Economic Governance and Development in Vietnam and Mozambique

Activity 2: Private Sector Productivity and Efficiency

Reconsidering the Association between Firm-Level Technical Efficiency and Constraints to Doing Business: The Case of Mozambican Manufacturing

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February 2011

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The intent of the FFU working paper is to stimulate and exchange ideas on issues pertinent to the economic and social development of Mozambique and Vietnam. A multiplicity of views exists on how to best foment economic and social development. The discussion paper series aims to reflect this adversity.

As a result, the ideas presented in the discussion paper are those of the authors. The content of the paper do not necessarily reflect the views of the Ministry of Planning and Development or any other institution within the Government of Mozambique.

Abstract

Several papers have analysed the association between firm-level technical efficiency and the constraints to doing business using investment climate assessment (ICA) data. However, these studies have pursued a two-step approach that may be biased by the omission of the exogenous firm characteristics (including firm specific doing business constraints) in the first step production function estimation, if inputs and the firm specific attributes are correlated.

In this paper we therefore follow the approach outlined in Wang and Ho (2010) that accommodates exogenous determinants of inefficiency in a fixed effects stochastic frontier model. The results show that the technical efficiency level in Mozambican manufacturing is on average 0.68, when it can be distinguished between time-varying inefficiency and time-invariant fixed-effects. This figure should be compared to an average technical efficiency level of 0.41 when using a traditional stochastic frontier approach. Second, a one-step approach to analysing the association between firm-level technical efficiency and constraints to doing business leads to important differences in results and policy recommendations as compared to conclusions reached in the often applied biased two-step approach. Our results show very limited evidence of a well determined association between perceived doing business constraints and firm level technical efficiency.

Contents

List of Acronyms

CEMPRE	Enterprise Census
CTA	Confederation of Mozambican Business Associations
DNEAP	National Directorate of Studies and Policy Analysis
ICA	Investment Climate Assessment
ISIC	Insternational Standard Industrial Classification
PARPA II	Poverty Reduction Strategy Plan
RPED	Regional Programme on Enterprise Development
TFP	Total Factor Productivity

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1. Introduction

Private sector development is one of the main development objectives in the poverty reduction strategy (PARPA II), and the competitiveness of the Mozambican economy is a great concern of the current president Armando Guebuza. In 2007 the Presidential International Advisory Board was set up with the objective to advice the government on the changes needed in the business environment in order to improve international competitiveness. Although efforts are made to improve the competitiveness of the Mozambican business environment it still has a relatively low ranking in international comparisons.

Productivity is an important indicator of manufacturing sector performance and competitiveness. Many studies have documented the link between productivity growth and other indicators of success, including employment creation, export status and technology adoption. However, only a few studies detailed productivity studies of the Mozambican economy exist. They highlight that past Total Factor Productivity (TFP) growth in Mozambique can be explained by changes in capacity utilization. Concern has therefore been raised about sustaining strong productivity growth as Mozambique approaches its technology frontier.

Using firm level data from 1999 to 2006 we contribute to this discussion by estimating technical efficiency among a sample of Mozambican manufacturing enterprises applying a fixed effects stochastic frontier model. First, we find that the technical efficiency level in Mozambican manufacturing is on average 0.68, when we are able distinguish between time-varying inefficiency and time-invariant fixed-effects. This figure should be compared to an average technical efficiency level of 0.41 when using a traditional stochastic frontier approach.

Second, we look the association between firm-level technical efficiency and the constraints to doing business, using the one-step approach outlined in Wang and Ho (2010) that accommodates exogenous determinants of inefficiency in the fixed effects stochastic frontier model. We document that this one-step approach to analysing the association between firm-level technical efficiency and constraints to doing business leads to important differences in results and policy recommendations as compared to conclusions reached in the often applied biased two-step approach. Contrary to previous studies, our results show very limited evidence of a well determined association between perceived doing business constraints and firm level technical inefficiency.

The paper is structured as follows. In Section 2, provides a selective literature review of available productivity studies of the Mozambican economy. Section 3 presents the data and Section 4 provides the empirical approach and productivity results. Section 5 concludes.

2. Manufacturing Productivity in Mozambique: A Selective Literature Review

This section focuses on papers studying productivity in Mozambique. In 1998, the Confederation of Mozambican Business Associations (CTA) in collaboration with the World Bank undertook the first Regional Programme on Enterprise Development (RPED) study of 153 manufacturing enterprises. This study was followed by a survey of 193 enterprises in 2002 (87 of which were also interviewed in 1998) under the auspices of the World Bank's Investment Climate Assessment (ICA, 2003). These studies were the first attempts to measure manufacturing performance and productivity at the firm level in Mozambique.

Using a cross-section stochastic frontier approach, they estimated an average technical efficiency to 0.38 with a relatively high standard deviation of 0.23, indicating that many inefficient firms are able to survive in the manufacturing sector in Mozambique. Comparing these figures with the ones reported for other developing countries documented in Tybout (2000) show that the efficiency dispersion is higher than observed in several other developing countries. Moreover, according to RPED (1999) and ICA (2003) Mozambique also lacks behind in terms of absolute productivity, questioning the regional competitiveness of the Mozambican manufacturing sector. Eifert, Gelb and Ramachandran (2005) use cross-country firm-level data (including the one described in ICA, 2003) and confirm this result.

Studying the period 2001 to 2004, Mozambican production efficiency was the lowest among their sample of African and Asian countries. However, several studies suggest that efficiency has improved since the first generation ICAs. The follow-up study of the same Mozambican firms as in ICA (2003) carried out by DNEAP (2006) suggests that capacity utilization has improved significantly between 2003 and 2006, which could indicate that overall production efficiency has improved during this period. But, no formal productivity analysis was carried out by DNEAP (2006).

Jones (2008) looks at productivity from the macroeconomic perspective, by undertaking a growth accounting exercise for Mozambique. He concludes that the annual average contribution of TFP to post-war output growth was 23 percent (or 1.4 percentage points). However, changes in TFP were largely driven by improvements in capacity utilization rates, and "deep" TFP growth was modest. Jones (2008) therefore concludes that the change in TFP was dominated by movement toward the production frontier rather than outward movements of the frontier itself.

Finally, using a different approach the recent study by Warren (2010) explored factors shaping technological patterns and dynamics in the Mozambican manufacturing sector (especially the metalworking and chemicals sectors) and their relationship to enterprise performance. His analysis revealed that the two industries in focus appear to be experiencing a process of growing technological obsolescence. This increasing level of outdated technology is confirmed in the case of the food-processing sector in Imani Development (2000). Moreover, production processes are becoming more and more simplified leading to a weakening of their technology capability and skill base. However, given the skill-level and technology at hand, firms are producing relatively efficiently and improving productivity, but the limited level of knowledge and simple production systems are insufficient to support a process of sustained technology and industrial development.

3. Data overview

The data used in this paper combines five different enterprise surveys (containing information for the years 1999 to 2006) with the INE enterprise census (CEMPRE), which has 2002 as the base year.[1] Using firm names and addresses we were able to combine the data sources. All firms included in the data have been observed at least twice during the period 1999 to 2006. This criterion was selected in order to be able to check the consistency of time-invariant characteristics and financial figures. Moreover, the survey information on location, legal structure, sector, firm age and size, financial information and constraints facing firms were made comparable over time.

In some cases the surveys overlap. The information was compared and in the few cases where the answers differ we relied on the survey which was carried out closest to the data wanted. For example, in the case of financial information KPMG is often superior to the other data sources since it only ask the firms about previous year financial numbers, whereas for example ICA 2009 report numbers referring to the years 2003 and 2006 (that is recollection three to six years back in time).

All surveys have detailed financial accounts information, but only ICA (2003), DNAEP (2006) and ICA (2009) have detailed doing business data covering the years 2003 and 2006, respectively. We therefore focus primarily on these years throughout the analysis. Moreover, the surveys and the census cover agricultural (primary), manufacturing and industry (secondary), and service sector (tertiary) firms. However, in this paper we focus exclusively on the manufacturing sector (ISIC 15 – ISIC 37). Table 1 gives an overview of the data available for analysis. We operate with two different samples: A) One with 755 observations for 277 firms and B) one with 434 observations for 217 firms. The later data includes observations for 2003 and 2006 only (years where variables are confirmed by at least 2 different surveys), respectively.

[1] The five surveys are: ICA (2003), DNEAP (2006), INE (2006), ICA (2009) and KPMG (various years).

TABLE 1: DATA OVERVIEW

Full Data		Balanced panel	
Obs.	Firms	Obs.	Firms
755	277	434	217

Note: Data covers the period 1999 - 2006. Years 2003 and 2006 are best covered with 245 and 231 observations, respectively.

However, the surveys in combination provide the information necessary to get some measure productivity and efficiency at the firm-level.

TABLE 2 provides the summary statistics of the variables considered in the subsequent analysis.

TABLE 2: SUMMARY STATISTICS

	Full sample		Reduced sample	
	Mean	Std. dev.	Mean	Std. dev.
Real revenue (million MTN)	112	955	73	899
Real capital (million MTN)	227	2362	157	2084
Real intermediates (million MTN)	78	622	45	558
Employees	73	158	42	119
Share Small (less than 10 employees)	0.297	0.457	0.440	0.497
Share Medium (10 to 99 employees)	0.552	0.498	0.493	0.501
Share Large (100 employees and above)	0.151	0.358	0.067	0.250
Firm Age (Year of establishment)	1988	14	1991	11
Share 0-10 years old	0.252	0.434	0.346	0.476
Share 11-20 years old	0.400	0.490	0.396	0.490
Share above 20 years old	0.348	0.477	0.258	0.438
Revenue growth (note 1)	0.235	0.503	0.235	0.503
Employment growth (note 1)	0.210	0.393	0.210	0.393
Revenue per employee growth (note 1)	0.025	0.559	0.025	0.559
Location (Maputo = 1, Other = 0)	0.833	0.373	0.862	0.346
Sector 1 Food processing (ISIC 15)	0.260	0.439	0.267	0.443
Sector 2 Textiles. garments. footwear etc. (ISIC 17. 18 & 19)	0.142	0.349	0.157	0.364
Sector 3 Wood and furniture etc. (ISIC 20 & 36)	0.172	0.378	0.180	0.384
Sector 4 Non-metallic products etc. (ISIC 22. 24. 25 & 26)	0.131	0.338	0.106	0.308
Sector 5 Metal products. equipment and machinery etc. (ISIC 27. 28 & 29)	0.248	0.432	0.267	0.443
Sector 6 Electrical machinery and transport means etc. (ISIC 31. 34 & 35)	0.048	0.213	0.023	0.150
Total observations (firms in parenthesis)	755	(277)	434	(217)

Note 1: Growth rates from 2003 to 2006. Estimates based on 217 firm observations.

We use real revenue as our output measure. Real capital stock is measured as end-period capital stock book value. Material inputs include all indirect costs plus raw material costs. All these figures have been deflated by a GDP-deflator. Ideally we would have preferred sector level deflators and variable specific deflators. However, producer-price indices and investment/capital deflators are not available in the Mozambican case. Behind the numbers reported for the full sample we have an: 1) Average number of employees of 73, confirming that the average firm is relatively large in this sample as compared to the firm "population" average according to the CEMPRE (INE, 2004), 2) Average capital-revenue relationship to be 1.45, and 3) Average real revenue per employee of 402.161 MTN.

Most firms in the sample are rather old with an average establishment year of 1988. Location of the firm may be a little misleading since most firms considered (83 percent) have their headquarters in Maputo, while their main production facility may be located in another province.

Several of the firms considered are multi-product firms. Unfortunately, we do not have information on which product that contributes most to the firms overall activity and several two digit sectors have therefore been grouped together. An example is ISIC 20 (wood) and ISIC 36 (furniture) – 17.2 percent of the sample – where a typical case is a carpenter that produces both products of wood and wood furniture. Similarly, ISIC 17 (textiles), ISIC 18 (garments) and ISIC 19 (footwear) – 14.2 percent of the full sample – are found to have many overlapping multiproduct firms. Using the same reasoning firms found in ISIC 27 (basic metals), ISIC 28 (fabricated metal products) and ISIC 29 (equipment and machinery) are added into one sector (24.8 percent of the data considered), as is electrical machinery (ISIC 31) and transport means (ISIC 34 and 35) – 4.8 percent. The remaining sectors are grouped into a non-metallic product sector (13.1 percent) and consist of firms in publishing and printing (ISIC 22), chemicals (ISIC 24), rubber (ISIC 25) and other non-metallic mineral products (ISIC 26).

TABLE 2 also provides summary statistics on some selected performance indicators: a) Real revenue growth, b) Employment growth and c) Revenue per employee growth. The reported figures are growth rates from 2003 to 2006 and have 217 firm observations. The general picture emerging is rather positive. The firms considered have in three years on average increased real revenue by between 23.5 percent, showing that the manufacturing sector is keeping its growth momentum (in terms of real revenue) as documented in RPED (1999) and ICA (2003). The same picture emerges in terms of employment generation with a three year increase of on average 21 percent, leaving rather modest increases in labour productivity of 2.5 percent. This result is contrary to that of RPED (1999) and ICA (2003), which found very limited employment creation by Mozambican manufacturing sectors in the late 1990s and the early Millennium.

One of the main aims of this paper is to consistently analyze the association between firm efficiency and constraints to doing business. In TABLE 3 we therefore provide summary statistics on constraints to doing business available in ICA (2003), DNEAP (2006) and ICA (2009). All constraint variables take on nonnegative integer values {0, 1, 2, 3, 4} where; 0 = no obstacle, 1 = slight obstacle, 2 = moderate obstacle, 3 = major obstacle, 4 = serious obstacle.

TABLE 3: DEVELOPMENTS IN CONSTRAINTS TO DOING BUSINESS

	All	2003	2006
1 Access to Finance	2.483	2.441	2.221
2 Access to Land	0.922	0.841	0.978
3 Business Licensing and Permits	0.938	0.841	0.961
4 Corruption	1.922	1.898	1.502
5 Crime	2.021	1.959	1.857
6 Customs and Trade Administration	1.391	1.396	0.896
7 Electricity	2.054	2.012	1.714
8 Workforce Education	1.739	1.735	1.411
9 Labour Regulations	1.397	1.367	0.900
10 Political Instability	1.601	1.649	0.762
11 Tax Administration	1.536	1.429	1.095
12 Tax Rates	2.195	2.139	1.987
13 Transportation	1.346	1.318	1.359

Note: Factors problematic for the operation and growth of businesses (Code: 0 = no obstacle, 1 = slight obstacle, 2 = moderate obstacle, 3 = major obstacle, 4 = serious obstacle)

TABLE 3 shows that access to credit remains the main constraint to doing business in the full survey and in 2003 and 2006. However, significant improvement is observed between 2003 and the most recent survey in 2006. This trend is noticeable in most of the categories considered, access to land, business licensing and transportation being the exceptions.

TABLE 4: FIRM CHARACTERISTICS AND DOING BUSINESS CONSTRAINTS

	Small	Young	Maputo	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6
1 Access to Finance						POS	POS	
2 Access to Land		POS	NEG	NEG				
3 Business Licensing and Permits		POS	POS	POS	POS		POS	
4 Corruption	NEG	NEG	POS		POS	POS		
5 Crime			POS			POS		NEG
6 Customs and Trade Administration	NEG		POS			POS	POS	
7 Electricity						POS	POS	NEG
8 Workforce Education	NEG		POS		POS			NEG
9 Labour Regulations	NEG			POS	POS	POS	POS	
10 Political Instability	NEG		POS				NEG	NEG
11 Tax Administration				POS		POS		
12 Tax Rates			POS	POS		POS		
13 Transportation		POS	NEG		POS	POS		NEG

Note: Poisson estimations. All estimations included a constant. NEG (negative) and POS (positive) refers to the sign of the coefficient on significant variables at the 10 percent level (at least).

TABLE 4 looks at the relationship between some firm specific characteristics and the above described 13 constraints to doing business in Mozambique. As the constraint variables only take on nonnegative integer values we rely on poisson regressions of the probability of being constrained within the categories considered. In the following, we only comment on some of the results in TABLE 4. First, we notice a negative coefficient on the firm size indicator (takes the value one if a firm has between one and nine employees, and zero otherwise) in five out of the 13 cases. Small firms therefore seem to be less constrained in areas regarding corruption, dealing with customs, labor market issues and political stability.

Being located in Maputo does not seem to be associated with larger constraints in accessing land and issues regarding transportation are also of less concern in the Capitol city area. However, in 7 out of the 13 cases being located in Maputo is associated with facing more constraints to doing business. Similarly, firms producing non-metallic products perceive themselves more constrained in nine out of 13 cases.

4. Productivity

We divide our productivity analysis into two parts: First, we obtain consistent estimates of firm specific technical efficiency levels. Second, we analyze whether specific firm characteristics can explain the observed technical efficiency dispersion.

4.1. Obtaining firm specific technical efficiency estimates

Our point of departure for estimating firm technical efficiency in Mozambique is the following standard production function (formulated in logarithms):

(1) $$y_{it} = \alpha l_{it} + \beta k_{it} + \gamma m_{it} + u_{it}$$

where *y* is revenue, *l* is number of employees, *k* is capital and *m* is intermediate inputs. Total factor productivity (TFP) is represented by *u*. We follow the tradition of the stochastic frontier models where the error term *u* includes effects on output from random shocks (*v*) and inefficient use of inputs (*w*):

(2) $$y_{it} = \alpha l_{it} + \beta k_{it} + \gamma m_{it} + v_{it} - w_{it}$$

The random error *v* is assumed to be *iid* across firms and time with identical zero mean and constant variance. Assume furthermore *v* to be uncorrelated with factor inputs. The inefficiency level for firm *i* at time *t* is described by the nonnegative *w*.

A standard parameterization of the inefficiency term uses a time-invariant model, where the inefficiency term is assumed to have a truncated-normal distribution. In this case all individual effects can be interpreted as inefficiency, which means that inefficiency accounts for all the time-invariant and individual-specific effects in the data. This assumption has been relaxed in for example Battese-Coelli (1992), where the inefficiency term is modelled as a truncated-normal random variable multiplied by a specific function of time. However the time-varying pattern of inefficiency is the same for all firms, and again inefficiency and individual heterogeneity becomes inseparable. This illustrates that allowing for both individual fixed effects and the inefficiency effect complicates estimation significantly as highlighted in Greene (2005). Moreover, recent literature has been concerned about the simultaneity problem in estimating (1) and (2).

At least a part of the TFP will be observed by the firm at a point in time early enough so as to allow the firm to change the factor input decision. If that is the case, then profit maximization of the firm implies that the realisation of the error term of the production function is expected to influence the choice of factor inputs. Consider the term *w* as the part of the error term that is observed by the firm early enough to influence decisions. Greene (2005) shows that a fixed-effect panel regression will solve the simultaneity problem and deliver consistent estimates of the parameters if one assumes that this part of TFP is a plant-specific attribute and invariant over time.

In this paper we therefore (in addition to the time-invariant and time-varying decay model) apply the solution to the above problem proposed in Wang and Ho (2010), where they use a panel stochastic frontier model that takes into account both time-varying inefficiency and time-invariant fixed effects, where a simple transformation to remove firm individual fixed effects is done prior to estimation.

Moreover, the Wang and Ho (2010) approach also accommodates exogenous determinants of inefficiency in the model, a feature important for the analysis in this paper. In the results (Table 5) below we report inefficiency estimates following all three above described methodologies: (i) The standard time-invariant model, (ii) The Battese-Coelli (1992) model and (iii) The Wang and Ho (2010) model.

TABLE 5 report the results for both the time-invariant (columns 1 to 3) and time-varying decay stochastic frontier (columns 4 to 6) model as well for the Wang and Ho (2010) fixed effects approach (column 7). For the time-invariant and Battese-Coelli (1992) approach we also report results excluding firms with less than 5 employees (columns 2 and 5) and estimations on the balanced panel using 2003 and 2006 information only (columns 3 and 6).

TABLE 5: PRODUCTION FUNCTION ESTIMATES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
					Battese-Coelli (1992)		Wang-Ho (2010)
	Frontier, TI	Frontier, TI	Frontier, TI	Frontier, TVD	Frontier, TVD	Frontier, TVD	FE
	Full	5 employees and above	Balanced Full	Full	5 employees and above	Balanced Full	Full
Capital (log)	0.100***	0.090***	0.071***	0.100***	0.090***	0.067***	0.079**
	(0.015)	(0.016)	(0.015)	(0.015)	(0.016)	(0.015)	(0.033)
Employment (log)	0.210***	0.226***	0.211***	0.211***	0.225***	0.214***	0.305***
	(0.033)	(0.036)	(0.037)	(0.033)	(0.035)	(0.037)	(0.072)
Intermediates (log)	0.679***	0.681***	0.723***	0.678***	0.680***	0.719***	0.325***
	(0.020)	(0.021)	(0.023)	(0.020)	(0.021)	(0.023)	(0.034)
Average technical efficiency/ Relative productivity	0.413 (0.105)	0.557 (0.129)	0.533 (0.110)	0.412 (0.108)	0.507 (0.120)	0.479 (0.137)	0.684 (0.168)
Number of observations	755	705	434	755	705	434	755
Number of groups	275	274	217	275	274	217	275

Note: Year dummies included in all specifications. Standard errors in parenthesis. *, **, *** indicates significance at a 10%, 5% and 1% level, respectively. All estimations were carried out in Stata 11 using (i) pre-programmed procedures and ado-files used in the paper Wang and Ho (2010).

The estimated coefficient on physical is between 0.079 and 0.100 using the full data, with the lower coefficient estimate obtained using the fixed effects stochastic frontier approach. The coefficients on employment and inputs also vary across samples and estimator choice. All variables are significant at the 1%-level, except for the coefficient on physical capital using the Wang and Ho (2010) approach (significant at the 5%-level). The coefficient on employment lies between 0.210 and 0.305, whereas the coefficient on inputs is between 0.325 and 0.723. Table 5 also report the estimated technical efficiency ($te_i = e^{-(\max \hat{\mu} - \hat{\mu}_i)}$, where $\max \hat{\mu}$ is the sample maximum of the estimated fixed effect and $\hat{\mu}_i$ is the estimated effect for firm *i*). An efficiency score equal to 1 indicates full efficiency, and scores less than 1 indicate inefficiency. Using the time-invariant or the time-varying decay stochastic frontier approach the sample mean is around 0.41 for the full sample. This estimate is somewhat below that obtained by Söderbom and Teal (2004) for Ghana, and in the lower range of the ones reported in Tybout (2000) for several developing countries. Moreover, the standard deviation is suggesting that the dispersion of efficiency in Mozambique is similar to figures observed in other developing countries. In order to be able to compare with other recent studies (see for example Liedholm and Mead, 1999) we exclude very small firms from the sample (columns 2 and 5), which increases the mean technical efficiency estimates to between 0.507 and 0.557, an estimate closer to the developing country average reported in Tybout (2000). Finally, applying the fixed effects stochastic frontier approach increases the average technical efficiency level to 0.684, which indicates the importance of being able to distinguish between time-invariant fixed-effects and time-varying inefficiency. Whether this average level of technical efficiency is low/high compared to other developing countries is not possible to assess, since this paper (to our knowledge) is the first to apply the Wang and Ho (2010) estimator in a developing country setting.

Finally, the results suggest that the within country variation in technical efficiency is as large in Mozambique as in other countries in Sub-Saharan Africa, meaning that several relatively inefficient firms are able to stay in business. This questions whether the level of competition in manufacturing is sufficient to insure natural firm turnover to occur.

4.2. Obtaining unbiased estimates of efficiency determinants

Recent literature determining whether observable characteristics can explain efficiency differences have proceeded in two steps. In the first step, one obtains an estimate of firm productivity/efficiency levels, ignoring seemingly exogenous firm characteristics. In the second step, an analysis of the association between the firm specific efficiency levels and the exogenous characteristics are carried out; for example by simply regressing efficiency on the exogenous determinants.

Dollar et al. (2005) provides an example of applying this two-step approach in the context of constraints to doing business and firm level technical efficiency. However, as highlighted in Cornwell and Schmidt (2008), this approach leads to biased results, as the first-step production function regression of output on inputs will be biased by the omission of the exogenous firm characteristics, if inputs and the firm specific attributes are correlated.

TABLE 6: FIRM TECHNICAL INEFFICIENCY AND CONSTRAINTS TO DOING BUSINESS

	(1) Two-Step Procedure			(2) Wang and Schmidt (2002)			(3) Wang and Ho (2010)		
	Coefficient	Std.error		Coefficient	Std.error		Coefficient	Std.error	
1 Access to Finance	0.544	(0.055)	*	-0.044	(0.037)		0.082	(0.069)	
2 Access to Land	0.102	(0.061)	*	-0.028	(0.023)		-0.018	(0.041)	
3 Business Licensing and Permits	-0.077	(0.060)		-0.108	(0.090)		-0.024	(0.045)	
4 Corruption	-0.028	(0.054)		0.113	(0.094)		0.120	(0.080)	
5 Crime	-0.024	(0.057)		-0.062	(0.052)		-0.030	(0.046)	
6 Customs and Trade Administration	0.028	(0.051)		0.045	(0.037)		0.069	(0.068)	
7 Electricity	0.198	(0.053)	*	0.045	(0.037)		0.014	(0.041)	
8 Workforce Education	-0.027	(0.059)		-0.081	(0.067)		-0.124	(0.083)	
9 Labour Regulations	0.156	(0.051)	*	0.118	(0.098)		-0.030	(0.046)	
10 Political Instability	0.045	(0.056)		0.139	(0.116)		0.100	(0.070)	
11 Tax Administration	0.064	(0.053)		-0.024	(0.020)		0.133	(0.074)	*
12 Tax Rates	0.191	(0.058)	*	-0.116	(0.097)		-0.077	(0.064)	
13 Transportation	0.186	(0.050)	*	-0.180	(0.037)	*	-0.026	(0.040)	

Note: All estimations included size, age and location variables in addition to the investment climate indicators. Standard errors in parenthesis. * indicates significance at minimum 10% level. For comparative purposes the two-step procedure uses the time-invariant technical inefficiency estimate (u), where te = exp(-u) is the relationship to the results shown in Table 4 (column 1).

TABLE 6 reports correlates between a set of firm specific doing business characteristics and firm efficiency estimated above, in order to study whether there is any systematic variation in efficiency across the 13 different doing business indicators (in addition to location, firm size and age controls, which are not reported in TABLE 6). We report results based on (i) a traditional (biased) two-step approach, (ii) a conditional mean model (one-step) approach as described in Wang and Schmidt (2002) and (iii) estimates based on the one-step approach outlined in Wang and Ho (2010) that accommodates exogenous determinants of inefficiency in a fixed-effects stochastic frontier model.

First, our results show that conclusions reached using one-step and two-step approaches are quite different, a result also highlighted in Wang and Schmidt (2002). In 6 out of 13 cases, we get an opposite sign on the coefficient estimates using the biased conventional two-step method (column 1) as compared to the one-step conditional mean model presented in column (2). Moreover, several of the coefficient estimates in the two-step approach are well determined (5 out of 13), as compared to only one coefficient estimate (transportation) using the Wang and Schmidt (2002) approach.

Second, although acknowledging the bias problems in column 1 estimates, we still observe differences in 3 out of 13 cases regarding the determinants of technical inefficiency, depending on whether we follow the "pooled" (column 2) or the fixed-effects (column 3) stochastic frontier model. Moreover, only one of the doing business indicators are well determined in columns 2 (transportation) and 3 (tax administration), respectively. This could suggest only minor importance of these perceived constraints on firm's relative efficiency, when following a one-step estimation approach.

Focusing on column 3 where we are able to distinguish between time-varying inefficiency and time-invariant fixed-effects show that firms that perceive dealing with tax authorities as a major constraint to doing business are more likely to be inefficient in production. Given that larger firms in our sample are found to be more technical inefficient (not reported, but well-determined at a 10% significance level using the Wang and Ho (2010) approach), the result is consistent with the findings in Byiers and Rand (2009), who shows that firm size is associated with greater firm difficulties in terms of facing tax authorities, part of which may be related to greater visibility to public officials.

5. Conclusion

Recent contributions have highlighted that past TFP growth in Mozambique (which contributed significantly to the recorded post-war growth success) largely can be explained by changes in capacity utilization. Concern has therefore been raised about sustaining strong productivity growth as Mozambique approaches its technology frontier.

Using firm level data we contribute to this discussion by estimating technical efficiency among a sample of Mozambican manufacturing enterprises. Using a traditional stochastic frontier approach we show that manufacturing firms in Mozambique exhibit relative low efficiency levels (0.41) as compared to other developing countries. Applying a fixed effects stochastic frontier model that distinguishes between time-varying inefficiency and time-invariant fixed-effects improves the average technical efficiency level in Mozambican manufacturing to 0.68. However, efficiency dispersion is as high as in other developing countries meaning that a large set of relatively inefficient firms are able to stay in business among highly efficient ones. This questions whether the current business environment provides an equal playing field for firms in the manufacturing sector and ensures that natural firm turnover mechanisms are allowed to take place.

In order to start this discussion we assess the association between firm level technical inefficiency and thirteen constraints to doing business and conclude that only few of these perceived constraints are strongly correlated with firm efficiency when applying an unbiased one-step approach to estimating the determinants of technical inefficiency. However, we show that firms that perceive dealing with tax authorities as a major constraint to doing business are more likely to be inefficient in production, related to the fact that larger more inefficient firms are more involved with/visible to tax authorities.

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TABLE A: TWO-DIGIT MANUFACTURING SECTORS (ISIC CLASSIFICATION)

Sector 15:	Food products and beverages
Sector 16:	Tobacco
Sector 17:	Textiles
Sector 18:	Garments, apparel, etc.
Sector 19:	Leather, luggage, handbags and footwear
Sector 20:	Wood and of products of wood and cork
Sector 21:	Paper and paper products
Sector 22:	Publishing, printing and reproduction of recorded media
Sector 23:	Coke oven products and refined petroleum
Sector 24:	Chemicals and chemical products
Sector 25:	Rubber and plastic products
Sector 26:	Other non-metallic mineral products
Sector 27:	Basic metals
Sector 28:	Fabricated metal products, except machinery and equipment
Sector 29:	Equipment and machinery
Sector 30:	Office, accounting and computing machinery
Sector 31:	Electrical machinery and apparatus
Sector 32:	Television and communication equipment and apparatus
Sector 33:	Medical precision and optical instruments, watches and clocks
Sector 34:	Motor vehicles, trailers and semi-trailers
Sector 35:	Other transport means
Sector 36:	Furniture; manufacturing n.e.c.
Sector 37:	Recycling

Note: Several of the firms considered are multi product firms. Unfortunately, we do not have information on which product that contributes most to the firms overall activity and several two digit sectors have therefore been grouped together: ISIC 20 (wood) and ISIC 36 (furniture), where a typical case is a carpenter that produces both products of wood and wood furniture. Similarly, ISIC 17 (textiles), ISIC 18 (garments) and ISIC 19 (footwear) are found to have many overlapping multiproduct firms. Using the same reasoning firms found in ISIC 27 (basic metals), ISIC 28 (fabricated metal products) and ISIC 29 (equipment and machinery) are added into one sector, as is electrical machinery (ISIC 31) and transport means (ISIC 34 and 35). The remaining sectors are grouped into a non-metallic product sector and consist of firms in publishing and printing (ISIC 22), chemicals (ISIC 24), rubber (ISIC 25) and other non-metallic mineral products (ISIC 26).