DISCUSSION PAPER SERIES

DP15524

CURRENCY SHOCKS AND FIRM BEHAVIOUR IN ETHIOPIA AND UGANDA

Tewodros Gebrewolde, Michael Koelle, Pramila Krishnan and Andualem Telaye Mengistu

DEVELOPMENT ECONOMICS

ISSN 0265-8003

CURRENCY SHOCKS AND FIRM BEHAVIOUR IN ETHIOPIA AND UGANDA

Tewodros Gebrewolde, Michael Koelle, Pramila Krishnan and Andualem Telaye Mengistu

Discussion Paper DP15524
Published 07 December 2020
Submitted 01 December 2020

Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: +44 (0)20 7183 8801
www.cepr.org

This Discussion Paper is issued under the auspices of the Centre's research programmes:

- Development Economics

CURRENCY SHOCKS AND FIRM BEHAVIOUR IN ETHIOPIA AND UGANDA

Abstract

We examine the links between currency shocks and firm behaviour, with data from Ethiopia and Uganda, two countries with different exchange-rate regimes. We construct measures of currency shocks using matched customs and firm-level data, based on both the actual currency of invoicing and bilateral exchange rates. We find that currency depreciations based on the currency of invoicing to importers in Ethiopia lower the likelihood of using imported inputs, lower the share of imported inputs for firms, and lowers productivity. In contrast, there are no effects on any similar firm-level outcomes for Uganda. The use of bilateral currency shocks obtains confused results in both countries, signalling the value of using the currency of invoicing in this analysis.

JEL Classification: N/A

Keywords: Currency of Invoicing, Currency shocks

Tewodros Gebrewolde - tewodros.gebrewolde@theigc.org
International Growth Centre, Addis Ababa

Michael Koelle - michael.r.koelle@gmail.com
OECD Paris

Pramila Krishnan - pramila.krishnan@pmb.ox.ac.uk
University of Oxford and CEPR

Andualem Telaye Mengistu - tandish@gmail.com
Policy Research Institute, Addis Ababa

Acknowledgements
*We are grateful to Dr Adam Mugume and Dr Louis Kasekende for their help and their interest in this project. We are very grateful to Meredith Crowley whose collaboration on the project to examine exchange rates has helped re fine this paper. We thank Jacob Rauschendorfer, the Country Economist for the IGC in Uganda; David Henning for excellent research assistance with the data on Uganda used here; Rahel Solomon and Verena Wiedemann for excellent research assistance with the data on Ethiopia. We gratefully acknowledge support from the International Growth Centre's special grant call for this project (project 32424). The views expressed in this article are those of the authors, and do not necessarily represent the views of the OECD or its member countries.

Currency Shocks and Firm Behaviour in Ethiopia and Uganda*

Tewodros M. Gebrewolde †, Michael Koelle ‡, Pramila Krishnan §, Andualem T. Mengistu ¶

December 4, 2020

Abstract

We examine the links between currency shocks and firm behaviour, with data from Ethiopia and Uganda, two countries with different exchange-rate regimes. We construct measures of currency shocks using matched customs and firm-level data, based on both the actual currency of invoicing and bilateral exchange rates. We find that currency depreciations based on the currency of invoicing to importers in Ethiopia lower the likelihood of using imported inputs, lower the share of imported inputs for firms, and lower productivity. In contrast, there are no effects on any similar firm-level outcomes for Uganda. The use of bilateral currency shocks obtains confused results in both countries, signalling the value of using the currency of invoicing in this analysis.

*We are grateful to Dr Adam Mugume and Dr Louis Kasekende for their help and their interest in this project. We are very grateful to Meredith Crowley whose collaboration on the project to examine exchange rates has helped refine this paper. We thank Jakob Rauschendorfer, the Country Economist for the IGC in Uganda; David Henning for excellent research assistance with the data on Uganda used here; Rahel Solomon and Verena Wiedemann for excellent research assistance with the data on Ethiopia. We gratefully acknowledge support from the International Growth Centre's special grant call for this project (project 32424). The views expressed in this article are those of the authors, and do not necessarily represent the views of the OECD or its member countries.

†International Growth Centre, Addis Ababa

‡Organisation for Economic Cooperation and Development, Paris

§University of Oxford and CEPR

¶Policy Research Institute, Addis Ababa

1 Introduction

What is the impact of currency shocks on firms in developing countries? In what follows we examine the impact of currency shocks on trade and productivity, comparing Ethiopia and Uganda. These are both land-locked economies with small but growing manufacturing sectors. Value-added in Ethiopian manufacturing stands at an average of 6% in the last five years and growing at 14% per year while that in Uganda has averaged 9%, but growing far more slowly at 3% per year (see the World Bank Manufacturing Value-Added Database). But critically, the exchange rate regimes in the two countries allow for a sharp contrast: both countries have seen a trend nominal depreciation against the dollar, the main currency of trade-invoicing, but under very different exchange rate regimes. The National Bank of Ethiopia operates a managed float and has a policy of gradual depreciation of the Birr (which is not freely convertible), with occasional sharper adjustments reflecting changes in the parallel market, while in Uganda, the capital account is open and the exchange rate is floating, thus implying potentially different impacts of currency shocks on incentives for firms and on productivity.

Currency shocks will affect firms differently depending on the currencies their imports and exports are invoiced in, and their exposure to traded inputs and outputs. The competitive pressures induced thus are likely to affect firm productivity with potentially ambiguous effects. For instance, a depreciating home currency imposes greater competitive pressure through increased costs of inputs, which might encourage firms to adopt more efficient production techniques or force less productive firms to exit the market (Melitz (2003); Melitz and Ottaviano (2008)). Verhoogen (2008), suggests another route to productivity improvements where depreciation leads to quality upgrading. Alternatively, such exchange rate depreciation which raises a firm's total sales may lead to higher productivity in increasing returns to scale firms (Fung (2008)). However, depreciation, by raising the costs of imported inputs might force substitution into poorer quality but cheaper inputs might also lower labour productivity and lower the quality of outputs (Bustos (2011)). In brief, theory suggests that the potential effects of movement in currencies are ambiguous but empirical evidence, particularly at the firm-level, is sparse [1].

[1] Alfaro et al. (2018) examine the effects of aggregate real exchange rate (RER) on Total Factor Productivity(TFP): in Asia, real depreciations are associated with faster growth of firm-level TFP, negative effects in import-intensive emerging economies elsewhere and no effects for industrialised economies;

In what follows, we document the effect of currency shocks on entry and exit into imports and the share of imported inputs, as well as on labour productivity, abstracting from the specific channel for the effects.

In addition to our focus on two of the poorer developing economies, we are able to construct firm-level measures of real effective currency shocks using data on the currency of invoicing at the firm level, which allows us to construct the exact impact on importers and exporters of fluctuations in exchange rates. Most studies use either data on currency shocks at the aggregate level or use more refined measures as in Dai and Xu (2017) and Murphy and Siedschlag (2012), who combine data on trade flows to construct shocks based on bilateral exchange rates. Nevertheless, this remains a proxy given that it does not capture the actual rate used in contracting trades. The construction of firm-specific real effective exchange rates does help to identify heterogeneous trade exposure of firms by trading partner. However, since much of international trade is usually invoiced in vehicle currencies – e.g. US dollars or the Euro even for trade with countries with a different national currency – this introduces more heterogeneity than is likely to be correct. Cravino (2017) is the only other paper we are aware of that uses data on the currency of invoicing to examine the effect of currency shocks, in this case on aggregate productivity in Chile. In our case, we find that the use of the bilateral exchange rates offers counter-intuitive results compared to the use of the currency of invoicing, suggesting that the use of the bilateral measure might be misleading.

We use a survey of medium and large manufacturing firms and associated establishments in Ethiopia over the period 2012-17 (Large and Medium Scale Manufacturing Industries Survey (LMMIS))[2] that is conducted annually by Ethiopia's Central Statistical

Ekholm et al. (2012) use Norwegian firm-level data on trade exposure to examine the effects of a real appreciation and find re-structuring of firms led to increases in TFP; Choi and Pyun (2017) provide a year-by-year analysis and find that RER depreciation has positive effect on productivity in Korea. This positive effect is more pronounced for firms with higher export exposure. They also find that the significant productivity gain in response to immediate RER depreciation disappears when RER depreciation persists over time; Dai and Xu (2017) construct firm-specific effective exchange rates based on trade data to examine the consequences for labour re-allocation

[2]These data have been used to examine related issues, relying on the period 1996-2011. For instance, Abreha (2017) has an excellent account of the relationship between importing and firm productivity, finding evidence for selection and learning from importing, while Bigsten et al. (2016) examine the impact

Authority, together with administrative data on importers, exporters and prevailing exchange rates recorded by the Ethiopian Customs and Revenue Authority (ERCA) to study firm productivity and exposure to shocks, particularly in the price of imported inputs. A special feature of this survey is that it records the currency in which transactions are invoiced. Firms are likely to be very sensitive to currency shocks; access to foreign exchange has been rationed in this period and thus fluctuations in the exchange rate affect the cost and quantity of imported inputs. The rationing of foreign exchange[3] combined with thin domestic input markets makes the supply of imported inputs critical across many sectors in Ethiopia [4].

We contrast our results in Ethiopia to Uganda, a country which operates a floating exchange rate, thus implying a potentially different impact of currency shocks on productivity. The data on Ugandan firms come from the corporate tax records for the period 2010-2017 while data on employees (matched to the firms) come from the Pay As You Earn (PAYE) database. These data afford far less detail compared to the survey data on firms in Ethiopia; but the information on exports and imports from the Uganda Revenue Authority, as well as the currency of invoicing are similar to the data on Ethiopia, which allows for a comparison of the effects of firm-level exposure to exchange rate shocks. This comparison is illuminating: both are land-locked countries in East Africa with a heavy reliance on imported inputs but substantially different exchange-rate regimes. Moreover, firms in both countries on average use imported materials at a similar intensity, and are thus exposed to exchange rate shocks to similar degrees.

Using detailed Ethiopian firm survey data, we document, that the shortage of raw materials is a major constraint for manufacturing firms. Moreover, the importance of this

of trade liberalisation on firm performance. Gebrewolde and Rockey (2016) examine the consequences of industrial policy post 2003.

[3]Private sector access to foreign exchange (U.S. dollars) is severely constrained by a large trade deficit and ambitious government infrastructure projects funded by foreign debt, which enjoy priority in allocation of foreign currency. The National Bank of Ethiopia's annual report claims that 38% of total imports ($6 billion) was spent on capital goods and 31% ($4.9 billion) on consumer goods. Haile (2019) provides a detailed account of the evoluation of real exchnage rate in Ethiopia over the period covered in this paper.

[4](Aghion et al. 2009) examines the links between exchange rate volatility and productivity growth, arguing that exchange rate volatility leads to fluctuations in a firm's profit since revenues fluctuate but its costs do not, under assumptions of input price stickiness, leading to lower growth in productivity.

constraint, as well as the reliance on imported inputs due to insufficient availability in the local market, is sharper for more productive firms. Unsurprisingly, those firms are thus also more exposed to exchange rate shocks. We estimate the effect of these shocks on importing and on labour productivity, and find that exchange rate shocks reduce both the likelihood of importing and the share of imports. Our results further suggest that they lower labour productivity in firms. By contrast, in Uganda under a floating exchange rate regime, we find no effects of currency shocks on either importing or labour productivity, suggesting that firms are able to smooth out such fluctuations. These results are based on measures of shocks constructed using the actual currency of invoicing; in addition, we contrast them with measures of shocks based on the bilateral exchange rates which are the typical measured used in the literature. We find that the use of the latter gives confusing and noisy results suggesting that the measure of shocks used matters in interpreting the impact of currency shocks.

To summarise, this paper makes a contribution to two strands of the literature on firm-level outcomes. The first is the literature on currency of invoicing and the links to firms[5];we are able to match data on the currency that imports are invoiced in to the characteristics of the direct importers and extrapolate this to indirect importers using the same inputs. The second is the link from currency shocks to firm-level outcomes, particularly imports and productivity, where the literature is sparse as explained above. In part, this is due to the difficulty of obtaining administrative data on both customs transactions and firm-level data that can be matched to it. Our data from Ethiopia and Uganda enable us to do precisely this, and hence examine the evidence of this link under different exchange rate regimes.[6].

[5]There is a large literature studying the determinants of invoicing (see for instance Goldberg and Tille (2008)) but few that are able to link these to firm characteristics. The handful of papers that can do so include Amiti et al. (2018) who use data on Belgian firms and their imports to study exchange rate pass-through; Chen et al. (2019) examine detailed firm-level transactions data for UK imports, invoicing currency choices and the response of import prices to exchange rate changes; Corsetti et al. (2018) who use similar data on the UK to establish that the currency in which exports and imports are invoiced is a good proxy for the currency in which firms set prices.

[6]The literature on the effects of exports and imports on productivity is extensive; the main issue is trying to identify the mechanisms that drive the positive effect of trade that are usually found. Amiti and Konings (2007) find that importing intermediate inputs raises productivity for Indonesian firms, while Halpern et al. (2015) examine Hungarian manufacturing and estimate potential gains from imports using

2 Data and Variable Construction

2.1 Data

The Central Statistical Agency (CSA) in Ethiopia conducts annual surveys of medium and large establishments and associated firms. They surveys cover all firms with at least ten employees and using power-driven machinery. The surveys provide detailed information on the ownership, production, domestic and export sales, domestic and imported material inputs, employee composition, and asset structure of firms. We use data over the six years, 2012-2017, using an unbalanced panel of over 6000 firms, matched to information on export and import transactions, and the currency they are invoiced in, from the Customs and Revenue Authority. The data on Uganda come from the Corporate Income Tax Data for the eight years 2010-2017, giving us an unbalanced panel of over 2500 firms over the years. In addition, as in Ethiopia, these data are matched by firm with the information on export and import transactions, with their currency of invoicing from the Uganda Revenue Authority. By construction of our data, our analysis will be limited to larger formal sector firms in both countries, which are likely to be the main users of imported inputs, and at the same time the main contributors to aggregate productivity. In this paper, we confine ourselves to the most commonly-used (see e.g. Bloom et al. (2018)) measure and define productivity in terms of labour productivity. For Uganda, we estimate labour productivity as the value of production/number of workers using data on the number of workers from the PAYE data; while for Ethiopia, we have information on the number of workers (comprising both unskilled and skilled workers) from the firm surveys, and construct a measure based on the value of output (again, the value of production) divided by the total number of workers taken as an average over the year. We focus on the impact of currency shocks on the use of imported inputs and subsequently on labour productivity since both countries have a large share of firms that use imported inputs making this an important share of costs[7] We begin by describing the aggregate fluctuations in exchange rates before defining the measures of firm-level currency shocks we will use to examine the impact of these fluctuations on firm-level behaviour.

a structural model.

[7]We do not discuss exporter behavior in part because all firms export to some degree in the Ugandan sample in every year, while only about 5% of firms in Ethiopia do so. Additionally, there has been little change in this margin over the period.

2.2 Aggregate currency fluctuations

Over the period of our data between 2010 and 2017, both countries saw trend nominal depreciation in their currencies against the US$ and the Euro (Figure A.1 and B.1). However, the Birr (ETB) appreciated against the dollar in real terms in 2010, which led to a 20% nominal devaluation in September 2010 by the National Bank of Ethiopia that eventually stabilised the real exchange rate under the nominal crawling peg regime. After 2015 the Birr started to slightly depreciate in real terms against the dollar; in 2017 a second nominal devaluation took place. Under its flexible exchange rate regime, the Ugandan Shilling saw strong nominal depreciations at the beginning and the end of the observation period, with a more gradual development in the years in between. In real terms, this implies a pattern of depreciation, then appreciation, and again depreciation.

Importantly, there is a substantial time-series variation in the dollar exchange rate of the Birr and Shilling, but also cross-sectional variation in exchange rates against different major currencies of invoicing. In contrast to the US dollar, the Birr's movement against the Euro was characterised by a sequence of nominal (and real) appreciation, depreciation, and again appreciation. The difference with the US dollar is entirely driven by global adjustments between these major currencies. For example, in 2014 the Birr underwent a strong real and nominal appreciation against the Euro; this was driven by the depreciation of the Euro against the US dollar in that year. Similar differences between major invoicing currencies exist in Uganda. Our later empirical analysis, which will control for time fixed effects and therefore for global annual exchange rate movements, exploits precisely this variation in fluctuations across currencies of invoicing.

2.3 Firm-level currency shocks

Currency shock measures are generally generated as changes to effective exchange rates faced by an industry (Goldberg 2004) or a firm. Ekholm et al. (2012) in its investigation of the employment response of Norwegian manufacturing firms to the Norwegian Kroner's real appreciation in the early 2000s constructs the currency shock as the change in aggregate (country) level effective exchange rates, interacted with firm-level trade exposure. In contrast, Dai and Xu (2017) use firm-level bilateral exchange rates with firm-level import weights to construct the currency shock in their study of the impact of exchange-rate

changes. We follow their construction except that we use the actual currency of invoicing rather than the bilateral exchange rate as our main measure of shocks.

The derivation of the import-weighted exchange rate shock is laid out below. Let i denote the manufacturing firm in Ethiopia/Uganda; j, the currency of invoice for the good and ϵ_{jt},the exchange rate (e.g. ETB/USD or UGS/USD) between currency j and the Ethiopian birr or the Ugandan shilling. The currency shock measure for imports is generated as follows, denoting the firm-level effective exchange rate changes for imports and exports as FER_IM_{it} and FER_EX respectively:

$$\Delta FER\_IM_{it} = \Sigma_j(\frac{IM_{ij,t-1}}{\Sigma_j IM_{ij,t-1}})\Delta \ln \epsilon_{jt} \tag{1}$$

$IM_{ij,t-1}$ is firm i's imports invoiced in currency j in time t-1, $IM_{i,t-1}$ denotes the total imports of firm i in period t-1 both of which are obtained from the Customs and Revenue; $\Delta \ln \epsilon_{jt}$ is the change the real exchange rate, in birr/shilling to currency of invoicing in period t. The weights are generated in period $t-1$ to mitigate potential endogeneity issues. Note that these weights represent the share of imports of firm i invoiced in currency j, relative to all imports, and differs from the import intensity of the firm which is the share of imported inputs in the firm's costs.

Similarly, we define the export weighted change in real effective exchange rate as follows:

$$\Delta FER\_EX_{it} = \Sigma_j(\frac{EX_{ij,t-1}}{\Sigma_j EX_{ij,t-1}})\Delta \ln \epsilon_{jt} \tag{2}$$

$EX_{ij,t-1}$ is firm i's exports invoiced in currency j in time t-1, $EX_{i,t-1}$ denotes the total exports of firm i in period t-1 and again, these are obtained from the Customs and Revenue records rather than the firm-level data, while $\Delta \ln \epsilon_{jt}$ is the change the real exchange rate, in birr to the currency of invoice exchange rate in period t as before.

Our measures of import weights originate from two sources of variation. For firms that are direct importers (that is, firms for whom we observe an entry in the Customs import registry) we use the firm-specific currency of invoicing. By construction, given our data, this applies to all firms in Uganda, and to those firms in Ethiopia which import directly (and not via intermediaries) and which we can link to the Customs data. For indirect importers in Ethiopia – that is, firms which in the manufacturing survey report a positive quantity of imported materials but which show no imports under their own name in the

Customs data – we assign the average import-weighted exchange rate of their industry and year. For exports, we only assign weights for direct exporters – that is, firms with exports reported in the Customs data.

An alternative to constructing firm-level exchange rates using the currency of invoicing would be to assign the bilateral exchange rate between the domestic currency (i.e. Ethiopian Birr or Ugandan Shilling) and the currency of the trading partner. However, this would likely not accurately reflect the exposure of Ethiopian and Ugandan firms to exchange rate shocks, since most international trade is invoiced in vehicle currencies. For instance, whereas only 4.5% of Ethiopian and 3.3% of Ugandan manufacturing firms' imports originate in the United States, 86% of all import transactions are invoiced in US dollars in either of the two countries. More generally, currencies of invoicing are much more concentrated than trading partners. To top three currencies of invoicing (USD, EUR, JPY in Ethiopia and USD, KES, EUR in Uganda) account for 97-98% of all trade, whereas the top three import origin countries account only for 43-45% of imports. Using the bilateral exchange rate based on the national currencies of trading partners would therefore likely overstate the true extent of variation in currency shocks that manufacturing firms in a developing country would face. While our preferred measure of currency shocks is therefore based on currency-of-invoicing-weighted exchange rates, we nevertheless contrast our results to estimates obtained using the bilateral exchange rate.

In the next section, we lay out our empirical strategy in examining the effects of currency shocks on firm behaviour. Note that increases in the values of these measures capture depreciations and thus might sensibly be associated with increasing costs of inputs and increased competitiveness in exports. We construct these measures using both the currency of invoicing and the bilateral exchange rates, and compare the impacts of using these two different measures in what follows.

3 Empirical strategy

Our interest lies in assessing the impact of these currency shocks on firm behaviour. We consider three outcomes: first, the (change in) importer status between years; second, the change in the share of imported inputs used; and finally, whether these fluctuations have an impact on labour productivity.

The main estimable equation is as follows:

$$\Delta Y_{it} = \beta_0 + \beta_1 \Delta FER\_IM_{it} + \beta_2 \Delta FER\_EX_{it} + \gamma'(F_i * T_t) + \epsilon_{it} \tag{3}$$

ΔY_{it} in equation 3 captures the main outcomes of interest. ΔFER_IM_{it} is the firm-level fluctuations in exchange rates weighted by import shares Similarly, ΔFER_EX_{it} is the firm-level fluctuation in exchange rates weighted by export shares. All the specifications include a full set of industry-year interactions, $F_{it} * T_{it}$, where the industry is measured at the two-digit ISIC code level in both countries. This implies that the impact of fluctuations is identified within narrow industry-year categories for firms. We emphasise that these specifications capture the reduced-form effects of shocks on firm outcomes, and cannot shed light on the exact mechanisms for these effects. We estimate these equations using the measures of shocks constructed using alternatively the currency of invoicing and the bilateral exchange rates for each country[8].

4 Summary Statistics

4.1 Ethiopia

We begin with a description for firms that use imported inputs (loosely labeled importers) versus those that do not, pooled over the six years, 2010-2017. The majority of firms using imported inputs are indirect importers, purchasing their inputs from import agents or large firms; just under 60 percent of firms use imported inputs, but only 10% are direct importers. Table A.1 displays these summary statistics, by the change in importer status between subsequent years, in four categories: i) did not use imported inputs, , ii) stopped using imported inputs, iii) began using imported inputs, and iv) continue to use imported inputs. The dependence on imported inputs is high; the average share amongst importers ranges from 44 percent amongst entrants to importing in any year to 58 percent for firms that continued to use imported inputs. There are strong patterns in other variables as well; labour productivity, firm size (as measured by number of workers),

[8]Note that in principle, for the case of Ethiopia, we would wish to examine the effect of both changes in the official exchange rate and the parallel-market premium. The data on the premia are only available as a percentage mark-up on the dollar and thus this effect is absorbed by the time fixed effects in the empirical analysis.

the share of public sector firms and the share of exporters,all increase as we move from non-importers to importers in the first to fourth category, In brief, importers are larger and more productive on average, with a slightly higher share (at 4-5%) of government-owned firms. The Herfindahl index (which ranges from 1/N to one, where N is the number of firms in the market.) shows a slight fall, going from 0.25 to 0.21, indicating that importers are perhaps slightly less concentrated.

Figure A.2 describes the main explanatory variable, the average fluctuation in exchange rates for importers, defined above as ΔFER_IM_{it}. Using the measure based on the currency of invoicing, there is considerable variation across the distribution of firms, with peaks at various points in the distribution ranging from -18 to 4, with strong peaks at various points in the distribution, suggesting important shocks to firms across the years. By comparison, the distribution of fluctuations using the bilateral exchange rates, has a wider range, and is less concentrated, as would be expected given the larger variation in trading partners than in currencies of invoicing.

The next two figures describe the main reasons for the use of imported inputs in Ethiopia and the reasons for working below capacity, both drawn from the LMMIS surveys. Figure A.3 summarises the main reasons for imports which are the lack of both availability of local substitutes as well as the quantity and quality of domestic substitutes, with the most productive firms also being the most reliant on imported inputs. Figure A.4 displays the main constraints to working at full capacity reported by firms. The main constraint reported, consistent with the pattern above, is the shortage of raw materials and spare parts, reported by over 25 percent of firms in the bottom quintile of labour productivity, rising to just under 40 percent for the top quintile. These two figures summarise the enormous joint impact of the nominally depreciating birr and the rationing regime, which makes obtaining limited foreign exchange to import materials a major constraint to firms.

Figure A.5-Figure A.8 display the relationship across the productivity distribution for the key correlates: size (measured by total employment), labour quality (proxied by the share of administrative and technical workers); the share of imported inputs; and currency shocks for importers, using the currency of invoicing alone. In brief, each of these variables describes a clear and increasing effect across productivity quintiles. There is a sharp and

increasing relationship between productivity and size. More productive firms have higher quality of labour in terms of the share of skilled labour, use more imported inputs, but also suffer larger exchange-rate shocks as importers. These figures are an indication of the risks associated with currency shocks. We document their impacts later in the regressions below.

4.2 Uganda

Table B.1 displays the summary statistics for Uganda, organised as for Ethiopia, by the change in importer status between subsequent years, in four categories: did not use imported inputs, stopped using imported inputs, began using imported inputs, and continue to use imported inputs. Unlike in Ethiopia, importers in this sample are all direct importers. The distribution of firm size across these categories suggests little variation, contrary to the pattern observed for Ethiopia. Apart from the relatively small group of 133 firms who have stopped importing, labour productivity is higher for importers. The Herfindahl index across groups is similar across groups but far higher than the values observed for Ethiopia at an average of 0.43, suggesting substantial concentration. Almost all firms in this sample are exporters as well, which is very different from Ethiopia.

In a direct comparison with Ethiopia, Figure B.1 displays the kernel density of currency shocks. Using the currency of invoicing, shocks here, as in Ethiopia have various peaks, reflecting the different episodes of appreciations and depreciations for different currencies of invoicing. The distribution of fluctuations using the bilateral measures is has again a wider range and less concentration than currencies of invoicing. This suggests that, at least on an annually aggregated basis, firms in Ethiopia and Uganda faced similar distributions of real exchange rate shocks at market prices, despite the different exchange rate regimes. However, the different regimes – with their starkly different implications for rationing and for the existence of parallel markets price premia – might be expected to have very different implications for firms.

Unlike for Ethiopia where we use a panel of surveys of firms, the tax database used for Uganda has data on the number of workers but no information on the share of skilled workers. Figure B.2 presents the distribution of firm size, using the total number of workers across productivity quintiles which suggests a different pattern from Ethiopia:

firm size first rises across the distribution and then falls, with the most productive firms being smaller on average. The information that is truly comparable is that drawn from the customs and revenue data in each of the countries i.e. the share of imported inputs, and the currency shocks for importers (using the currency of invoicing), presented in Figure B.3 and Figure B.4. The patterns here are different from those for Ethiopia, with little variation across the distribution of productivity. The distribution of currency shocks across the productivity distribution suggests a slightly upward trend, apart from that for the middle quintile but this pattern is perhaps more noisy than informative; as we will see, it is also consistent with the patterns we observe below in analysing the impact of these fluctuations on firm-level outcomes.

5 Currency shocks and firm level outcomes

Tables C.1-C.2 for Ethiopia and tables D.1 -D.2 for Uganda offer estimates of the effect of exchange-rate shocks: first on (the change in) the probability of being an importer, followed by the change in import shares. Tables 2 and 3 present the results,contrasting the results using the currency of invoicing in the first column, labelled CI with those using the bilateral measure in the second column, labelled BI. For the currency of invoicing, currency shocks to importers (where increases measure relative depreciations) sharply lower the likelihood of being an importer[9] and also lower the share of imported inputs in production, while currency shocks to exporters raise this share in Ethiopia. It ought to be noted that for exporters, currency shocks raise import shares; exporters are able to obtain access to foreign exchange as a priority, at the official rate, and the coefficients here suggest that the effects are similar and their effective size will depend on relative import and export intensities for the firm. Do these effects balance out? The answer is no, since only about 6% of firms in Ethiopia export, ensuring that for the majority of firms exchange rate shocks enter only on the import side rather than also the export side.[10]. In brief, the

[9]The marginal effects of a 10% increase in fluctuations suggest that the probability of becoming an importer rises by 2%, while that of becoming an importer falls by 3%.

[10]The marginal effects of a 10% increase in fluctuations for importers (a fall of 8%) and exporters (a rise of 8%) is symmetric but the net effect depends on the relative import and export intesities by firm. For instance, for the average exporter, the import intensity is 0.4 relative to the export intensity of 0.38, suggesting that the net effect in the face of an increased fluctuation will be a fall in import shares of 1%.

currency shocks have a strong negative effect on both the extensive and intensive margins of importing in Ethiopia. The regressions using the bilateral exchange rate measure of fluctuations is offered in the second columns of both tables as a comparison. In the case of importer status between years, shocks here seem to have no effect, while in the case of import shares, the effect of import shocks is similar to the results for the CI albeit with a much smaller effect; while the effect of the export shock in contrast is negligible. In brief, using the bilateral measure suggests small to negligible effects on imports, which might be driven by the artificial heterogeneity introduced by the use of this measure.

We contrast these results with those for Uganda; here, currency shocks based on the currency of invoicing have no impact on either importer status or import shares. However, using the measure of shocks based on the bilateral exchange rate, as shown in the second columns of both tables, suggests that real depreciations would *raise* the probability of importing and the import share which is surprising and inexplicable. The effect of the export shocks is positive for both the intensive and extensive margin as well. Again, these results are likely to be an artefact of the construction of the bilateral exchange rate measure, which creates more heterogeneity across firms than actually exists.

Table C.3 and Table D.3 display the effects of currency shocks on the growth in labour productivity in both countries. The currency shocks based on the currency of invoicing as well as based on the bilateral exchange rate seem to lower labour productivity growth in Ethiopia; while in Uganda the import shocks have no impact using either measure but the export shock measured using bilateral exchange rates exhibits a positive effect on productivity .

In both countries, there has been a trend nominal depreciation against the US dollar over much of this period, and in the Ugandan case firms seem to be able to protect themselves against fluctuations around this trend; while in Ethiopia, the combination of rationing and a parallel-market premium fluctuating around an appreciating real trend has meant that these shocks seem to have been costly for importers, and resulted in lower labour productivity of firms over time. The results using the bilateral measures of currency shocks offer a slightly more confused picture; while some results are similar, others are counter-intuitive and suggest that reliance on bilateral measures where trade is largely invoiced in a dominant currency like the US dollar might be misleading.

In sum, the results indicate that the exchange rate regime in Ethiopia imposes sharp costs on both the intensive and extensive margins for importers and on labour productivity, while for Uganda the floating regime seems to allow firms to smooth the effect of such fluctuations.

6 Conclusion

We use data from a detailed survey of firms in Ethiopia (2012-2017) and the Corporate Income Tax Data from Uganda and PAYE data (2010-2017), together with administrative data from the Customs and Revenue Authorities in both countries, to examine the impact of firm-specific currency shocks on import behaviour and firm productivity.

We find strong effects of exchange-rate shocks on importers and productivity in Ethiopia and no effects on firm-level outcomes in Uganda, using measures of shocks based on the currency of invoicing. For Ethiopia, increases in currency shocks based on the currency of invoicing lower both the extensive and intensive margins on imports, and also lower labour productivity growth. In contrast, in Uganda, where the exchange rate is determined as a floating rate in the market, we cautiously conclude that currency shocks have no effect on importers or productivity. Ugandan firms seem to be able to weather their currency shocks while Ethiopian firms are more constrained and must bear the burden of such fluctuations. Finally, we document the effects on firm behaviour that are obtained if bilateral exchange rate measures had been used instead and find mixed and partly contradictory results here, suggesting that it is important to use accurate measures of currency shocks to understand the impact on firms and trade.

References

Abreha, K. G., *Importing and Firm Productivity in Ethiopian Manufacturing*, May: The World Bank Economic Review, 2017.

Aghion, P., P. Bacchetta, R. Rancière, and K. Rogoff, "Exchange rate volatility and productivity growth: The role of financial development," *Journal of Monetary Economics*, 2009, *56*, 494–513.

Alfaro, L., A. Cuñat, H. Fadinger, and Y. Liu, "The Real Exchange Rate, Innovation and Productivity: Regional Heterogeneity, Asymmetries and Hysteresis," 2018. CEPR Discussion Papers 12943.

Amiti, M. and J. Konings, "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia," *American Economic Review*, 2007, *97*, 5.

_ , I. Oleg, and J. Konings, "Dominant Currencies: How firms choose currency invoicing and why it matters," 2018. Working Paper Research 353.

Bigsten, A., M. Gebreeyesus, and M. Söderbom, "Tariffs and Firm Performance in Ethiopia," *Journal of Development Studies*, 2016, *52*, 7.

Bloom, N., E. Brynjolfsson, L. Foster, R. Jarmin, M. Patnaik, I. Saporta-Eksten, and J. Van Reenen, "What drives differences in management practices?," *American Economic Review*, 2018. forthcoming.

Bustos, P., "Trade Liberalization, Exports, and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinian Firms," *American Economic Review*, 2011, *101*, 1.

Chen, N., W. Chung, and D. Novy, "Vehicle Currency Pricing and Exchange Rate Pass-Throug," 2019. CESifo Working Paper Series 7695.

Choi, B. and J. H. Pyun, "Does real exchange rate depreciation increase productivity? Analysis using Korean firm-level data," *The World Economy*, 2017, *41*, 1.

Corsetti, G., M Crowley, and L. Han, "Invoicing and Pricing-to-market Evidence on International Pricing by UK exporters," 2018. CEPR DP 13282.

Cravino, Javier, "Exchange Rates, Aggregate Productivity and the Currency of Invoicing of International Trade," 2017.

Dai, Mi and Jianwei Xu, "Firm-specific exchange rate shocks and employment adjustment: Evidence from China," *Journal of International Economics*, 2017, *108.*

Ekholm, K., A. Moxnes, and K.H. Ulltveit-Moe, "Manufacturing restructuring and the role of real exchange rate shocks," *Journal of International Economics*, 2012, *86*, 1.

Fung, L., "Large real exchange rate movements, firm dynamics, and productivity growth," *Canadian Journal of Economics*, May 2008, *41*, 391–424.

Gebrewolde, T. M. and J. Rockey, "The Effectiveness of Industrial Policy in Developing Countries: Causal Evidence from Ethiopian Manufacturing Firms," 2016. Working Paper.

Goldberg, L. S., "Industry-specific exchange rate for the US," *Economic Policy Review*, 2004, *10*, 1.

_ **and C. Tille**, "Vehicle Currency Use in International Trade," *Journal of International Economics*, 2008, *76*, 2.

Haile, Fiseha, "The Exchange Rate Why It Matters for Structural Transformation and Growth in Ethiopia," 2019. Policy Research Working Paper 8868.

Halpern, L., M. Koren, and A. Szeidl, "Imported Inputs and Productivity," *American Economic Review*, 2015, *105*, 12.

Melitz, M.J., "The impact of trade on intra-industry reallocations and aggregate industry productivity," *Econometrica*, 2003, *71.*

_ **and G. Ottaviano**, "Market size, trade, and productivity," *Review of Economic Studies*, 2008, *75.*

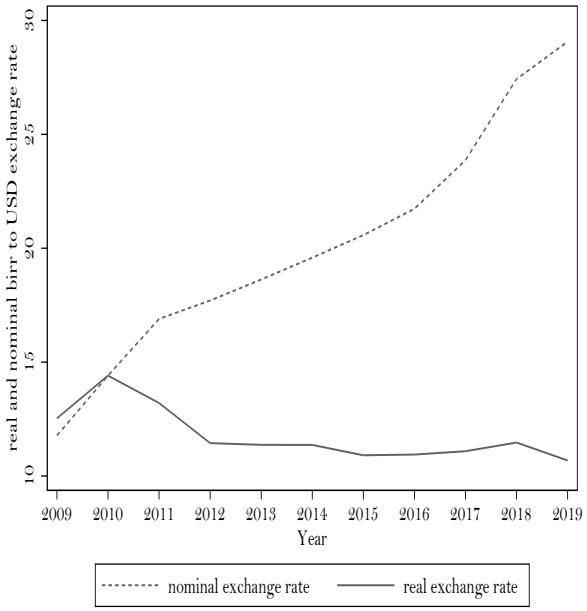
Murphy, G. and I. Siedschlag, "The Effect of Real Exchange Rate Changes on Labour Productivity Growth," 2012. Papers WP439.

Verhoogen, Eric A., "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector," *The Quarterly Journal of Economics*, 2008, *123*, 2.

Appendices

A Descriptive Statistics: Ethiopia

Figure A.1 Aggregate trend in the Birr to EURO and USD exchange rate



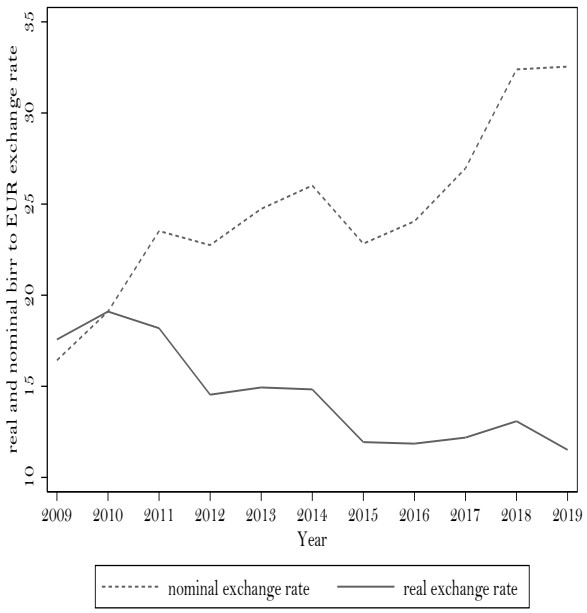


Table A.1 Summary statistics by change in importer status-Ethiopia

	mean	sd	count
Stayed non-importer			
ln(Labour productivity)	11.53	1.68	1834
ln(Total workers)	3.11	0.94	1834
Share of imported inputs	0.00	0.00	1834
Herfindahl index	0.25	0.36	1834
Government owned	0.02	0.15	1834
Exporter	0.04	0.19	1834
Became a non-importer			
ln(Labour productivity)	11.90	1.77	1130
ln(Total workers)	3.27	1.05	1130
Share of imported inputs	0.00	0.00	1130
Herfindahl index	0.23	0.37	1130
Government owned	0.03	0.16	1130
Exporter	0.05	0.21	1130
Became an importer			
ln(Labour productivity)	12.16	1.55	1629
ln(Total workers)	3.59	1.27	1629
Share of imported inputs	0.44	0.38	1629
Herfindahl index	0.21	0.31	1629
Government owned	0.05	0.21	1629
Exporter	0.08	0.26	1629
Stayed an importer			
ln(Labour productivity)	12.38	1.64	3133
ln(Total workers)	3.79	1.29	3133
Share of imported inputs	0.58	0.38	3133
Herfindahl index	0.21	0.26	3133
Government owned	0.04	0.20	3133
Exporter	0.06	0.25	3133
Total			
ln(Labour productivity)	12.06	1.68	7726
ln(Total workers)	3.51	1.21	7726
Share of imported inputs	0.33	0.40	7726
Herfindahl index	0.22	0.32	7726
Government owned	0.04	0.19	7726
Exporter	0.06	0.23	7726
Observations	7726		

Figure A.2 Kernel densities of exchange-rate fluctuations: Ethiopia

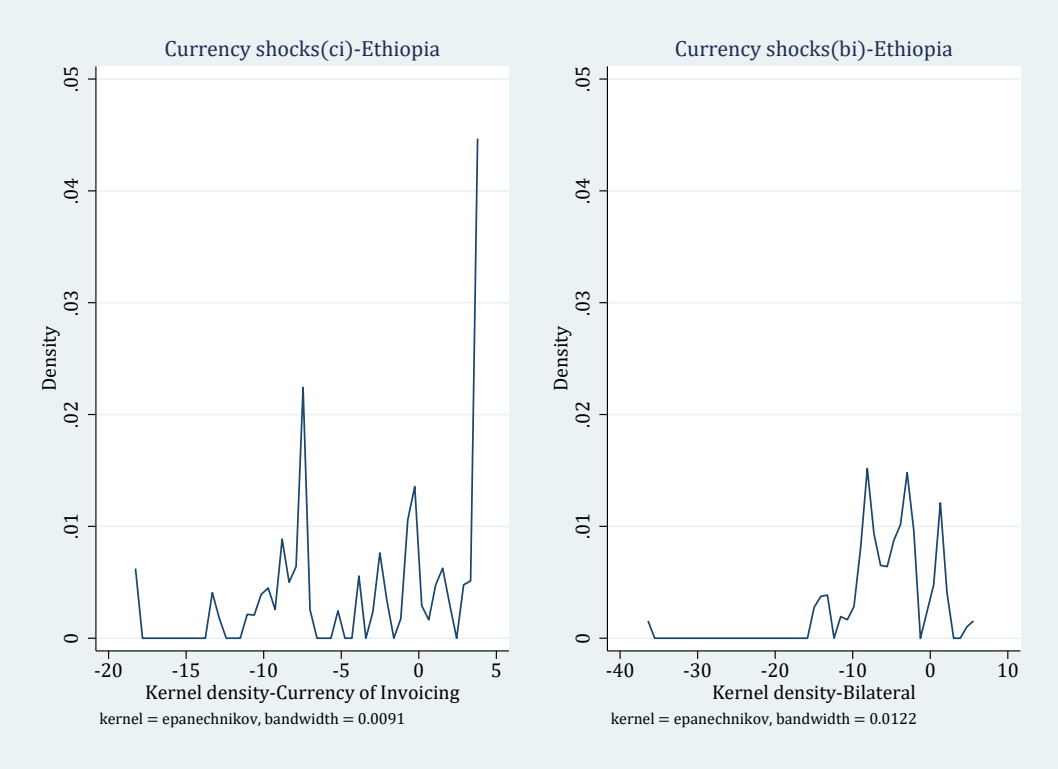


Figure A.3 Reasons for using imported inputs: Ethiopia

Figure A.4 Reasons for operating below capacity: Ethiopia

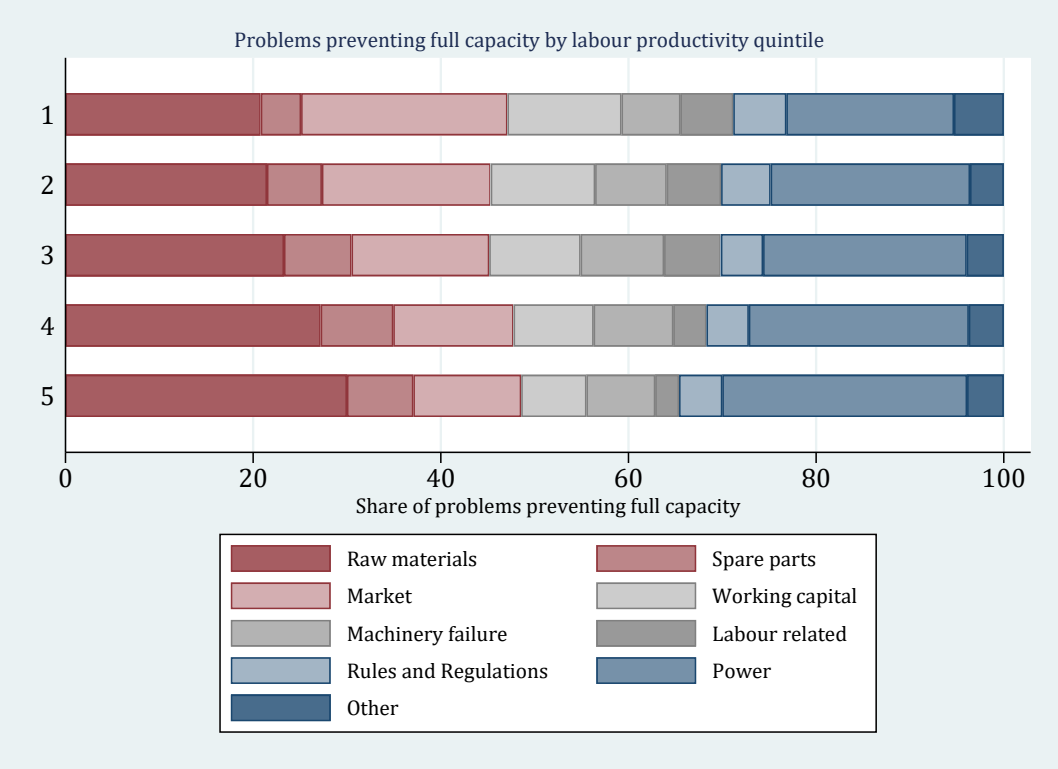


Figure A.5 Size and labour productivity: Ethiopia

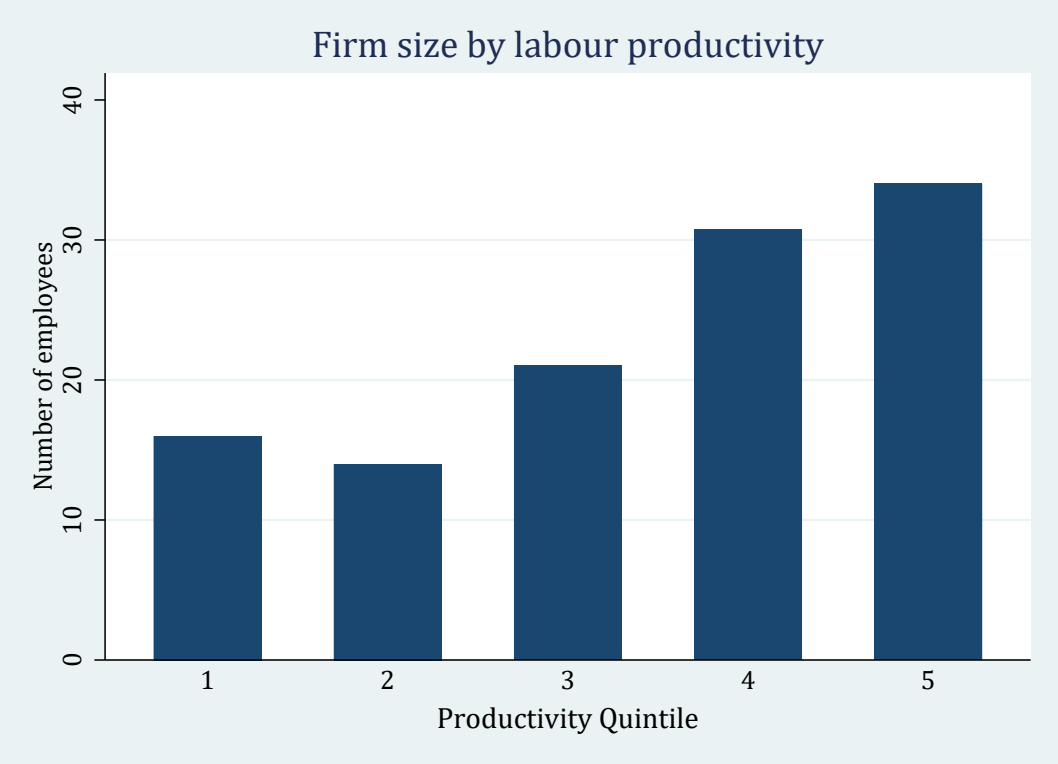


Figure A.6 Labour quality and labour productivity: Ethiopia

Figure A.7 Shares of imported inputs and labour productivity: Ethiopia

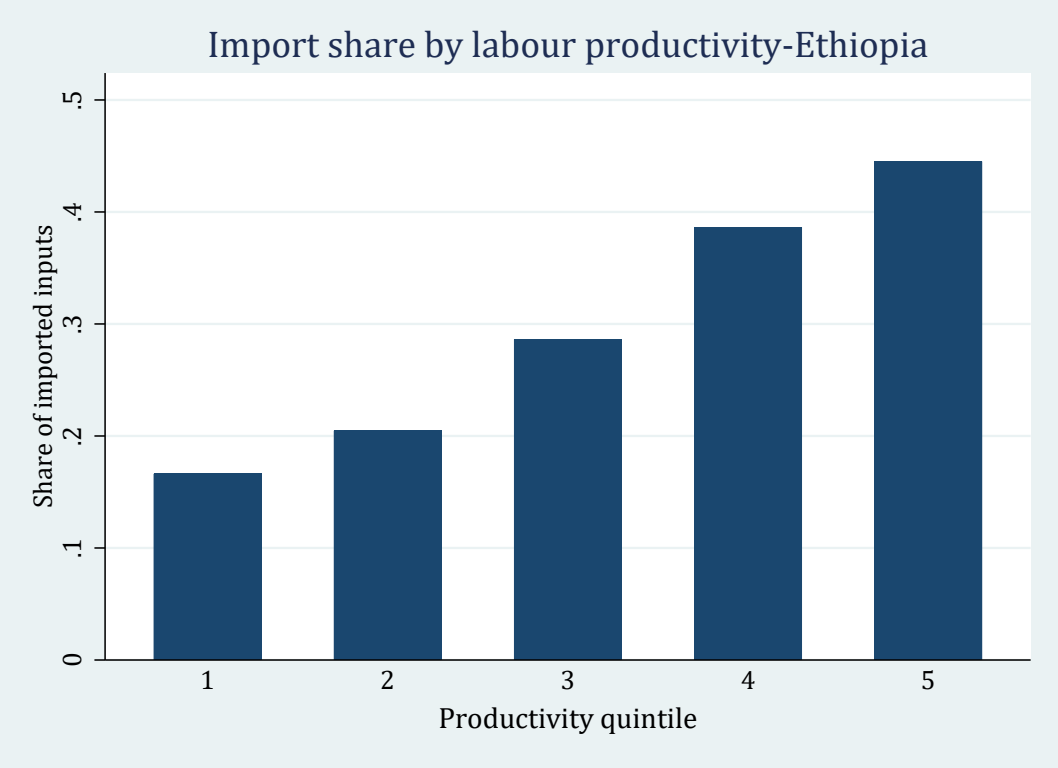
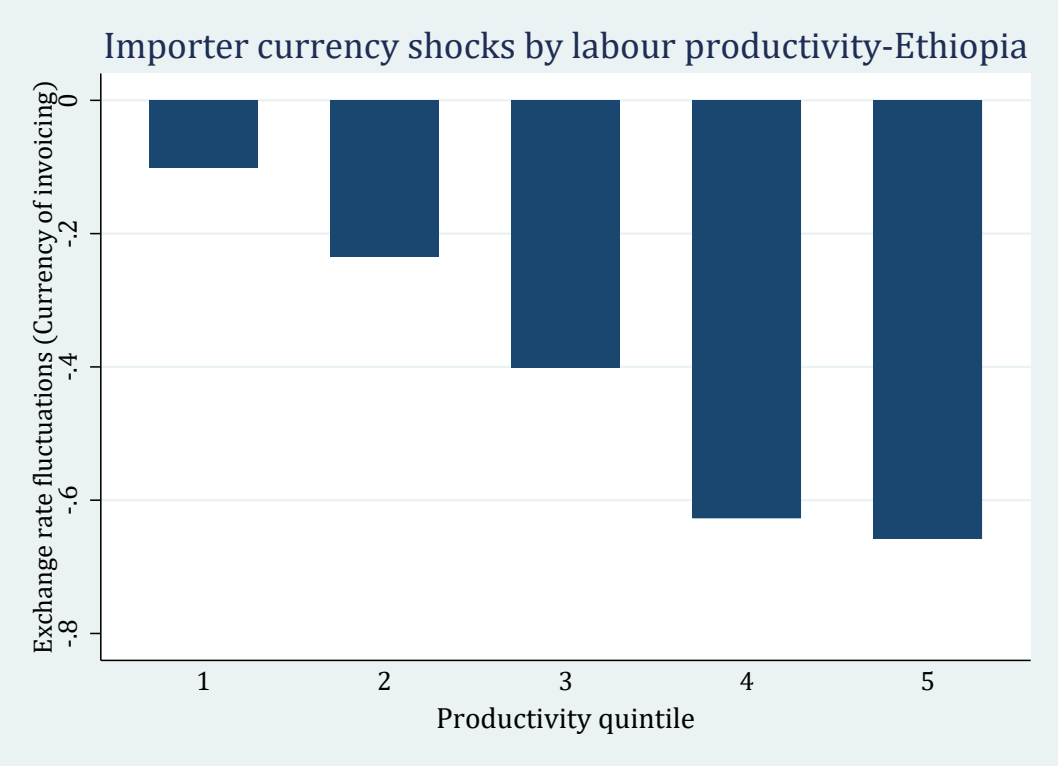
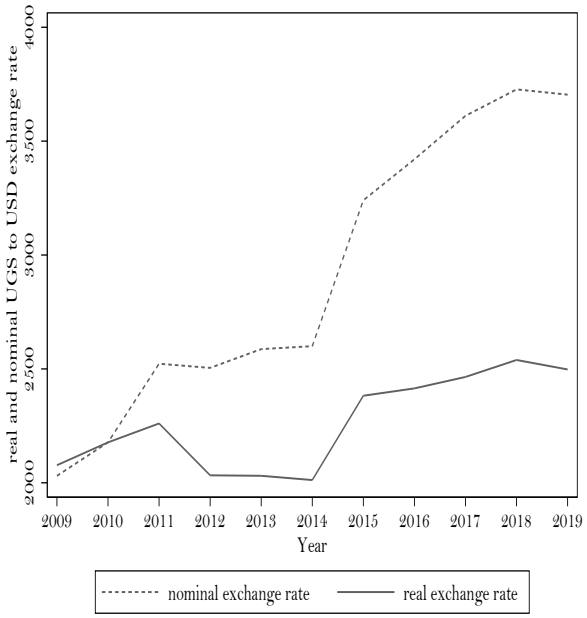


Figure A.8 Exchange-rate fluctuations to importers and labour productivity: Ethiopia



B Descriptive Statistics: Uganda

Figure B.1 Aggregate trend in the Ugandan Shilling to EURO and USD exchange rate



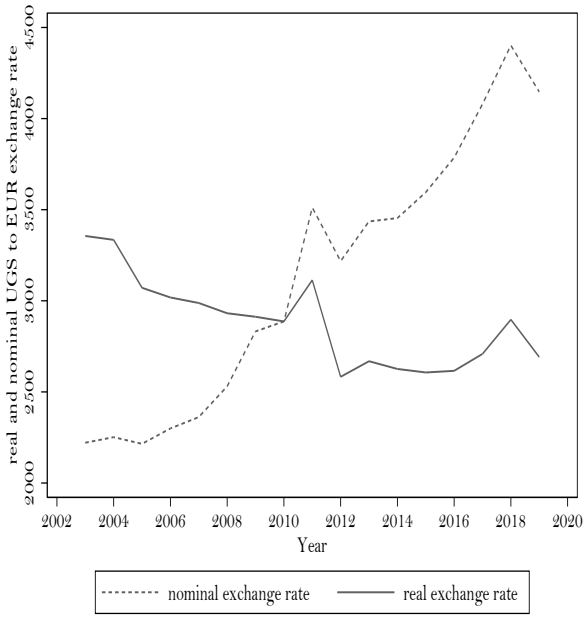


Table B.1 Summary statistics by change in importer status-Uganda

	mean	sd	count
Stayed non-importer			
ln(Labour productivity)	16.77	1.38	941
ln(Total workers)	6.29	1.78	941
Share of imported inputs	0.00	0.09	941
Herfindahl index	0.43	0.28	941
Exporter	0.97	0.16	941
Became a non-importer			
ln(Labour productivity)	16.82	1.37	127
ln(Total workers)	6.31	1.49	127
Share of imported inputs	0.01	0.10	127
Herfindahl index	0.43	0.26	127
Exporter	0.98	0.15	127
Became an importer			
ln(Labour productivity)	16.74	1.23	299
ln(Total workers)	5.74	1.48	299
Share of imported inputs	0.70	0.36	299
Herfindahl index	0.45	0.27	299
Exporter	0.98	0.13	299
Stayed an importer			
ln(Labour productivity)	16.75	0.99	472
ln(Total workers)	6.27	1.34	472
Share of imported inputs	0.74	0.31	472
Herfindahl index	0.41	0.27	472
Exporter	0.99	0.09	472
Total			
ln(Labour productivity)	16.76	1.27	1839
ln(Total workers)	6.20	1.62	1839
Share of imported inputs	0.31	0.42	1839
Herfindahl index	0.43	0.28	1839
Exporter	0.98	0.14	1839
Observations	1839		

Figure B.1 Kernel densities of exchange-rate fluctuations: Uganda

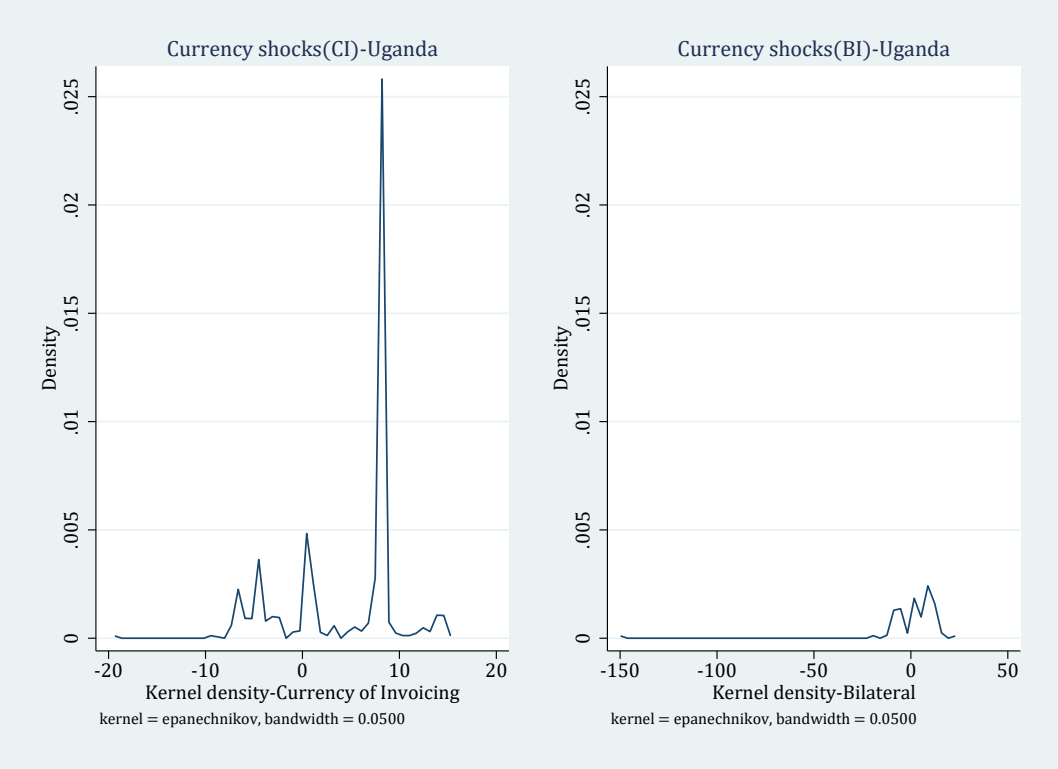


Figure B.2 Size and labour productivity: Uganda

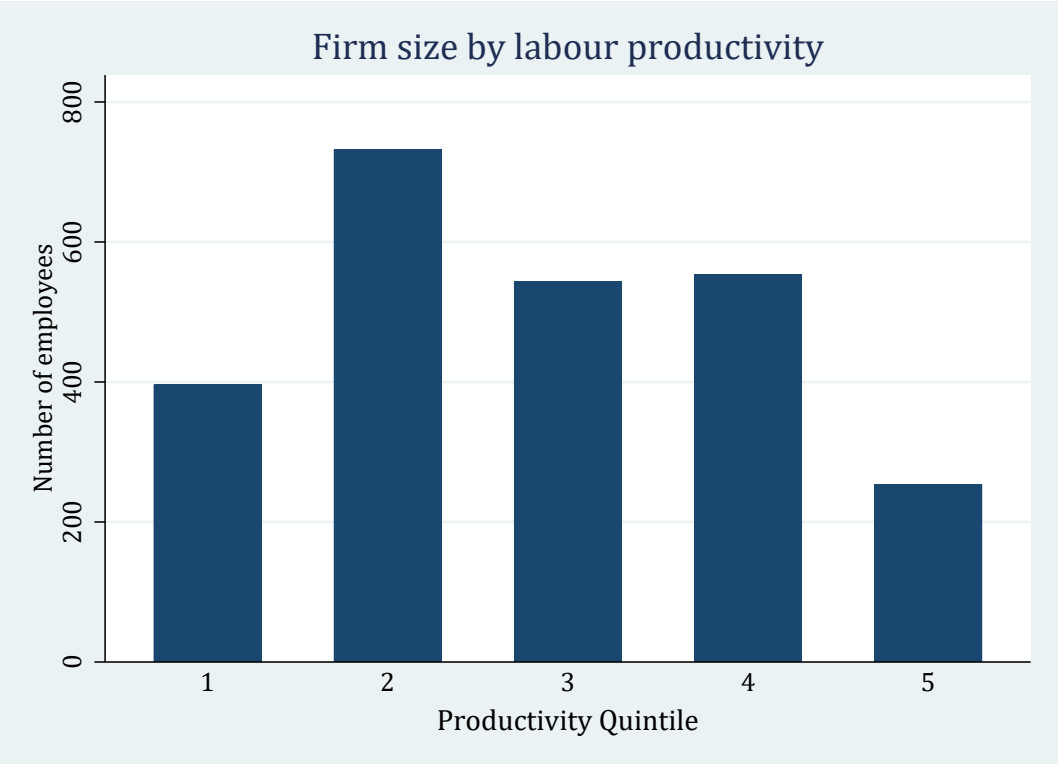
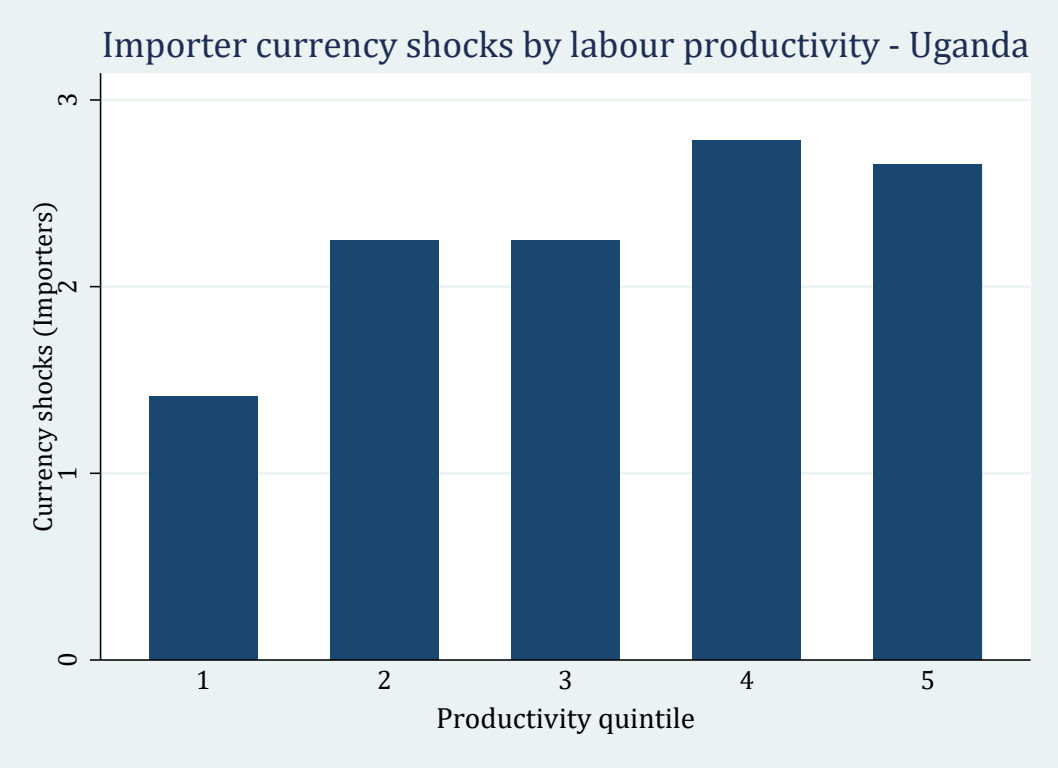


Figure B.3 Shares of imported inputs and labour productivity: Uganda

Figure B.4 Exchange-rate fluctuations to importers and labour productivity: Uganda



C Impact of exchange rate fluctuations: Ethiopia

Table C.1 Ologit: Change of importer status-Ethiopia

	(1)	(2)
	CI	BI
D.importer		
Import shock	-0.033**	0.004
	(0.016)	(0.011)
Export shock	0.036	-0.013
	(0.032)	(0.008)
Year FE*Industry FE	Yes	Yes
Pseudo-R2	0.054	0.054
Observations	6073.000	6073.000

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C.2 Change in share of imported inputs-Ethiopia

	(1)	(2)
	CI	BI
Import shock	-0.008***	-0.003**
	(0.002)	(0.001)
Export shock	0.009**	-0.001
	(0.004)	(0.001)
Year FE*Industry FE	Yes	Yes
Adjusted-R2	0.124	0.123
Observations	6073.000	6073.000

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C.3 Currency shocks and labour productivity-Ethiopia

	(1)	(2)
	CI	BI
Import shock	-0.025*	-0.023***
	(0.01)	(0.01)
Export shock	0.021	-0.013**
	(0.04)	(0.01)
Year FE*Industry FE	Yes	Yes
Adjusted-R2	0.038	0.042
Observations	3003.000	3003.000

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

D Impact of exchange rate fluctuations: Uganda

Table D.1 Ologit:Change of importer status-Uganda

	(1)	(2)
	CI	BI
D.importer		
Import shock	0.031	0.024*
	(0.069)	(0.013)
Export shock	-0.003	0.010**
	(0.013)	(0.004)
Year FE*Industry FE	Yes	Yes
Pseudo-R2	0.230	0.234
Observations	1487.000	1487.000

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D.2 Change in share of imported inputs-Uganda

	(1)	(2)
	CI	BI
Import shock	0.001	0.004**
	(0.008)	(0.002)
Export shock	-0.000	0.001*
	(0.002)	(0.001)
Year FE*Industry FE	Yes	Yes
Adjusted-R2	0.259	0.264
Observations	1487.000	1487.000

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D.3 Currency shocks and labour productivity-Uganda

	(1)	(2)
	CI	BI
Import shock	-0.003	0.006
	(0.015)	(0.005)
Export shock	0.000	0.002*
	(0.003)	(0.001)
Year FE*Industry FE	Yes	Yes
Adjusted-R2	0.309	0.312
Observations	1299.000	1299.000

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$