Trade Liberalization and Productivity Growth: Firm-level Evidence from Cameroon

Ousmanou Njikam
Faculty of Economic Sciences & Management. University of Yaounde II Cameroon. E-mail: onjikam2002@yahoo.fr

John Cockburn
Poverty and Economic Policy (PEP) Research Network. CIRPEE, Department of Economics, University of Laval Quebec City (Quebec) G1K 7P4, Canada. E-mail: jcoc@ecn.ulaval.ca

Abstract
Does trade liberalization foster total factor productivity (TFP) growth in the manufacturing sector? Does sectoral trade orientation determine sectoral TFP levels and growth rates? These questions are addressed using pooled pre-and post-liberalization panel data from Cameroonian firms of eight manufacturing industries. A single production function for the whole manufacturing sector is estimated using the Olley and Pakes approach and TFP indexes are derived. The results show that the pre-liberalization period was a very successful one for Cameroonian manufacturing firms. The estimated growth rate of TFP in manufacturing is 1.9 percent per annum. Except in textile, TFP rises rapidly in every manufacturing industry, ranging from a low of 0.04 percent per annum in rubber to a higher of 3.9 percent in wood. Over the post-liberalization period TFP growth in manufacturing decelerated on average by 0.2 percent per annum. The textile and rubber industries realize TFP growth rates of 1.7 and 3.9 percent per annum respectively while the observed annual TFP growth rates in the rest of industries are much slower than before trade liberalization. We then use the panel data methods to test for the effects of trade liberalization variables. We control for the endogeneity of trade policy using one-period lagged liberalization variables. To make the effect of trade liberalization clearer, we control for firm-level and industry heterogeneity, the political instability of the late 1980s and early 1990s, and for the 1994 devaluation. The results indicate that firms in industries with greater outward-orientation are more productive. Industry effective rate of assistance is a source of decreased TFP growth. To render the positive effect of import competition on TFP growth significant, the issue of supply constraints such as poor infrastructure, erratic supply of energy, low skill labor, corruption, etc. must be adequately addressed. The exit of less productive firms contributes to productivity improvements. TFP also increases with firms age while the political instability negatively affects firms' TFP growth.

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1. Introduction

In reaction to the slow or negative economic growth of the 1980s, Cameroon embarked upon a trade liberalization program. In this regard and between 1993 and 1994 the list of firms reserved for public sector was reduced, quantitative restrictions were dismantled, licensing requirements were drastically scaled back,[1] reference prices were progressively removed, and the number and level of tariff rates on most products were reduced.[2] Within a regional framework i.e. within the CEMAC zone, significant tariff reductions were introduced with fall not only in the average rate but also in the number of rates.[3] In sum, micro reforms included the removal of protective trade barriers, privatization, and market deregulation. At the macro level and in January 1994, Cameroon and the other CFA zone countries realigned the parity of their currency from 50 to 100 CFA francs to the French franc.

It is generally believed that the lifting of government controls and regulations on economic activity, and the move toward outward-orientation would stimulate firms' productive performance. The conventional neoclassical trade theory postulates that trade liberalization by exposing manufacturing industries to competition and by enlarging markets delivers static gains such as better allocation of resources. These gains arise from specializing according to the principle of comparative advantage. The endogenous or new trade theories contrary contend that the opening to freer trade ushers in a more competitive environment, facilitates the diffusion of new technologies and triggers the innovation. Moreover, trade acts as the conduit for the transfer of new technologies, improved access to better technologies, adoption of new methods of production, new organization of industries, and increase in intermediate goods available.[4] In response to the conflict between old and new trade theories, a variety of trade models have been developed. In the context of these models, which might be called the "*new new*" trade theory, firms' heterogeneity is crucial to understanding world trade.[5]

Although a clear theoretical consensus has emerged on the role of trade liberalization in fostering productivity growth, there are still misgivings about the existence of a positive empirical link between trade liberalization and productivity growth. Indeed, the empirical investigations of the trade-productivity relationships have produced conflicting results. The need to illuminate the debate by empirical analysis motivates this paper. Specifically, given that the main objective of trade liberalization was to improve manufacturing productivity, it is appropriate to ask how far trade liberalization contributed to better productivity performance of Cameroonian manufacturing in the post-liberalization period. The present paper addresses this issue. In order to obtain as accurate an impact of trade liberalization on firm TFP growth as possible, we take into account variables that may exert an independent effect on productivity growth e.g., firm-level control variables and macroeconomic variables such as

[1] There was a simplification of the process of obtaining import as well as export licenses and authorizations. Sensitive imported goods were steadily transferred to government-controlled goods and import licenses for government controlled goods were almost automatically granted.

[2] There were four individual taxes on imports before trade liberalization e.g. custom duty, import turnover tax, entry fiscal duty, and the complementary tax. Within the reform the custom duty and fiscal entry duty were replaced by a custom duty applicable to all imports. The import turnover tax and complementary tax were replaced by the turnover tax.

[3] For instance, the production internal tax was abolished and the unique tax was replaced by a generalized preferential tariff.

[4] For a compact elaboration on these issues see among others Kim (2000), Keller (2000), and Winter (2004).

[5] For important contributions in this area see among others Melitz (2003), Bernard et al. (2003), Helpman et al. (2004), Baldwin (2005), Baldwin and Robert-Nicoud (2006), and Gustafsson and Segerstrom (2007).

the political instability of the late 1980s and early 1990s-widespread non-violent pro-democracy protests-and the large devaluation of January 1994.

The rest of the paper is structured as follows. Section 2 presents the model used to assess the impact of trade liberalization on total factor productivity (TFP). Section 3 presents the data. Section 4 compares some characteristics of Cameroon manufacturing industries in the post-liberalization with those in the pre-liberalization period. Section 5 presents the empirical results and section 6 concludes and gives the policy implications of the findings.

2. Model

Our analysis relies on correctly measuring firm productivity. To this end we build on the works by Olley and Pakes (1996). These authors address two major concerns that have afflicted production function estimates for a long time: simultaneity and selection biases. They propose a three-step estimator to remedy both the selection and endogeneity problems.

Let the production function be

(1) $y_{it} = \beta_0 + \beta_1 L_{it} + \beta_2 E_{it} + \beta_3 M_{it} + \beta_4 K_{it} + \varepsilon_{it}$

where y_{it} is the logarithm of output of firm i at time t, and correspondingly, L_{it}, E_{it}, M_{it}, and K_{it} are the firm's (log of) labor, energy, materials, and capital inputs. The last term, ε_{it}, is an error representing all disturbances that prevent (1) from holding exactly. Let this term be composed of two parts,

(2) $\varepsilon_{it} = \omega_{it} + \eta_{it}$

The term η_{it} could be capturing unpredictable demand shocks while ω_{it} could be firm productivity, for instance. If ω_{it} is known to the firm, the optimal labor input choice, for example, will be a function of ω_{it}, and simple OLS estimation will suffer from a simultaneity bias because $E\left[\varepsilon_{it} \middle| L_{it}\right] \neq 0$. If the term ω_{it} is constant over time, $\omega_{it} = \omega_i$, all t, taking time-or within-firm differences of equation (1) and proceeding with OLS on the transformed data can lead to consistent parameter estimates. But, in our framework, ω_{it} is firm productivity, and how this changes in relation to trade liberalization is exactly the question we are asking. This strategy is therefore ruled out.

The firm productivity ω_{it} is identified from the firm's materials choices. We assume that labor, materials and energy are variable inputs so that their choice is affected by ω_{it}, whereas capital is determined by past values of ω, not the current one. Let M_{it} be the optimal choice of materials by the firm. Therefore, the demand of materials is a function of productivity ω_{it} and capital input K_{it} i.e. $M_{it}(\omega_{it}, K_{it})$. By assuming that the demand function of materials is invertible, ω_{it} can be written as a function of M_{it} and K_{it}.[6] The inverse of the demand function of materials is specified as follows,

(3) $\omega_{it} = f(M_{it}, K_{it})$

Substituting (3) and (2) into (1) gives,

(4) $y_{it} = \beta_1 L_{it} + \beta_2 E_{it} + \phi_{it}(M_{it}, K_{it}) + \eta_{it}$

[6] To invert the demand function of materials, one assumes the hypothesis of monotonicity i.e. the use of materials by the firms that maximize their profit increases with ω_{it} given the capital input. Another assumed hypothesis is that the markets are competitive such that all firms face the same prices. However, Levinsohn and Petrin (2003) argue that the estimation is valid under imperfect competitive structures such as Cournot oligopoly with linear demand functions.

with $\phi_{it}(M_{it},K_{it})=\beta_0+\beta_3 M_{it}+\beta_4 K_{it}+f(M_{it},K_{it})$. We include a fourth-order polynomial expansion in M_{it} and K_{it} (including all the interaction terms) to capture the unknown function $\phi_{it}(.)$, which yields,

(5) $$y_{it} = \beta_0 + \beta_1 L_{it} + \beta_2 E_{it} + \beta_3 M_{it} + \beta_4 K_{it} + \sum_{m=0}^{4}\sum_{k=0}^{4-m} \beta_{m,k} (M_{it})^m (K_{it})^k$$

In the first step of estimation, the coefficients of variable inputs, labor (β_1) and energy (β_2) are estimated by OLS on equation (5) and $\hat{\phi}_{it}$, which is needed later is calculated.

The second step deals with the exit decision. Exit is conditional on the realization of productivity and the exit threshold for productivity (see Liu, 1993). We generate an estimate of the survival probability by running a probit regression on a fourth-order polynomial in materials and capital i.e.

(6) $$X_{it}(1,0) = \sum_{m=0}^{4}\sum_{k=0}^{4-m} \beta_{m,k} (M_{it})^m (K_{it})^k$$

where $X_{it}=1$ if the firm remains in the sample at time t and $X_{it}=0$ if the firm exits. The estimated survival probability, which is needed in the last step, is denoted by $\hat{P}_{it}$.

Finally, in the third step, the materials and capital coefficients (β_3 *and* β_4) are estimated using the non-linear least square from the following equation,

(7) $$(y_{it}-\hat{\beta}_1 L_{it}-\hat{\beta}_2 E_{it})=\beta_c+\beta_3 M_{it}+\beta_4 K_{it}+f_t(\hat{\omega}_{t-1},\hat{P}_{it})+\eta_{it}$$

where $f_t(\hat{\omega}_{t-1},\hat{P}_{it})$ is a fourth-order polynomial in $\hat{\omega}_{it-1}=\hat{\phi}_{it}(M_{it-1},K_{it-1})-\beta_3^* M_{it-1}-\beta_4^* K_{it-1}$ and $\hat{P}_{it}$. The estimate of $\phi_{it}(M_{it-1},K_{it-1})$ is $f_t(M_{it-1},K_{it-1})$, which is evaluated from the coefficients of polynomial terms estimated using equation (5). η_{it} is independently and identically distributed. OLS estimates are the initial values for the iterative search of the non-linear least square estimation.

Using the estimates of coefficients of labor, energy, materials, and capital we estimate (log) TFP as,

(8) $$TFP_{it}=y_{it}-\hat{\beta}_1 L_{it}-\hat{\beta}_2 E_{it}-\hat{\beta}_3 M_{it}-\hat{\beta}_4 K_{it}$$

Finally, we regress the computed TFP on trade liberalization variables. The effects of liberalization depend on sectoral export shares (XS). Indeed, and as suggested by the advocates of the export-led growth strategies, productivity growth may depend on export orientation. So, during the initial phase of liberalization sectors with high and increasing share of exports may be more likely to benefit from dynamic effects of trade. Therefore, we assume that the effects of liberalization depend on sectoral XS. The technological progress in the rest of the world may manifest itself by quality improvements embodied in imported intermediate inputs, which in turn may lead to productivity growth. It can then be postulated that industries, which extensively use imported intermediate inputs, are more likely to benefit from technological progress in the outside world. Also, during the initial phase of liberalization, sectors with high and increasing share of imports may be more likely to adjust and restructure. We control for the share of imported inputs in sectoral output (MS).

The import penetration puts pressure on domestic firms driving them to increase their productive efficiency or to exit the industry. On the other hand, if import penetration is overwhelming, the domestic firms may not be able to face the competition therefore a decline in TFP. We control for the intensity of foreign competition in each sector by the import

penetration rate (MPR). Openness to foreign trade (OPEN) possibly affects the performance of firms through the introduction of new goods, improved access to better technologies, adoption of new methods of production, new organization of industries, increase in intermediate goods available, and the opening of new markets that permit the expansion of exports (Winter, 2004).

The political economy perspective on protection of manufacturing industries contends that it leads to a massive waste of resources to fund lobbying activities to perpetuate rent-yielding protection. In the absence of data on the effective rate of protection (ERP), we follow Chand et al. (1998) and use the effective rate of assistance (ERA) or assistance on value-added, which is conceptually analogous to the measure of ERP. The ERA takes account of the value added by giving assistance (tariff, quotas, subsidies, etc) on both outputs and intermediate inputs of each of the industries over time.

The Olley and Packes method of computing firm productivity addresses the problem of simultaneity in input choices. However, the endogeneity of the previous trade policy variables could be an issue as well. For instance, the government authorities may change trade policy in response to pressures by industries experiencing less productivity growth, thus the simultaneity between trade policy at time t and productivity growth from t-1 to t. The instrumental variable estimation is a way to address this issue; however, we do not have in the context of Cameroon good instruments e.g., political economy determinants of trade policy. To circumvent the endogeneity problem of trade policy, we follow Fernandes (2001) and consider the impact of one-period lagged trade policy measures on firm productivity growth rates. The productivity growth in some industries may be higher than in others due to factors that we do not fully capture. We therefore allow for exogenous differences in productivity growth rates across industries by including fixed effects α_j in the specification below. We also include time fixed effects α_t in the regression. We estimate pooled regressions including firms in all industries as follows,

(9) $\Delta \ln TFP_{jt} = \beta_0 + \alpha_j + \alpha_t + \beta_1 \ln XS_{jt-1} + \beta_2 \ln MS_{jt-1} + \beta_3 \ln MPR_{t-1} + \beta_4 \ln ERA_{t-1} + \beta_5 OPEN_{t-1} + \nu_{it}$

Here Δ indicates a one-year difference i.e. change in that variable in consecutive years. The error term ν_{it} is i.i.d.

There is a substantial degree of heterogeneity across firms in different industries in our sample (see section 3 of the paper). Therefore, the impact of trade liberalization on TFP growth may vary depending on firm characteristics. We introduce cross-firm variation in the impact of trade liberalization according to firm capital deepening (KDEE), size, age, and an indicator for firm exit. The inclusion of an indicator for exiting firms allows testing the incidence of industry rationalization – the disappearance of inefficient firms. Firm productivity increases with age if learning-by-doing effects or improvements in the workforce quality are important; if improving scale economies are achieved; and if older firms manage to modernize their capital stock. The size influences the way in which firms are affected by trade liberalization. The increased exposure to foreign competition may increase firm size by increasing the elasticity of demand. On the contrary, import competition may reduce demand, causing industry contraction and firm size (Roberts and Tybout, 1996). The increase in capital intensity has generally been considered by the scholars as one of the main sources of increase productivity. The trade liberalization might also affect differently firm productivity depending on industry characteristics such as the degree of domestic competition (DCOM) in an industry. We follow Fernandes (2001) and capture the degree of domestic competition in the

industry using the Herfindahl index, which summarizes the degree of inequality of market shares across firms in an industry.

The TFP levels are estimated for two different periods, between which there was trade liberalization and other significant changes to the Cameroonian economy. For instance, from 1990 through 1993 Cameroon went on serious political instability with the operations "*villes mortes*", "*pieds morts*", etc.-campaign of widespread non-violent pro-democracy protests, including significant labor strikes. Also, there was a large devaluation i.e. in January 1994, Cameroon and the other CFA zone countries realigned the parity of their currency from 50 to 100 CFA francs to the French franc. In order to make the effects of trade liberalization on productivity growth clearer, a dummy variable (Dpol) taking the value 0 during the years of political instability and 1 otherwise is used. We also created a devaluation dummy variable (Ddev), which takes the value 0 before devaluation and 1 after. The augmented equation (9) is specified as follows,

$$(10)\ \Delta \ln TFP_{jt} = \beta_0 + \alpha_j + \alpha_t + \beta_1 \ln XS_{jt-1} + \beta_2 \ln MS_{jt-1} + \beta_3 \ln MPR_{jt-1} + \beta_4 \ln ERA_{jt-1} + \beta_5 OPEN_{jt-1} + \beta_6 Dpol + \beta_7 Ddev + \beta_8 \ln KDEF_{jt} + \beta_9 \ln SIZE_{jt} + \beta_{10} \ln AGE_{jt} + \beta_{11} \ln DCOM_{jt} + \nu_{it}$$

3. Data

The firm level data for the present study are from the Cameroon National Institute of Statistics and National Account, which is instructed to gather annual information on all manufacturing firms. Though the coverage of the manufacturing sector is incomplete (informal firms for instance are excluded) the sample covers large, medium-size and small-size formal manufacturing firms. Our sample consists of firms employing at least 10 permanent workers, and covers the following industries, food processing, beverage-tobacco, textile-weaving, wood-furniture, paper-printing, chemical, rubber-plastic, and mechanical-electrical. The analysis is over two different trade policy regime periods. The pre-liberalization covers the period 1988/89-1993/94 while the post-liberalization period covers the period 1996/97-2001/02.[7] For each firm and year, we observe the data on production, labor, materials, investment, and energy (water, electricity, and fuel). We also observe industry and firm identity codes. This allows us to track establishment over time and to get an idea on the exit, survival, and entry of firm in each industry.

The variables are defined as follows. Output is the observed production per year. It is measured in constant price (using sector's output price index as deflator). The labor input is in three categories according to the level of skill i.e. L_1 is the total number of foreigners and engineers per year, L_2 is the total number of middle executive per year, and L_3 is the total number of workers and temporary workers per year. The gross capital stock estimates at constant prices are derived using the perpetual inventory method. This requires data on the gross capital stock for a benchmark year and gross investment for all the years. Fortunately, data on gross investment at current price were available for each year and for each firm. Thus, the real capital stock is defined as follows, $K_{it} = (1-\delta)K_{it-1} + I_{it}$. We assume a depreciation rate (δ) of 4 percent per year. The benchmark capital stock is calculated using the approach of Hall and Jones (1999) i.e. $K_0 = (K/Y)_0 = (I/Y)/g_I + \delta$ where Y is gross output, g_I is the growth

[7] There is a dispute over the time required before any positive effects of trade liberalization are felt (see Papageorgiu et al. 1990). In order to further capture the lag effects of liberalization, the years 1994/95 and 1996/96, which immediately follow the post-liberalization period were not taken into account in the analysis.

rate of gross investment (I) over the next five years during respectively, the pre-and post-liberalization periods, and δ is the depreciation rate. Real investment is computed by deflating investment at current price by the wholesale price index for machinery and machine tools. Raw material is not proportional to output and is therefore included in the analysis; it is measured in constant price using the price index of raw materials (usually four major intermediate consumption) in each industry as deflator. The total value of energy used per year is in constant prices (using the price index of each category of energy as deflator); it is an aggregate of the plant level consumption of fuel, water, and electricity.

The liberalization variables are defined as follows. Export and import intensities are the ratio of exports and imports to output, respectively. Import penetration rate is the ratio of imports to output plus imports minus exports. Openness is the ratio of trade (exports plus imports) to output. Effective rate of assistance is measured as a percentage of value-added by each manufacturing industry. Capital deepening is measured by the ratio of capital to labor. The measure of firm size is the average employment over the sample period. The age of form is measured by the number of years from the start-up operations. The degree of competition across industries is measured by the Herfindahl index.[8] The summary statistics of all variables are presented in appendix.

4. Characteristics of Cameroonian manufacturing industry

Some basic characteristics on the manufacturing industries before and after liberalization are presented in table 1. The industry shares of the total value-added suggested that at least in quantitative terms, the beverage-tobacco, textile-weaving, wood-furniture, and chemical industries dominated the manufacturing sector during the pre-liberalization period. Together, they accounted for nearly 78.8 percent of manufacturing value-added. Concerning the industry share of total employment, the food processing, rubber-plastic, and wood-furniture industries registered the largest shares of employment i.e. they accounted for nearly 73.6 percent of manufacturing employment. During the post-liberalization period, the beverage-tobacco and wood-furniture industries dominated i.e. both industries accounted for nearly 68.1 percent of manufacturing value added. During the same period, three industries e.g. food processing, rubber-plastic, and beverage-tobacco accounted for nearly 66.8 percent of manufacturing employment.

The industry-specific export and import shares, import penetration rate, and openness to foreign trade are also reported in table 1. These figures reveal that before liberalization, the manufacturing sector as a whole average shipped 27.6 percent of its output abroad while the imports represented 34.4 percent of its output. The wood-furniture and rubber-plastic industries exported 73.2 and 82.9 percent of their output, respectively, while in the paper-printing, rubber-plastic, and chemical industries, the imports represented respectively, 70.3, 57.4, and 41.8 percent of output. In terms of exposition to foreign competition and openness to world trade, the mechanical-electrical and rubber-plastic industries were leading. Over the post-liberalization era, the manufacturing sector was more oriented toward foreign markets, as 33.2 percent of its output was exported, with the wood-furniture, textile-weaving, and rubber-plastic sectors recording shares of 118.1, 59.2, and 53.6 percent, respectively. The imports accounted for roughly 21.7 percent of manufacturing output, with the paper-printing, mechanical-electrical, chemical, and beverage-tobacco industries recording the most important shares. The paper-printing, mechanical-electrical, and chemical industries were

[8] The Herfindahl index for an industry and year is the sum of firms' squared market shares relative to industries' output.

more exposed to foreign competition (in terms of imports penetration) while the wood-furniture, textile-weaving, and paper-printing industries were more outward-oriented.

Concerning the competitiveness issues, the most widely available indicator of a sector's competitiveness is the relative value-added by each worker in that sector. Table 1 indicates that the pre-liberalization leading industries were beverage-tobacco and chemical while the post-liberalization leading sectors were wood-furniture and beverage-tobacco. However, in general productivity will be compensated by higher wages. Therefore, higher productivity may not translate into a competitive edge if wages are proportionately higher. Taking into account wage as well as productivity differences gives us unit labor costs-ratio of wage to value-added. This offers a better indicator of competitiveness. The figures in table 1 show that the pre-liberalization leading sectors were mechanical-electrical, food, and paper-printing while the post-liberalization most competitive industries were mechanical-electrical, paper-printing, rubber-printing, and food processing.

Table 1: Characteristics of Cameroonian manufacturing industries, 1988/89-1993/94 and 1996/97-2001/02

	Value added per worker	Unit labor cost	Value added share (percent)	Employment share (percent)	Exports share (percent)	Imports share (percent)	Import penetration rate	Openness
Pre-liberalization period, 1988/89-1993-94								
Food	2.8639	0.5224	11.7748	27.3313	19.1009	18.7231	0.1879	0.3782
Beverage	11.0477	0.3913	22.2885	13.4116	2.8658	27.0186	0.2176	0.2988
Textile	2.5629	0.3554	3.776	9.7944	59.1811	12.8433	0.2393	0.7202
Wood	30.5179	0.3826	45.7882	9.974	118.1267	3.5061	0.2398	1.2163
Paper	4.6745	0.655	2.0406	2.9019	5.5732	53.9611	0.3636	0.5953
Chemical	6.8232	0.3639	7.2108	7.0253	31.8105	33.1394	0.327	0.6495
Rubber	1.2585	0.5833	4.9407	26.0973	53.6471	10.2135	0.1806	0.6386
Mechanical	4.1843	0.6699	2.1806	3.4643	24.6166	41.5425	0.3553	0.6616
All Manufac.	6.6477	0.4342	100.00	100.00	33.1535	21.6502	0.3159	0.548
Post-liberalization period, 1996/97-2001/02								
Food	0.2706	0.5768	5.9729	46.0804	23.3562	33.2072	0.3023	0.5656
Beverage	9.1679	0.2491	27.7114	6.31	4.134	24.1524	0.2012	0.2829
Textile	4.1631	0.3995	18.4268	9.2402	33.508	14.6902	0.181	0.482
Wood	2.8413	0.4306	16.5952	12.1933	73.1504	14.7707	0.3549	0.8792
Paper	3.998	0.5317	8.1026	4.2309	11.3315	70.2651	0.4421	0.816
Chemical	7.2482	0.3952	16.0465	4.6217	4.9219	41.819	0.3055	0.4674
Rubber	0.8032	0.4648	5.8877	15.3025	82.894	57.3501	0.7703	1.4024
Mechanical	1.2984	0.6151	1.2569	2.021	19.303	24.0516	0.7352	2.4335
All Manufac.	2.0876	0.8592	100.00	100.00	27.6257	34.3512	0.3219	0.6198

Source: Authors' calculations.

Using simple changes, and between pre-and post-liberalization periods, the industry shares of total value added dropped in 3 industries and improved in the remaining 5 industries, with textile-weaving, paper-printing, and chemical industries registering extraordinary improvements of 388, 297.1, and 122.5 percent respectively. The bulk of manufacturing employment originated from 3 industries with food processing leading-the food processing experienced a dramatic improvement in its share of total employment of nearly 68.6 percent. Concerning the export and import shares, there were differences across industries. The export share increased in 4 industries with paper-printing registering the dramatic increase (103.32 percent), followed by rubber-plastic (54.52 percent), and then beverage-tobacco (103.32 percent). The export share dropped in the remaining 4 industries with chemical having the worst record of –84.53 percent. The import share dropped in beverage-tobacco and mechanical-electrical and improved in the remaining industries with rubber-plastic leading, followed by wood-furniture, and then food processing.

It is also useful to analyze the main trends over both sample periods by industry (table 2). Concerning the rate of growth of real gross output, the pre-liberalization was marked by an extremely mild expansion of manufacturing production with real output for the sector as a whole increasing at the pace of 0.22 percent per annum. Four industries experienced decreasing output, with the most decline (-13. 6 percent per annum) occurring in the chemical industry. Four industries experienced rising output, with paper-printing experiencing the most increase of 13.1 percent per annum. The total manufacturing import penetration rate and openness to foreign trade increased nearly by 4.5 and 6.4 percent per annum, respectively. The import penetration rate increased in 4 of 8 industries, with the food processing registering the striking increase of nearly 10.8 percent per annum. In the remaining 4 industries the import penetration rate decreased. The openness to foreign trade exhibited increase in 6 of 8 industries, with 3 industries (paper-printing, food, and wood-furniture) registering dramatic increases of nearly 9.9, 7.7 and 7.1 percent per annum, respectively. Estimates of the annual rates of growth of labor productivity are also presented for individual industries in table 2. It should be noted that the productive performance of the Cameroonian manufacturing sector appears to have been better before trade liberalization. For instance, between 1988/89 and 1993/94 labor productivity grew in 3 industries from a low pace of 3.9 percent annually in beverage-tobacco to a high pace of 37.4 percent annually in textile-weaving and fell in the remaining industries. The unit labor cost increased on average by more than 3 percent annually in 4 industries.

After trade liberalization, the real gross output rose in total manufacturing as well as in every manufacturing industry, ranging from a low of 3.7 percent per annum in mechanical-electrical to a high of 9.3 percent per annum in wood-furniture. Still during the post-liberalization period, the manufacturing industries have increasingly been less exposed to import competition and less outward-oriented. As table 2 indicates, except in beverage-tobacco and wood-furniture industries where openness to foreign trade grew by 21.9 and 3 percent per annum, respectively, import penetration rate and openness to foreign trade dropped in total manufacturing as well as in all industries. The labor productivity grew only in 2 industries e.g. wood-furniture (8 percent per annum) and chemical (11.4 percent per annum), while the labor cost was growing annually by more than 4 percent on average in 3 industries.

Table 2: Annual rates of growth (percent) of Cameroonian manufacturing characteristics, 1988/89-1993/94 and 1996/97-2001/02

Industry	Value added per worker	Unit labor cost	Import penetration rate	Openness	Real gross output
Pre-liberalization period, 1988/89-1993/94					
Food	-1.599	0.5681	10.7811	7.7251	5.805
Beverage	3.9147	5.3359	-1.8176	-1.2352	-8.69
Textile	37.3858	-22.772	1.2043	0.0882	11.688
Wood	16.3345	-12.115	-24.4427	7.0725	0.0492
Paper	-0.4266	5.2516	-1.1028	9.91	13.1111
Chemical	-15.224	13.4348	0.3935	-1.3079	-13.599
Rubber	-4.727	-11.382	-12.3676	2.5016	-12.017
Mechanical	-1.7229	2.9281	3.1308	4.8175	-11.248
All Manufacture	-4.7323	0.4487	4.491	6.3783	0.2165
Post-liberalization period, 1996/97-2001/02					
Food	-10.723	-0.7187	-23.2056	-21.1535	3.9905
Beverage	-1.0493	-5.5773	-30.2319	21.8677	5.8291
Textile	-19.842	11.5338	-24.6619	-7.9696	3.6187
Wood	7.9837	-2.1957	-20.0525	3.0419	9.2659
Paper	-12.289	-1.703	-4.9143	-6.7703	7.3083
Chemical	11.4316	-16.808	-34.3468	-34.891	4.363
Rubber	-16.587	14.931	-31.0698	-10.5185	4.6885

Mechanical	-25.218	4.7924	-12.7191	-35.4518	3.7316
All Manufacture	-4.5597	-0.8921	-18.074	-14.5198	4.4582

Source: Authors' calculations.

5. Results

In order for the results not to be plagued by the small sample size both pre- and post-liberalization samples were pooled together. The computed F score to test the necessity of introducing a trade liberalization dummy, which enters the model additively and multiplicatively is 3.9631. This F value if higher than the 1 percent critical value of $F_{0.01}$ (7, 1180)=2.8. We therefore used the trade liberalization dummy in the regressions. The coefficient estimates for the production function parameters are in table 3. The output elasticity with respect to each input has the expected positive sign. Materials have the largest output elasticity, followed by energy, and then foreigner-engineers.

Table 3: Coefficient estimates for the production function

Variables	Coefficient	Standard-deviation	t value	p value
Worker	0.0416	0.014	2.97	0.003
Middle executive	0.0302	0.0269	1.12	0.262
Foreigner-engineers	0.1222	0.0341	3.59	0.00
Energy	0.1561	0.0218	7.16	0.00
Material	0.6322	0.0124	51.0	0.00
Capitals	0.0271	0.0081	3.33	0.001

The firm-level TFP were estimated using equation (8). A first way to compare the productivity estimates is to compare the dispersion they imply. The first two columns of table 4 contain the coefficients of variation. The dispersion appears to be relatively large in five industries (food, beverage-tobacco, textile-weaving, wood-furniture, and paper-printing) before trade liberalization. After trade liberalization, three industries e.g. chemical, rubber, and mechanical-electrical saw a substantial widening of the TFP levels. To compare the productivity growth estimates, columns 4 and 5 in table 4 list the pre-and post-liberalization annual rates of growth. The results show that the pre-liberalization period was a very successful one for the Cameroonian manufacturing industries. The TFP grew on average at the rate of 1.94 percent per annum in the manufacturing sector. Concerning the sub-sectors, except in textile where TFP dropped by 0.98 percent per year on average, the remaining seven industries under study experienced rising TFP. A different picture emerges after trade liberalization. For the manufacturing sector as a whole, TFP decreased at the pace of 0.2 percent per annum. There were however differences across industries. The growth rates of TFP were positive in four industries, but were relatively lower. The dramatic decline occurred in wood-furniture, beverage-tobacco, and mechanical-electrical industries. However, the trade reform – or at least the opening of the local market – positively affected TFP in textile-weaving and rubber-plastic industries i.e. in both industries the annual growth rates of TFP improved from –0.98 and 0.04 percent before trade liberalization to 1.69 and 3.88 percent following the opening to foreign trade.

Table 4: Coefficients of variation of total factor productivity levels and total factor productivity growth rates

	Coefficient of variation (percent)		Annual rates of growth (percent)		
	Pre-	Post-	Pre-	Post-	Improvement

	liberalization	liberalization	liberalization	liberalization	(+) or drop (-)
Food	27.21	19.86	3.79	1.386	-
Beverage	25.09	19.56	1.95	-1.399	-
Textile	29.66	27.98	-0.98	1.6875	+
Wood	38.98	31.52	3.88	-7.6818	-
Paper-printing	34.91	10.19	1.47	0.345	-
Chemical	27.18	35.78	3.25	1.37	-
Rubber	22.61	23.62	0.0389	3.875	+
Mechanical	28.01	31.61	2.09	-1.103	-
All manufac.	31.4256	28.8773	1.9361	-0.19	-

Coming to the patterns of association between the trade liberalization variables and the firm-level TFP growth, the coefficient estimates of equation (9) are given in table 5. The results in columns (i) and (iv) were obtained when fixed effects were omitted. In fact, the estimates obtained by dropping the industry fixed effects, aims to gauge the potential importance of unmeasured industry characteristics in driving TFP growth. The results in columns (ii) and (v) were obtained when time effects were omitted. Columns (iii) and (vi) report the results when both time and fixed effects were in place. The coefficients on the one-period lagged of export share, import-output ratio, and import penetration ratio have a positive sign and are insignificant. Also, the coefficient associated with the one-year lagged of effective rate of assistance has a negative sign and is insignificant.

In the search for an accurate assessment of the impact of trade liberalization on firm-level TFP growth rates, equation (10) was estimated and the results are presented in table 5. Three robust findings emerge from the estimates. First, and like most of the previous literature, the coefficient on the export-to-gross output ratio is positive and significant at the 10 percent level in all specifications. This result suggests that firms in industries with greater outward-orientation are more productive. For instance, and using the results in column (vi), an increase in the export-output ratio by 10 percent, ceteris paribus, will increase firm-level TFP growth by 0.25 percent, a modest but significant effect. Second, the increase in the effective rate of assistance (ERA) is an impediment to productivity growth. Indeed, the coefficient associated with the ERA is negative and significant at the 1 percent level in three of the four specifications. For instance, the point estimate of ERA reported in colunm (vi) suggests that a 10 percent drop in the ERA leads to 0.89 percent rise in TFP growth rate, a quite dramatic and significant effect.

Finally, the coefficients on the import to gross output ratio and import penetration ratio are positive and insignificant. These results suggest that firms in industries with greater import competition are more productive. However, this effect is not significant possibly reflecting the inability of Cameroonian manufacturing firms to effectively cope with foreign competition. This inability is primary due to huge supply constraints the local producers usually face in Cameroon e.g. poor infrastructure, erratic supply of energy (water and electricity), corruption and bad governance, low skill of labor force, etc. Indeed, the increased competitive pressures on manufacturing firms in a liberalized trade regime force them to be more efficient in the use of resources. This can be achieved through better organization, improved managerial efficiency, more effective utilization of labor, better capacity utilization, etc. However, this view or hypothesis does not have empirical support in Cameroon manufacturing sector. The reasons, in a context of lack or inadequate infrastructure, high utility prices, etc. as it is the case in Cameroon, producers must produce their own power, transport, and/or communication services. The cost and production techniques are then

directly affected. Also, poor transport networks and inadequate telecommunication services usually lead to inappropriate incentive systems and inefficient management such as unreliable supply of inputs, waste of time on the road to deliver messages, hold of conversations that could be handled in moments over a working phone line, etc. The result is the increase in x-inefficiency despite the liberalization pressures to reduce x-inefficiency.

Concerning the control variables, three robusts findings emerge from the results reported in table 5. First, the coefficient on the exit indicator is negative and significant at the 5 and 10 percent levels in all specifications. This indicates that firms that cease to produce are lees efficient. This finding corroborates the findings of Pavcnick (2002) in the Chilean plants. Second, and in all specifications, the coefficient on the age variable is positive and significant at the 5 percent level. Therefore, TFP growth rate increases with the age of firms. Finally, the political instability of the late 1980s and early 1990s appears to have affected negatively and significantly firms' TFP growth. Indeed, the coefficient associated with Dpol is negative and significant at the 1 and 10 percent levels in all specifications.

Table 5: Impact of lagged trade policy on TFP growth (robust standard-errors are within parentheses)

	Results without the control variables				Results with the control variables			
	OLS	Fixed effects			OLS	Fixed effects		
		(i)	(ii)	(iii)		(iv)	(v)	(vi)
Constant	0.0003	/	/	/	0.052	/	/	/
	(0.0126)				(0.0743)			
$lnXS_{t-1}$	0.017	0.0159	0.0172	0.0161	0.0228***	0.0243***	0.0229***	0.0246***
	(0.0134)	(0.0134)	(0.0135)	(0.0135)	(0.0135)	(0.0154)	(0.0136)	(0.0155)
$lnMS_{t-1}$	0.0111	0.012	0.0115	0.0115	0.0135	0.0009	0.014	0.0017
	(0.0385)	(0.0381)	(0.0388)	(0.0384)	(0.0384)	(0.037)	(0.0386)	(0.0372)
$lnMPR_{t-1}$	0.034	0.0074	0.0388	0.0072	0.0222	0.01	0.022	0.0099
	(0.0322)	(0.0326)	(0.0323)	(0.0327)	(0.0326)	(0.0325)	(0.0326)	(0.0327)
$lnOPEN_{t-1}$	0.004	0.0151	0.0046	0.0158	0.0225	0.0255	0.0234	0.0266
	(0.0488)	(0.0518)	(0.0493)	(0.0523)	(0.0494)	(0.0496)	(0.0496)	(0.0499)
$lnERA_{t-1}$	-0.0028	-0.0044	-0.003	-0.0046	-0.0085	-0.0652*	-0.0885*	-0.0527*
	(0.0145)	(0.0149)	(0.0146)	(0.015)	(0.0146)	(0.0115)	(0.0214)	(0.0148)
Exit					-.0444***	-0.448***	-0.0447**	-0.0453**
					(0.0297)	(0.0295)	(0.0299)	(0.0297)
lnKDEE					-0.003	-0.0031	-0.0031	-0.0033
					(0.0071)	(0.0072)	(0.0074)	(0.0074)
lnSIZE					-0.003	-0.003	-0.0029	-0.003
					(0.0101)	(0.0101)	(0.0105)	(0.0106)
lnAGE					0.0295**	0.0299**	0.0313**	0.0317**
					(0.0156)	(0.0154)	(0.0167)	(0.0163)
lnDCOM					-0.01	-0.0105	-0.0112	-0.0133
					(0.007)	(0.0072)	(0.0142)	(0.0145)
Dpol					-0.137*	-0.114***	-0.1371*	-0.115***
					(0.0313)	(0.0721)	(0.0316)	(0.0725)
Ddev					0.544	0.0395	0.054	0.0409
					(0.0399)	(0.0689)	(0.0449)	(0.0737)
Fixed effects		no	yes	yes		no	yes	yes
Time effects		yes	no	yes		yes	no	yes
# Obs.	1193	1193	1193	1193	1193	1193	1193	1193
SSE	0.4361	0.4322	0.4373	0.4334	0.4333	0.4318	0.4344	0.4329
R^2	0.005	0.0268	0.0054	0.0272	0.0238	0.0347	0.0246	0.0355

Note: The fixed effects and time effects estimates are not reported. SEE is the standard error of estimation.

* significant at 1 percent
** significant at 5 percent
*** significant at 10 percent

6. Conclusion

In this paper firm-level panel data were used to assess the effects of trade liberalization on firm-level total factor productivity (TFP) growth. The study covered eight Cameroon manufacturing industries, namely, food processing, beverage-tobacco, textile-weaving, wood-furniture, paper-printing, chemical, rubber-plastic, and mechanical-electrical. For the results not to be plagued by the small sample size of most industries, the pre-liberalization sample, which covers the period 1988/89-1993/94 and the post-liberalization sample, which covers the period 1996/97-2001/02 were pooled. Then, a single production function for the whole manufacturing sector was estimated using the Olley and Pakes semi-parametric approach and TFP indexes were then derived. We finally used the panel data methods to test for the effects of trade liberalization variables on firms' TFP growth. To make the effects of trade liberalization on productivity growth clearer, we controlled for political instability and 1994 CFA franc devaluation, which took place across the two different trade policy regimes.

The pooling test showed that omitting the trade liberalization dummy variable, which enters the model additively and multiplicatively, would produce biased findings. The empirical results also showed that the output elasticity with respect to each input had the expected positive sign with materials having the largest output elasticity. By comparing the dispersion the estimated firm-level TFP indexes imply, the results showed that the dispersion was relatively large in five industries before trade liberalization. After trade liberalization, three industries saw a substantial widening in TFP levels. In terms of productivity growth, the pre-liberalization period was a very successful one for the Cameroonian manufacturing industries i.e. TFP increased on average by 1.9 percent per annum. Except in textile-weaving industry where TFP decelerated on average by 0.98 percent per annum, the per year average growth rate of TFP increased in the remaining seven industries under study. During the post-liberalization period, the annual growth rates of TFP was positive in four industries, but were relatively lower. Two industries saw drop in per year average growth rate of TFP while two industries experienced increase in per year mean growth rate of TFP.

The assessment of the role of trade-related variables in influencing firms' TFP growth revealed three robust findings. Firstly, increases in effective rate of assistance to Cameroonian manufacturing negatively affected TFP growth in the sector. Secondly, our evidence shows significant productivity gains from outward-orientation. Thirdly, the import competition had a positive effect on driving TFP growth. However, this positive impact is insignificant possibly because of the existence of huge supply constraints such as poor infrastructure, erratic supply of energy (water and electricity), corruption, bad governance, poor skill of labor force, etc. the local producers usually face in Cameroon. Concerning the control variables, three robust findings also emerged from our analysis. Firstly, the exit of less productive firms contributed to productivity gains. Secondly, the TFP growth rates increase with the age of firms. Finally, the political instability of the late 1980s and early 1990s negatively affected firms' TFP growth.

The above findings have strong policy implications for TFP growth in the Cameroon manufacturing sector:

- Policy actions aim at reducing the protection of manufacturing sector are sources of raising TFP growth.
- Help the manufacturing industries to support foreign competition by adequately addressing the issue of supply constraints such as poor transport and telecommunication infrastructure, erratic supply of energy (water and electricity), corruption, bad governance, etc. is conducive to improvement in TFP growth.
- Measures to foster outward-orientation of different industries are conducive to improvement in firm-level TFP growth.

References

Baldwing, R.E., 2005. 'Heterogeneous firms and trade: testable and untestable properties of the Melitz model', *NBER Working Paper 11471*, 1-25

Baldwing, R.E. and F. Robert-Nicoud, 2006. 'Trade and growth with heterogeneous firms', *CEP Discussion Paper No 727*, 1-22.

Bernard, A., J. Eaton, J. Jensen and S. Kortum, 2003. 'Plants and productivity in international trade', *American Economic Review 93*, 1268-90.

Chand, S., P. McCalman and P. Gretton, 1998. 'Trade liberalization and manufacturing industry productivity growth' in *Microeconomic Reform and Productivity Growth. Workshop Proceedings*, 239-71.

Fernandes, A.M., 2001. 'Trade policy, trade volumes and plant-level productivity in Colombian manufacturing industries'. *Unpublished working paper*. Yale University, 1-42.

Gustafsson, P. and P. Segerstrom, 2007. 'Trade liberalization and productivity growth', *NBER Working Paper*, 1-36.

Hall, R.E. and C.I. Jones, 1999. 'Why some countries produce much more output per worker than others?', *Quarterly Journal of Economics, 114 (1)*, 83-116.

Helpman, E., M. Melitz and S.R. Yeaple, 2004. 'Export vs FDI with heterogeneous firms', *American Economic Review 94*, 300-17.

Keller, W., 2003. 'Do trade patterns and technology flows affect productivity growth?', *The World Bank Economic Review, 14(1)*, 117-47.

Kim, E., 2000. 'Trade liberalization and productivity growth in Korean manufacturing industries: price protection, market power, and scale efficiency', *Journal of Development Economics 61*, 55-83.

Levinsohn, J. and A. Petrin, 2003. 'Estimating production functions using inputs to control for unobservables', *Review of Economic Studies 70(2)*, 317-42.

Liu, L., 1993. 'Entry-exit, learning, and productivity change. Evidence from Chile', *Journal of Development Economics 42*, 217-42.

Melitz, M., 2003. 'The impact of trade on intra-industry reallocations and aggregate industry productivity', *Econometrica 71(6)*, 1695-1726.

Olley, G.S. and A. Pakes, 1996. 'The dynamics of productivity in the telecommunications equipment industry', *Econometrica 64(6)*, 1263-97.

Papageorgiu, D., A. Choksi and M. Michealy, 1990. *Liberalizing Foreign Trade Regime in Developing Countries*. Washington DC: World Bank.

Pavcnick, N., 2002. 'Trade liberalization, exit, and productivity improvements: evidence from Chilean plants', *Review of Economic Studies 69*, 245-76.

Roberts, M. and J. Tybout, 1996. *Industrial Evolution in Developing Countries: Micro Patterns of Turnover, Productivity and Market Structure*. New York: Oxford University Press.

Winter, A., 2004. 'Trade liberalization and economic performance: an overview', *The Economic Journal 114*, F4-F21.

Appendix

Summary statistics of variables in Cameroon manufacturing industries

Variable	Mean		Standard Deviation		Minimum		Maximum	
	Food processing [(1) 6 years, 18 firms; (2) 6 years, 10 firms]							
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Output	1708.98	4913.94	1625.74	5423.5	65.59	160.45	7497.62	7922.43
Worker	10544	5331	23491	12168	8	2	121842	42427
Middle executive	52	99	115	136	1	1	502	468
Foreigner-engineer	32	58	59	67	2	4	497	201
Materials	903.2	2803.51	1062.59	3987.63	28.08	74.27	7929.65	6787.17
Energy	57.67	213.79	67.71	224.76	2.05	5.35	377.17	826.2
Capital	267.65	670.42	512.11	1357.13	48.19	3.12	2482.87	6097.61
Export share	0.19215	0.2089	0.0544	0.0798	0.1419	0.0994	0.2939	0.2887
Import share	0.2013	0.3095	0.0923	0.2189	0.118	0.167	0.372	0.75
Import penetration	0.1949	0.264	0.0689	0.1237	0.1222	0.1801	0.3181	0.5131
Openness	0.3935	0.5184	0.1111	0.2589	0.2722	0.3641	0.5742	1.0384
Effective rate of assitance	0.1554	0.2931	0.05466	0.0294	0.0766	0.2652	0.2206	0.3389
Capital intensity	2.2196	1.4093	5.0447	2.1979	-0.3492	0.001	19.4841	14.5146
Size	10628	5488	20996	11173	22	26	63361	36252
Age	16	29	10	10	1	13	39	47
Herfindahl	0.0999	0.2188	0.004	0.0099	0.0952	0.202	0.1073	0.2335
	Beverage-tobacco [(1) 6 years, 13 firms; (2) 6 years, 10 firms]							
Output	6188.76	4585.61	11017.39	25238.86	41.12	59.59	48662.6	11501.7
Worker	4536	1047	12767	3769	2	2	63237	23514
Middle executive	125	49	239	64	1	1	1494	263
Foreigner-engineer	80	42	123	68	2	1	576	280
Materials	2185.14	9105.05	3636.61	16191.67	5.01	13.6	21507.2	76053.6
Energy	190.59	606.61	390.21	1184.27	2.04	2.12	2655.32	5295.74
Capital	511.11	1555.91	1509.21	3014.11	3.05	2.89	12120.6	11371.6
Export share	0.0298	0.0606	0.0093	0.0374	0.0137	0.0212	0.039	0.0962
Import share	0.2713	0.3538	0.0581	0.2577	0.19	0.1195	0.343	0.799
Import penetration	0.2171	0.2537	0.0372	0.14098	0.1653	0.1088	0.2631	0.4686
Openness	0.3012	0.4145	0.0594	0.29	0.2293	0.1407	0.3818	0.893
Effective rate of assistance	0.3729	0.1884	0.1292	0.0731	0.1914	0.0605	0.5387	0.2516
Capital intensity	2.6595	2.9804	9.8235	3.7322	0.0043	0.0078	60.1404	12.9148
Size	4741	1139	11228	2290	22	6	41462	7766
Age	15	25	13	14	1	9	42	50
Herfindahl	0.3008	0.3779	0.0548	0.0314	0.247	0.352	0.3773	0.4404
	Textile-weaving [(1) 6 years, 09 firms; (2) 6 years, 04 firms]							
Output	3112.86	7906.68	5958.06	3976.13	4.53	3.57	30936.2	35903.8
Worker	718	656	1312	647	4	1	6946	1485
Middle executive	22	73	33	80	1	1	141	194
Foreigner-engineer	51	75	75	99	1	1	237	286
Materials	2314.27	11477.3	6175.37	16735.09	1.11	1.64	40463.7	48866.9
Energy	148.12	943.54	318.5	1238.67	0.399	0.95	1716.04	3559.97
Capital	115.17	1427.7	143.41	2285.37	0.22	0.34	420.85	7603.06
Export share	0.5829	0.417	0.0926	0.2719	0.4741	0.0958	0.6986	0.7125
Import share	0.1242	0.1984	0.0396	0.2533	0.076	0.0385	0.18	0.701
Import penetration	0.2109	0.2509	0.0793	0.2363	0.1426	0.0412	0.3218	0.6401
Openness	0.7072	0.6153	0.112	0.4619	0.5778	0.1364	0.8318	1.3067
Effective rate of assistance	0.1052	0.1564	0.1047	0.08956	0.0248	0.0742	0.3084	0.2751
Capital intensity	0.7505	0.8917	1.7998	1.3215	0.0006	-0.1143	7.9898	4.9403
Size	792	805	783	799	30	3	2016	1790
Age	14	26	6	5	5	18	23	31
Herfindahl	0.4459	0.6658	0.0585	0.047	0.382	0.6136	0.5653	0.7295

Wood-furniture [(1) 6 years, 17 firms; (2) 6 years, 11 firms]								
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Output	1011.15	2460.67	1506.77	2381.83	13.67	8.79	9719.69	9905.01
Worker	1178	238	3902	247	2	4	16981	1020
Middle executive	8	20	10	25	1	1	70	112
Foreigner-engineer	12	21	11	19	1	1	42	79
Materials	323.59	1120.83	527.39	1707.68	2.45	7.27	3233.82	7830.16
Energy	73.72	263.58	161.34	275.37	0.34	1.13	1157.87	1677.46
Capital	413.23	640.58	977.47	1521.65	0.069	0.23	4412.22	6038.66
Export share	1.0493	0.9424	0.5167	0.7378	0.1908	0.3021	1.6844	2.1062
Import share	0.0373	0.3166	0.0223	0.7238	0.019	0.0117	0.078	1.794
Import penetration rate	0.1148	0.467	0.0862	1.0497	0.074	0.0165	0.2634	2.6094
Openness	1.2368	1.2589	0.3094	1.3772	0.9218	0.3138	1.7314	3.8998
Effective rate of assistance	0.1104	0.14985	0.0618	0.03617	0.0614	0.1015	0.2211	0.2043
Capital intensity	1.7916	1.8508	3.5147	3.8103	0.0002	0.0103	20.1554	14.946
Size	1198	280	3903	240	14	7	16701	840
Age	13	24	5	6	1	9	20	32
Herfindahl	0.1627	0.1622	0.0128	0.0319	0.1397	0.1286	0.1799	0.2077
Paper-printing [(1) 6 years, 15 firms; (2) 6 years, 08 firms]								
Output	538.89	225.03	762.43	333.83	34.13	26.87	5583.98	1035.57
Worker	1357	761	5000	1372	4	30	3980	4002
Middle executive	12	24	10	23	1	7	48	148
Foreigner-engineer	11	19	7	12	1	3	34	56
Materials	319.00	1810.89	424.25	1444.94	1.95	123.06	2870.68	6793.52
Energy	9.91	46.87	12.28	57.89	0.42	10.08	85.04	309.44
Capital	152.72	153.13	469.13	240.29	18.33	7.72	2412.57	1429.05
Export share	0.0496	0.1294	0.0888	0.1169	0.006	0.0144	0.2307	0.276
Import share	0.5355	0.6289	0.0761	0.1407	0.457	0.497	0.68	0.896
Import penetration rate	0.3608	0.4179	0.0547	0.0683	0.3162	0.3427	0.4694	0.5247
Openness	0.5852	0.7582	0.1622	0.2111	0.468	0.5442	0.9112	1.0843
Effective rate of assistance	0.0279	0.03788	0.0119	0.0068	0.005	0.0247	0.0368	0.0439
Capital intensity	1.8101	0.8789	4.4426	1.3013	-0.1053	0.0036	24	4.6692
Size	1380	804	3910	1275	18	54	15583	4011
Age	12	24	10	10	1	14	35	43
Herfindahl	0.1286	0.2018	0.0214	0.0192	0.1074	0.1765	0.1723	0.2211
Chemical [(1) 6 years, 16 firms; (2) 6 years, 09 firms]								
Output	4017.62	1044.91	11065.76	4397.54	57.37	69.52	59123.6	2723.3
Worker	4270	1099	13355	2413	8	2	66617	10314
Middle executive	26	45	51	86	1	2	223	322
Foreigner-engineer	20	25	19	23	1	4	82	89
Materials	2548.47	11822.02	7409.03	34785.78	19.89	136.96	40046.2	176467.1
Energy	91.94	582.84	220.53	1556.32	1.11	16.83	1363.19	9723.97
Capital	242.57	745.82	642.8	2474.63	1.22	7.19	3969.89	16898.53
Export share	0.3164	0.0812	0.1151	0.0432	0.1387	0.048	0.431	0.1645
Import share	0.3337	1.1458	0.0367	1.2061	0.284	0.082	0.384	3.004
Import penetration rate	0.3307	0.4067	0.0468	0.3183	0.2794	0.0795	0.3862	0.7824
Openness	0.6499	1.2269	0.1259	1.2314	0.4839	0.1362	0.789	3.1688
Effective rate of assistance	0.1184	0.0903	0.0777	0.0378	0.0429	0.0347	0.2267	0.1419
Capital intensity	0.9485	4.4861	1.5774	13.7854	0.0003	0.0048	8.2786	76.7092
Size	4316	1169	10894	2132	16	13	44545	6502
Age	17	25	9	6	2	14	38	33
Herfindahl	0.5217	0.7646	0.0322	0.0381	0.46	0.7098	0.5474	0.8204

Rubber-plastic [(1) 6 years, 10 firms; (2) 6 years, 08 firms]								
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Output	600.39	1528.94	852.98	1918.31	22.88	49.52	4311.41	7641.08
Worker	834	776	1651	1614	8	4	5614	5527
Middle executive	40	43	99	99	1	1	343	422
Foreigner-engineer	21	29	42	52	1	3	156	169
Materials	318.34	870.78	373.86	989.37	12.17	22.29	1156.91	3444.09
Energy	45.28	161.17	117.55	263.55	0.29	10.79	638.78	1140.43
Capital	529.12	733.64	1567.12	1590.37	0.41	4.71	9168.98	5847.49
Export share	0.5275	1.0606	0.0799	0.5943	0.4538	0.3054	0.6371	1.78
Import share	0.1152	0.5295	0.0763	0.5205	0.026	0.091	0.246	1.478
Import penetration rate	0.1878	0.8629	0.1186	0.7688	0.0641	0.3523	0.4039	2.1165
Openness	0.6425	1.5935	0.124	0.9427	0.5573	0.7081	0.883	3.2584
Effective rate of assistance	0.0798	0.0627	0.06285	0.0194	0.0221	0.0348	0.1949	0.0842
Capital intensity	0.4688	2.1372	0.7431	4.3971	0.0015	0.0612	3.1359	22.321
Size	895	848	1361	1734	13	35	4256	5367
Age	9	18	5	4	1	9	17	25
Herfindahl	0.2931	0.314	0.092	0.0387	0.2144	0.275	0.4819	0.3751
Mechanical-electrical [(1) 6 years, 33 firms; (2) 6 years, 08 firms]								
Output	300.00	383.23	417.92	471.29	3.47	9.77	3173.26	1784.244
Worker	106	347	399	999	3	3	5163	4354
Middle executive	7	6	9	6	1	1	53	20
Foreigner-engineer	9	11	11	18	1	1	57	62
Materials	198.78	198.34	361.6	233.72	1.76	3.21	2771.59	937.2
Energy	9.88	22.35	15.48	48.13	0.29	0.94	97.24	244.37
Capital	135.11	81.59	436.8	286.98	28.75	0.19	2379.99	2003.85
Export share	0.2888	0.2941	0.1324	0.2093	0.1205	0.0336	0.4822	0.49
Import share	0.3658	1.8066	0.1687	1.681	0.04	0.528	0.516	4.77
Import penetration rate	0.3783	1.005	0.0705	0.8773	0.3129	0.4993	0.4992	2.7733
Openness	0.7148	2.1007	0.174	1.5874	0.521	0.9985	0.9983	5.0454
Effective rate of assistance	0.0301	0.02135	0.0084	0.01113	0.0189	0.0141	0.04263	0.0431
Capital intensity	2.3929	1.7406	9.0427	1.7669	-5.7502	0.0003	52.8841	6.57
Size	122	364	211	783	5	5	1143	2400
Age	7	20	8	11	1	9	32	40
Herfindahl	0.0036	0.2954	0.0011	0.0362	0.0021	0.2365	0.0049	0.3579

Note: (1) stands for the pre-liberalization sample and (2) stands for the post-liberalization period. Values are in 10^6 constant CFA francs.