4th quartile which are affected as a result of the domestic regulation are more likely to be the medium-sized enterprises in absolute terms rather than the usual big ones.

7 Upstream Effects

This section uses data on chemical firms, which produce dyes, to measure the upstream effects of the regulations. In other words, I would like to check whether there is any spillover effect of the environmental regulations and if any, will further corroborate my findings I demonstrate so far. The MoEF bans the complete production and import of the harmful chemical (Azo-dyes) in 1997. By doing so, it effectively, though inadvertently, turns the input industry, in this case the chemical companies, into de facto diffusers of environmental compliance (Tewari and Pillai, 2005). In addition, the domestic regulation in 1997 also indirectly shifts the impetus of enforcement from the state-level to private stakeholder agencies, which are now directly at the firing line. Facing a zero demand for one of their crucial products, the chemical companies opposes the government's ban to begin with. But, due to widespread demand for the new, safer dyes among the leather and textile firms, the chemical firms start experimenting with development of the substitutes and also offered technical assistance to adapt them smoothly as well as efficiently.

To check for these possible spill-over or upstream effects, I concentrate on two firm-level attributes – domestic sales and R&D expenditure of chemical firms. The reason: as a result of the regulations, the chemical firms initially experiences a decline in demand for the input—the one, which has been banned—particularly from the leather and textile industries. This primarily corresponds to a negative effect on their domestic sales. Facing a potential loss resulting from the drop in demand, the chemical firms start developing new chemicals, working closely with their clients (the leather and textile firms, who are the users of their products) by showing them samples, giving them chemicals on credit and offering technical assistance, all as a way to increase sales. Therefore, I should find no net effect on the domestic sales of the chemical firms – the simultaneous decrease after the ban and the consequent increase as a result of the innovation of the safe improved dye cancels out. On the other hand, the decision to produce the new suggested/substitutable input for subsequent use in the leather and textile industries should render a positive effect on the R&D expenditure of the firms. **Table 7** produces the required result.

Columns (1) - (4) focus on domestic sales, whereas (5) - (8) use R&D expenditure as the dependent variable. I use the entire manufacturing set of firms minus the leather and textiles sector as the control group in my estimations. In accordance with my conjecture,

I do find no effect of the regulations on the domestic sales of the chemical firms. I take a step further to divide the firms into four different quartiles by size to see if there is a difference in the behaviour. And indeed, there is. The small firms do suffer a negative impact on the domestic sales, but the effect is limited only in case of the 1994 German regulation.

Now, I turn my attention to the case of product innovation through R&D investments by chemical firms. I find significant and strong positive evidence of product innovation in case of both the regulations. The effect is significantly higher in case of the foreign regulation. In other words, the regulations by Germany and Govt. of India is effective in the sense that it forces the input supplier or the upstream firms to innovate and on the other hand also lowering the costs of compliance through proper diffusion of the quality standards among the leather and textile industries (Pillai, 2000). The effect is significantly higher in case of the export regulation. Lastly, on dividing firms by size I find significant evidence of R&D investments for firms, which belong to the 3rd quartile or upper-middle size cohort of firm distribution. This product innovation propels the large firms to re-capture the domestic market and help minimizing the loss in the net revenue. However, this is not the case for the small firms (as shown by the previous result).

Tewari and Pillai (2005) reports the presence of several subsidiaries of multinational firms in the chemical sector of India. This presence of multinational firms could very well drive the aggregate results reported above. To check, I divide the firms according to their ownership and run the estimations reported in columns (1) - (2) and (5) - (6) (results not reported). The foreign firms experience significant increase in their aggregate domestic sales as compared to the domestically-owned firms (for which I do not find any significant net effect). On the other hand, in case of the R&D investments, it is the opposite. In other words, I find significant and positive effect for the domestic firms vis-a-vis the foreign firms. This result reinforces the earlier result about the effect of the regulations on the domestic sales. The substitutable chemicals are readily available with the foreign multinationals, so they experience a surge in their domestic sales in the post-regulation period without investing in R&D. This was not the case with the domestic firms.

8 Sensitivity Analysis

Table 8 produces some robustness checks using different techniques and different samples. I report results only for the export earnings of a firm. In columns (1) and (2), I interact industry and time fixed-effects to control for industry-level unobservable heterogeneity which vary over time. In particular, the interacted fixed effects will control for the yearwise phasing out of the quotas in regard to the MFA. As the result demonstrates, the

interaction of the industry and year fixed effects does little to alter the primary result. I continue to find significant and positive effect of the 1994 regulation on exports of leather and textile firms. However, I do not find any significant effect in case of the 1997 domestic regulation.

Even though the interaction of the industry and year fixed effects should control for the confounding effects of the MFA phase-out on the aggregate (leather and textile) export revenues, it could still be possible that I am picking up the effect of the MFA, unless I divide my sample and separately estimate the effect of the regulations on the leather and textile firms individually. A significant effect on the leather exporters' revenues would reject the null hypothesis that the aggregate effect is driven by the MFA phase-out. Columns (3)-(4) use only the textile firms as the 'treated' group, whereas columns (5) and (6) employ only the leather firms. The results show that the relative increase in the export earnings of the leather and textile firms over the period of 1990-2002 is a significant causal effect of the 'Azo-dye' ban on earnings.

In columns (7) and (8), I deal with the problem of zeroes. For all the previous estimations in the paper, I use natural logarithm of dependent variable plus one to estimate the model in percentage changes. I understand that dealing with zeroes is a huge issue and the plus one method is somewhat arbitrary. One standard way to deal with the situation is to instead estimate using a Poisson Pseudo-Maximum Likelihood (PPML) following Silva and Tenreyro (2006). Like logging the dependent variable, PPML estimates the coefficients in terms of percentage changes. On the other hand, unlike log, PPML is able to handle zeroes. PPML gives consistent point estimates for a broad class of models: the dependent variable does not have to follow a Poisson distribution or be integer-valued (it can be continuous). I estimate the standard errors using Eicker-White robust covariance matrix estimator. As the point estimates demonstrate, both the regulation induces significant gains from exports.

Column (9) uses both the regulation dummies. I do not find any difference in the outcome from my earlier results. Exports increased as a result of the 1994 regulation. Column (10) conducts a placebo test, using an ex-ante ex-post approach to prove that the 1994 regulation is not endogenous. It could be possible that some of the exporters, who are the members of some importers organisation, knew about the 1994 regulation before. Therefore, they may have adjusted themselves according to the modalities of the regulation, thereby having a positive impact on the export earnings in the post-regulation period. I argue that this is not the case. I use two ex-ante variables, $Ban94(t - 3)$ and $Ban94(t - 2)$, which takes value 1 for all the year less than three and two years of the regulation, respectively. I also use ex-post variables, $Ban94(t + 2)$ and $Ban94(t + 3)$, which takes a value 1 for the year greater than two and three years of the regulation.

The results show that the ex-ante estimates are less than the concurrent effect of the regulation, whereas ex-post estimates portray some kind of amplification effect of the *Ban94*, proving that the regulation is not endogenous. In columns (11) and (12), I use a different control group. In particular, I look for a control group, which is within the leather and textile sector and is outside the purview of the ban. Though, it is not clearly mentioned anywhere that which sector within the leather and textiles group is not impacted by the ban. But, a careful reading points out that the man-made fabric sector (within textiles) and footwear (within leather) could act as a possible control group. I find my estimates to be significant and positive. Lastly, in column (13) I check the effect of the 1994 ‘Azo-dye’ regulation on the productivity of a leather and textile firm. I estimate the productivity using Levinshon and Petrin (2003) methodology⁷. I continue to use the other manufacturing sectors less the chemical as the control group. As the result shows, I do not find any effect of the ‘Azo-dye’ regulation on the productivity of a leather and textile firm at the aggregate.

9 Conclusion

This paper investigates the trade, adaptation and exit effects of the imposition of a purely exogenous technical standard or trade-related environmental regulation, specifically designed for the Indian leather and textile firms. It exploits firm-level data from leather and textile manufacturing sector to present evidence, which is at odds with the prevalent view of environmental compliance and trade competitiveness of firms from developing countries. In particular, I find that regulations lead to significant increase in gains from international trade for both the leather and textile firms, especially in case of the foreign regulation. The gains in trade is realised on the basis of a signalling effect through the use of high-quality raw materials. Exploring the effect on the adaptation cost of the firms, I find significant increase in the expenditure towards usage of import of raw materials as a result of the regulation. Regulation, on average, acts as a barrier and when emerged from a buyer in the international market, can be termed as a trade cost, which can impact firm survival. I investigate the impact of the regulations on the exit probabilities of firm. Higher use of imported raw materials entail low exit probabilities in case of foreign regulation, whereas, high productivity firms are the survivors for the domestic regulation. On dividing the firms by size, I find that the increase in revenue from exports are concentrated only on the upper-middle and big firms of the size distribution. This gain is a result of the increased use of imported raw materials (firms of 4th quartile) and use of new production technology (3rd quartile firms). I also find that the foreign regulation led to sorting effect - led to the discontinuation of the small firms from the export market.

⁷Please see Levinshon and Petrin (2003) for details.

Lastly, I find significant evidence of the product innovation, but in case of the upstream or chemical firms.

There is considerable debate about whether regulations or standards do help or hurt the competitiveness of firms. And, this paper is a small empirical contribution to this continuously growing literature. Though this paper does not test Porter's hypothesis (1995) directly, but it explore issues somewhat similar. The results go beyond the assumed trade-off between the compliance and the competitiveness of the firms and prove that firms from developing countries can also comply with stringent global standards that are increasingly becoming associated with trade, without necessarily undermining their competitiveness. One problem that could have hindered the performance of the firms is the non-motivation of the state to comply or the jurisdictional battles, which often complicate the effective implementation and enforcement of standard. The argument is that the political weakness of the state and its limited administrative and technical capacity could pose a threat to the effective diffusion of new norms and standards (Dasgupta, 2000). But, it was not the case for India. The Govt. of India's matching regulatory action in response to the embargo by Germany is also an important component in the transformation of the firms. Nonetheless, in the context of these reforms, India not only promoted the quality of production for the domestic market but also for exports in order to obtain the necessary foreign revenue for development and investments. And, in the process, the leather and textile industry played an important role. Finally, the study adds further fuel to the debate of environmental regulations and trade with the regulations helping those Indian industries to upgrade and making their presence felt in the global market in the background. According to an interview conducted by Tewari and Pillai (2005) in Indo-German Export Promotion Project in New Delhi, April 2003, there is a general agreement that India had taken case of its Azo-dye problem and emerged as a model in the international circles, especially among its competitor countries, such as China, Pakistan.

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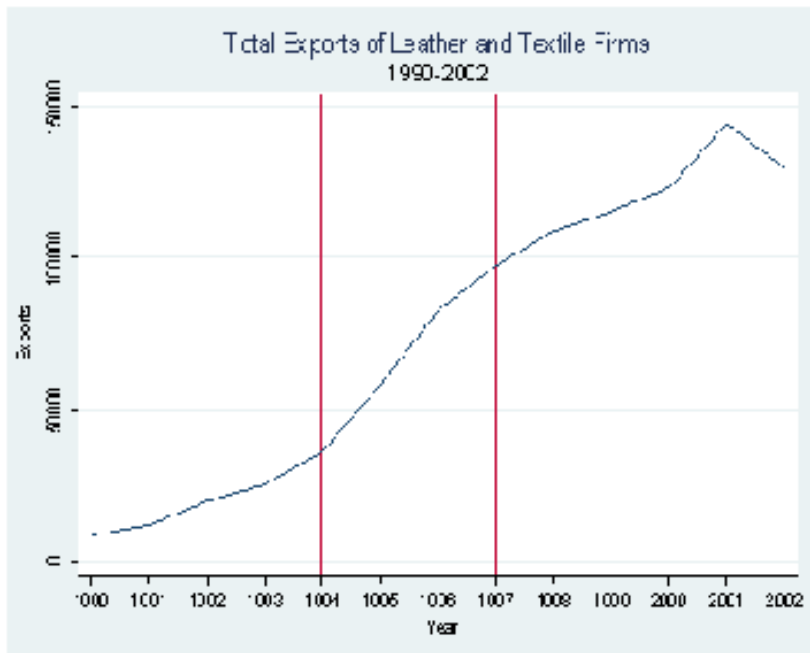


Figure 1 Exports of Indian Leather and Textile Firms, 1990-2002

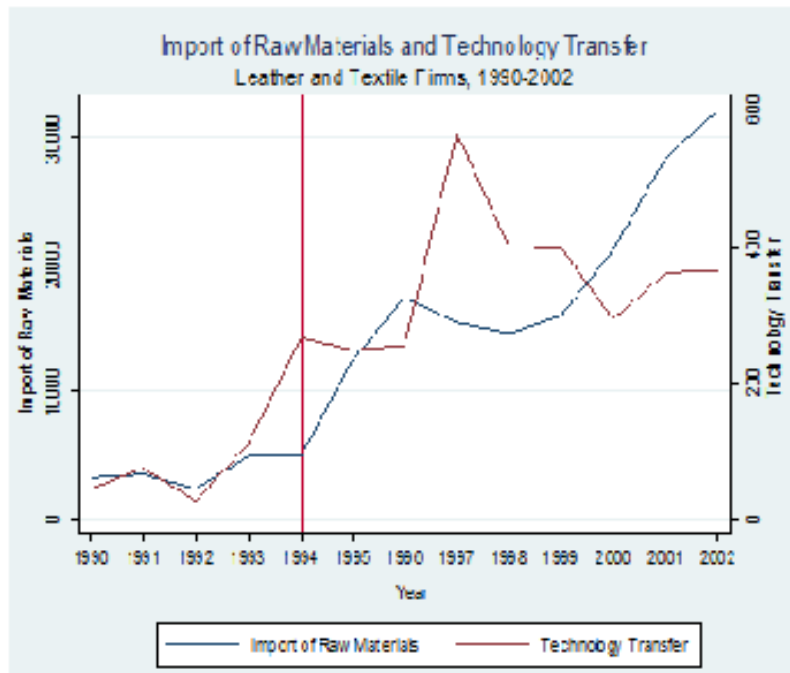


Figure 2 Import of Raw Materials and Technology Transfer of Indian Leather and Textile Firms, 1990-2002

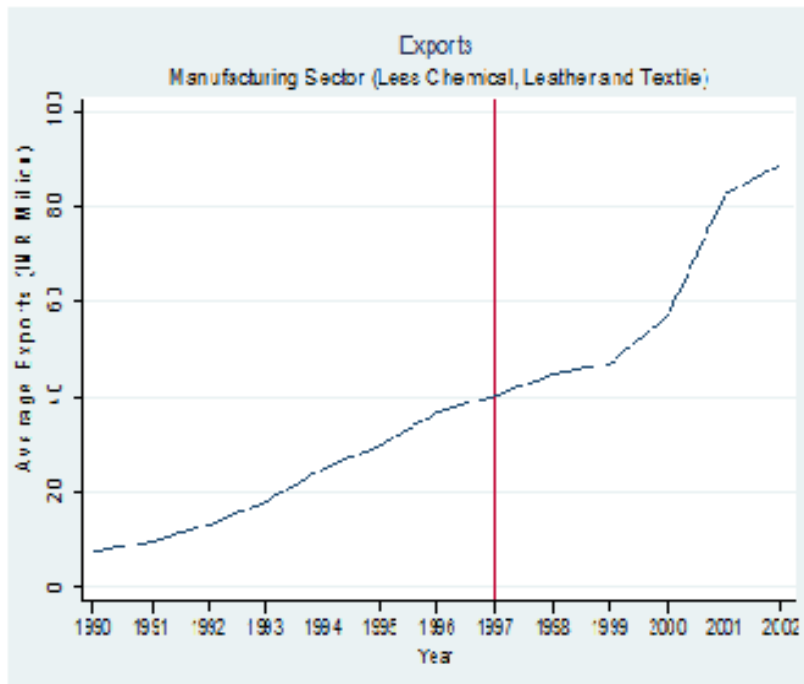


Figure 3 Exports of the Control group - Manufacturing Sector Less Chemical, Leather and Textile Firms, 1990-2002

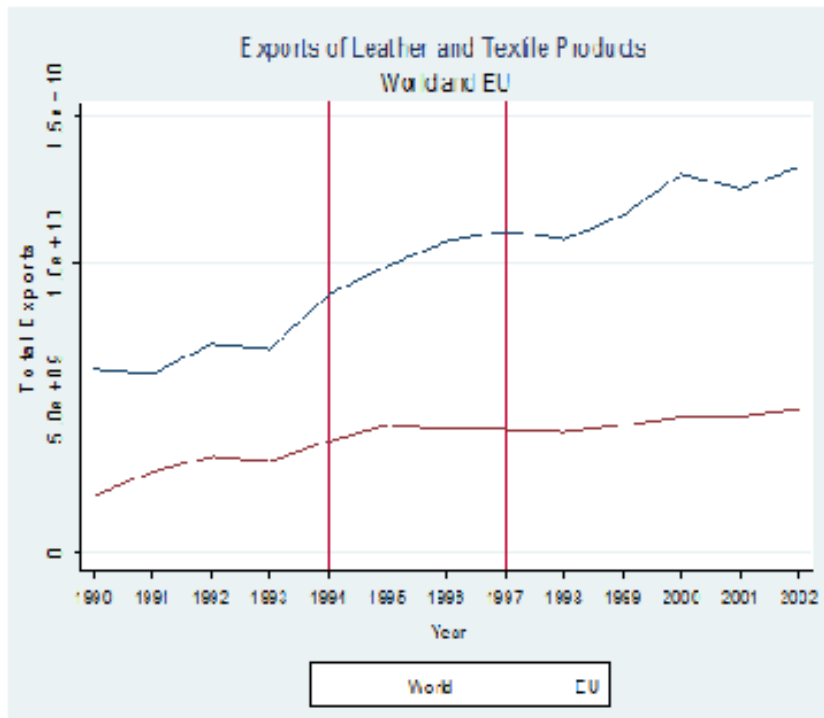


Figure 4 Total Exports of Indian Leather and Textile Products to the World and EU, 1990-2002

All Leather and Textile Firms				
	1994 Regulation		1997 Regulation	
	1990-1994 Pr e-Ban	1995-2002 Post-Ban	1990-1997 Pr e-Ban	1998-2002 Post-Ban
Total Sales	20.80	27.84**	59.43	84.43*
Exports	3.04	10.59***	4.39	6.28*
Import of Raw Materials	1.22	2.31***	9.92	18.62*
Expenditure on Raw Material (Domestic)	7.21	9.70*	23.42	33.07**
Expenditure on Technology Transfer	0.09	0.10	0.30	0.30
Expenditure on R&D	0.10	0.07*	0.28	0.35**
Expenditure on Plant & Machinery	0.19	0.25**	0.47	0.77*

Notes: Figures are the simple averages (deflated by the wholesale price index number) over all the leather and textile firms. Values are expressed in INR Millions. *, **, *** denotes significance at 10%, 5% and 1% level, respectively.

Table 1: Comparison of Firm-level Characteristics - Before and After the 1994 and 1997 Regulation

	Exports							
	Export Regulation				Domestic Regulation			
	OLS		ATE		OLS		ATE	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LnTdu*Ban94	1.013 ^a (0.077)	0.289 ^a (0.087)	0.299 ^a (0.087)	0.975 ^a (0.043)				0.913 ^a (0.053)
Ban94	-0.078 ^b (0.031)	0.084 ^b (0.034)	-0.110 (0.145)					
LnTdu*Ban97					1.030 ^a (0.084)	0.126 ^c (0.073)	0.128 ^c (0.073)	
Ban97					-0.157 ^a (0.029)	-0.199 ^a (0.029)	-0.073 (0.145)	
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-square	0.342	0.824	0.825	0.825	0.335	0.824	0.825	
N	36769	36769	36769	36769	36769	36769	36769	36769
Firm FE	No	Yes	Yes	No	No	Yes	Yes	No
Year FE	No	No	Yes	No	No	No	Yes	No

Notes: The dependent variable is the natural logarithm of exports plus 1. LnTdu is a dummy variable, which takes a value 1 if the industrial sector is Textiles, Apparel and Leather. I use the entire manufacturing sector less the chemical as the control group. Ban94 and Ban97 are regulation dummies which takes a value 1 when the year is greater than 1994 and 1997, respectively. All the regressions include the individual terms of the double interactions. Firm controls include age of a firm, age squared, ownership indicator (either domestic or foreign) and size of a firm. I use total assets of a firm as its size indicator. Numbers in the parenthesis are clustered standard errors. Standard errors are clustered at the firm level. ^c, ^b, ^a denotes 10%, 5% and 1% level of significance. Intercepts are not reported.

Table 2: Effect of the Bans on Exports

	Import of Raw Materials			Technology Transfer				
	Export Regulation	Domestic Regulation	Export Regulation	Domestic Regulation	Export Regulation	Domestic Regulation		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LnTDu*Ban94	0.290 ^a (0.100)	0.294 ^a (0.101)			0.003 (0.212)	0.017 (0.207)		
Ban94	0.138 ^a (0.034)	-0.085 (0.175)			0.075 (0.059)	0.501 ^c (0.261)		
LnTDu*Ban97			0.251 ^a (0.086)	0.256 ^a (0.085)			0.071 (0.241)	0.061 (0.243)
Ban97			-0.180 ^a (0.033)	-0.088 (0.175)			-0.056 (0.063)	0.499 ^c (0.262)
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-square	0.847	0.848	0.847	0.848	0.760	0.762	0.760	0.762
N	18483	18483	18483	18483	4932	4932	4932	4932
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes

Notes: Columns (1)–(4) use natural logarithm of import of raw materials by a firm plus 1 as the dependent variable, whereas columns (5)–(8) use natural logarithm of payments towards technology transfer plus 1 for the same. LnTDu is a dummy variable, which takes a value 1 if the industrial sector is Textiles, Apparel and Leather. I use the entire manufacturing sector less the chemical as the control group. Ban94 and Ban97 are regulation dummies which takes a value 1 when the year is greater than 1994 and 1997, respectively. All the regressions include the individual terms of the double interactions. Firm controls include age of a firm, age squared, ownership indicator (either domestic or foreign) and size of a firm. I use total assets of a firm as its size indicator. Numbers in the parenthesis are clustered standard errors. Standard errors are clustered at the firm level. ^a, ^b, ^c denotes 10%, 5% and 1% level of significance. Intercepts are not reported.

Table 3: Effect of the Bans on Import of Raw Materials and Technology Transfer

	Exit Decision											
	Export Regulation						Domestic Regulation					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
LnTDu*Ban*IRM	-0.002 ^a (0.001)	-0.022 ^c (0.024)	-0.002 ^a (0.001)	-0.004 ^a (0.003)	-0.003 ^b (0.003)	-0.001 (0.001)	-0.001 (0.001)	-0.002 ^a (0.001)	-0.0003 (0.000)	0.002 (0.001)	-0.007 (0.006)	-0.0001 ^a (0.001)
LnTDu*Ban*DRM						0.002 (0.002)						0.001 ^a (0.001)
LnTDu*Ban*TA		-0.015 (0.023)				-0.001 ^b (0.001)						-0.002 ^b (0.002)
LnTDu*Ban*TFP			0.002 (0.003)	0.005 (0.006)	0.002 (0.003)	-0.003 ^b (0.002)			-0.002 ^a (0.000)	-0.002 ^b (0.001)	-0.001 (0.003)	-0.001 ^a (0.001)
LnTDu*Ban*PM				0.001 (0.002)	0.001 (0.002)					-0.001 (0.001)	-0.0004 (0.001)	
LnTDu*Ban*Cap				-0.003 (0.003)							0.006 (0.004)	
R-square	0.085	0.090	0.107	0.085	0.096	0.091	0.208	0.178	0.153	0.112	0.158	0.277
N	428	15	394	170	170	548	474	1554	1254	688	197	560
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Since, the decision is either stay or discontinue, our dependent variable is either 0 or 1. I analyse using conditional Probit regressions. Marginal Effects are reported. LnTDu is a dummy variable, which takes a value 1 if the industrial sector is Textiles, Apparel and Leather. I use the entire manufacturing sector less the chemical as the control group. I use Ban94 and Ban97 as the export and domestic regulation dummy, respectively. Ban94 takes value 1 when the year is greater than 1994. Ban97 takes value 1 if the year is greater than 1997. IRM is the amount of raw materials imported by a firm. DRM is the expenditure on raw materials used from domestic sources. TA is the amount of technology adoption of a firm. Technology Adoption is the sum of research and development expenditure of a firm and technology transfer. TFP is the total factor productivity of a firm. It is measured with Levinshon and Petrin (2003) methodology. PM is the amount of expenditure on the repairs of plant and machinery by a firm. Cap is the amount of capital employed by a firm its production process. All the firm characteristics are used in their natural logarithm form. All the regressions include the individual terms of the double interactions and double interaction terms of the triple interactions. Numbers in the parenthesis are clustered standard errors. Standard Errors are clustered at the firm-level. ^a, ^b, ^c denotes 10%, 5% and 1% level of significance. Intercepts are not reported.

Table 4: Effect of the Bans – On the Survival Probabilities of the firms

	Exports		Imp of RawMat		Technology Transfer	
	Export (1)	Domestic (2)	Export (3)	Domestic (4)	Export (5)	Domestic (6)
1stQr*LnTDu*Ban94	-0.087 (0.122)		0.066 (0.234)		0.170 (0.274)	
2ndQr*LnTDu*Ban94	0.069 (0.100)		0.165 (0.140)		0.008 (0.230)	
3rdQr*LnTDu*Ban94	0.254 ^b (0.111)		0.206 (0.139)		0.478 ^b (0.189)	
4thQr*LnTDu*Ban94	0.677 ^a (0.139)		0.364 ^a (0.124)		-0.084 (0.251)	
1stQr*LnTDu*Ban97		-0.180 (0.123)		-0.121 (0.203)		0.304 (0.456)
2ndQr*LnTDu*Ban97		-0.172 ^c (0.097)		-0.006 (0.156)		-0.032 (0.437)
3rdQr*LnTDu*Ban97		0.100 (0.122)		0.181 (0.137)		0.605 ^b (0.276)
4thQr*LnTDu*Ban97		0.463 ^a (0.127)		0.378 ^a (0.115)		-0.083 (0.290)
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
R-square	0.829	0.828	0.849	0.849	0.763	0.763
N	36769	36769	18483	18483	4932	4932
Coeff Eq (p-value)	0.000	0.000	0.563	0.127	0.011	0.063
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is the natural logarithm of exports plus 1. LnTDu is a dummy variable, which takes a value 1 if the industrial sector is Textiles, Apparel and Leather. I use the entire manufacturing sector less the chemical as the control group. Ban94 and Ban97 are regulation dummies which takes a value 1 when the year is greater than 1994 and 1997, respectively. Quartiles are defined according to the total assets of a firm. I use total assets as the size indicator. A firm belongs to 1st quartile if the assets of that firm is below 25th percentile of the total assets of that industry to which the firm belongs. A firm belongs to 2nd, 3rd and 4th quartile, if the total assets of a firm is between 25th to 50th percentile, 50th to 75th percentile and above 75th percentile, respectively. Firm controls include age of a firm, age squared, ownership indicator (either domestic or foreign) and size of a firm. I use total assets of a firm as its size indicator. All the regressions include the individual terms of the double interactions and double interaction terms of the triple interactions. Firm controls include age of a firm, age squared, ownership indicator (either domestic or foreign) and size of a firm. I use total assets of a firm as its size indicator. Numbers in the parenthesis are clustered standard errors. Standard errors are clustered at the firm level. ^{c, b, a}; denotes 10%, 5% and 1% level of significance. Intercepts are not reported.

Table 5: Effect of the Bans- Quartile Regressions

	Exit Decision	
	Exp Reg	Dom Reg
	(1)	(2)
1stQr*LnTDu*Ban94	-0.009 ^b (0.003)	
2ndQr*LnTDu*Ban94	-0.001 (0.004)	
3rdQr*LnTDu*Ban94	-0.0003 (0.004)	
4thQr*LnTDu*Ban94	-0.006 (0.003)	
1stQr*LnTDu*Ban97		-0.012 ^c (0.006)
2ndQr*LnTDu*Ban97		-0.017 ^a (0.005)
3rdQr*LnTDu*Ban97		-0.036 ^a (0.004)
4thQr*LnTDu*Ban97		-0.029 ^a (0.004)
R-square	0.052	0.060
N	5208	3906
Coefficient Equality (p-value)	0.001	0.004
Industry FE	Yes	Yes
Year FE	Yes	Yes

Notes: Since, the decision is either stay or discontinue, the dependent variable is either 0 or 1. I analyze using conditional Probit Regressions. Marginal effects are reported. Column (1) analyses the impact of the export regulation of 1994, whereas column (2) is concerned with the domestic regulation of 1997. Ban94 and Ban97 are export and domestic regulation dummy which takes a value 1 when the year is greater than 1994 and 1997, respectively. LnTDu is a dummy variable, which takes a value 1 if the industrial sector is Textiles, Apparel and Leather. I use the entire manufacturing sector less the chemical as the control group. Quartiles are defined according to the total assets of a firm. I use total assets as the size indicator. A firm belongs to 1st quartile if the assets of that firm is below 25th percentile of the total assets of that industry to which the firm belongs. A firm belongs to 2nd, 3rd and 4th quartile, if the total assets of a firm is between 25th to 50th percentile, 50th to 75th percentile and above 75th percentile, respectively. All the regressions include the individual terms of the double interactions and double interaction terms of the triple interactions. Numbers in the parenthesis are the clustered standard errors. Standard Errors are clustered at the firm-level. ^{c b a} , , denotes 10%, 5% and 1% level of

significance. Intercepts are not reported.

Table 6: Effect of the Bans on the Exit Decisions- Quartile Regressions

	Domestic Sales			R&D				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CheDu*Ban94	-0.034 (0.037)				0.074 ^a (0.025)			
CheDu*Ban97		-0.029 (0.035)				0.040 ^b (0.019)		
1stQr*CheDu*Ban94			-0.090 ^c (0.054)				0.006 (0.012)	
2ndQr*CheDu*Ban94			-0.084 (0.068)				0.019 (0.016)	
3rdQr*CheDu*Ban94			0.013 (0.070)				0.051 ^b (0.024)	
4thQr*CheDu*Ban94			0.034 (0.077)				0.071 (0.065)	
1stQr*CheDu*Ban97				-0.046 (0.058)				0.012 (0.019)
2ndQr*CheDu*Ban97				-0.023 (0.069)				0.013 (0.029)
3rdQr*CheDu*Ban97				0.032 (0.069)				0.025 ^c (0.015)
4thQr*CheDu*Ban97				-0.010 (0.064)				0.026 (0.055)
R-square	0.909	0.909	0.912	0.911	0.158	0.170	0.727	0.719
N	38098	38098	38098	38098	38114	38114	38114	38114
Coeff Equality (p-value)			0.000	0.000			0.000	0.000
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable in columns (1) - (4) is the natural log of domestic sales, whereas, in columns (5) - (8), it is R&D. Ban94 and Ban97 are export and domestic regulation dummy which takes a value 1 when the year is greater than 1994 and 1997, respectively. CheDu is a sector specific dummy which takes a value 1 if firm belongs to a chemical sector. I use manufacturing sector less the textile, apparel and leather sectors as the control group in my estimation. All the regressions include the individual terms of the double interactions. Quartiles are defined according to the total assets of a firm. I use total assets as the size indicator. A firm belongs to 1st quartile if the assets of that firm is below 25th percentile of the total assets of that industry to which the firm belongs. A firm belongs to 2nd, 3rd and 4th quartile, if the total assets of a firm is between 25th to 50th percentile, 50th to 75th percentile and above 75th percentile, respectively. Firm controls include age of a firm, age squared, ownership indicator (either domestic or foreign) and size of a firm. I use total assets of a firm as its size indicator. Numbers in the parenthesis are clustered standard errors. Standard errors are clustered at the firm level. ^{c, b, a} denotes significance at 10%, 5% and 1% level. Intercepts are not reported.

Table 7: Upstream Effect of the Bans

