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Trade Reforms and Market Selection: Evidence from Manufacturing Plants in Colombia*

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June 2007

Abstract

We use plant output and input prices to decompose the profit margin into four parts: productivity, demand shocks, mark-ups and input costs. We find that market fundamentals embodied by each of these components are important in explaining plant exit. Then, we use cross-sectoral tariff variation, as well as tariff changes within sectors over time, to assess whether the impact of different components of the profit margin on plant exit changes with increased international competition. Our estimation specifications control for other policy changes observed over the period, summarized by a time-varying reform index incorporating labor market regulation, financial market regulation, taxation and privatizarion. International competition intensification leads to an increased impact of productivity and other market fundamentals and a lower impact of mark-ups, in explaining plant exits. As a result, we find that changes in market selection due to lower sectoral effective tariffs result in higher average productivity.

Keywords: Trade liberalization, plant exit fundamentals, market selection

JEL Classification: F43, L25, O47

*We thank Diana Hincapie and Rafael Santos for excellent research assistance. We thank Mary Amiti, Sebastian Edwards, Larry Kleinman, Ralf Martin, Alejandro Micco and participants at the Euro-Latin Network Conference in 2006, the IMF Annual Research Conference in 2005, the Job Reallocation, Productivity Dynamics and Trade Liberalization Conference in Bogotá in July 2005, and the Universitat Pompeu Fabra macro seminar for helpful comments on related work. Support for this research was provided by NSF Grant SES-0617816, the Tinker Foundation, and aUniversity of Houston GEAR grant.

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1 Introduction

It is clear that an important means by which market economies restructure and innovate, in terms of both product and process innovations, is via entry and exit of establishments. Consistent with that view, in economies like the U.S., the entry and exit process has been identified as an important component of aggregate productivity growth. Aggregate productivity growth is achieved in part by the continuous reallocation of businesses. Low productivity businesses are more likely to exit and the truncation of the lower tail of the productivity distribution of establishments contributes to raising aggregate productivity.[1]

In developing economies, one somewhat surprising finding is that the pace of establishment and firm turnover is typically not that different from that observed for industrialized economies.[2] Even after controlling for differences in the size and industry distributions across countries, the pace of firm and establishment turnover is roughly similar across countries. This finding is surprising given that one may expect poor market institutions and structure to raise barriers to both entry and exit. Barriers on either margin can, in theory, reduce the pace of firm and establishment turnover. For example, administrative entry costs can lower entry and thus reduce exit as well, since low productivity businesses would be less likely to enter to begin with, leaving less room for exit of unsuccessful firms.

While the pace of entry and exit (and more generally output and input reallocation) does not appear to vary as systematically across countries as one might expect, there is increasing evidence that poor market institutions adversely impact the nature of the restructuring and reallocation. That is, there is evidence that the reallocation and restructuring is less productivity enhancing in economies with poor market institutions. For example, Bartelsman et. al (2006, 2007) show that measures of allocative efficiency vary considerably across countries and within countries over time. In particular, in transition economies over the course of the 1990s the findings show that productivity improved in part because of increases in allocative efficiency. In a related way, in Eslava, Haltiwanger, Kugler and Kugler (2004, 2005, 2006), we have found greater flexibility in factor adjustments, improvements in productivity due to increased allocative efficiency,

[1] See, e.g., Baily et al. (1992), Bartelsman and Doms (2000), Foster et. al. (2001,2006), and Olley and Pakes (1996). These findings do not suggest that reallocation is causal for productivity growth but rather that the process of an economy finding the best ways of doing business involves substantial trial and error with reallocation and entry and exit.

[2] See Bartelsman et al. (2006) and Tybout (2000).

and market selection becoming more related to prfit margin fundamentals over the course of the 1990s. These changes in micro dynamics at the establishment level follow after the introduction of market reforms in Colombia in the early 1990s.[3]

While the findings to date from both transition economies and Colombia suggest that market reforms have improved allocative efficiency as predicted by the theory, there has been less progress relating specific market reforms to the links between allocation and efficiency. In this paper, we explore a specific link – namely that between trade reforms and plant exit. Trade liberalization has been a core component of market reforms in developing economies and, in particular, of economies in Latin America. Empirically, one interesting aspect of trade reform in Colombia is substantial variation across sectors. This between sector, within country, variation reflects both substantial differences in the changes in tariffs introduced by trade reforms for different sectors, and substantial differences in the distortions to the distribution of surviving plants implied by the initial level of tariffs. This variation in trade reforms across sectors, along with rich longitudinal establishment-level data for the manufacturing sector of Colombia permits us to explore the impact of trade liberalization on establishment exit in Colombia. In particular, we explore whether increased competition due to trade liberalization in Colombia affected establishment exit, and whether the reduced trade barriers impacted the role of different profit margin fundamentals in determining plant exit in Colombia. In this respect, we explore the impact of trade reforms on the role of idiosyncratic (i.e., plant-level) total factor productivity, demand shocks, markups and cost variation. Finally, we explore whether, as predicted by theory, there is an increase in aggregate productivity associated with the truncation of the lower tail of the distribution of plant-level productivity following trade reforms.[4]

One important novel feature of our analysis is the separate measurement of physical productivity (rather than revenue-based productivity), mark-ups and input costs. The

[3]The underlying theory showing the impact of distortionary institutions on productivity can be found in Banerjee and Duflo (2003), Restuccia and Rogerson (2004) and Hsieh and Klenow (2006).

[4]In earlier work (e.g. Eslava et. al, 2006), we have provided evidence that market fundamentals became more important determinants of plant exit in the 1990s relative to the 1980s in Colombia. The 1990s were a period of market reforms on many dimensions during the 1990s in Colombia (market reforms included trade, financial market, labor market, privatization, and tax reforms). In contrast to this paper, our earlier work made no attempt to identify the impact of particular reforms on market selection. Moreover, the cross-sectional variation of the regulations was not exploited in the earlier work paper, while here we rely partly on the variability of tariffs across sectors to identify the effects of the trade reforms on market selection.

measurement of each of these shocks also permits us to evaluate separately the impact that each of these determinants of plant exit. We are able to measure separately these sources of variability because the Colombian Manufacturing data has plant-level prices of both inputs and outputs. This is a unique feature of the Colombian data, which is useful for our purposes in several ways. First, we are able to deflate output with plant-specific deflators, leading to a measure of TFP that has been stripped from demand effects. Our approach contrasts with most of the literature, where the measurement of TFP uses plant level revenue deflated with a sector-level price index. Given within sector price variability, this strategy confounds high physical efficiency and low prices. Second, we are able to precisely estimate demand shocks at the plant level due to the availability of plant-level output prices. In our estimation of the demand process, we also permit markups to vary across plants. We find that plants with higher productivity, those facing lower input prices, and those facing positive demand shocks and less elastic demands, are less likely to exit. We also find evidence that the role of the markup diminishes with lower tariffs.

Since the Colombian manufacturing plant-level data cover a wide range of manufacturing industries, we can exploit differences in tariffs between industries, as well as within industries over time, to explore the impact of trade reforms on market selection. We find that lower tariffs are associated with an increased impact of some fundamentals on plants exits. In particular, the effect of productivity, input prices, and demand shocks on the probability of exiting is larger at lower tariffs levels. As a result, we find that the probability of exiting has increased over our sample period in relation to the observed reduction of tariffs.

The rest of the paper proceeds as follows. In Section 2, we describe the market reforms introduced in Colombia during the 1990s. In Section 3, we describe the data from the Annual Manufacturing Survey. In Section 4, we present results on the impact of market fundamentals and the interaction of market fundamentals and trade reforms on exit probabilities. Section 5 presents the implications for average plant-level productivity. We conclude in Section 6.

2 Trade Reforms in Colombia

Colombia underwent substantial swings in trade policy during the past three decades. After considerable trade liberalization in the 1970s, the administration of President Belisario Betancur implemented a reversal towards protection during the early 1980s in response to the appreciation of the exchange rate, which had contributed to increased foreign competition. Betancurt's policies increased the average tariff level to 27 percent in 1984, but the degree of protection across industries was far from uniform. Manufacturing sectors benefited the most from increased protection as the average tariff in manufacturing rose to 50 percent. However, even within manufacturing some sectors benefitted more than others from protection. The sectors with the highest nominal tariffs were textiles and apparel at nearly 90 percent and wood products at 60 percent. These two sectors also enjoyed the highest levels of protection through non-tariff barriers.

While barriers to trade were reduced in the second half of the 1980s, trade was largely liberalized in Colombia during the first half of the 1990s. Figure 1 shows average effective tariffs and the standard deviation of effective tariffs starting in 1984.[5] From this initial level, the figure shows an initial substantial decline both in average effective tariffs and the dispersion of these tariffs in 1985. The figure then shows a gradual decrease in tariffs initiated during the administration of President Virgilio Barco in the late 1980s.

In 1990, the Gaviria administration introduced a comprehensive reform package, which included measures to modernize the state and liberalize markets. Reforms during the 1990s occurred in the areas of trade, financial and labor markets, privatization and the tax system. Probably the most important of all these reforms was the trade reform carried out at the beginning of the 1990s.

The average nominal tariff declined from 27 to about 10 percent overall, and from 50 to 13 percent in manufacturing, between 1984 and 1998. In particular, there was a drastic drop in average effective tariffs and in the dispersion of effective tariffs between 1990 and 1992 during the Gaviria administration. By 1992, the average effective tariff was at 26.6% compared to 62.5% in 1989 and compared to 86% in 1984. Similarly, the dispersion of tariffs fell substantially during the early 1990s, though dispersion across industries still remained substantial as the standard deviation of tariffs remained at around 0.2. At the same time, between 1990 and 1992, the average non-tariff barrier dropped to 1.1 percent.

After Gaviria's term, Ernesto Samper gained the election in 1994 based on a platform which partly opposed trade liberalization and other reforms.[6] While the new government

[5] The effective tariff for a given final good adjusts the tariff levied to the good itself, by substracting the the weighted sum of tariffs on the inputs used to produce that good, where the weights are given by the share of the input in production costs derived from the Input-Output table.

[6] Note that the Colombian electoral system at the time ruled out election for more than one term. This may provide an additional rationale for the depth of structural reforms in Colombia in the absence of an economic crisis.

did not dismantle the existing reforms at the time, it managed to stop the momentum for further liberalizing trade. This is clear in Figure 1, where the average and standard deviation of tariffs remains pretty much flat after 1992.

The description above makes clear that there were important changes in both the mean level and the dispersion of tariffs across sectors. The remarkable aspect of Colombian trade reforms is that at the same time that the overall level of protection was lowered, the sectoral structure of protection was also substantially altered as barriers to trade were lowered to similar levels across sectors irrespective of their initial level. In this paper, we exploit the cross-sectional variation in tariff reductions to identify the differential impact of the reforms on exit, and analyze whether these changes changed market selection. In particular, we ask whether there is evidence that these changes in tariffs affected both the mean exit rate and the impact of market fundamentals on plant exit. Then, we attempt to quantify the effect of changes in market selection related to trade reform on average productivity.

3 Data

Since we are interested in estimating the impact of market fundamentals on exit, we require information on plant characteristics, including: productivity, demand shocks, demand elasticities, and input prices. Also, since we are also interested in estimating the impact of trade liberalization plant exits, we require information on tariffs. Finally, since we want to control for other ongoing reforms that may had coincided with the trade reforms, in some specifications we require a measure of other regulations. In this section, we provide a description of the data, and we then explain the measurement of physical productivity and demand shocks.

3.1 Data Description

We use data from the Colombian Annual Manufacturing Survey (AMS), and unbalanced panel that registers information on all manufacturing establishments with 10 or more employees. Establishments with less than 10 employees but with a nominal value of production over a certain level are also included.[7] A plant is included in our sample in a given year if, satisfying one of these requirements, it reports positive production for that year. We have data covering the 1982-1998 period, at an annual frequency. The AMS

[7] For instance, for 1998 the value limit was set at close to U$35,000.

records include information on the value of production, number of employees, value of materials used, physical units of energy demanded, value of the stock of capital and purchases of capital. Moreover, an establishment also reports the quantities and value of each output it produces, and each material it uses. Prices for these individual goods and services can be constructed, at the plant level, from this information, and in turn used to create plant level indices of prices for outputs and inputs.

3.1.1 Plant-level Prices of Inputs and Outputs

We start by constructing materials price indices and outputs price indices for each establishment, using the information on individual products and materials for each plant. To create a plant-level index of materials prices, we first calculate weighted averages of the price changes of all individual materials used by the plant. The weight assigned to each input corresponds to the average share (over the whole period) of that input in the total value of materials used by the plant.[8] Plant-level price indices are then generated recursively from these plant-level price changes. Given the recursive method used to construct the price indices and the fact that we do not have plant-level information for material prices for the years before plants enter the sample, we impute material prices for each plant with missing values, using the average prices in their sector, location, and year. When the information is not available by location, we impute the national average in the sector for that year. A similar method is used to construct output price indices.

We use plant-level output prices to construct physical quantities of output, measured as nominal output deflated with the plant-level price index. Similarly, we construct physical quantities of materials used as nominal value of these materials deflated with the plant-level materials price index. Physical quantities of energy usage are directly reported at the plant-level.

3.1.2 Capital Stock

We construct a series of the capital stock for each plant, j, following the perpetual inventory method. Gross investment is generated from the information on fixed assets

[8] Since some large outliers appear, we trim the 1% percent tails of the distribution of plant-level price changes, as well as any cases that show reductions of prices beyond 50% in absolute value or increases in prices beyond 200%. In addition, given that the inflation rate in Colombia has hovered around 18% during the period, we choose to drop cases with very large price increases.

reported by each plant, using the expression:

$$I_{jt} = K_{jt}^{NF} - K_{jt}^{NI} - d_{jt} - \pi_{jt}^{A},$$

where $K_{jt}^{NF}$is the reported value of fixed assets by plant j at the end of year t, K_{jt}^{NI} is the reported value of fixed assets reported by plant j at the start of year t, d_{jt} is the depreciation reported by plant j at the end of year t, and π_{it}^{A} is the reported inflation adjustment to fixed asset value by plant j at the end of year t (only relevant since 1995, the first year in which plants were required by law to consider this component in their calculations of end-of-year fixed assets). We deflate gross investment using a deflator for capital formation from National Accounts' Input-Output matrices (or the equivalent "output utilization matrices" since 1994); the deflator varies in general at the 2-digit sector level, and for a few sectors at a higher level of disaggregation. Denote this deflator as $D_{S(j)t}$ where $S(j)$ is the sector to which plant j belongs. The plant capital stock is, thus, constructed recursively following:

$$K_{jt} = \left(1 - \delta_{S(j)}\right) K_{jt-1} + \frac{I_{jt}}{D_{S(j)t}},$$

where δ_j is the depreciation rate for the 3-digit sector to which a plant belongs; we use the depreciation rates calculated by Pombo (1999). We initialize the capital stock for each plant using the first reported nominal capital stock (at the beginning of year), $K_{jt_0}^{NI}$, deflated by the average capital deflator for the current and previous years, D_{t_0} and D_{t_0-1}:

$$K_{it_0} = \frac{K_{it_0}^{NI}}{\frac{1}{2}(D_{S(j)t_0} + D_{S(j)t_0-1})}.$$

3.1.3 Employment

The level of employment or the number of workers is reported directly by each establishment. Although not part of the AMS, we also obtain hours per worker to measure labor usage. We obtain average wages at the 3-digit sector level from the Monthly Manufacturing Survey.[9] Our measure of hours per worker in sector $S(j)$ to which plant j

[9]Data on sector wages are reported separately for production and non-production workers. We use a weighted average of the wages of those two categories, where the weights are the shares of each type of worker in total sector employment. We deflate the nominal wages using the CPI obtained from the National Department of Statistics.

belongs is:

$$H_{jt} = \frac{earnings_{S(j)t}}{w_{S(j)t}},$$

where $w_{S(j)t}$ is the measure of sectoral wages at the 3-digit level, and $earnings_{S(j)t}$ is a measure of earnings per worker constructed from our data as

$$earnings_{S(j)t} = \frac{\sum_{j \in S} payroll_{jt}}{\sum_{j \in S} L_{jt}}.$$

3.1.4 Descriptive Statistics of plant-level variables

Table 1 presents descriptive statistics of the quantity and price variables just described. The quantity variables are expressed in logs, while the prices are relative to a yearly producer price index to discount inflation. The sample has been restricted to plants in three-digit sectors with more that 20 establishments (in an average year); since we make use of within-sector variation at different points in the paper, this is the sample we use for all of our estimations. In the next section, we use the variables summarized in Table 1 to estimate the production function and inverse-demand equation.

Table 1 also shows entry and exit rates. A plant is classified as entering in t if it exists in our sample in year t but not in $t-1$. Similarly, the plant exits in t if it exists in the sample in t but not in $t+1$. Note that Table 1 reports entry and exit rates of 9% and 10% respectively, somewhat lower than those reported for developed countries (Davis, Haltiwanger, and Schuh (1996)). Lower entry and exit rates for Colombia are consistent with the perception that developing economies are subject to greater rigidities than more developed countries (see Tybout, 2000, for a discussion of this issue).

3.1.5 Tariffs and Reform data

Our data on effective tariffs come from the National Planning Department. Effective tariffs are available at the product level for each year, using a classification system (and therefore product identifiers) that were created for the Andean Community. In the tariffs database, each of these products is also assigned a four digit sector ISIC code. We construct effective tariffs at the four digit level by averaging effective tariffs across products in a given sector.

We also use an index of reforms other than trade in some of our specifications. We construct this index from the institutions index produced by Lora (2001). Lora generates indices of market reform in each of five areas: labor regulation, financial sector regulation, trade openness, privatization and taxation. He then averages those individual indices to construct an index of overall reform. The indices for individual areas of regulation fall in a 0-1 scale, where 0 (1) corresponds to the most (least) rigid institutions in Latin America over the period for each of the five categories that compose the aggregate index. We modify Lora's index in two ways. First, we exclude trade reform from the calculation of the overall index, since we look at trade institutions directly through tariffs. Second, we use a different 0-1 scale, where the index in each category is calculated relative to the minimum and maximum level of reform in Colombia during the period, rather than the minimum and maximum relative to Latin America.

The mean and standard deviation of effective tariffs, as well as the index of other reforms (which only varies over time) are described in Figure 1. As described above, both the mean and the standard deviation of effective tariffs go down significantly between 1984 and 1992, and then show little variation. Figure 1 also shows that the index of other reforms, which goes up as market reforms are implemented, increased at the same time that tariffs were being reduced.

3.2 Estimation of Productivity and Demand Shocks

We begin by estimating production and demand functions at the plant level, to obtain measures of TFP, demand shocks and demand elasticity. Given the endogeneity and omitted variable problems involved when estimating the production functions through OLS, we estimate total factor productivity using downstream demand to instrument inputs. We then estimate demand shocks with plant-level price data, using TFP to instrument for output in the demand equation.

3.2.1 Total Factor Productivity

We estimate total factor productivity for plant j in year t as the residual from a production function:

$$Y_{jt} = K_{jt}^{\alpha}(L_{jt}H_{jt})^{\beta}E_{jt}^{\gamma}M_{jt}^{\phi}V_{jt},$$

where, Y_{jt} is output, K_{jt} is capital, L_{jt} is total employment, H_{jt} are hours per worker, E_{jt} is energy consumption, M_{jt} are materials, and V_{jt} is a productivity shock.

Our total factor productivity measure is estimated as:

$$TFP_{jt} = \log Y_{jt} - \widehat{\alpha}\log K_{jt} - \widehat{\beta}(\log L_{jt} + \log H_{jt}) - \widehat{\gamma}\log E_{jt} - \widehat{\phi}\log M_{jt}. \tag{1}$$

where $\widehat{\alpha}$, $\widehat{\beta}$, $\widehat{\gamma}$, and $\widehat{\phi}$ are the estimated factor elasticities for capital, labor hours, energy, and materials. Since productivity shocks are likely to be correlated with inputs, OLS estimates of factor elasticities are likely to be biased. We thus present IV estimates, where we use demand-shift instruments which are correlated with input use but uncorrelated with productivity shocks. We also use input prices and government spending as instruments in this estimation. A more detailed description of this estimation and its results can be found in Eslava, Haltiwanger, Kugler and Kugler (2004).[10]

Table 2 presents summary statistics for our TFP measure (labeled TFP in the table), and compares it to alternative measures of productivity. We compare our IV TFP measure with a TFP measure estimated using cost shares (calculated at the 3-digit level) as factor elasticities (TFPC) and with a TFP measure estimated using factor elasticities from an OLS estimation of the production function (TFPO). Our TFP measure is highly correlated with both of these alternatives, with correlation coefficients above 0.85; thus, in spite of variation in estimated factor elasticities across different methods, we find that the TFP distribution across plants is similar.[11] The similarity between our TFP measure and one that uses cost shares at the 3-digit level addresses concerns related to the fact that our 2SLS factor elasticities do not vary across sectors. In addition, it is important to point out that we have find that the results in this paper are largely robust to the use of these alternative TFP measures and factor elasticities. In what follows, for space reasons, we focus on the results using the TFP estimates based on an IV estimation.[12]

Table 2 also shows other interesting patterns that we exploit in the analysis in the following sections. First, observe that TFP (measured either using our preferred measure in row 1 of Table 2 or TFPC which uses the cost share factor elasticities) is inversely correlated with plant-level prices. This is an interesting pattern, consistent with the intuition that more productive plants have lower marginal costs and thus set lower prices if they face downward sloping demand curves. We exploit this inverse relationship to estimate demand elasticities and demand shocks in the next section.

Table 2 also illustrates the importance of being able to measure plant-level prices and physical efficiency. TFP2 is a measure of "revenue" productivity, similar to that used more frequently in the literature, given the absence of plant-level prices. Similar

[10] This estimation strategy follows Syverson (2004).

[11] The finding that the distribution of plant-level TFP is robust to alternative estimation methods is analogous to related findings by Biesebroeck (2006).

[12] While the results are quite robust to alternative measures of TFP we have found our estimation of the determinants of exit due to market fundamentals (Table 6) are more precisely estimated when we use the IV based TFP which is consistent with the latter having less measurement error.

to the other measures of productivity we have reported, it is calculated using equation (1), but where Y_{jt} is plant-level revenue divided by sectoral level prices and M_{jt} is expenditures on materials divided by sectoral level materials prices. Although TFP and TFP2 are positively related, the correlation coefficient is only 0.68, significantly below the correlation of TFP with both TFPC and TFPO. Moreover, TFP2 is essentially uncorrelated with plant-level prices; the relation between prices and TFP, which we exploit in our data to identify demand elasticities and shocks, disappears when only sector level prices are available.

3.2.2 Demand Estimation

While productivity is likely to be one of the crucial components of profitability, other components are also probably important determinants of plant exits. For example, even if plants are highly productive, they may be forced to exit the market if faced with large negative demand shocks. Another important determinant of exits is likely to be the degree of market power of a producer, which empirically can be captured by the mark-up or the inverse of the demand elasticity. In this section, we describe how we estimate both the demand shocks as well as demand elasticities.

Our demand shock measure is estimated as the residual from estimating a demand equation, which in its simplest form may be written (in logs) as:

$$\log Y_{jt} = -\varepsilon_j \log P_{jt} + \log D_{jt}.$$

In this case, the demand shock is estimated using the following expression:

$$d_{jt} = \log \widehat{D_{jt}} = \log Y_{jt} + \widehat{\varepsilon}_j \log P_{jt}, \tag{2}$$

where d_{jt} is the demand shock faced by firm j at time t and $-\widehat{\varepsilon}_j$ is the estimated elasticity of demand, which may potentially vary across plants or sectors.

Using OLS to estimate the demand function is likely to generate an upwardly biased estimate of demand elasticities because demand shocks are positively correlated to both output and prices, so that $\widehat{\varepsilon}$ will be smaller in absolute value than the true ε. To eliminate the upward bias in our estimates of demand elasticities, we use TFP as an instrument for Y_{jt} since TFP is positively correlated with output (by construction) but unlikely to be correlated with demand shocks (Eslava et al., 2004).

Columns (1) and (2) of Table 3 report the OLS and IV results from the simple demand equation. To allow the demand elasticities to vary across sectors, we estimate the demand equations at the 3-digit level – this is feasible since our instruments vary across plants. The reported results are the averages of the estimated elasticities and their standard errors across the 3-digit sectors. OLS results presented in Column (1) suggest an elasticity of -0.8. Meanwhile, IV results in Column (2) which use TFP as an instrument for output, show a much higher average elasticity (in absolute value) of -2.23.[13]

We also estimate a different demand specification, where we let the demand elasticity vary over time and by a plant's location. To do this, we include the "density of roads" in the state in which the plant is located both as a control and as an interaction variable in the demand specification. The idea behind including density of roads is that this is a good proxy for access to markets, so that we should expect demand to increase as the density of roads increases and also competition to increase as access to markets improves. In this case, the demand equation may be written as,

$$\log Y_{jt} = -\gamma \log P_{jt} + \alpha \times Density_{R(j)t} + \beta \times Density_{R(j)t} \times \log P_{jt} + \log D_{jt},$$

where $Density_{R(j)t}$ is measured in kilometers of paved roads per square kilometer of total area of the state $R(j)$ in which the plant is located.[14] We estimate this equation including three-digit fixed effects, but do not let γ vary by sector to keep the specification parsimonious in this, more saturated, case. We also include national level GDP growth as an additional control, to make sure that the variation of roads over time is not reflecting other aggregate effects. In this case, the demand shock is again estimated as the residual from the demand equation, while the demand elasticity may be written as:

$$\widehat{\varepsilon}_{R(j)t} = -\widehat{\gamma} + \widehat{\beta} \times Density_{R(j)t}. \tag{3}$$

Column (3) of Table (3) reports results for this specification. As expected, we find that increased road density increases the demand for output. Also, increased road

[13] The sample size is larger in this table than in Table 2 because the estimations in that table require information on the instruments used for estimating the production function, while demand estimations only require information on output prices, physical output, and TFP estimates. Also, these estimates differ slightly from the ones we report in Eslava et al. (2004, 2006a), because in this paper we have restricted the sample to plants in sectors with more than 20 plants for the average year. We focused on sectors with a minimum number of plants given our interest in conducting robustness analysis with alternative estimates of factor elasticities at the sectoral level and our use of sectoral level variation in our analysis of the impact of tariffs.

[14] For each state, we have this indicator for each decade (1980s and 1990s). The data were provided by CEDE.

density increases the demand elasticity, consistent with the idea that greater competition due to greater access to markets makes demand more responsive to changes in prices. In Table 4, we report the implied average demand elasticity from this specification. The average elasticity when we allow for road density to enter the demand equation is -2.08, which is close to that estimated in Column (2) of Table 3, and the standard deviation is 0.17. Moreover, as expected, all estimated elasticities are negative.

4 Effects of Market Fundamentals and Tariffs on Plant Exit

According to selection models of industry dynamics (e.g., Jovanovic (1982), Hopenhayn (1992), Ericson and Pakes (1995), and Melitz (2003)), producers should continue operations if the discounted value of future profits exceeds the opportunity cost of remaining in operation. The model we regard as most relevant is the one presented by Melitz and Ottaviano (2005), which is an extension of Melitz (2003) allowing for variable mark-ups. We consider a producer with market power that makes decisions on outputs, inputs, and output prices, given productivity shocks, demand (shifter and elasticity) shocks and input price shocks drawn by the producer from a joint distribution. Moreover, given fixed costs of operating each period, the producer makes a decision on whether or not to stay or exit at each point in time. In this model (as in other closely related models), the producer's exit decisions should be affected by shocks to productivity, input prices, and mark-ups (demand shifter and elasticity):

$$e_{jt} = \begin{cases} 1 \text{ if } PDV\left\{\pi(TFP_{jt}, P_{Ijt}, D_{jt}, \varepsilon_{jt})\right\} - C_{jt} < 0 \\ 0 \text{ if } PDV\left\{\pi(TFP_{jt}, P_{Ijt}, D_{jt}, \varepsilon_{jt})\right\} - C_{jt} > 0. \end{cases}$$

That is, plant j exits if the discounted value of profits is below the fixed cost of operating, and the plant continues in operation if the opposite holds, i.e., if net profits are negative. Profits, π, (and, in turn, their present discounted value, PDV) are a positive function of demand and productivity shocks, a positive function of the demand elasticity, and a decreasing function of input price shocks.

The model implies that the plant exits if its fixed cost of operating in the period exceeds the discounted value of profits. Assuming that the fixed cost follows a normal distribution, we can in practice estimate a plant's probability of exit using a probit model, where we specify the probability of exit between t and $t+1$ as a function of measures of market fundamentals in period $t-1$:

$$\Pr(e_{jS(j)R(j)t}) = F\left(\lambda_S + \theta GDP_t + \delta_1 TFP_{jt-1} + \delta_2' P_{Ijt-1} + \delta_3 D_{jt-1} + \delta_4 \varepsilon_{R(j)t-1}\right) + u_{jt}, \tag{4}$$

where $e_{js(j)R(j)t}$ takes the value of 1 if the plant j in sector $S(j)$ and region $R(j)$ exits between periods t and $t+1$; F is the cumulative density function for a normal distribution; λ_s are 3-digit industry effects; GDP_t is the growth of aggregate gross domestic product in year t; TFP_{jt-1} measures productivity in period $t-1$, P_{Ijt-1} is a vector of energy and materials prices in period $t-1$, D_{jt-1} is a demand shifter in period $t-1$, $\varepsilon_{R(j)t-1}$ is the price elasticity of demand for plant j in region $R(j)$ in period $t-1$, and u_{jt} is an i.i.d. error term.

Table 4 reports summary statistics for the determinants of exit included in equation (4) (except for input prices which are reported in Table 1), as well as for effective tariffs and indices of trade and other reforms, which will be included in an expanded specification.

Table 5 reports the marginal effects obtained from estimating the baseline specification in equation (4), with more controls in each subsequent column. Column (1) reports the effect of productivity and input prices on plant exit when sector fixed effects and aggregate GDP growth are included, but idiosyncratic demand effects are left out. As expected, higher lagged productivity is negatively related to the probability of exit, while higher lagged energy and material prices are positively related with the probability of leaving the market. In particular, a one standard deviation increase in TFP yields a 1.2 percentage point decrease in the probability of exit, and a one standard deviation increase in energy and material prices yields respective increases of 0.44 and 0.57 percentage points in the probability of exit. Since the average exit probability is 10% these effects reflect large percentage changes in the probability of exit.

The magnitudes of all the estimated coefficients are larger when idiosyncratic demand effects are included. Column (2) includes the output price as a rough control for demand, while Columns (3) and (4) include our measures of demand shifts and elasticities. The results in Column (3) controlling for demand shocks show that a one standard deviation increase in TFP and demand yields respective reductions of 1.3 and 3.3 percentage points in the probability of exit, while a one standard deviation increase in energy and material prices yield a 0.46 and 0.9 percentage points increase, respectively, in the probability of exit.

When we control for the degree of market power in Column (4), the effect of the demand shock is even larger, while the effects of productivity and prices are very similar.

In this specification, a one standard deviation increase in the demand shifter and an the elasticity of demand reduces the probability of exit by 4 and 0.29 percentage points, respectively. As usual, since the price elasticity of demand is strictly negative, a larger demand elasticity (i.e., closer to zero) is associated with more inelastic demand (i.e., more market power and less exit).

In order to assess the impact of trade reform on market selection, we estimate the baseline probit specification adding the sectoral tariff and reform index as dependant variables as well as interactions with the measures of market fundamentals in period $t-1$ included in the baseline specification. In addition, we also include an index for other contemporaneous reforms which occurred at the same time as the trade reform. This index summarizes the degree of flexibility in the areas of labor and capital market regulations as well as the extent of market orientation in terms of the tax system and privatizations.[15] Since the 1990s were characterized by the introduction of widespread reforms in all of these areas, it is important to control for other reforms to make sure that tariffs are not also picking up these additional institutional changes. The following equation is estimated:

$$\begin{aligned}\Pr(e_{jS(j)R(j)t}) = F(&\Lambda_S + \Theta GDP_t + \Delta_1 TFP_{jt-1} + \Delta_2' P_{Ijt-1} + \Delta_3 D_{jt-1} + \Delta_4 \varepsilon_{jt-1} \\ &+\Delta_5 \tau_{S(j)t} + \Delta_{1,5} TFP_{jt-1} \times \tau_{S(j)t} + \Delta_{2,5}' P_{Ijt-1} \times \tau_{S(j)t} \\ &+\Delta_{3,5} D_{jt-1} \times \tau_{S(j)t} + \Delta_{4,5} \varepsilon_{R(j)t-1} \times \tau_{S(j)t} \\ &+\Delta_6 R_t + \Delta_{1,6} TFP_{jt-1} \times R_t + \Delta_{2,6}' P_{Ijt-1} \times R_t \\ &+\Delta_{3,6} D_{jt-1} \times R_t + \Delta_{4,6} \varepsilon_{R(j)t-1} \times R_t) + z_{jt}\end{aligned} \tag{5}$$

where $e_{jS(j)R(j)t}$, Λ_s, GDP_t, TFP_{jt-1}, P_{Ijt-1}, D_{jt-1}, and ε_{jt} are defined as in equation (4). $\tau_{S(j)t}$ is the tariff in sector $S(j)$ in year t, R_t stands for the index of reforms other than trade at time t, and υ_{jt} is an i.i.d. error term.

Given the presence of interaction terms, note that, for instance, the marginal effect of productivity in model (5) is now given by:

$$\frac{\partial \Pr(e_{jS(j)R(j)t})}{\partial TFP_{j,t-1}} = F'(\Delta' X_{jt}) * \left(\Delta_1 + \Delta_{1,5}\tau_{S(j)t} + \Delta_{1,6} R_t\right) \tag{6}$$

where F' is the marginal density for the normal distribution, and $\Delta' X_{jt}$ summarizes all covariates and coefficients in (5). A similar expression applies for the marginal effects of other fundamentals.

[15] Both the trade reform index and the other reform index are constructed using information originally collected by Eduardo Lora at the IDB. For a fuller description of how we construct these indices see Eslava et. al. (2006).

Table 6 reports results of estimating the specifications that include interactions. Column (1) in Table 6 reports results from estimating equation (5). Column (2) reports results from adding the index of other reforms as a control, but not interacting it with any other variable. Column (3) shows results of estimating equation (5). Each row reports the marginal effect for the corresponding variable, following the example of equation (6). Marginal effects are calculated at the mean value for all variables, except for tariffs, which are allowed to vary from column to column. For Column (1) tariffs are set at 60%, and for Column (2) they are set at 20%; since the mean value of tariffs is 56%, the effects reported in Column (1) are close to what is obtained by setting tariffs at their mean values. These marginal effects are based on the estimation of equation (5), which includes interaction of all fundamentals with both effective tariffs and the index of reforms other than trade. Column (3) of Table 6 reports the difference between the effects in columns (1) and (2), and its standard error.

Results from Column (1) show that the effects of fundamentals are in general consistent those estimated with the more parsimonious model reported in Table 5. The two exceptions are energy prices and demand elasticity, which show smaller effects in the specification that includes interactions, and no statistical significance when evaluated at the 60% tariffs.[16] In addition, we find that trade liberalization increased the importance of productivity, input prices, and demand shocks as determinants of a plant's probability of exiting.

The effect of a reduction in effective tariffs from 60% to 20%, similar to the reduction in tariffs experienced in Colombia in the early nineties, can be explored by comparing Columns (1) and (2) of Table 6. We find that a reduction in tariffs increases the impact that plant productivity, input prices, and demand shocks have on the exit probability. In particular, with the change in tariffs we are analyzing, an increase of one standard deviation in productivity from its mean value reduces the probability of exit by 1.4 percentage points if tariffs are at 60%, and by 1.5 points if tariffs are at 20%. A similar one standard deviation increase in demand shocks reduces the probability that a plant exits by 4.1 percentage points if tariffs are at 60%, and by 4.4 percentage points if tariffs are at 20%. Similarly, the effect of a one standard deviation in material prices goes from 0.86 to 1.3 percentage points. The estimated effect of a change in energy prices more than doubles when moving from 60% to 20% tariffs, but it is insignificant in size in both cases. The differences in the marginal effects of these fundamentals between the cases

[16] Moreover the sign of the effect of demand elasticity depends heavily of the level of tariffs at which effects are being evaluated.

of 60% and 20% tariffs are shown to be significant in Column (3) of Table 6. Again, in considering the magnitude of these effects it is useful to recall that the average exit rate is 10%. As such, these predicted effects are large relative to the average exit probability.

On the other hand, the change in the marginal effect of demand elasticity shows that, while with high tariffs market power reduces the probability of exit, the same is not true after a reduction in tariffs to 20%. Neither of these marginal effects evaluated at 20% and 60% tariffs are individually significant but interestingly the difference is significant in the direction predicted by theory. That is, increased competition through a reduction in tariffs diminishes the role of markups in accounting for variation in the probability of exit.[17]

Interestingly, the marginal effect of tariffs holding all other factors constant is not statistically significant once all other plant profit margin fundamentals are controlled for. Although a one standard deviation increase in tariffs reduces exit by 1 percentage point, the change is not statistically significant. Instead the impact of tariffs is through its interactions with the fundamentals as discussed above.

As a summary measure of the overall impact of these interaction effects, we conducted the following counterfactual. Using the estimated probability of exit specification, we compare the predicted probability of exit when we permit all explanatory variables to take on their actual values in each year to the predicted probability of exit when we permit all explanatory variables to take on their actual values except for tariffs which we fix at the 1984 levels. Figure 2 shows this comparison and indicates that the predicted probability of exit would had been higher every year with the actual tariffs than if tariffs had stayed at their 1984 levels, with the difference being particularly acute during the 1990s. The difference between these two predictions is in the 0.6 to 1 percentage point range during the 1990s – again a large effect relative to the average exit rate. Note as well that this counterfactual likely understates the impact of tariff reform on average exit rates since it neglects the impact of tariff reform on the distribution of fundamentals.[18]

[17]The marginal effect of the demand elasticity in Table 6 is small relative to the findings in Table 5. Recall that our demand elasticity varies across plants only via the road density variable. This variation is sufficient to yield plant-level variation in demand elasticities such that controlling for many other factors this variation is important for plant exit (Table 5). However, when we also control for tariffs and interact all of the market fundamentals with tariffs, this variation in demand elasticities yields relatively modest effects (although as noted this modest variation changes in the predicted manner).

[18]That is, the counterfactual in Figure 2 is a static counterfactual with the t-1 market fundamentals to predict exit in period t being the actual fundamentals and not the dynamic counterfactual simulation where the distribution of fundamentals are allowed to change over time due to the impact of selection

5 Effects of Tariff Induced Exits on Average Productivity

The analysis on exits above suggests that increased foreign competition due to trade liberalization has induced greater exit of plants through an increased importance of market fundamentals in determining exits. In particular, productivity, demand shocks, and input prices have become more important in determining which plants remain in operation. These results would then suggest that greater competition due to trade liberalization is weeding out the least productive plants and keeping the most productive plants in operation. Thus, one may expect market selection to contribute to increased average productivity.

In Table 7 we present evidence that changes in market selection due to lower sectoral effective tariffs result in higher average productivity. Column (1) in this table reports the expected average plant productivity that would had resulted given the pattern of exits predicted by our probit model above using actual tariffs. That is, considering the set of plants j present in year $t-1$, we estimate:

$$\overline{TFP}_t = \sum_{j \epsilon continuers} [TFP_{jt}(1 - \Pr(e_{jS(j)R(j)t}|\tau_{S(j)t}))] + \sum_{j \epsilon exit} [TFP_{jt-1}(1 - \Pr(e_{jS(j)R(j)t}|\tau_{S(j)t}))]$$

where $continuers$ is the set of $t-1$ plants that actually went on to produce in t, and $exit$ is the set of $t-1$ plants that actually exited in that year. That is, for plants that we observe in t $\overline{TFP}_t$ uses their productivity level in t (TFP_{jt}), while for those that exited we use TFP_{jt-1}. Column (2) reports the expected average plant productivity that would had resulted given the pattern of survivals predicted by our probit model had tariffs been kept at their 1984 levels:

$$\begin{aligned}\overline{TFP}_{1984} &= \sum_{j \epsilon continuers} [TFP_{jt}(1 - \Pr(e_{jS(j)R(j)t}|\tau_{S(j)1984}))] \\ &\quad + \sum_{j \epsilon exit} [TFP_{jt-1}(1 - \Pr(e_{jS(j)R(j)t}|\tau_{S(j)1984}))].\end{aligned}$$

The last column in Table 7 reports the difference between the expected average productivity with the actual tariffs and the expected average productivity had tariffs been kept

over time.

at their 1984 levels. This difference becomes positive after the big reduction in tariffs in 1992, indicating that average productivity increased due to market selection after trade liberalization was fully implemented.

In particular, the results suggest that the average plant-level productivity would had been between 12 and 29 percentage points lower had there not been changes in plant exits due to trade reforms. The evidence is consistent with trade liberalization contributing to raise average productivity by forcing low productivity plants out of the market and truncating the productivity distribution on the left.

6 Conclusion

We find that market fundamentals, embodied in the plant components of the profit margin, are important determinants of plant exits. These results confirm findings from previous studies, but our analysis goes further than the existing literature by analyzing the impact of specific profit margin fundamentals rather than relying on proxies.

In particular, we find that higher physical productivity, higher mark-ups (due to either to an increase in demand levels or a fall in the elasticity of demand) and lower input costs reduce the probability that plants exit. In exploring the role of trade reforms, we find that lower effective tariffs increase the marginal impact of productivity and input costs on plant exit, and reduce the impact of the mark-up on exit. As a result, lower effective tariffs have increased exit during the period of study.

All of these findings point towards greater competitive forces due to trade reforms impacting plant selection. Given evidence of intensified competition, we also investigate the implied impact on aggregate productivity. For this purpose, we conduct counterfactual exercises to show what productivity would had been if there had been no changes in plant survival due to lower effective tariffs.

In particular, we quantify the implied average plant-level productivity estimated using plant exit probabilities holding tariffs at their beginning of the period levels. The average plant-level productivity would have been as much as 29 percentage points higher had there not been changes in plant exits due to trade reforms. These results thus suggest a truncation of the productivity distribution on the left due to greater exit of less productive plants after trade reforms.

The changes in the nature of market selection induced by trade liberalization in Colombia, controlling for other market reforms, have increased attrition among manufacturing plants with the lowest productivity. Hence, after reforms were implemented in the early 1990s, there has been an improvement in allocative efficiency in the sense that the reallocation induced by plant turnover yielded larger increments in aggregate productivity in the 1990s than in the 1980s.

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Table 1: Descriptive Statistics

Variable	
Output	10.67
	(1.77)
Capital	8.44
	(2.11)
Labor	10.95
	(1.16)
Energy	11.40
	(1.91)
Materials	9.88
	(1.88)
Output Prices	-0.11
	(0.60)
Energy Prices	0.38
	(0.49)
Material Prices	-0.03
	(0.46)
Entry Rate	0.09
	(0.29)
Exit Rate	0.10
	(0.29)
N	98,833

Notes: This table reports means and standard deviations of the log of quantities and of log price indices deviated from yearly log producer price indices. The sample has been restricted to plants in three-digit sectors that have reports for more than 20 plants per year (in average). The entry and exit rates are the number of entrants divided by total plants and number of exiting plants divided by total number of plants. A plant that enters in t is defined as a plant that reported positive production in t but not in t-1, while a plant that exits in t is one that reported positive production in t but not in t+1.

Table 2: Descriptive statistics for different measures of TFP

TFP Measure	Standard deviation	Correlation Coefficients Matrix TFP (1)	TFP2 (2)	TFPC (3)	TFPO (4)	RP1 (5)
TFP	0.7668	1	0.69	0.90	0.86	-0.65
TFP deflating output and materials with sector-level prices (TFP2)	0.6079		1	0.53	0.40	-0.00
TFP with factor elasticities equal to cost shares (TFPC)	0.7660			1	0.86	-0.64
TFP with factor elasticities from OLS (TFPO)	0.6620				1	-0.72
Output prices relative to PPI (RP1)	0.5777					1
N		85,203	85,203	85,203	85,203	98,833

Notes: This table reports standard deviations and correlation coefficients for different measures of TFP and for the plant-level output prices. All figures are simple means of statistics calculated at the three-digit sector level. The exception is the total number of observations for the calculation of each correlation coefficient, reported in the last line, which includes all sectors. The factor elasticities used to estimate TFP (column (1)) are obtained from a 2SLS estimation of the production function, as described in the text. The equivalent factor elasticities used for TFPC (column (3)) are cost shares calculated at the three-digit sector level. For column (4), factor elasticities are obtained from an OLS estimation of the production function. Meanwhile, TFP2 in column (2) uses the same factor elasticities as in column (1), but the price indices used to deflate output and materials are calculated at the three-digit sector level rather than at the plant level. Sector level price indices are calculated as the geometric mean of plant level price indices for a given three-digit sector, using output shares as weights. Relative output prices RP1 are constructed as the log difference between plant level price indices and the aggregate log Producer Price Index, and reported in column (5).

Table 3: Demand Estimation

Instrument: TFP from 2SLS estimation of the production function

Regressor	OLS (1)	2SLS (2)	2SLS (3)
Relative Price	-0.7725 (0.0667)	-2.0914 (0.1362) [0.3563]	-1.7244 (0.0478) [0.4224]
Relative Price × Road Density			-1.4368 (0.1678) [0.3835]
Road Density			0.7328 (0.0549) [1]
Root MSE	1.5825	1.7621	1.7109
N	73,697	73,697	73,697

Notes: This table reports results from estimating demand functions. Standard Errors are in parentheses. First Stage R^2 in square brackets. The dependent variable is physical output in logs, and the regressor "Relative Price" is the log difference between plant-level price and the yearly PPI. In Columns (1) and (2), both the estimation constant and demand elasticities are allowed to vary by three-digit sector; the figures reported are simple means of three-digit sector level statistics. The exception is N, which corresponds to the total number of observations including all sectors. The two-stage least squares regression in column (2) instruments price with the 2SLS TFP measure, lagged one period. The regression in Column (3) includes as a regressor an index of the kilometers of paved roads per squared kilometer of area in the state in which the plant is located. An interaction between this index and the relative price is also included. This interaction is instrumented using an interaction between the plant's TFP (lagged) and the road density index. Although the estimated coefficients in this regression do not vary across sectors, three-digit sector fixed effects are included.

Table 4: Descriptive Statistics of Determinants of Survival

Variable	
Lagged TFP	1.1745 (0.7765)
Lagged Demand Shock (Column 2 Table 3)	10.7134 (2.0482)
Lagged Demand Shock (Column 3 Table 3)	10.6185 (1.8304)
Lagged Demand Elasticity (Column 3 Table 3)	-2.0869 (0.1732)
Reforms Other than Trade	0.4508 (0.1220)
Effective Tariffs	0.5599 (0.3854)
GDP Growth	0.0408 (0.0121)
N	57,886

Notes: This table reports means and standard deviations of the variables used to estimate exit probabilities. TFP is calculated using factor elasticities from a 2SLS estimation procedure, while demand shocks and demand elasticities come from the estimations reported in Table 3. The Index of Other Reforms is constructed using all components of the Lora Overall Reform Index, except those included in the Trade Index. Each of the sub-components of Lora's index has been re-scaled to be 0 in the year of less liberalization in Colombia and 1 in the year of most liberalization in Colombia. Effective Tariffs are available at the four-digit level, calculated from data by the National Planning Department.

Table 5: Determinants of Exit Probability.

	(1)	(2)	(3)	(4)
Lagged Productivity	-0.0158**	-0.0296**	-0.0167**	-0.0158**
	(0.0014)	(0.0019)	(0.0014)	(0.0013)
Lagged Energy Prices	0.0091**	0.0101 **	0.0094**	0.0093**
	(0.0022)	(0.0022)	(0.0021)	(0.0021)
Lagged Materials Prices	0.0124**	0.0209**	0.0197**	0.0178**
	(0.0025)	(0.0026)	(0.0024)	(0.0023)
Lagged Output Prices		-0.0294**		
		(0.0027)		
Lagged Demand Shock (Column 2 Table 3)			-0.0160**	
			(0.0006)	
Lagged Demand Shock (Column 3 Table 3)				-0.0218**
				(0.0006)
Demand Elasticity (Column 3 Table 3)				-0.0165**
				(0.0063)
Sector Effects	YES	YES	YES	YES
GDP Growth	YES	YES	YES	YES
Likelihood Ratio	666.42	786.65	1482.84	1784.91
	(31df)	(32df)	(32df)	(33df)
N	57,886	57,886	57,886	57,886

Notes: This table reports marginal effects from a Probit estimation of the probability of exit, where exit is 1 for plant i in year t if the plant produced in year t but not in year t+1. Standard errors in parentheses. All specifications include sector effects at the three-digit level, and growth of GDP, as well as plant-level productivity, energy prices, and materials prices. Column (2) includes output prices, and column (3) includes a measure of demand shocks estimated using column (2) in Table 3. Column (4) includes measures of the demand shock and demand elasticity estimated using column (3) of Table 3. * indicates significance at the 10% level, ** indicates significance at the 5% level.

Table 6: Determinants of Exit Probability in a Model with Reforms and Tariffs.

	Ef. Tariffs at 60% (1)	Ef. Tariffs at 20% (2)	Difference (1) - (2)
Lagged Productivity	-0.0144** (0.0014)	-0.0197** (0.0021)	0 .0053** (0.0020)
Lagged Energy Prices	0.0012 (0.0022)	0.0058* (0.0032)	-0.0046* (0.0027)
Lagged Materials Prices	0.0187** (0.0025)	0.0273** (0.0038)	-0.0086** (0.0035)
Lagged Demand Shock	-0.0227** (0.0007)	-0.0243** (0.0010)	0.0016* (0.0009)
Lagged Demand Elasticity	-0.0042 (0.0065)	0.0097 (0.0102)	-0.0139* (0.0083)
Effective Tariffs	-0.0033 (0.0041)	-0.0034 (0.0043)	0.0001 (0.0001)
Other Reforms Index	YES	YES	
Interactions with Other Reforms Index	YES	YES	
Sector Effects	YES	YES	
GDP Growth	YES	YES	

Notes: This table reports marginal effects and standard errors from a Probit estimation of the probability of exit where exit is 1 for plant i in year t if the plant produced in year t but not in year t+1. Standard errors in parentheses. Marginal effects are evaluated at mean values of all variables, except for effective tariffs. In Column (1) effective tariffs are set at a value of 20%, while in Column (2) they are set at 60%. Column (3) reports the difference between effects when tariffs are at 20% and at 60%. The specification includes sector effects at the three-digit level, and growth of GDP, as well as plant-level productivity, energy prices, materials prices and demand shocks and elasticities. Effective tariffs and interactions of effective tariffs with all of the plant-level regressors are also included. Similarly, we include an index of reforms other than trade reform, and interactions of this index with all of the plant-level regressors. The TFP measure is obtained using the factor elasticities from a 2SLS estimation procedure. The demand shock and demand elasticity measures used for this Table come from the demand specification reported in Column (3) of Table 3. * indicates significance at the 10% level, ** indicates significance at the 5% level.

Table 7. Average TFP(t) using exit between t-1 and t as projected by exit model

	Average TFP_t (using TFP_{it} for actual continuers and TFP_{it-1} for plants that actually exited)		
Year	Actual tariffs (1)	1984 tariffs (2)	Difference (1)-(2)
1986	1.0454	1.0473	-0.1909%
1987	1.0507	1.0527	-0.1994%
1988	1.1058	1.1079	-0.2096%
1989	1.1140	1.1167	-0.2720%
1990	1.1311	1.1336	-0.2545%
1991	1.1344	1.1388	-0.4307%
1992	1.0719	1.0765	-0.4600%
1993	1.0436	1.0421	0.1533%
1994	1.0580	1.0565	0.1509%
1995	1.0622	1.0602	0.1987%
1996	1.0678	1.0666	0.1239%
1997	1.0416	1.0401	0.1488%
1998	1.0345	1.0316	0.2910%

Note: This table reports the average, calculated over the sample of t-1 plants, of TFP_i*$pexit_{it}$, where $pexit_{it}$ is the probability that plant i exited between t-1 and t. TFP_i is the plant's TFP in t for plants that are actually observed in t (those that continued from t-1 to t), and it is the plant's TFP in t-1 for plants that actually exited between t-1 and t. The sample has been restricted to plants in 4-digit sectors for which tariffs are available for 1984.

Figure 1. Effective tariffs and reform index, 1984-1998

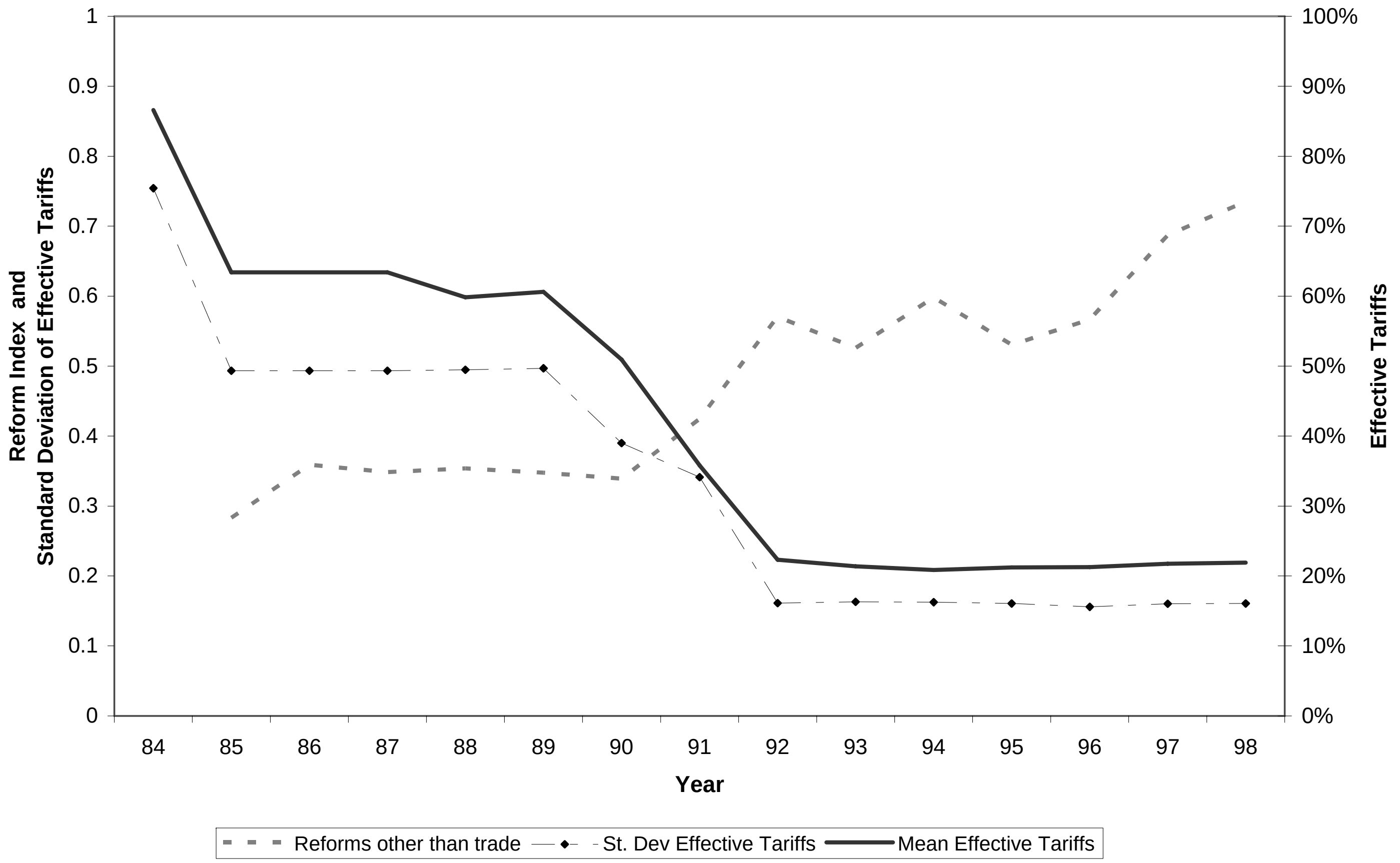

Figure 2. Predicted probability of exit: actual tariffs vs. 1984 tariffs