Formalising informal cross-border trade: Evidence from One-Stop-Border-Posts in Uganda

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Abstract

Informal trade is pervasive between sub-Saharan African countries. This study examines the relationship between trade informality and trade costs. More specifically, using an augmented gravity model, I exploit time and custom point variation in the introduction of a border facility which is aimed at reducing border delays and corruption. I find a significant decrease in trade informality in the second quarter after the introduction of an OSBP, with indications that this change is mainly driven by a fall in large-scale informal trade. I examine whether this result can be explained by formalisation of individual cross-border traders by using first-hand data set of traders operating at two border towns between Kenya and Uganda. I find that few traders formalise despite the reduced costs associated with the introduction of the border facility, and that trade costs and border crossing choices are not only associated with export restrictions, but are also gendered.

Keywords: Trade, border, informality

JEL Classifications: O17, O12, F14, F15

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1 Introduction

Sub-Saharan African economies continue to suffer from the highest trade costs in the world (World Bank, 2017). These costs are high even when trading with other countries in the region (Eberhard-Ruiz and Moradi, 2019). High trade costs have been suggested as a factor which contributes to the persistently low recorded levels of intra-African trade, and a factor which encourages unrecorded informal cross-border trade (Lesser and Moisé-Leeman, 2009; Golub, 2015; FAO, 2017).

Under- and unreported trade flows between neighbouring countries – also known as informal cross-border trade (ICBT) – are especially pronounced in sub-Saharan Africa (SSA). Between Uganda and its neighbours alone, informal exports were estimated to be USD 538 million in 2018 (38 percent of formal exports to its neighbours) (UBOS, 2019). Due to the red tape, poor infrastructure and security involved in crossing formal border points, informal trade can offer lower trade costs, incentivising individuals to trade through this channel, some of whom would otherwise not engage in cross-border trade at all (Little et al., 2010; Golub, 2015). As such, there are arguments that there are short term gains from informal trade: entrepreneurship promotion, in particular amongst women, contribution to regional food security, and employment and income creation for those who participate in them. Trade is found to be the main source of income for two thirds of the informal traders operating in the border crossings between the DRC and Rwanda (Mora and Roshan, 2011; Brenton et al., 2013). ICBT can act as a cushion to price distorting policy effects, providing supplies of food products which may otherwise be unavailable (Ackello-Ogutu and Echessah, 1998).

There are nevertheless concerns about the longer term implications (Lesser and Moisé-Leeman, 2009). High levels of informality reduces state capacity for tax collection. Countries where trade informality is high have a narrow tax base. In SSA, the median government revenue as a percentage of GDP stood at just 19 percent in 2018 (UNU WIDER, 2020), and many of these countries depend heavily on trade-related taxes as sources of government revenue, in some cases accounting for half of the total revenue (Cantens and Raballand, 2017). With the proliferation of regional trade agreements, which involve slashing tariff rates imposed on regional partners, this reason against trade informality has become weaker. For example,

tomato traders operating within the East Africa Community face zero tariffs. What is more important is that high levels of trade informality reduces the effectiveness of national-level policies. For example, Sequeira (2016) finds that tariff reduction has not led to large increases in formal trade volumes due to the prevalence of bribery to evade tariffs occurring in the ports of Mozambique. It also affects basic national accounting. Uganda discovered that their trade balance figures from Bank of Uganda (BoU) was USD 500 million higher than those recorded by the Ugandan Bureau of Statistics (UBOS) on the expenditure side of the National Accounts. They later were able to reconcile the gap, explained partly by informal cross-border trade (UBOS, 2006).

With these implications in mind, a key question is how trade informality can be reduced without a contraction of total trade. In this paper, I examine whether a reduction in trade costs could be effective in achieving this.[1] In theory, traders choose to trade formally or informally by evaluating their relative costs (Bhagwati, 1974; Deardorff and Stolper, 1990; Golub, 2015; Bensassi et al., 2019).

I test this relationship by exploiting the spatial and time variation across custom points of the introduction of One-Stop-Border-Posts (OSBPs) – a border facility which aims to reduce delays and corruption at the customs. Firstly, using trade-flow level data, I use an augmented gravity model to examine whether trade informality, defined as bilateral informal trade relative to total trade, between Uganda and its neighbours changes with the introduction of an OSBP. I find that the association between the introduction of an OSBP and trade informality is small, negative and statistically insignificant. This result is robust to a number of specifications, including the use of country-pair-time fixed effects, which capture changes in tariffs, border regulations and bilateral political relationships over time, as well as addressing the potential bias arising from the differential timings of treatment. Suggestive evidence indicates that this small effect size is due to an increase in trade informality at the quarter when an OSBP is introduced and then a subsequent reversion in the next two quarters when trade informality significantly decreases. I explore the mechanisms through which these changes occur. I find indicative evidence that informal trade has expanded and then contracted, with the

[1] Anderson and Van Wincoop (2004) categorised trade costs into three groups: 1) transportation costs, 2) distribution costs for wholesalers and retailers and 3) border-related trade barriers.

contraction mainly driven by 'large-scale' informal trade. This might imply that there is a decrease of more productive informal traders, who could be competitors of formal traders, as oppose to informal traders who operate just to survive.

Aggregate trade flow analysis however masks individual-level changes. In particular, it does not provide evidence on whether individual informal traders have changed from trading informally to trading formally. In order to investigate this, a team of enumerators and I collected a set of trader-level data at two major border crossings between Uganda and Kenya, both of which have recently constructed an OSBP. A random sample is drawn from the census of 4757 shops and stalls, conducted immediately before the trader survey was undertaken. Using responses from 876 traders, I find that since the OSBP came into operation, hardly any traders have decided to switch their main border crossing routes. Only five percent reported switching route, and of that less than three quarters switched from an informal border crossing to the customs. A quarter of them declared that they would cease trading if they could only trade through the customs. This suggests that the changes in trade informality as a result of the OSBP observed in the trade flow level analysis is due to traders entering and exiting the market, or changing the volumes of their consignment, rather than individuals switching from informal to formal trading activities.

These survey responses point to the challenges in formalising existing informal traders. I investigate the factors associated with these challenges by comparing the characteristics of traders who cross through the customs and those that use an informal border crossing. By using probit estimation with sample selection, I find that traders who use informal border crossings tend to be male and trade in perishable goods. Results also suggest that export restrictions play a role in determining the prevalence of informal trade. This is consistent with the relationship between traders' characteristics and their self-reported border payments. The value of informal payments tends to be higher for women cross-border traders compared to their male counterparts. These results which reveal the role of gender in cross-border trade may partially explain the difficulties in formalisating informal trade: there exists deep-rooted discrimination which results in differences in trade costs faced by different traders.

This study contributes to the trade and development literature in three ways. First, this

paper contributes to the literature examining tax evasion in cross-border trade. This body of literature mainly uses indirect methods to detect evasion. Bhagwati (1964) first proposed the trade gap method, which makes use of the discrepencies in data reported by the exporting and importing countries of the same trade flow as a proxy for smuggling. Fisman and Wei (2004) extended this method to not only uncover tax evasion by firms under-reporting the value of imported goods but also through misclassifying products. These methods have been adopted and further extended to various countries and contexts.[2] Despite its widespread usage, the trade gap method has been criticised for its misuse and misinterpretation (Forstater, 2018). There have been recent developments in detecting trade tax evasion by using transactional-level data, such as the use of price filter method (Yang, 2008; Demir and Javorcik, 2020)[3], and analysing custom agencies' behaviour (Sequeira, 2016; Chalendard et al., 2020). These indirect methods to detect trade tax evasion nevertheless ignore trade flows at informal border crossings, analyses of which have been dominated by ethnographic studies (e.g. Little et al. (2010), Titeca (2012) and Gallien (2018)). While there have been quantitative studies on the networks of informal traders in West Africa (Trémolières and Walther, 0173; Walther, 2015), and studies documenting challenges in traders' lives captured through surveys (Titeca and Kimanuka, 2012; Brenton et al., 2013; Van den Boogaard et al., 2018a,b; Tyson, 2018), ICBT has only attracted interest amongst economists recently. These studies mainly examine factors which might affect informal traders' behaviour, such as official trade taxes (Bensassi et al., 2019), information about border taxes and procedures (Croke et al., 2020) and COVID-19 Wiseman (2020). This study contributes to this discussion by providing macro- and micro-level evidence on trade activities which occur at informal border crossings and at customs.

Secondly, this study contributes to the understanding of the relationship between trade costs and trade volumes. While there is a vast literature on the effect of tariff reduction on trade flows (Goldberg and Pavcnik, 2016), there is less evidence on the effects of trade costs through measures beyond trade liberalisation policies. This is despite the fact that tariffs have fallen

[2]For example tariff evasion between Germany and Eastern European countries (Javorcik and Narciso, 2008), between India and its major trading partners (Mishra et al., 2008), Kenya, Mauritius and Nigeria (Bouet and Roy, 2012), trade between Kenya and Tanzania (Levin and Widell, 2014) and in Ethiopia (Mengistu et al., 2018).

[3]A consignment is flagged to be suspicious if the reported price is abnormal, defined as above or below the arm's length price range

to low levels in recent decades, while non-tariff barriers remain substantial. An example of a non-tariff trade cost is time costs. Delays can lead to spoilage, depreciation of goods and obsolescence of technological goods (Hummels and Schaur, 2013). These time costs could occur during the transportation of goods from origin to destination (Hummels and Schaur, 2013), as well as at customs (Djankov et al., 2010). There has been a political momentum to reduce these costs through trade facilitation measures, with USD 3.6 billion being disbursed as aid to support these measures between 2005 and 2018 (UNCTAD, 2020). Existing studies have generally found positive effects of these measures on formal trade flows by either examining trade facilitation measures as a whole, using indicators as proxies (Portugal-Perez and Wilson, 2012; Wilson et al., 2003), or focusing on specific components, such as port efficiency (Clark et al., 2004; Feenstra and Ma, 2014; Sant'Anna and Kannebley Júnior, 2018) and custom reforms (Fernandes et al., 2015, 2016). This paper uses a trade facilitation measure which aims at reducing time costs to understand whether it affects formal and informal trade flows.

Lastly, this study contributes to the body of research examining efforts to formalise firms. The literature provides splitting views of the role of informal firms in economic development: 1) informal firms are promising firms which are held back by costly regulations (De Soto, 1989); 2) informal firms are holding back economic growth through unfair advantage against compliant firms (Levy, 2010); 3) informal firms are highly unproductive and are only operating in the informal sector to survive (La Porta and Shleifer, 2014). Ulyssea (2018) finds evidence to support the co-existence of all these view. In contrast to La Porta and Shleifer (2014) who argue that formal and informal firms operate in separate economic spaces, Ulyssea (2018) finds that formal and informal firms operate in overlapping markets. In this study on OSBP, in line with the first perspective, formalisation is expected to take place through a reduction in cost of compliance through reduction in time delays, and in line with the second perspective, formalisation is expected to take place through an increased cost of participation in corruption. This study builds upon the existing evidence on interventions reducing the extensive margin of informality (Monteiro and Assunção, 2012; De Mel et al., 2013; Rocha et al., 2018; Benhassine et al., 2018) by examining informality at the border, where regulations imposed upon traders are beyond domestic ones.

The rest of this paper is structured as follows: in section 2, I provide some context to this

study and description of the two datasets which I will be using in my analysis. In section 3, I describe the conceptual framework which is used to guide my empirical analysis. In section 4, I describe the empirical strategy, discuss threats to identification and the results of my analysis of the effect of the introduction of OSBPs on the ratio of informal-to-total trade between Uganda and its neighbours. In section 5, I conduct traders' level analysis to understand choices of border crossing and the associated border costs. In section 6, I conclude.

2 Context and data

2.1 Informal cross-border trade

ICBT in this paper refers to 'trade in legitimately produced goods and services, which escapes the regulatory framework set by the government, as such avoiding certain tax and regulatory burdens' (Lesser and Moisé-Leeman, 2009)[4]. Under this definition, trade in illicit goods, such as narcotics, is not included, and is outside the scope of this paper[5]. These traders may or may not be registered firms (Lesser and Moisé-Leeman, 2009)[6]. Traders who are not registered, but pay full taxes at the customs, are referred to as formal traders[7].

I use two sets of data for the analysis of informal cross-border trade: 1) aggregate informal trade values data collected by the Bank of Uganda (BoU) and the Ugandan Bureau of Statistics (UBOS), and 2) trader-level data which a team of enumerators and I have collected.

[4]The distinction between 'informal trade' and 'smuggling' is discussed in Cantens et al. (2015). In this study, I prefer the term 'informal trade' to broaden the perspective that the activities may not always be conducted with the intent to evade tax and to recognise that some of the 'informal' trading routes have been established before borders were drawn. Other studies especially those in economics, such as Yang (2008), have used the term 'smuggling' instead of 'informal trade'.

[5]By excluding illicit products, I can focus on formalisation of the trading activity rather than the legality of the actual product, as pointed out by Cantens et al. (2015).

[6]This is different from existing studies examining formalisation of firms, e.g. La Porta and Shleifer (2014); Ulyssea (2018); Benhassine et al. (2018); De Mel et al. (2013). Unlike these papers, this study focuses on border taxes and border crossing routes rather than other types of taxation such as income tax that require business registration. Cross-border traders are able to pay border taxes at the customs without business registration.

[7]When referring to the trade flow (as oppose to traders), any trade flow which is not officially recorded at the customs is defined as informal.

2.1.1 Aggregate informal trade flows

I use the quarterly informal cross-border trade values data from 2015 to 2017 collected by the BoU and UBOS. Enumerators are hired by the BoU and UBOS, and took no part in the operation of the customs. They monitored informal trade flows for 14 days each month and created estimates for the rest of the days, taking seasonality effects into account.[8] This dataset covers 18 official custom points along Uganda's borders with the DRC, Kenya, Rwanda, South Sudan and Tanzania. The data collection points are chosen according to existing knowledge of the intensity of ICBT, as well as adequate infrastructure and government support to implement the field study.

This dataset captures two types of informal trade flows[9]:

- **Goods which are transported cross the border through informal trading routes**. These trading routes are near, but not at, the customs. These informal trading routes are widely used by cross-border traders and are known by the officials. Enumerators are stationed at strategic points to record the goods that have been carried or transported across the border. This informal trade flow is represented by the dotted line labelled as I1 in Figure 1. In the same diagram, the yellow triangles represent the established informal border crossing.

- **Under-declaration of goods at custom offices**. This is done by comparing the volume inside the vehicle against the paper work completed. The enumerators count what is inside the vehicle and match the paper work through the car plate. They record the discrepency between what they counted and the paper work. This informal cross-border trade flow is represented by the dotted line labelled as I2 in Figure 1. In that diagram, the orange rectangle represents the official customs office.

[8] The formula for this up-rating model is documented in UBOS (2006).

[9] I confirmed the coverage of this survey and data collection method by observing the enumerators in the field.

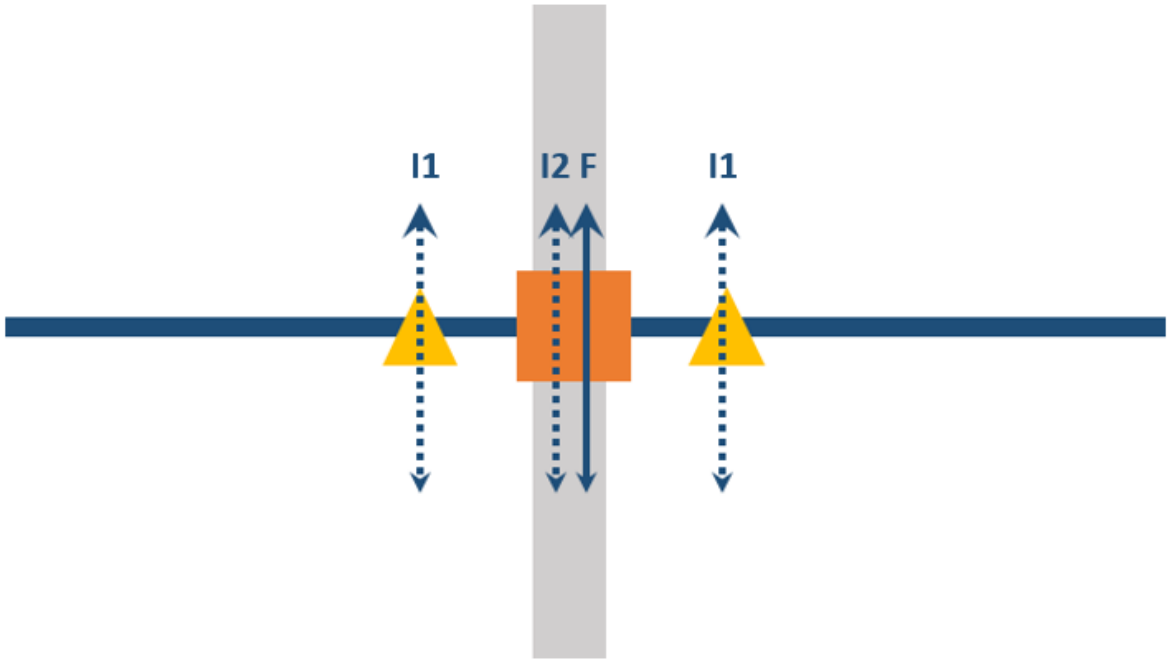

Figure 1: Types of informal cross-border trade

Diagram showing informal cross-border trade which occurs at informal border crossings (I1) and informal cross-border trade occurs at customs (I2). Formal trade is labelled as F.

Enumeration depends mostly on the observation of packaging, which is generally uniform across border posts around Uganda[10]. When needed, enumerators verify by inquiring the traders, custom, security and revenue officers. They also weigh selected goods for further verification. Monitoring is only conducted from 7am to 6pm, which means night activities are not captured, but UBOS notes that underestimation due to this is minimal.[11] The enumerators have no links with the customs or law enforcement.[12]

This BoU-UBOS dataset only captures informal trade flows which take place at established informal border crossings located close to the customs. For example, in Busia, a border town between Kenya and Uganda, there exists two established informal border crossings, where both are within 500 meters from the customs office. The rationale for focusing on established informal border crossings is not only because of data limitations. Firstly, they are routes which are common across Uganda (UBOS, 2006) and other parts of sub-Saharan Africa. More

[10] Although each record represents an observation of a trader, I only have access to the aggregated trade flow.

[11] Of course this cannot be cross-validated. The value of total informal trade captured can be viewed as an underestimation.

[12] Enumerators do not wear uniforms and are even sometimes questioned by the custom officers. I witnessed this at the time of fieldwork in Busia.

importantly, it is a set-up where I can investigate trade costs other than those caused by distances, since the two routes are in such close proximity. Secondly, the sheer value of trade flowing through these crossings is highly visible.

2.1.2 Trade informality measure

I define trade informality as the ratio of informal trade values over total informal trade values. As oppose to measuring trade informality using absolute values of informal trade, this ratio captures the composition of the two types of trade instead of the contraction or expansion of trade. While trade informality can also be measured by a ratio of informal-formal trade values, it will present computation challenges due the presence of zeros in formal trade flows.

To construct this trade informality measure, I match the informal trade values in the BoU-UBOS survey dataset with a dataset of formal trade values by country-pairs, customs and time.[13] This dataset of aggregated customs transactions was provided by BoU. For comparability, I restrict formal trade flows to only those occurring across the land regional borders (i.e. excluding international trade customs such as Entebbe), and with the neighbouring countries. It is not possible to compare informal trade values with formal trade values between Uganda and other trading partners because of the coverage of the ICBT survey data. In addition, ICBT is generally localised and flows between neighbouring countries (Eberhard-Ruiz and Moradi, 2019).

Using the combined dataset, I observe that the level of informality differs across trading partner, the direction of trade and sector (Figure 2). For example, informal trade dominates formal trade when examining flows between Uganda and the Democratic Republic of Congo (DRC), and South Sudan. In contrast, formal trade dominates informal trade for flows between Uganda and Kenya. With Kenya being Uganda's trading partner with the highest GDP, trade values with Kenya is the highest. Low values are observed for flows between Uganda and Tanzania. This is not surprising as the land border which they share is short compared to the land border shared with the DRC, South Sudan and Kenya. Just examining trade informality by trading country masks heterogeneity in the values of informal trade across border crossings

[13] There is no overlap between ICBT flows and formal trade flows as enumerators from the BoU and UBOS only record the under-invoiced amount for the ICBT survey.

within the same border. Figure 3 shows that for each border, there are some border crossings with substantial informal trade activities, in particular Mpondwe at the Uganda-DRC border, Busia at the Uganda-Kenya border and Elegu at the Uganda-South Sudan border.

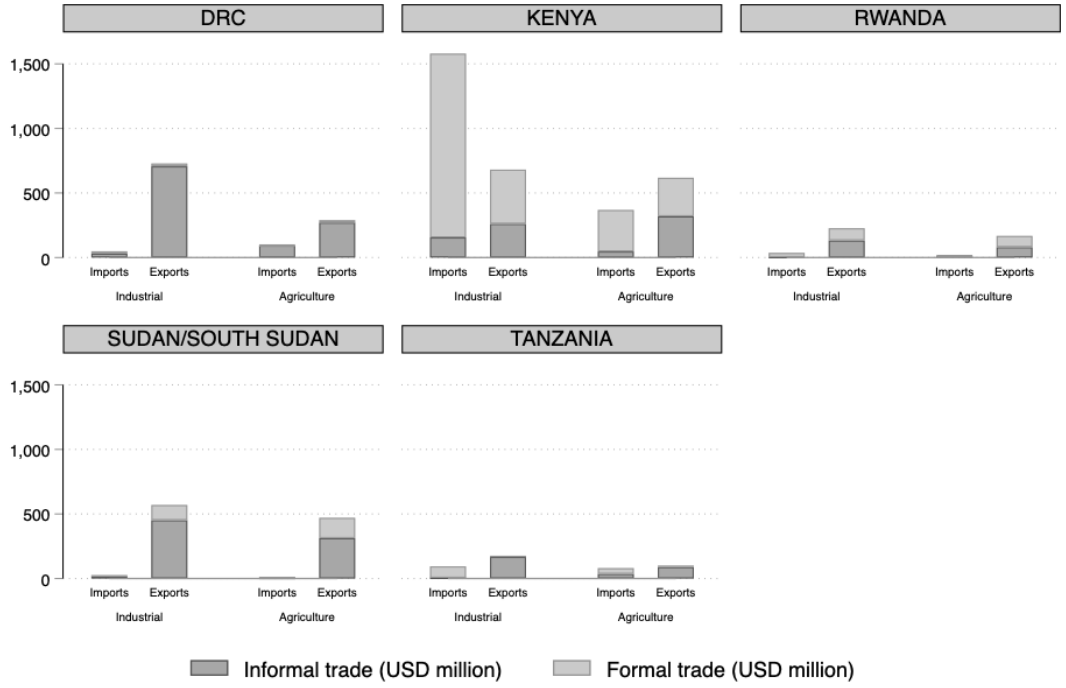

Figure 2: Informal and formal trade between Uganda and its neighbours by trading partner and direction of trade

Total informal and formal export and import values by sector and by trading partner. The values are aggregated across the time period Q1 2010 to Q4 2016. All values are expressed in USD million. Only trade through surveyed land borders as part of the ICBT survey are included. Trade flows are only between Uganda and its neighbours. Formal trade values are entries into customs, provided by BoU. Informal trade values are from the ICBT survey administered by the BoU and UBOS.

2.1.3 Cross-border traders data

To analyse traders' border crossing choices and their border costs, I conducted a cross-border traders survey with traders operating in Busia and Malaba, two border towns between Uganda and Kenya. Busia, in particular, is known for its porous border, partly due to its lack of natural barriers (e.g. a river) (Bhan and Kimani, 2016; Soi and Nugent, 2017; Tyson, 2018). Both border towns have a recently constructed OSBP. Data collection took place from late August 2018 to early October 2018.

The data collection is conducted in two steps. Firstly, I, together with a team of enumer-

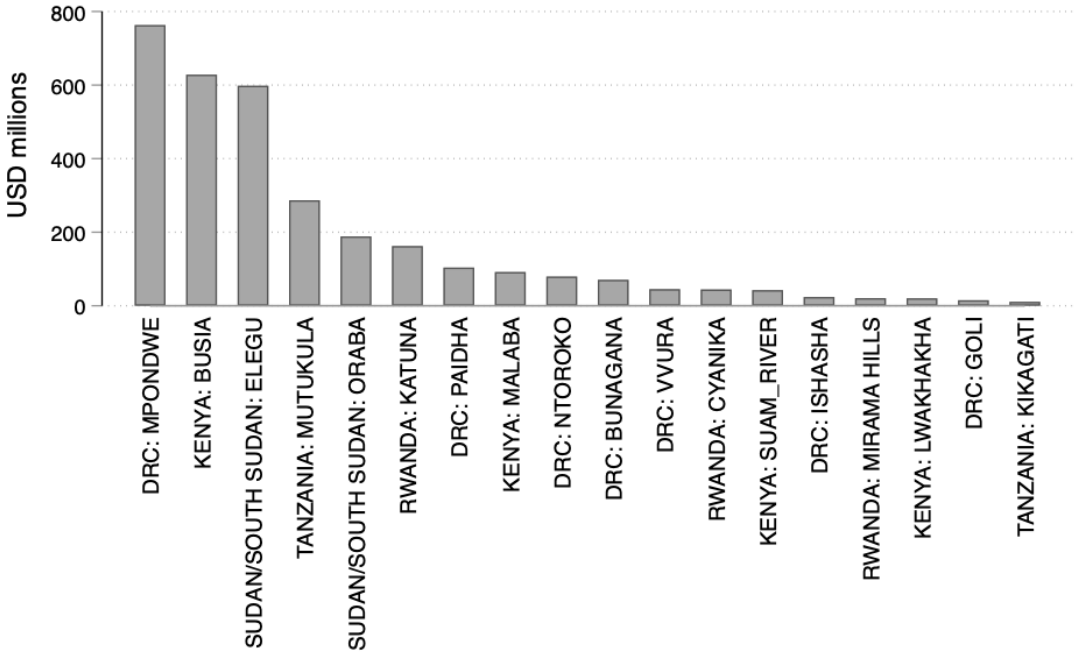

Figure 3: Total informal trade value (export plus imports) between Uganda and its neighbours (USD million) from 2010-2016 by land border crossings.

Total informal trade values by customs. The values are aggregated across the time period Q1 2010 to Q4 2016. All values are expressed in USD million. Only trade through surveyed land borders as part of the ICBT survey are included. Trade flows are only between Uganda and its neighbours. Data is from the ICBT survey administered by the BoU and UBOS.

ators, conducted a census of all the shops and stalls situated within the 1.5 km radius centred at the customs. In this census, we captured both local and regional traders; one of the largest grains market in East Africa is situated in Busia, Uganda. We recorded basic characteristics of 4757 shops and stalls: shopkeeper's gender, size of the shop/stall (small/medium/large/permanent) and broad categorisation of what was being sold. GPS locations were also recorded.

From the census, I randomly selected shops or stalls within specified strata[14]. The strata were constructed according to non-market areas and markets. In Busia Uganda and Busia Kenya, I created five strata each, with four markets for each side of the border. For Malaba, the strata are only according to which country (Uganda or Kenya). 876 interviews were completed and

[14]If the shopkeeper was not present, the enumerator is asked to approach the neighbouring shop. While this might introduce bias, e.g. shops that are not open at that time of the day might have certain characteristics, it is not logistically possible to do otherwise without a large compromise in sample size. I attempt to partly circumvent the bias by randomising the assignment of the areas where enumerators will be working on each day.

usable for analysis[15].

Referring back to Figure 1, this traders' survey captures who crosses the border through I1 (informal border crossing) and who crosses through the customs (I2 and/or F), as well as the payments which traders made as they were crossing the border. This includes both official taxes and informal payments to other agents.

2.2 Border trade costs and the role of trade facilitation

Uganda is a member of the Custom Union of the East African Community (EAC) Common Market. While internal tariffs imposed on other members, Kenya, Tanzania, Rwanda and Burundi, are generally eliminated (Kiuluku and Chekwoti, 2013), there remains ad-hoc tariff rates and a certificate of origin needs to be presented at the customs in order for these favourable tax rates to be applicable. There is a three-band Common External Tariff (CET) in place but 'sensitive products' are excluded from these bands. 66 products (HS8 level) are included in this list of 'sensitive products', and have tariffs which are substantially higher than the maximum 25 percent rate for non-sensitive product (EAC, 2017).

Payments at borders extend beyond tariffs. Although some goods are subject to zero import duties, traders are still required to pay VAT, withholding taxes, excise duties and infrastructure levies when bringing their goods across the border. I rely on border tax data collected by Sauti Africa at the Busia customs from the Ugandan Revenue Authority. Sauti Africa is a social enterprise set up to provide timely and accurate border and price information for traders through a mobile platform. Their information about border taxes are more up-to-date and comprehensive compared to those available in UNCTAD, which only has information about tariffs and in many cases the data are missing.

Cross-border traders also face non-tariff barriers (NTBs) which include inefficient custom procedures, bribery and corruption. According to the NTB tracker (COMESA, EAC, SADC, 2017), 'lengthy and costly customs clearance procedures' is the most common complaint filed by traders. Indeed, the average time for 'border compliance to export' in sub-Saharan Africa was 103 hours in 2016. In addition to delays at customs, surveys have found that a

[15] 21 % refused to respond or did not complete most of the survey

large proportion of respondents have reported high incidences of bribery and/or harassment by custom officers at borders (e.g. at the Kenya-Uganda border (Tyson, 2018) and at the DRC-Rwanda border (Brenton et al., 2013; Mora and Roshan, 2011)).

OSBPs, a trade facilitation measure, have been a key instrument adopted by the EAC to facilitate trade (JICA, 2017). The main objective of the establishment of OSBPs is to 'enhance trade through the efficient movement of goods, persons and services within the Community' (EAC, 2016). While formalisation of trade is not the main objective of this border facility, it has been suggested that the associated decrease in trade costs could incentivise informal traders to trade formally (Lesser and Moisé-Leeman, 2009).

In the EAC, the operation of OSBPs in Uganda is regulated under the East African Community One Stop Border Posts Act (2016) and the East African Community One Stop Border Posts Regulations (2017), as well as bilateral agreements between Uganda and its neighbours. An increasing number of OSBPs have been planned and constructed over the past five years. Within the EAC, 15 border crossings are designated to be converted or have already been converted into OSBPs (EAC, 2016), while 80 OSBPs are being planned, built or are in operation across sub-Saharan Africa (Tralac, 2016). In Uganda, the operational OSBPs in the time period of our data coverage (2010-2016) are listed in Table 1.

Although OSBPs around the world can be set up differently (OECD/SWAC, 2019), the OSBPs in Uganda are set up such that there are two offices on either side of the border, and the trader only needs to enter the office of the destination country. Prior to the operation of an OSBP, a trader would have to enter both offices. In addition, the OSBP offices are designed as open offices, aimed at reducing incidences of bribery. All border-related services are housed inside the OSBP, including various certifications, a revenue office to pay taxes and information desks. The OSBPs operate for 24 hours - this is aimed at providing flexibility to traders crossing the border, as well as providing a secure place for traders to cross.

The OSBP which has been constructed in Busia, a border crossing between Uganda and Kenya, has become a success story for aid for trade (TMEA, 2018, 2017). Since the operation of the OSBP in Busia, the average border-crossing time has been reported to have been reduced by 80%. For example, before the OSBP, a truck took an average of one hour and 26 minutes to

cross the border, compared to only 17 minutes after the OSBP has been constructed (TMEA, 2017). These reductions in delays is especially relevant to those who trade in perishable goods – Bensassi et al. (2019) found that trade in perishable goods is associated with informality. From my traders level data, more than half of the respondents chose 'faster border crossing' as one of the benefits of the OSBP. Other benefits include 'clearer instructions' and 'less harrassment'.

Table 1: Dates when the OSBPs are fully introduced at the custom points.

OSBP	Completed infrastructure	Fully introduced	Border
Mutukula	Q1 2016	Q3 2016	Tanzania
Busia	Q2 2016	Q2 2016	Kenya
Mirama Hills	Q2 2015	Q4 2015	Rwanda
Malaba	Q1 2015	Q2 2016	Kenya

Dates are obtained from Trademark East Africa (TMEA) who is a partner to implementing these OSBPs. 'Completed infrastructure' refers to the date when the construction of the custom building is completed. 'Fully introduced' refers to the date when the border crossing starts to operate as a OSBP where traders only need to be checked once when they cross the border.

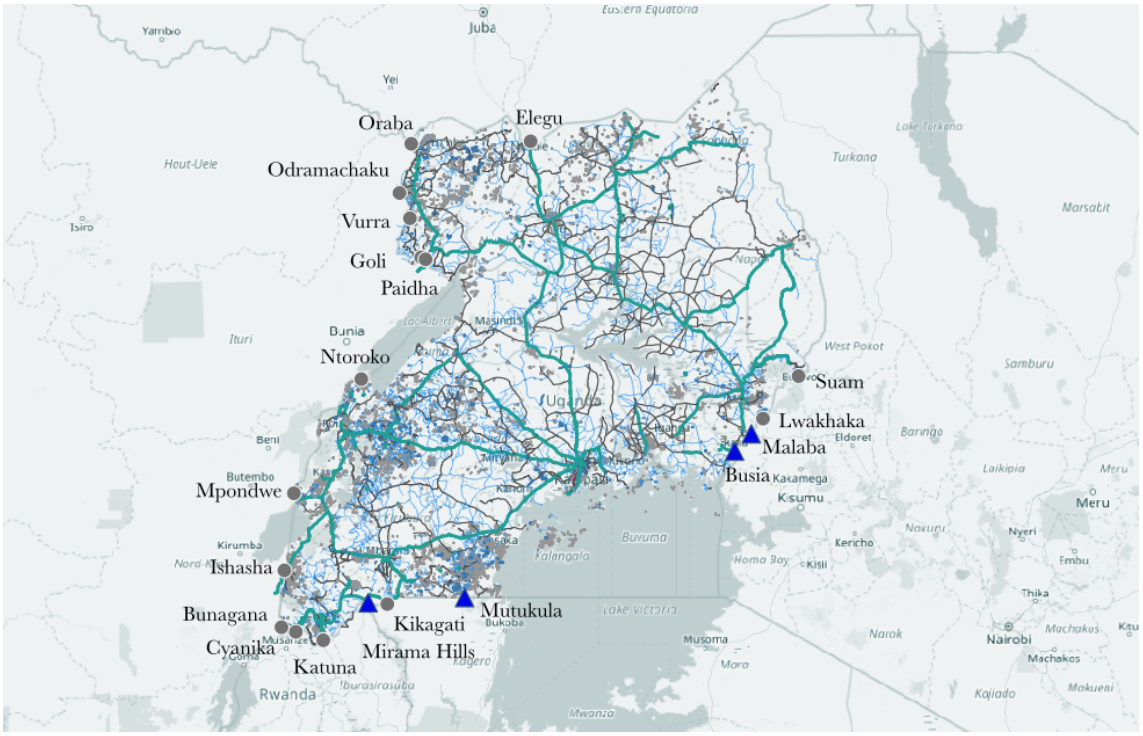

Figure 4: Customs point surveyed by BoU and UBOS

A map of Uganda and its neighbours, with each customs point surveyed by BoU and UBOS labelled. Triangle points are custom points with OSBPs at some point between 2010 and 2016. Lines are roads, including primary, secondary and paths, and are obtained using OpenStreetMap.

3 Conceptual framework

I provide a conceptual framework within the micro-foundations of a gravity model to understand how changes in trade costs could affect traders' decisions to trade formally or informally. Similar to the profit functions in Bensassi et al. (2019), Dutt and Traca (2010) and Yang (2008), traders choose their level of formality depending on their expected costs and benefits. A trader in country o exporting a good x_l face some exogenous bilateral transport costs (iceberg cost) τ and unit production cost w_i. Both formal and informal exporters receive the following profit:

$$\Pi = \pi - \tau w_l x_l \tag{1}$$

where π differs between the three types of traders (see Figure 1).

The formal trader (labelled as F in Figure 1) who passes through the customs and does not evade taxes face the following profit function (Equation 2), where p_l is the unit price of the

good, v^F is variable cost of exporting, which include taxes, time taken to clear goods and harassment by officials, and fixed cost f^F which include costs required for business registration and permits.

$$\pi^F = p_l x_l(1 - v^F) - f^F \tag{2}$$

Following Dutt and Traca (2010), a tariff-evader at the customs has an opportunity to evade a portion $0 < h \leq 1$ of the fixed (f^F) and variable cost of compliance (v^F) and has a profit function of Equation 3. h depends on the honesty of the official – lower h (honesty) means the exporter can evade costs[16]. There is also a cost of evasion, denoted by v^{I2}, such as bribery, and fixed cost, such as establishing networks with brokers and custom officers.

$$\pi^{I2} = p_l x_l(1 - hv^F - v^{I2}) - hf^F - f^{I2} \tag{3}$$

I then extend the profit function of a tariff-evader at the customs to one for an informal trader who crosses through the informal border crossing (denoted as I1 in Figure 1). A trader who crosses through an informal border crossing (I1 in Figure 1) has the following profit function (Equation 4), where v^{I1} are variable costs and f^{I1} are fixed costs to cross through the informal border crossing. Variable costs include efforts from repackaging (Bhagwati and Hansen, 1973; Pitt, 1981) and hiring specific 'transporters' to carry the goods, as well as the possibility that some goods may be lost or stolen on the way due to poor security and poorly paved roads. Fixed costs include the need to establish networks with the officials monitoring those crossings, and efforts needed to gather information regarding the 'way of working' when crossing these informal border crossings[17]. As shown, official taxes and costs of compliance are no longer relevant for these traders' profit function.

$$\pi^{I1} = p_l x_l(1 - v^{I1}) - f^{I1} \tag{4}$$

An informal trader who crosses through informal border-crossing routes will only choose to formalise (i.e. crossing the border through the customs and not evade tax) if the cost of

[16]The level of honesty h is analogous to the level of 'zeal' in Dutt and Traca (2010), where exporters pay less tariffs if the custom official has lower zeal.

[17]In several in-depth interviews, traders revealed to me that during the first time they cross the border to trade, they were accompanied by another friend who was more experienced in cross-border trade activities.

evasion outweighs the benefits (comparing π^{I1} in Equation 4 and π^{F} in Equation 2), satisfying the inequality in Equation 5.[18]

$$\underbrace{p_l x_l v^{I1} + f^{I1}}_{\text{Cost of evasion via I1}} > \underbrace{p_l x_l v^{F} + f^{F}}_{\text{Benefit of evasion}} \tag{5}$$

Similarly, an informal trader who crosses through the customs but evades taxes (I2 in Figure 1) will only formalise if the cost of evasion has outweigh the benefits (comparing π^{I2} in Equation 3 and π^{F} in Equation 2, satisfying the inequality in Equation 6.

$$\underbrace{p_v x_v c^{I2} + F^{I2}}_{\text{Cost of evasion via I2}} > \underbrace{p_v x_v v^{F}(1-h) + f^{F}(1-h)}_{\text{Benefit of evasion}} \tag{6}$$

There is also a possibility that a change in trade costs could lead to traders who have been crossing informal border crossings (I1) to start evading tax at customs (I2) if there is a sufficient increase in the cost of evasion and decrease in benefit of evasion (Equation 7).

$$\underbrace{p_l x_v c^{I1} + F^{I1}}_{\text{Cost of evasion via I1}} > \underbrace{p_l x_v c^{I2} + F^{I2}}_{\text{Cost of evasion via I2}} + \underbrace{p_l x_v h v^{F} + h f^{F}}_{\text{Additional benefit of evasion via I1 compared to I2}} \tag{7}$$

We can apply these scenarios to understand what a trade facilitation, such as the OSBP, can influence traders' formalisation decisions. First, by reducing delays at customs, a trade facilitation measure should reduce v^F and f^F. This means this reduces the benefit of evasion in the perspective of an informal trader operating at informal border crossings (I1). Second, by reducing corruption and the associated harrassment, a trade facilitation measure should increase the honest of officials h. This means that in addition to the reduction in time costs at customs, the benefit of evasion is further reduced for informal traders who evade taxes at the customs (I2). The resulting decisions depends upon the magnitude of these changes and the cost of informality. The direction of the change in informality as a result from a trade facilitation measure is therefore ambiguous.

[18] This is similar to Yang (2008) which evalutes the net benefit of a smuggling route over another.

4 OSBP and trade flow

4.1 Identification strategy

I estimate the change in trade informality associated with an introduction of an OSBP in an augmented gravity model (Equation 8) using a within estimator.

$$\Theta_{vijnt} = \beta_0 + \beta_1 OSBP1_{vijt} + z_{vijnt}\beta_2 + \alpha_{it} + \gamma_{jt} + \delta_{ijt} + \zeta_{nt} + \eta_t + \iota_{vijn} + e_{vijnt} \quad (8)$$

where variable $OSBP1_{vijt}$ is a dummy variable which equals to one if the border crossing v between country i and country j at time t has an OSBP in full operation, and equals to zero if otherwise. The parameter of interest is β_1. $100 \times \beta_1$ provides the change in percentage point of informal-total trade (Θ_{vijnt}) between country i and j for sector n associated with the introduction of an OSBP. There are two sectors, agriculture and industrial. If β_1 is smaller than zero, then the introduction of an OSBP is associated with a decrease in trade informality.

z_{vijt} captures other time-varying customs point-specific factors. I include here precipitation levels[19] which can affect whether or not a border post is open or not and how easy it is to transport goods in less well paved roads. I also include a dummy which indicates when the physical building of the OSBP has been constructed. This is distinct from when the OSBP is in full operation, only after then when traders can clear their goods only once, instead of twice when crossing the border.

α_{it} and γ_{jt} are exporter and importer time-varying fixed effects, which capture the sizes of exporter and importer markets, as well as macro-economic factors in the respective countries. δ_{ijt} is a country-pair fixed effect which captures time-varying policies, including changes in tariffs, border regulations and changes in country-pair political relationships across time. ζ_{nt} captures sector specific time-varying effects, such as seasonality of agricultural trade. η_t captures time trends. ι_{vijn} captures border-crossing effects that are time invariant. This includes particular characteristics of the border crossing, such as whether it has a natural

[19] Location-specific quarterly median precipitation level is obtained from NASA Power. Where exact longitudes and latitudes of a border post is not available, I approximate a location and obtain its longitude and latitude using Google Earth.

barrier or not, and characteristics of the border crossing that are more relevant for a sector, for example whether historically the trading route through that border crossing is for agricultural or industrial products.

This set of fixed effects, and notably the country-pair-time fixed effect, are used to reduce possible bias arising from potentially omitted variables as well as from statistical discrepancies. These discrepancies are non-trivial when using macroeconomic statistics of African economies, as highlighted in Jerven (2013). More generally, analyses on bilateral trade often suffer from the lack of available up-to-date data on tariffs and NTBs (Anderson and Van Wincoop, 2004; Goldberg and Pavcnik, 2016). As our variable of interest varies with customs and across time, country-pair-time fixed effect can be included in the estimation, and reduces the need to include data on tariffs and NTBs explicitly.

I report the definitions and summary statistics of the variables in tables A.1 and A.2.

4.2 Results

I find that the introduction of an OSBP is negatively associated with trade informality (column 1 in table 2), but this association is not significant and small. To understand whether the relationship changes over time, following Baier and Bergstrand (2007), I modify the main specification to account for lagged effects (columns 2 and 3). The estimates suggest that there has been an initial increase in trade informality at the quarter of the introduction, and a decrease in the subsequent two quarters. A F test of the restriction that the summation of the coefficient of $OSBP1_{vijnt}$ and the coefficient of the lagged variable of $OSBP1_{vijnt}$ by one period is equal to zero provides a p-value of 0.2366; a one-tail test of the sum being less than zero is 0.1183. Column (3) suggests that a stronger lagged response is detected in the second quarter compared to the first quarter following the introduction. A F test of the restriction that the summation of the coefficient of $OSBP1_{vijnt}$ and the coefficients of the two lagged variables is 0.0240 and the one-side test provides a p-value of 0.0120. This provides weak evidence that an introduction of an OSBP is associated with a decline in trade informality within the time when it is first introduced and two quarters afterwards.

These associations are different for agricultural and industrial trade. I find that the decline in

trade informality during the two quarters after the introduction of an OSBP is driven mainly by a decline in trade informality in industrial products (column 9). The associations with agricultural trade are not significantly different from zero (column 7).

Table 2: Introduction of an OSBP and quarterly informal-total trade ratio

	(1) All	(2) All	(3) All	(4) All	(5) All	(6) Agriculture	(7) Agriculture	(8) Industrial	(9) Industrial
OSBP at t	-0.0592	0.0310	0.0301	-0.171**	-0.0294	-0.0533	0.0136	-0.0650	0.0467
	(0.0798)	(0.0738)	(0.0731)	(0.0735)	(0.0655)	(0.0985)	(0.0821)	(0.101)	(0.0965)
1 period lagged OSBP		-0.130***	-0.0278		-0.189**		0.00730		-0.0629**
		(0.0372)	(0.0443)		(0.0884)		(0.0985)		(0.0290)
2 periods lagged OSBP			-0.177**		-0.272***		-0.182		-0.173***
			(0.0667)		(0.0404)		(0.112)		(0.0442)
1 period lead OSBP				0.0465	0.0481				
				(0.0661)	(0.0660)				
2 periods lead OSBP				0.0767	0.0690				
				(0.132)	(0.131)				
Precipitation	-0.00620	-0.00391	-0.00150	-0.00560	-0.000904	-0.00466	0.00317	-0.00773	-0.00616
	(0.00830)	(0.00778)	(0.00781)	(0.00979)	(0.00892)	(0.00669)	(0.00673)	(0.0169)	(0.0158)
OSBP construction completed	0.109*	0.108	0.108	0.0488	0.0510	0.207*	0.211*	0.0117	0.00430
	(0.0644)	(0.0640)	(0.0642)	(0.118)	(0.118)	(0.106)	(0.105)	(0.0664)	(0.0645)
R-squared	0.269	0.269	0.269	0.275	0.279	0.421	0.423	0.352	0.358
N	2012	1940	1868	1868	1724	1006	934	1006	934
Degrees of freedom	34	34	34	34	34	28	30	28	30

Within estimates of the associations between introduction of OSBP and trade informality. Bilateral trade flows are restricted to trade between Uganda and its neighbours and is disaggregated by quarters and sector. The definitions of all the variables can be found in Table A.1. Outcome variable is trade informality, defined as informal bilateral trade value divided by total bilateral trade. All regressions include customs-sector-time, time, sector-time, country-time and country-pair-time fixed effects. All outcomes are analysed at bilateral trade flow level by sector. Sample is restricted for the time period between Q1 2010 and Q4 2016. Clustered standard errors by customs in parentheses. * p<0.10, ** p<0.05, *** p<0.01

A decrease in the informality ratio can be driven by several mechanisms: 1) an increase in total trade, with the increase in formal trade larger than informal trade, 2) a decrease in total trade, with the reduction in informal trade larger than formal trade, and 3) a decrease in informal trade that is at similar magnitude as an increase in formal trade, leaving total trade the same.

To explore these mechanisms, I modify the main specification such that the dependent variable is one of (a) total trade values (informal plus formal trade) and (b) informal trade values. I estimate the following augmented gravity model using Poisson pseudo-maximum likelihood

(PPML), including the same fixed effects as our main specification (Equation 8).[20].

$$X_{vijnt} = \exp(\beta_0 + \beta_1 OSBP1_{vijnt} + z'_{vijnt}\beta_2 + \alpha_{it} + \gamma_{jt} + \delta_{ijt} + \zeta_{nt} + \eta_t + \iota_{vijn}) + e_{vijnt} \quad (9)$$

The estimates provide suggestive evidence that the changes in informal and formal trade vary at different times (see table A.3). In the period when an OSBP is introduced, while the association of the OSBP on total regional trade is not significantly different from zero (row 1, panel A), there is evidence showing that informal trade has increased for both agricultural and industrial products (row 1, panel B). This suggests that informal trade increased with a similar decrease in formal trade.

The next period provides a different picture. The OSBP is associated with an expansion in total regional trade in the quarter after the introduction (row 2, column 3, panel A), with an increase in informal trade (row 2, column 3, panel B). This suggests that the decrease in trade informality in this quarter may be due to formal trade expanding more than informal trade. This expansion of trade is then reversed in the second period after the introduction of an OSBP (row 3, column 3, panel A), with a decrease in informal trade (row 3, column 3, panel B). This indicates that the decrease in trade informality in the second quarter may be due to informal trade decreasing more than formal trade. Taking these estimates together, the expansion then contraction of regional trade indicates that the OSBP has not significantly changed the total value of regional trade. Indeed, F test of the null hypothesis that the summation of the three coefficients reported in column 3, panel A is equal to zero provides a p-value of 0.2263. Similarly, there is an initial increase and then decrease of informal trade, with a F test of the null hypothesis that the summation of coefficients at the three time periods reported in column 3, panel B is equal to zero provides a p-value of 0.7176.

If productivity is reflected by the size of traded consignments, informal traders can be cate-

[20]This method proposed by Silva and Tenreyro (2006) addresses selection bias when ignoring zero trade flows and to avoid Jensen's inequality problem when taking logs of the gravity model. By including fixed effects, this augmented gravity model is most similar to Larch et al. (2018), which uses PPML method to estimate the effect of currency unions on bilateral trade flows, and Álvarez et al. (2018) which also uses PPML method to estimate the effect of institutions on bilateral trade. Note that using PPML to estimate the association between OSBP and informal-total trade ratio leads to similar results as when using ordinary least squares. Ordinary least squares is used because only four observations have informal-total trade valued at zero and the ratio is not log-transformed.

gorised by 'small-scale' and 'large-scale', where the later is more productive than the former. The 'small-scale' traders may reflect traders who operate to survive and do not compete with the formal traders, as described by La Porta and Shleifer (2014), whereas the 'large-scale' traders could be viewed as 'parasites' (Levy, 2010), competing unfairly against formal firms, or productive firms who are held back by regulations (De Soto, 1989). I explore the types of traders who are driving the change in value of informal trade. While it is not possible to know the value of each consignment, the BoU-UBOS ICBT dataset is disaggregated by the mode of transport. With the assumption that consignments transported by vehicles, which include cars and trucks, are large in value, and consignments transported by foot, cycle and motorcycle are small in value, I examine whether modes of transport change with the introduction of an OSBP. I modify the main specification (equation 8) by replacing the outcome variable with the proportion of informal trade transported by foot, cycle, motorcycle and vehicle.

Similar to the patterns observed in trade informality, regional trade and informal trade, I find that the mode of transport changes at different time periods after the introduction of an OSBP (see table A.4). The estimates suggest that there is a decrease in the proportion of 'small-scale' informal trade in the first period after the introduction of an OSBP, and an increase in the proportion of 'large-scale' informal trade. This however reverses in the second quarter after the introduction of an OSBP, with an larger increase in the proportion of 'small-scale' informal trade than the decrease in the previous period and a larger decrease in 'large-scale' informal trade than the increase in the previous period. This suggests that the overall decrease in trade informality is mainly driven by a decrease in 'large-scale' informal trade.

4.2.1 Threats to identification and robustness checks

I address different threats to identification in several ways. First, I provide two pieces of evidence to support the assumption that the border posts in where an OSBP is introduced and the border posts which never have OSBPs follow a common trend in trade informality in the counterfactual scenario where the OSBPs were never introduced in any of the border posts. I provide two pieces of evidence to support this assumption. First, I find that the anticipatory effects are not significantly different from zero (see columns 4 and 5 in table 2). A F test of

the coefficients of the two lead variables jointly equal to zero provides a p-value of 0.3123. Second, I apply Callaway and Sant'Anna (2020)'s estimation method for differential timings to treatment. They show that the commonly used ordinary least squares (OLS) estimation with two-way fixed effects produces biased estimates when the treatment effect is dynamic. I use their alternative estimator to test whether there are anticipatory effects. By grouping observations according to when the OSBP is introduced, I estimate the associations between the introduction of an OSBP and trade informality at each time period. I report the estimates in Figure 6. In the figure, each group represents the border posts which have experienced an introduction of the OSBP at the same time, and their respective trade informality is compared with border crossings which did not have an OSBP yet or would never have an OSBP. I find that the influence of the introduction of an OSBP on informal-total trade flows prior to its full implementation is not significantly different from zero. I then use Callaway and Sant'Anna (2020)'s estimator to calculate the aggregate effect size of all groups. The coefficient remains to be small and negative (-0.0804), as well as insignificant (se = 0.0485). To estimate the dynamic treatment effects, the group treatment effects shown in figure 6 are then averaged to obtain the average effects at different time periods after the treatment period. Consistent with the estimates derived from the main specification, estimates show that there is significant decrease in trade informality at the second period after the introduction of an OSBP (see figure 7).

Second, in order to have a more comparable control group, I modify the comparison group by excluding all trade flows which were exporting or importing to and from the DRC and South Sudan. The DRC and South Sudan are not members of the EAC, and so their trade agreement with Uganda is legally different from Kenya, Rwanda and Tanzania. Results remain consistent (see table A.5).

Some assumptions are made with regards to the ICBT flow survey data. Firstly, as enumeration only takes place two weeks each month, I assume that the up-rating model employed by UBOS and BoU is reflective of the reality.[21] Any systematic underestimation or overestimation of ICBT flows is assumed to be uncorrelated with the introduction of the OSBP. There may be

[21] The up-rating model is recommended by Ackello-Ogutu (1996). The formula used is documented in UBOS (2006).

concerns that this up-rating model changes in order to produce certain more optimistic results with the introduction of the OSBP. For example, would civil servants working in UBOS be incentivised to change ICBT data such that data shows there is a decrease in informal trade? By interviewing those involved in collecting the data and by observing the enumeration process, I am confident that this possibility can be ruled out due to the following reasons. First, the exact date when OSBPs are fully implemented is not widely known. This date is different from the date when there is a ceremony to promote the new border facility, as the OSBP is fully functional before the ceremony. In order to obtain the exact dates, I had to ask the manager who was directly involved in constructing the OSBPs. Second, those compiling the raw data are working under UBOS, which has limited incentives to produce results for trade policy. Third, even if there are incentives, through my interviews with government officials, the main objective of the OSBPs is not to reduce informality, but rather to reduce border-crossing times.

I also assume that any observations not captured by the enumerators during that period of data collection is missing at random, and that measurement error is not correlated with the introduction of the OSBP. I argue this assumption is strong, but reasonable. Some enumerators have reported that it is harder to enumerate at some customs compared to others due to the physical condition of border crossing, but this difference should be constant across time. In addition, the enumerators have been assigned to different border posts each month; enumerators are only told which custom post they will be fielded at a week or so before the assignment. To validate the quality of the UBOS-BoU ICBT survey data, I compare the ICBT survey data gathered by the Kenyan Bureau of Statistics. As the two countries share the border, I compare the goods traded and the values of the border posts which they have in common.[22] I find that the composition of goods and the value of goods recorded by the two statistics offices are generally consistent and highly correlated (see figure 8).

For inference, while the main results use clustered standard errors by country-pair and customs, I also find estimation using clustered standard errors by country-pair, which is the standard practice for gravity model estimations, to be consistent (see table A.6).

[22]These are only agricultural products since I only have informal trade collected by BoU and UBOS disaggregated at HS4 level for agricultural trade.

5 Traders-level analysis

While the above analysis using aggregate trade flow data enables us to understand the changes in trade informality associated with the introduction of an OSBP across border points in Uganda, it is not possible to disentangle the dynamics of the entry and exit of traders and changes in the volumes of consignments, with the actual switches of individual traders from trading informally to trading formally. To explore this, I use trader-level data which my enumerators and I have collected in two of the major border towns between Kenya and Uganda to understand which traders have formalised (or in-formalised) after the OSBP has been operation. I also examine the drivers behind informality amongst cross-border traders by turning back to the micro-foundations of the augmented gravity model (i.e. referring to the inequalities in equations 5, 6 and 7).

5.1 Did informal traders formalise?

Survey responses provide evidence that there is a lack of switching between formal and informal trade. Only 5% of cross-border traders said that they had switched their main border-crossing route since 2016, the operating year of the OSBP in Busia and Malaba. Amongst those that switched, 73% changed their main border crossing route from an informal channel to the official customs crossing; 18 percent changed from official crossing to informal crossing; 9% changed between different informal border crossings. For those that have switched to the official customs crossing, three-quarters of them stated that the previous route was too dangerous or that official route is now safer, and the remainder attributed the change to the official route having better facilities and being less costly. None of these traders who switched to the official crossing have changed the products in which they trade, but most of them self-reported having increases in sales since they switched.[23]

I then explore the latent demand for formalisation by incorporating a hypothetical scenario in the questionnaire.[24] 19% of those who cross informally said that they would not change to

[23]The possible responses were 'Increased', 'Stayed the same' and 'Decreased'. These responses need to interpreted with caution since only a small sample switched the border-crossing routes.

[24]The question was asked to the cross-border traders whose main border crossing route is informal: 'If I pay you [X] will you change your route to the gazette crossing?'. The question was asked to the cross-border traders

crossing through the customs for any amount of money, while 55% of those who cross formally said that they would not change to an informal border crossing for any fee. The responses are different between traders surveyed in the Kenyan side of the towns and Ugandan side of the towns: only 6% of the Ugandan cross-border traders said that they were not willing to change their border crossing route at any price, while this percentage is 42% for responses in the Kenyan side of the towns. Even amongst those who responded in Uganda and were willing to switch, the price they would require is high: 52% chose 'More than UGX 1,000,000' (approximately USD 270). When faced with the question of whether they would cease trading entirely if the option of an informal border crossing no longer existed[25], a quarter of the informal cross-border traders stated that they would stop trading.

In the next section, I examine the factors which associate with the border-crossing decisions to better understand why so few traders have switched despite the reduction in trade costs at customs.

5.2 Who chooses to cross informally?

5.2.1 Identification strategy

I use probit estimation with sample selection to examine the factors behind the persistence of informality amongst cross-border traders[26]. Sample selection is needed as not all traders are cross-border traders and these cross-border traders are not randomly selected. In order to estimate the two equations simultaneously, there must be a variable which exists in the selection equation (Equation 10) and not the outcome equation (Equation 11).

The selection equation is similar to the specification used by Sequeira (2016) in her firm level

whose main border crossing route is formal: 'If I pay you [X] will you change your route to the Sofia or Marachi crossing?'. The enumerator only reveals the next choice if respondent says no. For surveys implemented in the Ugandan side of the towns, the choices were 1) UGX 100,000 2) UGX 200,000 3) UGX 500,000 4) UGX 1,000,000 5) More than UGX1,000,000 6) I will not change for any price. For surveys implemented in the Kenyan side of the towns, the choices were: 1) KES 3000 2) KES 5000 3) KES 10,000 4) KES 20,000 5) More than 20,000 6) I will not change for any price. The options are chosen through an initial round of focus group testing.

[25] Survey question is 'If you can only go through the gazette crossing, will you continue to trade?'

[26] I define the respondent as a cross-border trade if he/she bought or sold a good across the border in the past seven days. This underestimates the number of cross-border traders, but asking respondents to recall trading activities, such as specific amount bought and sold, is highly inaccurate for duration beyond a week. Most respondents reveal that they do not keep a monthly record of their sales and purchases

analysis of the effect of bribery on the extensive margin of trade. Here, the decision to conduct cross-border trade is captured in D_i, which is valued as one if a trader bought goods across the border, and zero otherwise. In this selection equation, there are factors which influence exporting/importing decisions but not the border crossing path z_i. There must be at least one element in this vector.

The border-crossing decision is captured by Θ_i, which is valued as one if the main border crossing route chosen by trader i is through the customs and zero otherwise. This decision depends on the border regulations T_n imposed at the border for product n. I include here export restrictions as well as the common external tariff (CET). The CET should not be applicable to the products being traded between Uganda and Kenya as it is only imposed on imports from non-EAC state to an EAC state. This is still relevant because those who are not able to present the adequate documentations to show the origin of the product would not be able to benefit from the zero tariff rates between the member states. I also include traders' characteristics (captured in the vector X_i), such as traders' age, gender, education level and information access. I report the definitions and summary statistics of these variables in tables A.8 and **??**.

$$D_i = (T_n\beta_1 + X_i\gamma_1 + z_i\delta + u_i > 0) \tag{10}$$

$$\Theta_i = \alpha + T_n\beta_2 + X_i\gamma_2 + \epsilon_i \tag{11}$$

5.2.2 Selecting exclusion restriction

I identify the exclusion variable by examining the reasons behind being a cross-border trader, and the reasons behind choosing the specific border crossing. The responses from the survey show that the reasons for these two decisions are distinct (see table A.7). The reasons for importing are directly related to the profit of a trader's business, such as the price of the goods across the border compared to the domestic market and the quality of the goods. The choice of border-crossing route is mainly driven by the security of the route. From informal interviews, traders frequently voice their concerns about crossing the border at night (for example when they have travelled from the capitals and reached the border at night).

With the results of the survey responses, the variable which I use as the excluded variable

is the method of gathering price information. The ability to gather accurate, timely price information can improve firm profitability. I use a dummy variable which captures whether or not the trader uses a mobile platform, internet or calling other people to gather price information. Mobile platforms should in theory provide more timely and accurate price information and thus affect the ability of traders to source and sell goods at more competitive prices (Jensen, 2007; Aker and Mbiti, 2010; Aker and Fafchamps, 2014). In the set of control variables, I include the variable capturing the method of gathering border information so to ensure that exclusion variable only captures the variation in the source of price information. I assume that the method of gathering price information does not have a role in influencing a traders' choice of whether or not to cross the border formally or informally, except through the channel of increased profitability.

5.3 Results

I find that export restrictions play a role in determining whether the trader uses the customs or informal border crossing as their main trading route (see table 3). Export restrictions have a negative and significant association on whether a trader crosses the border through the customs (column 1). This provides support to Porteous (2017)'s finding that informal trade is related to the ineffectiveness of export bans of grains in Tanzania. I do not find that the common external tariff (CET) has a significant association with the choice of border crossing route (column 2).

Moving beyond official regulations, gender plays an important role in determining the choice of border crossing. Male traders are less likely to use the customs compared with female traders. The fact that the gender of the trader matters reflect the persistence of informality in border crossing choices. Even with smoother border crossing at customs, and even if taxes are lowered, the gendered aspect of trade costs remains. I examine in section 5.4 whether the gendered nature of border-crossing choice might be partially explained by informal payments. I also find that those who trade in perishable products, such as fruits and vegetables, are more likely to use the informal border crossing. Due to the time-sensitivity of these products, the reduction in delays may need to be much lower for these traders to switch to a formal

crossing.

Training also have a positive association with the likelihood that the trader chooses to cross the border formally. Training sessions have been conducted in Busia and Malaba through various bodies, from the Ministry of Trade to international organisations, such as TradeMark East Africa, the World Bank and USAID, and charities and social enterprises, such as Sauti Africa, World Vision and EASSI. There are also several accounts of those who received training from banks such as the Equity Bank and DFC bank. Almost all responses find these training sessions beneficial for their businesses. Relatedly, having the knowledge of Simplified Certificate of Origin (SCOO) is positively associated with the decision to cross the border formally.[27] While the direction of this relationship is expected, not all cross-border traders who know about the SCOO reported using it. According to the survey responses, some traders reported that they never used it and some only used it occasionally. Over half of those who knew about the SCOO continue to use the informal border crossings as their main trading route. While it might be the case that officials do not always accept the SCOO, this does not appear to be true in Busia and Malaba. Nearly all traders (93%) report that the custom officers have accepted their SCOO without any problems.[28].

[27]This is a simplified clearance form which can be used by traders who are trading goods originated from EAC partner states and the value of traded goods is USD 2000 or below.

[28]Question was asked to the respondent 'During the last time you crossed the border, did the custom officer accept the Simplified Certificate of Origin?' The choices are: 1) Yes without any problems 2) Yes, but need to pay 3) No, not accept.

Table 3: Cross border traders' border crossing decision: formal or informal?

	(1)	(2)
Cross via customs		
Age	-0.0140	-0.0112
	(0.0107)	(0.0143)
Male	-0.396***	-0.358***
	(0.118)	(0.0969)
Education	0.0371	0.104***
	(0.0301)	(0.0176)
kiswahili	0.289*	0.200
	(0.153)	(0.126)
Employee dummy	-0.166	-0.114
	(0.188)	(0.255)
Perishability	-0.370**	-0.403*
	(0.172)	(0.214)
Received training	0.463**	0.482**
	(0.233)	(0.204)
Know SCOO	0.591***	0.663***
	(0.227)	(0.244)
Threatened to confiscate good, pay bribe	-0.251	-0.233
	(0.240)	(0.268)
Border info: digital	-0.233	-0.231
	(0.268)	(0.304)
Export restricted	-0.644***	
	(0.220)	
Import duty (CET)		-0.0621
		(0.607)
select		
Age	-0.0102**	-0.0110***
	(0.00439)	(0.00379)
Male	0.0183	-0.0312
	(0.158)	(0.155)
Education	-0.0471	-0.0681
	(0.0932)	(0.102)
kiswahili	0.301**	0.365***
	(0.138)	(0.137)
Employee dummy	-0.438***	-0.483***
	(0.142)	(0.167)
Perishability	0.442**	0.456**
	(0.217)	(0.182)
Received training	0.328*	0.356**
	(0.174)	(0.152)
Border info: digital	0.296***	0.234**
	(0.113)	(0.0970)
Export restricted	0.444	
	(0.392)	
Import duty (CET)		0.805
		(1.122)
Price info: digital	-0.332***	-0.263**
	(0.113)	(0.112)
Rho	0.706	0.517
Test indept Chi-squared	9.385	3.243
Test indept p-value	0.00219	0.0717
N	686	686

Probit estimates of the associations between traders' characteristics and decision to cross the border formally. Lower panel reports the estimates for the selection equation where traders self-select as cross-border traders (either exporters or importers). Upper panel reports the estimates for cross-border traders only, and is the equation of interest. The outcome variable is a binary variable which is valued as one if the cross-border trader crosses using an informal border crossing and zero otherwise. The definitions of all the variables can be found in Table A.8. Include samples taken in Uganda and Kenya sides of the border towns Busia and Malaba. Missing covariates are dummied out. Clustered standard errors by strata in parentheses. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

I address the potential threat of omitted variable bias by including behavioural variables. Specifically, I elicited risk aversion and recall ability following De Mel et al. (2013)'s method.[29] While recall ability is not significantly associated with decision to cross the border formally, high risk takers are positively related to the decision to cross the border formally (see table A.10). This could be the case when perceived risk, such as harrassment or unexpected bribe extraction, is higher at the customs than at informal border crossings.

Characteristics of importers could be of particular interest since they usually face higher border taxes compared to exporters. The results remain similar when analysing only importers in the decision equation (see table A.11).

5.4 Taxes and border payments

The results reported in section 5.3 reveal certain factors which may explain some of the challenges in formalising existing informal traders. Here, I further explore the extent to which the significant factors identified to be associated with a trader's choice of border crossing are partially explained by border costs.

There are a number of different agents that traders may need to pay when they conduct informal cross-border trade.[30] These payments (which are per one dollar traded) are plotted against CET (Figure 5).

The first observation is that, for all payments, they are on average low in value compared to the traded value (less than 1% of value of good). They are however paid each time that the trader crosses the border, meaning that these low-value payments add up. Almost a third of the cross-border traders in the survey cross daily, and 56% of them cross weekly.

[29] De Mel et al. (2013) examined formalisation of firms in Sri Lanka. To elicit risk, they asked the respondent 'are you generally a person who is fully prepared to take risks or do you try and avoid taking risks' with a scale from 0 to 10. Although in my survey the question and the scale were the same, I found that many respondents answered 10 as if the question was a binary one (prepared to take risks or not). As in De Mel et al. (2013), the respondents were not financially incentivised for this question. As such I coded the risk aversion variable as binary. For eliciting recall ability, I followed De Mel et al. (2013)'s survey in providing numbers for the respondent to recall. I also included one example (four digits to recall) then for the actual enumeration respondent are tested up to eight digits. The enumeration is according to when the respondent made a mistake, i.e. 1 is enumerated if the respondent was incorrect in recalling the five digits of the first test. If the respondent was correct, the respondent was asked to recall six digits.

[30] The different types of informal payments faced by cross-border traders are also documented in Sierre Leone by Van den Boogaard et al. (2018a).

The second observation is that there is heterogeneity in the variation of the payments for different receivers. The first type of payment are informal payments (see top left graph).[31]. They are usually given to the officials outside custom offices and in the case of informal routes, officials are stationed to collect these payments at established paths. For those trading in goods which have a CET rate of 25%, informal payment varies considerably – in some instances, the value is higher than for those who trade goods with higher import duties. The second type of payment is to the transporter (see top right graph). These transporters, usually with connections with those working in the customs, are specifically hired to carry goods to cross the border on behalf of the trader while the trader waits on the other side of the border. The total payment therefore includes any extra payment that the transporter has to pay at the border, as well as the wage of the transporter and fuel expenses. The payments are the highest for those trading in goods with a CET of 100%, but is relatively flat for other products. The third type of payment is the payment to brokers (bottom left graph). Brokers are usually hired to assist in buying and selling in markets. For example, a buyer of grains may not know which seller has better value or quality. A broker can help the buyer or seller to execute the transaction and can even load the goods directly to the transporter's vehicle. The third type of payment is to the officer at the trade information help desks. These help desks were set up by COMESA and the EAC to assist traders in crossing the border formally. Situated inside the OSBP, the trade information help desks are where traders obtain the SCOO. Most traders who do use the SCOO do not complete the forms themselves, but go to the help desk where the officer helps them to fill it in. These services are supposed to be free, but the survey data suggests that this is not always the case.

[31] Also called kitu kidogo, Kiswahili term for petty corruption, literally translated as 'little something'.

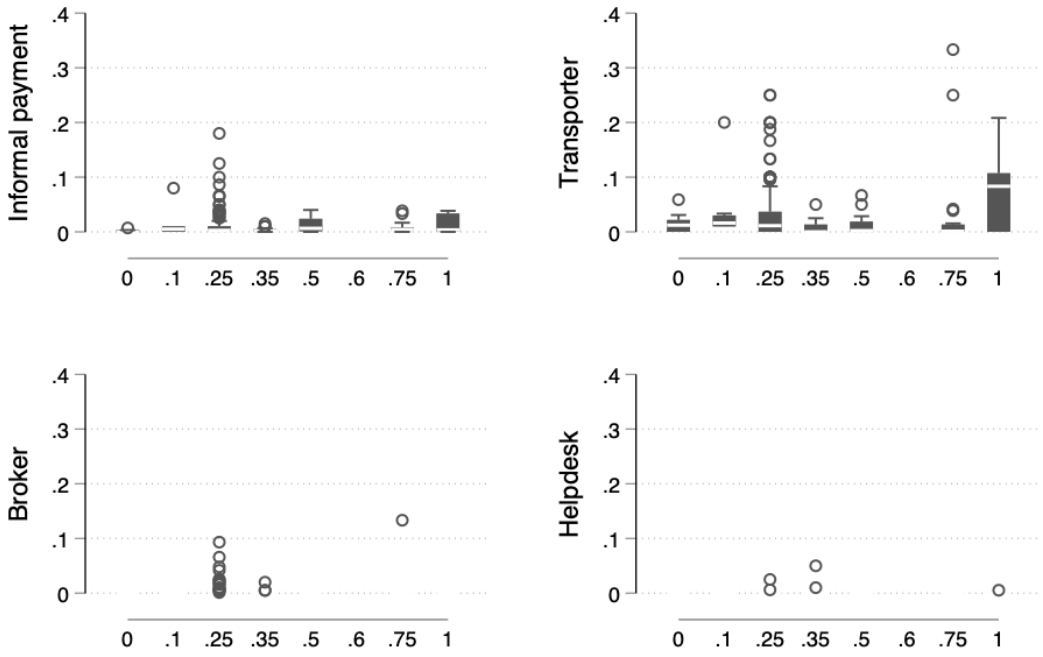

Figure 5: Border payments in USD per USD 1 value of goods against CET import duty

Value of different types of border payments, expressed as USD per USD 1 value of goods traded across the border. Top left graph presents informal payments; top right graph presents payments to transporters who carry goods across the border; bottom left graph represents payments to brokers; bottom right graph represents payment at the help desk. X-axis shows the Common External Tariff imposed to goods outside the EAC.

To understand the factors which determine these border payments, I regress the following using an OLS estimation:

$$payment_i = \alpha + \beta T_n + X_i\gamma + u_i \tag{12}$$

where $payment_i$ is the amount paid at the border during the most recent time that the trader i crossed the border, T_n is the official regulation imposed on good n, X_i is a vector of traders' characteristics and u_i is the error term.

I find that gender of the trader is the main factor which is associated with the amount of informal payments paid (see column 1, table A.12). The estimates suggest that male traders tend to pay less informal payments compared to their female counterparts. These results point to the gendered aspect of trade costs – males face lower informal payments compared to women. This may partially explain the previous finding that there is a higher likelihood of male traders crossing the border informally than female traders.

6 Conclusion

This study examines the relationship between trade informality and trade costs. Informal trade flows include both under-invoicing at customs and trade at established informal border crossings. I use the introduction of a One-Stop-Border-Post – a border facility which combines two border posts into one to reduce border delays and corruption – as the vehicle through which trade costs are reduced at customs.

I find suggestive evidence showing that the introduction of the OSBP is associated with a lagged response in total regional trade, informal plus formal trade, between Uganda and its neighbours: first an expansion and then a contraction. The resulting aggregate is small and insignificant. While this is inconsistent with the studies related to facilitation, where these measures are generally trade creating (Portugal-Perez and Wilson, 2012; Wilson et al., 2003; Fernandes et al., 2016; Sant'Anna and Kannebley Júnior, 2018), it is not surprising. These studies exclude informal trade and include international trade flows, participants of which may face different sets of barriers that do not exist for those participating in regional trade. For example, traders participating in international trade may face more stringent regulations imposed by international trade partners, and thus require deeper networks and expertise to successfully evade tax. Future research can seek to understand the heterogeneity in border costs faced by regional and international traders. Further analysis at sectoral and product level could also reveal productivity implications.

I find suggestive evidence that there is a lagged response in trade informality, which is reduced in the two quarters after the quarter of the introduction of an OSBP. I find indicative evidence that informal trade has expanded and then contracted, with the contraction mainly driven by 'large-scale' informal trade. Referring back to the three perspectives of informal firms – those pulled by regulation (De Soto, 1989), those who are 'parasites' (Levy, 2010) and those who are unproductive survivors (La Porta and Shleifer, 2014), this pattern suggests that the introduction of an OSBP has led to a decrease in trade conducted by the first two types of informal traders, who may be competitors of formal traders, and an increase in trade participated by the survivors, who are less likely to be competitors of formal traders.

By using trader-level data, I find that hardly any of the traders switched their border-crossing

routes. This suggests that the changes in trade informality as a result of the OSBP observed in the trade flow level analysis is due to traders entering and exiting the market, or changing the volumes of their consignment, rather than individuals switching from informal to formal trading activities. This finding echoes the stickiness of informality found in previous studies in other contexts (La Porta and Shleifer, 2014). In this study, due to the nature of the OSBP, I am not able to the effect of the change in cost of compliance and the effect of the change in cost of non-compliance. With separation of these two forces usually examined through interventions implemented on domestic traders (Monteiro and Assunção, 2012; De Mel et al., 2013; Rocha et al., 2018), further research can seek to understand whether these findings extend to the context of cross-border traders are needed.

I also find that the factors beyond trade policy matters for trade informality. First, I provide the gendered nature of trade, which is consistent with what was observed in West African networks (Walther and Tremolieres, 2018). In particular, the finding that women traders face higher informal border payments than male traders resonate with other studies which show that informal payments and taxes are biased against women (e.g. amongst market traders in Zimbabwe (Ligomeka, 2019), households in Sierre Leone (Van den Boogaard, 2018), and toilet-usage fees amongst market traders in Tanzania (Siebert and Mbise, 2018)). More research is needed to understand the gender differences in costs imposed on cross-border traders. Understanding these costs could inform relevant trade policies to allow for more inclusive participation in the exporting and importing market. I also find evidence that product characteristics matter. This is in line with the importance of time costs, which disproportionately burdens those who trade in perishable products, as observed in Benin (Bensassi et al., 2019). Acknowledging that this study does not have an exogenous change to informality at the micro-level, further research can seek to understand the causes of trade informality.

This study seeks to estimate the effect of a reduction in trade costs, through trade facilitation, on formalisation of trade and attempts to unpack the persistence of informality. Such persistence of informality could mean that total regional trade might shrink if formality is abruptly and stringently enforced. The potential loss of traders, and a potential reduction in the flow of goods, particularly staples, has important implications for the welfare of not just the traders

themselves, but also for regional food security and the region's vulnerability to external shocks.

A Appendix

A.1 Trade flow analysis

Table A.1: Description of key variables for trade flow analysis

Variable	Description	Source
Informal-total trade ratio	Informal trade/Informal+formal trade	UBOS, BoU
Informal trade (USD)	Informal trade values from ICBT	UBOS, BoU
Formal trade (USD)	Formal trade recorded at customs	BoU
Agriculture (d)	Equals 1 if sector is agriculture, 0 if industrial	BoU
OSBP in operation	Equals 1 if OSBP is in full operation in that quarter, 0 otherwise	TMEA
OSBP construction concompleted	Equals 1 if physical infrastructure of customs is completed in that quarter, 0 otherwise	TMEA
Precipitation	Median precipitation per day of that quarter (mm)	NASA Power

Table A.2: Summary statistics of trade variables

Variable	Obs	Mean	Std. Dev.	Min	Max	P50
Informal-total trade ratio	2012	.727	.347	.001	1	.934
Total trade (USD million)	2016	3.157	6.776	0	60.321	.453
Informal trade (USD million)	2016	1.585	3.429	0	34.919	.279
Formal trade (USD million)	2016	1.573	5.544	0	59.303	.023
Foot (prop of informal)	2012	.148	.195	0	.937	.067
Cycle (prop of informal)	2012	.236	.25	0	.996	.144
Motorcycle (prop of informal)	2012	.132	.192	0	.949	.037
Vehicle (prop of informal)	2012	.382	.345	0	1	.311
Agriculture (d)	2016	.5	.5	0	1	.5
OSBP at t	2016	.026	.159	0	1	0
OSBP construction completed	2016	.044	.204	0	1	0
Precipitation	2016	2.163	1.415	0	7.21	2.13

Table A.3: Introduction of an OSBP and quarterly regional trade values

	(1) All	(2) All	(3) All	(4) Agriculture	(5) Agriculture	(6) Industrial	(7) Industrial
Panel A: Total regional trade (USD)							
Total trade (USD)							
OSBP at t	0.699	0.916	0.912	0.833	0.795	0.609	0.966*
	(0.614)	(0.603)	(0.604)	(0.640)	(0.769)	(0.610)	(0.548)
1 period lagged OSBP		-0.287***	0.519***		0.890***		0.289
		(0.0829)	(0.148)		(0.303)		(0.211)
2 periods lagged OSBP			-1.271***		-1.337***		-1.226***
			(0.342)		(0.454)		(0.318)
N	2016	1944	1872	1008	936	1008	936
Degrees of freedom	34	34	34	28	30	28	31
* p<0.05, ** p<0.01, *** p<0.001							
Panel B: Informal trade (USD)							
Informal trade (USD)							
OSBP at t	1.420*	1.825***	1.822***	1.622**	2.033***	1.286*	1.719**
	(0.730)	(0.703)	(0.703)	(0.738)	(0.763)	(0.771)	(0.705)
1 period lagged OSBP		-0.532***	0.410*		0.623		0.213
		(0.126)	(0.213)		(0.516)		(0.182)
2 periods lagged OSBP			-1.547***		-1.916***		-1.276***
			(0.442)		(0.577)		(0.393)
N	2016	1944	1872	1008	936	1008	936
Degrees of freedom	34	34	34	28	30	28	30

PPML estimates of the associations between introduction of OSBP and bilateral trade flows. Bilateral trade flows are restricted to trade between Uganda and its neighbours and is disaggregated by quarters and sector. The definitions of all the variables can be found in Table A.1. Outcome variable for Panel A is total bilateral trade between Uganda and its neighbours, expressed in USD. Outcome variable for Panel B is informal trade between Uganda and its neighbours, expressed in USD. All regressions include the control variables *OSBP construction completed* and *precipitation*, but are not reported. All regressions include customs-sector-time, time, sector-time, country-time and country-pair-time fixed effects. All outcomes are analysed at bilateral trade flow level. The time period covered is from Q1 2010 to Q4 2016. Clustered standard errors by customs in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table A.4: Introduction of an OSBP and informal trade transported by different means

	(1)	(2)	(3)	(4)
	Foot	Cycle	Motorcycle	Vehicle
OSBP at t	0.0342	-0.0268	-0.0720	-0.00132
	(0.0351)	(0.0358)	(0.0519)	(0.0614)
1 period lagged OSBP	-0.0566*	-0.0189	0.0139	0.0967**
	(0.0311)	(0.0231)	(0.0268)	(0.0403)
2 periods lagged OSBP	0.0808**	0.107**	-0.0205	-0.176**
	(0.0321)	(0.0446)	(0.0224)	(0.0751)
R-squared	0.250	0.295	0.238	0.254
N	1868	1868	1868	1868
Degrees of freedom	34	34	34	34

Within estimates of the associations between introduction of OSBP and informal trade transported by different means. The definitions of all the variables can be found in Table A.1. Outcome variable for Column 1 is the value of informal trade transported across the border by foot divided by total value of informal trade. Outcome variable for Column 2 is the value of informal trade transported across the border by bicycle or tricycle divided by total value of informal trade. Outcome variable for Column 3 is the value of informal trade transported across the border by motorcycle divided by total value of informal trade. Outcome variable for Column 4 is the value of informal trade transported across the border by vehicle (e.g. car or truck) divided by total value of informal trade. Consignments transported by foot, bicycle, tricycle and motorcycle are interpreted as 'small-scale', and consignments transported by vehicle are interpreted as 'large-scale'. All regressions include the control variables *OSBP construction completed* and *precipitation*, but are not reported. All regressions include customs-sector-time, time, sector-time, country-time and country-pair-time fixed effects. All outcomes are analysed at bilateral trade flow level. The time period covered is from Q1 2010 to Q4 2016. Clustered standard errors by customs in parentheses. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

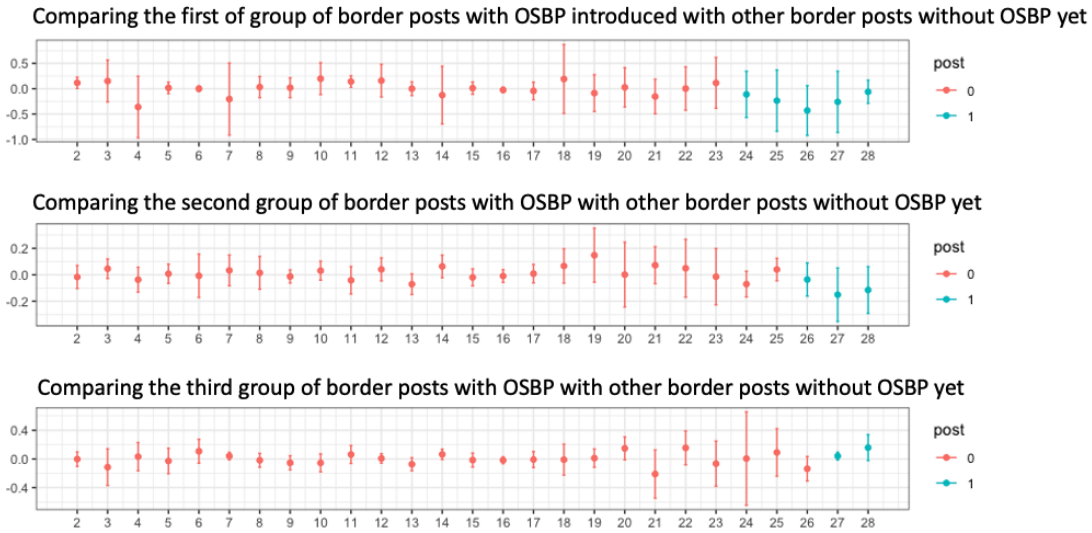

Figure 6: Pre-trend test

Point estimates of the associations between introduction of OSBP and trade informality using the estimator proposed in Callaway and Sant'Anna (2020). 95 percent confidence level intervals are shown. Outcome variable is trade informality defined as informal trade values divided by total trade values in USD. No control variables or fixed effects are included. Sample is restricted for the time period between Q1 2010 and Q4 2016. Each group represents the group of trade flows which are treated at the same time. The first group (top) is treated first. There are two treated of border posts in this first group. The second group (middle) is treated second. The third group (bottom) is treated last. There is one border post treated in in the second and third group. Red points represent point estimates of the association before the implementation of OSBP for that group. Green points represent point estimates of the association after the implementation of OSBP for that group. X-axis represents the time period. For example in reverse order, 28 is equivalent to time at Q4 2016 and 27 is equivalent to time at Q3 2016.

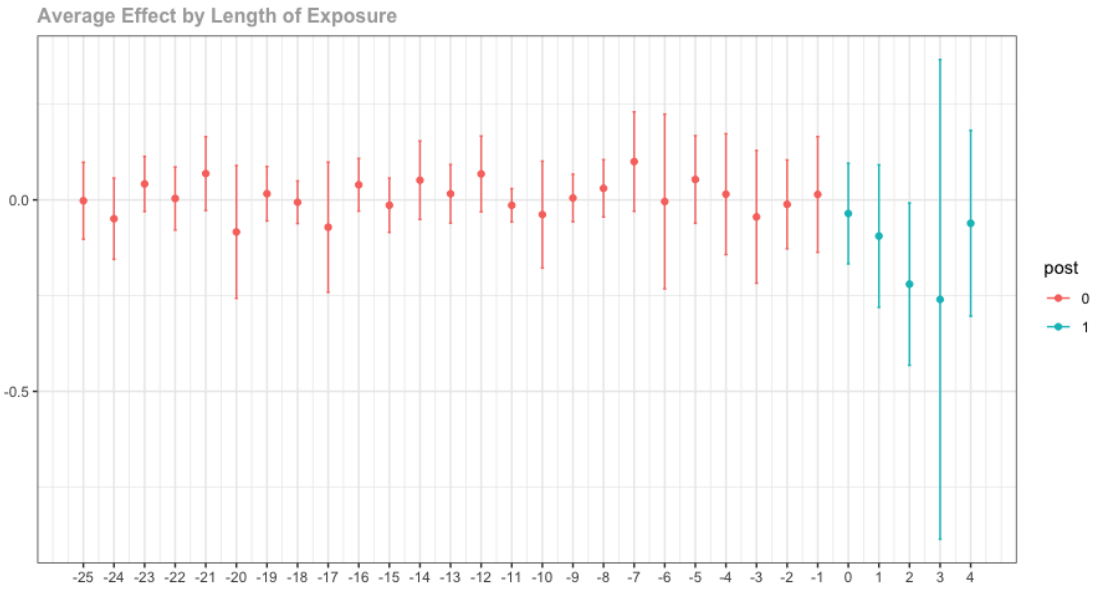

Figure 7: Aggregate dynamic effect

Point estimates of the associations between introduction of OSBP and trade informality using the estimator proposed in Callaway and Sant'Anna (2020). 95 percent confidence level intervals are shown. Outcome variable is trade informality defined as informal trade values divided by total trade values in USD. No control variables or fixed effects are included. Sample is restricted for the time period between Q1 2010 and Q4 2016. The effects are Each group represents the group of trade flows which are treated at the same time. The first group (top) is treated first. There are two treated of border posts in this first group. The second group (middle) is treated second. The third group (bottom) is treated last. There is one border post treated in in the second and third group. Red points represent point estimates of the association before the implementation of OSBP for that group. Green points represent point estimates of the association after the implementation of OSBP for that group. X-axis represents the time period. For example in reverse order, 28 is equivalent to time at Q4 2016 and 27 is equivalent to time at Q3 2016.

Table A.5: Sample exclude trade with the DRC and South Sudan: Introduction of an OSBP and quarterly informal-total trade ratio

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All	All	All	All	All	Agriculture	Agriculture	Industrial	Industrial
OSBP at t	-0.0601	0.0289	0.0299	-0.172**	-0.0306	-0.0555	0.0128	-0.0647	0.0471
	(0.0821)	(0.0765)	(0.0759)	(0.0762)	(0.0678)	(0.103)	(0.0862)	(0.107)	(0.103)
1 period lagged OSBP		-0.128***	-0.0279		-0.188*		0.00668		-0.0625*
		(0.0387)	(0.0461)		(0.0900)		(0.104)		(0.0302)
2 periods lagged OSBP			-0.177**		-0.272***		-0.180		-0.174***
			(0.0711)		(0.0421)		(0.121)		(0.0464)
1 period lead OSBP				0.0445	0.0467				
				(0.0696)	(0.0699)				
2 periods lead OSBP				0.0802	0.0715				
				(0.144)	(0.142)				
Precipitation	-0.0112	-0.0122	-0.00227	-0.0114	-0.00492	-0.0168	-0.0000161	-0.00554	-0.00453
	(0.0207)	(0.0194)	(0.0190)	(0.0200)	(0.0182)	(0.0240)	(0.0225)	(0.0285)	(0.0266)
OSBP construction completed	0.109	0.107	0.108	0.0467	0.0493	0.205*	0.211*	0.0120	0.00454
	(0.0673)	(0.0670)	(0.0672)	(0.126)	(0.126)	(0.113)	(0.111)	(0.0703)	(0.0684)
R-squared	0.332	0.333	0.333	0.343	0.349	0.489	0.492	0.389	0.398
N	1008	972	936	936	864	504	468	504	468
Degrees of freedom	16	16	16	16	16	14	16	14	16

Within estimates of the associations between introduction of OSBP and trade informality. Bilateral trade flows are restricted to trade between Uganda and its neighbours and is disaggregated by quarters and sector. The sample is further restricted to exclude trade with the DRC and South Sudan. The definitions of all the variables can be found in Table A.1. Outcome variable is trade informality, defined as informal bilateral trade value divided by total bilateral trade. All regressions include customs-sector-time, time, sector-time, country-time and country-pair-time fixed effects. All outcomes are analysed at bilateral trade flow level by sector. The time period covered is from Q1 2010 to Q4 2016. Clustered standard errors by customs in parentheses. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table A.6: Introduction of an OSBP and quarterly informal-total trade ratio. Clustered standard errors by country pair.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All	All	All	All	All	Agriculture	Agriculture	Industrial	Industrial
OSBP at t	-0.0592	0.0310	0.0301	-0.171**	-0.0294	-0.0533	0.0136	-0.0650	0.0467
	(0.0798)	(0.0738)	(0.0731)	(0.0735)	(0.0655)	(0.0985)	(0.0821)	(0.101)	(0.0965)
1 period lagged OSBP		-0.130***	-0.0278		-0.189**		0.00730		-0.0629**
		(0.0372)	(0.0443)		(0.0884)		(0.0985)		(0.0290)
2 periods lagged OSBP			-0.177**		-0.272***		-0.182		-0.173***
			(0.0667)		(0.0404)		(0.112)		(0.0442)
1 period lead OSBP				0.0465	0.0481				
				(0.0661)	(0.0660)				
2 periods lead OSBP				0.0767	0.0690				
				(0.132)	(0.131)				
Precipitation	-0.00620	-0.00391	-0.00150	-0.00560	-0.000904	-0.00466	0.00317	-0.00773	-0.00616
	(0.00830)	(0.00778)	(0.00781)	(0.00979)	(0.00892)	(0.00669)	(0.00673)	(0.0169)	(0.0158)
OSBP construction completed	0.109*	0.108	0.108	0.0488	0.0510	0.207*	0.211*	0.0117	0.00430
	(0.0644)	(0.0640)	(0.0642)	(0.118)	(0.118)	(0.106)	(0.105)	(0.0664)	(0.0645)
R-squared	0.269	0.269	0.269	0.275	0.279	0.421	0.423	0.352	0.358
N	2012	1940	1868	1868	1724	1006	934	1006	934
Degrees of freedom	34	34	34	34	34	28	30	28	30

Within estimates of the associations between introduction of OSBP and trade informality. Bilateral trade flows are restricted to trade between Uganda and its neighbours and is disaggregated by quarters and sector. The sample is further restricted to exclude trade with the DRC and South Sudan. The definitions of all the variables can be found in Table A.1. Outcome variable is trade informality, defined as informal bilateral trade value divided by total bilateral trade. All regressions include customs-sector-time, time, sector-time, country-time and country-pair-time fixed effects. All outcomes are analysed at bilateral trade flow level by sector. The time period covered is from Q1 2010 to Q4 2016. Clustered standard errors by country-pair in parentheses. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

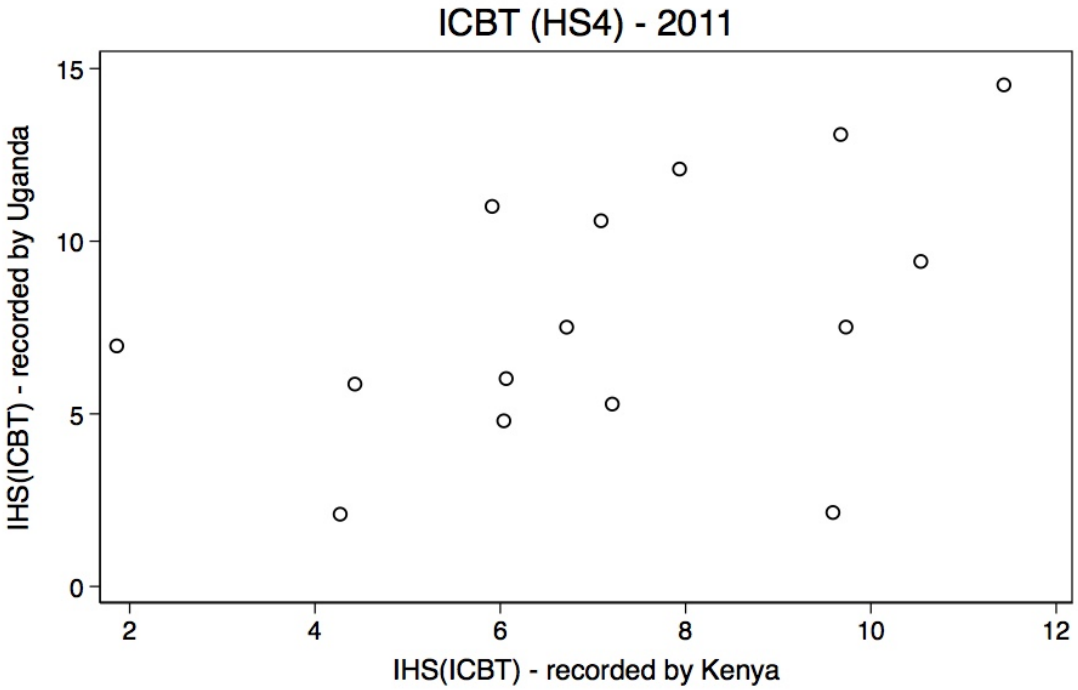

Figure 8: Comparing ICBT data recorded by Kenyan and Ugandan Bureau of Statistics

Informal trade values recorded by Uganda against informal trade values recorded by Kenya. This is for agricultural trade only. Currency converted into USD for comparability and then took a IHS transformation. Only available for June 2011. Product aggregation by HS4.

A.2 Trader analysis

Table A.7: Reasons for importing, exporting and border-crossing choices

Reason	Import	Export	Crossing choice
Availability and choice of goods	12.67		
Experience	0.34		
Quality of goods	12.33		
Travelling time or proximity to market	6.51	6.00	21.68
Price of goods (buying or selling)	66.78	60.00	
Transport cost	0.68		
Other	0.68		
Competitors		8.00	
Customers		25.33	
Payments at border crossing			10.46
Time taken to cross the border			34.69
Facilities of border crossing			0.77
Procedures required at border crossing			0.51
Security			31.89
Obs	292	150	392

Percentage of exporters, importers and cross-border traders. Data collected by author in the cross-border trader survey implemented in Busia and Malaba, border towns between Uganda and Kenya.

Table A.8: Description of the key variables used in the trader-level analysis

Variable	Description
Cross-border trader	Equals 1 if respondent is a cross-border trader, 0 otherwise
Importer	Equals 1 if respondent is an exporter, 0 otherwise
Exporter	Equals 1 if respondent is an importer, 0 otherwise
Surveyed in Uganda	Equals 1 if respondent was surveyed in Uganda, 0 otherwise
Surveyed in Busia	Equals 1 if respondent was surveyed in Busia, 0 otherwise
Channel	Equals 1 if respondent's main border crossing is through the official customs, 0 otherwise
Exported restricted	Equals 1 if the good traded has export restrictions, 0 otherwise
Import duty (CET)	Duty rate imposed on that product
Age	Age of respondent
Male	Equals 1 if respondent is a male, 0 otherwise
Education	Equals 1 if not completed primary; 2 if completed primary; 3 if completed secondary; 4 if had some college or university education; 5 if completed university
Kiswahili	Equals 1 if respondent's main language is Kiswahili, 0 otherwise
Perishability	Equals 0 if product of trade is not perishable, 1 if semi-perishable, 2 if perishable
Received training	Equals 1 if trader has received training regarding trading across the border, 0 otherwise
Know SCOO	Equals 1 if trader knows about the Simplified Certificate of Origin, 0 otherwise
Threated to confiscate good, pay bribe	Equals 1 if trader has been paid a bribe in the past 3 months after being threatened of confiscation, 0 otherwise
Border info: digital	Equals 1 if trader uses mobile and internet to find border information, 0 otherwise
Recall ability	Scale of 1 to 5 with 1 indicating low recall ability, 5 indicating high recall ability.
Risk aversion	Equals 1 if trader scored more than 5 in the 10-point scale, 0 otherwise
Price info: digital	Equals 1 if trader uses mobile and internet to find price information, 0 otherwise
Employee dummy	Equals 1 if trader has paid wages in the past month, 0 otherwise

Table A.9: Summary statistics of key variables for trader-level analysis

Variable	Obs	Mean	Std. Dev.	Min	Max	P50
Cross-border trader	818	.462	.499	0	1	0
Importer	378	.73	.444	0	1	1
Exporter	378	.349	.477	0	1	0
Surveyed in Uganda	818	.576	.495	0	1	1
Surveyed in Busia	818	.842	.365	0	1	1
Cross via customs	378	.286	.452	0	1	0
Export restricted	818	.065	.246	0	1	0
Import duty (CET)	795	.291	.154	0	1	.25
Age	818	38.438	9.666	18	86	38
Male	818	.372	.484	0	1	0
Education	816	2.452	.998	1	5	2
kiswahili	818	.436	.496	0	1	0
Employee dummy	704	.277	.448	0	1	0
Perishability	804	.822	.824	0	2	1
Received training	817	.185	.388	0	1	0
Know SCOO	593	.228	.42	0	1	0
Threatened to confiscate good, pay bribe	582	.1	.3	0	1	0
Border info: digital	818	.372	.484	0	1	0
Recall ability	815	2.891	1.252	1	5	3
Risk aversion	795	.843	.364	0	1	1
Employee dummy	704	.277	.448	0	1	0
Price info: digital	818	.518	.5	0	1	1

Table A.10: Cross border traders' border crossing decision: formal or informal? Include risk and recall variables.

	(1)	(2)	(3)
Cross via customs			
Age	-0.0141	-0.0122	-0.0138
	(0.0103)	(0.0116)	(0.0119)
Male	-0.343***	-0.357***	-0.357***
	(0.0881)	(0.0366)	(0.0615)
Education	-0.00971	0.0320	-0.0154
	(0.0535)	(0.0445)	(0.0503)
kiswahili	0.492***	0.428***	0.507***
	(0.137)	(0.123)	(0.155)
Employee dummy	-0.0361	-0.0956	-0.0512
	(0.207)	(0.220)	(0.210)
Perishability	-0.320***	-0.219	-0.327***
	(0.0931)	(0.165)	(0.117)
Received training	0.356*	0.366*	0.352*
	(0.211)	(0.208)	(0.204)
Know SCOO	0.491**	0.442**	0.497**
	(0.214)	(0.200)	(0.227)
Threatened to confiscate good, pay bribe	-0.242	-0.244	-0.230
	(0.163)	(0.165)	(0.182)
Border info: digital	0.128	0.158*	0.123
	(0.0999)	(0.0917)	(0.101)
Recall ability	0.0329	0.0266	0.0349
	(0.0727)	(0.0696)	(0.0714)
Risk aversion	0.605**	0.557**	0.602**
	(0.250)	(0.265)	(0.262)
Export restricted	-0.822***		-0.798***
	(0.257)		(0.224)
Import duty (CET)		0.582	0.375
		(0.569)	(0.596)
select			
Age	-0.00883	-0.00894	-0.00919
	(0.00602)	(0.00574)	(0.00641)
Male	0.0444	0.0325	0.0339
	(0.151)	(0.157)	(0.152)
Education	-0.000827	-0.0274	-0.00429
	(0.0782)	(0.0782)	(0.0782)
kiswahili	0.151	0.185	0.167
	(0.121)	(0.117)	(0.123)
Employee dummy	-0.356***	-0.376***	-0.378***
	(0.0547)	(0.0637)	(0.0640)
Perishability	0.408*	0.383*	0.422*
	(0.229)	(0.216)	(0.231)
Received training	0.238	0.232	0.245
	(0.231)	(0.230)	(0.236)
Border info: digital	0.716***	0.720***	0.706***
	(0.171)	(0.185)	(0.180)
Recall ability	-0.0343	-0.0326	-0.0315
	(0.0461)	(0.0465)	(0.0507)
Risk aversion	0.325	0.326*	0.312*
	(0.205)	(0.198)	(0.188)
Export restricted	0.517*		0.576**
	(0.304)		(0.281)
Import duty (CET)		0.356	0.504
		(0.842)	(0.769)
Price info: digital	-0.331***	-0.308**	-0.319**
	(0.122)	(0.127)	(0.126)
Rho	0.780	0.866	0.769
Test indept Chi-squared	7.658	1.430	5.244
Test indept p-value	0.00565	0.232	0.0220
N	818	818	818

Probit estimates of the associations between traders' characteristics and decision to cross the border formally. Lower panel reports the estimates for the selection equation where traders self-select as cross-border traders (either exporters or importers). Upper panel reports the estimates for cross-border traders only, and is the equation of interest. The outcome variable is a binary variable which is valued as one if the cross-border trader crosses using an informal border crossing and zero otherwise. The definitions of all the variables can be found in Table A.8. Include samples taken in Uganda and Kenya sides of the border towns Busia and Malaba. Missing covariates are dummied out. Clustered standard errors by strata in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table A.11: Cross border traders' border crossing decision: formal or informal? Restricted sample to importers only

	(1)	(2)
Cross via customs		
Age	-0.0140	-0.0112
	(0.0107)	(0.0143)
Male	-0.396***	-0.358***
	(0.118)	(0.0969)
Education	0.0371	0.104***
	(0.0301)	(0.0176)
kiswahili	0.289*	0.200
	(0.153)	(0.126)
Employee dummy	-0.166	-0.114
	(0.188)	(0.255)
Perishability	-0.370**	-0.403*
	(0.172)	(0.214)
Received training	0.463**	0.482**
	(0.233)	(0.204)
Know SCOO	0.591***	0.663***
	(0.227)	(0.244)
Threatened to confiscate good, pay bribe	-0.251	-0.233
	(0.240)	(0.268)
Border info: digital	-0.233	-0.231
	(0.268)	(0.304)
Export restricted	-0.644***	
	(0.220)	
Import duty (CET)		-0.0621
		(0.607)
select		
Age	-0.0102**	-0.0110***
	(0.00439)	(0.00379)
Male	0.0183	-0.0312
	(0.158)	(0.155)
Education	-0.0471	-0.0681
	(0.0932)	(0.102)
kiswahili	0.301**	0.365***
	(0.138)	(0.137)
Employee dummy	-0.438***	-0.483***
	(0.142)	(0.167)
Perishability	0.442**	0.456**
	(0.217)	(0.182)
Received training	0.328*	0.356**
	(0.174)	(0.152)
Border info: digital	0.296***	0.234**
	(0.113)	(0.0970)
Export restricted	0.444	
	(0.392)	
Import duty (CET)		0.805
		(1.122)
Price info: digital	-0.332***	-0.263**
	(0.113)	(0.112)
Rho	0.706	0.517
Test indept Chi-squared	9.385	3.243
Test indept p-value	0.00219	0.0717
N	686	686

Probit estimates of the associations between traders' characteristics and decision to cross the border formally. Lower panel reports the estimates for the selection equation where traders self-select as cross-border importers. Upper panel reports the estimates for cross-border traders only, and is the equation of interest. The outcome variable is a binary variable which is valued as one if the cross-border trader crosses using an informal border crossing and zero otherwise. The definitions of all the variables can be found in Table A.8. Include samples taken in Uganda and Kenya sides of the border towns Busia and Malaba. Missing covariates are dummied out. Clustered standard errors by strata in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table A.12: Traders' characteristics and informal payments at border crossings

	(1) Informal payments
Age	0.00511
	(0.0204)
Male	-0.562**
	(0.146)
Education	0.202
	(0.234)
kiswahili	0.317
	(0.184)
Received training	-0.238
	(0.232)
Know SCOO	0.452
	(0.413)
Perishability	0.462
	(0.292)
Export restricted	0.487
	(0.629)
Import duty (CET)	0.227
	(0.275)
Observations	287
R^2	0.244

Standard errors by strata in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

OLS estimates of the associations between traders' characteristics and informal payments at border crossings. Outcome variable is informal payments expressed as USD per USD 100 value of goods being traded across the border. Regressions include enumerator fixed effects. Definition of all variables can be found in table A.8. Clustered standard errors by strata in parentheses. * p<0.10, ** p<0.05, *** p<0.01

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