Regional integration and informal trade in Africa

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Regional integration and informal trade in Africa: evidence from Benin's borders

Abstract

Regional trade is low in sub-saharan Africa. But a large share of regional trade is informal, i.e. not recorded in official data. This paper studies the relationship between trade barriers and informality of trade. We use an original survey of informal transactions across Benin's land borders, which provides the first direct and comprehensive account of trade volumes and product coverage for this type of trade. We combine this data with official trade records and exploit variation across products and countries to measure the impact of tariff and non-tariff barriers to trade on informality. Increasing tariffs on a given product by 10% makes it about 12% more likely that this product is imported informally rather than formally. Non-tariff measures also increase informality. Our results also suggest that compliance costs, aside from tariffs and regulations, contribute to explain informality.

1 Introduction

Trade between African countries appears to be low, despite significant efforts to promote regional trade. Most regional economic community agreements have had little success in raising trade between members above initially low levels. The share of intra-regional imports in total imports in the main regional trade agreements on the continent remained, by 2008, between 2 and 15 percent; by comparison, the share of intra-RTA trade worldwide, excluding the EU, was estimated at 35 percent in 2008 (De Melo and Tsikata, 2015). This is often seen as evidence that borders in Africa have remained "thick", despite tariff reductions, due to persistent obstacles to trade such as non-tariff measures and burdensome procedures at customs (WorldBank, 2012).

An assessment of regional trade in Africa cannot be complete, however, without including *informal cross-border trade*, a form of trade pervasive in many developing regions, and particularly in Africa (Golub, 2015). The unrecorded flows of goods across borders represent a significant share of international trade on the continent. The low level of intra-African trade in official data is thus known to be due, to some extent, to the large share of transactions which this type of data fails to record. One may expect that trade liberalization episodes should result in a reduction of informality; if they do not, the persistence of informal trade might indicate that some forms of trade impediments have remained high. But testing these hypotheses, and quantifying the link between trade barriers and informality, is generally out of reach due to the lack of data.

This paper presents the first quantitative study of informal cross-border trade, based on comprehensive data for one country. We use an original survey covering cross-border transactions at non-authorized locations on each land border of Benin, West Africa, to document the size and composition of informal trade flows. We match this data to customs data on legal trade for the same trade directions and

period, and identify some of the determinants of informality in trade. We relate tariff and non-tariff barriers to the probability that a given product be traded informally rather than formally. We also identify product characteristics, such as perishability, which associate positively with informality.

A distinction must be made between two forms of informal trade.[1] Some trade goes unrecorded because of evasion at customs, using practices such as under-invoicing, misclassification, or mis-declarations. In parallel, some trade occurs outside of official border crossing points, avoiding customs entirely. We focus on the second form. Case studies have suggested the importance in magnitude of this form of trade; we confirm this with our data. Despite the difficulties inherent to collecting data on informal activities, our data offers a remarkably rich view of informal trade at Benin's borders. The ECENE survey (*Enquête sur le commerce extérieur non enregistré*) was conducted by the National Institute of Statistics of Benin (IN-SAE) in 2011. 171 border crossing points were identified and surveyed; a total of 8,883 traders were interviewed, 10,415 single-product flows recorded. These crossing points are all distinct from official border points.[2]

The case of Benin is particularly relevant for this issue. A small, poor country, it is a member of WAEMU[3], a monetary and customs union of eight countries in West Africa. It shares land borders with three WAEMU members, Togo, Burkina-Faso and Niger (see figure1). This union has progressively dismantled internal tariffs and put in place a common external tariff. Benin's fourth border is with Nigeria, the second-largest economy of the continent. Nigeria and Benin also share membership in a regional agreement, the ECOWAS[4], larger than WAEMU but less advanced in terms of trade liberalization. As of 2011, the ECOWAS had not dismantled internal

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[1]*Smuggling* implies evasion from taxes or restrictions. In our context, some informal transactions qualify as smuggling, but an important share involves goods facing no duty in the country of destination. We therefore use the broader notion of *informal trade* to encompass all unrecorded transactions.

[2]Informal trade in our data is in legal products, i.e. this type of trade is illegal because it avoids customs, not because of the nature of the goods.

[3]West African Economic and Monetary Union.

[4]Economic community of West African States.

tariffs. Nigeria has a protectionist trade policy with high peaks, non-tariff barriers and import bans; its currency is non convertible and chronically overvalued (IMF, 2017). Thus, Benin's borders offer a case study of trade liberalization efforts at different stages, and gives us the opportunity to examine their impact on the informality of trade. We focus on trade at Benin's two main land borders, with Togo and Nigeria; and consider *regional trade*, i.e. exports and imports at these two borders.[5]

Figure 1: Map of Benin and its neighbours.

Our results shed new light on several aspects of the issue. First, we confirm the quantitative importance of informal trade in the region. In the case of trade with Nigeria, Benin's main trade partner, the informal to formal trade ratio is estimated at about 1 for imports, 5.1 for exports. Regional trade is thus significantly larger in reality than in official trade data. Informal trade is not restricted to agricultural products. Industrial products make up more than half of informal imports from Nigeria in value. The overlap between products traded formally and informally is small: many products are traded exclusively on the informal channel, implying a

[5]Informality plays also a prominent role in so-called entrepôt trade, i.e. imports from third countries which transit through Benin or Togo before being smuggled to Nigeria (see next section). As our focus is on regional integration, we largely leave this phenomenon out of the picture.

reevaluation of export diversification in regional trade as well.

Second, we measure a positive and significant semi-elasticity of trade informality to tariffs. Considering trade with Nigeria, raising the tariff on a given product (at 6-digit level of classification) by 10 percentage points increases the probability that this product is traded informally, rather than formally, by about 0.12. Non-tariff measures (sanitary and phyto-sanitary measures, or SPS, and technical barriers to trade, or TBT) associate positively with informality. The ad-valorem tariff equivalent of SPS measures is estimated at about 20%.

In the case of trade between Benin and Togo, formal trade data is affected by noise due to the parallel phenomenon of entrepôt trade (third-country imports transiting through Togo and Benin and smuggled into Nigeria). We show that such trade is prevalent in import data from Benin's customs.[6] Using Togo's customs data to circumvent this issue, we find some evidence of a positive link between WAEMU's external tariff, and informality of trade between Togo and Benin, although weaker than for trade with Nigeria. This might indicate that some trade impediments remain, despite the *de jure* removal of trade barriers within WAEMU; one reason for this could be the cost of origin certification. SPS and TBT also attract positive coefficients, albeit lower than at the Nigeria border.

Third, we identify other determinants of informality beyond tariffs and non-tariff barriers. Local unprocessed agricultural produce has long circulated across borders in the region without much control. The WAEMU and ECOWAS have in principle liberalized this trade between members.[7] We find a high prevalence of informality for these products across all borders: they are essentially traded outside of customs. Controlling for this category, we also find that product perishability predicts trade

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[6]In other words, formal trade records contain third-country imports, labeled with WAEMU origin in order to benefit from preferential treatment.

[7]In the WAEMU, free movement applies to these products (article 10 of the treaty), with exemption from origin certification. A similar disposition is found in article 36 of ECOWAS' revised treaty, however applied tariff data show that this was not yet applied by all countries in 2011. See next section for more details on this.

informality, possibly due to lengthy procedures at customs.[8] These results suggest that, beyond tariffs and regulatory measures, the costs of compliance also contribute to the pervasiveness and persistence of trade informality.

This paper contributes to the literature on trade integration and trade costs in Africa. It shows that the low level of intra-regional trade, as well as the low product diversity in this trade (De Melo and Tsikata, 2015; Carrère, 2013), are attributable in part to the incomplete coverage of official trade statistics. A common view is that trade is made too costly in the region by a combination of trade protections, lack of infrastructure, and red tape.[9] In part, the effect of such costs of trade is not to suppress trade, but to make it informal. So far, there has been no attempt to quantify this margin of trade creation (or formalization). We measure the impact of trade policy measures (tariffs and regulations) at this margin. Results are also consistent with trade facilitation (e.g. reduction in delays for clearing procedures) playing a role.[10]

A large literature has studied tax evasion in international trade, using *mirror data*, i.e. relying on data from the exporting country to identify missing flows in the importer's records (Bhagwati, 1964; Fisman and Wei, 2004; Javorcik and Narciso, 2008; Mishra et al., 2008; Bouet and Roy, 2012). These papers focus on *evasion at customs*: products shipped through official borders (e.g. ports) with the payment of taxes and duties reduced or avoided by creative methods (underinvoicing, misclassification, etc.). Our focus is distinct: informal cross-border trade taking place on routes bypassing the official border points. The paper thus sheds light on a different form of evasion in trade which, if less studied, seems no less important in magnitude,

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[8]We also find, in the case of trade with Togo, a positive impact for parts and components, another category of products likely to be time sensitive (Hummels and Schaur, 2013).

[9]According to the Doing Business 2011 report, Sub-Saharan Africa is the world's most expensive region to trade within (WorldBank, 2011). The same report shows that delays are up to three times as long in Sub-Saharan African compared with other regions of the World.

[10]However, these results do not rule out the possibility that other factors, including artificial colonial borders, or State weakness (Alesina et al., 2011), may also contribute to the pervasiveness and persistence of informal trade.

in particular in Africa. Mirror data are of no help to study this, since trade flows are missing from both partners' records.[11]

Because of the lack of data, most existing studies on informal cross-border trade in Africa are qualitative and based on field work, or case studies relying on indirect inference and accounting. Much of the literature has focused on smuggling in transit and re-exports, which has in some contexts reached impressive volumes of trade. This is the case at the border between Senegal and the Gambia (Golub and Mbaye, 2009). Golub (2012) focuses on this trade in Benin, Togo and Nigeria. Although this trade is larger in volume and has thus attracted much attention, we focus instead on informality in domestic trade, which has more direct implications for regional integration. Ackello-Ogutu and Echessah (1997) use similar data from direct border monitoring, between Kenya and Uganda, and show that informal trade at this border includes some re-exports but also large volumes of domestic trade, both in agricultural products and in manufactures (mostly from Kenya). Egg and Herrera (1998), Golub and Hansen-Lewis (2012) describe the role of trade networks, often based on kinship, in the organization of cross-border trade.

The paper is structured as follows. The next section 2 gives elements of institutional context for the study. Section 3 describes the data sources, in particular on informal trade, in detail. Section 4 presents estimates of the volume and product composition of informal and formal trade, and descriptive statistics. Section 5 presents a simple model that we use as basis for the empirical estimations. Section 6 presents the empirical results. Section 7 concludes.

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[11]Smuggling at customs is possibly present in our context too, but is not directly observed by us. We discuss how this is likely to affect our results in the empirical part.

2 Context: regional integration and trade in Benin's region

Regional agreements   Benin is a founding member of the WAEMU, a customs union, along with three of its direct neighbors, Togo, Niger and Burkina-Faso, and four other countries. All eight countries are also members of the ECOWAS, a larger regional grouping which also includes Nigeria. The ECOWAS aims to promote economic integration but plays also a role in political cooperation and stability. Its stated objective is to create a regional common market.

The WAEMU being a customs union, goods should in principle freely circulate within it. Articles 4 and 77-81 of the WAEMU treaty define free movement of goods as one of the pillars of community freedoms. This, however, does not apply in practice, and most products are subject to control at internal borders. Imported goods may face taxes at these customs, either because they have not WAEMU origin or no certificate for it; or because of remaining tariffs and restrictions.[12]

The trade regime within WAEMU is closest to free circulation for local unprocessed products from agriculture, mining and fishery.[13] A certificate of origin is not required for these products (*Protocole additionnel N. III/2001, UEMOA/WAEMU*). Such products have traditionally been traded on secondary roads (Egg and Herrera, 1998), often not passing through official customs border posts. One reason for this may be that the cost of transport through official borders crossings is too high for local producers selling in nearby markets across the border. Such flows are thus often seen as inherently informal; a tolerant policy towards them is also motivated

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[12]For example, a recent report by the International Trade Centre (ITC, 2017) based on a survey of firms in Benin states that "In principle, regulations within WAEMU guarantee free movement of products of origin, with total exemption of customs taxes and duties. Yet, the survey reveals that customs taxes are applied de facto by member countries on imported products". Firms also complain of the lack of transparency regarding these taxes, and of the delays, cost and complexity of the procedure to obtain certificates of origin.

[13]These include " mineral products extracted from [member countries'] soil or deposited on the shore of the maritime coasts, live animals born within the community, harvested vegetable products, fishery and hunting products, products extracted from the sea by boats registered in a member state, products from live animals that are reared in a member state" (WAEMU treaty).

by food security concerns (Golub, 2015). Given these specificities, we will control for local unprocessed goods in the empirical analysis.

Within WAEMU, industrial products are facing higher effective restrictions on movement, due in particular to stringent rules and administrative procedures to certify the origin of these goods (Ayuk and Kaboré, 2012; ITC, 2017). Products originating outside the WAEMU space face a common external tariff (CET), which has four tariff bands: 0% (essential social goods), 5% (basic goods, raw materials, equipment goods, specific inputs), 10% (inputs and intermediate products) and 20% (final consumption goods).

Within the ECOWAS (and thus, between Benin and Nigeria), trade in local unprocessed goods has also been liberalized since 1993, so these products are also, in principle, circulating freely between members.[14] However such provisions are often not applied within the ECOWAS (UNECA, 2010; ITC, 2017). This is confirmed by the level of applied tariff reported by ECOWAS countries to the ITC in 2011, which was not zero for these products. Nigeria's trade policy has long been highly protectionist, with most-favored-nation (MFN) tariffs reaching 35%, a list of import prohibitions on more than 25 groups of items, as well as other numerous other forms of non-tariff barriers and price distortions.[15] In 2011, these tariffs applied to imports from Benin in 2011, as the implementation of tariff reduction and harmonization at the level of the ECOWAS had not yet started. Imports from Nigeria into Benin were, in 2011, facing the WAEMU's external tariff.

Informal trade, smuggling, and Entrepôt trade   The combination of Nigeria's protectionist trade policy with the size of its markets have led to the flourishing of so-called entrepôt trade, by which imports from outside the region (e.g. China, EU countries) facing steep protection in Nigeria transit through Benin, or Togo and

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[14]Article 36 of the revised treaty.

[15]For some products such as rice, some levies are applied in addition to tariffs, raising effective protection to 100% or higher.

Benin, before being smuggled into Nigeria. This highly lucrative trade constitutes, in volume, the most prominent form of unrecorded cross-border trade in the region; it has attracted most of the attention in the literature so far (Igue and Soule, 1992; Raballand and Mjekiqi, 2010; Golub, 2012). The main features of this trade have been documented in these studies: trade concentrates in a few products facing high tariffs or import bans in Nigeria, such as rice, palm oil, textile, and used cars; smuggled volumes can be estimated from large discrepancies between e.g. Benin's official imports and consumption figures for such goods. Such transit activities have become an important part of Benin's and, to a smaller extent, Togo's economy, and these two countries compete in taxes and in the quality of their port and transshipment infrastructures to attract this trade.

In this paper, we focus instead on informality of trade in regional goods. This question has attracted comparatively less attention, despite its relevance for regional integration. We therefore consider exports and imports (i.e. trade in domestic products), and exclude re-export and transit flows. Data from the ECENE survey, which records these four types of flows, shows that informal trade at Benin's borders is far from being restricted to entrepôt trade. For example, in the case of imports from Nigeria into Benin, the ratio of informal to formal trade in value is close to 1.[16] These imports include agricultural and industrial products, which Nigeria exports to Benin and the WAEMU zone. This implies that a large share of regional trade fails to be measured in official data; raising the question of what explains such a prevalence of informality. Thus, trade informality needs to be taken into account in the discussion of regional integration in Africa.

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[16]This figure excludes trade in petroleum products, yet another prominent form of smuggling at the Benin-Nigeria border, due to the highly subsidized price of these products in Nigeria. We exclude these flows from most of our analysis. See next section for details.

3 Data sources

3.1 Informal and formal trade data

The analysis in this paper relies primarily on two sources of data, recording informal and formal cross-border trade flows between Benin and its direct neighbours.

The first source is ECENE (*Enquête sur le commerce extérieur non enregistré*), a survey conducted by Benin's national statistics institute, the INSAE, in 2011, with the aim to estimate the size and composition of informal trade more precisely, and to account for this component in national accounts.

The institute first identified 171 illegal border crossing points which were actively used by informal traders, scattered all along Benin's land borders. Figure 2 shows the coverage of survey points.[17] These crossing points were then surveyed during a 10-day period during day time, in September 2011, by a team of 350 surveyors, 30 controllers and 12 supervisors.

A 4-page questionnaire was administered to informal traders, with questions on the nature, quantity and value of smuggled goods, the origin and destination of the shipments, and the transport mode. Products were codified at a high level of detail (10-digit codes of the Harmonized commodity description and coding system of classification, HS-10). A total of 8,883 questionnaires were filled, with 10,415 single-product flows recorded and retained after data cleaning by the institute (down from 10,749 flows in the primary data) (INSAE, 2011).

Trade flows are classified as exports, imports, re-exports and transit. The latter two categories correspond to flows of goods originating in third countries (typically in Asia or Europe), which enter Benin (possibly legally) before crossing one of Benin's land borders to reach one of the neighboring countries. In this article, we focus on regional trade; therefore we ignore this so-called entrepôt trade (re-exports and transit flows).[18] We present results on imports and exports of Benin with its direct

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[17]Note that a few non-border districts have a survey point: this is due to trade done on rivers and lakes, such as lake Nokoué at Abomey Calavi close to the coast.

[18]See Golub (2012) for an account of entrepôt trade.
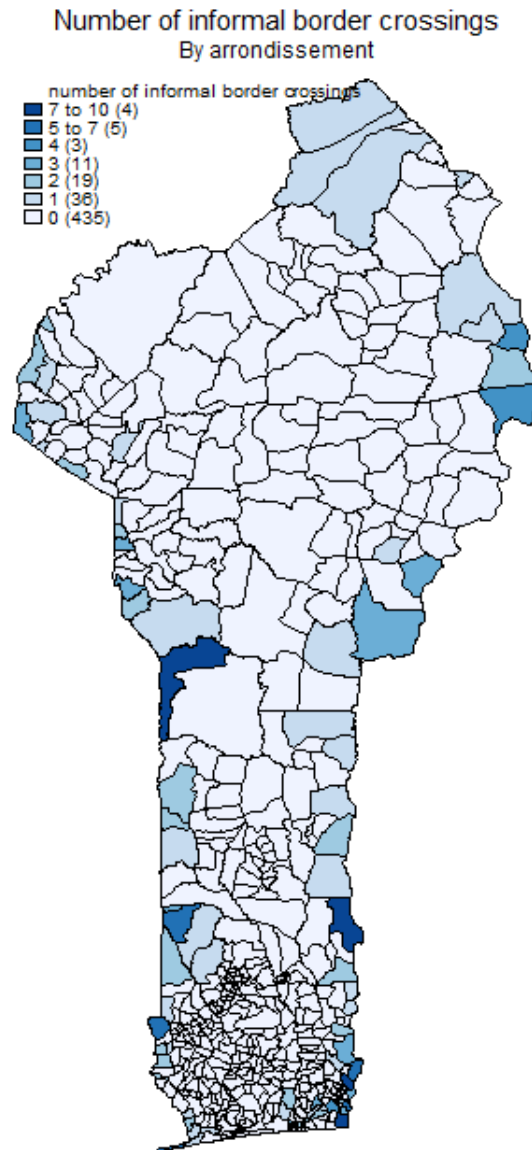
Figure 2: Number of border crossings by arrondissement

neighbours.

Questions may arise on the quality of the data, given the peculiar nature of the survey. One may ask why illegal traders should accept to answer a survey conducted by public agents (surveyors and supervisors from the INSAE). The difficulties faced in the conduct of the survey are explained in detail in the report published by the INSAE (INSAE, 2011). In particular, the report explains that the survey was

conducted in cooperation with the Customs administration.[19]

The number of questionnaires filled suggests that the conditions were indeed met to allow the survey to be collected in good conditions.[20] This, however, does not eliminate the concern of selection. Some products may be less likely to appear in the survey: in particular, products facing more restrictions may be traded at night, or people trading them may be more reluctant to answer questions. As will be discussed in the results section, this creates a potential underestimation of our coefficients of interest.

The second source of data are official trade records from Benin's and Togo's customs. Data are provided at the 8-digit level of the WAEMU's own classification (close to the HS system), on a monthly and bilateral basis. We use Benin's customs as the data source for Benin's exports, and for its imports from Nigeria. In the case of imports from Togo, we rely instead on *mirror data*, i.e. Togo's records of these trade flows (its exports to Benin). This is because, as we will show, Benin's data clearly overestimate this trade. The total value of trade from Togo to Benin is more than four times higher in Benin's than in Togo's records. Our analysis of the gap between the two sources shows that it is probably due to third-country imports transiting through Togo, falsely declared of Togolese origin in order to benefit from tariff exemption. Therefore, we use the more reliable data from Togo for these flows.

Formal trade data on the four bilateral trade flows (imports and exports, to and from Nigeria and Togo) are matched with the corresponding informal flows.[21] To match the informal and formal trade sources, we aggregate trade flows at the 6-digit

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[19]This cooperation was necessary since part of the work of customs agents consists in fighting informal trade by being present at crossing points and controlling traders. Cooperation with the customs ensured that such operations would not interfere with the conduct of the survey.

[20]The data also appears to be consistent: the number of wrong product codes is low; distributions of unit values by product have non excessive levels of dispersion. Products appearing most frequently, and the direction of their trade, are those expected based on existing studies on informal trade in the area.

[21]Since we focus on trade of local products, we use *origin*, and not *provenance*, in both trade data. Thus, imports mentioning Nigeria as origin are kept in our database, but imports with Nigeria as provenance (and a third country as origin) are not.

level of the harmonized system (HS-6). This reduces the risk of product misclassi-fication, and makes data compatible with other data such as the tariff data, also at HS-6 level.

Our variable of interest is the trading mode - formal or informal - for each product traded between Benin and one border country. We use two methods for measuring informality of trade. One is to estimate the share of informal trade in total trade of each product:

$$InformalShare_{ic} = \frac{X_{ic}^{inf}}{(X_{ic}^{inf} + X_{ic}^{form})} \tag{1}$$

where X_{ic}^{form} is the total value of formal trade (exports or imports) of product i to/from country c reported in customs data for September 2011. X_{ic}^{inf} is the total value of informal trade recorded in ECENE for the same product and country, extrapolated to a monthly value (i.e. multiplied by 31/10).

There is a clear risk of measurement error in traded values; the short sampling period of ECENE is one reason to be concerned about this. Using monthly formal trade data, the highest frequency available, reduces this issue without eliminating it. Other sources of measurement error may exist in both trade data sources.

To address this issue, one possible alternative is to ignore data on values traded, and to code a product as 1 if it appears in the ECENE survey; 0 if it only appears in official trade records. We label this binary variable "entry to informality". This may be more reliable if we believe that our data sources will generally capture the presence of trade of a given product correctly, without always measuring the volume or value precisely. We will experiment with both methods in the empirical analysis.

3.2 Trade policy data

Data on applied bilateral tariffs from the ITC are used to measure applied protection of Benin and Nigeria.[22]

We also use data from the WAEMU on the common external tariff (CET) applying at the external borders of the union. In the case of trade between Togo and Benin, tariffs are in principle absent. However, we use the CET data to test for the possibility that some products may face this tariff rate if they fail to have their origin certified. These data are averaged at the 6-digit level; there is little variation in tariff rates at 8-digit lines.

To identify unprocessed goods with tariff exemption, we use the definition in the WAEMU treaty for this category that we directly map with the 6 digit HS products in our database. We verify that production of the good is positive in the country of interest, and that applied tariffs for these products, as reported by the WAEMU in ITC data, are zero within the union.

Data on phyto-sanitary measures (SPS) and technical barriers to trade (TBT) are obtained from the World Trade Organization's I-TIP Goods data.[23] I-TIP goods provides comprehensive information on non-tariff measures (NTMs) applied by WTO members in merchandise trade. For the countries of interest in our study, the data cover all TBT and SPS multilateral measures at 8-digit level, initiated in different periods of time (from 1987 to 2013) and still in force in 2013. For our study we drop all the SPS and TBT created after 2011, and we code a dummy SPS and a dummy TBT as 1 if there is a measure at the 6 digit level, and 0 otherwise.

3.3 Data on product classifications

We use the classification by Broad Economic Categories (BEC) of the UN, also available online, to identify parts and components. The classification developed by

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[22]These are data on effective protection as reported by WTO member countries to the ITC.

[23]The database is available online at https://i-tip.wto.org/goods/

Rauch (1999) is used to identify differentiated products. This author defined as differentiated those products without a reference price, or without a price quoted on organized exchanges.[24] Rauch's definitions are based on the 4-digit SITC Rev. 2 classification, converted into HS codes using the concordance provided by the World Bank's WITS. Finally, to identify perishable goods, we elaborate on the classification used in Emlinger et al. (2008).[25] To classify agricultural products we use the WTO classification at the 6-digit level, available on World Bank's World Integrated Trade Solution website.

4 Descriptive statistics

4.1 Magnitude of informal trade

Using the ECENE data, we evaluate informal export and import flows at Benin's borders for the entire month of September 2011, extrapolated from the 10-day survey period. This yields total trade values of 10847 million CFA Francs for imports, and 2867 million CFA for exports, summing over all origin/destination countries. The major part of this trade is with Nigeria and Togo, and we focus on trade with these two countries in the rest of the paper.[26]

In table 1, we compare these estimates with monthly trade values from national customs data. Both sources are subject to measurement and sampling errors, but provide an indication of orders of magnitudes.

Table 1 shows that the larger informal trade volumes are with Nigeria. Petroleum products account for 90% of Benin's informal imports from Nigeria: our data captures this large smuggling operation due to highly subsidized prices in Nigeria, caus-

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[24]Rauch (1999) proposes two definitions.The conservative definition minimizes the number of commodities that are classified as homogeneous goods, while the liberal definition maximizes this number. We employ the conservative definition, but empirical results do not differ much when using the liberal one.

[25]The classification of perishability is based on the costs to maintain temperature and humidity conditions during transport, including expenses incurred during delivery. We thank the authors for sharing their data.

[26]The borders with Burkina-Faso and Niger are much shorter, and the survey included only 1 and 2 border crossing points, respectively, with these countries.

Table 1: Benin's regional trade: official trade versus ECENE (September 2011)

| | Value, 10^6 FCFA | | |
	Formal	Informal	Ratio
		Nigeria	
Imports	1401.41	10062.66	7.18
excl. petroleum pdts.	961.70	953.32	0.99
Exports	526.26	2699.10	5.13
		Togo	
Imports	17622.47	683.23	0.04
using mirror data	3860.4		0.18
Exports	77.61	153.09	1.97

Source: Formal trade: customs data. Informal trade: ECENE survey. Monthly values for informal trade are extrapolated based on survey data. *Mirror data* use Togo's customs data for exports to Benin, instead of Benin's customs data for imports from Togo. 2011 exchange rate: 1USD=506 FCFA.

ing strong price disparities between the two countries (LARES, 2005). This is reassuring on the capacity of the survey to accurately measure informal transactions, including those facing strong repression in Benin and Nigeria, and thus to reflect the reality of informal trade. We nevertheless exclude this trade products from the rest of our analysis due to its specific determinants. Excluding petroleum products, the ratio of informal to formal trade in imports from Nigeria is close to 1. Nigeria has long been a supplier to WAEMU countries of a large variety of agricultural and manufacturing products (Egg and Herrera, 1998). In some cases, avoiding import duties make these products competitive with respect to third country imports.

In the case of imports from Togo, we need to carefully distinguish between actual imports, and re-exports, i.e. third-country imports being transshipped through Togo and Benin to reach Nigeria's markets. As already indicated, it appears that some of this *entrepôt trade* falsely records Togo as the origin of goods when entering Benin, in order to benefit from tariff exemption. An indication of this practice is found in the discrepancy between Benin's and Togo's customs records of the same flows: the aggregate value is 17.6 billion CFA in Benin's data but only 3.8 billion in Togo's data

(i.e., mirror data).[27] When considering Togo's exports to Benin, we therefore view Togo's data as more reliable than Benin's, and rely on this data source throughout the paper.[28] Using this data, the ratio of informal to formal trade for these flows is estimated at 0.18, lower than in the case of imports from Nigeria. This may be due to the fact that trade liberalization is more advanced within WAEMU. We will discuss further this point in the light of our empirical results.

In the case of exports, the ratio of informal to formal trade is estimated at 5.1 for Nigeria and 2 for Togo, implying that official trade data significantly underestimate the volume of trade to both destinations. Benin's exports are predominantly to Nigeria, reflecting this market's size.

Overall, these figures confirm that that the actual level of regional trade in the area is significantly underestimated in formal trade data.

4.2 Structure of trade

Informal trade exhibits a remarkable level of product diversity. Tables 10 and 11, in appendix, display the detailed sector composition of formal and informal trade flows at Benin's two main land borders. During its 10 days of operation, the ECENE survey recorded 177 distinct products (6-digit HS codes) in imports from Nigeria, 247 from Togo, covering various sectors. Agricultural sectors (animal and vegetable products) represent 48%, in value, of informal imports from Nigeria, 60% of those from Togo.

The main products in informal imports from Nigeria include transformed food products (wheat flour, non-alchoolic beverages), vegetable products, wood products, transportation equipment (parts and accessories of motorcycles) and textile (woven fabrics of cotton).

Traditional agricultural products are more predominant in imports from Togo.

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[27]This could explain results in Carrère (2013), who finds actual trade flows within the WAEMU greater than the trade potential estimated with a gravity model.

[28]We carefully address this issue when estimating our model on imports from Togo, in section 6.2.

These include vegetable products (maize, oils, flour, manioc, rice), and cattle. The main non-agricultural item in informal imports is cement, of which Togo is a large producer.

Informal exports exhibit a higher concentration, and are dominated by traditional agriculture products (cattle,vegetable products) and wood. This reflects the structure of Benin's economy. Products facing protection in Nigeria feature predominantly in informal exports to this country: this includes vegetable oil and cement, under import bans in Nigeria; as well as rice, tomatoes and manioc flour, which face high tariffs and levies.

Table 2 presents the number of products appearing in both channels of trade, showing the high diversity of informal trade flows: for example, informal imports from Nigeria alone cover 62 2-digit sectors (chapters), out of a total of 99 existing chapters in the classification. The table also displays the overlap between the two, i.e. the number of products appearing in both channels. A remarkable feature is that this overlap is very low. It remains limited even when aggregating product categories at the 4-digit level, implying that this is not an artefact due to product classifications or errors in product codes.

This suggests that informal and formal trade are two distinct channels of trade, with a specialization of trade by product. This feature motivates our analysis, which will investigate the determinants of trade channel at the product level.

It also implies that accounting for informal trade flows substantially modifies the picture of regional trade, not only in aggregate volumes but also in product diversity. This contributes to the discussion on the low diversification of exports of sub-saharan African countries. Carrère (2013) shows that the high concentration of exports of West African countries (as measured by Theil index values), masks an important diversification at the extensive margin. She also finds that, if most WAEMU countries exhibit a high concentration of exports relative to their income

level, their exports within the zone are significantly more diversified than their extra-regional exports. An interpretation is that lower trade costs within the region, due to trade liberalization, as well as distance and common language, allow for a higher export growth at the extensive margin, with some experimentation in new products taking place towards close markets. Our results reinforce this view. True product diversity is likely to be significantly higher than apparent in official trade data. Moreover, it is possible that some of the growth at the extensive margin observed within regional agreements occurs by formalization of informal trade flows, made possible by the lowering of trade costs.

Table 2: Product composition of formal and informal trade

| | Number of Products | | | | | |
| | | Imports | | | Exports | |
Origin/destination	ECENE	Customs	Overlap	ECENE	Customs	Overlap
HS6						
Nigeria	177(63)	178(15)	37(8)	109(63)	5(2)	2(1)
Togo	247(103)	36(6)	10(1)	111(50)	10(1)	3(1)
HS4						
Nigeria	141	140	51	86	5	3
Togo	182	28	14	90	10	5
HS2						
Nigeria	62	52	44	38	5	4
Togo	62	21	20	44	7	6

Source: ECENE survey, Benin's and Togo's customs data. The table reports the number of distinct products appearing in each data source and bilateral trade flow, at 6-, 4- and 2-digit level of aggregation of the HS classification, for the period of September 2011. In parentheses the number of agricultural products, as defined by the WTO, excluding processed food.

4.3 Statistics on estimation sample

Our main samples cover imports and exports, formal and informal, between Benin and its main trade partners, Nigeria and Togo, in September 2011. The unit of observation is a product-country pair. The data source for formal trade is Benin's customs records, except for imports from Togo, for which we use Togo's customs data.

Tables 3 and 4 display descriptive statistics on the estimation samples. Tariffs do not appear to be significantly higher for products traded informally. Further estimation results will measure the relationship between tariffs and informality while controlling for other product characteristics. Note that, in the case of trade between Benin and Togo, we use the common external tariff (CET) of the WAEMU as potential determinant in the model. Imports and exports between the two countries should in principle face no tariff at this internal border of the zone. However, some trade flows may be applied the common external tariff (CET) of the zone, because the origin certification is costly to obtain.

Our data confirm that local unprocessed goods are essentially traded informally in the region. This may be due to the higher transport costs associated with using authorized routes rather than informal ones, for local producers selling to markets nearby. For example, the survey shows that at least 171 distinct informal border crossings existed at the time of the survey, while Benin's *Code des Douanes* (Customs code) lists about 30 authorized roads for import at all land borders. A tolerant policy toward these trade flows may also contribute to this.

Non-tariff measures, such as SPS and TBT, appear to be associated with informal trade. This is true also of perishable products, possibly due to time sensitiveness of these products. In contrast, differentiated products, as well as parts and components, are more likely to appear in formal trade records.

Table 3: Estimation sample: Benin's imports (September 2011)

		Nigeria			Togo		
		Informal	Formal	In both	Informal	Formal	In both
Nb. of products (HS6)		177	178	37	247	36	10
Tariff (ad-valorem) (2011)		15.6%	14.9%		15.5%	17.0%	*
Binary variables:							
SPS measures	Nb. products	32	8		50	4	
	Share	17.9%	4.4%	***	20.2%	11.1%	*
TBT measures		16	9		23	1	
		9%	5%	*	9.3%	2.8%	*
Unprocessed goods		43	7		63	0	
		24%	3.9%	***	25.5%	0%	***
Perishable		10	0		19	2	
		5.6%	0%	***	7.7%	5.5%	
Differentiated		97	131		129	20	
		54.2%	72.3%	***	52.2%	55.5%	
Parts and Components		8	17		8	0	
		4.5%	9.4%	**	3.2%	0%	

HS-6 products appearing in official imports (Benin's or Togo's customs data), in informal imports (ECENE survey), or in both.***,**, *: statistically different at 1, 5, 10% level (t-test of equality of means).

Table 4: Estimation sample: Benin's exports (September 2011)

		Nigeria			Togo		
		Informal	Formal	In both	Informal	Formal	In both
Nb. product-country pairs (HS6)		109	5	2	111	10	3
Tariff (ad valorem)		16.7%	19%		4.8%	5%	
Binary variables:							
SPS measures	Nb. products	60	2		7	0	
	Share	55%	40%		6%	0%	
TBT measures		4	0		7	2	
		3.7%	0%		6.3%	20%	*
Import ban		28	2				
		25.7%	40%				
Unprocessed goods		45	1		42	1	
		41%	20%		37.8%	10%	**
Perishable		16	0		14	0	
		14.7%	0%		12.6%	0%	
Differentiated		34	2		47	9	
		31.2%	40%		42.3%	90%	***
Parts and Components		0	0		4	1	
					3.6%	10%	

HS-6 products appearing in Benin's official exports (Customs data), in informal exports (ECENE survey), or in both.***,**, *: statistically different at 1,5, 10% level.

5 A model of trading mode choice

5.1 Theoretical model

In this section we build a simple model, which will serve as the basis for the empirical exercise. We consider firms trading goods across one of Benin's land borders. We take the example of imports from Nigeria into Benin; the same logic applies to imports from/exports to the other countries, which will be considered in the empirical exercise. Each trading firm (or "trader") faces the choice of trading formally or informally.

In the context of this paper, "formal trade" means crossing the border through one of the official land border crossings where customs operate, and having the shipment registered by the custom agents. "Informal trade" means crossing the border anywhere outside from the official crossings, so that the shipments are not recorded by customs and not subject to controls and duties.[29] Informal crossings are more numerous than formal ones.[30]

The formal and informal routes are two ways to move goods across the border, which differ in expected duration, cost and risk. We assume that trading costs for formal/informal trade are independent: i.e. shipping some goods formally has no impact on costs faced by the firm faced for informal shipments.[31]

Cost of time: we denote λ_i a parameter capturing the impact of delays on the value of a product i (e.g. its perishability). We model this cost of time as an iceberg cost: if shipping time is ST, then one needs to ship $1 + \lambda_i.ST$ units of good so that 1 unit arrives at destination. (Expected) shipping times on the formal and

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[29]Smuggling and tariff evasion taking place at the customs, through misclassification or under-invoicing, is not considered here. We discuss in the next section how the empirical results could be affected by it.

[30]For the purpose of the ECENE survey, 171 such crossings were identified and included in the sampling frame; while Benin's *code des Douanes* lists about 30 authorized roads for import.

[31]This is different from the hypothesis made in e.g. Pitt (1981). In our case, products tend to be traded either informally, or formally, rarely both (see section 4): this is one reason for not using such an hypothesis.

informal routes are noted ST_F and ST_I respectively, and these values are assumed to be known ex ante by the traders.

Monetary costs: crossing an official custom point involves paying the tariff T_i on the goods. Most tariffs considered here are ad-valorem : T_i is expressed as percentage of shipment value. We ignore the possibility of underdeclaring/smuggling so that tariffs paid at the custom would be lower than the official duty T_i.

On the informal route, monetary costs also apply, which we assume may depend on the tariff faced on the good : $g(Ti)$ is the ad-valorem equivalent of these costs, we expect $g' > 0$. This may represent bribes paid to custom agents to reduce the risk of a control. One possibility is that a bribe has to be paid in order to ensure that no control will be applied to one's shipment (e.g. custom agents will not be sent to the informal crossing point to block one's shipment). In the case of "rent sharing" between the payer and the receiver of the bribe, we expect to have $g(T_i) \leq T_i$ ("collusive corruption" in the terminology of Sequeira and Djankov (2014)). Alternatively, it may be the case that custom agents are in position to extract a bribe larger than the tariff from traders : $g(Ti) \geq T_i$ ("coercive corruption" in Sequeira and Djankov (2014)).

We denote by p_i^o the price of product i on the origin market (i.e. Nigeria), and p_i^d its price at destination (Benin). Traders are price takers on both markets. The cost of delivering one unit to the final destination in Benin, if taking the formal route, is given by $(1 + \lambda_i ST_F + T_i)p_i^o$. We assume here that tariffs are applied to the origin price (free on board price, excluding transport).

With informal trade, each trader also faces an idiosyncratic, unobserved, cost per unit delivered, denoted v, in addition to the tariff and time costs. This is intended to capture individual differences in access to some of the resources used in informal trade: for example, some traders may have access to better information on the routes, or to social capital which facilitates this type of trade operations. v is known

to each trader before deciding on the trading mode. Thus, the cost per unit of a good transported informally is given by $(1 + \lambda_i ST_I + g(T_i) + v)p_i^o$. We denote by G the cumulative distribution function of v among the traders.

For now, we make the additional assumption that $(1 + \lambda_i ST_F + T_i)p_i^o \leq p_i^d$, i.e. *formal trade is profitable*, so that product i is traded (at least formally) between Nigeria and Benin. We will relax this assumption later on.

Traders minimize trading costs. Therefore, a trader chooses the informal route if:

$$\lambda_i(ST_F - ST_I) + T_i - g(T_i) \geq v \qquad (2)$$

The probability of a trader of good i going informal then writes

$$P[Informal_i] = G(\lambda_i(ST_F - ST_I) + T_i - g(T_i)) \qquad (3)$$

This equation shows that the probability, for a trader of a good i, to choose informality increases with the tariff T_i if $g' < 1$,that is, if the tariff increases more the costs of formal than of informal trade. We see this as the most likely case.

The probability also increases with λ_i if $ST_F - ST_I > 0$. So, if formal trade is slower than informal trade, then we expect informal trade to be more frequent for time-sensitive products, e.g. perishable products, all else equal.

Aggregating traders To go from the individual probability in equation 3, to the informal share of trade by product, let us assume a number N of traders operating in sector i, who draw independent costs v from the same distribution. The share of traders going informal, in sector i, then follows a binomial distribution with individual probability $p = G(D_i)$, with $D_i = \lambda_i(ST_F - ST_I) + T_i - g(T_i)$. p is the expected value of the share of traders going informal. With traders of identical size, this is equal to the value share of informal trade in total trade of good i, $\frac{X_i^{inf}}{X_i}$:

$$E[\frac{X_i^{inf}}{X_i}] = G(D_i) \qquad (4)$$

As explained in section 3, we may want to work instead with a binary variable, an indicator for informal trade, rather than with the informal share of trade. This avoids using *trade values* in the formal and informal channel, X_i^F and X_i^{Inf}, which are subject to measurement and sampling errors. We show in section 3 that only a minority of products appear in both formal and informal trade data: the informal/formal share is at 0 or 1 for most products, so that a binary model applies naturally to the data.

Let us consider the probability[32] that a product is traded informally, $X_i^{inf} > 0$. Under the same assumption of a market of N traders of identical size for good i, this probability, for good i is given by:

$$P[X_i^{inf} > 0] = 1 - [1 - G(D_i)]^N \qquad (5)$$

$G(D_i)$ is, as before, the probability that an individual trader chooses informality. Zero informal trade implies that all traders go formal, which with independent draws is equal to $[1 - G(D_i)]^N$.

Assuming a logistic form for G, the probability of informal trade can be written as:

$$P[X_i^{inf} > 0] = 1 - \left[\frac{1}{1 + e^{D_i}}\right]^N = h_N(D_i) \qquad (6)$$

A first case to consider is $N = 1$, i.e. a monopoly in good i's trade. Then, the above probability is given by $G(D_i)$. With G logistic, we obtain a logit model.

Parameter N is difficult for us to evaluate, but likely to be greater than one for many products. For example, we observe, in ECENE data for informal flows, numerous shipments of the same good at different points (on the same border),

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[32]This is the probability of informal trade, conditional on being traded; since we assumed that formal trade exists.

which suggests the presence of several (independent) traders.

With $N > 1$, the probability function h_N is steeper. Without certain information regarding the functional form, we will, in the empirical exercise, rely on linear and logit functions.

Formal trade not always profitable   Let us now lift the hypothesis that formal trade is always profitable. This introduces the possibility of a share of informal trade equal to 1. The expected share of informal trade (for traded products), $s_i = \frac{X_i^{inf}}{X_i}$, can now be written as:

$$E[s_i|X_i > 0] = G(D_i) \quad if \quad 1 + \lambda_i.ST_F + T_i \leq p_i^d/p_i^o \tag{7}$$

$$E[s_i|X_i > 0] = 1 \quad if \quad 1 + \lambda_i.ST_F + T_i > p_i^d/p_i^o \tag{8}$$

The second equation corresponds to the case where only informal trade is profitable. Note that, as before, we consider only products for which there is trade of at least one type, so that the informal share of trade is defined.

In binary model form, the probability of informal trade (conditional on being traded) can be expressed by:

$$P[X_i^{inf} > 0|X_i > 0] = 1 - [1 - G(D_i)]^N \quad if \quad 1 + \lambda_i.ST_F + T_i \leq p_i^d/p_i^o \tag{9}$$

$$P[X_i^{inf} > 0|X_i > 0] = 1 \quad if \quad 1 + \lambda_i.ST_F + T_i > p_i^d/p_i^o \tag{10}$$

Thus, at low tariff levels, this probability follows the same function as in equation 5; above a threshold value, the probability goes to 1.

5.2   Econometric specification

Equation 4 specifies our main specification as a fractional response model. We estimate it as a generalized linear model (GLM) which can be estimated with a quasi-maximum likelihood estimator, as in Papke and Wooldridge (1996). We will employ this estimator with a logistic function for G. The model is identified under the assumption

$$E[\frac{X_i^{inf}}{X_i}] = G(\beta_1.X_i + \beta_2.Z_{ic}) \quad (11)$$

with $\frac{X_i^{inf}}{X_i}$ the share of informal trade in total trade of product i.

$\beta_1.X_i + \beta_2.Z_{ic}$ is the empirical counterpart of $\lambda_i(ST_F - ST_I) + T_i - g(T_i)$. Z_{ic} is a vector of trade policy variables (tariffs, binary indicators for non-tariff measures) varying across product and destination.[33] X_i is a vector of product characteristics (perishability; an indicator for unprocessed goods, for differentiated products and for parts and components).

The model is estimated on the sample of products traded in September 2011 (i.e. products appearing in at least one of the formal and informal trade records). The ECENE survey covers a 10-day period in that month; we match this data with monthly customs data for September. The dependent variable is the informal share of trade as estimated in the data.

Alternatively, we rely on the binary form of the model (equation 5), to exploit only information on the *presence* of each product in formal/informal trade, and not the value or volume traded, subject to caution. [34]

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[33]Tariffs will be introduced in log form, $log(1 + t)$ with t the ad-valorem duty, in order to allow for non-linearities in the g function. Results are similar when using tariffs in levels.

[34]Errors in product codes are rare in ECENE data, suggesting that misclassification of products by surveyors is minimal. Therefore we think the information on the presence of products in informal trade reliable even if the estimated traded value might not.

Our preferred specification in this case is a linear probability model:

$$P[Informal_{ic}] = \beta_1 X_i + \beta_2 Z_{ic} \tag{12}$$

We estimate this model by OLS on the sample with the dependent variable taking the value of 1 if we observe informal trade of product i (defined at HS-6 level) with country c, 0 otherwise. X_i and Z_{ic} are defined as above.

The linear form is intended to approximate for function h_N in equation 6. The aim is to estimate the slope of the informality curve, with respect to tariffs and other determinants. We will also employ logit models as an alternative functional form. Overall, results on the marginal effects of tariffs and other determinants, on informality of trade, are highly consistent across GLM, linear, and logit models.

In the case where formal trade is not always profitable, the model is identified by $E[s_i|T_i, \lambda_i] = f(T_i, \lambda_i)$, with $f(T_i, \lambda_i) = G(D_i)$ if $\lambda_i.ST_F + T_i \leq p_i^d$ and $f(T_i, \lambda_i) = 1$ else. We estimate this model by approaching function f with a logistic or a linear probability function.

Estimation issues A first issue to consider is selection into the sample, in particular for informal products. Our data source for these is the ECENE survey, which possibly fails to measure all informally traded products in the period considered. This can be an issue if this sampling selection is non-random. The main concern is that products facing higher protection could be harder to observe: these may be traded at night, or on routes not covered by the surveyors; traders of such products may be more reluctant to answer to surveyors. If these products are facing higher tariffs (i.e. if there is a correlation between tariffs and unobserved determinants of informality, such as other restrictions on trade), then this could imply an underestimation of the impact of tariffs on informality. In that case, our coefficient estimate

may represent a lower bound of the true impact.[35]

A related concern is selection on formally traded products. Evasion at customs, by way of underinvoicing or misclassification, has been studied in e.g. Fisman and Wei (2004); Javorcik and Narciso (2008); Mishra et al. (2008). This is distinct from the type of informal trade we consider, which avoids customs; the two may coexist. In the case of underinvoicing, products should still appear in our binary specification (in which each product traded is coded with a binary value); but they would be incorrectly coded as formal trade (since they appear in customs trade records), despite the fact that part of the trade has been smuggled. Some products may also be missing altogether.

We view this type of evasion as distinct from our focus. Our results may be affected, if there is some substitution between the two forms of evasion. For example, if underinvoicing at customs is present, then some high-tariff products will appear as "formal" in our sample (being recorded at customs), causing a downward bias of the tariff coefficient. In the results section, we show evidence of misclassification for imports from Togo, some products being traded at customs with a fake WAEMU origin. We address this issue by using mirror data, but we cannot be sure to eliminate it completely. One could wish to estimate the elasticity of all forms of evasion to trade barriers, but our data does not allow us to estimate this parameter.

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[35]Note however, that one of the trades facing strongest repression is the smuggling of petroleum products from Nigeria, which is abundantly recorded in our survey data. This selection issue thus seems not as important as one could fear.

6 Estimation results

6.1 Results: imports from Nigeria

We first present estimations using the sample of imports from Nigeria. Table 5 shows results from a linear probability model, excluding oil products.[36] We first estimate the impact of tariffs and non-tariff measures (SPS and TBT) separately (column 1 and 2), then include sequentially product characteristics: dummy variables for perishability, differentiated goods, and parts and components.

The tariff level applied by Benin on imports from Nigeria has a positive and significant impact on the probability of observing informal trade of a given product, across all specifications, with a coefficient of about 1.2. This implies that raising the tariff on one product by 10 percentage points increases the probability that this product be traded informally, rather than formally, by about 0.12.[37] SPS measures and TBT also have a significant and positive impact on informality of trade. The ad-valorem equivalent of an SPS is estimated at 21% (column 5).

Perishable products are more likely to be traded informally. Note however that the sample contains only 10 such products, all traded informally. We thus need to view this coefficient with some caution. We do not find any significant effect for differentiated goods, and parts and components.

We control for unprocessed goods across all specifications. Our results confirm that these products are, for the most part, crossing borders at non official crossing points, despite their de jure liberalization.[38] This may reflect higher costs of trading on authorized routes, for producers selling in markets at short distance across the border. It is also in line with the view that some trade in these products takes place

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[36] Note that oil products represent a large share of value traded, but our product-level specifications are little affected by this dominance. Including oil products (two product codes) does not affect the results significantly.

[37] In our specification the marginal impact of a tariff raise is given by $dP = \beta \frac{dT}{1+T}$, we take the value of the impact at the mean value of tariffs.

[38] Free movement should apply to unprocessed local goods within ECOWAS, according to its treaty, but applied tariff data between these countries were not at zero in data reported to the ITC in 2011. See section 3.

on traditional routes across borders, reflecting the artificial nature of some national borders in the region.(Golub, 2015).

Table 5: Informality in imports from Nigeria
Binary model, linear estimations

	(1)	(2)	(3)	(4)	(5)
			Dep. variable: 1 if informal		
Tariff	1.198***		1.214***	1.271***	1.243***
	(0.453)		(0.445)	(0.444)	(0.445)
TBT		0.166*	0.174*	0.175*	0.185*
		(0.092)	(0.097)	(0.097)	(0.101)
SPS measures		0.273***	0.274***	0.266***	0.265***
		(0.063)	(0.060)	(0.061)	(0.061)
Perishable				0.144**	0.146**
				(0.069)	(0.069)
Differentiated				-0.058	-0.049
				(0.066)	(0.067)
Parts & components					-0.099
					(0.124)
Unprocessed goods	0.461***	0.328***	0.347***	0.295***	0.292***
	(0.051)	(0.058)	(0.059)	(0.071)	(0.071)
Observations	318	318	318	318	318
R-squared	0.112	0.117	0.135	0.135	0.135

Standard errors in parentheses. Regressions are clustered at HS-4 level. * p<0.1, ** p<0.05, *** p<0.01. Sample includes all HS-6 products appearing in formal or informal trade records for Benin's imports from Nigeria, in September 2011. Dep. variable: 1 if product is traded informally, 0 else. Tariffs are measured as log(1+ ad-valorem rate). SPS measures, TBT (technical barriers to trade): 1 if importing country applies a SPS or TBT measure on one HS-8 product line within the HS-6 code.

Alternative functional forms   In Table 6 we report marginal effects from two alternative models: a logit model, with informality as the dependent variable (columns 1-3); and a generalized linear model (GLM) with the share of informal trade (in total trade of a product) as the dependent variable (columns 4-6).

Overall, results are in line with the previous specifications. The marginal impact of the tariff variable on the probability of informal trade is similar, estimated at 1.3 with the logit model, 1 in GLM.

Marginal effects in the logit model are larger than with GLM, for all the significant variables. The ad-valorem equivalent of SPS measures is estimated at 0.21 (GLM) or 0.33 (logit); coefficients on TBT are less significant. Unprocessed goods attract positive and significant coefficients.

We also experimented with alternative specifications to check the robustness of

the results. One alternative is to test the sensitivity of results to the presence of some products in both trade channels, formal and informal. We dropped these products and estimated a logit model: results are similar to those presented here. We also tried labeling such products as formal instead of informal, in binary response models, i.e. looking at the *exit of formality* margin, instead of the *entry into informality*. Finally, we estimated linear models on the informal share, as an alternative to GLM. Overall, the results are consistent with those presented here. These results are available on request.

Table 6: Informality in imports from Nigeria.
Alternative functional forms

	(1)	(2)	(3)	(4)	(5)	(6)
	Logit			GLM		
	Dep. variable: 1 if informal			Dep. variable: informal share		
Tariff	1.210***	1.331***	1.301***	0.978**	1.032**	1.007**
	(0.440)	(0.462)	(0.462)	(0.440)	(0.443)	(0.444)
TBT	0.189*	0.200*	0.212*	0.151	0.153	0.162
	(0.108)	(0.113)	(0.119)	(0.112)	(0.112)	(0.115)
SPS measures	0.446***	0.437***	0.432***	0.224***	0.217***	0.216***
	(0.148)	(0.153)	(0.153)	(0.075)	(0.075)	(0.074)
Perishable					0.199***	0.201***
					(0.074)	(0.074)
Differentiated		-0.061	-0.053		-0.064	-0.056
		(0.065)	(0.066)		(0.060)	(0.061)
Parts and components			-0.084			-0.091
			(0.115)			(0.104)
Unprocessed goods	0.486***	0.429***	0.424***	0.379***	0.316***	0.312***
	(0.122)	(0.138)	(0.138)	(0.065)	(0.079)	(0.079)
Observations	318	308	308	318	318	318

Robust standard errors in parentheses. All regressions are clustered at the HS4 level. * p<0.1, ** p<0.05, *** p<0.01

Marginal effects. Sample includes all HS-6 products appearing in formal or informal trade records for Benin's imports from Nigeria and Togo in September 2011, excluding petroleum products. SPS measures, TBT (technical barriers to trade): 1 if importing country applies a SPS or TBT measure on one HS-8 product line within the HS-6 code.

Tariff revenue implications   One may ask about the implications of these coefficient values in terms of tariff revenues: that is, on what side of the Laffer curve does Benin (or the WAEMU) find itself? Answering this question requires to take into account the particular feature of our setting that many products appear to be traded only informally. Thus, no tariff is raised on these products. By contrast, many products are traded exclusively on the formal channel: for these products,

our coefficient implies a positive relationship between tariff and revenue: increasing tariffs on these products would raise informality but not so much as to decrease tariff revenue. Details of the calculation are provided in the appendix. One has to note that we do not take into account evasion practices taking place at customs, such as under-invoicing or misclassification, which could modify this conclusion. This, however, raises the possibility that trade liberalization, in contexts similar to the region considered here, may not be costless to governments.

6.2 Results: imports from Togo

6.2.1 Comparing data sources

We now consider determinants of informality in trade flows from Togo to Benin. Two forms of trade need to be distinguished there. On one hand, Togo is an actor in entrepôt trade: as explained in Golub (2012), Togo has been competing with Benin for attracting re-exports, i.e. imports from third countries which have Nigeria's markets as final destination. Such trade transits through Togo or Benin before being smuggled into Nigeria, evading Nigeria's trade barriers. The route through Benin is shorter, but Togo may offer advantages in terms of infrastructure, such as a deep water port in Lome.

On the other hand, there is also some trade in regional products taking place at the Togo-Benin border. We are primarily interested in this form of trade. The two countries being members of the WAEMU custom union, one could expect that this border should be relatively frictionless, which could favor formality of trade. However, barriers to trade are not absent. One reason is that free movement of goods does not apply within the WAEMU: imports from outside the union are required to clear customs also at internal borders. In addition, internal trade flows may face duties because they lack a certification of origin, which may be costly to obtain.

Our problem is therefore to distinguish between the two forms of trade in the data. As shown in section 3, the volume of official imports as recorded by Benin raises suspicion about this data: a possibility is that some of these flows declare Togo as origin to benefit from WAEMU treatment, while being in reality imports from outside the union. This led us to the conclusion that Togo's records of the same flows (that is, the so-called mirror data) are more accurate.

We examine this hypothesis more precisely now. In 2011, the value of all imports from Togo in Benin, as reported by Benin's customs, was FCFA 125.8 billion. The corresponding number in Togo's records (i.e. exports to Benin) was FCFA 46.3

billion. The Benin data records 818 distinct 6-digit products, Togo only 106; of these, 86 are in common in the two datasets.

What explains the gap? Incentives to declare goods differ at the Beninese and Togolese customs. When entering Benin, products of WAEMU origin benefit from tariff exemption. Therefore, there exists an incentive to misclassify products from outside the WAEMU zone as Togolese products. On the contrary, the same products are not facing a tax when leaving Togo. Moreover, for goods imported from third countries, such as China, transiting through Togo and Benin to reach Nigeria's markets (i.e., entrepôt trade), the trader's best interest is to use Togo's transit regime, which entails a lower tax rate than for goods declared for domestic use (which have to pay the external tariff).[39]

Therefore, we hypothesize that entrepôt trade flows through Togo could appear in Benin's import data but not in Togo's export data (since transit are not recorded in customs data for exports and imports); that the gap between the two sources is largely attributable to entrepôt trade; and that Togo's export data are thus a more reliable measure of actual exports to Benin. We now present evidence in support of this hypothesis.

Table 7 shows the number of products, at 6-digit level, appearing in Benin's and Togo's records as imports from Togo to Benin in 2011. We ask whether these products also appear in Togo's records of exports to other destinations: all world countries excluding Benin, Nigeria and Niger. This should measure actual exports of Togo, since entrepôt trade is a phenomenon specific to trade with these three countries. In total, Togo exports 272 products to all other destinations, for a total value of FCFA 242.4 billion. Among the 818 products declared as imports by Benin,

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[39]One could ask why traders would not then use also the transit regime in Benin. One possibility is that goods banned for import in Nigeria cannot be declared in transit to this country, leaving "import for domestic use" as the only option; or that the WAEMU tariff for a product is low so that it makes little difference. Golub (2012) shows that some entrepot trade is declared in Benin for domestic use and discusses possible explanations.

less than 20% also appear as Togo's exports to other countries. By contrast, Togo's data on exports to Benin appear much more consistent: 3 quarters of the products are also found in other exports.

This is in line with our hypothesis: if Benin's customs record flows that are actually entrepôt trade, i.e. third-country imports sent mostly to the Nigeria's market, then it explains why these products are not connected to Togo's export specialization.

Table 7: Products in Togo-Benin trade

Exported to other destinations?	Benin customs		Togo customs	
No	659	80.6%	27	25.5%
Yes	159	19.4%	79	74.5%
Total	818	100%	106	100%

A further test is to look at the relation between these trade flows and Nigeria's trade barriers. In table 8, we regress the probability that a given product appears in Benin's customs records, or in Togo's, on the level of tariffs and the presence of import bans in Nigeria for that product.

Table 8: Trade between Togo and Benin: comparing data sources

	(1) Benin	(2) Togo	(3) Benin only	(4) Togo only	(5) Trade gap
MFN tariff (Nigeria)	0.85***	0.20***	0.66***	0.01	-1.98
	(0.08)	(0.04)	(0.08)	(0.01)	(3.07)
Import ban (Nigeria)	0.34***	-0.01	0.39***	-0.00	3.78**
	(0.08)	(0.01)	(0.09)	(0.00)	(1.27)
Tariff x ban	-1.13***	0.04	-1.22***	0.00	-9.85
	(0.29)	(0.08)	(0.28)	(0.01)	(5.46)
Observations	5051	5051	5051	5051	86
R^2					0.130

Robust standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01

Estimations based on Benin's and Togo's customs records for exports from Togo to Benin. Col 1-4: logit model, marginal effects. Dependent variable is 1 if product appears in Benin's customs data (col. 1), in Togo's customs data (col. 2), or *only* in one country's data, and not the other's (col. 3 and 4). Col. 5: OLS on the log of the ratio Benin data over Togo data, by product. Sample includes all HS-6 products (revision 3), col. 1-4, or all products common to both samples (col. 5).

These results show a strong relation between products reported as imports from Togo in Benin's customs data, and trade protection in Nigeria: a product under a ban in Nigeria is more likely to appear in this data, by about 34 percentage points; a tariff hike by 10 percentage points increases this probability by 8 points. This

relation is much less pronounced for products declared by Togo, although a positive link with the tariff is present. Columns 3,4 confirm these results when focusing on products which appear only in one of the records. In column 5, we estimate a model of the mirror gap, similar to those used in the literature (e.g. Fisman and Wei (2004)): the dependent variable is the log of the ratio of trade values declared by Benin and Togo, for the same product. Among products appearing in both sources, this gap is larger for products under a ban. Overall, these results show that the mismatch between the two data sources is strongly related to Nigeria's trade barriers, which predict the discrepancy at the intensive and extensive margins.[40]

These results confirm that, to measure Togo's exports to Benin, the exporter's data are more reliable than the importer's. In the next section we estimate the model of informality of trade at the Togo-Benin border, using Togo's customs data.

6.2.2 Determinants of informality in imports from Togo

Results of our model of trade mode choice for imports from Togo are presented in table 9. Togo and Benin are members of the WAEMU customs union, which implies the dismantlement of internal barriers to trade. However, evidence suggests that some obstacles remain in practice. One reason is that certification of origin may be costly to obtain. The problem of entrepôt trade may worsen this: customs officers may be suspicious regarding the origin of products, and prone to refuse preferential treatment in case of doubt. As a result, there is a possibility that some of Togo's exports face WAEMU's common external tariff (CET), since products without proper origin certification are required to pay this tariff. To test for this, we include the CET in the model. We also include binary variables for non-tariff measures (SPS measures and TBT), as well as indicators for product characteristics. In addition, we try including measures of Nigeria's protection in the model. The

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[40]Note that, in the literature, such as Fisman and Wei (2004), the relationship is generally in the other direction: importer's data are lower than the exporter's, which is attributed to underinvoicing or smuggling at the importer's customs. This differs in our setting due to the specificity of entrepôt trade, generating different incentives for traders.

reason for this is the following: the previous section has shown that some of the products in Togo's exports to Benin are actually transit trade (third-country imports intended for Nigeria's market). We try to mitigate this problem by using Togo's records instead of Benin's: but some of these products may still be present (as results in table 8, column 2, suggest). Including Nigeria's trade barriers serves to control for this.

The coefficient on the common external tariff is not significant in the baseline model, but becomes positive and significant when including controls for Nigeria's trade policy, with a coefficient lower, but close, to the one obtained for trade with Nigeria. Nigeria's tariffs attract a negative coefficient. This is consistent with some entrepôt trade flows being present in formal trade data, while our informal trade data seems to accurately exclude such trade from the *Import* category.[41] This would cause under-estimation of the coefficient on the CET, because of a positive correlation between Nigeria's and the WAEMU's tariff structures (the coefficient of correlation is 0.7).

By contrast, coefficients on SPS and TBT measures are lower, and less significant, than in the case of imports from Nigeria. The *Parts and components* variable attracts a positive coefficient; but note that there are only 8 such products in this sample, all traded informally. Local unprocessed goods are, again, consistently associated to informal trade. Other product characteristics have non-significant effects.

Therefore, these results do not allow to rule out entirely the possibility that the CET acts as a barrier to formal trade, with an effect smaller but similar to the effect of the tariff on trade at Nigeria's border. Access to preferential treatment may be costly or difficult for WAEMU products. Figures in table 1 show that the ratio of informal to total trade in aggregate is much lower at the Togo-Benin border than at the Nigeria-Benin border, which is consistent with trade liberalization in the WAEMU having lowered the incidence of informality, by removing some trade

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[41]In the ECENE survey, transit and re-exports are recorded separately in two categories which we exclude from our sample.

barriers. Results in this section indicate however that some obstacles to trade may remain.

Table 9: Informality: imports from Togo.

	(1)	(2)	(3)	(4)	(5)	(6)
	Linear model		Logit		GLM	
Tariff (WAEMU Common external tariff)	0.10	1.04**	-0.13	0.77**	-0.28	0.84
	(0.30)	(0.47)	(0.30)	(0.38)	(0.32)	(0.52)
SPS measures	0.05	0.07	0.07*	0.08**	0.03	0.05
	(0.04)	(0.04)	(0.04)	(0.03)	(0.05)	(0.05)
TBT	0.11***	0.10***			0.08	0.06
	(0.03)	(0.03)			(0.05)	(0.05)
Perishable	0.02	-0.00	0.05	0.03	-0.01	-0.04
	(0.05)	(0.05)	(0.05)	(0.06)	(0.10)	(0.10)
Parts and components	0.08**	0.07*			0.13***	0.11***
	(0.04)	(0.04)			(0.04)	(0.04)
Differentiated	0.06	0.04	0.02	0.01	0.06	0.04
	(0.06)	(0.05)	(0.05)	(0.04)	(0.06)	(0.06)
Unprocessed	0.14***	0.11***			0.19***	0.16***
	(0.04)	(0.03)			(0.05)	(0.05)
Nigeria's tariff		-1.24***		-1.16***		-1.45***
		(0.47)		(0.30)		(0.54)
Nigeria ban		0.05		0.03		0.04
		(0.04)		(0.04)		(0.06)
Observations	273	273	273	273	273	273
R^2	0.054	0.096				

Standard errors in parentheses. All regressions are clustered at the HS4 level. * $p<0.1$, ** $p<0.05$, *** $p<0.01$ Linear/logit/GLM estimates (marginal effects) of the probability of informality at HS-6 product level (or the informal share of trade). Formal trade data: Togo customs data for September 2011. Informal trade: ECENE data on imports from Togo into Benin, September 2011.

6.3 Results: exports

We turn to estimates of the determinants of informality in Benin's exports to Nigeria and Togo. Applying the same model on exports is made difficult by the low number of products appearing in Benin's formal trade records for exports: as shown on table 11, the formal sample has only 5 products exported to Nigeria, 10 to Togo.

This reflects, in part, the structure of Benin's economy. Most of its regional exports are in local unprocessed agricultural products, which are overwhelmingly traded on the informal channel. Another reason for the imbalance might be that the heavy involvement of Benin in entrepôt trade could have developed the informal trade sector to a point such that it became the main channel for exports to neighboring countries. An effort to be competitive in transit and re-exports may have implied that controls on exports have generally been weak, lowering the costs of trading informally for Benin's exporters. It could also be that Benin's customs exerted low or irregular control on exports, so that formal trade records would be incomplete and fraught with measurement error.

Section B in appendix reports results of the linear model applied to exports. The only significant variable is the indicator for local unprocessed goods, positively associated with informality in the sample of exports to Togo. This is largely due to the low number of observations, for formal trade in particular.[42] Results from logit and GLM estimations are similar.

Note that the share of informal trade is higher for exports to Nigeria than to Togo (table 1). This may be due to a lower level of trade impediments at the Togo border, which is an internal border within the WAEMU. This is however a hypothesis which we cannot test precisely due to data limitations.

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[42]In unreported results, we built a sample with formal trade data for a 3-month or yearly period, combined with the same ECENE data for informal trade. Results are more significant, and the tariff and ban variables have expected signs. However these results are problematic as the period coverage between the two sources differs widely, creating potential issues due to selection and seasonality.

7 Conclusion

The recorded level of regional trade is low in sub-saharan Africa; even in customs unions, such as the WAEMU, trade performance is generally seen as disappointing (Carrère, 2013). However, formal trade data underestimate the level of regional trade due to the importance of informal cross-border trade.

This paper exploits a rich survey of informal trade at Benin's borders, conducted by the National Institute of Statistics in September 2011, to quantify this form of trade, which is not possible with customs data (including mirror data). The data also allows us to test the relationship between trade barriers and informality.

We first estimate the magnitude of informal flows, and show that accounting for informal trade modifies substantially the picture of regional trade: this confirms that regional trade integration in West Africa is significantly underestimated in official trade data. Informal trade data also exhibit a remarkable level of product diversity, with little overlap between products in formal and informal trade. Thus, product diversity in trade is also largely underestimated in official trade data. Second, we measure a positive semi-elasticity of informality with respect to tariffs. Increasing tariffs on a given product by 10% makes it about 12% more likely that this product is imported informally rather than formally. We find that non-tariff measures also increase informality, with an ad-valorem equivalent of about 20% for SPS measures. Local unprocessed products are more likely to be traded informally. Perishability also associates with informality, suggesting that "time as a trade barrier" affects the choice of informality.

Our results can contribute to a discussion on trade policy in several aspects. First, reducing informality of trade may be a policy objective per se, for statistical purposes: official data offer an incomplete view of regional trade, and the design of trade policy requires, arguably, a more accurate knowledge of actual trade at a country's borders.

Second, our results suggest that informality is due in part to the high cost of compliance in formal trade: delays seem to play a role; informality persists for domestic products within WAEMU, which face no tariff. The fact that many products are traded exclusively on the informal channel also supports this hypothesis.

If some traders choose the informal channel not because their cargo fails some requirements (technical, sanitary, or of origin) but because the costs of compliance (delays or certification costs) are too high, then the reduction of these costs should generate a welfare gain. Our results suggest that such compliance costs play a role, although we cannot quantify precisely this effect.

References

Ackello-Ogutu, C. and P. Echessah (1997). Unrecorded cross-border trade between Kenya and Uganda. Technical paper n. 59, USAID.

Alesina, A., W. Easterly, and J. Matuszeski (2011, 04). Artificial States. *Journal of the European Economic Association 9*(2), 246–277.

Ayuk, E. T. and S. T. Kaboré (2012). *S'intégrer pour s'enrichir: L'intégration régionale et les stratégies de réduction de la pauvreté en Afrique de l'ouest.* IDRC.

Bhagwati, J. (1964). On the underinvoicing of imports. *Oxford Bulletin of Economics and Statistics 27*(4), 389–397.

Bouet, A. and D. Roy (2012). Trade protection and tax evasion: Evidence from Kenya, Mauritius, and Nigeria. *The Journal of International Trade and Economic Development 21*(2), 287–320.

Carrère, C. (2013). UEMOA, CEMAC: Quelle performance en matière de commerce? *Revue d'économie du développement 21*(1), 33–60.

De Melo, J. and Y. Tsikata (2015). Regional integration in Africa: Challenges and prospects. *CEPR DP10598*.

Egg, J. and J. Herrera (1998). *Échanges transfrontaliers et intégration régionale en Afrique subsaharienne*, Volume 6. IRD Editions.

Emlinger, C., F. Jacquet, and E. C. Lozza (2008). Tariffs and other trade costs: assessing obstacles to mediterranean countries' access to EU-15 fruit and vegetable markets. *European Review of Agricultural Economics 35*(4), 409–438.

Fisman, R. and S.-J. Wei (2004). Tax rates and tax evasion: evidence from "missing imports" in China. *Journal of Political Economy 112*(2), 471–496.

Golub, S. (2015). Informal cross-border trade and smuggling in Africa. *Handbook on Trade and Development*, 179.

Golub, S. and J. Hansen-Lewis (2012). Informal trading networks in west africa: The mourides of senegal/the gambia and the yoruba of benin/nigeria. In N. Benjamin and A. A. Mbaye (Eds.), *The Informal Sector in Francophone Africa : Firm Size, Productivity, and Institutions*, pp. 173–193. Washington, DC: The World Bank.

Golub, S. S. (2012). Entrepôt trade and smuggling in West Africa: Benin, Togo and Nigeria. *The World Economy 35*(9), 1139–1161.

Golub, S. S. and A. A. Mbaye (2009). National trade policies and smuggling in africa: The case of the Gambia and Senegal. *World Development 37*(3), 595 – 606.

Hummels, D. L. and G. Schaur (2013). Time as a Trade Barrier. *American Economic Review 103*(7), 2935–59.

Igue, J. O. and B. Soule (1992). *L'Etat Entrepôt au Bénin: Commerce Informel ou Réponse a la Crise?* Khartala: Paris.

IMF (2017). Nigeria. IMF country report, International Monetary Fund.

INSAE (2011). Enquête sur le commerce non enregistré au cordon douanier. Rapport, Institut National de la Statistique et de l'Analyse Economique, Cotonou.

ITC (2017). Benin: Company perspective. Technical report, International Trade Centre, Geneva.

Javorcik, B. S. and G. Narciso (2008). Differentiated products and evasion of import tariffs. *Journal of International Economics 76*(2), 208–222.

LARES (2005). Le traffic illicite des produits pétroliers entre le Bénin et le Nigéria: vice ou vertu pour l'Economie béninoise. Rapport, Laboratoire d'Analyse Régional et d'Expertise Sociale, Cotonou.

Mishra, P., A. Subramanian, and P. Topalova (2008). Tariffs, enforcement, and customs evasion: Evidence from India. *Journal of Public Economics 92* (10), 1907–1925.

Papke, L. E. and J. M. Wooldridge (1996). Econometric Methods for Fractional Response Variables with an Application to 401(K) Plan Participation Rates. *Journal of Applied Econometrics 11* (6), 619–632.

Pitt, M. M. (1981). Smuggling and price disparity. *Journal of International Economics 11* (4), 447–458.

Raballand, G. and E. Mjekiqi (2010). Nigeria's Trade Policy Facilitates Unofficial Trade but not Manufacturing. In *Putting Nigeria to Work: A Strategy for Employment and Growth* (World Bank ed.). Washington D.C.: Volker Treichel.

Rauch, J. E. (1999). Networks versus markets in international trade. *Journal of International Economics 48* (1), 7–35.

Sequeira, S. and S. Djankov (2014). Corruption and firm behavior: Evidence from African ports. *Journal of International Economics 94* (2), 277–294.

UNECA (2010). Assessing regional integration in africa iv: Enhancing intra-african trade. Technical report, Economic Commission for Africa, Addis Ababa.

WorldBank (2011). Doing Business. Making a difference for entrepreneurs. Technical report, Washington, DC: World Bank.

WorldBank (2012). De-fragmenting Africa : deepening regional trade integration in goods and services. Technical report, Washington, DC: World Bank.

A Trade data: sector distribution at HS2 level

Table 10: Sector coverage of formal and informal trade data: Imports

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Origin			Nigeria				Togo	
	Customs data		ECENE data		Customs data		ECENE data	
Sector	Nb. pdts. (HS6)	Value share (%)	Nb. pdts. (HS6)	Value share (%)	Nb. pdts. (HS6)	Value share (%)	Nb. pdts. (HS6)	Value share (%)
Animal & Animal Products	1	4.72	15	5.31	2	1.54	28	12.09
Vegetable Products	6	0.52	39	42.39	1	3.58	52	47.69
Foodstuffs	7	26.77	21	15.39	9	15.51	32	6.24
Mineral Products	2	0.01	2	0.47	2	37.22	5	7.12
Chemicals & Allied Industries	28	7.13	18	1.06	1	0.07	22	3.96
Plastics & Rubbers	14	3.31	11	2.24	5	25.93	12	2.58
Raw Hides, Skins, Leather and Furs	1	0.02	2	0.05			4	0.10
Wood & Wood Products	12	1.36	7	11.17	4	4.23	11	4.32
Textiles	17	2.21	14	5.74	4	1.58	24	7.57
Footwear & Headgear	5	1.15	7	2.30	1	1.98	7	2.98
Stone & Glass	11	13.73	6	0.55			7	0.88
Metals	17	8.96	8	0.82	6	8.33	11	1.29
Machinery & Electrical equipment	32	9.11	12	3.50			15	1.42
Transportation	5	14.00	6	7.80			3	1.11
Miscellaneous	20	6.99	9	1.20	1	0.03	14	0.64
Total	178	100	177	100	36	100	247	100

Table reports the number of products (HS-6 codes) and value share by sector for each country of origin and trading channel, September 2011. Source: Benin and Togo customs, ECENE survey. Data for Nigeria exclude petroleum products.

Table 11: Sector coverage of formal and informal trade data: Exports

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Destination			Nigeria				Togo	
	Customs data		ECENE data		Customs data		ECENE data	
Sector	Nb. pdts. (HS6)	Value share (%)	Nb. pdts. (HS6)	Value share (%)	Nb. pdts. (HS6)	Value share (%)	Nb. pdts. (HS6)	Value share (%)
Animal & Animal Products			19	27.37	1	55.61	18	53.92
Vegetable Products	2	69.68	42	63.92			31	28.61
Foodstuffs			15	1.60	3	9.58	17	6.33
Mineral Products			2	5.06			3	0.45
Chemicals & Allied Industries	1	0.94	5	0.04	1	12.19	9	1.62
Plastics & Rubbers	1	9.45			2	2.60	4	0.10
Raw Hides, Skins, Leather and Furs			2	0.21			1	0.29
Wood, Wood Products			8	0.97			5	5.94
Textiles	1	19.93	8	0.72			6	0.80
Footwear & Headgear			2	0.08			1	0.08
Stone & Glass			2	0.00			2	0.03
Metals			2	0.01			4	0.49
Machinery & Electrical equipment					1	0.47	6	1.13
Transportation					2	19.56	2	0.18
Miscellaneous			2	0.00			2	0.03
Total	5	100	109	100	10	100	111	100

Number of products (HS-6 codes) and value share by sector for each country of origin and trading channel, September 2011. Source: Benin's customs, ECENE survey.

B Results: exports

Table 12 displays results of the linear probability model for exports. Left-hand side variables differ by country of destination: in the case of Nigeria, we include a binary variable for import bans (columns 1-4). In the case of Togo, in columns 5-8, we include WAEMU's external tariff: as for imports from Togo, we allow for the possibility that trade between the two member countries may however face a barrier because of the cost of origin certification, with products without proper certification facing the external tariff. For clarity , we report separate estimates for trade to Nigeria, and to Togo.

Table 12: Informality in exports. Linear model

	(1)	(2)	(3)	(4)	(5)	(6)
				Dep. variable: 1 if informal		
Destination		Nigeria			Togo	
Tariff	0.031	-0.064	-0.070			
	(0.181)	(0.218)	(0.241)			
Import ban × Tariff	-0.580	-0.695	-0.662			
	(0.647)	(0.633)	(0.624)			
Import ban	0.112	0.137	0.130			
	(0.092)	(0.092)	(0.092)			
External tariff				0.347	0.346	0.416
(WAEMU)				(0.406)	(0.411)	(0.429)
Unprocessed good	0.039	0.022	0.022	0.096***	0. 091**	0.062*
	(0.028)	(0.017)	(0.024)	(0.035)	(0.037)	(0.034)
SPS measures		0.042	0.043		0.012	0.009
		(0.032)	(0.032)		(0.013)	(0.023)
TBT		0.047	0.047		-0.037	-0.013
		(0.031)	(0.032)		(0.129)	(0.133)
Perishable			0.009			-0.005
			(0.014)			(0.024)
Differentiated			0.007			-0.078
			(0.043)			(0.047)
Observations	112	112	112	118	118	118
R^2	0.036	0.048	0.048	0.042	0.043	0.064

Standard errors in parentheses. Regressions are clustered at HS4 level. * p<0.1, ** p<0.05, *** p<0.01
Sample includes all HS-6 products appearing in formal or informal trade records for Benin's
exports to Nigeria and Togo, September 2011. Nigeria sample: model includes Nigeria's
applied tariff to imports from Benin and an indicator for Nigeria's import bans in 2011. On
Togo sample, the tariff variable is WAEMU's common external tariff. SPS measures, TBT
(technical barriers to trade): 1 if importing country applies a SPS or TBT measure on one
HS-8 product line within the HS-6 code.

Few variables are significant. In the Nigeria sample, import bans attract a positive, non-significant coefficient. The interaction between bans and tariffs is negative,

reflecting the fact that tariffs have less impact in the case of products under ban. However, when controlling for non-tariff measures, these variables have a positive impact, and the tariff coefficient becomes slightly negative (non-significant). These results are evidently rendered unstable by the small number of observations in formal records, and should be viewed with caution.[43] Note that, in this sample, the indicator for unprocessed goods perfectly predicts informality.

In the case of trade with Togo, the tariff variable has a positive (non-significant) coefficients. The only significant variable is the indicator for unprocessed products, which has a value slightly smaller than for imports. This confirms the prevalence of informality for trade in these local products.

Results from logit and GLM estimations are similar; in the case of logit, the impact of some variables, such as unprocessed goods, cannot be estimated because the outcome does not vary within these categories.

C   Implications for tariff revenues

We consider here the implications of our results for the impact of a tariff change on tariff revenue. Omitting the product index, tariff revenues can be written as $RT = T.X_f$ with T the ad-valorem tariff and X_f the value of formal imports for a given product. Our linear specification implies

$$d\left(\frac{X_{inf}}{X_f + X_{inf}}\right) = \beta.dT/(1+T) \tag{13}$$

with β our estimate of the tariff coefficient (since tariffs enter the specification as $\ln(1+T)$).

Differentiating $\ln RT = \ln(T.X_f)$, and rearranging, one obtains:

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[43]In unreported results, we built a sample with formal trade data for a 3-month or yearly period, combined with the same ECENE data for informal trade. Results are more significant, and the tariff and ban variables have expected signs. However these results are problematic as the period coverage between the two sources differs widely, creating potential issues due to selection and seasonality. We therefore decided not to retain them.

$$\frac{d\ln RT}{dT} = \frac{d\ln(X_f + X_{inf})}{dT} + 1/T - \frac{X_f + X_{inf}}{X_f}\cdot\frac{\beta}{1+T} \qquad (14)$$

In this equation, the first term is the impact of a tariff change on total trade of the product. It is likely to be smaller than or equal to zero.[44]

The other two terms correspond to the revenue change due to the tariff change itself, and to the change in the share of trade subject to taxation. Note that we assume here, that all formal trade pays the entire tariffs due; things may get more complex if considering the possibility of evasion (e.g. by underinvoicing or misclassification) at customs.

Therefore, a sufficient condition for a tariff increase to have a negative impact on tariff revenues, is that $\beta \geq \frac{X_f}{X_f + X_{inf}}\cdot\frac{1+T}{T}$.

In the context of this study, two particular cases are of interest, as they are the most frequent in the data: those where $\frac{X_f}{X_f + X_{inf}}$ is equal to 0 or 1. If there are zero formal imports, then there are zero revenues, and the impact of a tariff raise is zero.

At the opposite extreme, when informal trade is zero, then the impact on revenues can very well be positive (provided that total trade does not contract too much): with β at about 1.3, and Benin's tariffs below 20%, β is far smaller than $\frac{1+T}{T}$, so the sum of the last two terms in equation 14 are positive.

Thus, the implications for revenues differ across products. For products heavily traded on the informal channel, tariff increases will not raise additional revenues, as the tax base has already vanished. This concerns in particular products with characteristics which make them prone to informal trade, such as unprocessed, or perishable products. On the other hand, for products which are traded mostly on the formal channel, our estimates suggest that Benin finds itself on the left (i.e.,

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[44]The same assumption is made in Fisman and Wei (2004).

revenue-increasing) part of the Laffer curve.[45] This means that tariff dismantlement should not induce enough formalization to "pay for itself" in this context. Note however, that we do not account here for other forms of evasion taking place at customs, i.e. under-invoicing or misclassification.[46]

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[45]The median value of the formal share of trade in the sample of Nigerian imports is 53%. With β at 1.3, $1/T - \frac{X_f + X_{inf}}{X_f} \cdot \frac{\beta}{1+T} \geq 0$ for tariffs below 69%. Thus $\frac{d\ln RT}{dT}$ is likely to be positive for all products above the median formal share.

[46]For example, estimates of the tariff elasticity of evasion in Fisman and Wei (2004), who indirectly observe evasion at customs (with mirror gaps), in the case of trade from Hong-Kong to China, are higher than ours; implying a negative relation between tax revenues and tax rates. However, estimates vary importantly in this literature: for example coefficients in Mishra et al. (2008) are much lower.