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The Impact of Devaluation on Productivity of Exporting Firms

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Abstract

This study is designed to empirically establish the impact of devaluation on firms' productivity. The data comes from four waves of the annual survey of Ethiopian Large and Medium Scale Manufacturing Firms (LMSM). We applied control function estimation methods for estimating the production function. The main findings of the study are that there is no strong evidence that devaluation has a positive impact on the total factor productivity of exporting firms. However, the results indicate that less import-dependent but export-oriented firms improve their competitiveness in the post-devaluation period.

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1. Introduction

It is believed that devaluation makes domestic firms more competitive in international markets, thereby boosting exports and productivity in the long run through spillovers and learning by doing effects. However, devaluation of the home currency affects the cost and price structures of trading firms simultaneously. For instance, Mengistu et al. (2017) found that depreciation of the Ethiopian Birr by 10 percent led to an increase in the prices of imports and exports by 7.9 and 6.2 percent respectively. Given Ethiopian firms' huge dependency on imported raw materials and intermediate inputs, the volume of imports might be disrupted due to a devaluation of the domestic currency. In this context, depreciation of the Ethiopian Birr will lead to a competitive disadvantage for Ethiopian exporting firms. Accordingly, we study the hypothesis that changes in the monetary policy (devaluation) have an impact on exporting firms' productivity.

To the best of our knowledge, there are no previous studies which examine the impact of devaluation on exporting firms' productivity, particularly in Africa. Some existing empirical evidence is limited to advanced economies (Baggs et al. 2009 for Canadian firms; Pyun and Choi 2018 for Chinese firms; and Forbes 2002 for a cross-country study). Policy changes in the form of devaluation can be used as a quasi-experiment for understanding the impact of devaluation on domestic firms' performance.

From theories and findings of previous empirical studies, devaluation increases the prices of imports, but decreases the price of exports. As a result, the volume of imports is expected to be lower after devaluation compared to the pre-devaluation period. Therefore, productivity gains due to importing through R&D spillover effects (Coe et al. 1997; Coe and Helpman 1995) cannot be exploited by domestic firms' due to devaluation. As a result, exporting firms might be negatively impacted by devaluation as the volume of their importing intermediate inputs may be affected.

The impact devaluation on aggregate productivity is also linked to the constraint that is imposed on firms' access to foreign intermediate inputs due to rising import costs. However, Blaum (2017) provides evidence that both the share of exports and imports increased after devaluation using micro-data for Mexican firms where the share of a firm's imports is expected to decline. Hence, the impact of large currency depreciation may not affect a firm's productivity negatively through restricting the firm's access to foreign inputs. Tybout et al. (1997) cement Baum's (2017) findings. They investigated firms' reactions to currency devaluation in terms of productivity and market orientation using a Cameroonian firm level dataset for the period 1992-95. They found that a devaluation of the Cameroonian currency improved firms' productivity. They also found that export-oriented firms had a better performance compared to non- exporters. Similarly, McLeod and Mileva (2011) found that real currency depreciation increased TFP and GDP growth from a panel data of 58 countries. However, Lu et al. (2013) found that depreciation of the Colombian currency by 26 percent led to a 32 percent drop in import value. According to them devaluation can slow down import churning and lead to a larger TFP decline. Further, Vellianitis – Fidas(1974) examined the impact of two US devaluations, (1971 and 1973) on agriculture exports using OLS regression in a cross-section design. They found that changes in the exchange rate did not have a significant impact on agricultural exports. Thus, previous findings regarding the impact of devaluation on imports which is the standard channel that affects firm level productivity are inconclusive.

The rest of this paper is organized as follows. Section 2 gives the data and identification strategy. The results and discussion are given in Section 3. Section 4 gives a brief conclusion.

2. Data and Identification Strategy

The data source for this study is the Survey of Large and Medium Scale Manufacturing Firms (LMSM) in Ethiopia from 2009 to 2012. This is an annual census of all manufacturing firms in Ethiopia with 10 or more employees surveyed by the Central Statistical Agency (CSA). Output, capital costs, and imported raw materials are adjusted by the GDP deflator collected from the National Bank of Ethiopia while the value of local raw materials is adjusted by the producer price index obtained from CSA. Labor is measured as the number of employees working in a firm. To determine the impact of devaluation on a firm's productivity and exports, we assume that the firms use a Cobb-Douglas production function specified as:

$$y_{it} = A_{it}(\tau)L_{it}^{\beta l}K_{it}^{\beta k} \ldots\ldots\ldots\ldots (1)$$

where y_{it} denotes output of firm i at time t and is a function of labor and capital. However, we are interested in examining whether a firm's productivity (technical changes) is a function of exchange rate policy (τ), denoted by $A_{it}(\tau)$. To establish the impact of monetary policy on a firm's productivity, we follow a two-step estimation. In the first step, we estimate the firm-level TFP. In the second step, we specify how productivity is affected by the devaluation of Ethiopian Birr (ETB). To estimate firm level TFP, we can linearize Equation (1) by taking the natural logarithm, and we get the following equation after adding a constant and error term while log of $A_{it}(\tau)$ is lumped with the error term:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + e_{it} \ldots\ldots\ldots\ldots (2)$$

The dependent variable is the total value of production of firm i in year t.

The basic framework of the control function estimation approach is presented as follows where the production function is specified as the Cobb-Douglas technology:

$$y_{it} = \alpha + w_{it}\beta + x_{it}\gamma + \omega_{it} + \varepsilon_{it} \ldots\ldots\ldots\ldots (3)$$

An unobserved productivity shock is given by:

$$\omega_{it} = f^{-1}(m_{it}, x_{it}) = h(m_{it}, x_{it}) \ldots\ldots\ldots\ldots (4)$$

where y_{it} is the log gross output, w_{it} is a 1×J vector of log free variable (labor), and x_{it} is a 1× K vector of log state variable (capital). ω_{it} is unobservable productivity and ε_{it} is an idiosyncratic output shock distributed as white noise. Finally, m_{it} denotes the intermediate inputs. Plugging Equation (4) in Equation (3) and adding an intermediate input to distinguish from the free variable, we obtain:

$$y_{it} = \alpha + w_{it}\beta + x_{it}\gamma + m_{it} + h(m_{it}, x_{it}) + e_{it} \text{...}(5)$$

$$= w_{it}\beta + \Phi_{it}(m_{it}, x_{it}) + e_{it}$$

where $e_{it} = \xi_{it} + \varepsilon_{it}$

Mollisi-Rovigatti (2017) assumed that a productivity shock follows the first order Markov process:

$$\omega_{it} = E(\omega_{it}|\Omega_{it-1}) + \xi_{it} = E(\omega_{it}|\omega_{it-1}) + \xi_{it} = g(\omega_{it-1}) + \xi_{it} \text{..}(6)$$

where Ω_{it-1} is the information set at t − 1 and ξ_{it} is the productivity shock, assumed to be uncorrelated with productivity ω_{it} and with state variables x_{it}. Following the Levinsohn- Petrin (2003) approach, we can rewrite Equation (6) as:

$$\omega_{it} = E(\omega_{it}|x_{it}, \omega_{it-1}, x_{it-1}, m_{it-1}, ...,\omega_{i1}, x_{i1}, m_{i1}) = E(\omega_{it}|\omega_{it-1}) = f[h((x_{it-1}, m_{it-1})] \text{..............}(7)$$

Based on Equation (6) and the orthogonality assumptions between the random error term and unobserved productivity shock, we can formulate two key functions for identifying the coefficient of free and state variables.

Using the estimates of the production coefficients in Equation (2), TFP of firm (i) at time (t) is given as:

$$TFP_{it} = Y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it} \text{...}(8)$$

The estimated input coefficients are obtained by estimating Equation (2) using the four control function estimation methods. These are Olley-Pakes (1996), Levinsohn-Petrin (2003), Wooldridge (2009), and Mollisi-Rovigatti (2017) estimators. These control function estimators can effectively deal with the problem of endogeneity due to self-selection bias and simultaneity of input choices and productivity. In addition to control function estimators, OLS and Fixed Effect (FE) estimates are also presented for comparison. Finally, the link between devaluation and productivity is specified as:

$$TFP_{it} = \beta_1(postd)_{it} + \beta_2(postd * \exp ort)_{it} + \beta_3(import)_{it} + \beta_4(foreign)_{it} + \gamma_i + \delta_t. + \varepsilon_{it} \text{......}(9)$$

where $\exp ort$ stands for a firm's export status, $postd$ is a dummy policy variable which reflects the immediate post-year of devaluation, and $import$ stands for a firm's import status. Ownership of firms is also considered an important variable because devaluation might have less impact on foreign owned firms due to their access to international finance in the form of foreign hard currency and is denoted by $foreign$. Finally, γ and δ stand for firm specific unobserved heterogeneity and time dummy respectively. ε it the random error term with IID $N \approx (0, \delta^2)$. An interaction of the policy variable with a firm's time invariant export status is included in the model to establish the impact of devaluation on the productivity of exporting firms. In Equation (8) the coefficient β_2 indicates the impact of devaluation on exporting firms.

Table I: Summary statistics for exporting and less exporting firms (in million)

	Obs	Mean	Sd	Min	Max
Exporter firms					
Capital	459	54.4	723	0.000297	14300
Output	459	19.4	60.9	0.21	795
Investment	260	2.844	16	0.000427	235
Raw materials	459	9.92	21.7	0.007257	192
Age	(453)	(22.7)	(15.42)	(8)	(91)
Less Exporter firms					
Capital	1336	2.26	11.4	0.000119	14300
Output	1337	4.44	20.3	0.006153	3000
Investment	612	0.63	4.3	0.000149	731
Raw materials	1337	2.80	10.1	0.001332	1370
Age	1320	(17.65)	(12.73)	(8)	(95)

In Table I we apply score matching to compare the descriptive statistics of exporters with less exporters using the year before devaluation (2009) and a firm's productivity as an outcome variable while labor is the only covariate variable in this estimation. In this case we use the LP productivity estimates. Accordingly, 459 firms are considered as treated (exporters) and 1,337 firms are in the control (less exporter group).

Though exporting firms are fewer as compared to the control group, on average they use relatively large amounts of inputs and have higher investments compared to less-exporter firms. Exporting (treated) firms have been operating in the industry for a longer time compared to less-exporting firms. Furthermore, on average, exporting firms produce more output (19.4 million ETB) compared to less-exporting firms (4.44 million ETB). This descriptive result gives some signals about the difference in terms of investments and production decisions.

3. Results and Discussion

As can be seen from Table I compared to control function estimators (OP, LP, and MR), the coefficients of variable input (labor) and capital (fixed) inputs are upward biased for the OLS estimator. This result indicates that there is simultaneity and a sample selection problem. If we had estimated production by OLS and FE estimators, the estimated productivity would have been an inaccurate policy prescription in establishing the impact of devaluation on productivity.

Table II. Input elasticity

Inputs	(OLS) (Upward biased)	(FE) (Downward biased)	(OP)	(LP)	(WRDG) [1]	(MR)
lnL	0.739***	0.672***	0.651***	0.733***	0.565***	0.399***
	(43.66)	(17.87)	(21.01)	(379.11)	(13.62)	(18.03)
lnK	0.309***	0.100***	0.237***	0.312***	0.216***	0.172***
	(37.04)	(2.97)	(3.57)	(24.69)	(9.56)	(4.84)
Year	0.181	0.414***	0.131***	0.170***	-1.577***	
	(11.55)	(10.77)	(7.91)	(27.47)	(-3.73)	
_cons	-356.786***	-821.1***				
	(-11.30)	(-10.64)				
N	6823	6823	3862	6736	1426	6736

Note: T- statistics in parentheses. * p<0.05, ** p<0.01, and *** p<0.001.

Table III: Summary of productivity statistics

	Export intensity		Import intensity				
	High	Low	High	Low	Survivor	Exit	Average
OP	15.465***	14.045	14.361***	13.735	14.207***	13.874	14.051
LP	(29)	(6741)	(3423)	(3347)	(3612)	(3158)	(6770)
	8.001	7.926	8.111***	7.731	7.947	7.903	7.927
WRDG	(28)	(6574)	(3399)	(3203)	(3530)	(3072)	(6602)
	10.576**	9.586	9.796***	9.379	9.648***	9.524	9.590
MRs	(29)	(6658)	(3389)	(3298)	(3581)	(3106)	(6687)
	11.855***	10.623	10.886***	10.36	10.718***	10.52	10.626
	(29)	(6657)	(3384)	(3302)	(3583)	(3103)	(6686)

The numbers in the brackets are the size observations, * p<0.05, ** p<0.01, and *** p<0.001.
Where **H0**: no productivity difference.

Outliers of the bottom and the top 1 percent of estimated productivity are dealt with using the Winsor2 technique. T-tests are applied to check whether there is a difference in productivity between high-exporters and low-exporters, high and low-importers, and exit and survived firms.

[1] We do not use the Wooldridge estimator because it considers observations from a small sample (1,426) and the year effect is not consistent.

A firm is considered as a highly intensive exporter if at least 10 percent of its output is sold in the international market. In same fashion, a firm that imports at least 10 percent of its intermediate inputs from abroad is categorized as a highly intensive importer otherwise it is a low intensive importer. Furthermore, a firm is said to exit if that firm does not appear in the subsequent survey years after entering the market.

Table IV. Impact of Devaluation on exporting firms' productivity

	(Full sample)	(Import intensity)		(Ownership)[2]		Export status	
		(High)	(Low)	(Foreign)	(Domestic)	(Treated)	(Control)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post Devaluation	0.0692	0.597	-0.158	-0.949	0.004	-0.341	0.254
	(0.36)	(1.12)	(-0.59)	(-0.41)	(0.02)	(-1.07)	(1.09)
Postd*Export	0.0721	-0.0733	0.0957	0.101	0.103		
	(0.59)	(-0.36)	(0.50)	(0.11)	(0.82)		
Import	0.0555			0.0318	0.0532	-0.0270	0.181
	(0.71)			(0.06)	(0.67)	(-0.27)	(1.44)
Ownership	0.380	0.501	-0.0467			0.244	0.544
	(1.54)	(1.55)	(-0.10)			(0.78)	(1.39)
2010	-0.234***	-0.403***	0.115	-0.559	-0.198**	-0.256**	-0.211
	(-3.57)	(-3.99)	(1.05)	(-1.48)	(-2.96)	(-3.18)	(-1.95)
2011	0.746***	0.347	1.048***	1.189	0.792***	1.239***	0.567**
	(4.44)	(0.68)	(4.85)	(0.54)	(4.66)	(3.87)	(2.74)
_cons	10.40***	10.56***	10.16***	11.78***	10.39***	10.95***	10.15***
	(124.44)	(65.88)	(90.03)	(13.49)	(124.92)	(133.36)	(80.11)
N	6686	3384	3302	375	6311	1330	5356

Note: T-statistics in parentheses. * $p<0.05$, ** $p<0.01$, and *** $p<0.001$.

We used Mollisi's-Rovigatti's (2017) productivity estimate since it is advantageous for large N but small T compared to Wooldridge's (2009) estimator. As can be seen from Table IV except for the high importers sub-sample the coefficient of the treatment variable is positive but statistically

[2] Ownership status of a firm is defined by the share of foreigners in the firm's total capital. Accordingly, if foreigners have at least 10 percent of the share then the firm is categorized as foreign owned otherwise it is a domestic owned firm.

insignificant. There is no significant difference between domestic and foreign owned firms in terms of productivity. In this case the treating variable, exports, is generated as time invariant and a firm might not be an exporter in one period in these four waves of the panel data. This finding is to some extent in line with Forbes' (2002) cross-country study. However, we find that there is no strong evidence that devaluation improves the productivity of exporter firms. This evidence might be related to the lack of a natural control group that can be used as a counterfactual of the treatment group. We have domestic firms which are neither importing nor exporting that can be considered as a control group. However, firms engaged in exporting and having high import intensity will not gain from a policy shock.

4. Conclusion

The estimation results indicated that devaluation of Birr against USD did not enhance the productivity of exporting firms significantly. Currency devaluation in the least developing countries may not enhance domestic firms' competitiveness. The long-term impact of devaluation in terms of productivity gains is hardly materialized. Moreover, there is no significant difference in those firms' productivity which are simultaneously engaged in exporting and importing due to this policy shock. In a country where domestic firms are highly dependent on foreign intermediate inputs, devaluation is a less effective policy instrument for enhancing the domestic firms' competitiveness. Hence, a macroeconomic policy like devaluation is not the right policy for boosting exports and raising firm level productivity in Ethiopia. To gain some dividend out of devaluation the share of imports needs to be reduced. Furthermore, we recommend that researchers should do a thorough investigation of the impact of devaluation on the productivity of firms and labor market outcomes such as wages, employment, and income distribution.

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