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# Existing Data to Measure African Trade

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## INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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## ABSTRACT

One finds a broad consensus in the literature regarding the lack of good information on trade in Africa, particularly intraregional trade. This paper attempts to identify gaps and remedies in measuring and tracking trade in Africa. We review the major international and regional databases that track trade in Africa, identifying the gaps therein. We also review the studies that have attempted to track informal trade between African countries, and we look at the major ongoing initiatives to track such informal trade. It appears that both international and regional databases suffer from a lack of reporting or from faulty reporting of African trade statistics. Informal trade flows pose an ongoing problem when measuring intraregional trade, although actual border-monitoring initiatives ongoing in selected countries constitute an interesting option for their quantification. When no direct monitoring method is available, estimating gravity equations represents an alternative with which to measure the potential trade between two partner countries, giving us an estimate of missing trade. A final avenue consists of estimating unregistered trade via national accounts data by comparing consumption, production, and declared trade.



**Keywords: trade databases, Africa, informal trade, missing trade**

*JEL Classification: F10, F14, F19*

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# 1. INTRODUCTION

In the Malabo declaration of June 2014, African countries committed themselves to tripling, by the year 2025, the level of intra-Africa trade in agricultural commodities and services, fast-tracking the establishment of a continental free trade area, and adopting a continentwide common external tariff scheme. Indeed, trade integration is recognized as a powerful leverage tool for growth, development, and poverty alleviation. The issue of international trade in Africa (both intra and extra regional flows) is the object of a long-term focus of African governments, international institutions, aid agencies, and other stakeholders. However, measuring and monitoring the level of intraregional trade and, in particular, regional integration is a major challenge for both analysts and policy makers.

The lack of good information on trade may be more serious with respect to, but is in no way limited to, intraregional flows. Significant questions surround the level of participation of Africa in world trade as well. General trends, however, indicate that Africa's share in world trade of goods is still very low, despite an upswing in recent years after having reached a minimum of 2 percent in 2010 (Bouet and Roy 2012; UNECA 2010). Africa's share in the global market is highly correlated with the evolution of commodity prices. The level of intra-Africa trade is equally low by world standards. While the share of in-trade reached 40 percent in North America and 63 percent in Western Europe in 2009, it was estimated at only 10 to 12 percent in Africa (UNECA 2010). The share is much lower for some regions: for example, Central Africa's share of intraregional trade is less than 2 percent.

It is unknown whether African countries' apparently low level of (world and regional) trade is a problem of measurement (data, construction of consistent indicators) or a problem related to structural factors, or, most likely, both. Nevertheless, better measurement of trade levels and patterns is a prerequisite for improved understanding of African trade's determinants, which in turn is critical for proper policy planning and implementation and the tracking of progress, as well as the impact of trade impact on major targets such as growth, income generation and distribution, and food insecurity. In addition, most African countries are parties to regional and international trade agreements. A thorough evaluation of the trade diversion and creation effects generated by such agreements requires reliable and up-to-date trade data.

A broad consensus exists in the economic literature as well as within Africa (African experts and regional institutions) that data on international trade across the continent are seriously lacking. On the one hand, we see a clear problem of reporting with respect to African trade data in international databases such as Comtrade. On the other, the underreporting, or downright nonregistering, of formal trade as well as missing information on informal trade, due to smuggling or weak data collection systems, constitute major challenges that need to be overcome (Bouet and Roy 2012).

The issue of informal trade is of key importance. Recent evaluations of its importance have led to high and divergent estimates. In a seminal study in Benin in 2010, informal flows represented almost 40 percent of total trade (INSAE 2010). In some countries and for some specific commodities, informal trade is estimated to be even greater than formal trade (see Azam [2007] and the case of bicycle tires in Benin). In Uganda, a border-monitoring survey pointed out that in 2006, informal exports flowing from that country to its five neighboring countries reached an estimated 86 percent of official export flows to those countries over the same period (Lesser and Moisé-Leeman 2009).

Finally, the huge share of intra-Africa trade that goes unreported to international and regional databases and that cannot be matched using traditional reconciliation techniques (since neither partner reports its trade) has given rise to the so-called "missing trade" literature, which has followed in the wake of Trefler (1995). Missing trade flows are defined here as those flows that may have taken place between two potential trading partners but that are unknown to the researcher because neither partner has reported them to the existing databases. Since a huge share of the potential trade flows in Africa fits this definition, the topic has been deemed important, and econometric models (mainly gravity equations) have been used to measure and predict these potential, unobserved trade flows (Villoria 2008). Given the growing literature on gravity models (Santos Silva and Tenreyro 2006; Helpman, Melitz, and Rubinstein 2008), a

legitimate question, from a research perspective, concerns the directions future work on this issue may take, including alternative approaches.

Our objective in this paper is to improve the understanding of trade data in Africa (both intra and extra-regional flows) through a comprehensive literature review that identifies the major gaps in existing databases. Our key questions are these:

1. What are the main (regional and international) sources of trade data?
2. What gaps exist in those databases?
3. What importance does informal trade assume in Africa, and what are the existing databases and ongoing initiatives in the field?

Thus, we offer a review and inventory of databases that report on trade (both formal and informal) in Africa.

In Section 2, we review the existing data repositories one can use to measure Africa's agricultural and total trade in goods; these include different global sources (such as Comtrade, BACI, and so forth) but also regional sources. Unfortunately, the bilateral statistics on trade in services are very poor, despite the increasing importance of services.

We present various summary statistics that highlight the frequency of notifications and point out the missing blocks due to the absence of notification. We discuss to what extent one can use mirror trade flows to fill the gaps and reconcile data.

In Section 3 we review the literature and ongoing initiatives about monitoring informal trade in Africa, and we proceed to an inventory of ongoing projects in the field.[1] In Section 4, we discuss the gravity approach, an alternative and useful technical method of retrieving missing trade data. Section 5 concludes.

[1] See the USAID-CILSS initiative on cross-border informal trade of agricultural products for a recent example (http://www.cilss.bf/IMG/pdf/2013_Octobre_West_Africa_Agricultural_Trade_Flow_Report_English.pdf).

## 2. EXISTING FORMAL DATA WITH WHICH TO MEASURE AFRICAN TRADE

In this section, we look at the different existing data sources—both regional and international—that measure African trade in goods (intra and extra regional flows), and we examine the gaps in those databases.

We put emphasis on two international databases—UN Comtrade and BACI. Focusing on the case of western African countries (referred to hereafter as ECOWAS [Economic Community of West African States]), we look at Comtrade and present various summary statistics highlighting the frequency of notifications and the missing cells caused by absent notifications. We then look at BACI to see to what extent one can use mirror trade flows to fill the gaps and reconcile data.

### Main International Data Sources with Which to Measure African Trade

Table 2.1 reviews several international sources of data on trade in goods. As noted earlier, there is a lack of data treating international trade in services.

**Table 2.1 Main international databases with which to measure international trade in Africa**

| Database | Main characteristics | Main limitations |
|---|---|---|
| Comtrade (United Nations) | • Original data are provided by countries on a bilateral basis (174 countries covered).<br>• Data are available at product levels (SITC HS and BEC).<br>• Historical data exist for many countries. | • Information for some African countries is missing.<br>• Sometimes countries report in different nomenclatures.<br>• Some goods are classified as "unspecified": "999'999" at HS6 (six-digit level).<br>• Countries report only strictly positive trade flows; no distinction is made between zero trade flows and missing values in raw data.<br>• Only flows higher than US$1,000 are reported. |
| BACI (Comptes Harmonisés sur les Echanges et L'Economie Mondiale [CEPII]) | • Original data are provided by the UN Comtrade database.<br>• BACI is constructed using a procedure that reconciles the declarations of the exporter and of the importer for values and quantities (Gaulier and Zignago 2010).<br>• It performs reconciliation using mirror data and gravity modeling.<br>• BACI extends considerably the number of countries for which trade data are available (more than 200) as compared with the original dataset. | • BACI's procedures are insufficient to track unrecorded trade, mainly when both countries report badly or do not report at all, as in the case of contraband.<br>• |
| National Bureau of Economic Research–United Nations world trade data | • The newest dataset updates the Statistics Canada World Trade Database described in Feenstra, Lipsey, and Bowen (1997) for the years 1970–1992.<br>• The newest dataset covers the years 1962–2000 and is constructed from United Nations trade data by Feenstra et al. (2005).<br>• It consists of bilateral trade data by commodity for 1962–2000.<br>• Data are organized by the four-digit SITC, revision 2. | • Data are more aggregated, at HS4, versus HS6 in Comtrade and BACI.<br>• Primacy is given to trade flows reported by importing countries.<br>• Data for Africa are almost absent (only Algeria, Angola, Libya, Morocco, Nigeria, and Southern African Customs Union). |

**Table 2.1 Continued**

| Database | Main characteristics | Main limitations |
|---|---|---|
| Trade Map (International Trade Centre) | • The starting point is Comtrade, plus regional or national sources.<br>• Trade Map uses a simpler procedure than does BACI to reconcile mirror flows.<br>• It covers 220 countries and territories and 5,300 products (HS).<br>• It has data on importing and exporting companies provided by Kompass International for most products for more than 60 countries.<br>• It contains indicators: volumes, growth rates, market shares. | • CD-ROMs (offline) contain international trade data for the last five years.<br>• Users cannot download large volumes of data as with Comtrade or BACI. |
| Global Trade Analysis Project (GTAP)—latest release is the GTAP 9 database | • Sources (for goods) are Comtrade and Global Trade Information Services.<br>• The database covers 140 regions and 57 sectors.<br>• It provides an African database (with the support of the Bank-Netherlands Partnership Program and the World Bank) that contains data for 42 African regions: 32 countries plus 10 other aggregated regions (West and Central Africa). | Statistics are less disaggregated: GTAP sectors are more aggregated than products in Comtrade and BACI. |
| CHELEM trade database (CEPII) | • Comtrade is the main source, but the IMF's DOTS is also used.<br>• CHELEM contains the bilateral flow of all traded goods expressed in millions of current dollars since 1967. The data from the different sources are harmonized and rendered coherent in a framework spanning the entire world and all goods, detailed in either 71 INT-CHELEM product categories, 43 INT-GTAP categories, or 147 INT-ISIC accounts.<br>• The CHELEM reconciliation of mirror flows proceeds also to a revaluation of import reports by retrieving the cost, insurance and freight such that they are expressed in FOB terms, taking into account the accuracy and the regularity of the declarations of the countries (de Saint-Vaulry 2008).<br>• CHELEM includes reconciliation using mirror data. | • CHELEM covers a longer time span (1967–2005) than BACI, it is also provides trade flows at a much more aggregated level and does not provide information about quantities. |

Source: Authors, based on above-cited sources.
Note: SITC = Standard International Trade Classification; HS = Harmonized System; BEC = Broad Economic Categories; DOTS = Directions of Trade Statistics.

Other databases exist, such as the World Bank's World Integrated Trade Solution (WITS), the World Trade Organization's Integrated Trade Intelligence Portal (I-TIP), the IMF's Directions of Trade Statistics (DOTS), the Food and Agriculture Organization's FAOSTAT, and the Global Trade Atlas (formerly the World Trade Atlas). Users of these databases face many of the same issues already detailed. The data that WITS and I-TIPS use come mainly from Comtrade, and data on the IMF's DOTS are highly aggregated. FAOSTAT provides interesting figures for food and agriculture exports and imports both in value and quantity but not on a bilateral basis. Finally, the Global Trade Atlas, supplied by Global Trade Information Services, requires a submission fee and has poor coverage of African countries.

## Special Focus on ECOWAS Using Comtrade

As mentioned, Comtrade is the original source of country-supplied bilateral trade data. However, providing data is not mandatory. Looking specifically at ECOWAS countries within the Comtrade database during the period 1998–2010, one can see that some of them do not notify (either as importer or exporter) on a regular basis (Table 2.2).

**Table 2.2 Frequency of declaration in Comtrade: ECOWAS countries, 1998–2010**

| ECOWAS country / ISO country code | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Frequency of declaration |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Benin / 204 | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | 13 |
| Burkina Faso / 854 | | | | Y | Y | Y | Y | Y | | Y | Y | Y | Y | 9 |
| Côte d'Ivoire / 384 | | | | Y | | Y | Y | Y | Y | Y | Y | Y | Y | 9 |
| Cape Verde / 132 | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | 13 |
| Ghana / 288 | | | | | | Y | Y | Y | Y | Y | Y | Y | Y | 8 |
| Guinea / 324 | Y | Y | Y | Y | Y | | Y | Y | Y | Y | Y | | | 10 |
| Gambia / 270 | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | 13 |
| Guinea-Bissau / 624 | | | | | | Y | Y | Y | | | | | | 3 |
| Liberia / 430 | | | | | | | | | | | | | | 0 |
| Mali / 466 | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | | Y | 12 |
| Niger / 562 | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | 13 |
| Nigeria / 566 | | Y | | Y | Y | Y | | | Y | Y | Y | Y | Y | 9 |
| Senegal / 686 | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | 13 |
| Sierra Leone / 694 | | | | | | | | | | | | | | |
| Togo / 768 | Y | Y | Y | Y | Y | Y | Y | Y | | Y | Y | Y | Y | 12 |
| Number of countries declaring trade | 8 | 9 | 8 | 11 | 10 | 12 | 12 | 12 | 10 | 12 | 12 | 10 | 11 | |

Source : Comtrade (United Nations 2015).
Note: Y = yes, trade data are available for at least one classification (HS or SITC). ECOWAS = Economic Community of West African States. See the appendix for the frequency of declaration for all African countries.

Moreover, even countries that declare their trade may declare it badly, especially trade with other African countries (Table 2.3). One can see that using these figures to calculate intratrade can lead to mistakes, given the missing data.

**Table 2.3 Declaring countries and share of ECOWAS intratrade for selected years, 1998–2010**

| ECOWAS countries / ISO country code | 1998 | 1999 | 2003 | 2004 | 2007 | 2010 |
|---|---|---|---|---|---|---|
| Benin / 204 | Y (15.3) | Y (11.7) | Y (21.1) | Y (24.8) | Y (18.5) | Y (18.5) |
| Burkina Faso / 854 | | | Y (44.2) | Y (42.67) | Y (27.3) | Y (26.8) |
| Côte d'Ivoire / 384 | | | Y (13.4) | Y (21.5) | Y (26.1) | Y (27.7) |
| Cape Verde / 132 | Y (1.8) | Y (1.6) | Y (4.1) | Y (1.6) | Y (1.1) | Y (1.4) |
| Ghana / 288 | | | Y (19.5) | Y (0.01) | Y (10.1) | Y (2.57) |
| Guinea / 324 | Y (9.5) | Y (8.9) | | Y (20.28) | Y (5.3) | |
| Gambia / 270 | Y (12.1) | Y (7.2) | Y (8.4) | Y 15.7 | Y (10.8) | Y (23.6) |
| Guinea-Bissau / 624 | | | Y (14.8) | Y (31.6) | | |
| Liberia / 430 | | | | | | |
| Mali / 466 | Y (34.9) | Y (29.4) | Y (38.3) | Y (41.6) | Y (46.2) | Y (35.7) |
| Niger / 562 | Y (25.8) | Y (30.0) | Y (30.0) | Y (28.4) | Y (22.2) | Y (11.1) |
| Nigeria / 566 | | Y (0.45) | Y (2.43) | | Y (2.3) | Y (0.41) |
| Senegal / 686 | Y (8.5) | Y (10.4) | Y (16.5) | Y (16.0) | Y (11.9) | Y (13.2) |
| Sierra Leone / 694 | | | | | | |
| Togo / 768 | Y (15.6) | Y (22.9) | Y (13.6) | Y (15.8) | Y (10.2) | Y (11.2) |

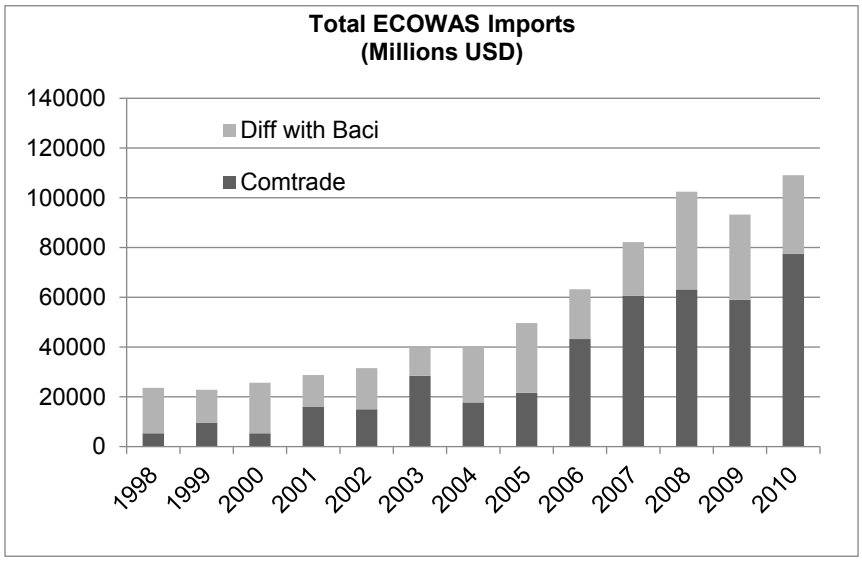
Source: Comtrade (United Nations 2015).
Note: ECOWAS = Economic Community of West African States. Y = yes, the country declares. Figures in parentheses indicate the share (%) of ECOWAS intratrade in the declaring country's total trade.

## Comparing Comtrade and BACI

As we indicate in Table 2.1, BACI uses data supplied by Comtrade; it then uses an original methodology to reconcile mirror flows (exports from country *i* to country *j* compared with imports of country *j* from country *i*). BACI addresses the main issues related to Comtrade, particularly the reporting in different nomenclatures and the absence of distinction between zero trade flows and missing values in raw data. When both countries (importer and exporter) report trade flows, BACI first express all values on a free-on-board–free-on-board (FOB–FOB) basis by removing transport costs from imports using a gravity model, and then using the average FOB–FOB value. The "reconciled" FOB–FOB value is computed as a weighted average of the two trading partners, the weight being an indicator of the accuracy of country reports computed from a variance analysis (Gaulier and Zignago 2010).

This harmonization procedure enables BACI to extend considerably the number of countries for which trade data are available, as compared with the original (Comtrade) dataset. The missing values at the end of the reconciliation procedure are only those flows concerning trade between two nonreporting countries in Comtrade. For instance, during the period 1998–2010 all of the ECOWAS countries appear in the BACI database.

**Figure 2.1 Total ECOWAS imports: Comparing BACI and Comtrade, 1998–2010**




Source: BACI (CEPII 2013) and Comtrade (United Nations 2015).
Note: Total imports by ECOWAS countries from the rest of the World. Figures are in millions of US dollars. Diff with BACI = difference with BACI. ECOWAS = Economic Community of West African States.

**Table 2.4 Comtrade versus BACI: ECOWAS imports, 1998–2010**

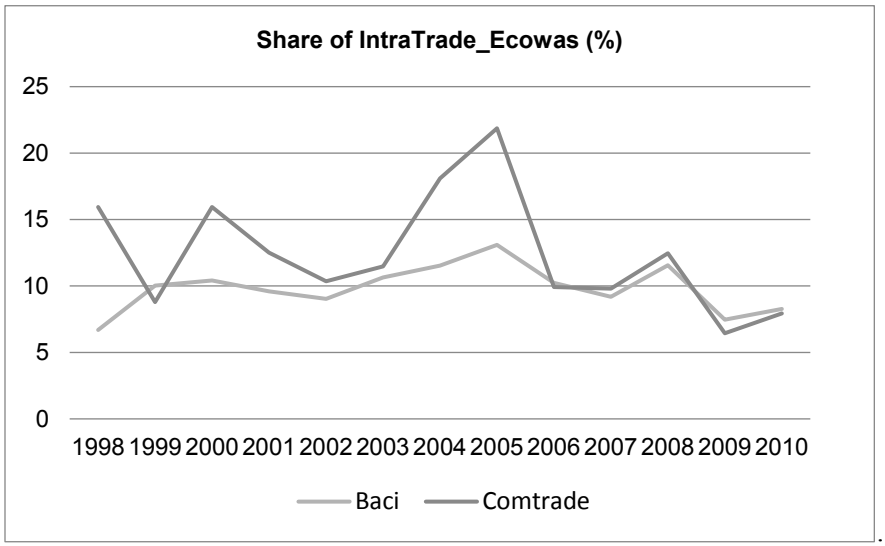
| | Total_Ecowas_M_ExtraEcowas (in US$ millions) | | | Total_Ecowas_M_Intra (in US$ millions) | | |
|---|---|---|---|---|---|---|
| Year | Comtrade | BACI_diff | BACI_diff/Comtrade | Comtrade | BACI_diff | BACI_diff/Comtrade |
| 1998 | 4,495 | 17,523 | 3.9 | 852 | 726 | 0.9 |
| 1999 | 8,827 | 11,753 | 1.3 | 851 | 1,444 | 1.7 |
| 2000 | 4,495 | 18,500 | 4.1 | 852 | 1,822 | 2.1 |
| 2001 | 14,077 | 11,947 | 0.8 | 2,013 | 748 | 0.4 |
| 2002 | 13,426 | 15,259 | 1.1 | 1,550 | 1,297 | 0.8 |
| 2003 | 25,180 | 10,387 | 0.4 | 3,264 | 974 | 0.3 |
| 2004 | 14,565 | 20,918 | 1.4 | 3,219 | 1,409 | 0.4 |
| 2005 | 16,900 | 26,291 | 1.6 | 4,729 | 1,777 | 0.4 |
| 2006 | 38,973 | 17,795 | 0.5 | 4,295 | 2,181 | 0.5 |
| 2007 | 54,701 | 19,956.5 | 0.4 | 5,947 | 1,601.2 | 0.3 |
| 2008 | 55,328 | 35,293.7 | 0.6 | 7,877 | 3,966.0 | 0.5 |
| 2009 | 55,244 | 31,083.4 | 0.6 | 3,805 | 3,157.1 | 0.8 |
| 2010 | 71,316 | 28,762.3 | 0.4 | 6,149 | 2,874.6 | 0.5 |

Source: BACI (CEPII 2013) and Comtrade (United Nations 2015).
Note: BACI_Diff = difference with BACI. ECOWAS = Economic Community of West African States.
Total_Ecowas_M_ExtraEcowas = Total imports of ECOWAS countries from the rest of the world. Total_Ecowas_M_Intra = Total imports of ECOWAS countries from other ECOWAS countries.

We note large differences between amounts reported by the two databases, particularly during the beginning of the period (late 1990s). In each of the years 1998, 1999, and 2000, the difference between total ECOWAS imports registered in BACI and what is registered in Comtrade amounts to more than the total registered in Comtrade (Figure 2.1 and Table 2.4). However, we can note that in some years the databases report similar ECOWAS intratrade shares (Figure 2.2)[2]. This is because even if BACI reports more intratrade compared to UN comtrade, extratrade is larger (Table 2.4). Indeed, intratrade is less well declared at both sides.

[2] Share of intra-regional (ECOWAS) trade in total trade.

**Figure 2.2 Share of intratrade: Comparing BACI and Comtrade, 1998–2010**




Source: BACI (CEPII 2013) and Comtrade (United Nations 2015).

## Main Regional Trade Databases

In addition to international trade databases, regional economic communities in Africa also provide trade figures. Table 2.5 presents the features of the main databases of such regional communities.

**Table 2.5 Main regional trade databases**

| Regional economic community | Main features of the database |
|---|---|
| West African Economic and Monetary Union (WAEMU) | – Data are provided by Banque Centrale des Etats de l'Afrique de l'Ouest (BCEAO) mainly through balance of payments.<br>– Data are highly aggregated in terms of commodities and partners (1960 on).<br>– Data come from individual balance-of-payments information for countries with little disaggregation (10 most traded products and matrix of total flows with main partners).<br>– The database performs no harmonization regarding informal or unregistered trade: each country has its own method to include unregistered trade (surveys and reweighting techniques), which is not publicly available.<br>– Source: NA.<br>– Link: http://edenpub.bceao.int/ |
| Economic Community of West African States (ECOWAS) | – The database provides only regional trade statistics starting in 2001.<br>– Data are at the HS2 level for total exports and imports.<br>– Data are at the HS6 level for exports to third countries.<br>– Source: NA.<br>– Link: www.ecostat.org/en/standard.php?file=sommaire |
| Economic and Monetary Community of Central Africa (CEMAC) | – Data are provided through balance-of-payment statistics.<br>– Trade data describe main commodities exported (10 to 20) but not imports.<br>– No information is given on sources and destinations (cannot link products to destinations).<br>– No information is provided about adjustments for informal trade (does not adjust).<br>– Data are available only from 1998 to 2010.<br>– Source: NA (Banque des Etats de l'Afrique Centrale).<br>– Link: www.beac.int/index.php/statistiques/statistiques-de-la-balance-de-paiement |

**Table 2.5 Continued**

| Regional economic community | Main features of the database |
|---|---|
| Economic Community of Central African States (ECCAS) | ECCAS does not provide trade data. |
| Southern African Development Community (SADC) | – SADC produces a statistics yearbook (Excel format).<br>– Yearbook provides information on total imports and exports and country-level intra-SADC trade starting in 2000.<br>– Source: national statistics offices of member states.<br>– Link: www.sadc.int/information-services/sadc-statistics |
| Southern African Customs Union (SACU) | – Information is provided in an online statistical database.<br>– Database provides data on trade for member states at HS6 level starting in 2007.<br>– Source: NA.<br>– Link: http://stats.sacu.int/ |
| Common Market for Eastern and Southern Africa (COMESA) | – Database consists of an online interactive data portal.<br>– Database covers trade data at the HS6 level.<br>– COMESA also produces annual international trade statistics bulletins with data for main products (SITC sections) and main trading partners.<br>– Main source: national statistical offices; extraregional trade is mirrored from Comtrade if not available.<br>– Link: http://comstat.comesa.int |
| East African Community (EAC) | – Information is provided on a trade data platform.<br>– Platform provides detailed trade data (HS6+) for the member states starting in 2008.<br>– Source: NA (EAC).<br>– Link: http://tradehelpdesk.eac.int/trade/form/ |
| Arab Maghreb Union (AMU) | – Database provides aggregate and detailed (SITC sections) regional trade data for both intra- and extra-AMU trade (with main regions in the world) starting in 1996.<br>– No data are provided for individual countries.<br>– There is no mention of informal trade.<br>– Source: UNCTAD.<br>– Link: www.maghrebarabe.org/fr/Base%20de%20donnees%20UMA%20FrontOffice.htm |

Source: Authors, based on above-cited sources.
Note: NA =primary source of the data is not available (provided by the institution); HS = Harmonized System; SITC = Standard International Trade Classification.

The regional databases are notable for their high level of aggregation in terms of both products and partners (total trade). Indeed, data coming from balance of payments information hardly cover 20 products. When commodities are disaggregated, in general trade partners are not (for example, ECOWAS). Some regional economic communities do not provide trade data at all (for example, Economic Community of Central African States). Overall, the West and East African regions (ECOWAS, East African Community, Common Market for Eastern and Southern Africa) provide the most detailed and up-to-date information.

It is common for information in the regional databases to be more up to date than that in international databases. Because the main source is a national office of statistics, the vicinity of regional institutions makes the data monitoring and claiming process easier. This is particularly the case for ECOWAS countries.

## 3. MONITORING INFORMAL TRADE AT COUNTRY BORDERS IN AFRICA

As we have seen in Section 2, using mirror flows to fill gaps and reconcile data is not sufficient, especially if both countries (exporter and importer) fail to declare or badly report their trade. To fill in such gaps, different initiatives have been developed to monitor informal (or unregistered) trade in Africa in recent years. In this section, we review several published studies that have attempted to measure informal trade across country borders and review several ongoing initiatives trying to measure such trade. We take a close look at three particular ongoing projects.

Monitoring informal trade at the border would seem to be the proper way to understand and quantify the phenomenon of missing trade. However, such monitoring can be expensive and is methodologically challenging. That is why initiatives of this sort have been limited, although they have increased in recent years. Table 3.1 lists the main ongoing initiatives. All present some limitations, most often related to financial constraints.

To circumvent the costs linked to a regular survey, at least in a desert zone, researchers might use aerial mapping technology and an algorithm to proxy the number of vehicles (trucks, cars) crossing the border from the trace left by the vehicles.

Studies are often partial: many are conducted on a particular border, or for only selected goods, or for a limited period of time (a few days). However, they all suggest the importance of the unrecorded trade. Figures are sizable in all surveys. In the case of Benin with all its neighbors, informal trade represented 40 percent of total trade in 2010 (INSAE 2010). In Uganda, a border-monitoring survey pointed out that in 2006 informal exports to its five neighboring countries amounted to an estimated 86 percent of official export flows to those countries over the same period (Lesser and Moisé-Leeman 2009). A previous study of Ugandan trade with Kenya (Ackello-Ogutu and Echessah 1997) showed that total unofficial trade (both imports and exports) amounted to about 152 percent of the average official trade for the year 1994.

**Table 3.1 Main studies and initiatives collecting data to track informal trade**

| Study or initiative | Geographical area | Goods | Main limitations |
|---|---|---|---|
| Ackello-Ogutu and Echessah (1997) | - Uganda and Tanzania | - All goods | - Important crossing points were omitted due to security reasons. |
| Lesser and Moisé-Leeman (2009) | - Uganda and five neighboring countries | - All goods | - Study was based on other sources. |
| Bensassi et al. (2013) | - Tunisia, Algeria, and Libya | - All goods | - Only a small part of the frontier was accounted for. |
| Bensassi et al. (2015) | - Algeria and Mali | - All goods | - Only a small part of the frontier was accounted for. |
| CILSS (Comite Permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel), 2013 ongoing | - West Africa<br>- Collection started in 2013 on a daily basis | - Agriculture and food products | - Road harassment has occurred on corridors.<br>- Project suffers from financial constraints, which often have stopped the work. |
| INSAE (Institut National de la Statistique et de l'analyse Économique) (2010) | - Benin with all of its neighbors | - All goods entering/exiting the country<br>- Products are very detailed and codified using the HS rev. 2 nomenclature, at 8 digits | - Financial constraints have limited the job: only 10 days in January for 2010 and 10 days in September 2011.<br>- There is a need to extend the period of the survey to night time (different goods exchanged and problem of security) and to a different time of the year (seasonality). |

**Table 3.1 Continued**

| Study or initiative | Geographical area | Goods | Main limitations |
|---|---|---|---|
| FEWS NET (Famine Early Warning Systems Network), 2005 ongoing | - Eastern Africa<br>- Southern Africa | - 88 food commodities and livestock | Funding will end in 2016.<br>There are problems extrapolating to wider areas. |
| Uganda Bureau of Statistics, 2005 ongoing | - Uganda and its neighbors | - All goods | Trade occurring at night is not covered.<br>Project experiences difficulty in accurately estimating the quantities of some traded items. |
| Regional Agricultural Trade Intelligence Network (Eastern Africa Grain Council) | - Eastern Africa (seven countries) | - 19 agricultural commodities in southern Africa | Methodology is not available. |

Source: Authors, based on above-cited sources.
Note: HS = Harmonized System.

In what follows, we discuss the three main ongoing initiatives: the CILLS initiative, ECENE, and FEWS NET.

## The CILSS Initiative

The Regional Support Program of Market Access is a program of CILSS (in English, the Permanent Interstate Committee for Drought Control in the Sahel). That program, with the support of the United States Agency for International Development (USAID), is tracking intraregional trade in agriculture and food products in West Africa. Data collection began in April 2013.

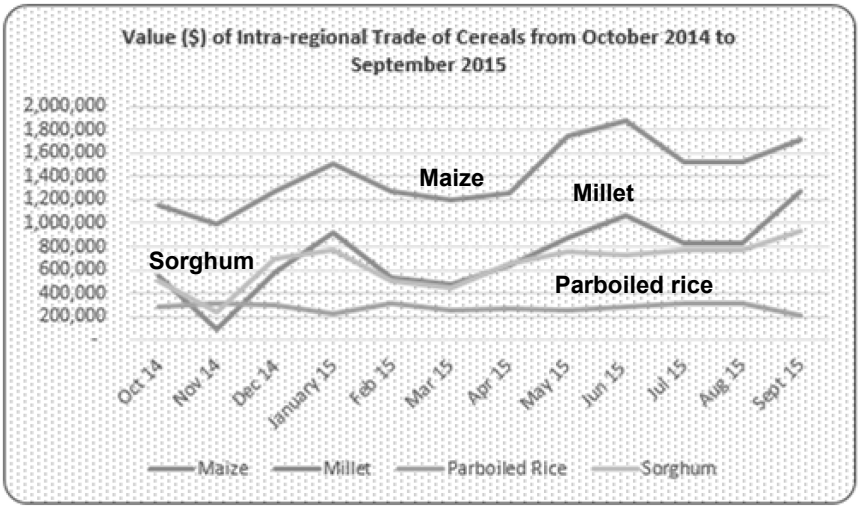
Data are collected on the value and volume of intraregional agricultural trade along the major commercial corridors linking Senegal, Mali, Burkina Faso, Benin, Togo, Ghana, Côte d'Ivoire, and Nigeria (Figure 3.1).

**Figure 3.1 Trade data collection points**


Source: Amedo and Tordina (2015).

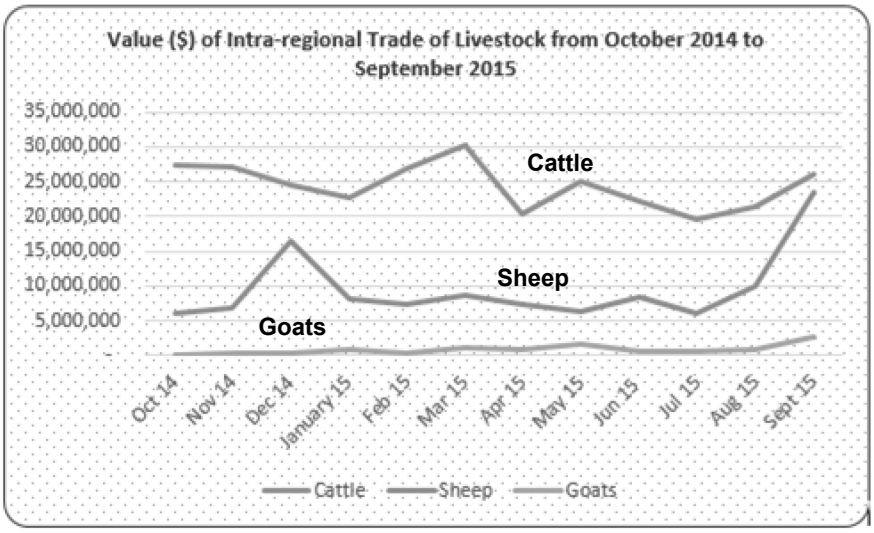
The major agricultural commodities targeted are livestock (cattle, sheep, and goats) and cereals (maize, millet, sorghum, and parboiled rice), which are the Feed the Future commodities (Figures 3.2 and 3.3).

**Figure 3.2 Intraregional trade (West Africa region) in cereals in fiscal year 2015**




Source: Amedo and Tordina (2015).
Note: Values are in US dollars.

**Figure 3.3 Intraregional trade (West Africa region) in livestock in fiscal year 2015**




Source: Amedo and Tordina (2015).
Note: Values are in US dollars.

## Methodology

CILSS selected seven professional partner organizations or national apex associations to collect the data. Each partner organization or association chose a focal point (person) per value chain/commodity per country. Two data collectors per association per commodity and per strategic market or exit point were selected. Data collection is done in the strategic markets and at exit points every day. The trade data collectors collect the following information:

- Date of departure of truck/train/tractor
- Country of origin
- Truck registration number
- Export volume (bags/number)
- Export price (FOB) per unit in local currency
- Type of commodity
- Variety (cereals) or category (livestock)
- Data collection point/loading point (in country of origin)
- Destination country
- Unloading point (in country of destination)
- Trader contact information

The two data collectors compare data at the end of the day to eliminate errors; they transfer the information into registers at the collection point, where it is consolidated at the end of each month and transmitted to focal points by courier or telephone. Volume is measured in tons, and value is measured by comparing the average monthly exchange rate of the local currency using the OANDA website to obtain a value in US dollars.

The focal points input data into computers and transmit those data by email to CILSS by the 10th day of the following month. After processing, CILSS produces monthly, quarterly, and annual reports.

Despite these efforts, the CILSS collection system faces many challenges, among which are the delay in payment of allowances to data collectors, the absence of national and regional meetings with data collectors and focal points for brainstorming, and the inability of data collectors to collect complete information on large numbers of livestock or sheep moving across borders during festivals.

### The Enquête Nationale sur le Commerce Extérieur Non Enregistré of Benin

For a long time, Benin's official foreign trade statistics did not account for unregistered transactions. However, such transactions were thought to be very relevant, considering the findings of previous studies and that customs did not cover a large number of border points. Thus, in 2010 and 2011 the Institut National de la Statistique et de l'Analyse Économique (INSAE) in Benin decided to investigate unrecorded trade and trade channels, considering all of the country's border frontiers. INSAE's survey of unregistered foreign trade is called the Enquête sur le Commerce Extérieur non Enregistré au Cordon Douanier (ECENE).

INSAE collaborates with different entities to conduct the investigation: the Customs Directorate, the Directorate in Charge of Foreign Trade, the Livestock Directorate, the National Police Directorate, and the Gendarmerie Directorate. The survey involves internal people in all of the agencies involved and external local people to ensure the collection of information.

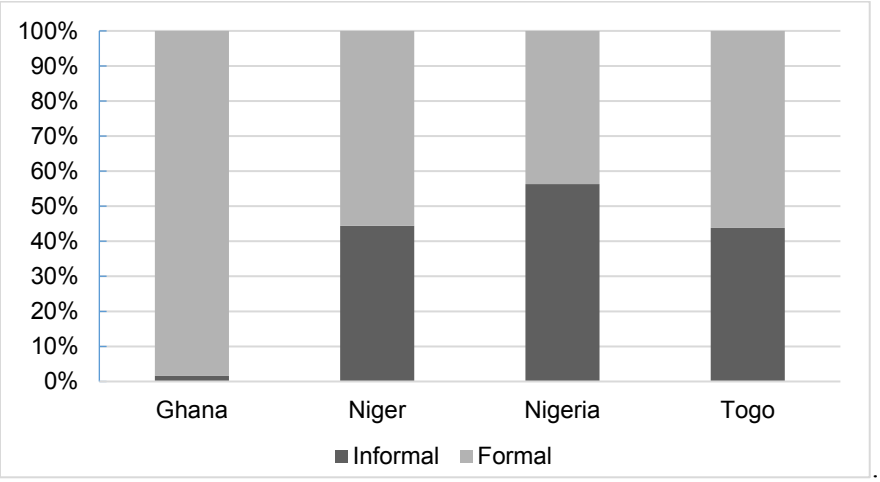
The process has three main steps:

- Choose fraudulent crossing points, and update them. The number of such points rose from 150 in January 2010 to 271 in September 2011. Sixty percent of these points are at the frontier with Nigeria, 39 percent are on the border with Togo, and the rest are found on the frontiers with Burkina Faso and Niger.
- Choose agents and guides who know the area well. Indeed, for each point one or two collection agents are assisted by a guide.
- Have collection agents collect data.

ECENE collects data on the quantity, value, origin, and destination of the goods transported and on the frequency of activities. INSAE expected it would conduct the survey in four parts (each quarter of the year) but because of financial constraints has completed only two installments so far (January 2010 and September 2011). INSAE still hopes to collect data in four passes. For that it will be necessary to update the methodology and the collection tools (for example, collecting the data directly to tablets).

The ECENE data highlight the huge share of informal trade in Benin's exports (Figure 3.4). Informal trade represents more than 50 percent of export flows to Benin's main partner, Nigeria. The same holds true for imports from Nigeria—that is, 57 percent of total import flows were informal.

**Figure 3.4 Benin exports (selected partners) in 2010**




Source: INSAE (2010).

## Famine Early Warning Systems Network

USAID created the Famine Early Warning Systems Network (FEWS NET) in 1985 as a provider of early warnings on food insecurity. The team comprises five US government agencies (USAID, the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, the US Department of Agriculture, and the US Geological Survey), two private companies (Chemonics International and Kimetrica), and various collaborators in data collection in the field.

Regarding cross-border trade, FEWS NET, in collaboration with local partners, conducts regular analysis of food commodity markets and trade in southern and eastern Africa. In eastern Africa, within the Food Security and Nutrition Working Group regional platform, the network participates in the monitoring of cross-border trade of 88 food commodities and livestock in 26 cross-border markets; it has produced quarterly cross-border trade bulletins with the Food and Agriculture Organization and World Food Programme (WFP) since 2005. These activities cover the countries of Tanzania, Burundi, Rwanda, Uganda, Kenya, Somalia, Djibouti, Ethiopia, Sudan, South Sudan, and Democratic Republic of the Congo and the following key commodities and cash crops: maize, beans, wheat, rice, sorghum, and sesame. In southern Africa, FEWS NET, in partnership with the Alliance for Commodity Trade in Eastern and Southern Africa (a specialized agency of the Common Market for Eastern and Southern Africa) and the WFP, monitors 29 border points and produces monthly bulletins (in partnership with the WFP). The countries covered are South Africa, Tanzania, Mozambique, Malawi, Democratic Republic of the Congo, Zambia, and Zimbabwe.

FEWS NET and its collaborators have contributed to a better understanding of trade flows in southern and eastern Africa, in the same way as CILSS in West Africa. The main challenges to the program are the extrapolation of the survey to wider areas and the funding, which is expected to end this year.

## 4. MEASURING MISSING TRADE WITH INDIRECT GRAVITY METHODS

Quantifying unregistered, or missing, trade is a key challenge. Monitoring trade flows at the border through surveys seems a natural solution (see Section 3). However, the financial and transaction costs associated with those surveys may represent a serious limitation.[3] Given those limitations, estimating gravity equations presents us with an interesting option to measure the potential trade between two partner countries. The predicted trade flows can then be compared to observed ones. This is particularly important for intra-Africa trade, where both partners usually fail to report their trade.

In a way similar to the Newtonian theory of gravitation, it is proposed that bilateral trade flows between two countries can be approximated by a "gravity equation" (Anderson 1979). It is assumed that countries trade in proportion to their respective GDPs (gross domestic products) and proximity (distance), just as planets are mutually attracted in proportion to their sizes and proximity. Anderson and van Wincoop (2003) proposed a microeconomic foundation to structural gravity models by especially emphasizing the importance of price endogeneity issues (multilateral resistance), an element neglected in previous "atheoretical" gravity models. The theoretical model now accepted as the best starting point assumes *N* countries and a variety of goods differentiated by country of origin and is formulated as follows:

$$X_{ij} = \frac{Y_i Y_j}{Y_W} \frac{{t_{ij}}^{1-\sigma}}{{P_i}^{1-\sigma} {P_j}^{1-\sigma}} \tag{1}$$

$${P_i}^{1-\sigma} = \sum_{j=1}^{N} \frac{Y_j \ {t_{ij}}^{1-\sigma}}{Y_W \ {P_j}^{1-\sigma}}, \tag{2}$$

where $X_{ij}$ stands for exports from *i* to *j*; $Y_i$, $Y_j$, and $Y_W$ are the GDPs of *i, j,* and *w* (*w* stands for world); $t_{ij}$ are the overall trade costs; $\sigma$ is the intrasectoral elasticity of substitution (between varieties), and $P_i$ and $P_j$ are the multilateral resistance terms. The multilateral resistance terms capture the fact that trade between *i* and *j* depends on trade costs across all possible export and import markets (Anderson and van Wincoop 2003). As a consequence, trade between two partners is determined by relative trade barriers (the bilateral barrier between them relative to average trade barriers that both face with all their trading partners).

Equation (1) is usually estimated in its log-linear form as

$$ln\, x_{ij} = \lambda + (1-\sigma)\, ln\, t_{ij} + \eta_i + \zeta_j + u_{ij}, \tag{3}$$

where $x_{ij} = \frac{X_{ij} Y_W}{Y_i Y_j}$, and $\eta_i$, $\zeta_j$ are i exporters and importers fixed effects, which are approximations of multilateral resistance terms.[4] Trade costs commonly take the following form:

$$ln\, t_{ij} = \rho\, ln\, dist_{ij} + \sum_k \beta_k Z_k, \tag{4}$$

where $dist_{ij}$ represents the distance between trading partners and $Z = (Z_1, Z_2 \ \ldots)$ stand for all other trade cost variables such as tariff, contiguity, colonial relation, regional trade agreement, common official language, and so forth.

[3] For instance, in addition to the financial cost, one has to convince traders to participate in the survey and customs administrations not to intervene.

[4] "Remoteness variables" can also be computed and used.

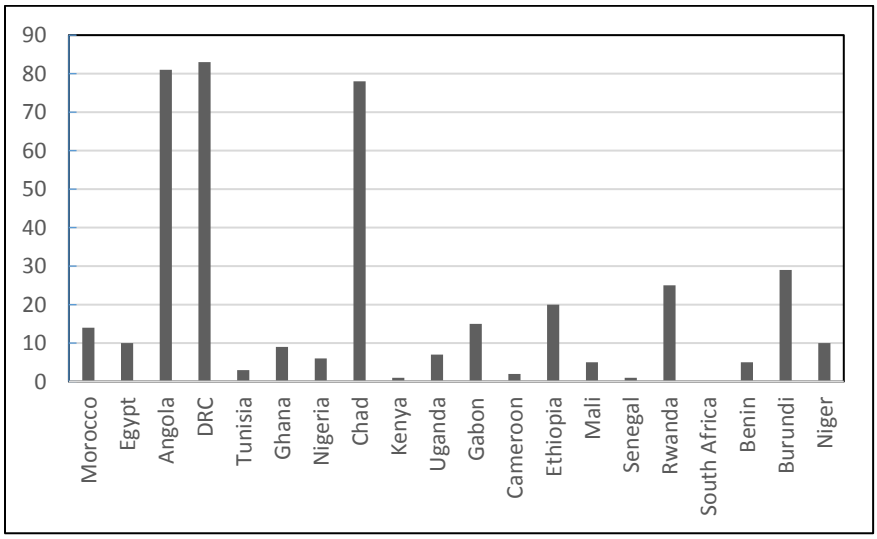
Equation (3) can be estimated by the ordinary least squares method. However, the log-linearization procedure raises at least two issues:

- The existence of zero flows in international trade data makes the estimation impossible for these observations. Dealing with these zero trade flows has led to a lot of debate in the empirical literature: truncating the sample or adding a small constant is questionable, and using a selection model à la Heckman seems preferable given that the probability of having positive (nonzero) trade between two countries may be correlated with unobserved characteristics of the countries (Bacchetta et al. 2012).
- In addition to the zero trade flow issue, due to Jensen's inequality, the interpretation of the coefficients of the log-linearized model can be misleading in the presence of heteroskedasticity (Santos Silva and Tenreyro 2006). Instead, a pseudo-Poisson maximum likelihood estimator can be used. This estimator also allows one to circumvent the problems caused by zero flows. The estimated model in this context is

$$x_{ij} = exp\left[\lambda + (1-\sigma)\, ln\, t_{ij} + \eta_i + \zeta_j\right] \epsilon_{ij} \,. \tag{5}$$

Once the equation has been estimated, predicted trade flows ($\hat{x}_{ij}$) can be used to compare the actual values to what would have happened given the country's characteristics.

**Figure 4.1 Missing trade in selected African countries (in %)**




Source: Villoria (2008).
Note: The percentage corresponds to the following ratio: predicted/(predicted + observed) trade.

Applying this approach to 22 manufacturing products in Africa in the GTAP 6 database (reference year 2001), Villoria (2008) finds that 2 percent of intra-Africa trade in manufactures is missing, with huge variations between regions: there is a very low incidence in southern and northern Africa and large values for West and Central Africa (Figure 4.1). Indeed, 25 percent of the countries (13 out of the 53) exhibit more than 50 percent of the missing trade. Given that agricultural products tend to be less monitored than industrial ones and subject to more informal transactions, one could expect larger missing trade ratios for the former. More generally, in accordance with Villoria's findings, models estimating the trade potential between countries based on economic size, geographical distance, and other characteristics consistently find that trade among Africa's economies is below the levels predicted (World Bank 2009).

## 5. CONCLUSION

Measuring trade in Africa still presents challenges, particularly when it comes to intraregional flows. Data are seriously lacking, and there is an obvious problem of reporting with respect to African trade data in both international and regional databases. This study has highlighted the main challenges and options available for future actions.

One conclusion we draw is that reconciling original data is not sufficient, especially for trade between African countries. Both reporters may not declare or may declare badly. To try to account for Africa's missing trade, a first step is to obtain the official customs statistics of African countries and include them in the international databases—such as Comtrade. However, that step will not be sufficient due to the existence of unregistered trade.

The use of data recorded by the customs officials may reveal the extent of unofficial trade between two countries. For a given commodity, the official trade figures of the two trading partners rarely tally. Even in cases where trade flows are recorded by both countries, values may not correspond due to over- or underinvoicing or misdeclarations aimed at exploiting lower tax rates. Further estimation problems arise when both countries do not record trade flows, as in the case of contraband (informal) flows; in that case, traders would therefore avoid declaring such goods in either country. Records hardly exist for such trade, and actual border monitoring (observation) may be the only option for quantification.

How to quantify unregistered trade is challenging. Different techniques have been proposed, including direct methods (such as surveys at the border) and indirect methods (mainly from gravity modeling exercises). Another avenue could be to try to estimate unregistered trade via national accounts data by comparing consumption, production, and declared trade. Finally, although the gravity approach has strong theoretical foundations, some univariate econometric techniques (interpolation, extrapolation, or projection models) could also be used at the aggregate level to estimate total missing trade (Chinganda 1993).

In short, we need to improve formal sources (customs data) and conduct more surveys of informal flows (more initiatives to measure informal trade via surveys—and not only for agricultural products). In addition, there is a need for harmonization and experience-sharing for measuring informal trade as a first step in the extrapolation of the figures at the continental level.

# APPENDIX: SUPPLEMENTARY TABLES

**Table A.1 Frequency of declaration in Comtrade by African countries (1995–2015)**

**Economic Community of West African States**

| Country | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Benin | Y | Y | Y | Y | Y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Burkina Faso | Y | Y | Y | Y | Y | y | y | y | y | y | y | | y | y | y | y | y | y | y | y | y |
| Côte d'Ivoire | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Cape Verde | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | | |
| Ghana | | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Guinea | y | y | y | y | y | y | y | y | | y | y | y | y | y | | | | | y | y | y |
| Gambia | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | |
| Guinea-Bissau | | | | | | | | | y | y | y | | | | | | | | | | |
| Liberia | | | | | | | | | | | | | | | | | | | | | |
| Mali | | y | y | y | y | y | y | y | y | y | y | y | y | y | | y | y | y | | | |
| Niger | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Nigeria | | y | y | y | y | y | y | y | y | | | y | y | y | y | y | y | y | y | y | y |
| Senegal | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Sierra Leone | | | | | | | | | | | | | | | | | | | | y | y |
| Togo | y | y | y | y | y | y | y | y | y | y | y | | y | y | y | y | y | y | y | y | y |

**Table A.1 Continued**

**Common Market for Eastern and Southern Africa**

| Country | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Burundi | Y | Y | Y | Y | Y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Comoros | Y | Y | Y | Y | Y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | | |
| DRC | | | | | | | | | | | | | | | | | | | | | |
| Djibouti | | | | | | | | | | | | | | | Y | | | | | | |
| Egypt | Y | Y | Y | Y | Y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Eritrea | | | | | | y | y | Y | y | | | | | | | | | | | | |
| Ethiopia | Y | | Y | Y | Y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Kenya | Y | Y | Y | Y | Y | y | y | y | y | y | y | y | y | y | y | y | | | y | | |
| Libya | | | Y | Y | | | | | y | y | | | y | y | y | y | | | | | |
| Madagascar | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Malawi | Y | Y | Y | Y | Y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Mauritius | Y | Y | Y | Y | Y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Rwanda | Y | Y | Y | Y | Y | | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Seychelles | Y | Y | Y | Y | Y | y | y | y | y | y | y | y | y | y | | y | y | y | y | y | y |
| Sudan | | | | | | | | | | | | | | | | | | y | | | y |
| Swaziland | | | | | | y | y | y | y | y | y | y | y | | | | | | | | |
| Uganda | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Zambia | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Zimbabwe | y | y | y | | y | y | y | y | | y | y | y | y | y | y | y | y | y | y | y | y |

**Table A.1 Continued**

**Other countries**

| Country | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South Africa | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Algeria | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Angola | | | | | | | | | | | | | y | | y | y | y | y | y | y | y |
| Botswana | | | | | | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Cameroon | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Congo | y | | | | | | | | | | | | y | y | y | y | y | y | y | y | |
| Gabon | | y | y | y | y | y | y | y | y | y | y | y | y | y | y | | | | | | |
| Equat. Guinea | | | | | | | | | | | | | | | | | | | | | |
| Lesotho | | | | | | y | y | y | y | y | | | | y | y | y | y | y | | | |
| Mauritania | y | y | | | | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | |
| Mozambique | y | y | y | | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Namibia | | | | | | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | |
| CAR | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Tanzania | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Sao Tome | | | | | | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| Chad | y | | | | | | | | | | | | | | | | | | | | |
| Tunisia | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y | y |
| South Sudan | | | | | | | | | | | | | | | | | | | | | |

Source: Authors.
Note: DRC = Democratic Republic of the Congo; y = available for at least one classification (Harmonized System or Standard International Trade Classification).

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