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Misallocation and Productivity in Colombia's Manufacturing Industries

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Abstract[1]

Following Hsieh and Klenow (2009), this paper studies productivity dispersions in Colombian industrial establishments using the Colombian Annual Manufacturing Survey (AMS) from 1982 to 1998. The United States is used as a benchmark to estimate the reallocation of capital and labor to equalize marginal products across plants in Colombia. Gains are found in manufacturing Total Factor Productivity (TFP) of approximately 3-8 percent and TPF is positively correlated with exporting status, age, size, and location in the central region of the country. There is also suggestive evidence that opening the economy in 1991 is associated with an increase in plant productivity levels for firms that export goods. The 1990 reform that reduced dismissal costs is associated with an increase in productivity, while the reform that increased labor costs in 1993 is associated with a decrease in plants' productivity. Further work is needed to establish a causal relation between productivity and policy changes.

JEL Classification: O47, D24.
Keywords: Total Factor Productivity, Industry, Reallocating factors of production, Colombia.

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1. Introduction

Hsieh and Klenow (2009) develop a monopolistic competition model with heterogeneous firms to show the effect of resource misallocation on aggregate productivity. Using data on establishments they find evidence of resource misallocation and consequent effects on aggregate total factor productivity (TFP) in China and India. This paper applies their methodology using Colombian industrial establishment data from the Annual Manufacturing Survey (AMS) from 1982 to 1998. When misallocation of capital and labor across plants in Colombia is hypothetically changed to the level of the United States, Colombia's manufacturing TFP increases between 3 percent and 8 percent. These gains are small compared to 30-50 percent and 40-60 percent reported by Hsieh and Klenow for China and India, respectively.

Firm-level regressions show that Total Factor Productivity related to "physical productivity"[2] (TPFQ) is positively correlated with exporting status, age, size, and location in the central region of the country. When relating distortions to policy changes in Colombia, we show a positive correlation between TFPQ and labor sector reforms, but emphasize the need for further work to establish a causal relation. We hypothetically reallocate resources by equalizing Total Factor Productivity related to "revenue productivity" (TFPR) across plants and within industries. The aggregate TFP gains that would result are between 47-55 percent. When comparing actual firm size to the size observed if TFPR were equalized across plants and within industries, we find that Colombia should have fewer mid-size plants and more small and large ones. We conduct several robustness checks by varying the parameter of elasticity of substitution between plant value added and the source of the labor and output shares.

The rest of the paper is structured as follows. In Section 2 we provide background information on trade labor market and financial reforms that took place during the period we study. Section 3 describes the panel dataset used in the analysis and the NBER-CES Manufacturing Industry Database used to calculate U.S. labor shares. Section 4 provides details about the methodology used to derive the empirical results. Section 5 starts with descriptive statistics, then provides the empirical findings with robustness checks, and ends with an assessment of the possibility of measurement error in the plant revenue and inputs variables. Section 6 shows how TFPQ and TFPR relate to different firms' characteristics and to how their

[2] The use of plant-specific deflator yields TFPQ, which is commonly denoted as "physical productivity," whereas using and industry deflator gives TFPR, which is known as "revenue productivity." See Foster, Haltiwanger and Syverson (2008) for details.

dispersion relates to the timing of trade and labor policies. Section 7 summarizes the main findings and concludes.

2. Background

During the early 1980s there were several reforms that increased effective protection.[3] Eslava et al. (2009) report that the average tariff level in 1984 was 27 percent, but there was variation across industries. In particular, they find that the average tariff protection in manufacturing rose to 50 percent during this period. Esguerra and Villar (2006) show that in 1985 the tariff schedule increased by 16 percent. During the second half of the 1980s there was a reduction in trade barriers, while trade liberalization reforms started in the first half of the 1990s. Trade reforms further reduced tariffs, resulting in effective protection rates falling from 62.5 percent to 26.6 percent between 1990 and 1991 (Edwards, 2001). Between 1991 and 1992 the average tariff level was 11 percent (Ocampo and Villar, 1992).

In 1991 a new Constitution gave independence to the Central Bank and introduced municipal decentralization. One of the most important reforms of that decade took place in 1993, when Law 100 amended the social security systems. This system went from pay-as-you-go to a fully-funded system with individual accounts, (see, e.g., Kugler and Kugler, 2009). The law also created a contributive health insurance regime, increasing contributions for health and pensions through employment by 10 percentage points from 1992 to 1996.

In the early 1990s Colombia started a broad process of economic and political reforms in areas including employment policies, social security, financial markets and trade. A main goal of the reforms was to achieve greater flexibility in the labor market. Law 50 of December 1990 modified severance payments savings accounts and reduced dismissal costs between 60 percent and 80 percent (see, e.g., Kugler, 1999 and 2005). In the same year Law 45 eliminated interest rate ceilings and requirements to invest in government securities, while lowering reserve requirements. Additional financial sector reforms took place in 1991. First, Law 9 abolished exchange controls. Second, financial markets were reinforced according to the Basel Accords. Finally, Resolution 49 eliminated restrictions on foreign direct investment (see, e.g., Kugler, 2006). A result of these financial reforms was an increase in capital inflows, which benefited the economy as a whole and especially the financial sector.

[3] See Garay (1998) for a detailed description of trade policies from 1983 to 1985.

In summary, labor costs were initially reduced in 1990 by the changes introduced with Law 50, but were later increased with the reforms of the health and pension systems as dictated by *Law 100* of December 1993. Frictions in financial markets were substantially lowered in 1990 and 1991 by *Law 45*, *Law 9* and *Resolution 49*. Trade protection increased during the mid 1980s, but in 1990 and 1991 trade liberalization started and continued with slower impetus during the rest of the decade.

3. Data

3.1. Annual Manufacturing Survey in Colombia 1982-1998

We use the panel created by Eslava et al. (2004) and a recently updated version of the same panel, created by the same authors and made available through the National Statistical Agency (*Departamento Administrativo Nacional de Estaditicas*, DANE).[4] Both of these panels use the Colombian Annual Manufacturing Survey (AMS) conducted by DANE starting in 1982 and ending in 1998 and 2004, respectively. The AMS is a census of industrial plants with more than 10 employees, or annual production above 115.5 million pesos (measured in 2005 prices).[5]

For the analysis we use plant information at the 4-digit International Standard Industrial Classification (ISIC) level on: employees (production and non-production personnel); output (at constant 1982 prices and a price index used to recover the nominal values;[6] capital stock (buildings, structures, machinery and equipment); and intermediate consumption (at constant 1982 prices and using the price index from Eslava et al., 2004).

The 1998 panel does not include all the variables necessary to replicate Hsieh and Klenow (2009), so we use the 2004 panel to obtain additional information on total wage and benefit payments. Major differences in the original and updated panel correspond to the way deflators are constructed. We merge both panels using information that does not involve prices (4-digit level ISIC, production and non-production personnel, year, energy consumption). We use price indexes to reconstruct nominal output and materials, and subtract them to obtain nominal value added.

[4] Eslava et al. (2004) use this dataset to study productivity and resource allocation in a period of structural reforms in Colombia.
[5] This value is adjusted every year using the Producer Price Index. 115.5 million pesos are approximately US$58,000.
[6] See Eslava et al. (2004) for details on the construction of price index.

As documented by Eslava et al. (2004), the plant capital stock is constructed recursively by depreciating the capital stock in the previous year and adding deflated investment. The deflator for investments calculated at the 3-digit ISIC code level corresponds to the implicit deflator for capital formation from the input-output matrices for 1991-94, and from the output utilization matrices for later years. Pombo (1999) calculates different 3-digit ISIC code level depreciation rates for buildings and structures, and machinery and equipment. We use these rates of depreciation and investment deflators to calculate the nominal capital stock variable.

To avoid losing firms due to missing values and the recursive method used to construct capital stocks, we impute values for machinery and equipment and/or buildings and structures when there are positive values for capital stock in previous and subsequent years for a specific firm.

We keep plants that have positive and non-missing values for value added, labor compensation and capital stock. For comparability with other studies and to account for the possibility of sample selection we restrict the sample to firms with 10 or more employees. We conduct the analysis with an unbalanced panel of 83,294 plant-year observations for the period between 1982 and 1998.

3.2. NBER-CES Manufacturing Industry Database

Data for U.S. labor shares comes from the National Bureau of Economic Research (NBER) and from the U.S. Census Bureau Center for Economic Studies Manufacturing Industry Database (CES). We first match the usSIC code with the ISIC revision 2 Colombian code. For the ISIC codes with more than one corresponding usSIC, we added the payroll and VA, then we calculated the labor shares. To assign U.S. labor shares to Colombian plants within 4-digit level ISIC sectors, we match usSIC codes to the ISIC Rev 2 codes (Colombian industrial codes).

4. Deriving the Results

Following Hsieh and Klenow (2009), we set the rental price of capital, R, to 10 percent and the elasticity of substitution between plant value added to $\sigma = 3$. This value corresponds closely to the Broda, Greenfiled and Weinstein (2006) estimate of $\sigma = 2.9$ for Colombia. Firm-specific capital distortions mean the cost of capital varies across firms according to $(1 + \tau_{K_{s,i}})R$, where i

denotes the firm and s denotes the industry, $\tau_{K_{s,i}}$ are the capital distortions, or the distortions that increase the marginal product of capital relative to the marginal product of labor.

The production function of each firm i in sector s is Cobb-Douglas with constant returns to scale.

$$Y_{s,i} = A_{s,i} K_{s,i}^{\alpha_s} L_{s,i}^{1-\alpha_s} \tag{1}$$

We set the elasticity of output with respect to capital in each industry, α_s, as one minus the labor share in the corresponding industry in the United States. This assumes that the U.S. shares by industry have less distortion compared to Colombia. In the main results we do not use Colombian shares because we need to separately identify the average capital distortion from the capital production elasticity by industry. We assume that the capital and labor shares differ by industry but not by plant. The capital share is calculated using information from the NBER-CES Manufacturing Industry Database from 1982 to 1997. Using the ISIC 3-digit classification for the industries in the analysis, U.S. capital shares have a mean value of 38.78, a minimum of 20.77 and a maximum of 77.56.[7] We report the output and labor shares for Colombia and the United States in Appendix Table A1.

We use the wage bill as labor input, which implies that *w=1*. We rescale the labor compensation and capital stock by $\frac{\sigma}{\sigma-1}$ to take into account rents. We use $\tau_{Y_{s,i}}$ to denote distortions that affect both marginal product of capital and labor. We can derive firm specific distortions and productivity using the following equations from Hsieh and Klenow (2009):

$$\tau_{K_{s,i}} = \frac{\alpha_s}{1-\alpha_s} \frac{wL_{s,i}}{RK_{s,i}} - 1 \tag{2}$$

$$\tau_{Y_{s,i}} = 1 - \frac{\sigma}{\sigma-1} \frac{wL_{s,i}}{(1-\alpha)P_{s,i}Y_{s,i}} \tag{3}$$

$$A_{s,i} = k_s \frac{(P_{s,i}Y_{s,i})^{\frac{\sigma}{\sigma-1}}}{K_{s,i}^{\alpha_s} L_{s,i}^{1-\alpha_s}} \tag{4}$$

[7] When computing the alphas we replaced negative values for one sector by missing, since replacing by 0 could create problems with other formulas which divide by alpha.

In the data we do not observe k_s, so we normalize k_s, = 1. This normalization does not affect the results. The marginal revenue products are affected by capital and output distortions in the following way:

$$MRPK_{s,i} = R\frac{1+\tau_{K_{s,i}}}{1-\tau_{Y_{s,i}}} \tag{5}$$

$$MRPL_{s,i} = w\frac{1}{1-\tau_{Y_{s,i}}} \tag{6}$$

$$TFPR_{s,i} = \frac{\sigma}{\sigma-1}\left(\frac{MRPK_{s,i}}{\alpha_s}\right)^{\alpha_s}\left(\frac{MRPL_{s,i}}{w(1-\alpha_s)}\right)^{1-\alpha_s} \tag{7}$$

Substituting $MRPK_{s,i}$ and $MRPL_{s,i}$ in $TFPR_{s,i}$ we get the equation to estimate TFPR at the plant level.

$$TFPR_{s,i} = \frac{\sigma}{\sigma-1}\left(\frac{R}{\alpha_s}\right)^{\alpha_s}\left(\frac{1}{1-\alpha_s}\right)^{1-\alpha_s}\frac{(1+\tau_{K_{s,i}})^{\alpha_s}}{1-\tau_{Y_{s,i}}} \tag{8}$$

We calculate TFPR at the industry level using the following equation:

$$\overline{TFPR_s} = \left[\frac{R}{\alpha_s}\sum_{i=1}^{M_s}\left(\frac{1+\tau_{K_{s,i}}}{1-\tau_{Y_{s,i}}}\right)\left(\frac{P_{s,i}Y_{s,i}}{P_sY_s}\right)\right]^{\alpha_s} * \left[\frac{1}{1-\alpha_s}\sum_{i=1}^{M_s}\left(\frac{1}{1-\tau_{Y_{s,i}}}\frac{1}{1-\tau Y_{s,i}}\right)\left(\frac{P_{s,i}Y_{s,i}}{P_sY_s}\right)\right]^{1-\alpha_s} \tag{9}$$

where distortions at the industry level are computed using labor compensation, capital stock and value added at the industry level.

$$A_s = \left(\sum A_{s,i}^{\sigma-1}\right)^{\frac{1}{\sigma-1}} \tag{10}$$

We trim 2 percent of plant productivity and distortions by cutting values below the 1st percentile and above the 99th percentile of the distribution of $log\left(\frac{TFPR_{i,s}}{\overline{TFPR_s}}\right)$ and $log\left(\frac{A_{s,i}}{A_s}M_s^{\frac{1}{\sigma-1}}\right)$. Where M_s corresponds to the number of firms in each industry sector. This corresponds to excluding approximately 12.8 percent of production. Then we recalculate $\tau K_{s,i}, \tau Y_{s,i}, A_{s,i}, \overline{As}, TFRP_{s,i}, \overline{TFRP_s}$.[8]

5. Results

5.1 Descriptive Statistics

The last column of Table 1 shows the number of plants by year. On average there are 4,376 plants per year. The table also shows the distribution for the number of plants by sector. "Textile, apparel and leather industries" is the largest sector, followed by the "Food, beverages and tobacco" sector. "Basic metal industries" and "Other manufacturing industries" have the smallest share of firms in the panel. Though there are fluctuations in the number of firms over time, the distribution of firms across sectors remains relatively constant.

Table 2 shows the number of firms that enter and exit the panel over time, with the last column indicating the net entry. We define entry as a firm that appears in the dataset and is not observed in the previous year. Exit corresponds to a firm previously observed that is not observed the next year in the dataset. Net entry is calculated as the difference between firms that enter in year *t* minus firms that exit in year *t-1*. Thus a particular firm can be counted both in the entry and the exit column (though not in the same year). On average 479 firms enter each year, while 594 exit. This corresponds to an average annual entry/exit rate of approximately 11 percent and 14 percent, respectively, of the plants observed in the panel.

As reported in the last column of Table 1 from year-to-year the number of plants declines slightly, with a more noticeable fall from 1991 to 92, likely due to a change in plant identifiers.[9] An additional explanation to the drop in number of firms is the aggregate economic cycle. Figure 1 reports the GDP growth rate and the net entry of firms. The values for this figure are taken from column (3) in Table 2. The figure shows a strong correlation between the decline in GDP growth during the late 1980s with a decline in the net number of manufacturing firms getting started.

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[8] We also estimated the results including and adjustment to TFPQ, as defined $TFPQ_{s,i}^{adjusted} = \frac{TFPQ_{s,i}}{\lambda_{st}^{\frac{1}{\sigma-1}}}$, where $\lambda_{st} = \frac{E_{st}}{E_{s0}}$ where E_s is total nominal value added for sector s. We do not need to adjust TFPR because all of the variables are in nominal terms. Specifically, labor is measured as payroll instead of physical units of labor. The main findings do not change once we account for the the TFPQ adjustment (not reported).

[9] We are able to match the new and old firm identifiers with a dictionary. However despite the dictionary, there were some plants that do not match.

This pattern is reversed when the economy recovers in the early 1990s, and on net there is a higher number of firms getting started.

Table 3 shows the number of plants by size categories (measured by the number of employees) in 1998. In this cross-section of plants the largest proportion of plants has between 20 and 49 employees. However, plants with employee size ranging from 100 to 249 have the largest share of total employment (24 percent).

To illustrate how well the panel represents overall economic activity in Colombia, Figure 2 shows the distribution of labor force by economic activity. We define informal as people who are not affiliated to health insurance through employment. The figure uses data from the 1998 Colombian Household Survey. Among the categories depicted in the graph, only 1.5 percent of the labor force reports working in the manufacturing sector, and 54.6 percent work in firms with more than 10 employees. Since Colombia's labor force in 1998 was around 15.3M people, this would correspond to approximately 126,476 people in the manufacturing sector working in firms with more than 10 employees. This number is smaller than the number we have in our dataset of 293,108 employees. This could be due to the fact that the Colombian Household Survey includes information from only 13 municipalities, while the panel dataset is a census of all manufacturing firms with more than 10 employees.

5.2 Empirical Results

Figure 3 plots the distribution of the plant TFPQ relative to the industry TFPQ for 1998. It is calculated as $log\left(\frac{A_{s,i}}{A_s}\ M_s^{\frac{1}{\sigma-1}}\right)$. This distribution is weighted by the value added share of the industry relative to the economy, divided by the number of firms in 1998 in a specific sector. Colombia's TFPQ dispersion is wider than in the United States, China and India as reported by Hsieh and Klenow (2009), and the left tail is thicker. The graph also shows lumps in the left tail, indicating the possibility of regulation that encourages firms to stay at a low level of productivity rather than expanding or exiting.

Figure 4 plots the distribution of plant TFPQ relative to industry TFPQ for each year. The long left tail is evident in the early 1980s, a period of high trade tariffs. After 1986 the tail diminishes. Coinciding with the opening of the economy and the period of liberalization in 1990 and 1991 the distribution is fairly smooth and more compact. After 1993, the long left tail starts to emerge again, with a particularly noticeable lump in 1996 and 1998.

Panel A in Table 4 shows the standard deviation and 10th, 25th, 75th and 90th percentiles of the dispersion of plant TFPQ relative to the industry TFPQ levels, weighted by share of value added of the industry relative to the economy, and divided by the number of firms in that specific year and sector. The table shows that across years, several measures of dispersion of TFPQ (the standard deviation, the differences between the 75th and 25th and the 90th and 10th percentiles) are wider in Colombia than those reported by Hsieh and Klenow (2009) for the United States. The U.S. standard deviation ranges from 0.79 to 0.85; the 75-25 percentile comparison from 1.09 to 1.22; and the 90-10 percentile comparison from 2.05 to 2.22. For Colombia these numbers are 1.60 to 2.43 for the standard deviation range; the 75-25 percentile comparison from 2.32 to 2.83; and the 90-10 percentile comparison from 4.37 to 6.14

Figure 5 plots the distribution of plant TFPR relative to industry TFPR for 1998. It is calculated as $log\left(\frac{TFPR_{s,i}}{\overline{TFPR_s}}\right)$. This distribution is weighted by the value added share of the industry relative to the economy, divided by the number of firms in 1998 in a specific sector. The Colombian TFPR dispersion is much wider than the U.S. dispersion and shows lumps in the left tail, again consistent with policies that favor inefficient plants. Figure 6 provides more detail by plotting the distribution of the plant TFPR relative to the industry TFPR by year. The dispersion in plant TFPR is large in the early 1980s, and it increases notably in 1986 and after 1993.

Panel B of Table 4 shows the standard deviation and 10th, 25th, 75th and 90th percentiles of the dispersion of plant TFPR relative to the industry TFPR levels, weighted by share of value added of the industry with respect to the economy, divided by the number of firms in that specific year and sector. The U.S. values reported by Hsieh and Klenow (2009) for the standard deviation of TFPR range from 0.41 to 0.49. The corresponding values for Colombia are from 0.84 to 1.64.

The first column of Table 5 shows the proportion of TFP gains from equalizing TFPR across plants within industries as: $100\left(\frac{Y_{efficient}}{Y}-1\right)$ where $\frac{Y}{Y_{efficient}}=\prod_{s=1}^{S}\left(\sum_{i=1}^{M_s}\left(\frac{A_{s,i}\overline{TFPR_s}}{\overline{A_s}TFPR_{s,i}}\right)^{\sigma-1}\right)^{\frac{\theta_s}{\sigma-1}}$, and θ_s corresponds to a Cobb-Douglas aggregator of products by industry $Y=\prod_s Y_s^{\theta_s}$. To ensure that $\sum_s \theta_s = 1$ we calculate θ_s as the industry's share of value added. Using U.S. labor shares and Colombian output shares (θ_s), column (1) in Table 5 shows that aggregate manufacturing TFP would increase by 47-55 percent with full liberalization. Using Colombian output shares and equalizing Colombian labor shares within each manufacturing sector results in an average increase of approximately 80 percent, as shown in column (2).

Table 6 shows how firms' size, measured as value added, would change if TFPR were equalized. The rows are actual plant size quartiles, and the columns correspond to the ratio of efficient plant size relative to actual size. From this efficient to actual size ratio we create four categories: 0-50 percent (the plant should reduce its reduce its size at least by 50 percent), 50-100 percent, 100-200 percent, and more than 200 percent (the plant should increase in size by at least doubling). For all except the bottom quartile, the highest percentages are in the 200+% column, indicating that the medium and large size firms should increase their plant size.

Figure 7 plots the efficient and the actual size distribution of plants in 1998. We calculate the efficient level of output as $Y_{s,i} efficient = \frac{\overline{A_s}}{M_s^{\frac{1}{\sigma-1}}} K_{s,i}^{\alpha_s} L_{s,i}^{1-\alpha_s}$ to compare it to the actual level of output given by $Y_{s,i} = \left(P_{s,i} Y_{s,i}\right)^{\frac{\sigma}{\sigma-1}}$. The hypothetical distribution is more dispersed than the actual distribution. In particular it shows a larger concentration of firms in the left and right tails. This indicates that there should be fewer mid-sized plants and more small and large ones.[10] This result—that the efficient distribution has a wider variance than the actual distribution—is consistent across years, as depicted in Figure 8.

Column (1) in Table 7 reports the proportion of TFP gains in Colombia relative to those in the United States in 1997, the period where the United States reports the largest gains. If Colombia moved to U.S. efficiency, TFP would increase between 3-8 percent. We find no evidence of improved allocations in Colombia from 1982 to 1998, which is what Hsieh and Klenow find for India. The implied decline in allocative efficiency is of 1 percent or 0.1 percent per year from 1982 to 1998.

5.3 Robustness

In this section we provide robustness results to the estimates obtained. In particular we vary the elasticity of substitution and the source of output and labor shares. Columns (2)-(4) of Table 5 show robustness results for the proportion of TFP gains from equalizing TFPR across plants within industries. Column (2) uses Colombian labor and output shares, while column (3) uses

[10] However, it is important to keep in mind the sample restrictions in the panel which exclude most plants with less than 10 employees.

U.S. shares for both. These results help assess the effects of industrial composition on measures of misallocation. Using Colombian labor and output shares increases the gains from equalizing TFPR within industries, while using U.S. labor and output shares results in more modest gains from equalizing TFPR within industries. In column (4) we increase the elasticity of substitution between plant value added from 3 to 5, finding an increase of 80 percent with full liberalization. It is worth noting that Broda, Greenfield and Weinstein (2006) report estimates of the elasticity of substitution among different varieties of a good to be equal to 2.9 in Colombia.

In Table 7 column (2) we show the results for the proportion of TFP gains in Colombia relative to those in the United States. In 1997 increasing the elasticity of substitution between value added from 3 to 5. By increasing σ to 5 we find that manufacturing TFP in Colombia would range from -0.9 percent and 9.0 percent.

5.4 Assessment of Measurement Error

To explore the impact that classical measurement error in plant revenue and inputs may have in the Colombian estimates, we regress revenues on inputs as:

$$\log\left(\frac{P_{si}Y_{si}}{P_sY_s}\right) = \beta_0 + \beta_1 \log\left(\frac{K_{si}^{\alpha_s}L_{si}^{1-\alpha_s}}{K_s^{\alpha_s}L_s^{1-\alpha_s}}\right) + \epsilon_{is} \tag{11}$$

We also regress inputs on revenues as:

$$\log\left(\frac{K_{si}^{\alpha_s}L_{si}^{1-\alpha_s}}{K_s^{\alpha_s}L_s^{1-\alpha_s}}\right) = \beta_0 + \beta_1 \log\left(\frac{P_{si}Y_{si}}{P_sY_s}\right) + \epsilon_{is} \tag{12}$$

Each regression includes weights derived from the share of value added of the industry over the whole economy, divided by the number of firms in that specific year and sector. Results are reported in Table 8. The table shows that the elasticity of inputs with respect to revenue is 0.92 in Colombia, relative to 1.01 in the United States. Assuming that the true elasticities are the same in all countries, the results suggest that classical measurement error might add 9 percent of the variance of log revenue in Colombia. The table also shows that the elasticity of revenue with respect to inputs is 0.95 in Colombia, and Hsieh and Klenow (2009) report that the corresponding U.S. elasticity is 0.82, indicating that classical measurement error actually lower the variance in Colombia by 16 percent relative to the U.S. Assuming that there is no correlation in the percentage errors in revenues and inputs, together these results indicate that greater classical measurement error in Colombia do not appear to contribute to the higher variance of TFPR.

If, like Hsieh and Klenow, we assume that the serial correlation in measurement error for a given plant is lower than the true correlation for revenue and inputs, and that the true correlations are the same across countries, then we should find that the growth rates in revenue and inputs varies more in Colombian plants than in U.S. plants. In Table 9 we test whether growth rates of revenue and inputs vary more across plants in Colombia than in the United States. First, we create the percentage growth of the firm value added, and the percentage growth of the sector value added. Then we compare the difference in variation of the firm with respect to the industry. This calculation is weighted by the share of value added of the industry over the whole economy, divided by the number of firms in that specific year and sector. Table 9 shows that the results provide mixed evidence on whether TFPR has more measurement error in Colombia than in the United States, because input growth varies less but revenue growth varies more in Colombia than in the United States.

To summarize, the results in this section test for evidence of classical measurement error in plant revenue and inputs in Colombia. Under the assumptions that the elasticities in revenue and inputs are the same across countries, and that measurement error is likely to have less serial correlation than the true values, we find mixed evidence in support of the hypothesis that measurement error could be driving the higher TFPR variance observed in Colombia relative to the United States.

6. Additional Results

In this section we show how TFPQ and TFPR dispersion relate to policy changes; and how it correlates to different firm and geographical characteristics.

Figure 9 shows TFPQ and TFPR dispersion over time with vertical lines indicating the timing of labor reforms. The dashed blue line in 1990 corresponds to *Law 50*, which reduced dismissal costs, while the red line indicates *Law 100*, which increased contributions for health and pensions through employment. Figure 10 shows TFPQ and TFPR dispersion over time with vertical lines indicating the timing of trade and financial sector reforms. The reforms in the early 1980s correspond to an increase in trade barriers (see Eslava et al., 2009; Esguerra and Villar, 2006; and Garay, 1998). The 1991 reform corresponds to *La Apertura*, or the opening of the economy, which brought a rapid acceleration of tariff reductions and elimination of import licenses (Edwards, 2001). After the passing of *Law 50* we see an immediate decline in TFP dispersion, but the declining trend is reversed in 1991, the year when many of the trade liberalization reforms were passed. This upward trend in TFP dispersion continues after the passing of *Law 100*, which increased labor costs.

Next, we look at how the timing of the labor market, trade and financial reforms coincides with the changes in labor and capital over time. Table 10 shows the change for capital and labor across years. In the early 1980s during the period of high trade barriers, labor decreases. In the late 1980s and after the 1990 reform, which reduced dismissal costs, labor increases. After the 1993 reform, which increased employment contributions, labor grows at slower rates or even decreases.

Regressions using an indicator for the year of the reform and after are reported in Table 11. For the regressions shown in Table 11 and in Table 12 the dependent variable is defined as the firm's log TFPR or TFPQ relative to the industry TFPR or TFPQ. Columns (1) of Table 11 show that firms that produce products for export are more productive, and that the opening of the economy in 1991 is associated with an increase in plant productivity levels for firms that export goods. Column 2 verifies that there is no increase in average productivity given the 1991 reform. Column (3) control for the years in which the labor reforms were passed. The reform that reduced dismissal costs in 1990 is associated with an increase in productivity, while the reforms that increased labor costs in 1993 are associated with a decrease in plants' productivity.

In Column (1) of Table 12 we regress the sector TFPQ on an indicator of whether or not the firm produces products for export. The results shown in column (1) are positive and significant, indicating that firms that produce products for export are more productive than firms that do not. Column (2) shows that older firms are more productive than firms that are less than 6 years old (measured from the first time the firm appears in the panel dataset).[11] Column (3) indicates that productivity increases with firm size (measured by the number of employees). Column (4) shows that, relative to the Atlantic region, firms in the Central region and in Bogotá are more productive, while firms in the Oriental region and in Orinoquía and Amazonía are less

[11] Given that we do not have firm' age information, we assume that any firm appearing in 1982 is one year old, the first year of the panel.

productive.[12] The last four columns of the table show the same results, but using TFPR instead of TFPQ. Firm size and whether or not the firm produces products for export have signs consistent with those reported for TFPQ, but not always significant values. The geographic indicators report that firms in Bogotá have higher TFPR values than the Atlantic region, while firms in Orinoquía and Amazonía regions have lower TFPR values. This could indicate that perhaps there is regional heterogeneity in barriers that prevent plants from increasing the marginal products of capital and labor.

Table 13 shows the dispersion of distortions, measured as the standard deviation $\tau_{K_{si}}$ and $\tau_{Y_{si}}$. The mean value for the standard deviation for $\tau_{K_{si}}$ is 153, and the mean value for the standard deviation of $\tau_{Y_{si}}$ is 0.78. Across the years, the standard deviation for the capital distortion ranges from 59 to 660, while the standard deviation for the output distortion ranges from 0.37 to 1.70. $\tau_{Y_{si}}$ dispersion increases over time, and $\tau_{Y_{si}}$ dispersion although declining on average, shows a sharp increase in 1993. This suggests that the increase in variability in TFPR in the 1990s, could be driven mostly from output distortions rather than capital distortions. Figure 11 shows a decline in the dispersion of $\tau_{K_{si}}$ and $\tau_{Y_{si}}$ in the late 1980s and early 1990s, a period of reduction in trade barriers and labor market reforms; and a sharp increase after 1991 the year during which the opening of the economy legislation was passed. This upward trend in $\tau_{Y_{si}}$ dispersion continues after the passing of *Law 100*, which increased labor costs.

7. Summary and Conclusion

In this paper we apply Hsieh and Klenow (2009) methodology to measuring misallocation and plant level manufacturing productivity in Colombia. We use a panel dataset with 74,392 plant-year observations for industrial establishment. The period that we study goes from 1982 to 1998. We find that plants in Colombia have a wider TFPR dispersion than those in the United States, indicating greater misallocation of resources across plants.

We hypothetically reallocate resources by equalizing TFPR across plants and within industries. The aggregate TFP gains that would result are between 47-55 percent. We compare the actual firm sizes to the size observed if TFPR were equalized. We find that in Colombia there

[12] It is important to keep in mind that for the Orinoquía and Amazonía region there are only 22 firm-year observations in the dataset. The number of plant-year observations for the other regions are: Atlantic, 6,832; Oriental, 9,640; Central, 22,678; Pacific, 11,419; and Bogotá, 23,801.

should be fewer mid-size plants and more small and large ones. In particular, we find that medium and large firms should increase their plant size. These results are consistent across years. We also show results from a scenario where Colombia would move to U.S. efficiency. This reallocation would result in aggregate TFP gains between 3-8 percent. We test for the robustness of our results by changing the elasticity of substitution between plant value added and the source of the labor and output shares. We find that using Colombian labor and output shares increases the gains from equalizing TFPR within industries; while using U.S. labor and output shares reduces the gains from equalizing TFPR within industries.

To the extent that changes in productivity are due to different policies being implemented, we show how TFPQ and TFPR dispersion relate to labor market, trade and financial policy changes and firm characteristics. While there is no clear causal evidence that trade and labor market reforms directly affected plants' productivity, we see some indication of concurrent increases in productivity with reductions in dismissal costs, and of reductions in productivity with increases in health and pension contributions. Future work can focus on causal tests of how specific policies affected plants' productivity as well as aggregate productivity.

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Table 1. Firms by Sector

	Food, Beverages and Tobacco	Textile, Apparel and Leather Industries	Wood Products and Wood	Paper Products and Paper	Chemicals Oil, Coal and Plastic Products	Non-Metallic Mineral Products	Basic Metal Industries	Fabricated Metal Products	Other Manufacturing Industries	Total
1982	934	1,387	298	378	620	320	64	1,055	115	5,171
1983	942	1,417	302	360	589	293	66	991	112	5,072
1984	917	1,425	285	352	587	268	64	923	110	4,931
1985	899	1,449	266	338	603	254	65	922	98	4,894
1986	914	1,474	276	332	604	246	66	926	99	4,937
1987	940	1,455	290	328	609	249	64	920	98	4,953
1988	920	1,398	292	320	634	225	64	933	104	4,890
1989	945	1,339	300	331	621	220	65	925	99	4,845
1990	946	1,274	285	313	607	205	64	891	96	4,681
1991	888	1,181	255	297	588	188	60	823	81	4,361
1992	845	958	237	278	563	169	51	706	77	3,884
1993	827	908	214	268	548	165	53	733	76	3,792
1994	794	883	214	264	543	153	46	681	70	3,648
1995	852	872	220	270	547	166	43	702	80	3,752
1996	848	831	204	257	548	168	43	686	78	3,663
1997	868	813	195	248	540	168	36	653	71	3,592
1998	830	744	167	233	512	150	35	585	70	3,326
Total	15,109	19,808	4,300	5,167	9,863	3,607	949	14,055	1,534	74,392

Source: AMS Colombia 1982-1998. Authors calculations

Table 2. Entry and Exit of Firms

Year	Exit	Entry	Difference
1982	802	-	-
1983	721	703	-99
1984	642	580	-141
1985	547	605	-37
1986	543	590	43
1987	580	559	16
1988	563	517	-63
1989	508	518	-45
1990	590	344	-164
1991	849	270	-320
1992	504	372	-477
1993	600	412	-92
1994	520	456	-144
1995	515	624	104
1996	468	426	-89
1997	557	397	-71
1998	-	291	-266

Source: AMS Colombia 1982-1998. Authors calculations

Note: The difference column indicates net entry. Net entry is calculated as the difference between firms that enter in year t minus firms that exit in year $t-1$.

Table 3. Size Distribution of Establishments in Colombia, 1998

Firm size class (number of employees)	Number of Firms				Employment			
	# of firms units	Cumulative total units	Share of total percent	Cumulative share percent	# of employees units	Cumulative total units	Share of total percent	Cumulative share percent
10-19	953	953	28.65	28.65	13,367	13,367	4.56	4.56
20-49	1,052	2,005	31.63	60.28	32,452	45,819	11.07	15.63
50-99	604	2,609	18.16	78.44	42,460	88,279	14.49	30.12
100-249	463	3,072	13.92	92.36	71,743	160,022	24.48	54.59
250-499	170	3,242	5.11	97.47	58,068	218,090	19.81	74.41
500-999	60	3,302	1.80	99.28	41,746	259,836	14.24	88.65
1000 or more	24	3,326	0.72	100.00	33,272	293,108	11.35	100.00

Source: AMS Colombia 1998, and authors' calculations.

Table 4. Dispersion of ln(TFPQ) and ln(TFPR)

Panel A: Dispersion of ln(TFPQ)																	
Year	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98
S.D.	1.77	1.82	1.70	1.81	2.43	1.78	1.88	1.83	1.70	1.60	1.82	1.84	2.08	1.98	2.07	2.01	2.14
75-25	2.52	2.52	2.32	2.46	2.81	2.64	2.75	2.64	2.43	2.37	2.43	2.58	2.83	2.82	2.58	2.71	2.58
90-10	4.55	4.93	4.49	4.86	6.14	4.74	5.00	4.89	4.41	4.37	4.76	4.74	5.36	5.12	5.27	5.20	5.51
Panel B: Dispersion of ln(TFPR)																	
S.D.	1.00	1.00	0.93	1.02	1.64	0.98	1.08	0.98	0.89	0.84	1.03	0.99	1.23	1.15	1.17	1.13	1.21
75-25	1.21	1.21	1.08	1.15	1.34	1.22	1.32	1.23	1.13	1.10	1.16	1.18	1.32	1.33	1.23	1.23	1.28
90-10	2.50	2.53	2.28	2.36	3.34	2.46	2.75	2.38	2.20	2.08	2.44	2.46	2.92	2.98	2.91	2.88	2.90

Source: AMS Colombia 1998, and authors' calculations.

Table 5. TFP Gains from Equalizing TFPR within Industries

Year	σ=3 US Labor Shares Col. Output Shares (1)	σ=3 Col. Labor shares Col. Output Shares (2)	σ=3 US Labor Shares US output shares (3)	σ=5 US Labor Shares Col. Output Shares (4)
82	48.85	83.36	41.36	75.46
83	47.26	78.37	41.55	70.30
84	48.83	84.55	42.60	76.49
85	48.12	82.27	42.06	74.51
86	51.21	77.66	42.84	74.67
87	48.53	77.86	43.11	72.27
88	54.49	87.02	44.67	90.49
89	48.82	78.60	43.75	76.93
90	47.07	73.83	45.71	77.22
91	48.02	78.56	45.44	77.56
92	49.94	78.30	44.96	87.62
93	50.84	79.05	46.14	81.77
94	54.40	80.01	51.91	85.36
95	51.64	79.00	49.98	84.41
96	48.67	77.29	46.06	78.12
97	50.47	77.44	-	82.93
98	50.53	73.34	-	78.64

Source: AMS Colombia 1982-1998. Authors calculations

Table 6. Percent of Plants, Actual Size vs. Efficient Size

	0-50%	50-100%	100-200%	200+%
Top Size Quartile	3.0	4.8	7.5	9.6
2nd Quartile	5.0	5.5	6.2	8.3
3rd Quartile	5.8	5.7	5.9	7.6
Bottom Quartile	12.3	5.0	3.8	3.9

Source: AMS Colombia 1998, and authors' calculations.

Table 7. TFP Gains from Equalizing TFPR relative to 1997 U.S. Gains

Year	Gains (%) $\sigma=3$ (1)	Gains (%) $\sigma=5$ (2)
82	4.16	1.00
83	3.05	-0.90
84	4.15	3.73
85	3.65	1.87
86	5.81	1.62
87	3.94	-0.57
88	8.11	9.07
89	4.14	1.77
90	2.92	0.96
91	3.58	1.88
92	4.92	7.49
93	5.55	4.89
94	8.05	6.60
95	6.12	7.34
96	4.04	3.27
97	5.30	5.11
98	5.34	3.96

Source: AMS Colombia 1982-1998. Authors calculations

Table 8. Regressions of Inputs on Revenue, Revenue on Inputs

	Colombia	US
Inputs on Revenue	0.92	1.01
Revenue on Inputs	0.95	0.82

Source: AMS Colombia 1982-1998. Authors calculations

Table 9. Dispersion of Input and Revenue Growth

Colombia	Inputs	Revenue
S.D.	0.36	0.52
75-25	0.31	0.44
U.S.		
S.D.	0.68	0.43
75-25	0.43	0.32

Source: AMS Colombia 1982-1998. Authors calculations

Table 10. Index of Mean Level of Value Added, Capital and Labor

Year	Value Added		Capital		Labor	
	Index	% change	Index	% change	Index	% change
1982	1.00		1.00		1.00	
1983	1.24	0.24	1.60	0.60	0.97	-0.03
1984	1.57	0.27	2.44	0.53	0.96	0.00
1985	2.09	0.33	3.02	0.24	0.92	-0.05
1986	2.77	0.33	3.33	0.10	0.90	-0.02
1987	3.41	0.23	4.34	0.30	0.92	0.02
1988	4.70	0.38	5.72	0.32	0.93	0.01
1989	6.28	0.34	7.37	0.29	0.93	0.01
1990	8.57	0.36	10.27	0.39	0.97	0.04
1991	11.55	0.35	15.05	0.47	1.04	0.07
1992	13.60	0.18	22.29	0.48	1.14	0.10
1993	15.88	0.17	29.20	0.31	1.18	0.03
1994	22.58	0.42	42.52	0.46	1.22	0.04
1995	28.31	0.25	58.48	0.38	1.15	-0.05
1996	33.27	0.18	76.76	0.31	1.10	-0.04
1997	41.27	0.24	105.52	0.37	1.11	0.01
1998	50.76	0.23	130.58	0.24	1.10	-0.01

Source: AMS Colombia 1982-1998. Authors calculations

Note: Value added and capital are in nominal terms.

Table 11. Regressions of TFPQ on Reform Year Indicators

Dependent variable:	log(TFPQ)		
	(1)	(2)	(3)
Exporter	1.048***		
	[0.033]		
Exporter*d91	0.109*		
	[0.062]		
d91	-0.158	-0.089	
	[0.111]	[0.086]	
d90			0.085***
			[0.030]
d93			-0.128**
			[0.054]
Observations	72,186	74,392	74,392
R-squared	0.130	0.010	0.000

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 12. Regressions of Sector TFPR and TRPQ on Firm and Geographical Characteristics

Dependent variable:	log(TFPQ)				log(TFPR)			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Exporter	1.088***			0.473***	0.195***			0.150***
	[0.028]			[0.036]	[0.016]			[0.020]
Age 6 - 10		0.191***		0.006		0.018		-0.001
		[0.040]		[0.038]		[0.022]		[0.022]
Age 10 and more		0.414***		0.041		0.053**		0.014
		[0.043]		[0.058]		[0.023]		[0.023]
Size 20-49			0.439***	0.388***			0.01	-0.009
			[0.021]	[0.022]			[0.015]	[0.016]
Size 50-99			1.006***	0.923***			0.099***	0.075***
			[0.028]	[0.029]			[0.019]	[0.020]
Size 100-249			1.426***	1.315***			0.169***	0.135***
			[0.051]	[0.049]			[0.030]	[0.030]
Size 250-499			1.599***	1.452***			0.085	0.036
			[0.123]	[0.119]			[0.061]	[0.062]
Size 500-999			2.122***	1.820***			0.212***	0.121***
			[0.043]	[0.053]			[0.026]	[0.030]
Size 1000+			2.338***	2.084***			0.237***	0.150***
			[0.053]	[0.058]			[0.046]	[0.046]
Oriental				-0.184**				-0.026
				[0.079]				[0.046]
Central				0.066*				0.025
				[0.035]				[0.023]
Pacific				0.006				0.009
				[0.040]				[0.026]
Bogotá				0.163***				0.074***
				[0.034]				[0.023]
Orinoquia and Amazonia				-0.545***				-0.316**
				[0.176]				[0.151]
Observations	72,186	74,392	74,392	72,186	72,186	74,392	74,392	72,186
R-squared	0.120	0.020	0.270	0.300	0.010	0.000	0.010	0.020

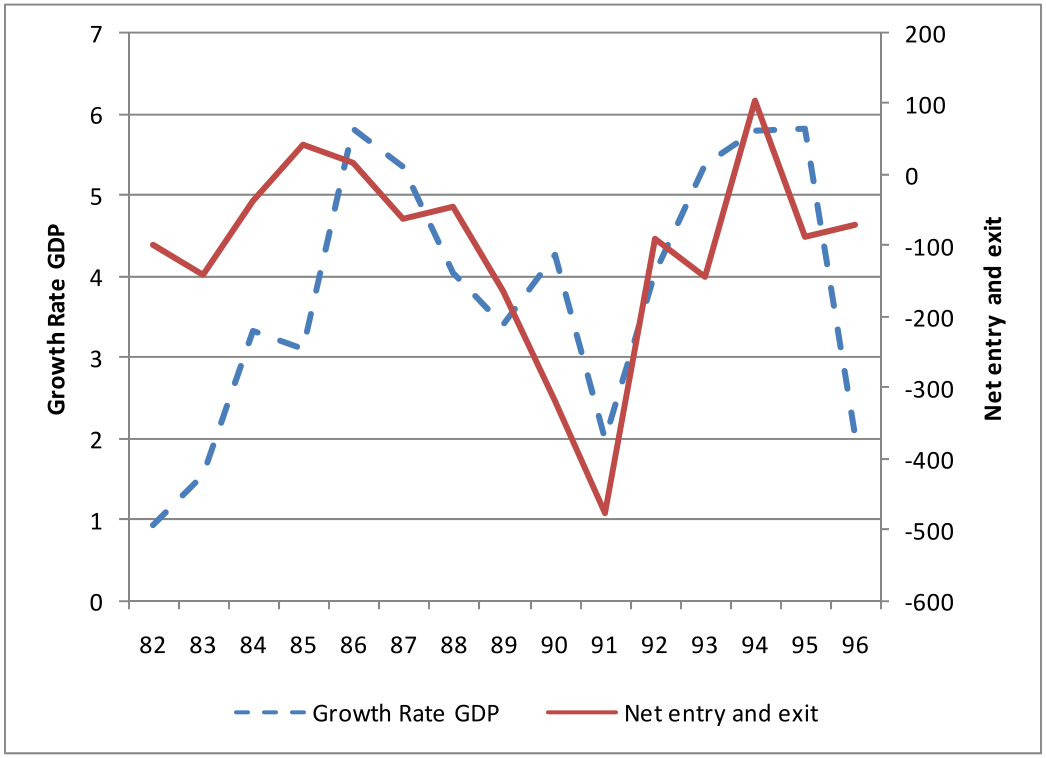
Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
Omitted region is Atlantica

Table 13. Dispersion of $\tau_{K_{si}}$ and $\tau_{Y_{si}}$

Panel A: Dispersion of τKsi																	
Year	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98
S.D.	179.17	125.74	92.62	128.80	187.22	101.12	86.09	105.80	136.31	99.90	187.20	659.89	58.46	75.97	218.30	103.47	69.32
75-25	16.31	13.91	13.70	12.81	13.85	14.01	13.33	12.29	12.03	11.83	11.84	11.60	10.12	10.13	9.91	9.82	9.25
90-10	50.09	44.74	40.47	38.13	39.43	38.69	40.64	38.64	38.70	37.74	35.51	34.11	29.53	31.93	30.10	30.30	28.94
Panel B: Dispersion of τYsi																	
Year	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98
S.D.	0.58	0.60	0.57	0.53	0.73	0.51	0.53	0.44	0.41	0.37	0.88	0.94	1.13	1.70	1.05	1.08	1.25
75-25	0.45	0.46	0.43	0.43	0.43	0.43	0.42	0.42	0.42	0.41	0.50	0.58	0.55	0.60	0.57	0.59	0.60
90-10	0.94	0.96	0.92	0.91	0.90	0.88	0.85	0.83	0.84	0.81	1.05	1.27	1.22	1.41	1.38	1.30	1.41

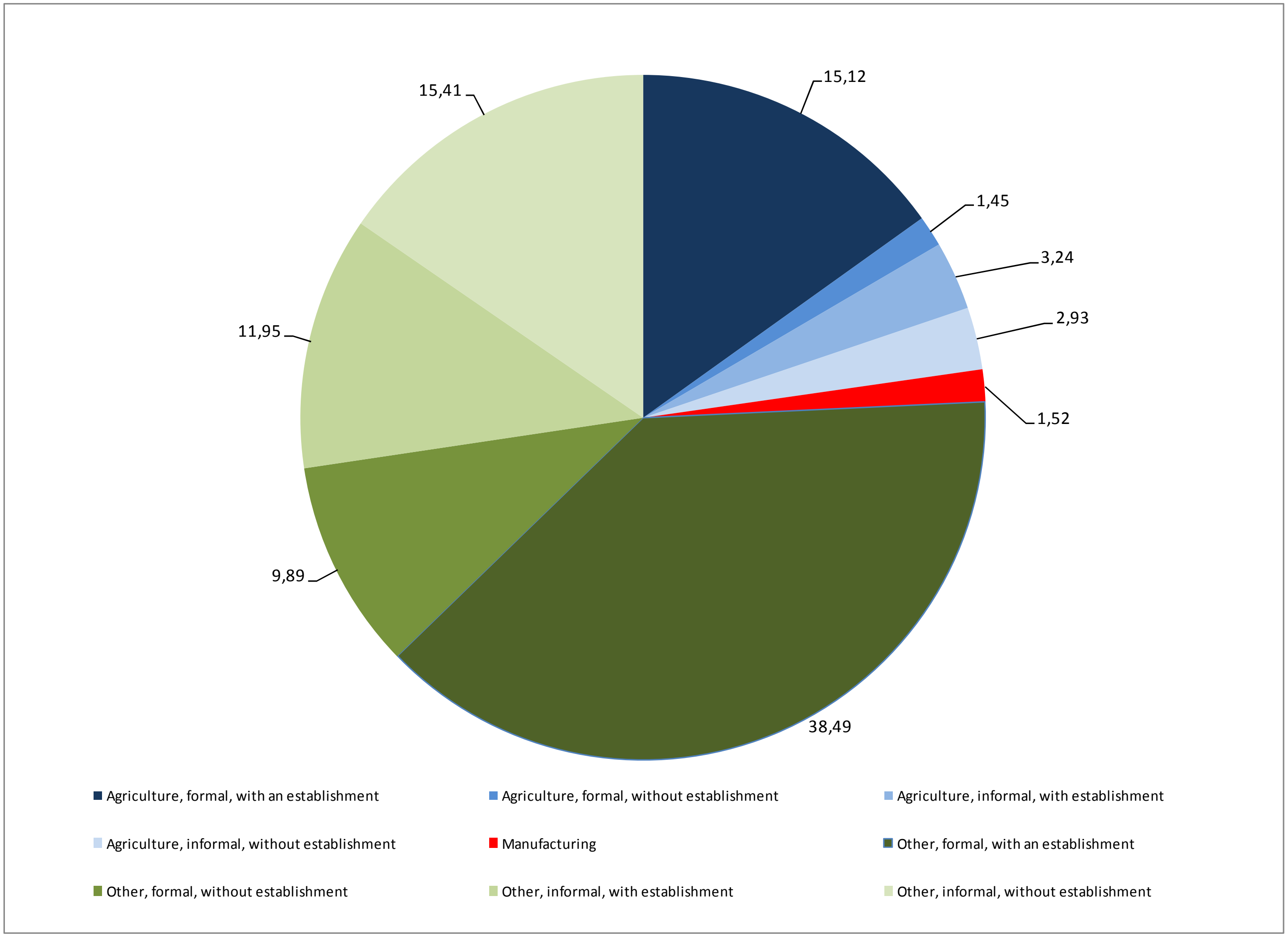
Source: AMS Colombia 1982-1998. Authors calculations

Figure 1. GDP Growth Rate and Net Entry of Firms



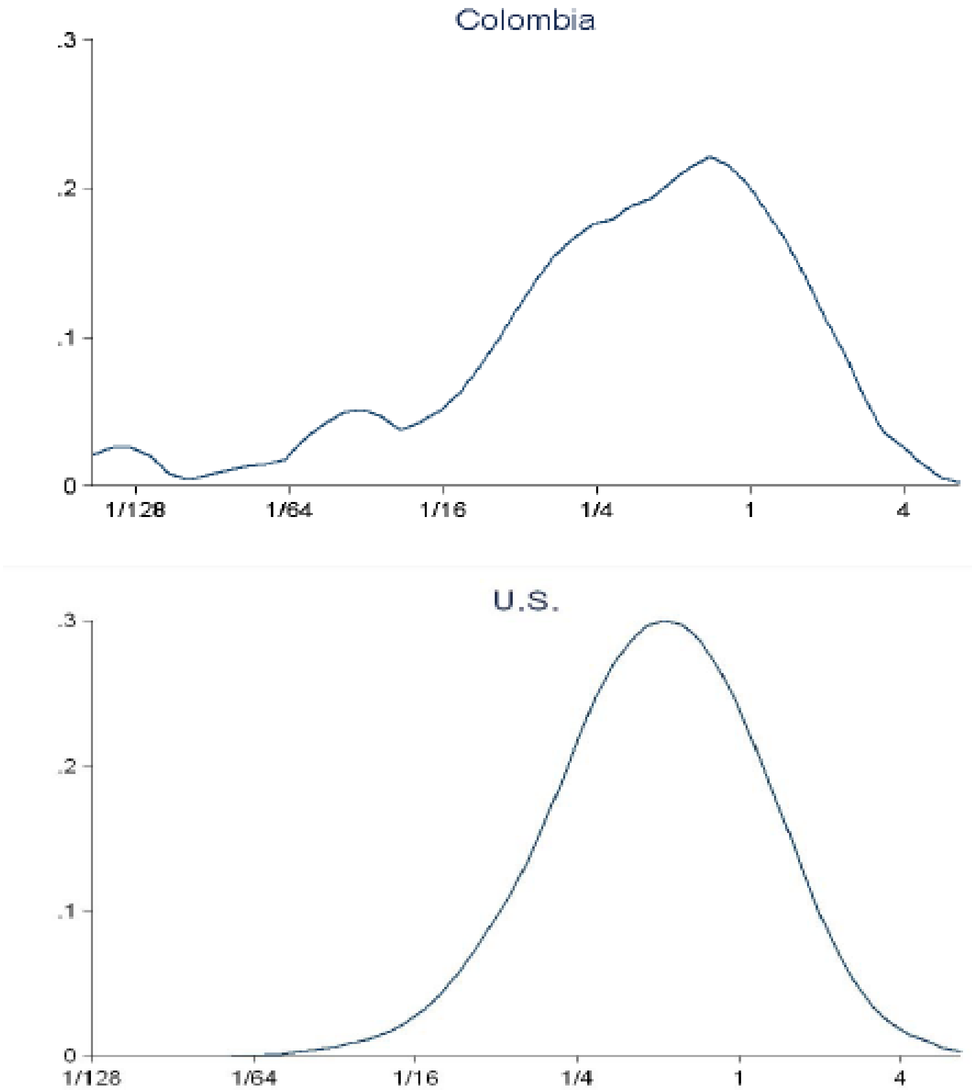
Source: Authors' calculations based on DANE and AMS Colombia 1982-1998.

Figure 2. Distribution of Labor Force across Activities



Source: 1998 Colombian Household Survey, which includes information from 13 municipalities.
Note: Informal employment is defined as people who are not affiliated with health insurance through employment.

Figure 3. Distribution of TFPQ



Source: Authors' calculations based on AMS Colombia 1982-1998.

Figure 4. Distribution of TFPQ in Colombia by Year

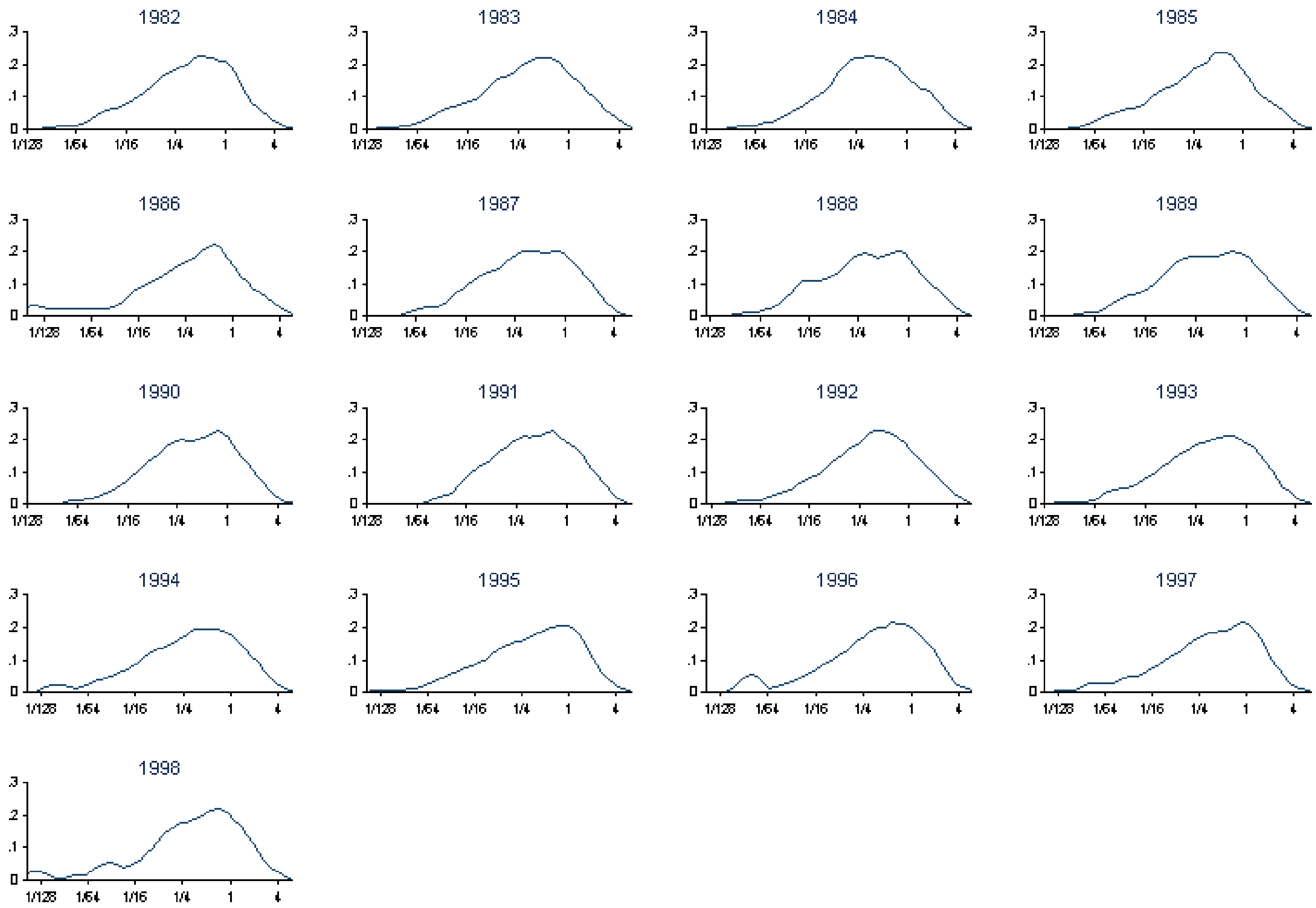
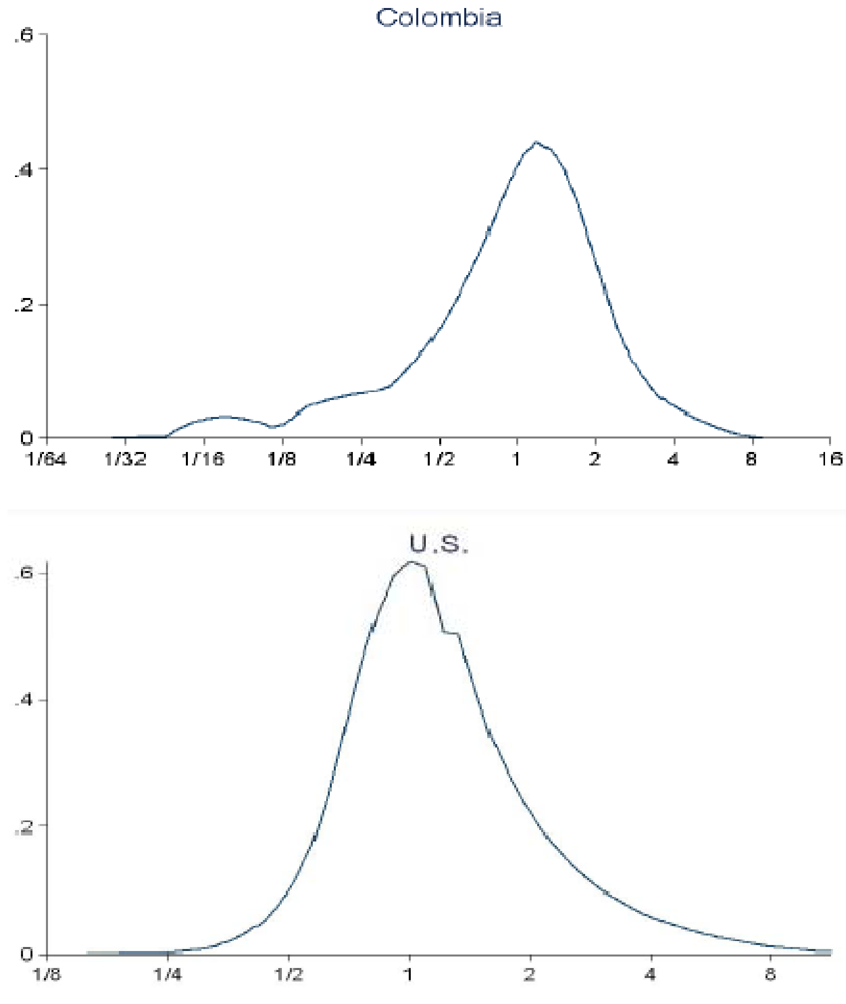


Figure 5. Distribution of TFPR



Source: Authors' calculations based on AMS Colombia 1982-1998.

Figure 6. Distribution of TFPR in Colombia by Year

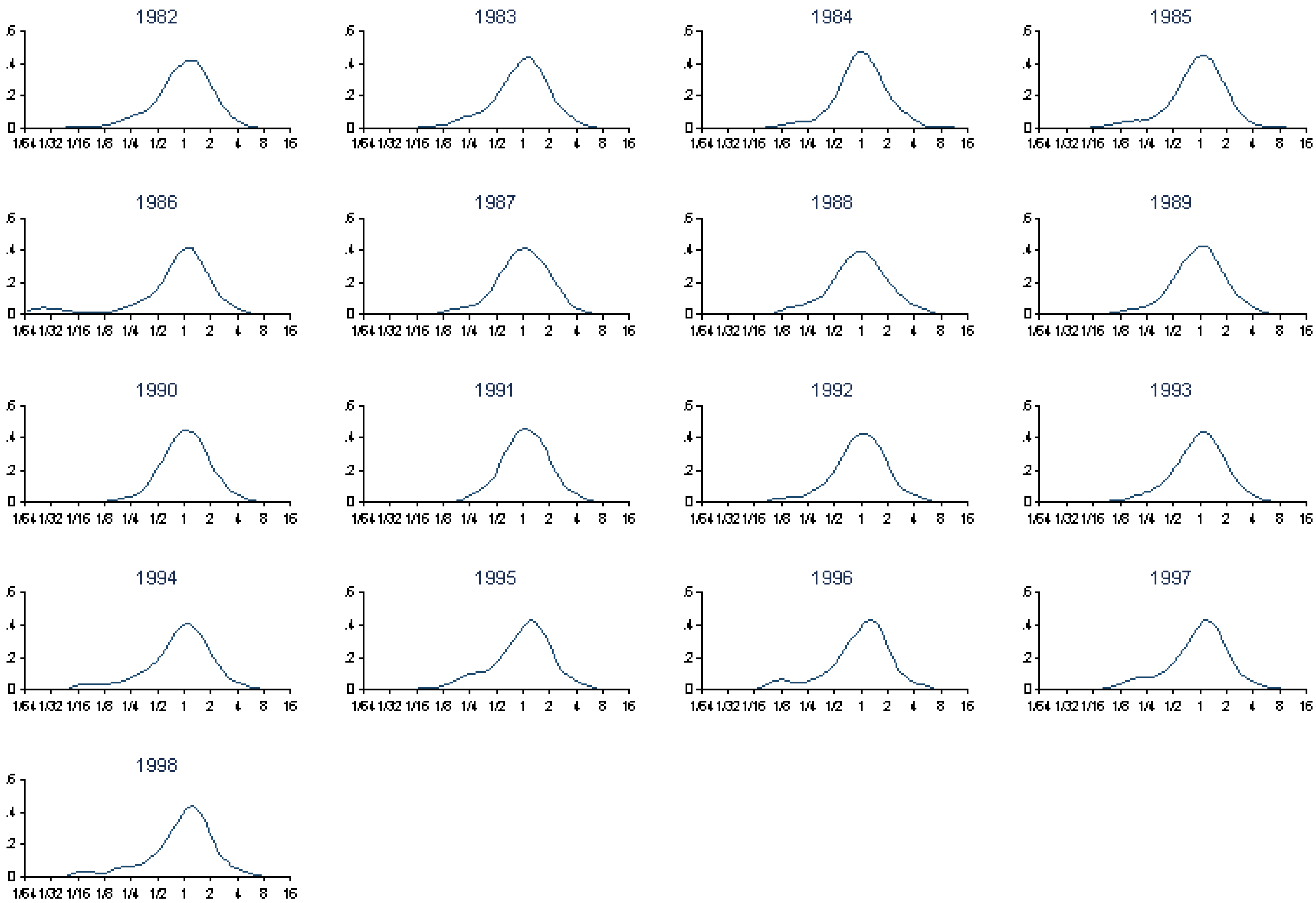
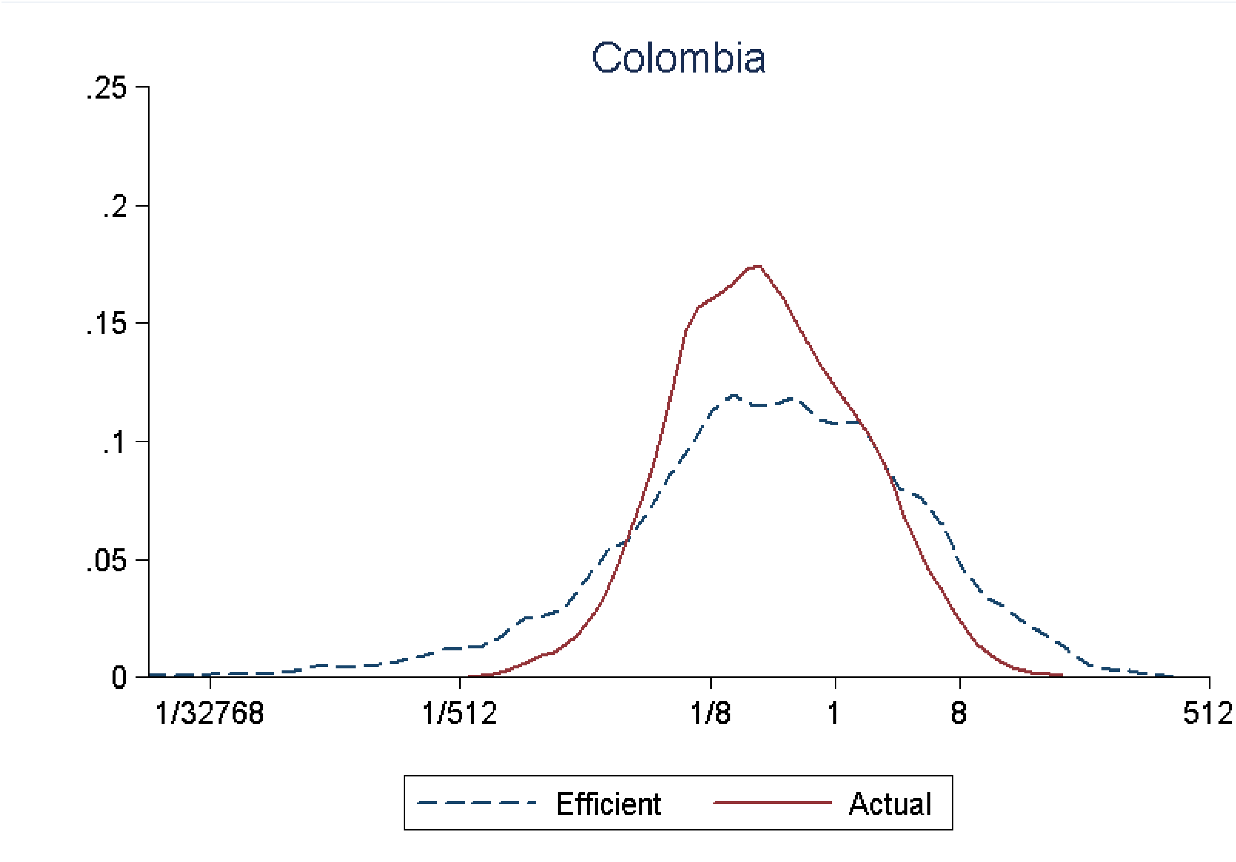


Figure 7. Distribution of Plant Size in 1998



Source: Authors' calculations based on AMS Colombia 1982-1998.

Figure 8. Distribution of Plant Size in Colombia by Year

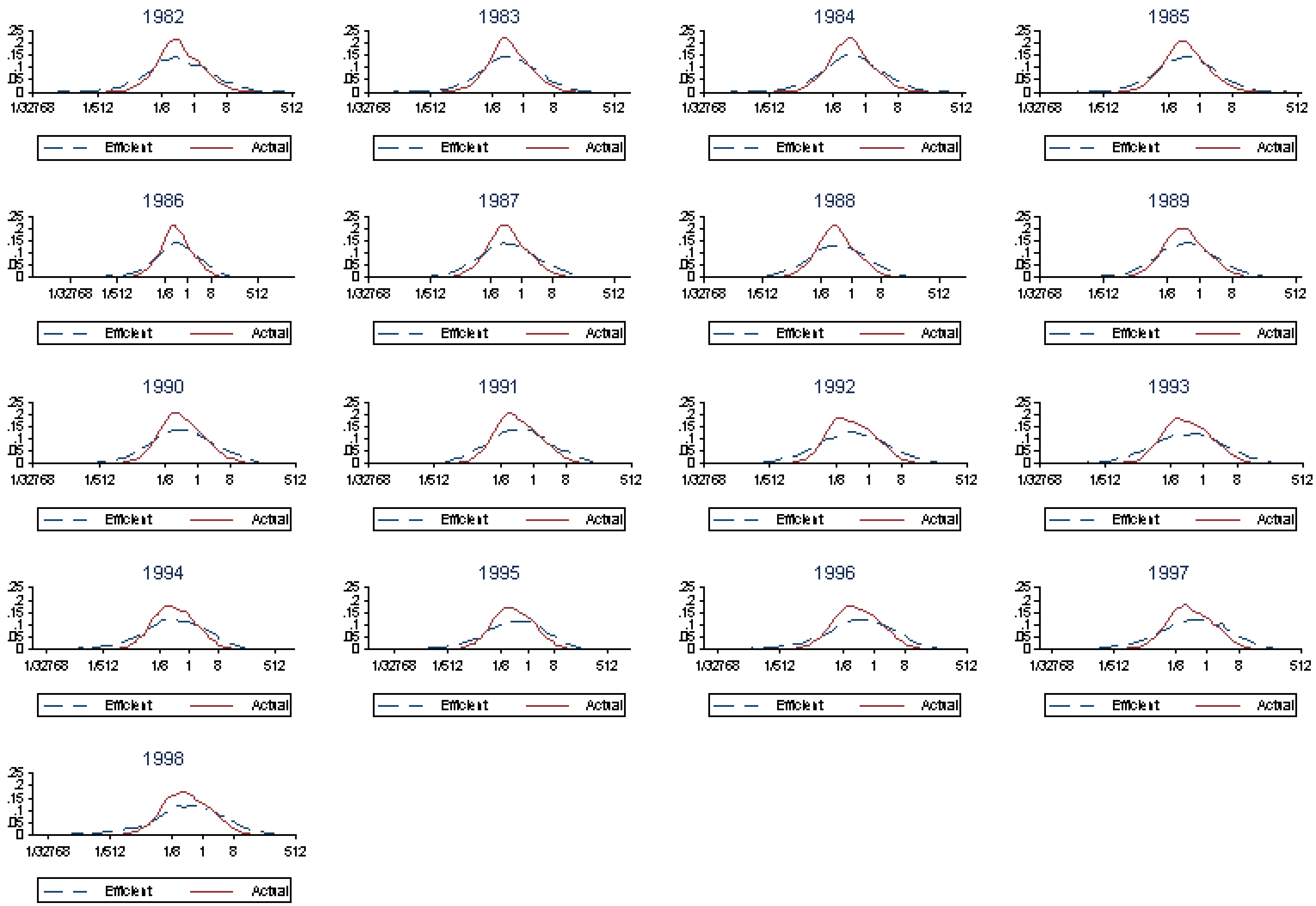
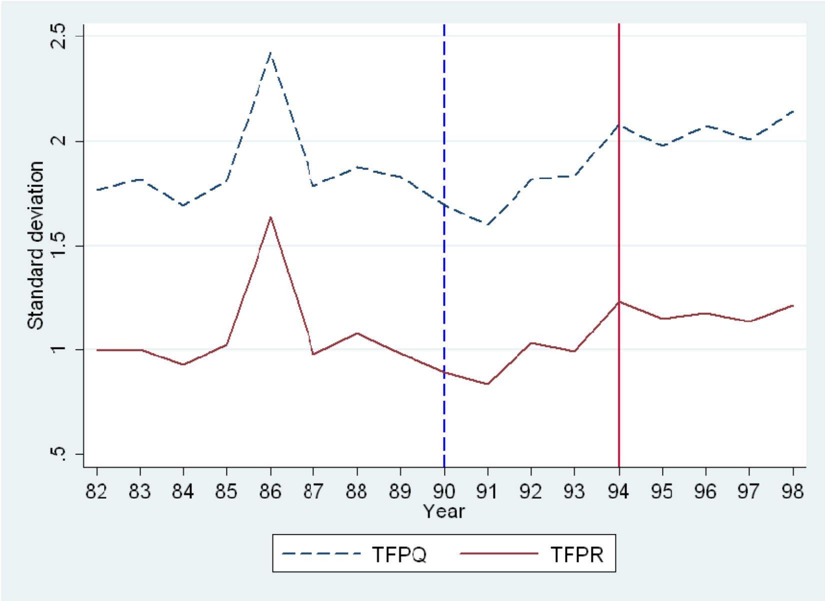


Figure 9. Dispersion of ln(TFPQ) and ln(TFPR) and Labor Reforms

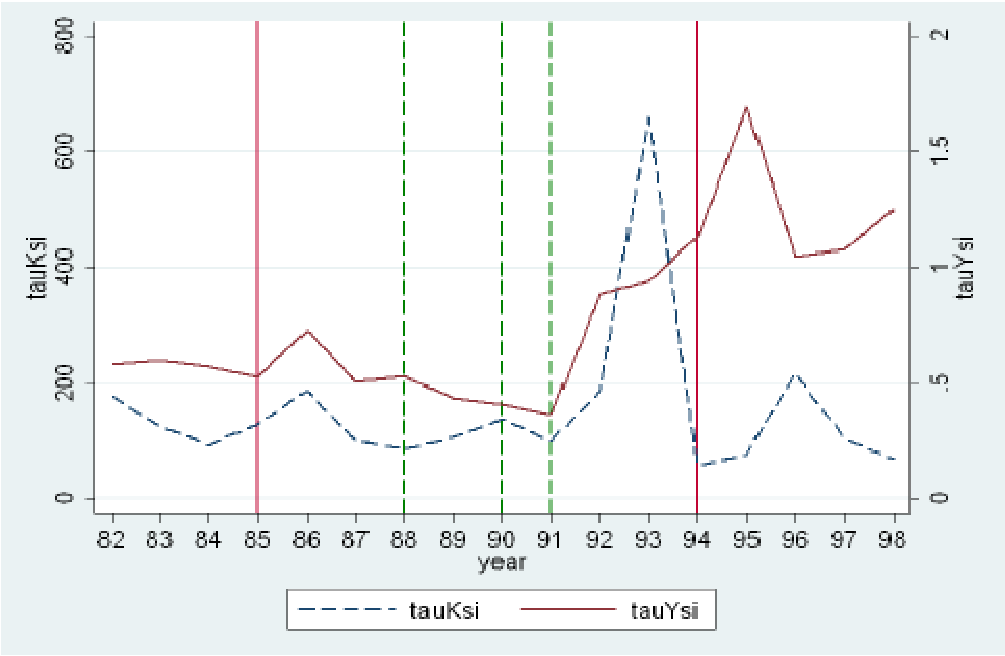


Note: The dotted blue lines indicate reductions in labor costs, while the solid red lines show increases.
Source: Authors' calculations based on AMS Colombia 1982-1998.

Figure 10: Dispersion of ln(TFPQ) and ln(TFPR) and Trade and Financial Reforms

Note: The solid red line indicates reforms that increased trade protection, while the green dotted lines indicate trade liberalization and financial sector reforms.
Source: Authors' calculations based on AMS Colombia 1982-1998.

Figure 11: Dispersion of ln($\tau_{K_{si}}$) and ln($\tau_{Y_{si}}$) and Trade and Financial Reforms



Source: Authors' calculations based on AMS Colombia 1982-1998.

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Table A1. Appendix: U.S. and Colombian Output and Labor Shares for 1998 by 3-Digit ISIC Code

ISIC 3 Rev 2.	Sector	Col. Output Share (%)	US. Output Share (%)	Col. Labor Share (%)	US. Labor Share (%)
311	Food manufacturing	17.19	7.27	16.69	52.42
312	Food manufacturing	3.35	1.10	17.80	36.14
313	Beverage industries	14.05	1.71	7.62	42.22
314	Tobacco Manuf.s	0.81	1.51	8.33	22.44
321	Manuf. of textiles	4.68	2.52	28.62	75.97
322	Manuf. of wearing apparel, except footwear	2.29	1.59	28.23	74.63
323	Manuf. of leather products of leather, substitutes and fur	0.51	0.19	28.81	74.43
324	Manuf. of footwear, except vulcanized or rubber or plastic footwear	0.82	0.12	25.09	74.17
331	Manuf. of wood and wood and cork products, except furniture	0.17	2.15	38.11	76.55
332	Manuf. of furniture and fixtures, except primarily of metal	0.37	1.80	35.63	76.26
341	Manuf. of paper and paper products	4.12	4.22	18.82	65.96
342	Printing, publishing and allied industries	2.34	7.64	24.67	67.39
351	Manuf. of industrial chemicals	3.86	3.14	12.76	41.96
352	Manuf. of other chemical products	10.82	8.20	17.26	34.49
353	Petroleum refineries	9.80	1.52	4.56	33.44
354	Manuf. of miscellaneous products of petroleum and coal	0.57	0.33	8.24	48.92
355	Manuf. of rubber products	1.18	1.13	27.21	72.64
356	Manuf. of plastic products not elsewhere classified	4.58	3.25	21.77	64.83
361	Manuf. of pottery, china and earthenware	1.48	0.16	20.67	79.23
362	Manuf. of glass and glass products	1.77	0.61	18.80	62.39
369	Manuf. of other non-metallic mineral products	3.79	1.49	13.31	62.25
371	Iron and steel basic industries	0.92	2.23	27.05	75.53
372	Non-ferrous metal basic industries	0.54	0.25	13.62	53.49
381	Manuf. of fabricated metal products, except machinery and equipment	2.60	6.99	25.43	74.34
382	Manuf. of machinery except electrical	1.66	6.53	28.32	73.17
383	Manuf. of electrical machinery apparatus, appliances and supplies	2.12	15.57	29.33	69.85
384	Manuf. of transport equipment	2.42	10.83	23.78	59.32
385	Manuf. of professional and scientific equipment not elsewhere classified	0.33	4.40	21.82	64.12
390	Other Manufacturing Industries	0.87	1.58	21.65	66.86

Source: AMS Colombia 1982-1998. Authors calculations