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Algeria–Mali trade

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Algeria-Mali Trade: The Normality of Informality
--Manuscript Draft--

Manuscript Number:	MEDJ-D-15-00039R1
Full Title:	Algeria-Mali Trade: The Normality of Informality
Article Type:	Research Paper
Keywords:	informal trade, Algeria, Mali, customs, smuggling, Kidal
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Response to Reviewers:	See Separate file

Algeria–Mali Trade:

The Normality of Informality

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Abstract

This paper estimates the volume of informal trade between Algeria and Mali and analyzes its determinants and mechanisms, using a multi-pronged methodology. In addition to mirror statistics analysis, we provide evidence of the importance of informal trade, drawing on satellite images and surveys with informal traders in Mali and Algeria. We estimate that the weekly turnover of informal trade fell from approximately US$2 million in 2011 to US$0.74 million in 2014, but that trade continues to play a crucial role in the economies of northern Mali and southern Algeria. We also show that official trade statistics are meaningless in this context because they capture less than 3 percent of total trade. Meanwhile, profit margins of 20–30 percent on informal trade help to explain the relative prosperity of northern Mali. Informal trade probably plays a strong role in poverty reduction, especially in the Kidal region.

JEL classification codes: F14, H26, J46

Keywords: informal trade, Algeria, Mali, customs, smuggling, Kidal

Introduction

With the rise of states with demarcated political boundaries, trade became regulated by government institutions, and, in parallel, informal trade began to develop. The term *informal trade* first appeared in a report of the International Labour Organization (1972) and then in an article by Hart (1973), an anthropologist who had worked in Ghana (Cantens, Ireland, and Raballand 2015). Informal trade forces states to strike a balance between rule avoidance and local economic development. Border studies and studies of informal trade are now commonly conducted by anthropologists, political scientists, and economists.

Using mirror trade statistics, economists have demonstrated that tariff evasion is quite widespread, especially among developing countries. These countries often report undervalued imports or "missing imports" or undervalued exports or "lost exports"——see, for example, Sequeira (forthcoming) who examines the situation in southern Africa. Various investigators have used official trade statistics to show the large discrepancies between declared imports and exports——see Fisman (2004), Jean and Mitaritonna (2010), Kaminski and Mitra (2012), Carrère and Grigoriou (2014), and Vezina (2015). The mirror statistics approach dates from the late 1960s with Bhagwati (1967), but it is now experiencing a revival, probably because of the easier access to detailed trade statistics data, the greater interest of African states in collecting tariff revenue, and a research interest in corruption and tariff evasion.

In several cases, informal cross-border trade has been estimated based on surveys, interviews, and consumption comparisons, thereby demonstrating the weakness of official trade statistics, mainly in Africa. Raballand and Mjekiqi (2010) estimated that the value of informal trade between Nigeria and Benin totaled several billion dollars in 2009; Golub (2012) estimated in West Africa the volume of informal trade in "entrepôt countries", such as Benin and Togo and Ayadi et al. (2014) demonstrated for Tunisia that the volume of informal cross-border trade was higher than that of the official trade between Tunisia and Algeria in 2013.

Algeria and Mali may be an extreme case because of the weakness of the state in the northern part of Mali. However, customs corruption and state capacity in this part of Africa seem to be comparable to that in other parts of the continent and can therefore illustrate the inaccuracy of official trade statistics and better describe the reasons behind such discrepancies.

This paper presents estimates of the informal cross-border trade[2] between Algeria and Mali (see map 1, which shows Mali and its border region with Algeria). It contributes to the growing literature on the inaccuracy or unreliability of official trade statistics, especially in Africa.

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[2] *Informal cross-border trade* is defined as the flow of goods not reported or inadequately reported to customs authorities. Thus it encompasses two practices: (1) the trade in goods through border posts for which false statements are made about the types or quantities of goods, and (2) the smuggling of goods (that is, when

Map 1 Mali

Source: http://www.lib.utexas.edu/maps/africa/mali_pol94.jpg.

Trade in the Sahel is paradoxical. On the one hand, observers and anthropologists describe at length the economic and social importance of trade between Mali and Algeria. On the other, according to official trade statistics the trade total is US$1–$2 million a year, and so the cross-border trade is minimal.[3]

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goods are passed unknown to customs authorities through or outside of border posts). The estimates presented here do not include products whose import is illegal in Mali (such as weapons and drugs) because collecting information and data on these products is even more difficult. Since 2013, Algerian authorities have considered any trade with Mali as smuggling because the border is officially closed.

[3] All dollar amounts are U.S. dollars unless otherwise indicated. Conversions in this report are made on the basis of US$1 = CFAF (Communauté Financière Africaine Franc) 480 in 2014.

Informal cross-border trade is said to be essential to survival of the Saharan region. Among others, Scheele (2012) has described the channels of this type of trade between southern Algeria and Mali. Scheele gives the impression that, for decades, informal cross-border trade has been largely tolerated on both sides of the border because, as in other regions of the world, it has enabled local populations, remote from capitals, to benefit from income generation and employment.

As for the main findings of this article, the official trade statistics appear to be extremely partial. A comparison of our findings with the official statistics reveals a ratio of 1 to 15 (and 1 to 40 in 2011) between official and unofficial trade. Indeed, based on cross-checks of different sources and relying on the estimated volumes, products, and destinations used in different regions of the world, we estimated the total informal cross-border trade between Algeria and Mali in 2011 at over $85 million, but it declined to less than $30 million in Mali in 2014.[4]

This article is organized as follows. The next section describes the weaknesses of official trade statistics. We then present satellite images demonstrating that the closure of the border is not so effective and estimate the volume of the informal cross-border trade in 2011 and 2014. The next section presents the economic incentives for smuggling and the underlying reasons for such trade flows. The last section offers our conclusions.

The official trade data

To get an overview of trade between Algeria and Mali, and identify the most traded goods, we analyzed official statistics in the COMTRADE database, based on customs declarations of both countries.

Mirror statistics literature proposes using the difference between the measurements reported by the authorities of the importing and exporting countries for the same trade flow to obtain an initial assessment of the informal cross-border trade. In principle, there is a minimum difference between the reported values on both sides of a border because exports are valued f.o.b. (without freight and insurance), and imports are valued c.i.f. (shipping and insurance costs are included). The difference can then be amplified by classification errors, problems of time, exchange rates, etc.[5] However, Bhagwati (1967) noted that for over 30 percent of the difference between reported imports and exports, "classic" explanations are no longer satisfactory. Beyond this threshold, presumption of undervaluation or overvaluation of imports or exports would be preferred.

The difference is calculated for a given year and a given pair of countries as

$$\%Gap_{ijt}^{k} = (Imports_{ijt}^{k} - Exports_{jit}^{k})/Imports_{ijt}^{k}.$$

in which k corresponds to a category of goods defined at level 6 of the Harmonized System (HS) classification, Revision 2.

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[4] If we include informal cross-border trade to Niger and Nigeria, the informal cross-border trade volume amounted to over $150 million. This research was based on interviews carried out during the spring of 2014 in the subregion, and the satellite images were taken in March 2014.

[5] For a discussion of potential explanations, see Raballand, Cantens, and Arenas (2013).

According to the official statistics, trade between Algeria and Mali is extremely low. Analysis of the official statistics seemed to reveal an enigma because Algerian authorities claimed that Algeria had a trade surplus with Mali, and Malian authorities claimed that Mali had a trade surplus with Algeria.

According to Algeria's official trade statistics, imports from Mali increased from $1.46 million in 2000 to over $6 million in 2010 and exports from $742,000 in 2000 to over $5 million in 2010 (for Niger and Mali). However, there appeared to be no correspondence between the flow of Malian exports to Algeria reported by the Malian authorities and the flow of imports from Mali reported by the Algerian authorities. The available trade data between Algeria and Mali are fluctuating and not reliable (see table 1, which summarizes the total trade flows between Algeria and Mali based on the customs declarations in COMTRADE). The transaction values recorded by the two countries are very different: Malian authorities recorded imports of over $1.89 million in 2011, whereas Algerian authorities recorded a total value of only $1.02 million in exports to Mali for the same year. Similarly, Malian authorities recorded exports to Algeria of more than $11.57 million in 2011, whereas Algerian authorities recorded a value of only $0.10 million in imports for the same year.

Table 1 Total Recorded Trade Flows: Algeria and Mali, 2007–12

US$, millions

Year	Algerian exports (recorded value on entry in Mali)	Algerian exports (recorded value when leaving Algeria)	Malian exports (recorded value on entry in Algeria)	Malian exports (recorded value when leaving Mali)
2007	1.32	0.62	0.16	1.95
2008	4.94	0.64	0.00	2.39
2009	0.00	2.65	0.00	0.00
2010	1.54	0.27	0.00	3.11
2011	1.89	1.02	0.10	11.57
2012	1.84	0.58	0.25	1.85

Source: COMTRADE.

In 2007 Malian authorities recorded the entry of 13 different types of goods, whereas the Algerian authorities recorded the export of 141 different types of goods for the same year (see table 2). As for Malian exports to Algeria, there is a low flow of registered trade, except for the year 2011 when 42 types of exports were recorded on the Malian side, whereas Algeria recorded receiving only four imports from Mali (see table 2).

Table 2 Range of Goods Exchanged between Algeria and Mali, 2007–12

	Number of imported goods recorded by Malian authorities	Number of exported goods recorded by Algerian authorities	Number of Malian exports recorded (to Algeria)	Number of Algerian imports recorded (from Mali)
2007	13	141	2	7
2008	149	21	8	1
2009	0	30	0	4

2010	35	27	6	0
2011	52	31	42	4
2012	59	70	6	4

Source: COMTRADE.

Where the exported goods reported by Algerian authorities and Malian imports appear to correspond, some wide disparities on recorded values and tonnage may be evident. Dates, for example, represent the largest volume of business, with an import value in 2011 of over $947,000 or approximately nine times the export value, $107,840. However, the main discrepancies in trade in 2011 can be found for mineral water and the equipment needed to purify water.[6] The trade gap is more than 120 times the import value of mineral water and 880 times the import value of purification equipment.[7] According to Algerian authorities, in five out of six years the most commonly exported goods are medical needles and other organic materials (HS6 294200), followed by water purification machines, salt, and vegetable oils (HS 151590 and HS 151790).

Malian authorities report that Malian exports are dominated by fruit exports, guava and mango, which, with a value of more than $2 million in 2011, had the highest export value between 2007 and 2012. According to Algerian authorities, cotton (HS 520100) was the main Malian export over the study period, with a value of $2.5 million in 2012.

In the official trade statistics, the fuel trade has extremely low values. Algerians declare that gasoline exports (HS 271000) amounted to $14,238 in 2007 and $7,105 in 2010. Malians declare that gasoline imports (HS 271000) amounted to $19,064 in 2011 and gas imports (HS 271129) amounted to $623 in 2008. No exports of cigarettes from Algeria are recorded. Annex B reveals Malian imports of cigarettes and gasoline in the official statistics as well as their total value and tonnage.

The empirics of smuggling in northern Mali

In spite of the border closure, smuggling continues between Algeria and Mali (although the volume has fallen sharply since 2011). The explanation is that the economic integration of northern Mali and Algeria is in fact rational.

This section presents some geographical factors explaining such flows, an indirect measure of smuggling with price gradients in Mali, some evidence of smuggling in the form of satellite images, and finally some estimates of the informal trade before and after the border closure.

An economic justification

Economically, even without considering the Algerian subsidies on transport and goods, it is understandable that the Malian cities of Kidal, and even Gao, gravitate toward Algeria because transit times are between seven and eight days to Algiers as opposed to at least 17 days to Dakar (Senegal) or via the southern road to Abidjan (Côte d'Ivoire) or Tema (Ghana)⸺see table 3. Moreover, the cost of shipping transport is much lower at ports in North Africa than those in West Africa. Finally, Kidal, for example, is not even linked to a paved road to Bamako, whereas border

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[6] For a detailed list of official traded goods, see annex A.
[7] These flows correspond to the humanitarian aid Algeria sent to Mali in 2011 in the water and health sectors, especially targeting regions in northern Mali.

towns in Algeria are linked to Algiers with paved roads. The internal economic integration of Mali thus seems relatively dysfunctional.

Table 3 Comparison of Distances and Average Transit Times between Kidal, Gao, and Bamako in Mali to Algiers, Dakar, Abidjan, and Tema

	Kidal	**Gao**	**Bamako**
Distance (km)			
Algiers (Algeria)	2,297	2,597	4,193
Dakar (Senegal)	2,950	2,650	1,400
Abidjan (Côte d'Ivoire)	2,400	2,050	1,150
Tema (Ghana)	2,250	1,900	2,000
Average transit times (days)			
Algiers	7	8	20
Dakar	18	17	13
Abidjan	23	22	19
Tema	24	23	22

Source: Comité de liaison de la route Transsaharienne (Liaison Committee for the Trans-Saharan Road 2009).

Almost all of the products sold in northern Mali are those subsidized in Algeria— pasta products, flour, and semolina products, but also fuel. In spite of the official closure of the Algerian border in January 2013, informal cross-border trade flows remain significant.

An indirect measure: price differentials

As just noted, Mali directly benefits from subsidy policies established by the Algerian authorities for certain products. This explains in part the access of the residents of northern Mali to products that cost less than those in Bamako. Kidal benefits even more because its prices are quite similar to those in Algeria. In terms of fuel, customs clearance of fuel is authorized only in Bamako, which allows the region up to Douentza to benefit from Algerian fuel prices.

Kidal is largely economically integrated with Algeria through informal cross-border trade. Figure 1 compares the prices of sugar, milk, couscous, refrigerators, cement, and flat screen TVs in four Malian cities with those in Kidal. Except for the prices of cement and milk in Bamako, Kidal is the least expensive city for all products. Apart from flat screen TVs, Gao and Timbuktu are often more expensive than Bamako and Mopti, which can be explained by the transport costs in relation to the Algerian border (or in relation to Bamako).[8]

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[8] It has not been possible to estimate the poverty impact of such price differentials because household surveys do not have enough disaggregated data on household consumption.

Figure 1 Comparison of Prices of Six Goods in Gao, Timbuktu, Mopti, and Bamako versus Kidal
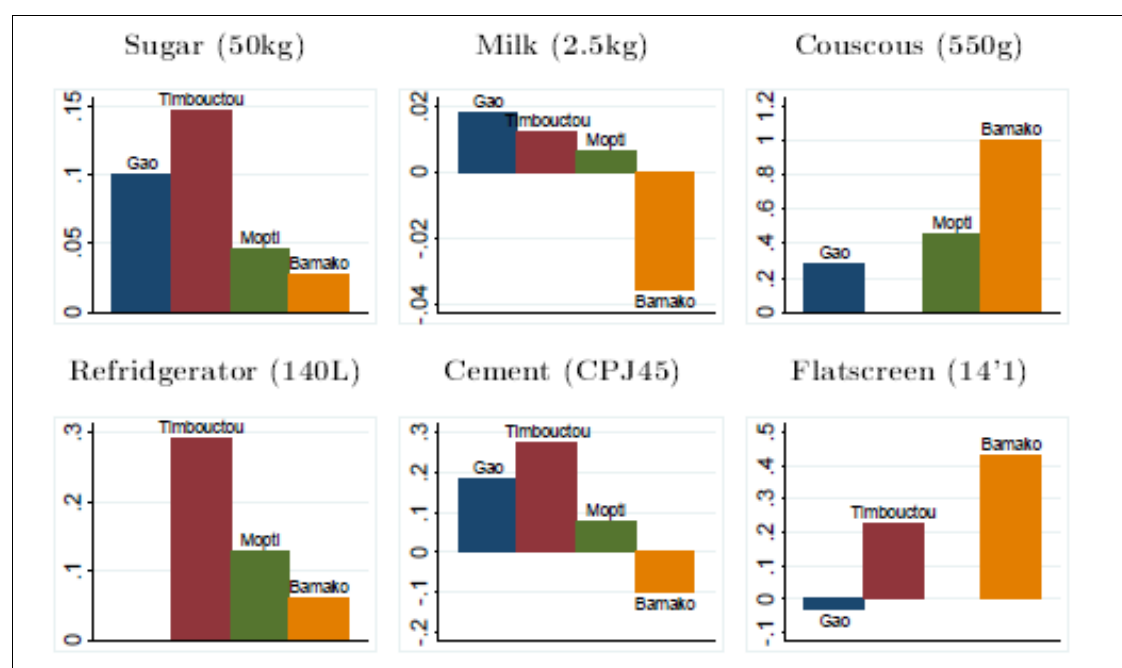
Source: National Statistical Institute of Mali.

Evidence from satellite images

To examine the presence of informal cross-border trade routes across the border, we commissioned a set of satellite images. The images were taken in March 2014, with a resolution of 50 centimeters and are 100 percent cloud-free. Because trucks and cars leave marks in dry terrain, the images bear witness to the transport activity around the border.

A sophisticated algorithm was used to identify informal roads on satellite images.[9] Automated data extraction of road traces was followed by a manual process (road digitization and importance qualification) to extract alternative roads from the large data set. This manual process helped to connect roads, close gaps generated by the automated process, and remove some false road segments that were identified along geological or topological edges.[10]

Informal roads were classified as minor or major, based on the visible depth of the traces and the number of parallel/adjacent traces clustered together (images 1 and 2). As a rule of thumb, when several traces (eight or more) were visible and organized in a cluster (as shown in image 1), the road was classified as major. In some areas, when the trace was very deep (roads were used several times by different vehicles), the road was also classified as major (otherwise it was classified as minor).

The satellite maps indicate intense trading activity around the Algeria-Mali border, despite its official closure. Maps 2 and 3 display major (red) and minor (green) off roads and the official roads (black dotted lines) around the border towns of Bordj Badji Mokhtar and In Khalil. Both major and minor

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[9] For more details on the methodology, see annex C.
[10] Because of the arid terrain, traces remain present on satellite images for weeks or even months, depending on the depth of the trace.

roads are numerous. Over a distance of 2 kilometers, there are at least three major routes (in red) over the border going to Bordj Badji Mokhtar.

**Image 1 Satellite Image of a Major Informal Road**

**Image 2 Satellite Image of a Minor Informal Road (One Trace)**
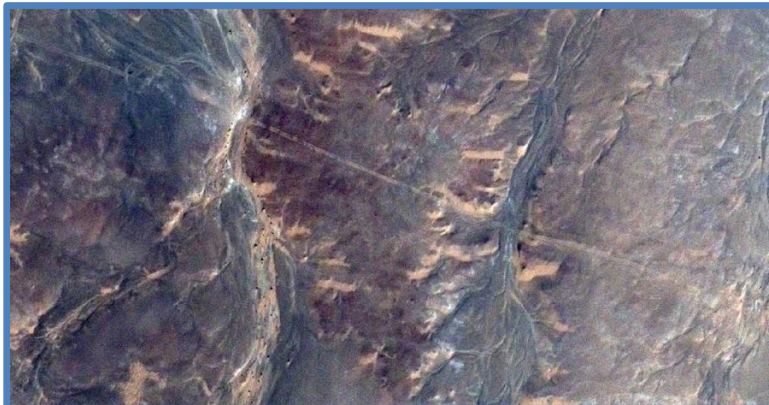
Maps 2 and 3 show the many roads that exist beyond the "official" roads (the black line in the middle of the image is the border between Algeria and Mali). Over a distance of 2 kilometers, at least three major routes (in red) cross the border near Bordj Badji Mokhtar. Therefore, despite official closure of the border, several trucks or cars are likely to go through the border every day in the vicinity of Bordj Badji Mokhtar.

Map 2 Informal Routes around Bordj Badji Mokhtar
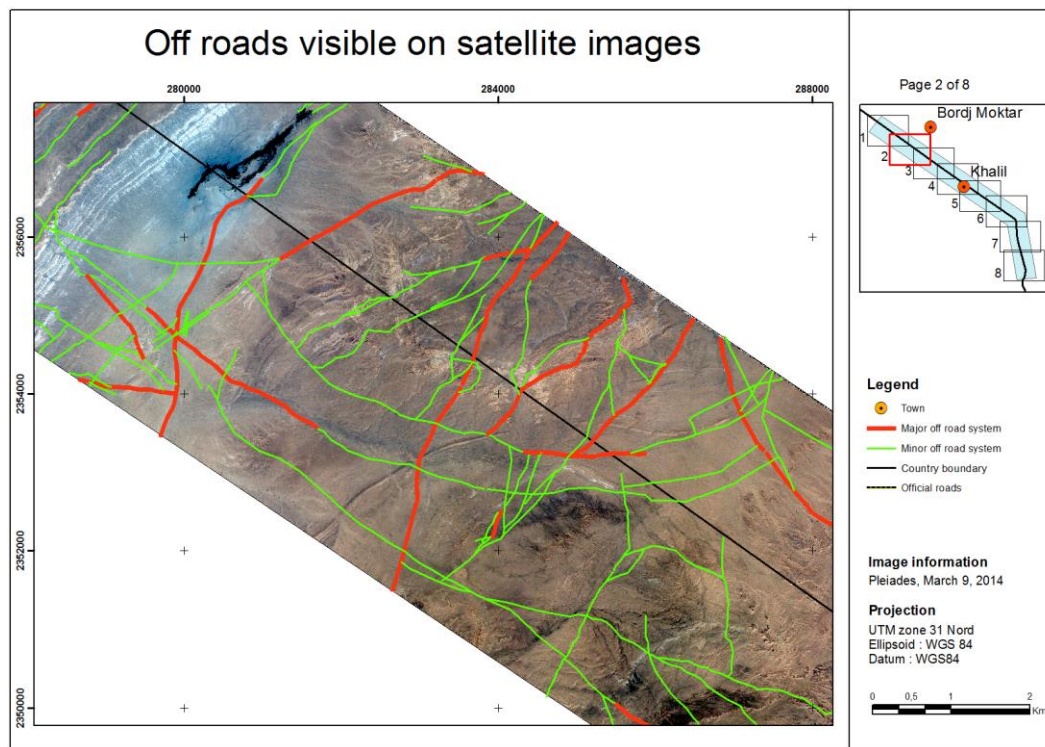
Map 3 Informal Routes around In Khalil
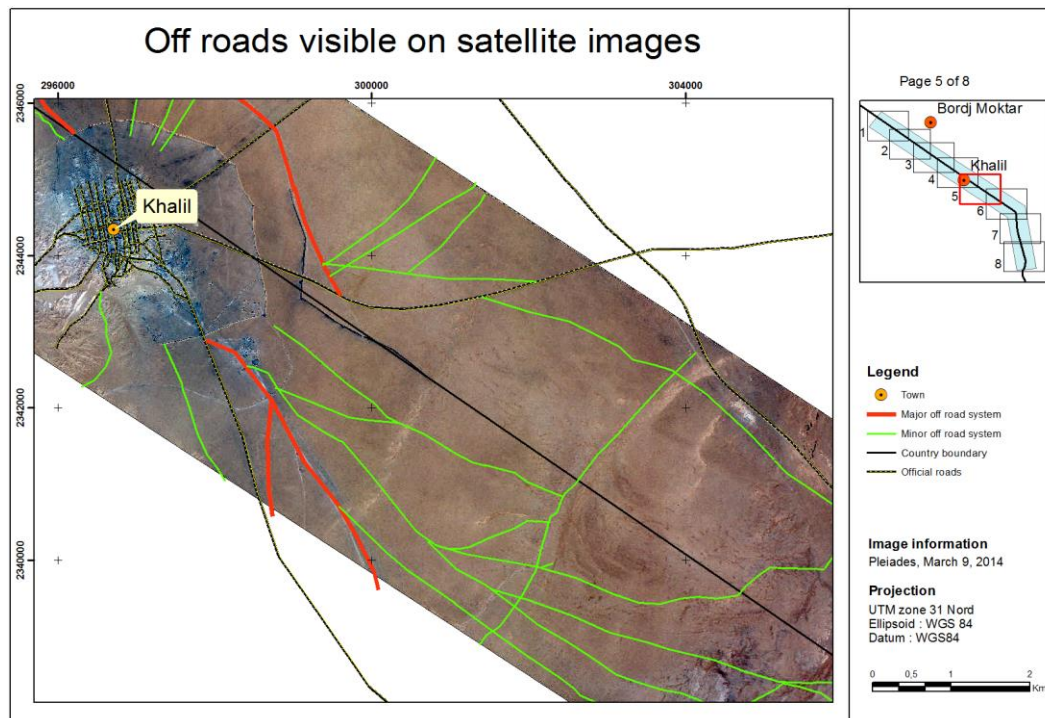
Estimating the volume of the informal cross-border trade

Methodology

Unlike in similar studies in Africa, it was not possible, for security reasons, to visit physically the Algeria-Mali border and conduct interviews there. We therefore had to cross-check the information provided by the various stakeholders interviewed, which included, on both sides of the border, a dozen traders, as well as local authorities, representatives of customs, and journalists who were well aware of trading practices.

Data and information were collected in several steps:

1. Customs and informants (on both sides of the border) were interviewed to identify the goods mainly traded between Algeria and Mali. In this way, we were able to identify some distribution networks and some traders.
2. The preliminary data and information were then cross-checked with the information gathered from the interviews conducted with those practicing formal and informal cross-border trade in Algeria and Mali in order to understand the networks, routes, and commodity prices.[11]
3. Estimates of the volume of informal cross-border trade were then derived from the route, quantity, and price data.

Computations were based on statements by the traders and customs officers[12] who were interviewed and asked about the number of vehicles crossing the border per week in 2011 and 2014, the products transported, their destination, and the selling price in different cities.

Averages were then calculated. Based on interviews about the means of transport, assumptions were made about unit tonnage and overloads. It was thus possible to calculate the turnover per product per city per week and per year.

"Supply chains" are mainly organized by a limited number of trucks/importers per product. It was confirmed during interviews that usually less than a dozen Malian "wholesalers" import cargo from Algeria. We therefore sought access to some of the "wholesalers" because they would know best the total quantities to order, on average, per week for any type of good. Several of them dealing with several products were interviewed. Wholesalers also mainly act as a network that often is linked by tribal, family, or ethnic ties, and therefore information is available as long as one has access to one of those groups.

Despite the cross-checking conducted of various sources of information, the limitations of this work should be taken into account, and therefore figures are only estimates and may differ from reality. However, the magnitude of such flows does seem plausible. Moreover, to our knowledge these estimates are the first of this type for Algeria–Mali informal trade flows.

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[11] A rather similar approach was used by Golub (2012) in West Africa.
[12] Approximately a dozen of traders and customs officers still involved or controlling this trade were interviewed.

Results

The main border crossing between Algeria and Mali, Bordj Badji Mokhtar, appears to have been superseded since 2012 by Tinzawaten and Timiaouine in Algeria.

The main products exported (smuggled) from Algeria to Mali are food (dates, flour, pasta, semolina, and milk powder) and gasoline, followed by consumer goods (appliances). In export volume, these products exceed the volume of Malian imports, which mainly consist of livestock products (sheep and camels) and *bazin* (traditional fabric), as well as Chinese green tea and cigarettes. Most of the trucks returning to Algeria from Mali are loaded with livestock collected along the route to Algeria.

Traders often import several types of cargo, including fuel barrels. It is estimated that 90 percent of supplies are preordered, a growing trend since the introduction of mobile and satellite phones to the "professional" structure of networks.

According to the interviewees, 180 trucks per week in "normal time"—that is, in 2011[13]—crossed the Algerian-Malian border, and 40 trucks crossed in 2014.[14] For 2011, the distribution of trade flow between the cities and the category of trucks used were as follows: Timbuktu, 20 trucks (10 tons only); Kidal, 35 trucks (20 tons at 70 percent; 10 tons at 10 percent; 30 tons at 15 percent; 40 tons at 5 percent); Gao, 35 trucks (20 tons at 70 percent; 40 tons at 30 percent); Bamako, 30 trucks (mainly 20 tons); and Niger and Nigeria, 60 trucks (40 tons at 80 percent). The total tonnage was 4,6700 (2,650 tons for Mali). Niger is de facto the main transit country for Nigerian imports from Algeria, but a portion of them transit first in Mali.

For 2011 the breakdown per good was as follows: 35 trucks of flour, 30 trucks of pasta, 25 trucks of semolina, 20 trucks of other staple products (oil, drinks, sugar, and milk powder), 30 trucks of fuel, 30 trucks of dates, 5 trucks of appliances, and 5 trucks of other products. In 2014 the breakdown was the following: 14 trucks of flour, 10 trucks of pasta, 4 trucks of semolina, 5 trucks of fuel, 3 trucks of sugar, 1 truck of milk powder, 1 truck of appliances, and 2 trucks of other products.

Given the unit volume, in 2011 the goods traded between Algeria and Mali represented a weekly volume of 4,640 tons: 750 tons for the Kidal region, 930 tons for the Gao region, 200 tons for the Timbuktu region, 770 tons for Bamako, and 1,990 tons for Niger and Nigeria. Because trucks can be overloaded, 25 percent should be added to the average (a 10-ton truck will carry up to 13 tons). Table 4 provides details on the prices and quantities per good and city.

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[13] This year was selected because, according to all traders, it was the "apex" of informal trade between Algeria and Mali. Trade flows began to decrease as of 2012 because of the military coup in Bamako and the subsequent fighting in the north of the country.

[14] Between 15 and 20 percent of goods smuggled from Algeria end up in the south of Gao and in Douentza, Mopti, and the southern part of Mali.

Table 4 Prices and Weekly Quantities of Consumer Goods by City, 2011

Product	Price in Bordj Badji Mokhtar (Algeria, per ton)	(1) Kidal (Mali)		(2) Gao (Mali)		(3) Timbuktu (Mali)		(4) Bamako (Mali)		(5) Niger (Niamey, Tahoua, and Agadez)		(6) Total quantity	(7) Total quantity, Mali	(8) Total turnover (CFAF, millions)	(9) Total turnover, Mali (CFAF, millions)
		Price per ton	Qty.	Price per ton	Qty.	Price per ton	Qty.	Price per ton	Qty.	Price per ton	Qty.				
Flour	170,000	230,000	107	280,000	195	320,000	40	480,000	200	470,000 (Niamey) 360,000 (Tahoua)	500	1042	542	401.0	188.0
Pasta	270,000	350,000	140	420,000	170	450,000	30	560,000	100	460, 000	640	1080	440	483.4	189.0
Dates	270,000	NS	NS	486,000	60	NS	NS	700,000	200	500,000	340	600	260	339.2	169.2
Wheat semolina	120,000	160,000	170	200,000	215	240,000	40	350,000	70	240,000	330	825	495	183.5	104.3
Milk	1,400,000	1,583,000	10	1,900,000	40	2100, 000	0	2,500,000	30			80	80	166.8	166.8
Diesel	200,000	250,000	143	300,000	100	350,000	40	350,000 (region of Mopti)	100	360,000	100	583	483	150.7	114.7
Gasoline	400.000	525.000	100	Imported from Niger	0	—	0	—	0						
Sugar	310.000	350,000	30	400,000	70	400,000 (from Mauritania)	0	600,000	0	540,000	80	180	100	81.7	38.5
Appliances	150,000	190,000	10	230,000	30	280,000	30	588,000	40			110	110	40.7	40.7
Other products	400,000	440,000	40	480,000	50	550,000	20	600,000	30			140	140	70.6	70.6
Total			750		930		200		770		1,990	4,640	2,650	1917.6	1081.8

Source: Authors' computations based on interviews.

Note: Prices are in Communauté Financière Africaine Francs (CFAF). Rate: US$1 = CFAF 506 in 2011 and CFAF 480 in 2014. All quantities are in tons.

From the number of trucks and the breakdown per product, we computed turnover per product per city—columns (1)–(5). The sum of imports from various cities is the total quantity per product—column (6). For each product, turnover—column (8)—equals tonnage times the price for each city. Columns (7) and (9) exclude goods to Niger and Nigeria. Trade is quite low from July to September. Therefore, estimates are based on 40 weeks. Data are by week because traders use that time frame for their orders of goods from Algeria to Mali.

The total informal cross-border trade between Algeria and Mali in 2011 was estimated at over $85 million, but it declined to less than $30 million in Mali in 2014. This revenue therefore fell by about two-thirds between 2011, the peak of trade between Algeria and Mali, and 2014.

Official statistics seem totally inadequate because in 2011 Algerians officially reported $1.02 million in Malian exports and Malians reported $1.89 million in imports the same year, representing 1.2 percent and 2.2 percent, respectively, of the estimated volume of informal cross-border trade.

If the informal cross-border trade to Niger and Nigeria is included, the volume of informal cross-border trade amounts to over $150 million in 2011.

These estimates appear relatively low when compared with those for countries with weak governance where the same type of estimation was undertaken. Therefore, those estimates are probably conservative. In a regional comparison, informal imports are now lower in Mali[15] at $45 per capita compared with Tunisia at $120 per capita, but they were almost similar in 2011 at $125 per capita. However, Mali remains lower than Nigeria ($250), but that probably stems from the fact that trade policy is much more restrictive in Nigeria than in Mali or Tunisia.[16]

The impact of border closure: decrease in flows since 2011 but still remain important

The 2013 closure of the border between Algeria and Mali led to the official end of trade between the two countries. In addition, on July 14, 2013, Algeria's Council of Ministers adopted measures to limit fuel smuggling at the country's borders because of its scale country-wide. In addition to their operational provisions, the adopted measures, still in force, were intended to control the distribution of fuel at gas stations by mandating the following:

- Instigation of controls by police services at all gas stations, including those inside the country
- Implementation of a reporting system to identify suspicious vehicles repeatedly passing the border
- Control of allocations of fuel to *fellah* (farmers)
- Ban on the allocation at gas stations of fuel to people with tanks and containers.

Informal cross-border trade flows have been significantly disrupted since 2012 and the rebellion in northern Mali. There, the informal cross-border trade underwent a multifaceted crisis: a decrease in demand because of the outflow of refugees and displaced people from Mali beginning in 2012; a decrease in supplies because traders fled to Mauritania or Niger, or they were displaced in Bamako; growing insecurity surrounding the commercial routes, which discourages some traders still living in northern Mali; and finally the closure of the Algerian border. The estimated turnover for 2011 and 2014 in Mali are presented in detail in table 5.

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[15] Data have been computed using figures for the population of northern Mali because the vast majority of is consumed in that area.
[16] Data for Nigeria (in particular the Lagos region) were taken from Raballand and Mjekiqi (2010); for Tunisia, from Ayadi et al. (2014). Figures are for all major imported products.

Table 5 Estimated Turnover: Mali, 2014

Product	Turnover in 2011 (CFAF, millions)	Trade decrease (%)	Inflation (%)	Turnover in 2014 (CFAF, millions)
Flour	188.0	60	30	97.8
Pasta	189.0	66	30 45[a]	83.5
Semolina	104.3	84	75 230[a]	29.2
Fuel	114.7	84	100	18.4
Sugar	38.5	50	25	24.1
Milk powder	166.8	80	120	73.4
Dates	169.2	100		0.0
Appliances	40.7	80	25	10.2
Other	70.6	80	40	19.8
Total	1,081.8			356.3

Data source: Interviews with traders and customs officials.

Note: CFAF = Communauté Financière Africaine Franc.

a. In Timbuktu.

Some products such as diesel and gasoline are now traded at very low volumes. Both are subject to vigorous control by the Algerian security services, leading to inflation. This control is also applied to semolina, which has produced shortages in the three northern regions. The closure of the Algerian border has had the direct effect of diverting all trucks shipping dates—the only authorized product exported to Algeria—toward the Niger border.

The trade flows evident as of early 2014 can in no way be compared with those recorded in a time of peace. The drop in turnover has been estimated at 67 percent. The closure of the Algerian border caused a substantial increase in prices, which did not necessarily lead to higher margins from merchants in northern Mali. The recorded inflation was the impact of a decrease in supply and in particular an increase in prices at the Algerian border. The main commercial consequence of this situation was fewer market opportunities for products from northern Mali.

Some products turn out to be uncompetitive in Bamako, such as milk powder, which is now cheaper in Bamako (CFAF 35,500 per carton) than in Timbuktu (CFAF 50,000 per carton). Other products that have undergone significant inflation in the north have seen their prices stagnate or even decline in Bamako. A ton of flour now costs CFAF 450,000 in Bamako because it has been subject to inflation of 30 percent in the three northern regions since 2011. A ton of sugar is now traded at CFAF 500,000 in Bamako, increasing by 25 percent in the three northern regions. The diversification of supplies in southern Mali has led to a trend of price stability and prevents the trading of products from the Algerian contraband.

Some possible explanations for smuggling

Subsidies and different price levels

The *wilayas* (provinces) in southern Algeria, including Tamanrasset, have a double subsidy system: a system of compensation for transport costs that is applied exclusively to these provinces and a

system of subsidizing the prices of widely consumed products (applied to the entire Algerian territory).

Because of the potential impact of subsidies on neighboring countries, Algeria put in place a barter system in 1994 to regulate trade flows in order to avoid subsidizing countries such as Mali and Niger, but also Morocco and Tunisia. It also prohibited the exports of subsidized goods in the barter trade regime.

Algeria's compensation fund for transport costs

The compensation system for transport costs consists of reimbursement of the costs arising from the supply and distribution of general consumer goods at the level of the *wilayas* in the southern regions of Algeria (Tamanrasset, Illizi, Adrar, Tindouf, Ouargla, Bechar, El Beidh, El Oued, Ghardaia, and Naama). Reimbursement covers transport both among and within *wilayas*. This scheme is intended to provide general consumer goods for people living in remote areas in southern Algeria.

The reimbursement system is calculated on the following basis: amount of compensation per operation = distance (km) × weight (tons) × DA 3 (Algerian dinars). For example, a company transporting a load of 40 tons from Tamanrasset to Alger (a distance officially estimated at 1,945 kilometers) would be entitled to reimbursement of DA 233,400 ($2,680). However, according to interviewees, the real cost of transportation is DA 180,000 ($2,070), which means a significant profit for the transporter, who has an incentive to transport goods between both cities.

The importance of consumer subsidies in Algeria

In Algeria, the main subsidized products are the following:

- Normal semolina: DA 900 ($10.30) per 25 kilograms[17]
- Superior quality semolina: DA 1,000 ($11.50) per 25 kilograms
- Milk: DA 25 ($.30) per liter
- Flour: DA 2,000 ($23) per 100 kilograms (bakers), DA 2,080 ($23.90) per 100 kilograms (retailers), DA 2,180 ($25.10) per 100 kilograms (consumers)
- Sugar: between DA 90 ($1) and DA 95 ($1.05) per kilogram
- Oil: DA 600 ($6.90) per 50 liters, DA 250 per 2 liters, DA 125 per 1 liter
- Cement: the price of cement is not defined, but high profit margins are fixed at DA 40 per 25 kilograms (wholesalers), or $.50 per kilogram, and DA 80 per 25 kilograms (retailers).

The budget allocation for subsidized products is not based on a study of actual consumption needs. Each wholesaler legally registered and not considered a smuggler is entitled to claim this refund, whatever the number of transactions and the amount of products shipped. When the refunds requested exceed the allocated budget, the outstanding amounts are rolled over to the following year.

Fuel is very heavily subsidized in Algeria. Throughout the country, regular gasoline sells for DA 21.20 ($.27) per liter, super for DA 23 ($.29) per liter, and diesel for DA 13.70 ($.17) per liter. The selling price in Mali was over $1.40 per liter in 2012.

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[17] In this article, $US1 = DA 75 in 2011 and DA 87 in 2014.

In border localities, each identified operator is limited in the quantities of subsidized products that can be traded in these regions. But this scheme does not limit the number of traders who are able to register for this activity, and thus it does not limit the threshold for allocations in border areas.

Restrictive trade arrangements

The border between Algeria and Mali is 1,376 kilometers long. Surveillance of the southern Algerian border is difficult because the population density is very low, particularly in the far south. Algeria's border with Niger is 956 kilometers. These borders cover a Saharan region crossed by tracks used by traders.

Several trade agreements have been signed between Algeria and Mali since 1975. The suspension in Algeria of the international transit regime (after alleged fraud) marked the end of the official massive supply of Mali and Niger through Algerian ports. To limit the exports of subsidized goods from southern Algeria to Mali and Niger, the Algerian authorities created a barter system but it has not been in effect with Mali since 2013.

A barter trade was already under way before 1994 because of the inconvertibility of the Algerian dinar—the proceeds from the sale of a product allowed the purchase of another one. Flows in both directions were established: dates–agricultural products, salt–livestock, construction materials–products from Nigerian industry, and so forth (Grégoire 1998). Since then, the barter trade has been established via a 1994 Algerian regulation.[18] The system set up by Algerian authorities (Ministry of Trade) attempts to "normalize" trade based on the traditional trade ties between Algeria and West Africa dating from long before the colonial period and the constitution of the Algerian state.

In the order of 1994, the main text regulating barter trade stresses in its two first sections the exceptional nature of barter trade. This system tries to regulate barter trade strictly while providing local administrative authorities with wide power of management and control. Under this same system, a balance between import and export values within the framework of barter trade must be strictly observed; the proceeds from the sale of Malian and Nigerien goods can only be allocated to the purchase of Algerian goods included in the list and the amount of purchased goods for export must not be higher than declared on entry (article 8). The order of 1994 set out the list of goods admitted under the barter on a tax and duties suspension basis.[19] To ensure a strict trade balance, customs maintains a tracking sheet of the transactions of each trader. At the end of the year, to comply with barter regulation, each operator who has not balanced its operations has to address the gap the following year under penalty of registration suspension.

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[18] Section 128 of the Finance Act of 1994 and the Decree Inter. of December 14, 1994, setting out the arrangements for exercising the barter trade with Niger and Mali (OJ No. 7 of February 15, 1995, p. 30) and repealing the decree of April 5, 1991, fixing the conditions and terms of import and export of goods under the barter trade border with Mali (OJ No. 29 of June 12, 1991, p. 914).

[19] The Algerian products authorized for barter are common dates; frezza dates, to the exclusion of other varieties of deglet nour dates; domestic salt; household objects made of plastic, aluminum, cast iron, iron, and steel; blankets; and local crafts, excluding wool rugs. The authorized products from Mali and Niger are livestock, henna, green tea, spices, turban fabric, Tarri fabric, mil, rancid butter for local consumption, dried vegetables, rice, and mango. Since the closure of the borders, only dried dates are allowed for export.

Even before the closure of the border, official barter trade had been falling since 2011: from $3.4 million in 2011 to $700,000 in 2013.

Corruption in border control agencies

In terms of customs controls, before 2012 there were some attempts on the Malian side to increase the number of declarations (even though duties were usually paid by a fixed amount by truck). Since 2013, however, customs has not yet been able to deploy back to the border or even to Kidal on a permanent basis. Therefore, there is de facto a laissez-faire policy, which may be explained by the current social and political tensions in the north of the country. In Algeria, controls are better enforced, even though the data on seizures are so low that collusion or bribing of some officials at the border may not be excluded (and was confirmed by traders' interviews).

Since the mid-2000s, efforts have been made to reaffirm the customs presence in northern Mali, in particular in Timbuktu. Before the crisis of 2012, a customs station operated in In Khalil, where it collected tariffs and duties. Customs agreed on a fixed price according to the goods transported, but it was more or less symbolic for each truck entering Mali on the condition that the truck not continue its journey south. If it did not comply, duties increased and the driver of the truck had to make an import declaration.[20] This factor explains the weakness of the official import data because, to a great extent, imports from Algeria to northern Mali were not reported.

According to several customs sources in Mali, 60 percent of the flows escape customs control. Quantities reported to customs are generally 40–50 percent less than the actual flows. Moreover, trucks are usually overloaded by 20–30 percent. Thus goods are declared for about 20 percent of their actual value. On average, customs offices in the north have been collecting about $1–$1.5 million, which means that the goods were probably cleared for about 5–10 percent of their value (for an average tariff rate of 20–25 percent).[21]

Today, the situation seems to have deteriorated even more because only a few tens of thousands of dollars are collected at the border (less than 1 percent of the value), and there are no longer any customs offices in northern Mali, largely because of the rebellion in January 2012. Malian customs officials struggle to win against smuggling actors, who are increasingly more organized and who have little difficulty in rendering customs offices inoperative. Customs offices are slowly reestablishing themselves in Timbuktu and Gao, but there are only a few agents in these two cities, and they are unable to travel in the region. In Kidal, there is no custom presence.

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[20] For a 10-ton truck coming from Bordj Badji Mokhtar, paid duties in 2014 were about CFAF 75,000 ($156) in Kidal, CFAF 120,000 ($250) in Gao, CFAF 140,000 ($290) in Timbuktu, and CFAF 400,000 ($830) in Bamako, as in northern Niger. These figures are averages. Many traders are paying duties sometimes more modest because of the corruption within customs, or even sometimes are fully exempt from customs duties by circumventing customs offices.

[21] According to the West African Economic and Monetary Union (UEMOA), customs duties at the Malian border (in percentage of the value of goods) are 20 percent for dates, couscous, pasta, and cigarettes and 10 percent for gasoline (for ordinary car) and car tires.

Conclusions

In the Sahel as in other parts of the world, borders are a fertile ground for informal cross-border trade, especially in a desert area. Walther (2009) refers to a "mobile space"— that is, the most appropriate method of managing uncertainty in Sahelian life.

Trader networks in Mali control the main trade sectors. And it is not uncommon for mayors, deputies, or presidents of the regional chambers of commerce, or their counterparts, to be involved in these sectors.[22] The system is therefore good for trade in northern Mali, but it erodes the legitimacy of these representatives elected by the population. It also explains why repression of the informal cross-border trade is all the more difficult because trader networks, which control flows, are decentralized (Walther 2014). Also, when a cargo is halted or a trader is neutralized, it is possible for another member of the network to replace the trader and to continue the traffic.

This article has highlighted the following key features of informal trade in the Sahelian region: (1) official statistics are extremely unreliable and demonstrate that regional integration is much higher than official statistics usually indicate; (2) informal trade has a strong impact on poverty reduction; (3) satellite images may be useful in a dry terrain to identify informal trade routes (and could be used, for example, in Libya, Tunisia, and Mauritania); and (4) a multidisciplinary approach (anthropology, economic, governance) is useful to better assess all the aspects of informal trade in regions such as the Sahel.

However, further study of informal trade is critical to understanding the "real" economy of Sahelian countries because formal companies usually account for only a small percentage of those found in a country. Despite the growing knowledge of the informal trade in the Sahel, many aspects, such as the link between licit and illicit trafficking, remain largely unknown and would require complementary research.

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[22] Walther (2009) showed that traders were heavily represented in the National Assembly of Niger.

Annex A: Goods Recorded on Both Sides of the Border: Algeria to Mali, 2007–12

Year	Exchange products	Declared value at import (US$)	Declared value at export (US$)	Ratio between declared value at import and export
2007	Perfumes and toilet waters	87	83	1.05
2007	Electrical appliances for switching	10,865	4,896	2.22
2007	New pneumatic tires of rubber	224,199	64,773	3.46
2007	Electrical switches for a voltage not exceeding 1,000 V	22,305	5,237	4.26
2007	Needles, catheters, cannulae, and the like	23,859	46,642	0.51
2007	Sodium hydrogencarbonate (sodium bicarbonate)	1,578	6,053	0.26
2008	New pneumatic tires of rubber	256,727	109,014	2.35
2008	Inner tubes of rubber	5,068	274	18.50
2008	Other perfumery, cosmetic or toilet preparations	568	1220	0.47
2008	Soap and organic surface-active products in bar	94	3,330	0.03
2010	Sanitary towels and tampons, napkins	91,782	96,022	0.96
2010	Filtering or purifying machinery and apparatus	62,936	68,040	0.92
2010	Electrical switches for a voltage not exceeding 1,000 V	7,911	6,493	1.22
2010	Other jams, fruit jellies, marmalades, etc.	223	129	1.73
2010	Needles, catheters, cannulae, and the like	13,503	19,390	0.70
2010	Electrical plugs and sockets for a voltage not exceeding 1,000 V	5,794	9,629	0.60
2010	Sodium hydrogencarbonate (sodium bicarbonate)	83,574	10,918	7.65
2010	Perfumes and toilet waters	1197	44	27.20
2011	Perfumes and toilet waters	29	29	1.00
2011	Instruments and appliances used for medical purpose	135,414	157,758	0.86
2011	Citric acid	18,994	2,819	6.74
2011	Dates, fresh or dried	947,290	107,840	8.78
2011	Sanitary towels and tampons, napkins	84,175	3,495	24.08
2011	Salt and pure sodium chloride; sea water	1,913	4,961	0.39
2011	Sodium hydrogencarbonate (sodium bicarbonate)	19,471	53,345	0.37
2011	Trade advertising material, commercial catalogues	68	263	0.26
2011	Bentonite	1,162	11,188	0.10
2011	Tubular metal needles and needles for sutures	1,426	16,297	0.09
2011	Mineral waters and aerated waters, unsweetened	275	33,327	0.01
2011	Filtering or purifying machinery and apparatus	398	350,764	0.00
2012	Vinegar and substitutes for vinegar obtained	160	160	1.00
2012	Surgical gloves	333	349	0.95
2012	Syringes, with or without needles	244	264	0.92
2012	Eye makeup preparations	118	107	1.10
2012	Freezers of the upright type	6,734	4,859	1.39
2012	Other jams, fruit jellies, marmalades, etc.	997	1,559	0.64
2012	Sanitary towels and tampons, napkins	74,338	31,932	2.33
2012	Soap and organic surface-active products in bar	882	278	3.17
2012	Sodium hydrogencarbonate (sodium bicarbonate)	26,487	46,570	0.57
2012	Garments of cotton, knitted or crocheted	1,287	25	51.48
2012	Uncooked pasta, not containing eggs, not stuffed	43181	760	56.82
2012	Couscous	2292,77	1,901	120.61
2012	Beauty, makeup, skin care (including suntan)	723	1,602	0.45
2012	Vegetable products	132	357	0.37
2012	Unfrozen orange juice, unfermented	1,216	4,771	0.25

2012	Perfumes and toilet waters	84	345	0.24
2012	Manicure or pedicure preparations	86	480	0.18
2012	Trade advertising material, commercial catalogues	89	596	0.15
2012	Tubular metal needles and needles for sutures	1,906	15,732	0.12
2012	Shampoos	51	688	0.07

Data source: UN COMTRADE.

Annex B: Imports of Cigarettes and Gasoline: Mali, 2007–12

Year	Exporting country	Tonnage (kg)	Value (US$)	Ratio to total tonnage	Ratio to total value
Cigarettes					
2007	Benin	361,800	6,705,806	37%	29%
2007	South Africa	609,790	16,045,517	62%	70%
2007	*Total*	*978,010*	*22,870,699*		
2008	Benin	249,000	4,995,733	24%	17%
2008	South Africa	796,173	24,020,439	76%	83%
2008	*Total*	*1,046,898*	*29,091,779*		
2010	Benin	20,837	386,080	1%	1%
2010	Senegal	13,444	491,939	1%	2%
2010	South Africa	1,401,702	31,660,008	97%	97%
2010	Switzerland	12,436	192,432	1%	1%
2010	*Total*	*1,449,631*	*3,275,6290*		
2011	Senegal	10,704	337,013	0%	1%
2011	South Africa	2,236,744	43,060,097	100%	99%
2011	*Total*	*2,247,588*	*43,397,619*		
2012	Senegal	386,779	6,460,212	17%	17%
2012	South Africa	1,923,189	31,573,934	83%	83%
2012	*Total*	*2,309,983*	*38,034,177*		
Gasoline					
2007	Benin	116,268,585	89,338,418	18%	19%
2007	Burkina Faso	18,943,967	7,375,192	3%	2%
2007	Côte d'Ivoire	143,423,978	101,716,372	22%	22%
2007	Ghana	51,423,696	37,953,627	8%	8%
2007	Senegal	231,040,500	166,509,945	36%	35%
2007	Togo	80,763,536	6,285,0512	12%	13%
2007	*Total*	*648,122,454*	*470,243,298*		
2008	Benin	131,710,362	68,370,980	20%	10%
2008	Côte d'Ivoire	130,920,524	147,560,768	20%	21%
2008	Ghana	61,830,224	37,056,767	10%	5%
2008	Senegal	248,145,957	405,520,714	38%	58%
2008	Togo	67,593,994	28,665,569	10%	4%
2008	*Total*	*650,688,664*	*697,416,591*		
2010	Benin	653,978,987	467,106,697	41%	39%
2010	Côte d'Ivoire	245,049,731	172,518,793	16%	14%
2010	Ghana	72,389,063	50,293,048	5%	4%
2010	Senegal	467,384,158	399,858,285	30%	33%
2010	Togo	120,187,706	95,054,371	8%	8%
2010	*Total*	*1,578,913,017*	*1,201,245,939*		
2011	Benin	222,780,997	253,799,430	25%	26%
2011	Côte d'Ivoire	128,113,517	145,604,076	14%	15%
2011	Ghana	75,705,792	86,354,302	8%	9%
2011	Senegal	417,733,154	428,311,413	47%	45%
2011	Togo	31,625,163	29,241,745	4%	3%
2011	*Total*	*8,9351,4399*	*961,107,209*		
2012	Benin	151,333,000	172,068,033	17%	18%
2012	Burkina Faso	15,868,320	18,621,642	2%	2%
2012	Côte d'Ivoire	114,477,971	129,099,918	13%	13%
2012	Gambia, The	17,171,000	10,399,719	2%	1%
2012	Ghana	62,415,167	69,525,921	7%	7%
2012	Niger	8,8769,000	99,288,612	10%	10%
2012	Senegal	433,966,422	447,072,157	48%	46%
2012	*Total*	*899,870,517*	*963,333,739*		

Data source: UN COMTRADE.

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Annex C: Algorithm Used to Identify Roads on Satellite Images

The algorithm used can be summarized as follows:

- Smooth image to reduce pixel size to 75 centimeters, judged as optimal.
- Apply Gaussian pyramid to reduce processing time.
- Apply anisotropic gradient to smooth image but keep irregular edges.
- Apply Sobel filter to sharpen image edges (first-degree derivative).
- Apply anisotropic gradient again.
- Thresholding: set to 0 all pixels with values below mean.
- Apply adaptive threshold method.
- Remove all objects (= block contiguous white pixels) below 100-pixel size.
- Compute eccentricity of bounding ellipse for all objects and keep only objects with eccentricity greater than 0.7 (to identify objects that are elongated—that is, road segments).
- Skeletonize image to keep only the trace.
- Apply a Hough line transform to find lines (applied several times with different parameter values).
- Keep only sets of lines that are parallel and close (distance interval is width of a truck).

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Authors' replies to the reviewers

Reviewer #1: Great contribution to literature on illegal trade. The use of satellite images to trace routes and estimate traffic is novel and will hopefully prove a very useful tool for trade economists.

Q: My main comment is that the paper is written more like a policy note than an academic paper. It'd be better in my opinion to edit it slightly. For example, the Intro could start with a more general discussion on the role of informal trade in history or nowadays and then move on to efforts by economists to measure it and then move on to the Mali-Algeria case. The headings could be adjusted to follow an Intro-Data-Empirics-Conclusion structure. I would also drop Box 1 and integrate it in the text. Your contributions to the literature could be made clearer.

A: - The introduction was rewritten as suggested. New references have been included on informal trade in general.
- The headings were amended as suggested.
- The box 1 was inserted in the text.
- The contribution to the literature was amended.

Minor comments:

1. **I think "Mali" is missing from the first sentence of the paper.**
Added.

2. **I think papers should be cited when the authors write: "the growing literature on the inaccuracy or unreliability of official trade statistics" and "Contrary to similar studies in Africa". Maybe this study should also be cited:Stephen S. Golub, 2012. "Entrepôt Trade and Smuggling in West Africa: Benin, Togo and Nigeria," The World Economy, Wiley Blackwell, vol. 35(9), pages 1139-1161, 09.**
Good suggestion. The reference was added in the literature review section (p1) and p11.

3. **A simple map could be included in the first section when talking about various cities. Map3 has so much information it is slightly confusing.**
A simple map was included at the end of the introduction.

4. **You could add a timeline graph to show the drop in informal trade following the policy implementation, and how it compares to comtrade data.**
Comtrade data are not recent enough to be able to have time series data before and after the closure of the border.

Reviewer #2

The paper is quite creative and original. I am not in a position to judge the soundness of the methodology, but the paper needs some careful editing and possibly some rewriting to make it read more like an academic paper. The conclusion needs to be expanded.

The paper was professionally edited and the conclusion expanded.