Barriers to Entry, Market Experimentation and Aggregate Productivity *

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Abstract

We use plant output and input prices to decompose the profit margin into three parts: productivity, demand shocks, and input costs. We find that market-oriented reforms increase the effect of market fundamentals on market entry. Our definition of a market is one industry in a particular region. Prior to reforms, we find that market fundamentals often work in the wrong direction with respect to the determinants of entry. These findings suggest frictions from poor market-oriented institutions distorted the process of entry. We find that market reforms increased the marginal effect of productivity, and other market fundamentals, on plant entry. We also find evidence that market reforms yielded an environment conducive to greater market experimentation.

Keywords: Barriers to entry, market oriented reforms, experimentation, productivity growth

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1 Introduction

The decision to enter a market has been directly related to the market and institutional framework through effects on the expected profitability of a new firm. Inter alia, market reforms lower barriers to entry and make the decision more dependant on market fundamentals. Improving the efficiency of market entry is important since it has become increasingly clear that a key channel through which market economies restructure and innovate is the 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 ongoing market selection process that involves entry of plants with high potential productivity and the exit of low productivity businesses.[1] In considering this evidence, it is critical to emphasize it is not simply the pace of entry and exit that matters but rather that the entry and exit decisions are determined by market fundamentals and not by market distortions. Under this assumption, exit will reflect a market selection process whereby less productive firms must leave the market. In turn, the expectation of being subject to dynamic market selection makes expected productivity an important input in the decision to enter, creates incentives for young firms to increase their productivity after entering the market, and makes incumbents react to the threat of entry by investing in increasing their productivity.

In the early 1990s, Colombia implemented a series of market-oriented reforms intended to improve the allocation of resources and, consequently, aggregate productivity. In Eslava, Haltiwanger, Kugler and Kugler (EHKK) (2005, 2006 and 2009), we have explored how these reforms affected allocative efficiency through their effects on the dynamics of factor adjustment and of plant survival. Our findings in those papers suggest important changes in the dynamics of both factor reallocation and plant survival after the reforms. These changes account for part of the pre- vs. post-reform differences in allocative efficiency documented in EHKK (2004). However, an important fraction of those differences remain still unexplained. Changes in the process of plant entry may help explain the remaining gap.

Given the importance of business turnover for productivity growth, rigid market institutions and concentrated market structures are expected to affect aggregate productivity by raising barriers to both entry and exit. Barriers on either margin can, in

[1] See, e.g., Baily et al. (1992), Bartelsman and Doms (2000), Foster, Haltiwanger and Krizan (2001, 2006), Foster, Haltiwanger and Syverson (2008), and Olley and Pakes (1996).

theory, reduce the overall pace of firm and establishment turnover. For example, administrative entry costs can lower entry as well as exit since start-ups would be less likely and this would relieve under-performing incumbents from exit pressures by new entrants. Moreover, recent theoretical models show that poor market institutions (including trade barriers) generate misallocation by introducing idiosyncratic distortions to profitability (see Banerjee and Duflo (2003), Melitz (2003), Hsieh and Klenow (2007), Restuccia and Rogerson (2007), and Bartelsman, Haltiwanger and Scarpetta (2008)).

Surprisingly, early evidence for developing economies shows that the pace of establishment and firm turnover is typically not that different from that observed for industrialized economies.[2] While this is at odds with the idea that developing economies, typically subject to more restrictive institutions, should have a slower pace of reallocation, recent findings from both emerging and transition economies suggest that market reforms improve allocative efficiency (for instance, Bartelsman, Haltiwanger and Scarpetta, 2008, 2009; Eslava, Haltiwanger, Kugler and Kugler, 2004, 2006, 2009). Thus, the working hypothesis is that poor institutions do not so much adversely impact the pace of entry and exit as they impact the type and nature of turnover. In particular, the working hypothesis in this paper is that poor institutions distort the role of market incentives for plant entry.

In this paper, we explore the role of reforms for the dynamics of entry. We are in a unique position to achieve this goal, as our data allows us to measure a plant's TFP, demand shocks, input prices and output prices. A challenge relative to our earlier work is that it is not feasible to estimate the determinants of entry at the micro level in an analogous fashion to estimating the determinants of exit. For the latter, the plants at risk are all plants in existence in a given market and exit can be modeled as a discrete outcome from this group. For entry, the at risk group is all potential entrants – a group that is inherently hard to measure. Given this challenge, we follow the insights and methods of Dunne et. al. (2007) to generate a market level measure of potential entrants. In turn, and again following the lead of Dunne et. al. (2007), we use a market level based estimation model of entry. The underlying conceptual model is familiar to the literature on plant dynamics – potential entrants make their decisions on the basis of expected profits. In a nondistorted economy, the determinants of expected profits are market fundamentals like expected productivity, expected demand and expected input costs. In a distorted economy, additional determinants are the rents and losses due to expected distortions. If the latter are sufficiently severe, then the role of expected

[2] See e.g. Bartelsman et al. (2008) and Tybout (2000).

market fundamentals will be distorted. Relative to previous work, an advantage of our approach is that we can directly measure these market fundamentals, rather thn having to rely on proxies such as the size of the population in the market.

Our results indicate that prior to market reforms, the impact of expected market fundamentals often worked in the wrong direction in Colombia – consistent with the hypothesis of substantial distortions. Following reforms, we find that the effect of market fundamentals like expected productivity, expected demand and expected input costs all changed towards the direction of a non-distorted economy. To measure market reforms in our analysis, we take two complementary approaches. First, we use a simple pre and post reform dummy to characterize the alternative regimes. Second, we use industry-specific information on trade liberalization to exploit a reform measure that has both cross sectional and time series variation.

A byproduct of our analysis of the impact of market reforms on entry is an exploration of where entrants fall in the distribution of plants in terms of market fundamentals. Our findings suggest that reforms yielded greater experimentation. Our evidence for this is that after reforms, the average productivity of new entrants actually fell. Other effects are also consistent with experimentation. First, the average productivity of exits also fell. Second, we find that after reforms productivity grows during the first few years after a plant enters, compared to a declining pattern of productivity upon entry pre-reforms. This evidence is suggestive, and consistent with findings from the recent literature, that less distorted economies exhibit similar patterns (see, Bartelsman, Haltiwanger and Scarpetta (2008)).

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 our analytical framework that in turn yields our empirical specification. In Section 4, we present the plant-level data from the Colombian Annual Manufacturing Survey, and describe how we construct market-level measures based on these data. In Section 5, we show our analyis of the determinants of entry. Here, we first show as a byproduct of developing our measures of market fundamentals where entrants fall in the distribution of market fundamentals. We then proceed to the core analysis of the paper – the role of market reforms for the determinants of market entry. The last section provides concluding remarks.

2 Market Reforms in Colombia

In the early 1990s, the government of President Cesar Gaviria introduced important reforms to eliminate rigidities in factor and product markets. Law 50 of December 1990 introduced severance payments savings accounts and reduced dismissal costs by between 60% and 80% (see, e.g., Kugler (1999, 2005)). In 1993, Law 100 changed the social security system by allowing voluntary transfers from a pay-as-you-go system to a fully-funded system with individual accounts, while at the same time increasing contributions (see, e.g., Kugler and Kugler (2009)).

Other reforms sought to reduce frictions in financial markets.To the extent that borrowing constraints prevail, less distorted financial markets would be conducive to more entry. In 1990, Law 45 eliminated interest rate ceilings as well as requirements to invest in government securities, and lowered reserve requirements. At the same time, supervision of financial markets was reinforced in line with the Basle Accords for capitalization requirements. Law 9 of 1991 abolished exchange controls, thus eliminating the monopoly of the central bank on foreign exchange transactions and substantially reducing capital controls. Finally, Resolution 49 of 1991 eliminated restrictions to foreign direct investment. This resolution established national treatment of foreign enterprises and eliminated limits on the transfer of profits abroad (see, e.g., Kugler (2006)). The policy change stimulated capital inflows and increased competition in all sectors, but in particular in the financial sector.

At the same time, Colombia underwent substantial changes in trade policy during the past three decades. After considerable trade liberalization in the 1970s, the administration of president Belisario Betancurt 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 received more protection than others. The sector with the highest protection was textiles and apparel, which had nominal tariffs of nearly 90 percent, and wood products followed with a nominal tariff of 60 percent. These two sectors also had 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 1982.[3] From this initial level, the figure shows an increase both in average effective tariffs and the dispersion of these tariffs that peaks in 1984, with a marked decline in 1985. The figure then shows a gradual decrease in tariffs which started during the administration of president Virgilio Barco in the late 1980s.

The average nominal tariff declined from 27 to about 10 percent overall, and from 50 to 13 percent in manufacturing, between 1984 and 1998. As Figure 1 shows, 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 won the presidential election in 1994 based on a platform which partly opposed trade liberalization and other reforms.[4] While the new government did not dismantle the existing reforms at the time, it managed to stop the momentum for further liberalization. This is clear in Figure 1, which shows that the average and standard deviation of effective tariffs remain flat after 1992.

If factor market reforms achieved the goal of reducing rigidities and sunk costs, we should observe changes in plant entry after the reforms. In what follows, we consider the impact of deregulation and trade liberalization on entry.

3 Analytical Framework

In most models of industry dynamics potential entrants are ex-ante identical, and decide whether or not to pay a fixed cost of entry c_E to participate in the market (Hopenhayn (1992), Melitz (2003), Melitz and Ottaviano (2008), and Asplund and Nocke (2006). While there is heterogeneity across incumbent firms in the level of productivity (or, more

[3]The effective tariff for a given final good adjusts the nominal tariff levied to the good itself, by substracting 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 for that good (using the corresponding entry in the Input-Output table).

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

generally, in the determinants of profitability), each firm only learns its own realization of profit shocks (which has several components – productivity, demand and input costs) after paying c_E. A potential entrant finds it worth to pay c_E if the expected net value of entry is non-negative. In equilibrium, the level of entry is determined by a zero-profit condition, so that for the marginal plant the expected net value of entry is zero.

The net value of entry is a positive function of profits, which in turn depend positively on the firm's productivity and demand shocks, and negatively on the costs of inputs. Market conditions such as the number of participants and the number of potential entrants will also affect firm's profits (see e.g. Dunne et al., 2007). Since a firm decides whether to enter or not without having oberved its own realization of these shocks, it calculates the expected value of entry on the basis of the observed determinants of profitability that characterize incumbent firms. We thus assume that the expected net value of entry depends on expected TFP, expected demand shocks, and expected input prices and wages in the respective market, as well as on the number of participants in the market and the number of potential entrants. The level of entry determined by the zero profit condition will in turn also depend on these expected conditions: when expected profits are higher, a larger number of entrants is necessary to drive the expected value of entry to zero.

Based on the above discussion, in practice we use market averages from the recent past to proxy for expected values. Specifically, we estimate the following reduced form relationship between the rate of entry into a given market and potential determinants of expected profits:

$$e_{s,r,t} = \alpha + \beta TFP_{s,r,t-1} + \gamma dshock_{s,r,t-1} + \delta wage_{s,r,t-1} + \eta pmat_{s,r,t-1} + \theta N_{s,r,t-1} + \mu NPE_{s,r,t-1} + \varpi X_{s,r,t-1} + \varepsilon_{s} \quad (1)$$

Where subindices s, r, and t refer to sector, geographical region, and year, respectively. The entry rate to sector s in region r and year t is defined as the number of entrants in period t divided by the number of market participants in that same period. In turn, a plant enters in period t if it is in our sample in t but not in $t-1$. The entry rate is modelled as a function of the productivity, the demand shock, the inputs prices, and the wage faced by the average plant in the market in year $t-1$ ($TFP_{s,r,t-1}$, $dshock_{s,r,t-1}$, $pmat_{s,r,t-1}$, and $wage_{s,r,t-1}$ respectively); of the number of plants in the market, $N_{s,r,t-1}$; and the number of potential entrants $NPE_{s,r,t-1}$. We also include some region and sector controls, summarized in vector $X_{s,r,t}$, such as per capita income, population, and density of roads (kilometers of paved road by kilometer of surface) in

region r, and sector effects. Note also that we only include the average fundamentals in period $t-1$ given the underlying assumption that the fundamentals are first order Markov processes, and that information at time $t-1$ is what potential entrants have in their information set when deciding entry.[5]

We estimate this model of market entry using Colombian data. The estimates for the basic model are of interest in their own right since Colombia has uniquely rich data to measure the fundamental determinants of profitability, especially TFP, demand shocks, and materials prices. In contrast to previous work (e.g.Dunne et al., 2007; Asplund and Nocke, 2006) , we are thus able to directly calculate the effects of these (expected) fundamentals, rather than having to rely in proxies of the size of the market, such as population or per capita income in the region where the plant is located.

Moreover, the important set of reforms adopted in Colombia during the nineties creates an interesting opprotunity to examine how entry relates to its theoretical determinants in more vs. less regulated environments. The distortions imposed by many regulations may isolate plants from the mechanisms that translate market fundamentals into profitability (Restuccia and Rogerson, 2007); for instance, protection from foreign competition may allow low productivity incumbents to continue producing, in turn generating disincentives for potential entrants to pay the fixed costs of entering the market. In fact, In Eslava et al. (2008), we find that the role of TFP as a determinant of a plant's survival is enhanced after market reforms. To explore the potential effects of market (de-)regulation, we examine the effect of market fundamentals on entry for the pre- and post-reform periods, and for different levels of tariffs. In particular, we re-estimate equation (1) interacting each of the determinants of entry (other than those in the vector of controls $X_{s,r}$) first with a post-reform dummy and then with sectoral effective tariffs.

Below, we describe the data and econometric strategy we use to estimate this empirical model.

[5] Under non-linearity of the profit function, the expected net value of entry will depend not only on the first moments of plant fundamentals, but also on second moments and some interactions between fundamentals. We do not include a full set of moments of fundamentals partly because, given that the unit of observation for this analysis is the sector-region cell, we end up with a relatively low number of observations. We plan to explore alternative specifications of the determinants of expected entry in future drafts.

4 Data

The dataset is drawn from the Colombian Annual Manufacturing Survey (AMS). The AMS is an unbalanced panel that registers information on all manufacturing establishments with 10 or more employees, or with a minimum level of nominal production. A plant is included in our sample in a given year if it reports positive production for that year. The AMS includes information on the value of production, number of employees, value of materials used, value of the stock of capital and purchases of capital. Quantities and value for each output the plant produces, and each material it uses are also reported. From this information, one can construct average prices at the plant level for these individual goods and services, and in turn use those average prices to create plant-level indices of prices for outputs and inputs.

4.1 Plant-level Profit Margin Components

We begin by estimating market fundamentals (productivity demand shocks, input prices) at the plant level; this information will later be aggregated to obtain average measures for sector s in region r. For this purpose, we have extended and refined the dataset on Colombian manufacturing plants first described in EHKK (2004) to cover the period 1998-2004.

4.1.1 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.[6] 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

[6]Since some large outliers appear, we trim the 1% percent tails of the distribution of plant-level price changes. In addition, given that the inflation rate in Colombia has stayed below 30% over the period, we choose to drop observations that show reductions of prices beyond 50% in absolute value or increases in prices beyond 200%.

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.

4.1.2 Total Factor Productivity

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

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

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

Our total factor productivity measure is estimated as:

$$TFP_{j,t} = \log Y_{j,t} - \widehat{\alpha}\log K_{j,t} - \widehat{\beta}(\log L_{j,t} + \log H_{j,t}) - \widehat{\gamma}\log E_{j,t} - \widehat{\phi}\log M_{j,t}. \quad (2)$$

where $\widehat{\beta}$, $\widehat{\gamma}$, and $\widehat{\phi}$ are estimated using the cost shares for labor hours, energy, and materials, calculated at the three-digit level. Our estimate of $\widehat{\alpha}$ is calculated as a residual assuming constant returns to scale.

The output $Y_{j,t}$ is measured as nominal output reported by the plant deflated with the plant-level price index. Note that by using a plant-level deflator we are not subject to the measurement problems that arise from the use of sector-level deflators, very common in the literature Similarly, our measure of materials $M_{j,t}$ corresponds to the nominal value of materials reported by the plant and deflated with the plant-level materials price index. Physical quantities of energy usage and number of workers, $E_{j,t}$ and $L_{j,t}$, are directly reported at the plant-level.

The capital stock is constructed following perpetual inventory methods, initializing the series for each plant with the capital stock reported by the plant at the end of its first year in our sample. 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. The initial capital stock is deflated using a simple average of this deflator over the two initial years that the plant appears in our sample. We use depreciation rates at the three-digit level calculated by Pombo (1999).

Finally, hours worked by employees are not directly reported in the AMS. To construct average hours per worker, we first obtain average wages at the 3-digit sector level from the Monthly Manufacturing Survey. 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.Our measure of hours per worker in three-digit sector S to which plant j belongs is:

$$H_{j,t} = \frac{earnings_{S,t}}{wage_{S,t}} = \frac{\frac{\sum_{j \in S} payroll_{j,t}}{\sum_{j \in S} L_{j,t}}}{wage_{S,t}},$$

where $wage_{S,t}$ is the measure of sectoral wages at the 3-digit level, and $earnings_{S,t}$ is a measure of earnings per worker constructed from our data as indicated by the second equality.

4.1.3 Demand Estimation

Our demand shock measure is estimated as the residual from estimating a simple demand equation:

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

where ε is the elasticity of demand. The demand shock is estimated as a residual:

$$d_{jt} = \log \widehat{D_{jt}} = \log Y_{jt} + \widehat{\varepsilon} \log P_{jt}, \tag{3}$$

where d_{jt} is the demand shock faced by firm j at time t and $\widehat{\varepsilon}$ is the estimated elasticity of demand. We estimate this demand equation using an instrumental variables approach, with lagged TFP as an instrument for Y_{jt}. This approach takes advantage of the fact that TFP is positively correlated with output but unlikely to be correlated with demand shocks (EHKK, 2004). Lagging the instrument avoids potential problems from measurement error and associated division bias.

4.2 Descriptive Statistics of Plant-level variables

Table 1 presents descriptive statistics of the quantity and price variables just described. All figures are calculated at the three-digit sector level, and reported for the average sector. Both price and quantity variables are expressed in logs, and output and materials prices are calculated as the log of the corresponding price index deviated from the logg PPI. The sample has been restricted to plants without missing values for the variables reported in the Table. 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 that entering and exiting plants represent 5% and 8% of the sample, respectively.

4.3 Data for the Sector-Region Level

The unit of observation in our equation of interest (1) is the "market" in a given year, where we define a market as a two-digit sector in a given geographical region. We divide the country into four regions: the northern coast, the eastern-center Andean region, the West, and the Amazonian and Planes region.[7].

For each sector-region-year cell we construct $TFP_{s,r,t}$, $dshock_{s,r,t}$, and $pmat_{s,r,t}$ by calculating an average of the respective plant-level variables across all plants producing in sector s and region r during year t. Also, N_t corresponds to the number of active plants in that sector-region cell during year t. Similarly, after having assigned to each plant the average wage of its three-digit sector, calculated as described above, we calculate $wage_{s,r,t}$ by averaging over the different plants in the s, r, t cell.

4.3.1 Potential Entrants

One of the challenges for the analysis of entry is to define the group of potential entrants. Here we follow the insights of Dunne et. al. (2007) to measure a proxy of potential entrants. For each market (defined at a sector, industry level of detail) we measure the total number of plants ever in existence over the 1982-2001 period as the starting point. We then define potential entrants in a given year in the market as this total less the number of current market participants. The idea is very intuitive – as a proxy for total potential participants in this market we use the total number of participants over the long period of time covered by the longitudinal panel.

While intuitive, this measure is undoubtedly a noisy proxy of potential entrants. For this reason, we follow Dunne et al. (2007) by not using this measure of potential entrants as the denominator of an entry rate but rather as an explanatory variable. For our entry rate we instead normalize by the actual number of market participants in period t.

[7] We avoid a higher level of disaggregation of sectors and regions to ensure we have cells that are sufficiently well populated.

4.3.2 Tariffs and Reform data

We examine potential changes in the entry process as a result of the adoption of reforms, by interacting each potential determinant of entry in equation (1) with a reform variable. We use two different such measures. First, we have a post-reform dummy, which takes the value of 1 in each year after 1990. Second, we use effective tariffs as a measure of the extent of trade liberalization.

Our data on effective tariffs come from the National Planning Department, and are available for each year of our sample up to 2001. The original data are presented at the product level and we calculate tariffs at the four-digit sector level as an average across all products in the sector. For this purpose, we use four-digit ISIC codes for each product, included in the same database. Each plant in our database is then assigned the average tariff for its corresponding four digit sector. We aggregate this information at the sector-region-year cell level by averaging over all plants in a given cell.

The mean and standard deviation of effective tariffs are described in Figure 1. Note that both moments of the distribution of tariffs reach a peak in 1984, and then show a significant reduction between 1984 and 1992. In particular, there is an important cut in tariffs between 1989 and 1991, which corresponds to the period of structural reforms described in Section 2. There is little variation in either of these moments after 1992.

5 Characterizing entry

5.1 Characteristics of entrants vs. incumbents

Before proceeding to our analyis of the determinants of entry, it is useful to first explore descriptive evidence about where entering plants fall in the distribution of all plants. Tables 2 and 3 provide summary statistics of the mean levels of some market fundamentals for entering and exiting plants relative to continuing plants, also capturing the patterns for the first two years after entry. To do this, we regress each market fundamental at the plant level against entry and exit dummies for the plant, as well as one and two lags of the entry dummy. Sector effects at the four digit level are controlled for. In addition, interactions are included with a pre/post reform dummy (post reform dummy takes on a value of 1 from 1991-2001) in column (1) for each market fundamental. In column (2), the interactions are with the effective tariff in the relevant four-digit industry for the plant. Note that when including interactions with tariffs we also include the post-reform dummy to control for the direct effect of reforms in areas other than trade. Table

2 reports estimated coefficients from these regressions, while Table 3 compares implied effects for the pre- vs. post-reform periods, and for scenarios with effective tariffs at 60% vs. 20% (roughly their pre- and post-reform average levels).

Several patterns emerge from this descriptive analysis. The first result is that entrants display higher productivity than incumbents, and they face lower demand. Moreover, using either the reform dummy or the tariff measure, we find that after reforms the average productivity of entrants declines, the average demand shock for entrants rises, the average output price for entrants rises and the average input cost for entrants declines. The post-reform decline in the relative productivity of entrants, compared to incumbents, is particularly marked, reducing the gap from 0.2 to 0.04.

Second, the patterns of post-entry growth of productivity change with reform. This is better captured by Figure 2. Pre-reform, average productivity in the first two years declines. Post-reform, the average productivity rises in the first few years after entry. Interestingly, by the third year the productivity is about the same comparing pre- and post-reform patterns, but plants have followed a very different trajectory over the first few years. Figure 3 shows related patterns for the demand shock. As already noted, pre-reforms entrants started with a larger demand deficit relative to incumbents. They catch up at a faster rate pre-reform but still remain below the post reform level.

To help interpret the patterns of entry, it is also instructive to examine the patterns for exit. Returning to Table 2 we observe that the average productivity and average demand of exits falls post-reform. In addition, the average output price increases as does the average input costs. These patterns are consistent with the results in EHKK (2009) that show that the role of market fundamentals increases for determining market exit. For current purposes, the key point is that these patterns fit with the patterns of entry in suggesting a greater degree of market experimentation, as described below. This is most evident in the patterns of productivity, which is the variable that should reflect such experimentation.

We interpret the results to be consistent with greater market experimentation as follows. With greater experimentation, we should observe greater heterogeneity including a lower tail of entrants right at the point of entry. As such, right at entry, mean productivity should fall, as we indeed observe. However, learning and selection effects are more important in an environment with greater market experimentation. Those that discover their "experiment" is not working exit – and given the greater experimentation this yields a lower average productivity of exits, which is what we observe. Moroever, conditional on survival, experimentation implies a greater rise in productivity in the years

following such entry. The greater growth will reflect both the direct effect of selection as well as any learning by doing. Again, this is what we observe.

It is worth noting that the patterns pre and post reform are similar qualitatively to the patterns observed cross sectionally between the U.S. and Europe (as in Bartelsman et. al. (2007)). The latter analysis finds that in the U.S. the relative productivity of entrants is lower than that of Europe, the relative productivity of exits is lower than that of Europe and that post-entry, U.S. plants exhibit more rapid productivity growth than their European counterparts. As in our analyis, they interpreted these patterns as being consistent with greater market experimentation in the U.S. Our results are also consistent with findings by Aghion et al. (2005), who show that after entry liberalization there is greater heterogeneity in performance within three-digit manufacturing sectors.

5.2 Determinants of entry into a sector in a given region

We now turn to the core empirical analysis of the paper. We estimate equation (1) using market level data for 1982-2001.[8] We define a market at the two-digit industry and region level in a particular year. Our dependent variable is the entry rate in the market defined as the number of entrants divided by the total number of operating plants from time $t-1$ to t. Our explanatory variables are as described above in section 3. Summary statistics of the market level variables we use in the estimation are reported in Table 4. The average market has 4.7 plants and 4.9 potential entrants, and displays an entry rate of 8.5%.

The results for the estimation of equation (1) are reported in Table 5. We report three sets of results. The first column reports results for the pooled sample not permitting the impact of market fundamentals to change over time. The second column shows the results permitting the impact of market fundamentals to change with the post-reform dummy. The third column permits the impact of market fundamentals to change with the tariff rate in the market (at the industry level).

The results in column (1) show a mixed pattern in terms of the role of market fundamentals. Expected productivity has no significant effect on the entry rate, while expected demand has a positive and significant effect. Expected input prices have a positive (counterintuitive) effect on entry and are marginally significant. On the other hand, expected wages have the expected negative sign and a significant effects. In sum,

[8] Though we have plant-level data up to 2004, our regression analysis is limited to 1982-2001 by the availability of data on effective tariffs.

not all the expected determinants of profitability affect entry in the expected way. This may reflect distortions derived from regulations; our findings below are consistent with this hypothesis.

Continuing with the baseline specification, we also find that the impact of the number of current market participants is negative, consistent with the fact that greater expected competition reduces expected profits and discourages entry. Finally, the impact of the number of potential participants is positive and significant. The impact of the number of potential entrants may reflect two, opposite, forces (Dunne et al., 2007). First, for a given expected value of entry, and an implied given probability of entry, an increase in the number of potential entrants increases the number of plants actually enter. Second, an increase in NPE may also increase expected future competition, reducing the value of entry. As in Dunne et al. (2007), we find that the former first order effect dominates.

The more interesting results and the focus of our analysis refer to the impact of market reforms on the role of potential determinants of entry. Here we focus our attention on the direction and magnitude of the changes in the coefficents. In Table 6, we use the results from Table 5 to quantify the changes in the coefficients and the significance of the changes. Column (3) of table 6 shows the post-reform vs pre-reform change in the effect of the different regressors on entry, obtained from the specification that includes interactions with our post-reform dummy. Similarly, column (6) shows the corresponding change when tariffs move from 60% to 20% (roughly the average magnitude of tariffs pre-reform and post-reform, respectively), from the specification that includes interactions with tariffs

The results in Table 6 show a general pattern of the effect of market fundamentals changing in the right direction (e.g., towards the effects of market fundamentals on entry being consistent with their theoretical effects on the value of entry). The results show that the changes in the effect of productivity and demand are both positive and significant using either the post-reform dummy or tariffs. Moreover, the change in the effect of materials prices is negative and significant using either reform variable. The change in the effect of wages is small and not significant. We also don't find much change in the effect of the number of current market participants or the number of potential entrants when using the post-reform dummy. However, the specification that includes interactions with tariffs shows a significant increase in the (absolute) effect of the number of participants and the number of potential entrants when tariffs move from 60% to 20%, indicating that a sufficiently large drop in tariffs enhances the effect of these two determinants of entry.

The quantitative implications of the changes in the impact of market fundamentals in Table 6 are large. For example, consider the change in expected productivity. The estimated change in the impact is 0.079. Using the standard deviations in expected productivity from Table 4, this implies that the impact of a one standard change in expected productivity increased by 0.02. This is a reasonably large change in the predicted entry rate given entry rates in the average market are around 0.085.

Table 6 shows not only the changes in effects but also the magnitude of the effect in the pre and post reform era as well as for high and low tariffs. The striking pattern that emerges is that in the pre-reform era (either using the dummy or the high tariffs) a number of market fundamentals work in the wrong direction. Such is the case of expected productivity, which has a large and negative effect in the pre-reform era (or at high tariffs). These results suggest that the determinants of market entry were highly distorted pre-reform. With the adoption of reforms the effect of market fundamentals moved significantly in the right direction.

6 Conclusion

When an economy undergoes market reform, many margins of firm dynamics are likely impacted. In prior work, we have found evidence that following the market reforms in Colombia market selection as well as factor adjustment (in capital and labor) for continuing plants are determined to a greater extent by market fundamentals. In the current paper, we examine the margin of entry in the wake of the market reforms in Colombia. Exploring entry is a challenge relative to the other margins since entrants emerge from the pool of potential entrants – a group inherently difficult to measure. We overcome this challenge by using insights from the recent literature on constructing proxies for potential entrants and using an empirical approach based on entry to a market (in our case at the industry, region level).

Our main findings are summarized briefly as follows. First, we find that pre-reform, entry appears to have been distorted by poor market institutions, as expected values of many of the market fundamentals affect entry rates in the wrong direction. Second, we find that reforms change the dynamics of entry so that change in the effect of market fundamentals moves in the direction of a less distorted economy. Specifically, we find that market entry becomes more positively related to expected productivity and expected demand and more negatively related to expected input costs. The effects of wages, number of participants in the market, and number of potential entrants do not

change significantly with reforms, although the effects of the two latter variables do change with a sufficiently large trade liberalization. Third, a byproduct of our analysis of the role of market fundamentals is that we characterize where market entrants fall in the distribution of market fundamentals across plants. Our descriptive analysis of these distributions suggests that reforms yielded greater market experimentation. The evidence for this is that post-reform we observe signs of greater learning and selection for each cohort of entering plants. Post reform, entering plants have lower average productivity but we also see that exits have lower productivity indicating greater selection. Moreover, the post-entry growth of productivity conditional on survival of young plants is greater following market reforms.

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Table 1: Descriptive statistics based on plant-level information

Variable	
TFP	1.2129
	(0.7626)
Demand Shock	0.3814
	(1.5585)
Output Prices	-0.1839
	(0.5439)
Material Prices	-0.0977
	(0.4358)
Entry	0.0515
	(0.2107)
Exit	0.0821
	(0.2699)
N	81,017

Notes: This table reports means and standard deviations of plant-level measures. All figures are calculated at the three-digit sector level, and reported for the average sector. Output and materials prices are the log of price indices deviated from yearly log producer price indices. The entry and exit variables 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. Factor elasticities used for TFP are cost shares calculated at the three-digit sector level. Demand shocks come from regressing physical output in logs against log plant-level prices relative to PPI. The sample has been restricted to plants without missing values for the variables reported in this table.

Table 2: Evolution of TFP, demand shocks, output prices, material prices and energy prices with respect to entry and exit times. 1982-2001

Regressor	TFP		Demand Shock		Output prices		Material Prices	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Entry	0.2035	0.0367	-1.0614	-0.9370	-0.0389	0.0061	-0.0094	-0.0561
	(0.0179)	(0.0210)	(0.0345)	(0.0405)	(0.0136)	(0.0159)	(0.0102)	(0.0120)
Entry x post-ref	-0.1644		0.1742		0.0365		-0.0548	
	(0.0240)		(0.0463)		(0.0182)		(0.0137)	
Entry x tariffs		0.1379		-0.0469		-0.0445		0.0305
		(0.0319)		(0.0614)		(0.0241)		(0.0181)
1 Lag of entry	0.1747	0.0386	-0.8832	-0.8469	-0.0448	0.0099	-0.0228	-0.0458
	(0.0160)	(0.0204)	(0.0308)	(0.0392)	(0.0121)	(0.0154)	(0.0091)	(0.0116)
1 Lag of entry x post-ref	-0.1411		0.0768		0.0591		-0.0229	
	(0.0226)		(0.0435)		(0.0171)		(0.0128)	
1 Lag of entry x tariffs		0.1131		0.0084		-0.0428		0.0206
		(0.0295)		(0.0569)		(0.0224)		(0.0168)
2 lag of entry	0.1175	0.0797	-0.7760	-0.7796	-0.0672	-0.0058	-0.0461	-0.0374
	(0.0166)	(0.0209)	(0.0320)	(0.0402)	(0.0126)	(0.0158)	(0.0095)	(0.0119)
2 Lag of entry x post-ref	-0.0231		0.0406		0.0554		0.0178	
	(0.0231)		(0.0444)		(0.0175)		(0.0131)	
2 Lag of entry x tariffs		0.0400		0.0509		-0.0525		0.0026
		(0.0304)		(0.0585)		(0.0230)		(0.0173)
Exit	-0.0923	-0.1190	-0.8396	-0.9875	-0.0114	0.0120	-0.0152	0.0079
	(0.0170)	(0.0176)	(0.0327)	(0.0339)	(0.0129)	(0.0133)	(0.0096)	(0.0100)
Exit x post-ref.	-0.0132		-0.1714		0.0184		0.0124	
	(0.0210)		(0.0405)		(0.0159)		(0.0119)	
Exit x tariffs		0.0319		0.0773		-0.0194		-0.0286
		(0.0284)		(0.0547)		(0.0215)		(0.0161)
Post-reforms	-0.0958	-0.0177	0.3032	0.1647	-0.0541	-0.1352	-0.1231	-0.1673
	(0.0066)	(0.0100)	(0.0126)	(0.0192)	(0.0050)	(0.0076)	(0.0037)	(0.0057)
Effective tariffs		0.1883		-0.3091		-0.1835		-0.0889
		(0.0178)		(0.0343)		(0.0135)		(0.0101)
Sector effects (4 digits)	YES	YES	YES	YES	YES	YES	YES	YES
R^2	0.1889	0.1902	0..3203	0.3208	0.2122	0.2145	0.2904	0.2911
N	71,337	71,337	71,337	71,337	71,337	71,337	71,337	71,337

Notes: This table reports regressions of TFP, demand shocks and output prices against sector effects, entry and exit dummies, and interactions of entry and exit dummies with a dummy for the post-reform period and with effective tariffs. Standard Errors are in parentheses. The post-reform dummy takes a value of 1 for period 1991-2001, 0 otherwise. The entry dummy takes a value of 1 for plant j in period t if the plant reports positive output in t but not in t-1. Conversely, the exit dummy takes a value of 1 for plant j in period t if plant reports having produced in t but not in t+1. The effective tariffs measure that varies at the four digit level. Left hand side variables are as defined in the notes to Table 1.

Table 3: Evolution of TFP, demand shocks, output prices, material prices and energy prices after entry. Pre-reform vs. post-reform

Panel A: Pre-reform and Post-reform effects

Regressor	TFP			Demand Shock			Output prices			Material Prices		
	Pre	Post	Dif	Pre	Post	Dif	Pre	Post	Dif	Pre	Post	Dif
	(1)	(2)	(2)-(1)	(3)	(4)	(4)-(3)	(5)	(6)	(6)-(5)	(7)	(8)	(8)-(7)
Entry	0.2035	0.0390	-0.1644	-1.0614	-0.8872	0.1742	-0.0389	-0.0024	0.0365	-0.0094	-0.0642	-0.0548
	(0.0179)	(0.0161)	(0.0240)	(0.0345)	(0.0309)	(0.0463)	(0.0136)	(0.0122)	(0.0182)	(0.0102)	(0.0091)	(0.0137)
First lag of entry	0.1747	0.0336	-0.1411	-0.8832	-0.8063	0.0768	-0.0448	0.0143	0.0591	-0.0228	-0.0457	-0.0229
	(0.0160)	(0.0160)	(0.0226)	(0.0308)	(0.0309)	(0.0435)	(0.0121)	(0.0121)	(0.0171)	(0.0091)	(0.0091)	(0.0128)
Second lag of entry	0.1175	0.0944	-0.0231	-0.7760	-0.7354	0.0406	-0.0672	-0.0118	0.0554	-0.0461	-0.0283	0.0178
	(0.0166)	(0.0160)	(0.0231)	(0.0320)	(0.0308)	(0.0444)	(0.0126)	(0.0121)	(0.0175)	(0.0095)	(0.0091)	(0.0131)

Panel B: Effective Tariffs at 20% and 60%

Regressor	TFP			Demand Shock			Output prices			Material Prices		
	60%	20%	Dif	60%	20%	Dif	60%	20%	Dif	60%	20%	Dif
	(1)	(2)	(2)-(1)	(3)	(4)	(4)-(3)	(5)	(6)	(6)-(5)	(7)	(8)	(8)-(7)
Entry	0.1195	0.0643	-0.0552	-0.9652	-0.9464	0.0187	-0.0206	-0.0028	0.0178	-0.0378	-0.0500	-0.0122
	(0.0121)	(0.0162)	(0.0128)	(0.0233)	(0.0312)	(0.0245)	(0.0092)	(0.0123)	(0.0097)	(0.0069)	(0.0092)	(0.0072)
First lag of entry	0.1064	0.0612	-0.0452	-0.8419	-0.8452	-0.0034	-0.0158	0.0013	0.0171	-0.0335	-0.0417	-0.0082
	(0.0114)	(0.0158)	(0.0118)	(0.0219)	(0.0304)	(0.0227)	(0.0086)	(0.0120)	(0.0089)	(0.0065)	(0.0090)	(0.0067)
Second lag of entry	0.1037	0.0877	-0.0160	-0.7490	-0.7694	-0.0203	-0.0373	-0.0163	0.0210	-0.0358	-0.0369	-0.0011
	(0.0116)	(0.0162)	(0.0122)	(0.0223)	(0.0311)	(0.0234)	(0.0088)	(0.0122)	(0.0092)	(0.0066)	(0.0092)	(0.0069)

Notes: this table reports pre- vs. post-reforms differences in market fundamentals of entrants with respect to incumbents, at the time of entry, and one and two years after entry. The differences are calculated interacting entry dummies with a post-reform dummy in Panel A and with effective tariffs in Panel B. Figures in Panel A are calculated using the coefficients reported in the odd-numbered columns of Table 2. Figures in Panel B are calculated on the bases of the estimated coefficients reported in the even-numbered columns of Table 2.

Table 4: Descriptive statistics for sector-region-year cells.

Variable	
Entry rate	0.0848
	(0.0562)
TFP	1.1545
	(0.2862)
Demand Shock	0.0666
	(0.6509)
Materials prices	-0.1186
	(0.3428)
Wages	4.6603
	(0.2640)
Tariffs	0.4578
	(0.3147)
Number of plants	4.6885
	(1.2277)
Number of Potential Entrants	4.8715
	(1.2497)
Total number of cells	532

Notes: This table reports means and standard deviations of cell-level measures, where a cell is a two-digit sector in a given region and a given year. The entry rate for a given cell is the number of entrants into that cell divided by the total number of plants in the cell. A plant that enters in t is defined as a plant that reported positive production in t but not in t-1. TFP, Demand Shocks, and Materials Prices for a cell are arithmetic averages of the corresponding plant level variables calculated across the plants in the cell. Wages are similarly calculated averaging over the plants in a cell, where the wage assigned to a plant is a weighted average of the wages of production and non-production workers in the three-digit sector the plant belongs to.

Table 5: Determinants of entry into sector-region-year cells

Regressor	(1)	(2)	(3)
TFP	-0.0126 (0.0135)	-0.0742 (0.0237)	0.0226 (0.0212)
TFP x posref		0.0791 (0.0217)	
TFP x tariffs			-0.1021 (0.0546)
Demand shock	0.0147 (0.0074)	0.0052 (0.0104)	0.0302 (0.0119)
Demand shock x posref		0.0283 (0.0122)	
Demand shock x tariffs			-0.0396 (0.0236)
Materials prices	0.0220 (0.0117)	0.0984 (0.0324)	-0.0399 (0.0195)
Materials prices x posref		-0.0980 (0.0301)	
Materials prices x tariffs			0.1804 (0.0543)
Wages	-0.0705 (0.0256)	-0.1167 (0.0401)	-0.1019 (0.0297)
Wages x posref		0.0181 (0.0303)	
Wages x tariffs			-0.0680 (0.0610)
N. plants	-0.0447 (0.0093)	-0.0738 (0.0178)	-0.0331 (0.0149)
N. plants x posref		0.0129 (0.0191)	
N. plants x tariffs			-0.0621 (0.0327)
NPE	0.0676 (0.0086)	0.0807 (0.0157)	0.0490 (0.0159)
NPE x posref		-0.0154 (0.0193)	
NPE x tariffs			0.0570 (0.0313)
Posref		-0.1777 (0.1471)	
Tariffs			0.4302 (0.2920)
Region controls	YES	YES	YES
Sector effects	YES	YES	YES
R^2	0.2199	0.2650	0.2639
N	532	532	532

Table 6. Determinants of entry into sector-region cells: pre-reform vs. post-reform and effective tariffs at 20% vs. 60%

Regressor	Pre-reform	Post-reform	Difference	Eff. Tariffs at 60%	Eff. Tariffs at 20%	Difference
	(1)	(2)	(3)	(4)	(5)	(6)
TFP	-0.0742	0.0049	0.0791	-0.0386	0.0022	0.0408
	(0.0237)	(0.0142)	(0.0217)	(0.0224)	(0.0151)	(0.0219)
Demand Shock	0.0052	0.0335	0.0283	0.0065	0.0223	0.0158
	(0.0104)	(0.0091)	(0.0122)	(0.0091)	(0.0088)	(0.0094)
Materials Prices	0.0984	0.0004	-0.0980	0.0683	-0.0038	-0.0722
	(0.0324)	(0.0133)	(0.0301)	(0.0225)	(0.0137)	(0.0217)
Wages	-0.1167	-0.0986	0.0181	-0.1429	-0.1155	0.0272
	(0.0401)	(0.0261)	(0.0303)	(0.0363)	(0.0270)	(0.0244)
N	-0.0738	-0.0609	0.0129	-0.0703	-0.0455	0.0248
	(0.0178)	(0.0112)	(0.0191)	(0.0140)	(0.0113)	(0.0131)
NPE	0.0807	0.0653	-0.0154	0.0832	0.0604	-0.0228
	(0.0157)	(0.0110)	(0.0193)	(0.0102)	(0.0112)	(0.0125)

Notes: this table reports pre- vs. post-reforms effects of different potential determinants of entry on entry rates. Standard errors are reported in parentheses. Figures in columns (1)-(3) come from an entry regression that includes interactions with a post-reform dummy. Basic estimated coefficients for this regression are reported in column (2) of Table 5. In turn, figures in columns (4)-(6) come from an entry regression that includes interactions with effective tariffs. Basic estimated coefficients for this regression are reported in column (3) of Table 5.

Figure 1. Efective tariffs, 1982-2001

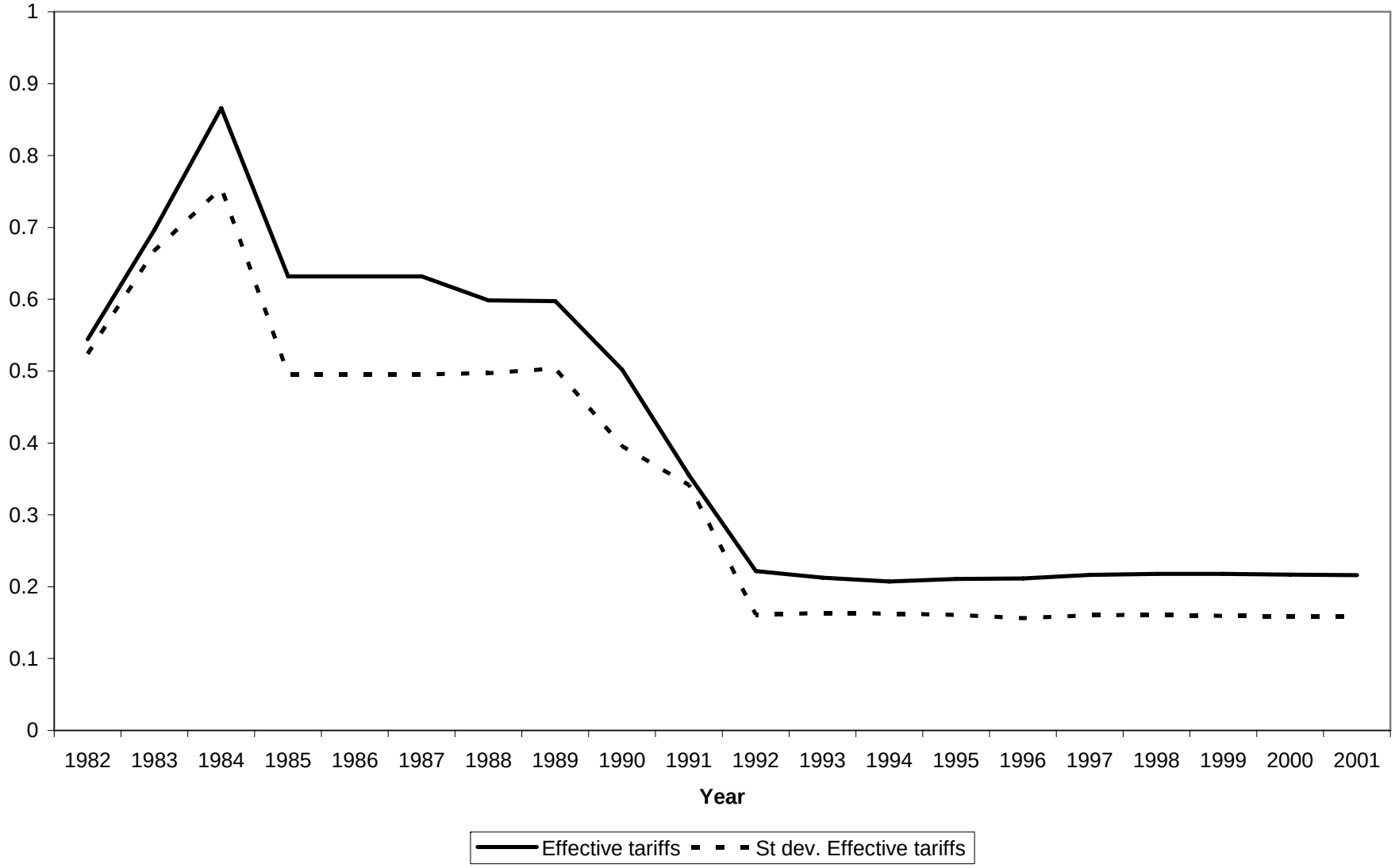

Figure 2. TFP of entrants relative to incumbents: first three years of operation.

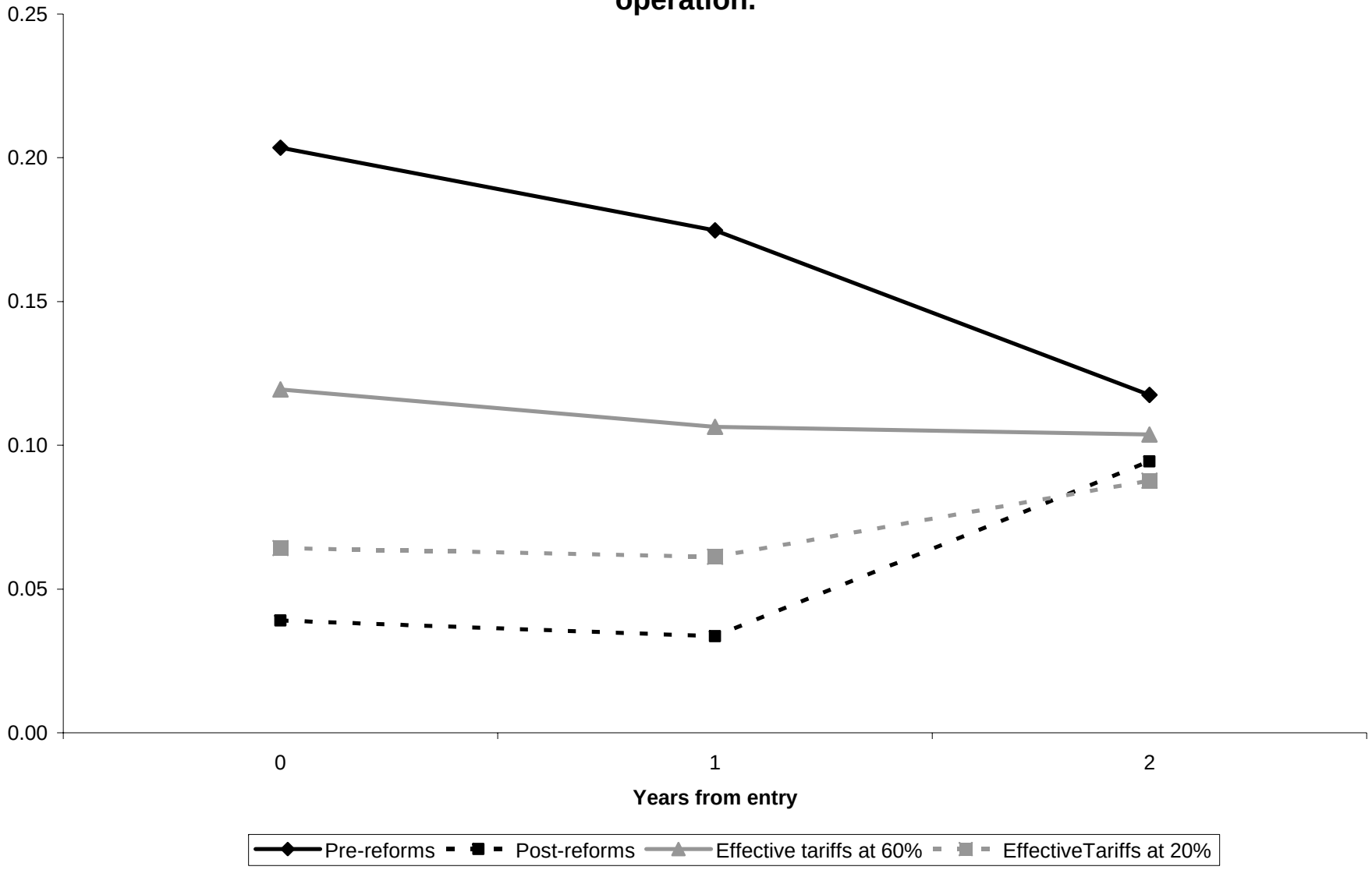

Figure 3. Demand shock of entrants relative to incumbents: first three years of operation.