CENTRE
D'ÉTUDES PROSPECTIVES
ET D'INFORMATIONS
INTERNATIONALES

No 2012 – 16
July

DOCUMENT DE TRAVAIL

Assessing the price-raising effect of non-tariff measures in Africa

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NON-TECHNICAL SUMMARY

In spite of widespread tariff reductions, intra-African borders remain "thick", with many hurdles standing in the way of regional trade (see e.g. the essays collected in Brenton and Isik, 2012). Inadequate transportation infrastructure is not the only obstacle. Ample anecdotal evidence summarized in, *inter alia*, Gillson (2011) and Charalamides and Gillson (2011) suggests that non-tariff measures (henceforth NTMs), whether deliberately protectionist or not, raise trade costs and inhibit regional trade in Africa. However, beyond the anecdotal evidence, little is known about the magnitude of the price-raising effects involved. Beyond old-style quantitative restrictions (QRs) and bans, even measures that could be potentially justified by market failures like sanitary and phytosanitary (SPS) measures or product standards are often ill-suited to both consumer protection needs and Government monitoring capabilities, generating unnecessary hurdles. The picture in the specific case of African markets suggested by the literature so far is somewhat ambiguous. Anecdotal evidence on the ground suggests that many regulatory measures unnecessarily raise trade costs in SSA. Border-effect estimates, however, suggest that staple food markets are, by and large, fairly well integrated at least in East Africa where data exists.

In this paper, we follow the price-based strand of the literature and estimate the price-raising effect of NTMs by combining the World Bank's International Comparison Project (ICP) price database with the new TRAINS NTM database. Combining the two datasets, we construct a (country × product) panel of 1'260 observations and run within-product regressions with country effects. Consistent with earlier estimates and with the anecdotal evidence, we find that, on average, SPS measures raise the domestic prices of foodstuffs by about 13% in sub-Saharan Africa. SSA is no outlier in this, with similar price-raising effects observed in other regions, but interaction terms with income suggest that the effect is heavier in low-income countries, possibly reflecting poor or restrictive administration of the regulations. We then use Kenya's household survey to show that, looking only at the effect of NTMs on prices (i.e. ignoring their non-trade objectives) they act like a regressive tax, a reflection of the

prominence of SPS measures in the estimated price effects and the large share of food in poor households' budgets.

ABSTRACT

In spite of widespread tariff reductions, intra-African borders remain "thick". Regional trade is inhibited by inadequate transportation infrastructure, but also by various government-imposed measures. This paper combines price data from the World Bank's International Comparison Project (ICP) with the new TRAINS database on non-tariff measures (NTMs) to estimate their effect on consumer prices for selected consumption products. Results based on panel regressions on 1260 country-product pairs suggest that, after controlling for tariffs, systematic cross-country cost-of-living differences, and product-specific unobservables, SPS measures contribute to raise the price of African foodstuffs by 14%. At the product level, rice and other cereals, some types of meat (e.g. poultry), and edible oils tend to fetch high AVEs. Combining our estimates with data on household expenditure patterns from Kenya's household survey, we show that the effect is regressive, raising the cost of living by 9% for poor households.

JEL Classification: F10, F11, F13, O55
Key Words: Ad-valorem equivalent/ Price-raising impact of non tariff measures, Africa

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CENTRE D'ÉTUDES PROSPECTIVES ET D'INFORMATIONS INTERNATIONALES

ÉVALUER L'AUGMENTATION DES PRIX LIEE AUX MESURES NON-TARIFAIRES EN AFRIQUE

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RESUME NON TECHNIQUE

En Afrique, en dépit de réductions tarifaires conséquentes, les barrières au commerce régional restent importantes comme l'ont notamment montré les études de cas rassemblées dans le rapport de Brenton et Isik (2012). Le faible niveau des infrastructures de transport n'est pas l'unique obstacle. De nombreux exemples résumés dans Gillson (2011) et Charamildes et Gillson (2011) indiquent que les mesures non tarifaires (les MNT), qu'elles soient délibérément protectionnistes ou non, augmentent les coûts et contraignent le commerce régional africain. A côté des mesures usuelles de restriction quantitative et de prohibition, d'autres MNT sont apparues, justifiées par des imperfections de marchés, telles que les mesures sanitaires et phytosanitaires (SPS) ou les normes sur les produits. Mais ces mesures, souvent inadaptées aux besoins de protection des consommateurs comme aux capacités de mise en place par les administrations, génèrent des coûts inutiles.

Au-delà des observations de terrain, on manque de mesures de l'impact des MNT sur les coûts et les conclusions de la littérature portant sur les marchés africains reste ambigüe. Les observations de terrain suggèrent que de nombreuses réglementations non essentielles augmentent les coûts de commerce. Cependant les estimations d'effets frontières indiquent que les marchés des biens alimentaires seraient généralement bien intégrés, du moins en Afrique de l'Est où les données ont permis de le vérifier.

Dans cette étude, nous estimons l'augmentation de prix induite par la présence de MNT en combinant les données prix du International Comparison Project (ICP) de la Banque Mondiale avec la nouvelle base TRAINS sur les mesures non-tarifaires. Nous construisons un panel (pays x produit) de 1 260 observations pour des estimations intra-produits avec des effets pays.

Confirmant les estimations précédentes et les observations sur le terrain, nous trouvons que les mesures SPS augmentent les prix domestiques des biens alimentaires ; ce surcoût est d'environ 13% en moyenne en Afrique subsaharienne. Cet impact sur les prix n'est pas particulier à cette région, mais l'interaction de la présence des mesures SPS avec le niveau de

revenu suggère que l'effet est plus important dans les pays à faible revenu. Ceci pourrait provenir de leur faible capacité de gestion de ces réglementations.

L'enquête ménage réalisée au Kenya nous permet de constater que l'impact des SPS sur les prix agit de manière régressive : il touche particulièrement les ménages à plus faibles revenus qui consomment davantage de biens couverts par différentes SPS. Ainsi ces ménages subissent un surcoût de 9% sur leur panier de biens de consommation.

RESUME COURT

En dépit de réductions tarifaires conséquentes, les barrières aux échanges intra-africains restent importantes. Le commerce régional est contraint par l'insuffisance des infrastructures de transport mais également par diverses mesures de protection non-tarifaire. Cette étude combine les données prix du International Comparison Project (ICP) de la Banque Mondiale avec la nouvelle base TRAINS sur les mesures non-tarifaires pour estimer leur effet (mesuré en équivalent ad valorem : EAV) sur les prix à la consommation d'un certain nombre de produits. Les résultats, sur la base d'une estimation en panel sur 1260 observations produit-pays, suggèrent, après avoir contrôlé pour les tarifs, des différences de coût de la vie entre pays et des effets produits inobservables, que les mesures SPS contribuent à augmenter le prix des biens alimentaires en Afrique de 13%. Au niveau produit, le riz et autres céréales, certaines viandes (volaille) et les huiles de cuisine présentent de très fortes EAV. En combinant nos estimations avec des données sur les dépenses des ménages au Kenya, nous montrons que l'effet est régressif, augmentant de 9% le coût de la vie des ménages les plus pauvres.

Classification JEL : F10, F11, F13, O55
Mots-clefs : Equivalent ad-valorem/ Impact sur les prix des mesures non-tarifaires, Afrique

ASSESSING THE PRICE-RAISING EFFECT OF NON-TARIFF MEASURES IN AFRICA[1]

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1. INTRODUCTION

In spite of widespread tariff reductions, intra-African borders remain "thick", with many hurdles standing in the way of regional trade (see e.g. the essays collected in Brenton and Isik, 2012). Inadequate transportation infrastructure is not the only obstacle. Ample anecdotal evidence summarized in, inter alia, Gillson (2011) and Charalamides and Gillson (2011) suggests that non-tariff measures (henceforth NTMs), whether deliberately protectionist or not, raise trade costs and inhibit regional trade in Africa. However, beyond the anecdotal evidence, little is known about the magnitude of the price-raising effects involved.

Beyond old-style quantitative restrictions (QRs) and bans, even measures that could be potentially justified by market failures like sanitary and phytosanitary (SPS) measures or product standards are often ill-suited to both consumer protection needs and Government monitoring capabilities, generating unnecessary hurdles. For instance, in Kenya each shipment of imported fertilizer must carry a quality certificate from the exporting country's bureau of standards and is further subjected to pre-shipment inspection (Keyser 2012). In Zambia, traders must submit fertilizer samples to the Bureau of Standards ninety days prior to shipment arrival even though quality certificates are never actually issued. Yet, in most countries in sub-Saharan Africa, in spite of the controls counterfeit fertilizers circulate widely, in large part because the adulteration takes place on the domestic market whereas controls are at the border (Gitonga 2004). In some cases, testing requirements are not even remotely related to any plausible concern. For instance, in Tanzania all imports and exports of food products must undergo mandatory testing for radiation contamination by the Tanzania Atomic Energy Commission, which has the capacity to test only 10 to 15 samples a day (Keyser 2012). The result of this proliferation of unnecessary non-tariff measures is, potentially, higher prices hurting low-income households.

Beyond the anecdotal evidence, what do we know about the effect of non-tariff measures (NTMs)? The literature, going back to the work of Baldwin (1975), Feenstra (1984), Deardorff and Stern (1985), Deardorff (1987), Baldwin (1989), Leamer (1990), or Anderson and Neary (1994), to name a few, can be classified into two broad families: quantity-based approaches and price-based ones.

[1] Without implicating them, the authors express their gratitude to Paul Brenton, Ian Gillson, Mariem Malouche and especially Lionel Fontagné for useful comments and suggestions.

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Prominent in the former category is Kee et al. (2009) who ran import equations at the product level (but aggregated over all origins) on factor endowments, tariffs, and NTMs. Algebraic manipulation of the estimates yielded ad-valorem equivalents (AVEs) for the NTMs included as explanatory variables. Because of the limited number of degrees of freedom, only a few explanatory variables could be included on the right-hand side, so NTMs were aggregated into a broad "core NTMs" category.

Price-based approaches consist of estimating AVEs by comparing directly NTM-ridden product prices with the prices of similar products on markets where those products are free of distortions, and can be applied by simple comparison of averages on a case-by-case basis after correction for transport costs and other observables (see Ferrantino 2006 for examples), or econometrically, as in Andriamanjara et al. (2004).

There are several well-known issues with the price-gap approach, discussed in Ferrantino (2006). For instance, many factors including imperfect substitutability or market structure affect prices beyond NTMs, and not all of them can be controlled properly in a regression analysis. In terms of data availability, the key issue for the price-gap approach is the availability and comparability of price data.

Whether estimated through quantity-based or price-based approaches, AVE estimates in the literature vary, with peaks typically higher than tariff peaks. Kee et al. (2009) find averages of 9.2% (simple) and 7.8% (trade-weighted) across 4,545 product-specific regressions. If products with no NTMs are eliminated, AVEs climb to 39.8% and 22.7% respectively. These estimates are somewhat lower than those of Bradford (2003) who finds average AVEs ranging between 7.8% (Canada), 28% (UK) and 52% (Japan). These higher orders of magnitude are comparable to those obtained using price-based methodologies by Andriamananjara et al., although individual estimates vary substantially (for instance, Andriamananjara et al. find a 73% average AVE for apparel). Kee et al. also observe that, unlike tariffs, NTM AVEs tend to rise with income levels, reflecting stiff agricultural NTMs in rich countries.

In the specific case of African markets, the effect of NTMs has recently been estimated by applying so-called "border-effect" approaches inferring the extent of market fragmentation induced by the existence of national borders from untapped price-arbitrage opportunities. For instance, Ihle, Cramon-Traubadel and Zorya (2010) put together a panel of close to 2'000 regional maize prices in East Africa over 2000-2008, combining data from the Eastern Africa Grain Council and from Michigan State University. Using a two-step procedure, they found East African maize markets to be well integrated except for Tanzania, a "rather isolated and internally fragmented island within the customs union of the East Africa Community" (p. 24). Their results are consistent with anecdotal evidence on the prevalence of restrictive and idiosyncratic trade measures in Tanzania (see supra).

Versailles (2012) assembled out of CPI data from national statistical offices a very large database of monthly prices for 24 goods and 39 cities in five East Africa Community (EAC) countries over 2004-2008, resulting in a total of close to one million observations at the (citypair × good × month) level. Let i and j be two cities, k a product and the exchange rate between the currencies used in cities i and j (one if they are in the same country). Versailles uses the "implicit exchange rate" , which deviates from one when the law of one price (LOP) does not apply, as his dependent variable and regresses the absolute value of on distance, country-pair dummies (which may correspond to borders, like for Kenya-Uganda, or to multiple border crossings, like for Kenya-Burundi), nominal exchange rates (to test for incomplete pass-through), and a proxy for non-tariff barriers taken from the World Bank's Doing Business index. Results are very telling. A distance of 100 km between two cities creates a 13% wedge from the LOP. The Burundi-Rwanda border moves prices away from the LOP by 11%, the Kenya-Uganda, by 17%, the Rwanda-Uganda, by 18%. As for the NTB variable, it is highly significant—as are most of the regressors, a reflection of the large sample size—but contributes very little quantitatively to border effects. Interestingly, Versailles uses the fact that his sample period straddles the transformation of the EAC into a customs union to test if that had any impact on departures from the LOP. Only for the Kenya-Uganda border did the customs union reduce departures, i.e. integrate markets. In terms of products, by and large staple foods recorded the smallest departures, suggesting that these markets are the most integrated in East Africa.

Thus, the picture suggested by the literature so far is somewhat ambiguous. Anecdotal evidence on the ground suggests that many regulatory measures unnecessarily raise trade costs in SSA. Border-effect estimates, however, suggest that staple food markets are, by and large, fairly well integrated at least in East Africa where data exists.

Beyond this ambiguity, the estimation of the trade-inhibiting effect of NTMs is constrained by data, which has for a long time been limited largely to three main sources. First, the Geneva-based ITC and a number of researchers (see e.g. Hoekman and Zarrouk 2009 for the North Africa-Middle East region) have collected survey data on exporter perceptions of trade barriers in export countries. Conducted in two waves over July-September 2008 and May 2009 respectively in a set of 11 countries in total, ITC questionnaires were sent to over 7'000 companies in the first wave and 4'400 in the second, with 24% and 39% response rates. Surveys results suggested that sanitary and phytosanitary (SPS) measures on foodstuffs and technical regulations on a wide range of products dominated the concerns of exporters (as opposed to traditional command-and-control measures like QRs and prohibitions). In a recent firm-level survey carried out in five SADC countries cited by Gillson and Charalambides (forthcoming), "roughly 80 percent of the respondents indicated that they faced some form of trade barrier within the region […]. Over half of the respondents indicated that the cost of these was equivalent to 5 percent of the CIF value of the imports/exports. A further 24 percent of respondents indicated a 5-15 percent attribution to trade barriers; and, 23 percent faced increased trade costs of over 15 percent" (p. 4). We will see later on in this paper that the econometric estimation of ad-valorem equivalents (AVEs) of NTMs yields estimates in that range.

Second, the WTO records NTM notifications by member states and is currently developing a portal to access the resulting data. The main limitation of the notifications database is that notification is voluntary, resulting in partial and potentially biased coverage, as measures that risk running afoul of WTO rules or raising objections from trade partners are likely to be under-reported.

Finally, official government data collected by UNCTAD is available in the TRAINS database through the World Bank's WITS portal. As described by Carrère and de Melo (2011), the TRAINS database suffers from several limitations. First and foremost, for most countries it was a one-shot exercise. Second, coverage in terms of countries was incomplete, with only 100 countries reporting any data. Third, coverage in terms of measures was centered on "core" measures (QRs, tariffs and price controls), with less complete coverage of new-type measures like SPS and TBT—precisely those flagged as important in private-sector surveys.

Over the last two years, however, a major effort has been undertaken to replenish the TRAINS database through a collaboration between the World Bank, UNCTAD and the African Development Bank (AfDB). The effort, which has led to the collection of data in 30 countries with broader coverage of measures than in TRAINS under a common, consistent nomenclature, is underway, with some of the data already published on WITS and some still under verification, at the time of writing, by UNCTAD's statistical division. The data is based on double-entry coding of regulatory measures, by type of measure (following a new, detailed nomenclature) and by product (following the HS code at six digits). Thus, at the finest degree of disaggregation, for each country there are notionally 121 possible measures, each of which can be applied to any of 5'959 products. However, there is only one year of data collection (as the new data is not directly comparable to old TRAINS data), so there is no variation in the time dimension as required by border-effect approaches. The present paper is the first attempt to use this data.

As for prices, apart from the new, "specialized" datasets used by Ihle et al. (2010) and Versailles (2012), several partial databases are available. Anderson et al. (2008) compiled a comprehensive database of agricultural prices for a large panel of countries and products. For consumer products, the World Bank's International Price Comparison Project provides price data for 63 tradable product categories (in addition to 42 services) in 146 countries, but for only one year (2005). The Economist Intelligence Unit also collects prices at the city (sub-national) level as a tool to set expatriate compensation. In both cases, only consumer goods are included, and comparability slants the basket toward products that are typically middle-class consumables.

In this paper, we follow the price-based strand of the literature and estimate the price-raising effect of NTMs by combining the World Bank's International Comparison Project (ICP) price database with the new NTM database. Combining the two datasets, we construct a (country × product) panel of 1'260 observations and run within-product regressions with country effects. Consistent with earlier estimates and with the anecdotal evidence, we find that, on average, SPS measures raise the domestic prices of foodstuffs by about 13% in sub-Saharan Africa. SSA is no outlier in this, with similar price-raising effects observed in other regions, but interaction terms with income suggest that the effect is heavier in low-income countries, possibly reflecting poor or restrictive administration of the regulations. We then use Kenya's household survey to show that, looking only at the effect of NTMs on prices (i.e. ignoring their non-trade objectives) they act like a regressive tax, a reflection of the prominence of SPS measures in the estimated price effects and the large share of food in poor households' budgets.

The paper is organized as follows. Section 2 describes the data and some stylized facts. Section 3 discusses estimation issues and results. Section 4 concludes.

2. DATA AND STYLIZED FACTS

2.1. Conceptual issues

Non-tariff measures (NTMs henceforth) are regulatory measures other than tariffs that affect imports or exports. As a prelude to the estimation of how they affect prices, this section discusses logical issues involved in their definition, as the term NTMs covers a wide set of regulatory measures whose form and purposes differ.

Conceptually, several points should be kept in mind when defining NTMs. First, contrary to tariffs, depending on their type, NTMs may apply either to imported goods only, or to both imported and domestically-produced goods. For instance, whereas a quantitative restriction (QR) will apply only to imported goods, a technical regulation will typically apply to both imported and locally-produced goods, since otherwise it would run afoul of GATT Article III (national treatment). This is in principle. In practice, enforcement tends to be concentrated at the border in SSA, so even measures that are nondiscriminatory de jure may affect imports disproportionately.

Second, NTMs apply to products. That is, an environmental regulation that prohibits domestic producers from dumping toxic effluents in a river as part of the production process is not an NTM, even though it may affect trade flows indirectly by raising the domestic producers' production costs and thus their ability to export and compete with imports. The reason for this exclusion is that including all domestic regulations on production in the list of NTMs would extend its scope to the point where everything should be there, at which point it would become unmanageable. Thus, regulations may be trade-relevant but nevertheless not included in NTM inventories.

A third issue is whether, from a normative point of view, NTMs are good or bad for welfare. If the domestic market is competitive, a QR is equivalent to a tariff at a rate inducing the same level of imports. However, it has long been known that, in the presence of market power on the domestic market, the equivalence breaks down, and a QR induces higher deadweight losses (Bhagwati 1968). Worse, the higher prices obtained on the domestic market are not compensated by increased employment, as the domestic monopoly (or oligopoly) holds back employment and output in order to maintain high prices. Thus, unlike a tariff, a prohibition or

QR hands back to domestic producers the market power that international trade would destroy.

Moreover, under a QR the market power extends to the holders of import licenses, who typically align their prices on the monopoly producer's. This type of situation is highly relevant in sub-Saharan Africa where market power is prevalent as small markets can accommodate only a few producers. In some cases, the import licenses themselves are given to the local producer, aggravating the monopolization and creating even stronger vested interests for the maintenance of QRs.

The case of technical regulations and SPS measures is different, as those measures are designed, at least in principle, to address externalities and other market failures. For instance, Rwanda bans the importation of plastic bags for environmental reasons. The reduction in consumer surplus induced by the measure must then be balanced against the reduced externality. In order to assess the welfare effect of such measures, a full cost-benefit analysis should be conducted. In practice, much of the difficulty in applying cost-benefit analysis lies in the evaluation of the monetary equivalent of the externality, which depends on unobserved societal preferences. Those preferences are likely to vary with a host of factors, including income levels. At low income levels, externalities might be less of a priority than at high levels, although very little direct (experimental) evidence is available on this.

In sub-Saharan Africa, casual observation and evidence gathered in Gillson (2011) and Charalamides and Gillson (2011) suggests that technical regulations are frequently designed with little regard to the actual concerns of consumers in terms of externalities and even more importantly to the testing and monitoring capabilities of governments, resulting in unnecessary paperwork and procedures that serve little purpose.

2.2. Quantifying NTMs: The MAST nomenclature

As mentioned in the introduction, data on NTMs is available through a recent data collection effort undertaken jointly by the World Bank, UNCTAD and the African Development Bank. The data consists of tables with HS6 products in rows and NTMs, coded according to the 2009 MAST nomenclature, in columns. It also contains references to the relevant legal texts as well as indications on the issuing and/or enforcing agency. The data has been collected either by national governments under the coordination of regional secretariats, as in Latin America, or by local consultants hired by the World Bank or the African Development Bank in SSA. In the latter case, it has been endorsed by governments through validation workshops held at the end of the data collection process. All of the data that was collected by the World Bank and the AfDB has been forwarded to UNCTAD for posting on WITS, the World Bank's portal for trade data, and is freely accessible. Some of it was, at the time of writing, still under verification by UNCTAD trade specialists.

Given the complexities involved in the definition of NTMs, in order to ensure consistency in data collection across countries, UNCTAD's Group of Eminent Persons adopted in July 2009 an exhaustive list known as the Multi-Agency Support Team (MAST) nomenclature. This nomenclature was revised in January 2012 by the WTO's legal department in order to make it suitable for the notification of measures by member states. The logical structure of the nomenclature, at its highest degree of aggregation, is shown in Figure 1.

Figure 1: The MAST nomenclature of NTM

IMPORT MEASURES	TECHNICAL MEASURES	**A**	SPS measures
		B	Technical regulations
	NON-TECHNICAL MEASURES	**C**	Pre-shipment inspection
		D	Price-control measures
		E	Licenses, quotas, prohibitions and QRs
		F	Charges, taxes & para-tariff measures
		G	*Finance measures*
		H	*Anti-competitive measures*
		I	*TRIMs*
		J	*Distribution restrictions*
		K	*Restrictions on post-sales services*
		L	*Subsidies (excluding export subsities*
		M	*Government producrement restrictions*
		N	*Intellectual property*
		O	*Rules of origin*
		P	Export measures (including export subsidies)

Source: MAST 2009.

Note: NTM data are collected only for categories A–I. The shaded categories J–P are used only to collect information from the private sector through surveys and web portals.

Categories A and B (SPS and TBT measures) are often referred to as "technical" ones. Categories C to O are non-technical ones and cover a mixture of command-and-control types of measures (price controls, quantitative restrictions and prohibitions) and a disparate set of measures. Some, like pre-shipment inspection (category C), are easy to track and affect all products. Some, like taxes and para-tariff measures (category F) are more difficult to track as they are sometimes administered in an untransparent way, serving, in some countries like the Democratic Republic of Congo, to finance low-productivity border-management administrations.

As for measures G to O (in italics), some of them are important and relatively straightforward to identify, like anti-competitive measures, forced channels (category H) and distribution restrictions (J). Some others are very difficult to code at the product level, like TRIMS[2] (I) or

[2] Trade-Related Investment Measures

intellectual property (N). Subsidies (L) are a particularly difficult case because of the loose definition given by the MAST:

> "Financial contribution by a government or government body to a production structure, being a particular industry or company, such as direct or potential transfer of funds (e.g. grants, loans, equity infusions), payments to a funding mechanism and income or price support.
>
> Note: this category is to be further sub-divided after further study on the subject.
>
> *Example: Price of imported wheat is much lower than local wheat because of subsidy given in the exporting country"*

Subsidies are often to certain companies and not to other depending on their location, ownership status (ethnic minorities, special groups and so on), or type (SMEs). It is difficult to track all subsidies granted under the myriad of schemes typically in place to serve various societal purposes, and even more difficult to decide when they are sufficiently prevalent to be ascribed to a particular product.

Rules of origin are in a category of their own, as they apply to certain *origins* rather than certain *products*. Thus, when a country has a preferential arrangement—and practically all countries do—rules of origin apply to all imported products. Thus, including them in the MAST nomenclature gives an appearance of exhaustivity but are difficult to operationalize for quantitative work.

Lastly, export measures (category P) are of growing importance, especially for foodstuffs in times of rising food prices. Gillson (2011) argues that export restrictions in times of high prices contribute to reduce incentives to expand production, and thus make shortages worse both over time (because supply does not react) and across space (as producers in surplus regions are banned from arbitraging price differences, so price spikes in deficit regions are not dampened by increased imports). Thus, export restrictions exert negative regional externalities and increase consumer price volatility.[3]

2.3. NTMs in Africa

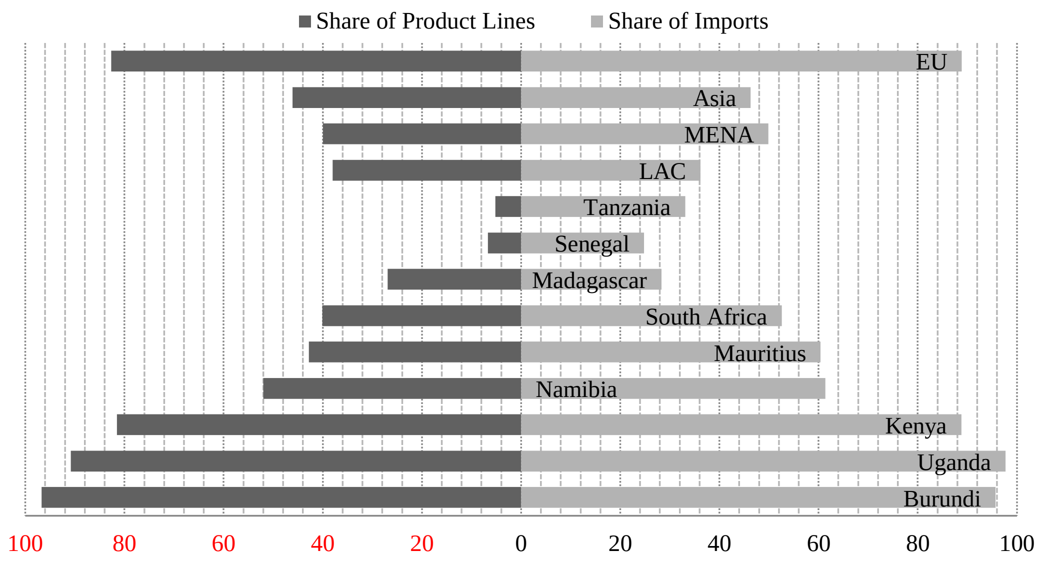
This section provides descriptive statistics on number and types of NTMs related to import flows, using frequency and coverage ratios. The frequency ratio is the proportion of HS6

[3] However, it should be kept in mind that—at least in principle—they reduce producer-price volatility, as local prices co-variate negatively with volumes in autarky, whereas they don't under integrated markets with a given international price.

products[4] covered by at least one type of NTM at the MAST 1-digit (A, B,…) level. The coverage ratio is the proportion of imports (in dollars) covered by at least one type of NTM.[5]

By and large, the proportion of imported goods subject to NTMs is large, as shown in Figure 2, where the LHS shows the proportion of product lines covered by NTMs (the frequency ratio) and the RHS shows the share of imports (the coverage ratio). East African countries have fairly high coverage ratios, with the exception of Tanzania and Madagascar. The E.U. has very high frequency and coverage ratios, as public demand for traceability and product safety is high. One would expect that low-income countries with low monitoring and testing capabilities would be able to handle fewer measures and therefore put fewer on the books. This is not the case, suggesting, as argued by Gillson (2011), that there is some overkill even in "modern-type" measures like SPS and technical regulations. Yet, the data in Figure 2 should be interpreted cautiously, as Tanzania appears as a low-frequency NTM user even though evidence on the ground suggests that it administers NTMs in a restrictive way and border-effect estimates suggest that its markets are insulated from regional ones.

Figure 2: Proportion of HS6 product categories and imports covered by one or more NTM



Source: Authors 'calculations based on TRAINS database

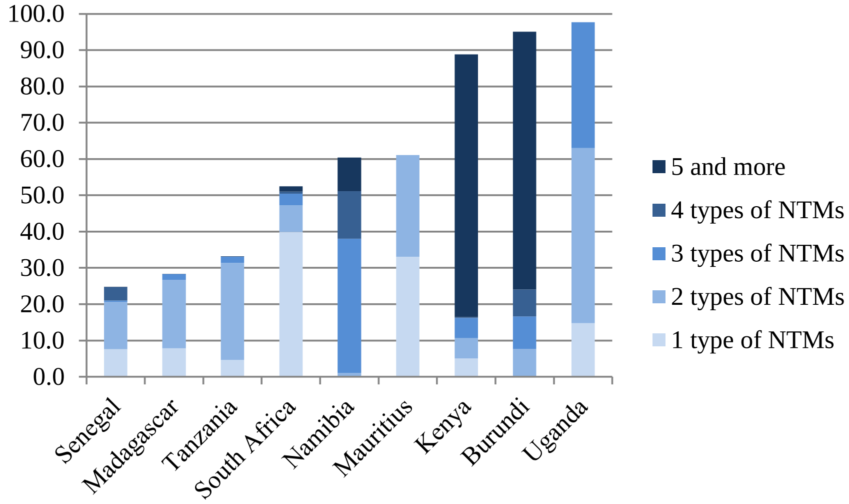
In addition, some countries, like Kenya and Burundi, are characterized by the simultaneous application of many measures (up to five) to the same product, as shown in Figure 3. This

[4] The non tariff measures can affect different tariff lines in the same HS6 product category

[5] These two measures are affected by well-known biases (the frequency ratio "weighs" equally small and large items, whereas the coverage ratio underestimates the restrictiveness of measures because stricter measures on a product reduce its imports and hence its implicit weight, pretty much like in a weighted average tariff).

may well translate into either overly complicated compliance verification processes for traders, or non-enforcement due to an imbalance between the mandate given to enforcement agencies and the resources put at their disposal, a common syndrome in SSA. Again, the data should be interpreted carefully as evidence on the ground suggests that regulatory enforcement is nonexistent in Burundi given the administration's very limited capabilities (see Cadot 2012).

Figure 3: Frequency ratios by number of NTMs applied simultaneously to the same product category



Source: Authors 'calculations based on TRAINS database

Patterns of coverage by type of foodstuff product seem to vary more systematically by country than by product, as shown in Table 1. Madagascar and Senegal have relatively few measures on fats & oils, vegetable products and prepared foods compared to other countries. The case of live animals is special given that a large part of the trade in live animal across African borders is informal and escapes controls, so that measures applied to this category of product are largely notional.

Table 1: Frequency ratios by type of product and country, foodstuffs

	Burundi	Kenya	Madagascar	Mauritius	Namibia	Senegal	South Africa	Tanzania	Uganda
Live Animal	99	78	35	94	91	99	100	33	**19**
Vegetables	88	73	61	81	95	6	89	24	76
Fats & Oil	82	56	5	75	89	9	80	27	84
Prepared Food	93	79	81	89	94	26	89	15	93

Source: Authors 'calculations based on TRAINS database

Table 2: Coverage of foodstuffs by type of measure

	Burundi	Kenya	Madagascar	Mauritius	Namibia	Senegal	South Afric	Tanzania	Uganda
A: SPS	92	75	55	86	63	30	92	16	59
B: TBT	50	61	10		77	32	30	24	56
C: Inspection	34	73	1	3	89	4	25		56
D: Price control		4	18		4	9			
E: QRs			2	21	95	3	2		

Source: Authors 'calculations based on TRAINS database

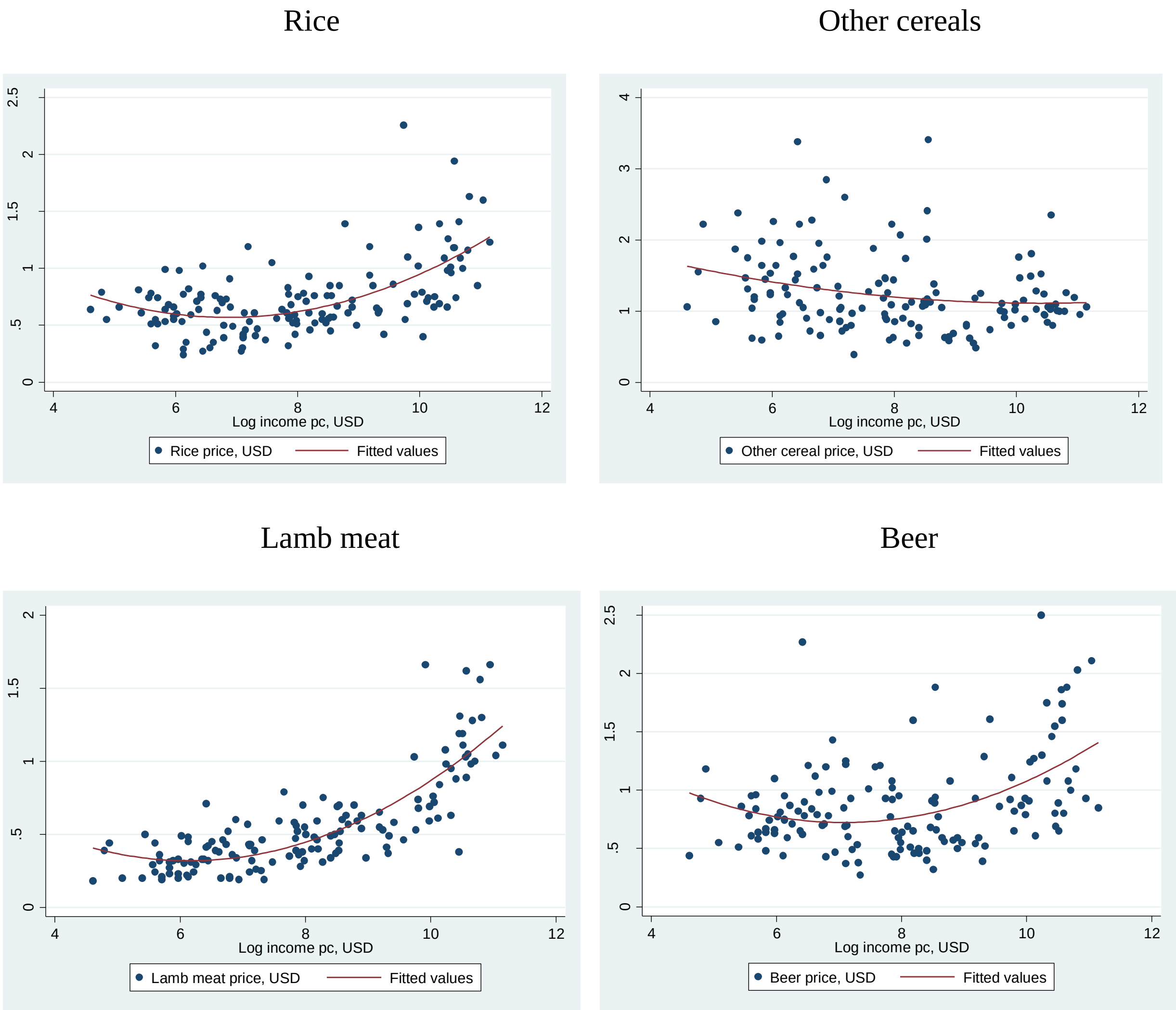
One of the few robust observations coming out of the data is that old-style command-and-control measures (QRs and price controls) have largely receded on the continent, something that is confirmed on the ground (with the possible exception of Namibia). However, Gillson and Charalambides (2012) note that up to one third of intra-SADC trade is still affected by non-tariff barriers notified under the SADC monitoring mechanism, some having to do with transport and logistics, including roadblocks, weighbridges, toll stations, customs and immigration procedures, and transiting (see e.g. Karugia et al. 2009). Gillson (2011) also notes numerous instances of temporary bans, especially on exports, in response to food crises. Thus, the picture should be nuanced in view of the data's incompleteness for a category of measures that is, judging by anecdotal evidence, on the rise.

All in all, the picture that emerges is one where SPS measures and technical regulations have spread while QRs and prohibitions have receded, but this overall picture masks two important stylized facts: (i) Many SPS measures seem to be ill-designed given local monitoring and testing capabilities; (ii) many temporary QRs, on the import and the export side, still disrupt the functioning of regional food markets.

2.4. Prices: The ICP data

The price data used in this paper is from the World Bank's International Comparison Project. Prices are available in local currency units together with 2005 nominal exchange rates for conversion into U.S. dollars. The International Comparison Program (ICP) is a worldwide statistical operation involving some 180 countries. It produces internationally comparable price and volume measures for gross domestic product and its component expenditures. The measures are based on purchasing power parities (PPPs). The complete list of products is given in Appendix 1, Table A1. These price data is at a higher degree of aggregation than the NTM data, so we aggregated NTM dummies (presence) up to ICP product categories generating hence frequency ratios by ICP products. It can be seen that it covers a wide range of goods and services, but at a high degree of disaggregation, and one that is not especially well suited to the analysis of household expenditure in developing countries, as it rather reflects the typical consumption basket of expatriates, like many other price databases for developing countries.[6] Out of all the prices given in Table A1, we kept all items from 1101111 (Rice) to 1103121 (Garments), as well as 1103121 (Garments), 110520 (Household textiles), 110531 (Major household appliances whether electric or not), 110532 (Small electric household appliances), 110540 (Glassware, tableware and household utensils), 110551 (Major tools and equipment), and (110552 Small tools and miscellaneous accessories).

Figure 4: Prices and log of income level



Source: Authors 'calculations based on ICP database

[6] Similar data is available at a high price from the Economist Intelligence Unit.

One major problem is that the coverage of food staples is very poor, with all cereals other than rice bunched into a catch-all “other cereals” category. This is particularly unfortunate given that a product like wheat is affected by an array of restrictive NTMs (import bans, quotas, levies, single-marketing channels and rules of origin on flour) which make it an important observation to ascertain the linkage between NTMs and prices.[7] Yet it is not in the sample because of the aggregation problem. Moreover, no intermediate goods are included, even important ones like fertilizers. Thus, one can only hope for a very crude analysis.

Prices vary systematically with income levels. Figure 4 shows the relationship between a number of them, after conversion to U.S. dollars at current exchange rates, and the log of GDP per capita, also in current dollar at current exchange rates. Interestingly, the relationship is often nonlinear, as shown by the quadratic fit superimposed on the figures, and sometimes nonincreasing, as shown by the case of other cereals.

The cross-sectional relationships between income levels and prices shown in Figure 4 are suggestive of systematic country-specific factors that will need to be controlled for in the econometric estimation of the relationship between NTMs and prices across countries. We now turn to a discussion of this and other estimation issues.

3. ESTIMATION AND RESULTS

We now turn to estimating the relationship between NTM coverage ratios and domestic prices at the product × country level, taking into account systematic differences between products (tariffs and sheer heterogeneity) and countries (cost of living). The hypothesis we test is that NTMs on imports raise domestic prices, although the extent of the price-raising effect may vary across regions, and the focus of our exploration is sub-Saharan Africa, where, as argued earlier, anecdotal evidence on the ground suggests a gap between, on one hand, the widespread use of NTMs and, on the other, the capabilities of enforcement agencies and even the demands of consumers themselves.

3.1. Estimation issues

Our estimation strategy can be thought of as a simple treatment-effect approach where prices are “treated” by NTMs. Assume that prices are determined by the following equation. Let i index countries and k products, let p_k^* be the world price of product k, p_{ik} its price in country i, t_{ik} the tariff imposed by country i on product k,

$$\delta_{ijk} = \begin{cases} 1 & \text{if country } i \text{ imposes an NTM of type } j \text{ on product } k \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

[7] See Gillson and Charalambides (2011) for details.

and λ_i a cost-of-living adjustment factor for country *i* depending on its level of income and a host of other characteristics such as size of the country, landlockedness, remoteness, the quality of the infrastructure, or the regulatory environment.

Let a_j be the cost of complying with NTM type *j* and let us assume, for now, that it is the same everywhere and for all products (we will relax this assumption progressively later on). With full pass-through of tariffs and NTM compliance costs to domestic prices, the basic price-determination equation is[8]

$$p_{ik} = p_k^* \left(1+\lambda_i\right)\left(1+t_{ik}\right)\prod_j \left(1+a_j\delta_{ijk}\right) \tag{2}$$

Putting (2) in logs, we have

$$\ln p_{ik} = \ln p_k^* + \ln\left(1+\lambda_i\right) + \ln\left(1+t_{ik}\right) + \sum_j \ln\left(1+a_j\delta_{ijk}\right) \tag{3}$$

Let $\delta_k = \ln p_k^*$, $\delta_i = \ln\left(1+\lambda_i\right)$, and u_{ik} be an error term. Note that

$$\ln\left(1+a_j\delta_{ijk}\right) = \begin{cases} \ln\left(1+a_j\right) & \text{if } \delta_{ijk} = 1 \\ 0 & \text{if } \delta_{ijk} = 0 \end{cases} \tag{4}$$

so $\ln\left(1+a_j\delta_{ijk}\right) = \delta_{ijk}\ln\left(1+a_j\right)$. Using this, our basic estimation equation is

$$\ln p_{ik} = \delta_k + \delta_i + \alpha \ln\left(1+t_{ik}\right) + \sum_j \beta_j \delta_{ijk} + u_{ik} \tag{5}$$

where δ_k and δ_i are product and country fixed effects and $\beta_j = \ln\left(1+a_j\right)$. The algebraic interpretation of estimated coefficients $\hat{\beta}_j$ is

$$\hat{\beta}_j = \ln\left(1+\hat{a}_j\right)$$

or

$$\hat{a}_j = e^{\hat{\beta}_j} - 1 \tag{6}$$

where $\hat{a}_j$ is the estimated ad-valorem equivalent (AVE) of NTM type *j*.

In (5), α is a pass-through parameter for tariffs: if $\hat{\alpha} = 0.2$, a tariff at 10% translates, on average, into a 2% rise in the domestic price of the affected product. By contrast, the pass-through parameter for NTMs cannot be identified because, unlike tariffs, we do not observe compliance costs. Thus, the estimated AVE for NTMs, $\hat{a}_j$, is the compliance cost's fraction

[8] We also explored an alternative formulation in which effects are not cumulative for QRs (when a QR is binding, other instruments have no effect). Results were similar to those reported in Section 3.2.

that is "passed-through"; if $\hat{a}_j = 0.2$ an NTM imposed on product *k* translates, on average, into a 20% rise in its domestic price across products and countries in the sample.

We also run a variant of (5) using frequency ratios instead of dummy variables to mark the presence of NTMs of each type,[9] the estimating equation becoming

$$\ln p_{ik} = \delta_k + \delta_i + \alpha \ln\left(1+t_{ik}\right) + \sum_j \beta_j c_{ijk} + u_{ik} \tag{7}$$

where c_{ijk} is the frequency ratio of type-*j* NTMs (the proportion of HS6 lines within ICP product *k* that are covered by one or more NTMs of type j).

We also run a constrained form of (5) where $\alpha = 1$ (i.e. assuming full tariff pass-through) by redefining our dependent variable as

$$\ln \tilde{p}_{ik} = \ln p_{ik} - \ln\left(1+t_{ik}\right) \tag{8}$$

The equation then becomes

$$\ln \tilde{p}_{ik} = \delta_k + \delta_i + \sum_j \beta_j \delta_{ijk} + u_{ik} \tag{9}$$

with dummy variables and a similar expression with δ_{ijk} replaced by c_{ijk} when using frequency ratios.

In order to account for heterogeneity and to highlight issues that may be peculiar to, *inter alia*, sub-Saharan Africa, we differentiate the treatment effect by region of the world. Our regions are East Asia and the Pacific (EAP), Latin America and the Caribbean (LAC), Middle East and North Africa (MNA), South Asia (SAS), and Sub-Saharan Africa (SSA).[10] The new equation is then

$$\ln p_{ik} = \delta_k + \delta_i + \alpha \ln\left(1+t_{ik}\right) + \sum_r \sum_j \beta_{jr} \delta_{ijkr} + u_{ik} \tag{10}$$

Given the panel structure of our sample (with products as the panel's "individuals") our base estimator is a within-product estimator with country (δ_i) effects to control for systematic cost-of-living differences across countries. We also cluster standard errors by product so as to allow for any arbitrary pattern of spatial correlation of product prices across countries.[11]

[9] Recall that our price data is at a higher degree of aggregation than the NTM data, so we aggregated NTM dummies up to ICP product categories using frequency ratios.

[10] Regional and country coverage is uneven and non-exhaustive (for instance, Central Asian countries are not included) because of the NTM database's incompleteness.

[11] The justification for doing this can be understood by analogy with conventional treatment-effects estimation. Think of products as "individuals" and countries as "time". Bertrand, Duflo and Mulainathan (2004) show that because of the correlation of the binary treatment variable over time, (zero until the start of the treatment, one thereafter), difference-

3.2. Results

Baseline regression results are shown in Table 3. The first three columns report unconstrained estimates, using either dummy variables as in (5) (column 1), or frequency ratios as in (7) (columns 2 and 3). The last two report constrained estimates as in (9), using either dummy variables (column 4) or frequency ratios (column 5). In specifications (1)-(2) and (4)-(5), we add interaction terms with GDP per capita (in 2005 PPP dollars), using data from the World Bank's World Development Indicators (WDI). In specification (3), we add interaction terms with the proportion of firms having ISO certification, also from the WDI.

The constraint of full pass-through ($\alpha = 1$) is rejected at any level of significance; in fact, there does not seem to be any pass-through of tariffs at all in domestic prices as measured by the ICP. Therefore, from now on, we disregard the constrained version of our price-determination equation.

As for NTMs, there seems to be a significant pass-through of compliance costs for SPS measures, with AVEs of 15% in the first two columns (unconstrained version) using the formula in (6), both significant at 1%. Applying the same formula to frequency ratios (second column), TBT measures have an AVE of 12.5%, significant at 5%.

Interaction terms with income are negative and significant, implying that, across the sample, the level (or pass-through) of compliance costs decreases with income. For instance, using the point estimates in column (1) and recalling that GDP per capita is measured in units of ten thousand dollars, at PPP$1'000 per-capita GDP (the income level of Madagascar), the AVE of type-A measures is

$$\hat{a}\big|_{y=1'000} = e^{(0.141-0.0151)} - 1 = 0.134$$

or 13.4%. At PPP$10'000 (South Africa), the AVE is just zero.

We also find that the proportion of firms with ISO certification interacts negatively with the compliance cost of SPS measures, suggesting that firm adaptability reduces compliance costs, although this effect is quantitatively small and estimated imprecisely.[12]

in-differences regressions will tend to over-reject the null hypothesis, i.e. to be over-optimistic on the existence of treatment effects. In order to correct for this bias, they recommend clustering standard errors by individual so as to allow for any arbitrary pattern of correlation of errors across time. Here, when putting the treatment variable (the presence of NTMs) in binary form, we also create correlation, but now across countries. In order to avoid introducing a bias, we then allow for the correlation of errors across countries for a given NTM.

[12] Interaction terms with a variety of domestic governance measures including various components of the World Bank's CPIA and Doing Business indicators yielded unstable and insignificant estimates, with strongly reduced sample sizes.

Table 3: Baseline regression results

	ln (price)			ln (tariff-corrected price)	
	(1)	(2)	(3)	(4)	(5)
ln (tariff)	0.006	0.004	0.017		
	(0.33)	(0.25)	(0.92)		
NTM type					
NTM A (SPS)	0.141	0.143	0.158	-0.037	-0.002
	(3.10)***	(3.03)***	(2.54)**	(0.52)	(0.03)
NTM B (TBT)	0.005	0.118	0.077	-0.025	0.104
	(0.14)	(2.35)**	(1.08)	(0.32)	(0.91)
NTM C (PSI & formalities)	0.062	0.088	0.113	0.076	0.050
	(0.88)	(1.11)	(1.22)	(0.68)	(0.36)
NTM D (price measures)	0.035	-0.046	-0.076	-0.027	0.100
	(1.09)	(0.71)	(0.69)	(0.22)	(0.44)
NTM E (QRs)	-0.085	-0.083	-0.082	-0.034	0.145
	(2.19)**	(1.14)	(0.86)	(0.31)	(0.70)
Interaction terms:	with GDP/capita a/		With iso certif. b/	with GDP/capita a/	
NTM A (SPS)	-0.151	-0.189	-0.008	0.112	0.090
	(2.27)**	(2.55)**	(1.77)*	(0.86)	(0.58)
NTM B (TBT)	0.010	-0.157	-0.006	0.149	0.010
	(0.20)	(2.39)**	(1.35)	(1.13)	(0.06)
NTM C (PSI & formalities)	-0.023	-0.082	-0.001	-0.128	-0.141
	(0.30)	(1.09)	(0.34)	(0.93)	(0.82)
NTM D (price measures)	-0.046	0.013	0.001	-0.235	-0.330
	(1.03)	(0.13)	(0.14)	(1.53)	(1.27)
NTM E (QRs)	0.121	0.122	0.005	0.007	-0.041
	(2.02)**	(1.47)	(0.92)	(0.04)	(0.17)
Constant	-0.518	-0.347	-0.030	-3.421	-2.955
	(6.73)***	(4.34)***	(0.30)	(26.42)***	(15.33)***
Observations	1260	1260	1218	1260	1260
Number of groups (products)	42	42	42	42	42
Fixed effects					
Product	yes	yes	yes	yes	yes
Country	yes	yes	yes	yes	yes
R-squared (within)	0.34	0.34	0.35	0.46	0.46

a/ GDP per capita measured in $10'000 for readability of coefficients.
Robust t-statistics clustered by product in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%

So far, our formulation allows for price heterogeneity across products and countries (through fixed effects) but not for heterogeneity of *treatment effects* across products or countries. That is, the coefficients on NTMs are not allowed to vary across products or countries. In order to explore heterogeneity of effects across regions, Table 4 reports estimates from a regression run using NTM dummies interacted with five region dummies. In order to obtain unbiased estimates, NTM types were also included linearly in the regression and country fixed effects were included (as well as product fixed effects).

In order to save space, Table 4 includes only the coefficients of interest. For robustness, a similar regression was run using frequency ratios and yielded similar point estimates.[13] Estimates vary substantially across regions, with SPS measures have a significant price-raising effect only for East Asia & the Pacific (EAP) and sub-Saharan Africa (SSA), with a stronger effect in EAP (22% applying formula (6) to the coefficient in) than in SSA (14%). PSI is found to have a 14% AVE, significant at 10%, in South Asia. The estimated effect of NTMs D and E is sometimes negative, but the number of observations on these measures is small, as these measures have largely been phased out (see Section 2), and estimated effects on them should be interpreted cautiously.

The significant price effect of SPS measures in SSA confirms the factual analysis of Charalambides and Gillson (2011) who argue that SPS measures in sub-Saharan Africa tend to be "nuisance regulations" affecting the cost of living, and estimated AVEs are in a plausible range.

Table 4: Parameter estimates, effect of NTMs by region

NTM dummies	EAP a/	LAC b/	MNA c/	SAS d/	SSA e/
NTM A (SPS)	0.201	-0.015	0.006	-0.044	0.129
	(3.39)***	(0.42)	(0.11)	(0.49)	(3.02)***
NTM B (TBT)	0.030	-0.021	0.089	0.087	-0.033
	(0.51)	(0.67)	(1.13)	(0.87)	(0.87)
NTM C (PSI & formalities)	0.009	0.062	-0.045	0.131	0.096
	(0.13)	(1.61)	(0.68)	(1.92)*	(1.40)
NTM D (price measures)	-0.137	-0.015	0.119	-0.278	0.024
	(2.11)**	(0.34)	(1.39)	(2.09)**	(0.54)
NTM E (QRs)	-0.126	0.046	0.024	-0.153	0.045
	(2.34)**	(1.11)	(0.32)	(2.07)**	(0.46)

a/ East Asia & the Pacific; b/ Latin America and the Caribbeans; c/ Middle East & North Africa; d/ South Asia; e/ Sub-Saharan Africa. All estimates from single fixed-effects regression; country and product FE included, standard errors clustered at product level. Robust t-statistics clustered by product in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%

In Table 5, we extend the analysis to the count of NTMs applied at the product level, by type (using the finer, 2-digit disaggregation of the MAST nomenclature). The results are weak, suggesting that several measures of a given type do not add up to a larger burden on traders, presumably because as long as they are of the same type they are likely to be enforced by the same or similar government agencies and to involve similar type of paperwork and proof of compliance.

[13] Results from this alternative regression are not reported for the sake of space. They are available from the authors upon demand.

In order to get a rough idea of what AVEs would look like if we were to differentiate them by product and country, here we generate AVEs at the level of (country × product) pairs in two steps. First, we include in the regression a full vector of interaction terms between NTM types and country dummies; in order to save on degrees of freedom, we include only NTMs of type A (SPS) for which the previous round of estimation gave significant estimates. Thus, our estimating equation becomes

$$\ln a_{iAk} = \beta\left(\delta_i I_{iAk}\right) + \delta_i + \delta_j + \delta_k + u_{ik} \qquad (11)$$

where c_{ik} now designates the frequency ratio of SPS measures only on product *k* in country *i*. The increase in the log of the price of product *k* in country *i* attributable to SPS measures is

$$\ln \hat{a}_{ik}\big|_{c=c_{ik}} - \ln \hat{a}_{ik}\big|_{c=0} = \hat{\beta} c_{ik} \qquad (12)$$

which gives AVEs given in Table 6. It can be seen that some of them are quite substantial in Kenya, e.g. on rice, poultry, beer, cereals and flours other than wheat and rice, sugar, and various types of meat. In Uganda, rice and cereals other than wheat and rice also stand out for their high AVEs.

All in all, it is fair to say that AVEs generated by SPS measures stand out as the most precisely estimated and that, while not prohibitive, they are substantial, in particular in view of how important is food in the cost of living for many households in the lower tail of the income distribution in SSA.

Table 5: AVE estimation results using number of NTMs per product

	ln (price)	ln (tariff-corrected price)
	(1)	(2)
ln (tariff)	0.009	
	(0.50)	
NTM type		
NTM A (SPS)	0.019	-0.002
	(2.44)**	(0.03)
NTM B (TBT)	0.097	0.104
	(3.18)***	(0.91)
NTM C (PSI & formalities)	-0.044	0.050
	(0.66)	(0.36)
NTM D (price measures)	-0.002	0.100
	(0.02)	(0.44)
NTM E (QRs)	0.001	0.145
	(0.03)	(0.70)
Interaction terms (GDP/capita)		
NTM A (SPS)	-0.034	0.090
	(1.86)*	(0.58)
NTM B (TBT)	-0.134	0.010
	(3.22)***	(0.06)
NTM C (PSI & formalities)	0.055	-0.141
	(0.74)	(0.82)
NTM D (price measures)	-0.004	-0.330
	(0.04)	(1.27)
NTM E (QRs)	0.022	-0.041
	(0.47)	(0.17)
Constant	-0.810	-2.955
	(7.24)***	(15.33)***
Observations	1260	1260
Number of groups (products)	42	42
Fixed effects		
Product	yes	yes
Country	yes	yes
R-squared (within)	0.34	0.46

Robust t-statistics clustered by product in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: Country × product price effects, Kenya and Namibia

Kenya	SPS (A)	**Namibia**	QR (E)
Rice	42.10	Coffee	41.16
Bread	42.10	Mineral waters	41.16
Other bakery products	42.10	Tobacco	41.16
Poultry	42.10	Rice	41.16
Fresh milk	42.10	Other cereals and flour	41.16
Cheese	42.10	Bread	41.16
Spirits	42.10	Other bakery products	41.16
Beer	42.10	Pasta products	41.16
Other cereals and flour	38.73	Beef and veal	41.16
Frozen	37.89	Pork	41.16
Lamb	37.46	Lamb	41.16
Coffee	36.62	Poultry	41.16
Sugar	36.20	Other meats and preparations	41.16
Other meats and preparations	35.78	Fresh or frozen fish and seafood	41.16
Fresh or chilled fruit	34.94	Fresh milk	41.16
Confectionery	34.52	Cheese	41.16
Beef and veal	34.10	Eggs and egg-based products	41.16
Pasta products	33.68	Butter and margarine	41.16
Fresh or chilled vegetables	33.26	Other edible oils and fats	41.16
Frozen or preserved vegetables	33.26	Frozen	41.16
Tobacco	32.83	Fresh or chilled vegetables	41.16
Preserved fish and seafood	32.83	Fresh or chilled potatoes	41.16
Preserved milk and milk products	32.83	Frozen or preserved vegetables	41.16
Other edible oils and fats	29.47	Sugar	41.16
Fresh or frozen fish and seafood	28.20	Jams	41.16
Butter and margarine	28.20	Confectionery	41.16
Jams	28.20	Spirits	41.16
Wine	28.20	Wine	41.16
Mineral waters	27.36	Beer	41.16
Eggs and egg-based products	25.26	Fresh or chilled fruit	40.33
Fresh or chilled potatoes	21.05	Preserved fish and seafood	39.51
Pork	18.10	Preserved milk and milk products	36.63
		Clothing materials and accessories	21.40
		Household textiles	20.58
		Footwear	18.93
		Major tools and equipment	15.64
		Garments	13.17
		Glassware	10.70
		Small electric household appliances	5.76
		Small tools and miscellaneous accessories	5.76

Table 6 (continued): Country × product price effects, Uganda and South Africa

Uganda	SPS (A)	**South Africa**	QR (E)
Tobacco	29.90	Fresh or chilled potatoes	64.35
Rice	29.90	Other edible oils and fats	2.57
Other cereals and flour	29.90		
Bread	29.90		
Other bakery products	29.90		
Pasta products	29.90		
Sugar	29.90		
Jams	29.90		
Confectionery	29.90		
Spirits	29.90		
Wine	29.90		
Beer	29.90		
Other edible oils and fats	29.30		
Fresh or chilled fruit	29.30		
Fresh or chilled vegetables	29.00		
Frozen	28.40		
Frozen or preserved vegetables	28.10		
Mineral waters	26.91		
Preserved fish and seafood	16.74		
Other meats and preparations	16.44		
Coffee	11.96		

3.3. Impact on household expenditures: An illustrative calculation for Kenya

We now explore the implications of our results for the cost of living across the distribution of income in one particular country, Kenya. To do this, we will combine our AVEs with household expenditure data from Kenya's household survey (HHS) and calculate the increase in the cost of living induced by SPS measures across the income distribution.[14] The principle behind our calculation is this. For urban households, price-raising NTMs increase the cost of goods purchased, so they act as a tax, which is supposed to be balanced by the reduction of some externality. Absent experimental evidence on the willingness to pay for the reduction of negative externalities, we can only look at the tax side. Needless to say, a proper cost-benefit analysis of NTMs should also quantify the externality reduction, although it lies outside the scope of this paper.

For rural households, we assume that production methods for auto-consumption or for domestic sales are not affected by SPS measures which, as discussed in the introduction, are essentially enforced at the border; or if they are, the rise in the price of the product just compensates for the compliance cost, so there is no net change in profits or income on the

[14] We obtained Kenya's HHS from the World Bank. It is particularly well suited to the type of calculation we perform as it clearly distinguishes between food purchases and auto-consumption.

production side. The only channel that is left is the consumption channel for net buyers, for which the effect is the same as for urban households. Thus, we calculate only a consumption effect and we calculate it on net (market) purchases excluding self-consumption.

Let *i* denote a Kenyan household, ℓ a product defined according to the HHS nomenclature, which is typically more aggregated than HS6 (the trade nomenclature at the level of which trade flows and NTMs are defined), and *k* a product at HS6. Let $\bar{a}_\ell = \sum_k \hat{a}_{k\ell} / n_\ell$ be the simple average of the estimated AVEs of NTMs imposed on all HS6 products *k* belonging to HHS category ℓ, and ω_ℓ^i the weight of product ℓ in household i's consumption basket. We defined a consumption-weighted AVE of SPS measures imposed on household i's consumption basket as

$$a^i = \sum_\ell \omega_\ell^i \bar{a}_\ell \tag{13}$$

Our approach consists in calculating averages of this magnitude at each centile of the income distribution.

3.3.1. Consumption patterns and NTM incidence

Table 7 shows differences in household expenditure patterns across quintiles of the income distribution, from the 20% poorest (Q1) to the 20% richest (Q5). Unsurprisingly, the share of food and even more the share of food auto-consumption decreases with income.

Table 7: Distribution of household expenditure shares, by income quintile (%)

Group	Food Auto-Cons	Food purchased	Non food item	Services	**Good purchased**
Q1	32.9	40.7	13.0	13.3	53.7
Q2	27.0	40.6	15.6	16.8	56.2
Q3	22.2	40.1	18.2	19.5	58.3
Q4	18.1	37.3	20.4	24.2	57.7
Q5	9.1	22.2	22.8	45.9	45.0

Source: Authors 'calculations based on Kenya Household Survey

Note: Q1 is the bottom quintile, Q5 is the top. Numbers are percentage expenditure shares; lines add up to 100%.

Appendix A2 Table A2a shows detailed expenditure patterns. In particular, Tables A2b and A2c show, for each item, the number and frequency of NTMs by type: SPS (A); TBT (B); Inspection (C); Price Control (D) and Quantity Control (E).

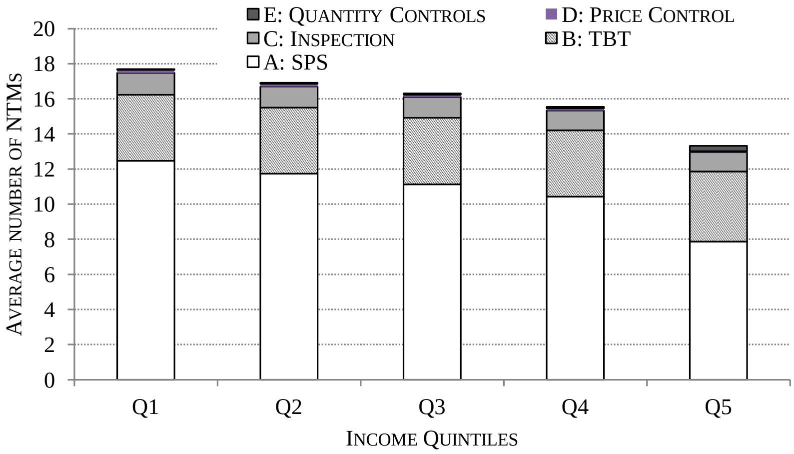
Let $\bar{n}_\ell$ and $\bar{c}_\ell$ be the respectively the average number and frequency ratio of NTMs imposed on HHS product category ℓ. Following the logic of equation(13), we define consumption-weighted NTM numbers and frequency ratios as

$$n^i = \sum_\ell \omega_\ell^i \bar{n}_\ell \quad (14)$$

and
$$c^i = \sum_\ell \omega_\ell^i \bar{c}_\ell \quad (15)$$

respectively. Figure 5 and Figure 6 plot quintile averages of these two numbers across the distribution of income. Figure 5 shows that the number of measures goes down with income, essentially because of the weight of SPS measures in the total.

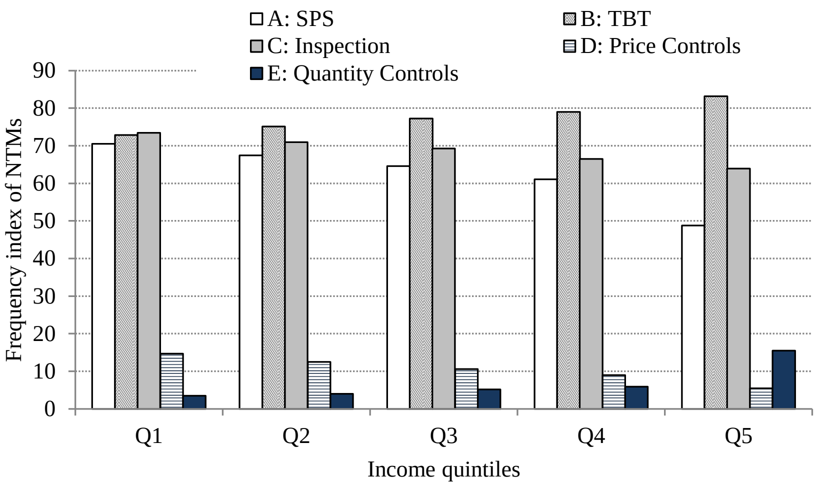
Figure 5: Average number of NTMs faced, by income group



Source: Authors 'calculations based on Kenya Household Survey

Figure 6 shows a more complex picture in terms of frequency ratios. Whereas SPS frequency ratios go down with income (because the weight of food goes down), frequency ratios for TBT measures (product standards other than for sanitary reasons) and QRs go up.

Figure 6: Frequency index of NTMs faced by income group



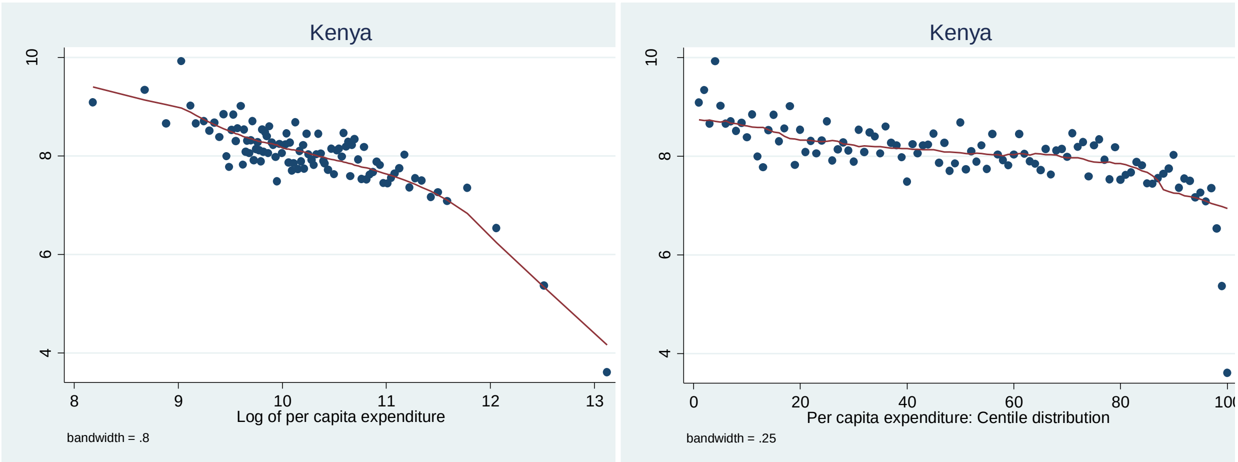
Source: Authors 'calculations based on Kenya Household Survey

3.3.2. Consumption-weighted AVEs

Here we merge the price gap exercise from the previous part with the household consumption by applying (13) on parameter estimates from Figure 7 These all concern foodstuffs, as coefficients on SPS measures were the only ones significantly different from zero. The result is plotted using a smoother regression[15] of the average value of a^i for each centile of the income distribution against the log of that centile's average income in panel (a), and on that centile's number (from 1 to 100) in panel (b).

Figure 7: Price-raising effect of SPS faced by Kenyan households

(a) on log income (b) on centiles of the income distribution



Both panels show that the incidence of SPS measures is regressive in Kenya, with consumption-weighted average AVEs going down from about 9% for the 5th centile to 7% for the 95th centile. This is a direct consequence of the decreasing weight of foodstuffs in household expenditure patterns. Again, it is worth stressing that this calculation is only half the story, as SPS measures are supposed to protect consumers from externalities (health hazards), and there is no particular reason to assume that benefits go up with income. However, if SPS measures are enforced arbitrarily with little relation with real issues on the ground, as suggested by the anecdotal evidence, they are regressive.

4. CONCLUDING REMARKS

Our results are very preliminary and should be interpreted with many caveats, the first and foremost being that the degree of disaggregation of the product nomenclature on which we base our AVE calculations (which construct the dependent variable) is much too coarse to

[15] A "smoother regression" is a set of linear regressions estimated observation by observation over moving windows. The advantage of this procedure is that it allows for highly nonlinear patterns, as it imposes no a priori functional form.

match the degree of disaggregation of the NTM database. This is an area where further, systematic data collection is urgently needed.

Notwithstanding the data limitations, results corroborate the factual analysis of Gillson (2011) and Charalambides and Gillson (forthcoming). Whereas SPS measures are generally those with the strongest rationale in terms of addressing potential market failures, in Sub-Saharan Africa they seem to be designed and implemented in a way that makes them cumbersome and costly. In Kenya, our estimation suggests that they raise the cost of living by about 9% for poor households, a non-trivial effect.

This of course does not mean that SPS measures should be abolished, as the observed effects should be sized against non-trade or non-economic objectives. Rather, our results suggest that SPS measures deserve policy attention in terms of improving design and implementation. In view of the evidence on the ground, the direction of improvement is clear: Systematic inspections should be replaced by risk profiling (on this, see e.g. Grigoriou 2012); paperwork should be simplified and consolidated into single forms made available online, and when testing is strictly necessary, it should as much as possible be outsourced to licensed private labs, as government-run standards bureaus rarely have the resources and capabilities to fulfill useful technical/testing functions in sub-Saharan Africa.

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APPENDIX

Table A1: The ICP products & services nomenclature

1101111 Rice	110723 Maintenance and repair of personal transport equipment
1101112 Other cereals and flour	110724 Other services in respect of personal transport equipment
1101113 Bread	110731 Passenger transport by railway
1101114 Other bakery products	110732 Passenger transport by road
1101115 Pasta products	110733 Passenger transport by air
1101121 Beef and veal	110734 Passenger transport by sea and inland waterway
1101122 Pork	110735 Combined passenger transport
1101123 Lamb, mutton and goat	110736 Other purchased transport services
1101124 Poultry	110810 Postal services
1101125 Other meats and preparations	110820 Telephone and telefax equipment
1101131 Fresh or frozen fish and seafood	110830 Telephone and telefax services
1101132 Preserved fish and seafood	110911 Audio-visual, photographic and information processing equipment
1101141 Fresh milk	110914 Recording media
1101142 Preserved milk and milk products	110915 Repair of audio-visual, photographic and information processing equipment
1101143 Cheese	110921 Major durables for outdoor and indoor recreation
1101144 Eggs and egg-based products	110931 Other recreational items and equipment
1101151 Butter and margarine	110933 Gardens and pets
1101153 Other edible oils and fats	110935 Veterinary and other services for pets
1101161 Fresh or chilled fruit	110941 Recreational and sporting services
1101162 Frozen, preserved or processed fruits	110942 Cultural services
1101171 Fresh or chilled vegetables	110943 Games of chance
1101172 Fresh or chilled potatoes	110950 Newspapers, books and stationery
1101173 Frozen or preserved vegetables	110960 Package holidays
1101181 Sugar	111000 Education
1101182 Jams, marmalades and honey	111110 Catering services
1101183 Confectionery, chocolate and ice cream	111120 Accommodation services
110119 Food products n.e.c.	111211 Hairdressing salons and personal grooming establishments
110121 Coffee, tea and cocoa	111212 Appliances, articles and products for personal care
110122 Mineral waters, soft drinks, fruit and vegetable juices	111220 Prostitution

Table A1 (continued)

1102111 Spirits	111231 Jewellery, clocks and watches
1102121 Wine	111232 Other personal effects
1102131 Beer	111240 Social protection
110220 Tobacco	111250 Insurance
1103111 Clothing materials and accessories	111261 FISIM
1103121 Garments	111262 Other financial services n.e.c
1103141 Cleaning and repair of clothing	111270 Other services n.e.c.
1103211 Footwear	111300 Net purchases abroad
1103221 Repair and hire of footwear	130221 Compensation of employees
110410 Actual and imputed rentals for housing	130222 Intermediate consumption
110430 Maintenance and repair of the dwelling	130223 Gross operating surplus
110440 Water supply and miscellaneous services relating to the dwe	130224 Net taxes on production
110442 Miscellaneous services relating to the dwelling	130225 Receipts from sales
110451 Electricity	130421 Compensation of employees
110452 Gas	130422 Intermediate consumption
110453 Other fuels	130423 Gross operating surplus
110511 Furniture and furnishings	130424 Net taxes on production
110512 Carpets and other floor coverings	130425 Receipts from sales
110513 Repair of furniture, furnishings and floor coverings	140111 Compensation of employees
110520 Household textiles	140112 Intermediate consumption
110531 Major household appliances whether electric or not	140113 Gross operating surplus
110532 Small electric household appliances	140114 Net taxes on production
110533 Repair of household appliances	140115 Receipts from sales
110540 Glassware, tableware and household utensils	150110 Metal products and equipment
110551 Major tools and equipment	150120 Transport equipment
110552 Small tools and miscellaneous accessories	150210 Residential buildings
110561 Non-durable household goods	150220 Non-residential buildings
1105621 Domestic services	150230 Civil engineering works
1105622 Household services	150300 Other products
110611 Pharmaceutical products	160000 Change in inventories and valuables
110612 Other medical products	180000 Balance of exports and imports
110613 Therapeutical appliances and equipment	
110621 Medical Services	
110622 Dental services	
110623 Paramedical services	
110630 Hospital services	
110711 Motor cars	
110712 Motor cycles	
110713 Bicycles	
110722 Fuels and lubricants for personal transport equipment	

Table A2a: share of items in total good purchased, by income quintile (%)

Group	Bread & Cereals	Bananas & Tubers	Poultry	Meats	Fish	Dairy	Oils & Fats	Fruits	Vegetables	Pulses (beans & peas)	Sugar, jam honey , chocolate	Non alacoolic beverages
Q1	19.6	2.8	0.1	4.2	2.6	7.1	5.1	1.4	8.1	4.6	12.1	2.6
Q2	16.1	3.0	0.3	6.2	2.2	7.8	4.1	2.0	7.5	4.3	10.3	2.6
Q3	14.3	3.1	0.3	7.4	2.1	7.2	3.6	2.4	7.2	4.1	8.3	2.6
Q4	12.2	3.4	0.7	8.1	2.0	6.7	3.2	2.6	6.6	3.8	6.8	2.6
Q5	6.6	2.3	1.3	7.4	1.7	6.3	2.3	3.1	5.0	2.4	3.6	2.5

Group	Other Food	Tobacco	Clothing & Footwear	Furnishing & routine hh	small appliances	large appliances	school supplies	medication	other	Total
Q1	5.5	2.0	8.9	5.3	0.2	1.2	0.3	1.6	4.8	100.0
Q2	5.8	1.7	11.8	5.1	0.6	1.3	0.3	1.4	5.5	100.0
Q3	6.0	1.7	13.9	4.7	1.1	2.4	0.4	1.4	5.6	100.0
Q4	5.8	1.8	17.1	4.3	1.8	2.8	0.7	1.4	5.4	100.0
Q5	4.8	1.0	20.0	4.4	2.2	13.0	1.2	1.7	7.1	100.0

Table A2b: Number of NTMs for each item, by type of NTM

Group	Bread & Cereals	Bananas & Tubers	Poultry	Meats	Fish	Dairy	Oils & Fats	Fruits	Vegetables	Pulses (beans & peas)	Sugar, jam honey , chocolate
Num A	17.6	15.6	14.7	12.4	12.2	13.7	13.8	16.5	15.9	18.5	16.5
Num B	4.9	4.6	3.6	3.0	4.0	5.0	0.1	4.8	4.4	5.3	0.7
Num C	1.8	1.5	1.0	0.9	1.6	1.7	0.7	1.6	1.5	1.7	0.9
Num D	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Num E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Group	Non alacoolic beverages	Other Food	Tobacco	Clothing & Footwear	Furnishing & routine hh	small appliances	large appliances	school supplies	medication	other
Num A	16.0	15.4	12.4	0.0	0.3	0.0	0.0	0.0	5.8	1.9
Num B	5.5	5.7	5.4	1.9	3.8	5.7	6.2	2.0	4.8	4.6
Num C	1.7	1.7	1.6	0.0	0.9	1.6	1.8	0.0	0.8	0.8
Num D	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.9	0.0
Num E	0.0	0.0	0.0	0.0	0.4	1.6	1.8	0.0	0.0	0.1

Table A2c: Frequency of NTMs for each item, by type of NTM (%)

Group	Bread & Cereals	Bananas & Tubers	Poultry	Meats	Fish	Dairy	Oils & Fats	Fruits	Vegetables	Pulses (beans & peas)	Sugar, jam honey , chocolate
Freq A	93.7	75.0	100.0	84.6	82.4	84.6	75.3	81.4	76.9	88.9	78.9
Freq B	92.1	75.0	100.0	83.1	82.4	84.6	2.5	75.7	69.2	85.2	10.5
Freq C	92.1	75.0	100.0	84.6	82.4	84.6	71.6	80.0	76.9	88.9	78.9
Preq D	25.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.4
Freq E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Group	Non alacoolic beverages	Other Food	Tobacco	Clothing & Footwear	Furnishing & routine hh	small appliances	large appliances	school supplies	medication	other
Freq A	82.8	88.0	77.8	0.0	9.1	0.0	0.0	0.0	88.9	62.5
Freq B	82.8	86.0	77.8	96.3	82.7	82.0	88.5	100.0	97.2	95.8
Freq C	82.8	86.0	77.8	0.0	49.1	82.0	88.5	0.0	77.8	70.8
Preq D	0.0	0.0	0.0	0.0	12.7	0.0	0.0	0.0	47.2	0.0
Freq E	0.0	0.0	0.0	0.0	35.5	82.0	88.5	0.0	0.0	8.3

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