Multiproduct Firms, Product Mix and Trade Reform:

Evidence from India*

Penny Goldberg	Amit Khandelwal	Nina Pavcnik	Petia Topalova
Princeton University	Columbia	Dartmouth College	Research Department
BREAD, NBER	Business School	BREAD, CEPR, NBER	IMF

January 2008
Preliminary Draft: DO NOT CITE

Abstract:

Recent theoretical models predict that, in addition to industry adjustment across firms, trade liberalizations may invoke a reallocation of output within firms via changes in product mix. This paper examines firms' product margin in India over the period of India's large-scale trade liberalization during the 1990s. On net, this margin is important as it contributes a quarter of total Indian output growth within the sample between 1989 and 2003. However, in contrast to evidence from the U.S, product churning—particularly the rationalization of products— is far less common in India. Firms do not appear to have adjusted their product mix in response to tariff declines on final goods. However, we do observe a robust relationship between tariff declines on intermediate inputs and an expansion in firms' product scope, suggesting that intermediate inputs may be an important component of India's tariff liberalization.

Keywords: Multiproduct firms, Product Mix, Trade Liberalization, India

*Please do not cite without authors' permission. We thank Matthew Flagge, Andrew Kaminski, and Michael Sloan Rossiter for excellent research assistance and to Andy Bernard, Pete Schott, and Steve Redding for comments and discussions.

Correspondence to Goldberg at pennykg@princeton.edu, Khandelwal at ak2796@columbia.edu, Pavcnik at nina.pavcnik@dartmouth.edu, or Topalova at PTopalova@imf.org.

1. Introduction

Micro-level empirical studies of firms have uncovered large heterogeneity in performance of firms within narrowly defined industries in developed and developing countries. Subsequent empirical and theoretical literature has emphasized gains in aggregate output that arise when policy shocks or changes in market fundamentals induce reallocation of resources from low to high performance firms within industries (see, for example, Baily, et. al. (1992), Dunne et. al. (1989a, 1989b), Roberts and Tybout (1996), Hopenhayn (1992) among others). International trade plays an important role in this process (see Melitz (2003), Bernard, Eaton, Jensen, and Kortum (2003), Melitz and Ottaviano (2008), and empirical work by Pavcnik (2002), Trefler (2004), Bernard, Jensen, and Schott (2006) as examples).[1] However, this literature predominantly treats each firm as producing a single product and abstracts from reallocation within multi-product firms through changes in product mix in response to shocks. Several recent models of trade suggest that firms might also change their product mix to adjust to changes in trade costs within industries (see Bernard, Redding, and Schott, henceforth BRS, (2006b), Eckel and Neary (2006), and Nocke and Yeaple (2006)). But the direct empirical evidence on the link between trade costs and firms' extensive product margin is scarce.[2]

The main objective of this paper is to extend this literature by examining whether Indian firms change their extensive product margin in response to India's large-scale tariff liberalization during the 1990s. The nature of this reform makes India an attractive setting for the study, in part because the reform was likely not anticipated by firms and tariff changes over 1991-1997 were likely not a result of the usual political economy process.[3] We are particularly interested in the within industry adjustment to trade reform because of the surprisingly little change in the structure of employment across industries in the aftermath of large trade liberalizations documented in several developing countries, including India (see, for example, Revenga (1997), Hanson and Harrison (1999), Feliciano (2001), Attanasio, Goldberg, and Pavcnik (2004), Currie and Harrison (1997), Topalova (2006), Wacziarg and Wallack (2004)). One potential explanation for this lack of change in the structure of employment, across industries, is that adjustment to trade reform occurs within firms through the product margin.

The focus on the firms' extensive product margin is relevant to the extent the changes in this margin account for a significant portion of changes in firms' output over time. Recent work by BRS (2006a, 2006b) has found that the contribution of the firms' product margin towards output growth

[1]Tybout (2003) provides an excellent survey.
[2]Baldwin and Gu (2006) examine responses of the product margin of Canadian exporters to lower U.S. tariffs in the aftermath of CAFTA.
[3]See section 2 and 5 for details.

trumps the contribution of firm entry and exit, a widely studied channel in the literature on firm dynamics. Product churning, on net, accounts for a third of the increase in U.S. output between 1972 and 1997 (BRS, 2006a). Evidence in BRS (2006a) suggests that product mix changes are potentially an important channel through which resources move from less to more efficient use *within* U.S. firms. Systematic analysis of firms' product margin is absent in the developing country context. Yet, countries at different stages of development exhibit sizable differences in the size distribution of firms and differences in efficiency of allocation of resources across heterogeneous firms (see for example Hsieh and Klenow (2006), Bartelsman, Haltiwanger, Scarpetta (2006), Restuccia and Rogerson (2007), Alfaro et. al. (2007)). Given the absence of systematic examination of the firms' extensive product margin in a developing country context, we thus first examine whether firms' extensive product margin and changes in product mix are in fact an important component of variation in output across Indian firms and over time.

To this end, our analysis relies on the information on Indian manufacturing firms from the Prowess, a firm-level panel database collected by the Center for the Monitoring Indian Economy (CMIE), which records data for medium and large firms in India. This data is not a manufacturing census, and therefore not suitable for studying firm entry and exit.[4] However, it contains detailed information about products that each firm produces from 1989 to 2003, which spans the period of India's trade liberalization. Throughout this paper, when we refer to extensive margin, we are referring to the additions or dropping of product lines within existing firms rather than entry and exit of firms.

We begin by documenting the characteristics of Indian multi-product firms in a cross section. Given the scant empirical evidence on multi-product firms, particularly for developing countries, data from BRS (2006a) on U.S. firms serve as a benchmark for our analysis. Along several dimensions, Indian multi-product firms appear quite similar to their counterparts in U.S. manufacturing. Within narrowly defined industries, India's multi-product firms are larger, more productive, and are more likely to export than single-product firms, just as the multi-product firms in the U.S. We find a striking resemblance of the distribution of products within the firm to the U.S. data. Finally, we also observe a positive correlation between the firms' extensive and intensive margin. These findings are consistent with theoretical models of multi-product firms, such as the model by BRS (2006b).

[4] Firm entry and exit are likely not an important margin for these larger firms (see, for example, Hopenhayn (1992), Melitz (2003), and empirical evidence in Dunne et. al. (1989a, 1989b) and Roberts and Tybout (1996)).

Our analysis furthermore suggest that the change in firms' product mix account on net for a non-negligible contribution (approximately 25%) of the increase in Indian manufacturing output within our sample over time. This validates the focus on firms' product margin in the subsequent empirical work on trade and product mix. But despite the above similarities in the cross section and in the contribution of net product margin over time in India and the U.S., the gross changes in product mix of Indian firms appear more distinct in the time series. BRS (2006a) uncover a substantial amount of product churning within U.S. firms: 70 percent of U.S. firms adjust their product mix over 5-year intervals. In contrast to the U.S., Indian firms infrequently drop a product or simultaneously add and drop a product. The contribution of the net product margin to total output growth is driven predominantly by product additions. Our results suggest that, product churning, or the "creative destruction" along the product dimension, does not appear an important feature of the Indian economy during the 1990s

The lack of product dropping observed in the data may on the surface appear inconsistent with predictions of recent models of trade and product mix. Most of these models predict product dropping in response to declines in trade costs. For example, BRS (2006b) extend the Melitz (2003) heterogeneous firm framework by allowing firms to draw both the standard firm ability, and productivity draw, which is common to all products, and a product expertise draw. The BRS (2006b) model yields self-selection of more productive firms into production (as in Melitz (2003)), and self-selection of products within firms. The framework predicts a positive correlation between a firm's intensive (output per product) and extensive margin (number of products), and we observe this feature in the Indian data. When the model is extended to the open economy, firms respond to symmetric trade liberalization in part by changing the number of products they manufacture. Lower variable trade costs induce firms to rationalize their extensive margin by shedding products with higher marginal cost of production. A multiproduct firm extension of Melitz and Ottaviano (2008), a model where product competition intensifies in response to foreign entry and that is perhaps better suited to study the consequences of unilateral trade reforms, also predicts that declines in trade costs are associated with firms dropping products (Baldwin and Gu (2006)).

Our empirical framework in section 5 that exploits differential changes in tariffs across Indian industries confirms the lack of relationship between declines on output tariffs and a firms' extensive margin—the number of products it manufactures—in India. This result might be somewhat surprising at first given the predictions of the abovementioned models of products and trade. However, these models feature frictionless factor markets. The lack of product dropping observed in India, could be potentially attributed to additional regulatory constraints (such as rigid

labor market regulation and remnants of industrial license policy) that continue to affect daily operations of Indian firms and potentially preclude the firms from eliminating unprofitable product lines. In fact, previous work finds that the relative rigidities imposed by India's industrial policy on manufacturing outcomes lower output and productivity in affected industries.[5] We plan to explore this further in future work by exploiting variation in labor institutions across Indian states to establish whether product margin responds to declines in tariffs in Indian states with pro-business labor regulations.

But while Indian firms' extensive margin is unresponsive to changes in output tariffs, we observe a robust relationship between tariff declines on intermediate inputs and an *expansion* of the firm's product line. This finding appears consistent with the recent evidence that lower tariffs on inputs boost firm productivity in developing country context (e.g., see Amiti and Konings (2007) for Indonesia and Topalova (2007) for India). Lower tariffs on intermediate inputs might lower the marginal cost of production for domestic firms either by lowering prices of intermediate products, and/or by increasing variety and quality of available inputs.[6] *Ceteris paribus*, lower marginal cost of production would increase firms' profits and for each firm expand the set of products that generate sufficient profit to cover the fixed production cost.

Detailed product-level data on India's imports at the six- and eight- digit Harmonized System (HS) level provides supportive evidence that declines in tariffs were associated with large expansion of imports of intermediate inputs. The vast majority of this expansion can be attributed to an increase in the volume of imports of new products, here defined as a six-digit HS category. This evidence of expansion in the extensive margin of imports is consistent with findings of the importance of increased variety of imports and the gains from trade generated by this channel in Klenow and Rodriguez-Clare (1997), Broda and Weinstein (2006), and Broda, Greenfield, and Weinstein (2006).

This preliminary evidence suggests a monotonic relationship between a firm's extensive margin and the number of intermediate inputs used in the manufacturing process. As the economy received access to cheaper and broader range of inputs, it appears that these inputs were channeled into the domestic consumer sector. Firms in the consumer sector, which for most of our sample was

[5]Studies estimate lower output and productivity in industries with more restrictive trade policy (Krishna and Mitra (1998), Topalova (2007), Sivadasan (2006)); lower output in industries when firms' entry and expansion were subject to regulation under the License Raj and pro-worker labor laws (Aghion et al. (2005), Aghion et al. (forthcoming)); and lower output in registered manufacturing in states after they have implemented pro-worker amendments to labor market legislations (Besley and Burgess (2002)).

[6] For example, see Ethier (1982), Markusen (1989), and Grossman and Helpman (1991).

still subject to non-tariff barriers, appear to have benefitted from the access to variety by expanding their product lines. Uncovering the precise mechanism of this adjustment, as well as the potential quality improvements resulting from better access to inputs, is left for future research.

The remainder of the paper proceeds as follows. Section 2 summarizes policy reforms in India. Section 3 describes our data and describes on characteristics of multiproduct firms in India in a cross section. Section 4 examines the extent of product mix changes among Indian firms and their contribution to output growth. Section 5 examines whether the observed changes in product mix in India can in part be attributed to India's trade reform. Section 6 concludes.

2. **Policy Reforms in India**

Examining multi-product firms in India is important, not only because India has emerged as one of the key players in the world economy with a large and diversified manufacturing sector, but also because it allows us to analyze the behavior of multiproduct firms in response to dramatic structural reforms, namely trade liberalization and industrial deregulation. In this section, we briefly outline some of the key features of these reforms.

India's post-independence development strategy was one of national self-sufficiency and heavy government regulation of the economy. India's trade regime was amongst the most restrictive in Asia, with high nominal tariffs and non-tariff barriers. The emphasis on import substitution resulted in relatively rapid industrialization, the creation of domestic heavy industry and an economy that was highly diversified for its level of development (Kochhar et al, 2006). Despite pervasive government ownership, private sector activity was allowed but heavily regulated through a system of complex industrial licenses, controls on the use of foreign exchange, controls on credit allocation and even prices. Under the Industries (Development and Regulation) Act of 1951, registered manufacturing units required licenses to establish new factories, expand capacity, change product lines or plant location (Aghion et al, forthcoming). In addition to licensing requirements, the Industrial Disputes Act (1947) provided significant protection for labor in the organized sector, by requiring companies with more than 100 workers to seek government permission for any retrenchment (Kochhar et al, 2006).In August 1991, in the aftermath of a balance-of-payments crisis, India launched a dramatic liberalization of the economy as part of an IMF adjustment program. An important part of this reform was to abandon the extremely restrictive trade policies. Figure 1 reports that average tariffs fell from more than 80 percent in 1990 to 39 percent by 1996 and non-tariff

barriers (NTBs) were reduced from 87 percent in 1987 to 45 percent in 1994 (Topalova, 2007). The structure of industrial protection changed, as tariffs across sectors were brought to a more uniform level reflecting the guidelines of the tariff reform spelled out in the IMF conditions (Chopra et al. 1995). There were some differences in the magnitude of tariff changes (and especially NTBs) according to final and intermediate industries with NTBs declining at a later stage for Consumer Goods (Figure 2). However, Figure 3 shows that all sectors of the economy were affected with the industries subject to larger pre-reform tariffs experiencing larger tariff cuts.

India remained committed to further trade liberalization beyond the Eighth Plan (1992-97) which ushered the radical changes to its trading regime. Since 1997 there have been further adjustments to import tariffs. However, at the time the government announced the export-import policy in the Ninth Plan (1997-2002), sweeping reforms outlined in the previous plan had been undertaken and pressure for further reforms from external sources had abated.

Several features of the trade reform are crucial to our study. First, the external crisis of 1991, which came as a surprise, opened the way for market oriented reforms (Hasan et al, 2007).[7] Thus, the liberalization of the trade regime was unanticipated by firms in India. Second, reforms were passed quickly as sort of a "shock therapy" with little debate or analysis to avoid the inevitable political opposition (Goyal, 1996). Consequently, while there is significant variation in the tariff changes across industries, these changes are not strongly correlated with baseline industry characteristics such as productivity, size, capital intensity (Topalova, 2007).[8] It is precisely this variation in tariffs across industries that will enable us to analyze how firms change their product mix in response to opening to trade.

The structural reforms of the early 1990s also included a stepped-up dismantling of the "license raj," the extensive system of licensing requirements for establishing and expanding capacity in the manufacturing sector, which had been the cornerstone of India's regulatory regime. The government of India, led by Rajiv Gandhi, began a process of liberalizing the pervasive government controls in 1985, when about a third of industries were delicensed. In 1991, with the external

[7]This crisis was in part triggered by the sudden increase in the oil prices due to the Gulf War in 1990, the drop in remittances from Indian workers in the Middle East, and the political uncertainty surrounding the fall of a coalition government and assassination of Rajiv Gandhi which undermined investor's confidence.

[8] This finding is consistent with Gang and Pandey (1996) who argue that political and economic factors can not explain tariff levels at the time of the reform.

pressure of the IMF, most of the remaining industries were delicensed, with less than 10 percent of industrial codes still subject to licenses in 1997. The removal of industrial licenses provided substantial freedom to firms, that had been previously required to seek permission not only to enter an industry, but also to expand capacity, move to a different location, alter product mix, or even change the kind of technology and inputs used in production as annual allocation of crucial raw materials was controlled by the government (Sharma, 2007). While the more gradual and selective delicensing does not offer as clean of a "natural experiment" as India's trade reforms, we can also examine how removing industrial regulations (including on product changes) affects the behavior of multi-product firms.

The sweeping economic reforms of 1991 did not include the politically sensitive labor legislation. However, India's federal system allows us to examine whether the behavior of multiproduct firms in response to important policy changes is shaped by labor laws. Even though the Industrial Disputes Act was passed at the central level, state governments could amend it under the Indian Constitution. Besley and Burgess (2004) examine all the 113 amendments made by state governments between 1958 and 1992 and code them as pro-worker, pro-employer or neutral. Thus, each of the 15 major states in India can be is classified as having pro-worker, pro-employer or neutral labor regulations based on the amendments until 1992. We exploit this geographic variation to establish whether firms responded differently to tariff cuts and industrial deregulation depending on the balance of power between labor and capital in the state in which they operate.

3. Data and Description of Multiproduct Firms in India

3.1 Data

We compile a firm-level panel database, from the Prowess database, collected by the Centre for Monitoring the Indian Economy (CMIE) that spans the period from 1989 to 2003.[9] The Prowess database contains information primarily from the income statements and balance sheets of about 9,500 publicly listed companies, almost 5,000 of which are in the manufacturing sector. The companies in the database together comprise 60 to 70 percent of the economic activity in the

[9] The Prowess database has now been used in several studies including Bertrand et al. (2002), Khanna and Palepu (1999), Fisman and Khanna (2004), Balakrishnan et al. (2000), Topalova (2007), Dinc and Gupta (2007), and Chari and Gupta (2007).

organized industrial sector, account for 75 percent of corporate taxes and 95 percent of excise duty collected by the Government of India (CMIE).

The Prowess database is the only Indian database, to our knowledge, that records detailed annual information on firms' product-mix.[10] Indian firms are required by the 1956 Companies Act to disclose product-level information on capacities, production and sales in their annual reports. The Prowess database compiles these detailed quantitative data and therefore enables us to track a firm's adding and dropping of products over time. Furthermore, for each product manufactured by the firm, the dataset provides the value of sales, quantity and units, allowing the construction of a time series of unit values at the firm-product level. Unlike the Annual Survey of Industries (ASI), India's manufacturing census of plants, the Prowess data is a panel of firms, rather than a repeated cross section. The Prowess is therefore particularly well suited for understanding how firms adjust their product lines over time and how their responses may be related to policy changes.[11]

As described in the Data Appendix, CMIE uses an internal product classification that is based on the Harmonized System and National Industry Classification (NIC) schedules. There are a total of 1,886 *products* linked to 108 four-digit NIC *industries* across the 22 manufacturing *sectors* (two-digit NIC codes). As a comparison, the U.S. manufacturing data used by BRS (2006a), contain approximately 1,500 products, defined as five-digit Standard Industrial Classification (SIC) codes, across 455 four-digit SIC industries. Thus, our definition of a product is slightly more detailed than BRS (2006a).

Examples of products within the Basic Metals sector (NIC 27) of this hierarchical mapping are listed in Table 1. The table reports two industries within the sector: Manufacture of Basic Iron & Steel which contains over 100 products and the 7 products in Casting of Iron and Steel. As with all classifications, the degree of detail varies across industries and sectors. As documented in Table A1, the number of products ranges from a low of 6 products in the Tobacco industry (NIC 16) to 506 products in the Chemicals industry (NIC 24).

[10] Product-level information are available for the 1997/98, 2000/01 and 2001/02 rounds of the Annual Survey of Industries (ASI), but there is no information in years closer to the economic reforms implemented in the early 1990s and plant identifiers are unavailable.

[11] The CMIE database is not well suited for understanding firm entry and exit because firms are under no legal obligation to report to the data collecting agency. However, since Prowess contains only the largest Indian firms, entry and exit is not necessarily an important margin for understanding these firms.

The product classification provides a concordance to the more familiar NIC industry codes used to classify economic activity in India. Each of the 1,886 product codes can therefore be mapped to a five-, four-, three-, two-, or one-digit NIC code. The concordance allows us to assess the relative degree of product disaggregation. Approximately 88 percent of the products map to most detailed five-digit NIC and 10 percent of the products concord to four-digit NICs. Products mapping to four- or five-digit NIC codes account for 99 percent of total output. With the exception of Printing and Publishing (NIC 22), products within all sectors overwhelmingly map to four- or five-digit NIC codes.[12] This gives us confidence that the variation in product detail is a fundamental feature of sectors rather than a problem with data. Moreover, given that our industrial policy measures are specified at the four-digit NIC, the majority of our product information is specified *at least* at this aggregation.

Several features of the product data give us additional confidence in its quality despite the self-reported and non-standardized nature of the dataset. First, as mentioned above, firms are required to report not just the names of products but product-level details about installed capacity, production, sales quantity and value. Table 2 reports that product-level data are available for 85 percent of the firms; this accounts for 85 percent of output and more than 90 percent of exports of the manufacturing firms in Prowess. Even more crucially, the product-level information and overall output are in separate modules of the Prowess database which enables us to cross check the consistency of the data. The final row of Table 2 reports that the total product-level sales account for 92 percent of the (independently) reported overall output of the firm.[13] This implies that product-level sales account for virtually all of the firm's total output.

Since our study predominantly analyzes firms' product mix, our final database includes the 4,216 manufacturing firms that report product-level information. The data span the period from 1989 to 2003. Table 3 summarizes these firms' sales, profits, assets, foreign exchange transactions, output, input expenses, the total wage bill and R&D spending.

[12] These figures are available upon request.

[13] There is some variation in the availability of product level information across sectors. However, with the exception of two of the smaller sectors (Publishing/Printing (NIC 22) and Office, accounting and computing machinery (NIC 30)), product details reporting is very high across sectors. Table A1 shows that in 14 of the 22 sectors, total product-level sales as a share of firm output exceed 85 percent.

We complement the data on firm product mix with various measures on trade policy at the industry level. Data on disaggregated tariffs for 1987-2001 have been compiled in Topalova (2007). Tariffs are reported at the six digit level of the Indian Trade Classification Harmonized System (HS) Code, which are then aggregated to the 116 NIC codes, using the concordance by Debroy and Santhanam (1993), to calculate average industry-level tariffs. We also combine industry-level output tariffs with the Input Output Transaction Table from 1993-1994 to calculate industry input tariffs (see below). To capture changes in the domestic industrial policy over this time period, we use Aghion et al. (forthcoming) measures of industrial delicensing. These industrial policy variables are mapped to the firms according to the firm's NIC identifier provided by Prowess.

3.2. Characteristics of Multi-Product Firms

Empirical studies have largely abstracted from explicitly examining the role and characteristics of multiproduct firms with large scale micro-level firm surveys (BRS (2006a, 2006b) and Baldwin and Gu (2006) are an exception). In this section, we document some facts on the prevalence and characteristics of multi-product firms in India. Given the scant empirical evidence on multi-product firms, particularly for developing countries, the facts uncovered by BRS (2006a) for U.S. firms serve as a useful benchmark for the Indian firms. However, we stress that these comparisons are simply made for illustrative purposes considering that the two countries are incredibly distinct along many dimensions of their respective economic environments. In addition, while we are mainly interested in predictions of multiproduct firm and trade models in an open economy setting, these models yield several more general predictions about characteristics of multiproduct firms and firms' extensive product margin in a cross section. In this section we also examine whether the patterns observed in Indian data are consistent with these predictions.

We begin by first documenting the prevalence of single- and multi-product (MP) firms in India. Table 4 reports the share of each type of firm, as well as their share of total manufacturing output in the Prowess sample. The table illustrates that multi-product firms account for 47% of manufacturing firms and 80% of manufacturing output.[14] By comparison, 41 percent of U.S. firms manufacture more than one product and these firms account for 91 percent of total output.

[14] The ASI rounds in 1997/98, 1999/2000 and 2001/02 record product-level information for manufacturing plants. Again, these data are not suitable for our analysis of the response to changes in economic policy because the sample

The third column of Table 4 shows that multiple-product firms manufacture on average 3 products, compared to 4 products for U.S. MP firms.[15] 33 and 24 percent of firms manufacture products that span more than one industry and sector, respectively. These multiple-industry and multiple-sector firms account for 62 percent and 54 percent of output, respectively.[16] Again for comparison's sake, 29 and 13 percent of U.S. firms span multiple industries and sectors, and account for 87 and 76 percent of firms, respectively. Thus, Indian firms appear more diverse on average, but smaller in scale, than the U.S. firms. These facts are consistent with observations by Kochhar et. al (2006) that India's economic policies have lead to more diversification, relative to countries at similar stages of economic development, and firms of smaller capacity. An alternative explanation, proposed by Khanna and Palepu (2000), is that diversification may be a response to the lack of well-functioning markets (e.g., capital, labor and product markets). As a result, the absence of market intermediaries may force firms to become more diversified to overcome these imperfections.

MPFs not only dominate manufacturing output, but they also differ in observable characteristics from single product firms. Table 5 reports the coefficient of the multi-product firm dummy from the regression of the log of the firm characteristics reported in column 1 on MPF dummy, controlling for industry and year fixed effects. The results illustrate that MPF on average have 133 percent ($e^{.85}$-1) higher output, 15 percent higher output per wages, 1 percent (thought not statistically significant) higher total factor productivity (TFP)[17], and are 13 percent more likely to export than single-product firms.[18] These figures are quite similar to the average percent differences between U.S. single- and multiple-product firms. BRS (2006a) show that U.S. MP firms have 115 percent higher output, 10 percent higher labor productivity, 1 percent higher productivity and are also

---

is not a panel of firms and similar information is not available prior to the reforms. However, in that sample, multiple-product plants are 51 percent of total plants and account for 78 percent of manufacturing output. These figures are remarkably similar to the Prowess sample.

[15]The unconditional mean is 1.97 products per firm.

[16] Appendix table 2.A reports the descriptive statistics on the MPFs by two digit NIC sectors. While there is variation across sectors in the prevalence of the MPF and average number of products, MPFs account for over 50% of industry output in 17 out of 22 sectors.

[17] TFP is obtained using the procedure developed initially by Olley and Pakes (1996). See Topalova (2007) for details of the productivity estimation for the Prowess system.

[18]We are in the process of obtaining these estimates from the ASI data that includes information on the number of workers. Preliminary results suggest that MPF firms are bigger, have higher labor productivity, and higher TFP than single product firms.

13 percent more likely to export. The comparisons between single- and multiple-industry and sector firms are similar, as shown in columns 2 and 3.

In Table 6, we document the distribution of products within Indian firms by reporting the average share of a product in total sales of a MPF. Within multi-product firms, output is highly unevenly distributed across products. Each row denotes the within-firm ranking of a product, in decreasing order, by the product's contribution to a firm's sales. Each column refers to firms producing the number of products noted on top of the column. We focus on firms that produce 15 or less products.[19] Output is highly skewed towards the main product. For a typical MPF in India that produces 3 products, the largest product accounts for 77% of the sales. The share of the largest product declines from 87% to 63% to 44 % of the sales in firms as one moves from firms that produce at most 2, 10, and 15 products, respectively. The distributions are slightly more concentrated towards the main output than for U.S. firms. For example, for the average three-product U.S. firm, the largest product accounts for 71 percent of output, followed by 22 percent and 7 percent. So while the fraction of multiple-product firms in Indian is slightly higher, within the firm, output is more concentrated. However, the differences to U.S. firms are not large. The highly skewed distribution of output within the firm can be explained by the MP firm model proposed by BRS (2006b), when the underlying distribution of firm ability and product expertise is skewed.

A large literature focuses on the size distribution of firms. The natural question arises what share of the differences in the distribution of output across firms can be attributed to the extensive or intensive margin. Table 7 reports the results of regressing the log number of products on log total firm output. The first two columns report all firms and MP firms in a single cross-section year (2000). In both columns, the coefficient is positive and statistically significant. Columns 3 and 4 pool the data and include year and firm fixed effects. This analysis suggests that 7 to 11 % of the variation in output across firms can be attributed to the variation in the extensive margin.[20] These point estimates are slightly smaller than the .13 coefficient documented in U.S. firms by BRS (2006b).

[19] Firms that produce at most 3, 6, 10, 15 products account for almost 50, 80, 90 and 100 percent of manufacturing sales respectively.

[20] The coefficient from regressions with log average sales per product as a dependent variable is by definition 1 less the coefficient on the log number of products.

Are bigger firms bigger because they produce more output per product and produce more products? One important prediction of the theoretical model developed by BRS (2006b) is that a firm's extensive (number of products) and intensive margin (output per product) are positively correlated. We document that this relationship also exists in the Indian data by regressing log average sales per product in a firm on log number of products manufactured by the firm. The results, both in a single cross-section year, and over time, are reported in Table 8. Column 2 reports a positive correlation between MP firms' extensive and intensive margin in 2000. The coefficient is .48 compared to a .49 coefficient for U.S. firms (BRS (2006b)). It is slightly lower in column 4, which uses all years, but nevertheless maintains a strong positive relationship between the two firm margins. Hence, the results from table 7 and 8 illustrate that larger Indian firms produce on average more products and firms that produce more products have on average larger sales per product. Moreover, the point estimates are very close to the observed relationships among U.S. firms and is consistent with the predictions of the model in BRS (2006b). One implication of this finding is that the extensive margin potentially amplifies the inequality in size across firms.

Differences in the firm level data and product classification make it extremely hard (if not impossible) to compare results for India with those of the existing studies for other countries. With that caveat in mind, we find that, in the cross-section, the Indian firms appear quite similar to U.S. firms in terms of prevalence and characteristics of multiple-product firms, distribution of products within the firm and the correlations between firm intensive and extensive margins. These similarities are rather surprising given the vast differences between the two countries in among others, their regulatory environment. The cross-sectional patterns of multi-product Indian firms (like their counterparts) also confirm several predictions of recent multiproduct firm and trade models.

4. Changes in Product Mix over Time

The above analysis highlights the dominant role of MPFs in Indian output and the importance of extensive margin for distribution of firm size in India in a cross section. This section extends the above analysis by examining the importance of changes in the firms' product margin over time. Systematic evidence on the importance of changes in product mix is only available for the U.S., where BRS (2006a) document a large degree of changes in the product mix within manufacturing firms. The reforms undertaken by India in early 1990s make the study of product mix changes in

India particularly useful. Before we directly link changes in firms' extensive product margin to declines in trade costs following India's trade reform, we document the extent to which firms change product mix in India during the period that spans its structural reforms, and whether these changes in product mix are an important component of adjustment in firms' output.

Figure 4 illustrates that the average number of products produced by a typical Indian firm in our data increased from 1989 to 2003. The right axis plots the coefficients on year dummies of a regression on number of products a firm produces on firm and year fixed effects.[21] There is a steady increase in the number of products manufactured by the firm from about 1.4 products per year in 1989 to almost 2.3 products by 2003. The figure therefore suggests that, on average, the extensive margin among Indian firms grew post 1991.

We now examine in greater detail the nature of product mix changes that led to the observed expansion of the extensive margin. Following BRS (2006a), we classify a firm's activity into one of four mutually exclusive groups: add products only, drop products only, both add and drop products or no activity. A product is added in period *t* if it was produced in period *t-1* but not in period *t*. In this table, a product is dropped in period *t* if it was produced in period *t-1* but not in period *t*. These figures are only computed for surviving firms so that the analysis focuses on product mix changes at incumbent firms. We report the summary of overall, five-year, three-year and annual firm activity in Table 9. The top panel reports the share of firm participating in each activity. The bottom panel weighs participation in each activity by the output of firms performing this activity

In contrast to many of the descriptive comparisons above, this table illustrates large differences in activity between Indian and U.S. firms. First, Indian firms are characterized by far less churning in product mix than U.S. firms as documented by BRS (2006a). Over a five-year period, 28 percent of firms report changes in their product mix, most of these being larger firms. The firms that switch products over a five-year interval account for 43% of the total output.[22] In similar five-year intervals, 68% of U.S. firms change product mix and these firms account for 93 percent of total output. Second, Indian firms that change product mix are far more likely to add products over time

[21] The reason for reporting year fixed effects from the within firm regression is to control for firm entry and exit into the Prowess sample.

[22] The middle and right part of the table repeats the analysis for single and multiproduct firms. Similar to the U.S., multiproduct firms in India are more likely to churn products than single product firms.

than to shed product lines: 22% of firms report adding at least one product, 4% of firms drop a product, and 2% of firms simultaneously add and drop a product.[23] This is in contrast to the U.S., where simultaneous adding and dropping of products is the most common activity of the firm. Third, like in the U.S., changes in product mix are more common among multiproduct firms than single product firms.

Although the extent of product switching is far lower in India, the resulting changes in firm-level characteristics are similar to those reported by BRS (2006a). As in BRS (2006a), we observe (results not reported here) that firm additions (deletions) are positively (negatively) associated with firm output and raw materials. For labor productivity, dropping a product is associated with higher labor productivity, which is consistent with the U.S. data, but there is no significant correlation between product additions and firm productivity. We also find that conditional on firm size, products with bigger sales are less likely to be dropped, however, unlike the U.S. data, product tenure and age do not appear to play a role.

Changes in product mix provide a non-negligible contribution to changes in output of continuing firms, despite the relatively lower product switching in India relative to the U.S. We decompose the aggregate change in output of continuing firms into changes in output due to changes in product mix (i.e., the extensive margin) and changes in output due to existing products (i.e., the intensive margin) in Table 10.[24] Following BRS (2006a), for each continuing firm j, we decompose the change in its output into the changes in output due to the extensive margin (E) and changes in output due to intensive margin (C)

$$\Delta Y_j = \sum_{i \in E} \Delta Y_{ijt} + \sum_{i \in C} \Delta Y_{ijt} ,$$

[23] One might worry that the lack of product exit is simply an artifact of the Indian data. While this could be the case, there are several reasons to believe that the lack of exit does not simply reflect the nature of the data. Inertia in reporting would likely affect both the reporting of product exit as well as product entry. Also, firms not only have to report product name, but also the quantity of product produced and value of sales. If firms continue to simply list products that they no longer produce, we would observe a large share of observations with zero production. Yet, only 13 percent of original product name-firm-year observations report zero production (we count these products as dropped). Moreover, apart from product exit, the Indian data are similar to the U.S. data along many dimensions as discussed earlier. Finally, in our analysis below we also observe that the magnitude of shrinking of products sales is limited, suggesting that lack of product dropping or reallocation away from "growing" to "shrinking" products could be real.

[24] Since Prowess is not a census and therefore not well suited for studying firm entry and exit, we report the results of this decomposition by focusing only on the set of continuing firms.

where *j* indexes a firm and *i* indexes a product. We decompose output changes due to extensive margin further into changes in output due to product additions (A) and product droppings (D):

$$\sum_{i \in E} \Delta Y_{ijt} = \sum_{i \in A} \Delta Y_{ijt} + \sum_{i \in D} \Delta Y_{ijt} \ .$$

Continuing products can be further decomposed into the contributions from growing (G) and shrinking products (S):

$$\sum_{j \in C} \Delta Y_{ijt} = \sum_{j \in G} \Delta Y_{ijt} + \sum_{j \in S} \Delta Y_{ijt} \ .$$

We can substitute these equations and re-write the aggregate change in output among continuing firms in the Prowess database as

$$\Delta Y_t = \sum_j \left[\sum_{i \in A} \Delta Y_{ijt} + \sum_{i \in D} \Delta Y_{ijt} + \sum_{i \in G} \Delta Y_{ijt} + \sum_{i \in S} \Delta Y_{ijt} \right]$$

The first two terms capture the growth due to changes in the firms' extensive product margin and the final two terms capture changes in the intensive margin.

Table 10 reports the decomposition. As in the U.S., the firm's intensive margin accounts for the majority (75 percent) of output growth over long time horizons in India. Interestingly, despite the lower prevalence of changes in product mix observed in India in table activity, the extensive margin accounts for a sizable contribution to changes in firm output over long horizons. While the importance of the margin fluctuates considerably over shorter horizons, this margin accounts for 25% of increases in output from 1989 to 2003. The respective contributions of extensive and intensive margin to output growth are similar to those found in the U.S., where extensive and intensive margin accounts for almost 30 and 70 percent of growth in output of continuing firms, respectively.

That said, further decomposition of extensive margin into contributions due to product entry and exit, and decomposition of intensive margin into contributions due to growing and shrinking products reveals important differences between Indian and U.S. firms. First, while product exit is an important contributor toward changes in output in the U.S., its contribution to changes in output in India is negligible (with the exception of 1992). The changes in output stemming from the extensive margin are for most part driven entirely by output growth due to product additions. Consequently, gross changes in output stemming from the extensive margin are of similar order of magnitude as net

changes. This is in large contrast to the U.S., where both product additions and product exit provide important contributions to output changes, so that the U.S. exhibits gross rates of output change that are an order of magnitude bigger than the net changes.

Similar patterns emerge when we decompose net changes in intensive margin into changes in output due to growing and shrinking products. The growth in the intensive margin in India is predominately driven by growth in "growing products", with little reallocation of output away from "shrinking products". This again translates into net and gross output changes of similar orders of magnitude. In contrast to India, the U.S. firms experience significantly more reallocation of output from shrinking to growing products within a firm, so that the gross output changes are an order of magnitude bigger than the net changes.

This section documents that despite similarities between U.S. and Indian MP firms in the cross section, their pattern of behavior, measured by product churning, appears quite distinct in the time series. The observed differences could speak to the sheer differences in the extent of how dynamic the two economies are. There appears to be less "creative destruction" in India during this period which is entirely plausible given India's lower level of industrialization and the historical legacy of its industrial policy. The less dynamic product margin in India could at least in principle be associated with higher regulation that spans industrial licenses, highly regulated entry of foreign goods and state labor market laws. We are not aware of any studies for India that relate these policies to product churning. However, previous work has found lower output and productivity in manufacturing industries subject to more restrictive trade policy (Krishna and Mitra (1998), Topalova (2007), Sivadasan (2006); lower output in industries when firm's entry and expansion was heavily regulated by industrial licensing requirements and pro-worker labor legislation (Aghion et al. (2005), Aghion et al. (forthcoming)); and lowered output in registered manufacturing in states after they have implemented pro-worker amendments to labor market legislations (Besley and Burgess (2004)). It is not clear whether these policies affect output through intensive and/or extensive product margin of firms. While examining all of the above policies is beyond the scope of the current paper, we study whether changes in trade policies are associated with changes in the extensive margin of firms. We pursue this analysis in the next section.

5. Product Mix and Trade Policy

5.1 The Extensive Product Margin and Tariffs

Recent theoretical and empirical trade literature emphasize the adjustments to trade reform that occur within industries.[25] Several recent papers (BRS (2006b), Eckel and Neary (2006), and Nocke and Yeaple (2006), Baldwin and Gu (2006)) incorporate the product margin as a channel of firm adjustments to external shocks.

These models generally predict that lower trade costs should lead firms to reduce their extensive product margin by dropping products. For example, BRS (2006b) incorporate multi-product firms in Melitz (2003) heterogeneous firm framework. Firms face sunk costs of entry and uncertainty about their future productivity. A firm's productivity in each product (i.e., the inverse of marginal costs) depends on a stochastic firm-specific ability and stochastic product-specific expertise. Firm ability and product expertise are revealed after a firm pays a sunk cost of entry. A firm then decides whether and which products to produce. A firm that chooses to produce at least one product pays a fixed headquarter cost that does not vary with the number of products it manufactures. Production of each product is also characterized by a fixed production cost. Higher ability firms have broader scope because they can produce products with lower expertise more profitably than low ability firms (i.e., they have lower zero-profit cutoff for product expertise). In equilibrium, the model yields self-selection of more productive firms into production (as in Melitz (2003)), and self-selection of products within firms. The model predicts that a firm responds to symmetric trade liberalization in part by changing the number of products it produces. Lower variable trade costs induce firms to rationalize their extensive margin by shedding relatively unproductive products.[26] A multiproduct firm extension of Melitz and Ottaviano (2008), a model where product competition intensifies in response to foreign entry and that is perhaps better suited to study the consequences of unilateral trade reforms, also predicts that declines in trade costs are associated with firms dropping products (Baldwin and Gu (2006)).

To our knowledge the link between declines in trade cost and the extensive margin has for most part not been directly examined empirically, especially not in a developing country setting. The large tariff declines resulting from India's unilateral trade liberalization provide a nice setting to examine the adjustment of the Indian firms' extensive margin.

[25] See Melitz (2003), Bernard et. al. (2003), Melitz and Ottaviano (2008), Pavcnik (2002), Trefler (2004), Bernard, Jensen, and Schott (2006), and Tybout (2003) for a survey.

[26] A symmetric bilateral decline in trade costs is associated with increase in domestic productivity cut off (through the increased labor demand because exporting is more profitable). Least productive domestic firms exit. All firms reduce product scope. Exporters produce a smaller range of products, but they increase the share of products sold abroad and exports per product. This leads to productivity growth within and across firms and in aggregate.

The following firm-level specification regresses the (log) number of products manufactured by firm *i* in time *t*, n_{it}, on the tariff rate of the firm's main industry (*m*), lagged one year, $\tau_{m,t-1}$[27]

$$\log n_{it} = \alpha_i + \alpha_t + \beta \tau_{m,t-1} + \varepsilon_{it} . \quad (1)$$

The regression includes firm fixed effects to control for time-invariant firm characteristics, and year fixed effects to capture unobserved aggregate shocks. Standard errors are clustered at the industry level. As discussed in detail in the trade policy section, Indian trade reforms provide an excellent setting to examine this relationship. India's reforms came as a surprise, and were likely not anticipated in the firm's decisions prior to the reform. Second, tariff cuts were large and brought a substantial decline in the dispersion of tariffs across industries. Industries with larger pre-reform tariffs experienced larger tariff declines, a pattern unlikely to be observed if traditional political economy concerns played an important role in India's trade liberalization of 1991. In fact, there is no evidence that industry tariff changes, which were mostly spelled out in the Eighth Five Year Plan (1992-1997) were correlated with pre-reform industry characteristics such as productivity, industry size, etc (Topalova, 2007). However, at the time the government announced the export-import policy in the Ninth Plan (1997-2002), sweeping reforms outlined in the previous Plan had been undertaken and pressure for further reforms from external sources had abated. Since variation in tariffs in this latter period may reflect various political economy factors, we restrict the analysis of the impact of the trade liberalization on the firms' extensive margin from 1989-1997.[28]

Column 1 of Table 11 reports the results using output tariffs as the trade policy measure. The coefficient is negative but statistically indistinguishable from zero. This suggests that declines in tariffs are uncorrelated with changes in the number of products at the firm-level. In column 2, we use industry's import penetration as an alternative (but obviously more endogenous) measure of industry exposure to foreign competition. As is the case with output tariffs, we find that import penetration is uncorrelated with the firms' extensive margin.[29] Schott (2004), Bernard, Jensen, and Schott (2006), and Khandelwal (2007) emphasize the importance of distinguishing import

[27] Tariffs are matched to the firm's 4-digit NIC industry code provided by Prowess. This industry code reflects each firm's main line of business.
[28] Restricting the analysis from 1989 to 1997 yields 2,872 unique firms.
[29] Import penetration is defined as the value of imports divided by net domestic output (computed from Prowess) plus imports.

penetration by origin of competition from low-income versus high-income countries. In unreported analysis, we have replicated the regressions in column 2 by distinguishing import penetration by origin of competition (low-income versus high-income) and this also yielded no statistical relationship between declines in output tariffs and changes in the number of products a firm produces.

Given that the consumer durable and nondurable sectors were still subject to non-tariff barriers (NTBs) during this period, the lack or relationship between changes in product mix and output tariffs is potentially not surprising. NTBs may have insulated any pro-competitive effects of lower tariffs on a firm's extensive margin. We investigate this possibility in two ways. First, in column 3 and 4 of Table 11 we estimate regression (1) separately for consumer goods (the majority of which remained protected by the NTBs) and intermediate goods (defined as intermediate, capital, and basic goods sectors), respectively. The coefficient on output tariff is small in magnitude and insignificant, which suggests that it is unlikely that the insignificant results are driven by the NTBs since these barriers were largely eliminated for the intermediate goods by 1997. Second, by 2001 over 80% of the HS6 lines were not subject to NTBs even among the consumer goods. We thus estimate regression (1) using data on only one pre- (1990) and one post-reform year (2001), by which the majority of NTBs were dismantled. The results of this regression are shown in column 5; the coefficient on output tariff continues to be small in magnitude and insignificant.

If lower output tariffs induce firms to simultaneously add and drop products in response to tariffs, this would leave the firm's extensive margin unchanged. While none of the existing models generate product switching in response to trade reform, Bernard, Schott, and Jensen (2006) find that U.S. firms that are exposed to greater degree of low-wage competition are more likely to switch an industry. Recall from Table 9 that simultaneous adding and dropping of product lines is quite rare for Indian firms. Nevertheless, in columns 6 and 7 of Table 11, we replace the dependent variable in equation (1) with an indicator (add_{it}) if firm i adds a product in year t, and drop if firm i drops a product, respectively. The coefficients on output tariffs remain small and statistically insignificant in both cases.

The lack or relationship between declines in trade costs and firms' extensive margin is somewhat surprising in light of the predictions of theory models of multi-product firms and trade. In

BRS (2006b), a decline in variable trade costs in a symmetric trade liberalization will reduce the range of products each domestic firm produces. Multi-product firm extension of Melitz and Ottaviano's (2008) model, a model that is better suited to analyze the unilateral trade reform, also predicts declines in the number of products firms produce with lower trade costs (Baldwin and Gu (2006)). We should emphasize that previous literature finds firm adjustments to the 1991 trade reform along other dimensions. In particular, lower output tariffs induce within-firm productivity gains in India ((Sivadasan (2006), Topalova (2007)). However, the results here suggest that lower tariffs are not associated with rationalization of product lines within surviving firms in India.[30]

The lack of findings could in part reflect data limitations. While the detail of our product classification is similar to the detail of product level data in the U.S. (where one observes substantial amount of product dropping), Indian firms might rationalize their product lines within product aggregates we observe in our data. Unfortunately, we are not aware of a data source that provides information on products at a more detailed level and covers a broad range of manufacturing industries in India. Alternatively, the lack of product dropping could potentially be attributed to regulatory constraints (such as rigid labor market regulation) that continue to affect daily operations of Indian firms and potentially preclude the firms from eliminating unprofitable product lines. The above model, on the other hand, feature frictionless factor markets. We plan to explore this further in future work by exploiting variation in labor institutions across Indian states to examine whether product margin responds to declines in tariffs in Indian states with pro-business labor regulations.[31]

5.2 The Extensive Margin and Input Tariffs

The existing models of trade and multi-product firms emphasize the consequences of declines in variable trade costs for *final* goods for the range of products and firm productivity. In these models labor is the only production input. Yet, a growing body of studies emphasizes imported intermediate inputs as an important channel of productivity improvements for domestic firms. Amiti and Konings (2007) and Topalova (2007) find that declines in tariffs on intermediate inputs are associated with improvements in firm productivity in Indonesia and India, respectively. Feenstra, Markusen, Zeile

[30] Firms could be dropping products by exiting the market but again, our data is not well suited to examine this channel. Moreover, given the size of these firms, firm entry and exit is unlikely to be an important margin of adjustment.

[31] Such analysis requires information on product mix changes in plants of a given firm located across states. The preliminary analysis based solely on the location of a firm's headquarter yields no significant findings.

(1992), Kasahara and Rodrigue (forthcoming), and Halpern, Koren, and Szeidl (2005) document positive association between the use of imported inputs and firm productivity.

Could declines in tariffs on intermediate goods also influence the range of products firms produce? Lower intermediate tariffs might lower the marginal cost of production for domestic firms either by lowering prices of intermediate products, and/or by increasing variety and quality of available inputs as in Ethier (1982), Markusen (1989), and Grossman and Helpman (1991). Lower marginal cost of production would increase firms' profits and for each firm expand the set of products that generate sufficient profit to cover the fixed production cost.[32] To explore the importance of the declines in input tariffs for the extensive margin, we estimate equation (1) with the input tariffs as the main independent variable of interest.[33] The results are presented in column 1 of Table 12 and confirm this. Unlike the coefficient on output tariffs in Table 11, the coefficient on input tariffs is negative and statistically significant. The point estimates imply that a 10 percentage point fall in input tariffs is associated with a 3.5 percent increase in the average number of products manufactured by a firm.

The coefficient on input tariffs is robust. We perform several robustness checks in the remaining columns of Table 12. Column 2 reports that the input tariff coefficient is not sensitive to lags. While the magnitude of the coefficient on the contemporaneous input tariff is smaller in absolute value, it lies within the confidence interval of the coefficients reported in column 1 and is statistically significant. Column 3 reports regression results that condition on both input and output tariffs. As before, output tariffs are essentially uncorrelated with the firm's extensive margin, but input tariffs remain statistically significant.

As discussed in section 2, in addition to trade barriers, extensive licensing requirements and strict labor regulations were important parts of the economic climate in India during this period. These additional distortions may have been constrained Indian firms in their product lines. In addition to liberalizing trade, the 1991 reforms stepped up the process of dismantling the pervasive industrial regulation in India. The share of delicensed industries increased from almost 40 to 91 percent from 1990 and 1997, with most of the delicensing occurring in 1991. The delicensed

[32]This requires an addition of a numeraire sector to the Melitz (2003) model.
[33]Data appendix contains the details on the construction of input tariffs.

industries corresponded to 57 and 92 percent of manufacturing output in 1990 and 1991, respectively (Aghion et al., forthcoming). The removal of licenses would have lowered product-specific entry costs and may have enabled firms to increase their extensive margins. On the other hand, it may have allowed firms to become more flexible to shocks by shutting down or restarting a product line in the absence of license requirements. Column 3 reports the regression of the extensive margin on input tariff, output tariff, and a dummy variable that takes a value of one if the industry was license free. The inclusion of delicensed variable does not affect the coefficient on input tariffs. Interestingly, the coefficient on delicensed is statistically insignificant.[34] The finding on input tariffs continues to hold in columns two and three which add the delicensing variable and import penetration, respectively.

The take-away message of Table 12 is that the number of products manufactured by the firm only appears correlated with input tariffs. These effects are particularly pronounced for firm producing consumer goods. Table 13 reports results where regression (1) is estimated separately for consumer goods (left panel) and intermediate goods (right panel)—defined as intermediate, capital and basic goods sectors. Column 1 indicates that the average effect of input tariffs from Table 12 is largely driven by the consumer goods sector. For consumer goods, the point estimate of input tariffs is -0.58, implying at a 10 percentage point reduction in input tariffs is associated with a 5.8% rise in the extensive margin. The coefficient for intermediate sectors (column 4) is not significant at conventional levels. The results for final goods are robust to inclusion of output tariffs in column 2 and inclusion of delicensing measure in column 3.

As discussed earlier, lower input tariffs might expand the range of products a firm can produce by lowering the marginal cost of production for domestic firms. This could occur through several channels. Lower input tariffs imply that intermediate inputs, both foreign and, through general equilibrium effects, domestic inputs should become cheaper. Alternatively, lower input tariffs might increase access of Indian firms to higher quality imported inputs, or to a greater variety

[34]The coefficient on the delicensed dummy is similar in the unconditional regressions. Note that Aghion et al (forthcoming) use the ASI data at the industry level from 1980 to 1997 to show that de-licensing only affected manufacturing output in states with more flexible labor markets, but our results (not reported) find no heterogeneous impact of delicensing on the firm's extensive margin across labor markets. A reason for the difference in findings could be the fact that many Prowess firms have plants in states with different labor markets which may wash away any heterogeneity. In future work we plan to extend our analysis to consider product lines at different plant locations.

of intermediate inputs used in the production process, which reduces marginal costs of production as in Ethier (1982), Markusen (1989), and Grossman and Helpman (1991).

5.3 India's Import Margins for Intermediate Goods

We use data on India's imports from 1989 to 2000 at HS-6 digit level to further examine the response of imports of intermediate goods to lower tariffs.[35] Expansion in imports of intermediates, defined as goods in basic, capital, and intermediate sectors, was substantial. The data indicate that India's aggregate imports more than tripled from 1987 to 2000, in real terms, and 72 percent of this increase was attributed to intermediates. Over 85% of the increase in intermediate imports originated from high-wage countries, which tend to export higher quality products (Schott (2004), Khandelwal (2007)).

Trade liberalization substantially increased intermediate imports and this growth was largely driven by the imports of new intermediate products (the extensive margin). To see this, Table 14 decomposes the growth in intermediate imports between 1987 and 2000 into the extensive and intensive margin. Here, the extensive margin refers to new six-digit Harmonized System (HS) codes that were not present in 1987.[36] The intensive margin refers to changes in imports within products that India imported in 1987. For the intermediate sector, the growth in volume of trade was overwhelmingly driven by expansion in the extensive margin. In these sectors, new six-digit HS codes account for 60% of growth in import volume. This is strong evidence that the availability of imported intermediate products increased substantially during India's liberalization episode. The importance of the extensive margin in the imported intermediate sectors contrasts sharply with the consumer goods sectors, where the extensive margin only accounts for 25% of all the growth in imports.

The above figures suggest that access to (new) foreign intermediate imports was potentially an important consequence of the trade liberalization. We directly link changes in tariffs to the number of available import varieties, here defined as a HS6 product-country pair, in the following specification

[35] Official Indian import data is obtained from Tips Software Services, Inc. It classifies products at the Harmonized System (HS) eight-digit level and records transactions for close to 10,000 manufacturing products imported from 160 countries from 1987-2000.

[36] We decompose imports at the six-digit HS level which is standardized across all countries and therefore not affected by arbitrary classifications by the Indian government at the eight-digit level.

(2) $$\log(1+v_{ht}) = \alpha_h + \alpha_t + \beta\tau_{h6,t} + \varepsilon_{ht}$$

where v_{ht} is the number of country-product pairs within the six-digit HS product h at time t and $\tau_{h6,t}$ is the tariff rate at the six-digit HS level.[37] The specification also includes HS6 digit product fixed effects and year fixed effects. As with the firm-level regressions, we restrict the regression to 1987-1996. Column 1 of Table 15 estimates (2) for all HS6 categories and shows that the tariff coefficient is negative and statistically significant. This finding is consistent with Klenow and Rodriguez-Clare (1997) who also identify extensive margin gains from Costa Rica's trade liberalization in the late 1980s. A negative coefficient suggest that lower tariffs might provide an additional welfare gain to Indian consumers through more imported varieties (Broda and Weinstein, 2006).[38] The second and third columns of Table 15 run the regression separately for final and intermediate sectors, respectively. As is suggested by the decomposition above, the overall effect is driven entirely by the intermediate sector. The final goods sector coefficient is not statistically significant, but the tariff liberalization had a statistically significant impact on the extensive margin in the intermediate sector.[39]

While the above analysis indicates an expansion in the number of intermediate imports commensurate with trade policy, we also find that the average unit value in the intermediate sectors fell as tariffs decline. In particular, a regression of log average unit value of the eight-digit HS code on lagged tariff at a HS6 digit level, HS8 category fixed effect, and year fixed effect reported in table 16 yields a statistically significant coefficient on lagged tariff of .152. The results suggest that lower tariffs are associated with lower unit value imports of intermediate products.

The above analysis of import data suggests that Indian firms might have benefited from trade reform via access to a greater variety of new products and cheaper intermediate products. Compared to the era of import substitution policies and high rates of tariff protection, the 1990s were characterized by increased access of Indian firms to foreign intermediate inputs. This section also

[37] India's tariffs are available at the six-digit HS level.
[38] We continue to obtain negative and significant coefficient when we use number of imported country-HS6 categories as a dependent variable, and log (1+number of HS8 category country pair) as a measure of imported variety.
[39] One explanation for the lack of finding in the consumer goods were the fact that NTBs still existed on these HS lines.

documents that lower input tariffs resulted in an increase in the firms' extensive margins, with the relationship particularly pronounced in the consumer goods sectors.

This preliminary evidence suggests a monotonic relationship between a firm's extensive margin and the number of intermediate inputs used in the manufacturing process. As the economy received access to cheaper and broader range of inputs, it appears that these inputs were channeled into the domestic consumer sector. Firms in the consumer sector, which for most of our sample was still subject to non-tariff barriers, appear to have benefitted from the access to variety by expanding their product lines. Uncovering the precise mechanism of this potential adjustment, as well as the potential quality improvements resulting from better access to inputs, is left for future research.

6. Conclusion

This study examines the importance of multiproduct firms and changes in the firms' product mix in a developing country context and links these changes to changes in trade costs stemming from a unilateral trade reform. Our analysis provides one of a few systematic account of the importance of multiproduct firms and changes in the product mix with large scale micro-level firm data, and yields several interesting findings.

In a cross-section of firms, we observe that Indian multi-product firms exhibit many characteristics similar to their counterparts in U.S. manufacturing. Multiproduct firms are bigger, more productive, and are more likely to export. In addition, the observed patterns are consistent with predictions of recent theory models of multi-product firms. For example, as predicted by BRS (2006b), we find positive correlation between the firms' extensive and intensive margin. One implication of this finding is that the extensive margin might amplify the inequality in size across firms.

Our cross sectional results so far are based on the medium and large manufacturing firms from CMIE's database Prowess. The Indian Annual Survey of Industries (ASI) provides an alternative data source of information on Indian manufacturing establishments. While ASI does not contain sufficient information for the analysis of changes in firms' product mix, it provides sufficient information for the above cross-sectional analysis. Unlike Prowess, it includes information on firms of all sizes and contains the information on employment. Consequently, we are in the process of examining the cross-sectional characteristics of Indian multiproduct establishments with the ASI data.

Our study also documents the prevalence of product mix changes among Indian firms and the contribution of the changes in the extensive product margin to output growth. Interestingly, the *net* extensive product margin accounts for a quarter of changes in output of continuing firms between 1989 and 2003. This magnitude nonnegligible and similar to its contribution to output growth in the U.S. However, despite similarities between U.S. and Indian firms in the cross section, their pattern of behavior, namely product churning, seems to diverge in the time series. In particular, Indian firms often add products, but they are less likely to drop a product or simultaneously add and drop a product. However, the characteristics of dropped products resemble the characteristics of dropped products in the U.S., although changes in the product mix are much less common in India than in the U.S. The less dynamic product margin in India could in principle reflect higher degree of regulation that spans industrial licenses, entry of foreign goods and state labor market laws.

The main objective of this paper is to extent the existing (at this point mainly theoretical) literature on trade and product mix, by examining whether Indian firms change their extensive product margin in response to India's large-scale tariff liberalization during the 1990s. To this end, we exploit differential declines in industry tariffs following India's 1991 trade reform to examine whether the observed changes in product mix are in part induced by declines in variable trade cost. We find no evidence of the relationship between declines on tariffs on final goods and a firms' extensive margin. The lack of findings of the link between the extensive product margin and output tariffs is potentially puzzling, given the predictions of recent trade models. The results could in part reflect data limitations. Indian firms might rationalize their product lines within product aggregates we observe in our data. Unfortunately, we are not aware of a data source that provides information on products at a more detailed level and covers a broad range of manufacturing industries in India. An alternative possibility is that the above models, that feature frictionless factor markets do not provide a good description of labor mobility in India. The lack of product dropping could potentially be attributed to regulatory constraints (such as rigid labor market regulation) that continue to affect daily operations of Indian firms and potentially preclude the firms from eliminating unprofitable product lines. We plan to explore this further in future work by exploiting variation in labor institutions across Indian states and whether product margin responds to declines in tariffs in Indian states with pro-business labor regulations.

While we find no link between declines in output tariffs and the firms' extensive margin, declines in tariffs on intermediate inputs were associated with increased probability that a firm starts producing a new product. These results are consistent with recent evidence that lower input tariffs

lead to increases in productivity of domestic firms in Indonesia (Amiti and Konings (2007)) and India (Topalova (2007)).

To this end, our work focuses on the firms' extensive margin and abstracts from product attributes. A related literature focuses on the relationship between trade shocks and product quality upgrading. Most of this literature focuses on quality upgrading that is induced by increased access to and more profitable export markets (Verhoogen (forthcoming)). The quality upgrading in response to trade openness could also arise because domestic firms in import competing sectors try to avoid competition from abroad by differentiating themselves. This idea has not been formalized in a trade context. But it is related to models by Acemoglu, Aghion, and Zilibotti (2006), and Aghion, Burgess, Redding, and Zilliboti (2005), where incentives to innovate depend on how far a firm lags behind the technological frontier. For firms that cannot escape the competition by the competitive fringe with innovation (because they are not at the technology frontier), more competition always reduces incentives to innovate. However, firms at the frontier have an incentive to innovate because this provides a venue to escape the competition. Examination of these channels remains a topic for future work.

Data Appendix

Product classification

The reporting of products by Indian firms is not governed by any particular product classification. Although CMIE has developed a classification of 5,800 codes based on the NIC and the HS schedule, the agency has not explicitly linked the product names reported by the firms to this classification. The names of products reported by the firm could differ in aggregation, or even in spelling (e.g., "Steel Rod" versus "Steel Rods"). We therefore standardized the approximately 8,500 product names to the 5,800 possible CMIE product codes. This mapping process was extremely time consuming and involved subjective calls. To minimize the scope for error and subjectivity in assigning the codes, the mapping was performed independently by two research assistants. The research assistants assigned product codes with identical NIC codes in 80% of the cases which represents 91% of output. A third research assistant resolved the differences between the mappings done by the first two research assistants by again manually checking the classifications.

Our final sample includes 1,886 product codes out of the universe of 5,800 product codes. The seemingly low coverage of products in the Prowess is not a source of concern. First, the distribution of unused codes is remarkably similar across sectors. Secondly, 25% of the unused codes are products in the agriculture and services sectors, which, of course, are not produced by manufacturing firms. The remaining unmatched codes appear to be a result of excess detail in the product codes. For many of these sectors, the number of potential CMIE products exceeds, by a large margin, the number of five-digit SIC products in BRS (2006a). The correlation between an industry's share in total unused codes and the number of possible codes in an industry is .99. Moreover, the chemicals sector alone account for 40% of the unused manufacturing product codes. Thus, if anything, the low coverage stems from the overly detailed CMIE product classification in certain sectors.

In all the analysis above, we refer to a *product* as the CMIE product code and not the reported product name.

Indicators for final and intermediate goods. Industries are classified according to their end use into Basic, Capital, Intermediate, Consumer Durables and Consumer Non Durables. The classification is adopted from Nouroz (2001), who classifies the official Input-Output categories into these categories. We match the Input-Output codes to the 4-digit 1998 NIC codes used in the Prowess. Consumer Durables and Consumer Non Durables are considered "final goods," while Basic, Capital and Intermediate are included in the "intermediate goods" category.

Output tariffs. Data on disaggregated tariffs for 1987-2001 have been compiled in Topalova (2007). Tariffs are reported at the six digit level of the Indian Trade Classification Harmonized System (HS) Code, which are then aggregated to the 116 NIC codes, using the concordance by Debroy and Santhanam (1993), to calculate average industry-level tariffs.

Input tariffs. We rely on the Indian national input-output (IO) table for 1993-94 and output tariffs in the construction of the industry input tariffs. For each industry, we create an input tariff for that industry as the weighted average of tariffs on inputs used in production for industry. The weights are constructed as input industry's share of the output industry's total output value. Formally, input tariffs are defined as $InputTariff_{mt} = \sum_{s} \alpha_{sm} Tariff_{smt}$, where α_{sm} is the share of input s in the value of industry m. For example, if a final good uses two intermediates with tariffs of 10 and 20 percent and value shares of .25 and .75, respectively, the input tariff for this good is 17.5 percent.

Effective Rate of Protection. Measure is based on the definition in Corden, 1966 and relies on output tariffs and Indian national input-output (IO) table for 1993-94. Formally,

$$erp_{mt} = \frac{OutputTariff_{mt} - \sum_{s} \alpha_{smt} InputTariff_{smt}}{\left(1 - \sum_{s} \alpha_{smt}\right)}$$

Delicensed. Delicensed is an indicator equal to one if the industry is not subject to licensing requirements in that particular year and zero otherwise. The information is obtained from Aghion et al. (forthcoming).

References

Acemoglu, D., P. Aghion and F. Zilibotti (2006) "Distance to Frontier, Selection and Economic Growth." *Journal of the European Economic Association*, 4, pp. 37-74.

Aghion, P., R. Burgess, S. Redding and F. Zilibotti (2005). "Entry Liberalization and Inequality in Industrial Performance." *Journal of the European Economic Association*, 3(2-3), pp. 291-302.

Aghion, P., R. Burgess, S. Redding and F. Zilibotti (forthcoming) "The Unequal Effects of Liberalization: Evidence from Dismantling the License Raj in India" *American Economic Review,* 2007, forthcoming.

Alfaro, L., A. Charlton, F. Kanczuk (2007). "Firm-Size Distribution and Cross-Country Income Differences, Harvard Business School Working Paper 07-086.

Amiti, M. and J. Konings (2007). "Trade Liberalization, Intermediate Inputs and Productivity, *American Economic Review*, 97, pp. 1611-1638.

Attanasio, O., P. Goldberg and N. Pavcnik (2004). "Trade Reforms and Wage Inequality in Colombia." *Journal of Development Economics*, 74(2), pp. 331-366.

Baily, M., C. Hulten, and D. Campbell (1992). "Productivity Dynamics in Manufacturing Establishments," Brookings Papers on Economic Activity, (Microeconomics), pp. 198-249.

Balakrishnan, P., K. Pushpangadan and M.S. Babu (2000). "Trade Liberalization and Productivity Growth in Manufacturing: Evidence from Firm-Level Panel Data." *Economic and Political Weekly*, October.

Baldwin, J. and W. Gu (2006) "The Impact of Trade on Plant Scale, Production-Run Length and Diversification", Economic Analysis Research Paper Series, #038, Statistics Canada.

Bartelsman, E. J. Haltiwanger, and S. Scarpetta (2006). "Cross Country Differences in Productivity: The Role of Allocative Efficiency," mimeo.

Bernard, A. and J. Eaton, J.B. Jensen, and S. Kortum (2003). "Plants and Productivity in International Trade," *American Economic Review* 93, pp. 1268-1290.

Bernard, A. and J.B. Jensen (2007) “Firm Structure, Multinationals, and Manufacturing Plant Deaths,” *Review of Economics and Statistics*, 89(2) May, pp. 193-204.

Bernard. A., J. Jensen, and P. Schott (2006). ‘Trade Costs, Firms and Productivity’, *Journal of Monetary Economics*, 53(5), July, pp. 917-937.

Bernard, A., J. Jensen, S. Redding, and P. Schott (2007). “Firms in International Trade.” *Journal of Economic Perspectives*, 21(3), pp. 105-130.

Bernard, A., S. Redding, and P. Schott (2006a). "Multi-product Firms and Product Switching," *NBER Working Paper* No. 12293.

Bernard, A., S. Redding, and P. Schott (2006b). "Multi-product Firms and Trade Liberalization," *NBER Working Paper* No. 12782.

Bernard, A., B. Jensen, and P. Schott (2006). “Survival of the Best Fit: Exposure to Low-Wage Countries and the (Uneven) Growth of U.S. Manufacturing Plants.” *Journal of International Economics*, 68(1), pp. 219-227.

Bertrand, M, P. Mehta and S. Mullainathan (2002), “Ferreting Out Tunneling: An Application to Indian Business groups,” *Quarterly Journal of Economics*, pp. 121-148.

Besley, Timothy and Robin Burgess (2004). “Can Labor Regulation Hinder Economic Performance? Evidence from India.” *Quarterly Journal of Economics*, 119(1), pp. 91-134.

Broda, C. and D. Weinstein (2006) “Globalization and the Gains from Variety.” Quarterly Journal of Economics, 121(2), May.

Broda, C., J. Greenfield and D. Weinstein (2006) “From Groundnuts to Globalization: A Structural Estimate of Trade and Growth” NBER Working Paper No. 12512.

Chari, A. and N. Gupta (2007) “Incumbents and Protectionism: The Political Economy of Foreign Entry Liberalization,” Forthcoming *Journal of Financial Economics*.

Chopra, A., C. Collyns, R. Hemming, K. Parker, W. Chu, and O. Fratzscher (1995). "India: Economic Reform and Growth," IMF Occasional Paper #134.

Currie, Janet and Ann Harrison (1997). “Sharing the Costs: The Impact of Trade Reform on Capital and Labor in Morocco.” *Journal of Labor Economics*, 15(3), Part 2, pp. 44-71

Debroy B. and A. T. Santhanam (1993). “Matching Trade Codes with Industrial Codes.” *Foreign Trade Bulletin*, 24(1).

Dinc, I. S. and N. Gupta (2007) “The Decision to Privatize: Finance, Politics and Patronage,” mimeo, MIT.

Dunne, T., M. J. Roberts, and L. Samuelson (1989a) “The Growth and Failure of U.S. Manufacturing Plants,” *Quarterly Journal of Economics* 104(4), pp. 671–698.

Dunne, T. , M. J. Roberts, and L. Samuelson. (1989b) “Plant Turnover and Gross Employment Flows in the U.S. Manufacturing Sector” *Journal of Labor Economics*, 7(1), pp. 48-71

Eckel, C and Neary, P (2006) 'Multi-product Firms and Flexible Manufacturing in the Global Economy', University College Dublin, mimeograph.

Ethier, Wilfred. (1982). "National and International Returns to Scale in the Modern Theory of International Trade." *American Economic Review*, 72, pp. 389-405.

Feenstra, Robert C., James R. Markusen, and William Zeile. (1992). "Accounting for Growth with New Inputs: Theory and Evidence." *American Economic Review*, 82(2), pp 415-421.

Feliciano, Zadia (2001). "Workers and Trade Liberalization: The Impact of Trade Reforms in Mexico on Wages and Employment." *Industrial and Labor Relations Review*, 55(1), pp. 95-115.

Fisman, R. and T. Khanna (2004). "Facilitating Development: The Role of Business Groups," *World Development*, 32(4).

Gang, I. and M. Pandey (1996). "Trade Protection in India: Economics vs. Politics?" *University of Maryland Working paper #27*. December.

Goldberg, P.K. and N. Pavcnik (2007). "Distributional Effects of Globalization in Developing Countries" *Journal of Economic Literature*, 45(1), pp. 39-82.

Goyal, S.K. (1996). "Political Economy of India's Economic Reforms," *Institute for Studies in Industrial Development (ISID) Working Paper*, October.

Grossman, Gene and Elanahan Helpman (1991). *Innovation and Growth in the Global economy,* MIT Press, 1991.

Halpern, Lazlo, Miklos Koren, and Adam Szeidl. (2005). "Imports and Productivity." CEPR Discussion Paper 5139.

Hanson, Gordon and Ann Harrison (1999). "Trade and wage inequality in Mexico." *Industrial and Labor Relations Review*, 52(2), pp. 271—288.

Hasan, R., Mitra, D., and K. Ramaswamy (2007). "Trade Reforms, Labor regulations, and Labor Demand Elasticities: Empirical Evidence from India," *Review of Economics and Statistics* 89(3), pp. 466-481.

Hopenhayn, H. (1992). "Entry, Exit, and Firm Dynamics in Long Run Equilibrium," Econometrica 60, pp. 1127-1150.

Hsieh, C. and P. Klenow (2007). "Misallocation and Manufacturing TFP in China and India," UC Berkeley mimeo.

Kasahara, Hiroyuki, and Joel Rodrigue. (forthcoming). "Does the Use of Imported Intermediates Increase Productivity?" *Journal of Development Economics*, forthcoming.

Khandelwal, Amit (2007) "The Long and Short (of) Quality Ladders," mimeo, Columbia University.

Khanna, T. and K. Palepu (1999). "Policy Shocks, Market Intermediaries and Corporate Strategy: the Evolution of Business Groups in Chile and India." *Journal of Economics & Management Strategy*, 8(2), pp. 271-310.

Klenow, P. and A. Rodriguez-Clare (1997), “Quantifying Variety Gains from Trade Liberalization,” unpublished manuscript.

Kochhar, K. U. Kumar, R. Rajan, A. Subramanian, I. Tokatlidis (2006). "India's Pattern of Development: What Happened, What Follows," *Journal of Monetary Economics* 53(2006), pp. 981-1019.

Krishna, Pravin and Devashish Mitra (1998). “Trade Liberalization, Market Discipline and Productivity Growth: New Evidence from India.” *Journal of Development Economics*, 56(2), pp. 447-462.

Markusen, James R. (1989) “Trade in Producer Services and in Other Specialized Intermediate Inputs.” *American Economic Review*, 77, pp. 85-95.

Melitz, Mark J. (2003). “The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity.” *Econometrica*, 71, pp. 1695-1725.

Melitz, M.J. and G. Ottaviano (2008). "Market Size, Trade, and Productivity" *Review of Economic Studies* 75 (1), pp. 291-316.

Nocke, V and Yeaple, S (2006). ‘Globalization and Endogenous Firm Scope’, NBER Working Paper, 12322.

Nouroz, H. *Protection in Indian Manufacturing: An Empirical Study*, MacMillan India Ltd.,Delhi, 2001.

Olley, G. Steven and Ariel Pakes (1996). “The Dynamics of Productivity in the Telecommunications Equipment Industry.” *Econometrica*, 64(6), pp. 1263-1297.

Pacnik, Nina (2002). “Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants” *Review of Economic Studies*, 69, pp. 245-276.

Revenga, Ana (1997). “Employment and Wage Effects of Trade Liberalization: The Case of Mexican Manufacturing.” *Journal of Labor Economics*, 15(3), pp. 20-43

Roberts, Mark and James Tybout. *Industrial Evolution in Developing Countries*. Oxford University Press, 1996.

Restuccia, D. and R. Rogerson (2007). "Policy Distortions and Aggregate Productivity with Heterogeneous Plants," NBER Working Paper 13018.

Schott, P. (2004). Across-product versus within-product specialization in international trade. *Quarterly Journal of Economics 119*, pp. 647-678.

Sharma, Gunjan (2007). “Competing or Collaborating Siblings? Industrial and Trade Policies in India,” mimeo, University of Missouri.

Sivadasan, Jagadeesh (2006). “Productivity Consequences of Product Market Liberalization: Microevidence from Indian Manufacturing Sector Reforms.” October 2006.

Topalova, P. (2007). “Trade Liberalization and Firm Productivity: The Case of India.” *IMF Working Paper, WP/04/28*.

Topalova, P. (2006) “Factor Immobility and Regional Impacts of Trade Liberalization: Evidence on Poverty and Inequality from India” unpublished manuscript.

Trefler, D. (2004). “The Long and Short of the Canada-U.S. Free Trade Agreement”. *American Economic Review*, 94(4), pp. 870-895.

Tybout, J. (2003). "Plant and Firm Level Evidence on the "New" Trade Theories," in E. K. Choi and J. Harrigan, ed., *Handbook of International Trade*, Blackwell: Malden, MA, 388-415.

Verhoogen, Eric (forthcoming) “Trade, Quality Upgrading and Wage Inequality in the Mexican Manufacturing Sector.” *Quarterly Journal of Economics*.

Wacziarg, R. and J. Wallack (2004). “Trade Liberalization and Intersectoral Labor Movements.” *Journal of International Economics*, 64(2), pp. 411-439.

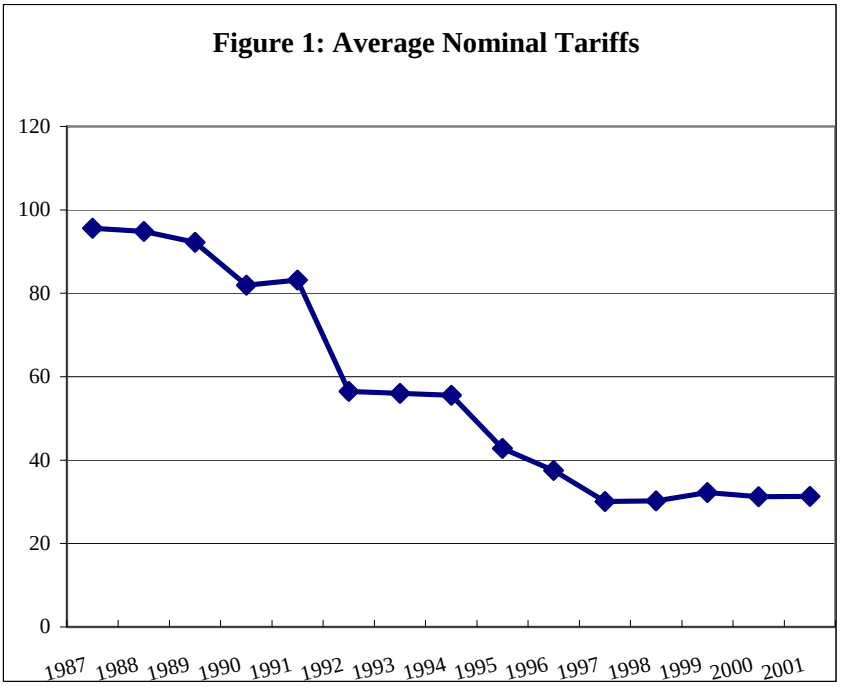


Figure 1: Average Nominal Tariffs
120
100
80
60
40
20
0
1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001

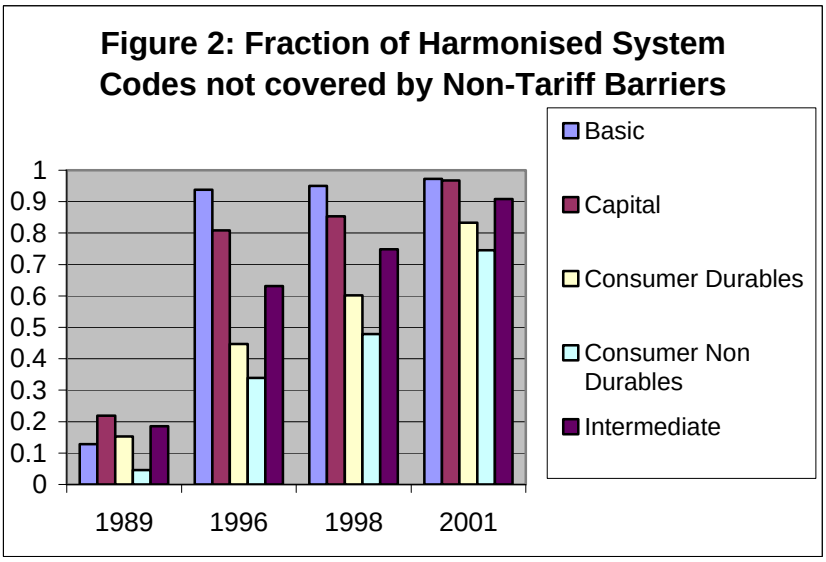
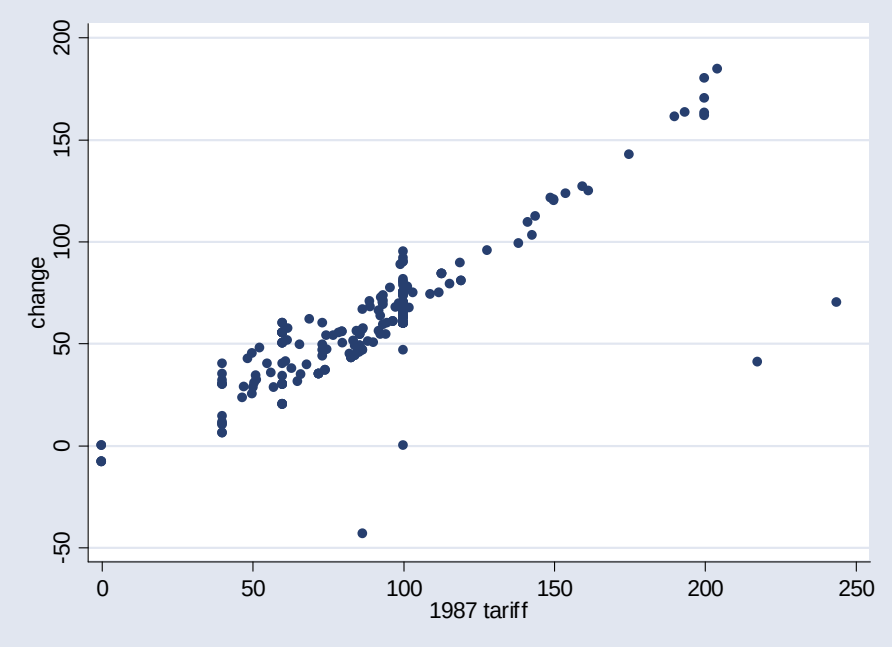


Figure 2: Fraction of Harmonised System Codes not covered by Non-Tariff Barriers
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1989
1996
1998
2001
Basic
Capital
Consumer Durables
Consumer Non Durables
Intermediate

Figure 3: Pre-reform Industry Tariffs and Industry Tariff Changes



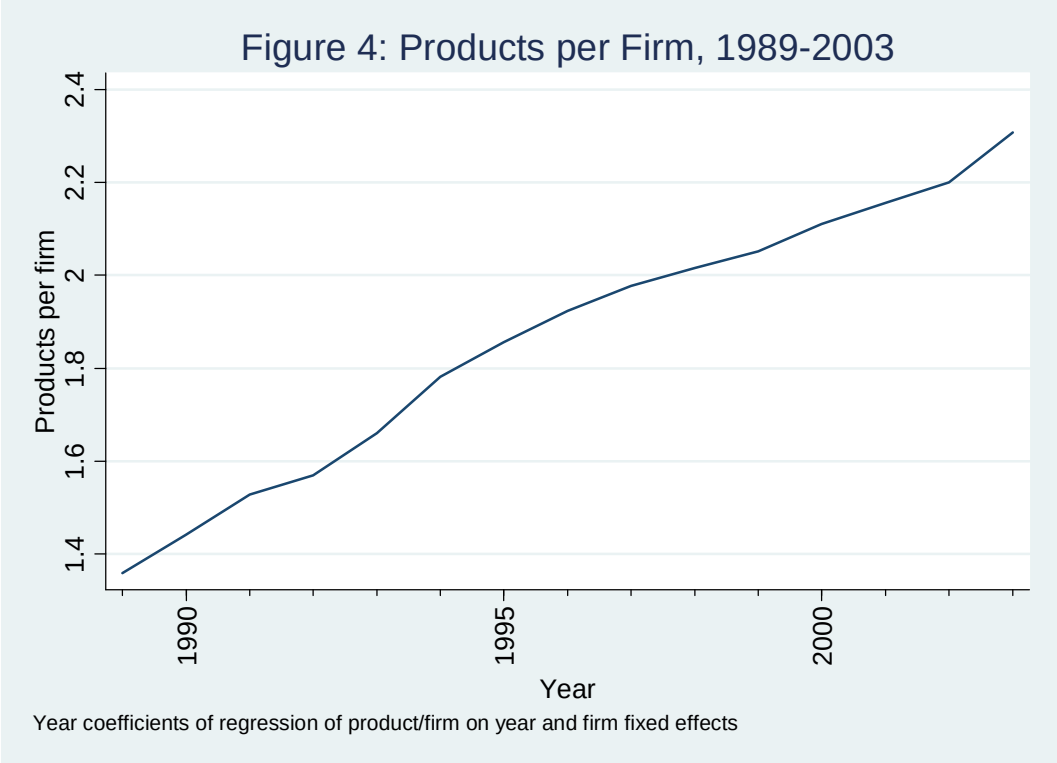


Table 1: Examples of Industries, Sectors and Products

NIC		Description
27		Basic Metal Industries (Sector)
2710		Manufacture of Basic Iron & Steel (Industry)
	130101010000	Pig iron
	130101020000	Sponge iron
	130101030000	Ferro alloys
	130106040800	Welded steel tubular poles
	130106040900	Steel tubular structural poles
	130106050000	Tube & pipe fittings
	130106100000	Wires & ropes of iron & steel
	130106100300	Stranded wire
2731		Casting of iron and steel (Industry)
	130106030000	Castings & forgings
	130106030100	Castings
	130106030101	Steel castings
	130106030102	Cast iron castings
	130106030103	Maleable iron castings
	130106030104	S.G. iron castings
	130106030199	Castings, nec

Products

Source: Prowess database and authors' matching of product names to product codes (see text). For NIC 2710, there are a total of 111 products, but only a subset are listed in the table. For NIC 2731, all products are listed in the table.

Table 2: Summary Statistics of Product-Reporting Firms

	Statistic
Years	1989-2003
Firms	4,971
Product-Reporting Firms	4,216
Share of output of reporting firms	0.85
Share of exports of reporting firms	0.91
Median product share of total output	0.92

Notes: Table summarizes aggregate statistics of product reporting manufacturing firms. Row 4 and 5 report the share of total manufacturing output and exports in Prowess by product-reporting firms, respectively. The final row reports the median share of product-reporting firms' total output covered by products. Source: Authors' calculations from the Prowess database.

Table 3: Firm-Level Summary Statistics

Variable	Mean (Rs. Crore)	Median (Rs. Crore)
Sales	158.1	29.8
PBDIT	18.9	3.0
Gross fixed assets	110.2	17.1
Total forex earnings	12.1	0.2
Total forex spendings	26.1	1.1
Value of output	142.1	27.7
Raw material expenses	57.6	12.2
Salaries and wages	9.3	1.7
R&D exp on current account	0.3	0.0

Notes: Table summarizes main firm-level variables from 1989-2003. Values are deflated using sector-specific wholesale price indicators and are reported in crore Rupees (1 crore = 10,000,000). Source: Authors' calculations from the Prowess database.

Table 4: Prevalence of Single- and Multiple-Product Firms

Type of Firm	Share of Firms	Share of Output	Industries or Sectors per Firm
Single-Product	0.53	0.20	1
Multiple-Product	0.47	0.80	3.06
Multiple-Industry	0.33	0.62	2.00
Multiple-Sector	0.24	0.54	1.68

Notes: Table classifies firms by single product, multiple product, multiple industry (four-digit NIC) and multiple-sector (two-digit NIC). Note that the unconditional products per firm is 1.97 over the sample period from 1989-2003. Source: Authors' calculations from Prowess database.

Table 5: Characteristics of Multi-Product Firms

	Multiple Product	Multiple Industry	Multiple Sector
Output	0.81	0.74	0.75
Salary per Output	0.15	0.18	0.18
TFP	0.01^	0.00^	0.01^
Probability of Export	0.13	0.11	0.15

Notes: Table summarizes mean percent differences in 2000 between single-product and multiple-product firms. Each row represents a separate regression of the dependent variable on a dummy that takes a value of one if the firm produces more than one product, industry and sector, respectively. Regressions include industry fixed effects and standard errors are clustered at the firm level. All coefficients are statistically significant at conventional levels with the exception of coefficients denoted with a "^". Probability of export is a linear probability regressions. There are roughly 2,800 observations in each regression.

Table 6: Distribution of Products Within the Firm

Average Share of Code in Firm Sales (High to Low)	Number of Products Produced by the Firm														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100	87	77	73	66	64	68	68	57	63	42	59	46	55	44
2		13	19	19	20	20	17	15	23	15	22	14	26	15	18
3			4	6	8	9	7	8	10	8	16	13	14	10	11
4				2	4	4	4	5	5	5	9	6	6	6	5
5					1	2	2	3	3	3	4	3	4	4	5
6						1	1	1	1	2	3	2	2	4	4
7							0	1	1	1	2	1	1	2	3
8								0	0	1	1	1	1	2	3
9									0	1	1	0	0	1	2
10										0	0	0	0	1	1
11											0	0	0	0	1
12												0	0	0	1
13													0	0	1
14														0	1
15															0

Notes: Columns indicate the number of products produced by the firm (truncated at 15 products). Rows indicate the share of the product, in decreasing order of size. Each cell is the (simple) average across the relevant firm-products in the sample (1989-2003).

Table 7: Intensive and Extensive Decomposition

	Number of Products (2000)	Number of Products (MP firms, 2000)	Number of Products (all years)	Number of Products (MP firms, all years)
Log Firm Sales	0.11	0.08	0.08	0.07
	0.01	0.01	0.00	0.00
Fixed Effects			year, firm	year, firm
R-squared	0.116	0.118	0.886	0.882
Observations	3,167	1,511	33,236	15,705

Notes: Table summarizes OLS regression of a log number of products on log total firm sales. Columns 1-2 are run on 2000 data, only, while columns 3-4 pool across all years. Columns 2 and 4 are run on multiple-product firms only. All regressions are significant at the 1 percent level.

Table 8: Correlation between Intensive and Extensive Margins

	Log Avg Sales/Product (2000)	Log Avg Sales/Product (MP firms, 2000)	Log Avg Sales/Product	Log Avg Sales/Product (MP firms)
Log Number of Products	0.080	0.477 ***	0.130 ***	0.424 ***
	0.053	0.104	0.016	0.031
Fixed Effects			year	year
R-squared	0.001	0.014	0.008	0.017
Observations	3,167	1,511	33,236	15,705

Notes: Table summarizes OLS regressions of log average sales per product on log number of products. Columns 1-2 are run on 2000 data, and columns 3-6 pool over all years. Columns 2, 4 and 6 include multiple-product firms only. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 9: Firm Activity

Percent of Firms

	All Firms				Single-Product Firms				Multiple-Product Firms			
Period	No Activity	Add only	Drop only	Add and Drop	No Activity	Add only	Drop only	Add and Drop	No Activity	Add only	Drop only	Add and Drop
Overall	42	45	5	8	53	42	na	5	29	48	11	11
Five-Year Average	72	22	4	2	80	19	na	1	63	26	8	3
Three-Year Average	80	15	3	1	87	13	na	1	73	17	7	2
Annual Average	90	7	2	0	94	6	na	0	86	9	5	1

Output-Weighted Percent of Firms

	All Firms				Single-Product Firms				Multiple-Product Firms			
Period	No Activity	Add only	Drop only	Add and Drop	No Activity	Add only	Drop only	Add and Drop	No Activity	Add only	Drop only	Add and Drop
Overall	22	72	1	5	46	52	na	2	17	76	1	5
Five-Year Average	57	28	2	12	76	24	na	0	53	29	3	15
Three-Year Average	69	23	2	6	84	16	na	0	65	25	3	7
Annual Average	83	13	3	1	93	7	na	0	81	14	4	1

Notes: Table classifies continuing firms into four mutually exclusive groups: no activity, add only, drop only and both. A product addition is defined as a firm adding a product in period t that it did not produce in the previous period. A drop in defined as a firm dropping a product in period t that it produced in the previous time period. These definitions imply that a single-product firm cannot drop a product only. Source: Authors' calculations from the Prowess database.

Table 10: Decomposition of Output for Continuing firms

		Extensive Margin			Intensive Margin		
Year	Gross Output	Net	Product Entry	Product Exit	Net	Growing Products	Shrinking Products
1989							
1990	7.8	0.7	1.4	-0.8	7.1	10.5	-3.3
1991	10.6	1.0	1.3	-0.3	9.6	12.8	-3.2
1992	-0.7	0.3	1.6	-1.3	-1.0	7.8	-8.9
1993	0.9	0.8	1.4	-0.6	0.2	7.3	-7.1
1994	13.9	3.6	3.8	-0.1	10.3	14.8	-4.5
1995	13.9	3.1	3.4	-0.3	10.8	15.4	-4.6
1996	18.1	0.7	0.8	-0.1	17.4	21.1	-3.7
1997	8.3	1.5	1.7	-0.2	6.8	12.6	-5.8
1998	7.2	0.4	0.6	-0.3	6.8	12.7	-5.9
1999	10.9	0.6	0.9	-0.3	10.3	15.4	-5.1
2000	13.5	0.2	0.5	-0.3	13.3	18.0	-4.7
2001	11.4	1.0	1.1	-0.1	10.4	15.8	-5.3
2002	3.1	4.5	4.7	-0.2	-1.4	6.7	-8.1
2003	13.6	1.3	1.4	-0.2	12.3	16.7	-4.4
1989-1993	15.0	3.2	4.2	-1.0	11.7	20.2	-8.4
1994-1998	52.7	10.5	11.1	-0.6	42.3	49.4	-7.1
1999-2003	42.5	10.0	10.7	-0.6	32.5	41.3	-8.9
1989-2003	197.7	49.8	52.5	-2.7	147.9	156.6	-8.7

Notes: Table decomposes aggregate output growth by within Prowess from 1989-2003. The table reports the aggregate output growth of continuing firms. Column 1 reports gross output. Columns 2-4 report report contribution of growth from the firms' extensive margin. Columns 5-7 report the contribution of growth from the firms' intensive margin. Source: Authors' calculations from the Prowess database.

Table 11: Firm Extensive Margin and Tariffs

	Products (All sectors)	Products (All sectors)	Products (consumer sectors)	Products (intermediate sectors)	Products (All sectors)	Add (all sectors)	Drop (all sectors)
Lagged Tariff	-0.017		-0.014	-0.006		-0.024	-0.005
	0.023		0.046	0.026		0.020	0.015
Lagged Import Penetration		-0.010					
		0.044					
Tariff					0.051		
					0.136		
Year FEs	yes	yes	yes	yes	yes	yes	yes
Firm FEs	yes	yes	yes	yes	yes	yes	yes
R-squared	0.9	0.92	0.91	0.89	0.94	0.2745	0.2549
Observations	14,801	11,568	6,897	7,904	4,096	11,568	11,568

Notes: Table summarizes firm-level regressions where the dependent variable is (log) number of products in columns 1-5, and add and drop dummies in columns 6-7, respectively. The independent variable for each regression is reported in the column heading. Column 1 uses lagged tariffs. Column 2 uses import penetration. Columns 3 and 4 report results for consumer and intermediate goods, respectively. Column 5 uses a pre-(1990) and post (2001) year. For 2001, the 1997 tariff is assigned. This regression is designed to estimate the impact of non-tariff barriers which were still in place in 1997, but dismantled in 80% of HS codes by 2001 (see text). Columns 6 and 7 report add and drop dummies, where drop is defined as the firm manufacturing the product in *t-1* but not in period *t*. With the exception of column 5, regressions are run on data from 1989-1997. Standard errors clustered at the industry level except column 5 which clusters at the industry-year level. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 12: Firm Extensive Margin and Import Tariffs

Lagged Input Tariff	-0.326 ***		-0.326 ***	-0.317 ***
	0.100		0.104	0.108
Lagged Tariff			0.000	-0.001
			0.023	0.023
Lagged License				-0.008
				0.012
Input Tariff		-0.255 ***		
		0.093		
Year FEs	yes	yes	yes	yes
Firm FEs	yes	yes	yes	yes
R-squared	0.9	0.9	0.9	0.9
N	14,801	14,801	14,801	14,801

Notes: Table summarizes firm-level regressions where the dependent variable is (log) number of products. Column 1 regresses the extensive margin on lagged input tariffs. Column 2 uses contemporaneous input tariffs. Column 3 controls for output tariffs and column 4 controls for licensing (see text). Standard errors clustered at the industry level. Regressions are run on data from 1989-1997. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 13: Firm Extensive Margin and Import Tariffs, By Sector

	Consumer Goods			Intermediate Goods		
Lagged Input Tariff	-0.458 **	-0.459 **	-0.524 ***	-0.197	-0.211	-0.212
	0.191	0.196	0.184	0.162	0.164	0.151
Lagged Tariff		0.001	0.018		0.007	0.013
		0.041	0.043		0.026	0.028
Lagged Deicensed			0.025			-0.024
			0.022			0.015
Year FEs	yes	yes	yes	yes	yes	yes
Firm FEs	yes	yes	yes	yes	yes	yes
R-squared	0.91	0.91	0.91	0.89	0.89	0.89
Observations	6,897	6,897	6,897	7,904	7904	7904

Notes: Table summarizes firm-level regressions where the dependent variable is (log) number of products. The left panel runs regressions on final goods (consumer durables and non-durables) sectors and right panel run regressions on intermediate goods (basic, capital and intermediates) sectors. Regressions are run on data from 1989-1997. Standard errors clustered at the industry level. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 14: Decomposition of Intermediate Imports

		Extensive Margin			Intensive Margin		
Period	Gross Import Growth	Net	Product Entry	Product Exit	Net	Shrinking (added products)	Growing (added products)
1987-2000	354	209	210	0	144	-39	184

Notes: Table decomposes import growth in the intermediate sectors (intermediate, basic and capital goods) in the extensive and intensive margins. The extensive margin refers to a new six-digit HS codes that were not imported in 1987. The intensive margin refers to changes in imports within products that India imported in 1987. Source: Authors' calculations from official Indian import data.

Table 15: Import Extensive Margin and Tariffs

	Log 1+Number of Varieties (Country-HS6)		
	All Products	Consumer Products	Intermediate Products
Lagged Tariff	-0.051 ***	-0.003	-0.083 ***
	0.013	0.024	0.016
Year FEs	yes	yes	yes
HS-6 FEs	yes	yes	yes
R-squared	0.87	0.87	0.83
Observations	42,755	16,690	20,254

Notes: Table summarizes product-level regressions of log (1+ number of varieties) on lagged output tariffs. A variety is defined as an six-digit HS product-country pair. Column 1 pools across all sectors. Columns 2 and 3 report coefficients for consumer goods and intermediate goods, respectively. Tariff is at the six digit HS level. Regressions are run for 1987-1996. Standard errors clustered at the six-digit HS level. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 16: Unit Values of Intermediate Imports (HS8) and Tariffs

	Intermediate Products
Lagged Tariff	0.152 ***
	0.043
Year FEs	yes
HS-6 FEs	
HS-8 FEs	yes
R-squared	0.9
Observations	31,002

Notes: The dependent variable is the log unit value of the HS8 category. Tariff is at the six digit HS level. Regressions are run for 1987-1996. Standard errors clustered at the six-digit HS level. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table A1: Products and Multi-product Firms by Sector

NIC Sector	Products	Industries	Products per Industry	Products per Firm	NIC4 per Firm	MP Firm Share	Multiple-Industry Firm Share	Multiple-Sector Firm Share	MP Share of Output	Multiple-Industry Share of Ouput	Multiple-Sector Share of Ouput	Products per MP Firm	Industries per MP Firm	Sectors per MP Firm
15 Food products and beverages	135	17	7.9	2.12	1.55	0.53	0.35	0.21	0.67	0.54	0.35	3.11	2.03	1.51
16 Tobacco products	6	1	6.0	2.04	1.73	0.58	0.49	0.45	0.85	0.84	0.84	2.78	2.25	2.17
17 Textiles	83	7	11.9	1.76	1.42	0.45	0.32	0.28	0.63	0.46	0.42	2.67	1.92	1.76
18 Wearing apparel	14	1	14.0	1.24	1.18	0.18	0.17	0.17	0.14	0.14	0.14	2.38	2.03	2.03
19 Tanning and dressing of leather	21	3	7.0	2.01	1.51	0.50	0.34	0.13	0.82	0.73	0.10	3.03	2.02	1.32
20 Wood and products of wood	13	2	6.5	2.20	1.77	0.61	0.45	0.37	0.73	0.39	0.38	2.94	2.21	1.82
21 Paper and paper products	32	3	10.7	1.40	1.21	0.24	0.19	0.15	0.50	0.47	0.44	2.68	1.88	1.72
22 Publishing/printing	13	3	4.3	1.61	1.29	0.36	0.64	0.29	0.22	0.84	0.19	2.71	1.48	1.88
23 Coke, refined petroleum products	24	2	12.0	2.77	1.77	0.60	0.44	0.44	0.98	0.81	0.81	3.97	2.29	2.12
24 Chemicals	506	9	56.2	2.26	1.43	0.53	0.32	0.17	0.79	0.61	0.34	3.36	1.79	1.38
25 Rubber and Plastic	85	3	28.3	1.68	1.34	0.40	0.26	0.21	0.67	0.33	0.31	2.72	1.82	1.71
26 Non-metallic mineral products	63	8	7.9	1.62	1.41	0.37	0.26	0.20	0.59	0.48	0.28	2.69	2.12	1.76
27 Basic Metal	103	3	34.3	1.85	1.34	0.46	0.26	0.20	0.85	0.44	0.40	2.84	1.71	1.54
28 Fabricated metal products	50	6	8.3	1.70	1.52	0.38	0.38	0.30	0.61	0.61	0.53	2.84	2.29	2.13
29 Machinery/equipment n.e.c.	195	14	13.9	2.20	1.81	0.55	0.48	0.32	0.78	0.74	0.62	3.20	2.46	1.87
30 Office, accounting and computing machines	19	1	19.0	1.56	1.36	0.29	0.20	0.20	0.37	0.10	0.10	2.96	2.26	2.28
31 Electrical machinery and apparatus	105	6	17.5	2.20	1.76	0.49	0.39	0.37	0.71	0.63	0.62	3.44	2.54	2.11
32 Radio, TV and communication	91	3	30.3	1.93	1.52	0.40	0.31	0.28	0.68	0.58	0.56	3.29	2.29	2.07
33 Medical, precision and optical instruments	71	5	14.2	1.63	1.38	0.30	0.22	0.18	0.48	0.45	0.42	3.10	2.25	1.95
34 Motor vehicles, trailers	96	2	48.0	2.03	1.52	0.51	0.39	0.35	0.63	0.59	0.57	3.02	1.97	1.97
35 Other transport	22	4	5.5	2.12	1.86	0.60	0.57	0.50	0.63	0.52	0.47	2.88	2.36	2.32
36 Furniture	22	5	4.4	1.53	1.29	0.24	0.09	0.09	0.34	0.07	0.07	3.21	2.20	2.01
Total	1,886*	108	17.5	1.97	1.48	0.47	0.33	0.24	0.80	0.62	0.54	3.06	2.00	1.68

Notes: Table reports summary statistics, by sector, for product-reporting firms. Column 1 our reports the total product codes by industry. Note that this column sums to 1,769 products, but there are 117 products in non-manufacturing industries (but produced by manufacturing firms) which we include in the analysis; a total of 1,886 product codes comprise the multiple-product Prowess sample. Column 2 reports the number of industries within each sector. Column 3 is the first column divided by the second column. Columns 4 and 5 report average products per firm and industries per firm, respectively. Column 6-8 report the fraction of firms that produce multiple products, industries and sectors, respectively. Columns 9-11 report the multiple-product (or industry or sector) firms' share of total output. Columns 12-14 report mean products, industries and sectors per MP firm. All figures are unweighted averages over 1989-2003. Industry refers to a 4-digit NIC code. Sector refers to a 2-digit NIC code. Source: Authors' calculations from the Prowess database.