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Botswana regional report

Implementation of the International Standard on Phytosanitary Measures, ISPM 15 (Regulation of wood packaging material in international trade): An empirical analysis of how the regulation affects the economy of a group of countries in Africa

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1. Introduction to the Botswana report

Botswana started to implement the ISPM 15 in 2006; the Government of Botswana has put in place two legislations related to the management of plant pests. The first legislation -the Plant Protection Act- has been emanated in 2009, while the second one -the Agrochemicals Act- has been emanated before the standard implementation, in 2000. Although Botswana has had proper regulations in place for several years, the lack of resources has inhibited the enforcement of the legislations on several aspects, and mostly at a practical level.

The local NPPO, which is part of the Ministry of Agriculture and Food Security, is the organization responsible for the management of plant pests and for setting up the procedures needed for the implementation of ISPM 15. In practice, NPPO actions have been limited. As an example, the inspections of consignments entering into the country, as well as of those leaving the country, are rarely done. If the inspections do happen, they are carried out completely at random as there is no manual that may guide the inspectors.

The primary reason why Botswana decided to implement and comply with ISPM 15 was to protect the country against the introduction of foreign pests. However, while this was the primary reason, the NPPO depended on customs for inspections at points of entry and only recently posted phytosanitary inspectors to inspect consignments coming into the country.

Since ISPM 15 was implemented in 2006, only one WPM treating facility has been operating in the country. The facility treats WPM using MB, and there is no plan in place as to what will happen when MB will be banned for quarantine purposes too. The NPPO is obliged to inspect the facility regularly, just as it is responsible for ensuring that inspections are carried out, but none of those controls are effectively enforced by the NPPO.

The Botswana report looks specifically at the implementation of the ISPM 15, its effect at the trade level and the costs and the benefits of the standard implementation at the WPM treating facilities point of view. The report is organized in the following way; next section sets out the context of the analysis by describing the effects –both at the economic and non-economic level- of standards for trade. Section 3 deals with the description of the qualitative component of the research. It reports the content of a number of qualitative interviews with private and public stakeholders and it highlights the main implementation challenges the country faced. Section 4 describes the macroeconomic analysis to see whether the standard implementation has had any effects at the trade level. The analysis points out which economic sectors have gained and which have lost in the international markets in the aftermath of the standard implementation. Section 5 looks at the viability –i.e. it compares the costs and the benefits- of the standard implementation from the point of view of the WPM treating facilities. The section looks at the costs and at the revenues the treating facilities face when treating WPMs.

2. Context and Framework of the Analysis

There are many environmental measures nowadays that help us regulate the impact of a diverse range of human activities on the environment. In many domains of environmental protection (such as air and water quality, provision of ecosystem services, climate stability), markets are not sufficient alone to regulate the extent of environmental degradation that affects welfare in a non-excludable and non-rival manner. In other words, market mechanisms cannot reduce the extent of "public bads", since it is often prohibitively expensive to exclude certain individuals alone from the welfare costs of environmental damage, while the disutility and displeasure experienced by any individual is independent of the one experienced by others. These are typically referred to as the case of "missing markets", where those contributing to environmental damage and those demanding a reduction of it do not physically meet to negotiate solutions to the problem, in the form of appropriate compensation mechanisms or other implicit pricing. In such cases, negative environmental externalities often affect other individuals than the ones generating them and policymakers need to intervene in order to limit environmental degradation.

On many occasions, policymakers resort to market-based instruments to control for the levels of environmental pollution and degradation (Pirard, 2012). This rather heterogeneous group of policy instruments incorporate a price component that aims at incentivizing (or disincentivizing) certain behaviors through the provision of financial rewards and penalties. Charges and taxes on pollution or environmentally-destructive activities increase the price of goods and services that result in pollution or excessive resource use. These can be applied per item (e.g. plastic bag levies) or based on measurable environmental parameters (e.g. a tax linked to the carbon intensity of fuels). Using financial penalties is a similar mechanism that goes a step further by implicitly "criminalizing" certain unsustainable behaviors and imposing monetary penalties to those deviating from the pre-defined "status quo". Instead of imposing charges that limit but nevertheless legitimize a certain activity, financial penalties treat non-compliant behavior as an environmental offence (e.g. a fine imposed on those discharging waste in a water source or engaging in hunting during certain periods of the year). Tradable permits is a form of policy mechanism that allows one to sell some entitled environmental rights that are not exercised, such as carbon permits in the EU emission trading scheme where environmentally-conscious companies may sell unused carbon allowances to firms that exceed their own quota (at a price determined by the overall supply and demand of total carbon allowances).

Naturally, market-based instruments can also reward certain types of behavior, as in the case of subsidies and fiscal incentives. For instance, several energy-saving technologies are subsidized at their initial stages of development and adoption (e.g. solar panel technologies). Fiscal incentives can render certain types of behavior more attractive to tax payers, for instance by exempting from income tax accrued revenues from "green" investments. Policymakers, and increasingly so also private companies and large investment funds, may also use positive discrimination in favor of public investment projects and contracts that have a positive environmental impact.

On many occasions, governments resort to policy measures that restrict pollution more directly, rather than through market price signals. These types of instruments are often referred to as command and control regulatory measures (Engel *et al*., 2008) or, alternatively, as non-tariff or non-market barriers to

trade when the measures apply specifically to imports and exports of goods and services. Again, there is a wide range of policy instruments that aim to directly influence the level of unsustainable activities (rather than indirectly via distorting relative prices). Licenses and quotas regulate the level of trade transactions (and hence amount of imports of certain commodities) through the issuance of permits and quantitative restrictions. In extreme cases, embargoes can be imposed on the entire amount of a particular commodity before reaching a destination market. Standards fall in this latter category of command and control instruments that restrict the production or trade of certain commodities as they often prescribe certain conditions that products need to meet in order to minimize health risks and enhance consumer protection. Environmental standards specifically aim at products complying with predefined processes that minimize or eliminate certain types of environmental damage. ISPM 15 addresses the need to treat wood packaging material thicker than 6 mm (to prevent the spread of pests and resulting damage to the ecosystems of importing countries) and falls into this category of standards.

There are some important issues that need to be recalled when discussing the distinction between the market-based and the command and control type of instruments (as in the case of phytosanitary environmental standards; see Harrington and Morgenstern, 2007). First, command-and-control measures directly regulate the extent of environmentally damage, rather than attempting to achieve this indirectly by influencing relative prices across traded commodities. Taxes and charges, instead, try to limit environmental damage by making environmentally-polluting products more expensive. While, in practice, taxes and charges may achieve similar results as command and control measures, their success depends on the underlying price elasticity. In other words, the decline in demand for an environmentally-damaging commodity will depend on how consumers and firms respond to price changes with respect to the initial level of prices. First, setting a tax at a very low level may result in a minimal adjustment of behavior; similarly, setting a tax at a very high level may achieve the exact same result that a more modest tax could have achieved. Second, charges and taxes do not only discourage behavior that damages the environment (when fulfilling their role as a price signal) but also generate public revenues. These additional public revenues can have multiple purposes. Governments, for example, can decide to make use of them to finance green public investment that further improves environmental quality. Thus, they can dedicate financial resources for the same purpose that the original environmental tax was adopted in the first place. Alternatively, governments can view these additional public revenues as a substitute for existing unpopular taxes. For example, environmental taxes could allow governments to reduce income taxes, particularly for those economies suffering from high unemployment rates. Environmental standards (and command and control measures more broadly) have, in general, a neutral fiscal effect, although governments can still collect some fees through issuing permits to those firms that are allowed to implement the standards. Historically, market-based instruments (such as tariffs) played a much more important role in generating public revenues, but the increasing prominence of other sources of taxable income (e.g. through sales or income taxes), accompanied by the development of a sophisticated system to collect these, supported a gradual transition towards non-trade barriers (and a gradual elimination of tariffs).

2.1 Implementation of Environmental or Trade Standards – Key Issues

There is a wide range of criteria policymakers need to have in mind when designing appropriate instruments, including environmental or trade standards. Effectiveness is naturally a key criterion to consider when selecting and designing policy instruments, which should grasp the extent to which the desired outcome has been achieved (e.g. preventing the spread of plant pests and diseases in the context of ISPM 15). In practice, policymakers and governments face multiple constraints when deciding the appropriate policy (or policy-mix) response to an environmental problem and as a result of this, multiple criteria are normally applied simultaneously. Efficiency is another critical factor that influences decisions behind the optimal response and policy instrument to tackle some environmental concerns this and primarily focuses on how well resources (public funds, human resources, etc.) have been utilized to achieve a specific (environmental) objective. This is also where cost-benefit analyses (similar to the one presented in Chapter 6) become handy, as they provide estimates on the country-specific net benefits (associated with a specific instrument) translated in monetary terms.

Policy instruments can rank differently when assessed in effectiveness and efficiency terms (Oosterhuis et al., 2014). While an instrument can be very effective in environmental protection, it may at the same time be very costly (and inefficient), leaving few other resources available for other uses. Efficiency becomes a more meaningful concept when trying to take into account any indirect (positive or negative and often unintentional) effect that the policy instrument is likely to induce. Environmental standards, for example, increase the cost of exports and may, hence, result in a considerable loss of competitiveness. This effect is likely to be sector-specific (and is the focus of Chapter 5), depending on the final change in consumer prices and producer profits, as well as the intensity of competition in international markets. Some sectors, such an environmental improvement can, for this reason, come at the expense of output loss and increased unemployment for the local population. For other sectors, there can be an increase in employment and demand by allowing local firms to export to new markets with more stringent environmental regulations. Furthermore, the increase in demand for environmentally compliant materials could, for instance, also create additional employment for treatment facilities, inspection agencies, and so forth.

Implementation costs of standards or other policy instruments are naturally an integral part of efficiency. Some obvious direct costs of implementation (e.g. related to acquiring specialised equipment to manage the standard, or training personnel) are straightforward to calculate in monetary terms. Trade and environmental standards often involve multiple other, less direct, transaction costs that would also need to be taken into consideration. These include:

i. Information costs. These relate to the information that is required to implement effectively the standard. For example, awareness raising campaigns to sensitize the public or firms to the necessity of the standard and its environmental benefits, or surveys to capture the expected responsiveness of target groups to a change in price as a result of the implementation.

ii. Administrative costs. These can be substantial costs (both for the government and target groups) when the standard entails detailed bureaucratic procedures with large numbers of individual firms or households involved (e.g. processing and evaluation of forms, or sampling costs). For the government,

the costs also often involve planning and decision-making costs; for instance staff costs in policy-making departments, as well as the cost of stakeholder consultations.

iii. Monitoring and enforcement costs. These depend on the complexity of the requirements and the efforts involved in verifying compliance with the standard. These costs can be borne either by the government or by the target groups. Corruption is often one of the key constraining factors (particularly in developing countries) behind enforcement of standards and it is often perceived as a separate cost itself.

iv. Judicial procedures. A standard will be less costly in this respect if its provisions and conditions are clearly specified and unambiguous. Nevertheless, legislative amendments, required to support implementation, can involve substantial costs and may delay implementation.

In addition to these costs, a number of other situation-specific considerations play a role in terms of identifying how successfully a trade or environmental standard is implemented:

i. The scale and nature of associated environmental benefits. It is likely that the legitimacy and social acceptance of a standard will be higher (as a means to ensure some environmental benefits, such as pest control in the case of ISPM 15) when the public sees a close link between the standard's implementation and its intended environmental services.

ii. The number of actors involved. The larger the number of government departments and companies involved, the higher the associated transaction costs described above are likely to be. The spatial distribution of actors can also be relevant; costs are for instance likely to be higher when the monitoring and enforcement process of a standard takes place in multiple locations.

iii. Financial constraints of the local government or institutions. This is particularly relevant in the case of developing countries where the successful implementation of the standard might be hindered by the availability of resources. Even when these resources become available, they might come at the expense of the provision of another public good.

iv. Social and cultural conditions. Customs, habits and traditions can affect the acceptance of a specific standard. Misconceptions and the spread of inaccurate information can hinder the acceptance and enforceability of a standard. This is also likely to happen when the standard is at odds with established social norms and common practices. In such cases, there is often much resistance to change, when a new (potentially beneficial) instrument is introduced. Consequently, low social acceptance will typically lead to infringements and this, in turn, to reduced effectiveness and high enforcement costs.

2.2 Economic and Non-Economic Impacts of Standards

Any thoroughly conducted cost-benefit analysis needs to take into consideration all these additional socio-economic side effects (positive or negative) that are associated with the implementation of a standard. Many of these, often indirect, side effects might not be evident at first sight. The implementation of a standard, for example, can create employment gains or losses in associated economic sectors and changes in competitiveness as a result of price distortions.

In the case of trade standards with an environmental objective (as ISPM 15), the expected environmental benefits associated with the standard's implementation also need to be monetized and contrasted against costs. There is a wide array of benefits that need to be incorporated into such an analysis (Born *et al*., 2005), specifically:

i. Direct use values, which can for instance be (a) consumptive use values when the standard aims to preserve an environmental asset that will be consumed in the future (timber, food, etc.); (b) recreational use values, which indicate the environmental asset preserved (e.g. forest) that is valuable to individuals for recreational purposes (for walks, camping, etc.); (c) aesthetic use values, as evident from the price premium associated property in the vicinity of the environmental assets. In addition, for specific (often indigenous) communities, environmental assets can also provide significant spiritual values and fulfillment.

ii. Indirect use values, which include preserving an environmental asset (e.g. forest) through which also additional environmental services are safeguarded. For example, forests provide ancillary ecosystem services to local communities in the form of flood protection, improved erosion control, protection of water resources and biodiversity, and more, as well as benefits in the form of carbon sequestration for the global community.

iii. Option values, which relate to the value of potential (i.e. as of yet an undiscovered potential for use in the future). For example, the preservation of a particular species may allow the development of some future medical breakthroughs.

iv. Non-use existence values, which concern the satisfaction of continued existence of an environmental asset, even when there are no immediate tangible benefits associated. People might value the continued existence of a particular tropical forest or natural habitat, even if they never visited or intend to visit it in the future.

v. Non-use bequest values, which relate to the satisfaction one receives by ensuring that the environmental assets remain available to future generations. This is an issue of intergenerational equity and fairness where current individuals wish to safeguard the possible (yet unknown) satisfaction of future generations.

vi. Non-use altruistic values, which are those attached to a resource being available to others in the current generation. This captures the issues associated with intragenerational equity and fairness; although we might not be directly affected by a certain loss of an environmental asset, we value that this environmental asset is available for other communities and individuals (many of whom might have limited opportunities to substitute such an environmental asset with another one).

Any comprehensive cost-benefit analysis associated with a trade standard with an environmental objective should attempt to incorporate as many of these values as possible. Naturally, attaching monetary values to all the benefits discussed above is a formidable task that, in most cases, allows us only to approximate the real value of a particular environmental asset. Furthermore, this largely remains an anthropocentric approach to the benefits of environmental assets, given that the latter are directly or indirectly measured through human preferences.

2.3 Standards and Issues of Fairness

Fairness is another important dimension that policymakers should consider when designing a new standard (Gross, 2007). Environmental standards, for instance, are often designed with an emphasis on the attainment of certain environmental targets, with little consideration given to how certain groups (e.g. low income groups, women, indigenous people, small-scale firms) may be disadvantaged or proportionately less favoured in the process. Small firms may be unintentionally excluded from the implementation of a new standard because of budget constraints due to initial transaction costs, or simply through informational barriers. Much literature points to multiple barriers (financial, informational, discriminatory) that particularly women often disproportionately face when they attempt to engage in new business practices (Brindley, 2005; Pehrsson, 2009). There is also evidence pointing to a lower participation of small firms in many new environmental initiatives, often as a result of limited access to capital and skills or due to higher transaction costs compared to their income. Small firms may also be less willing to align their production methods to a new standard, when this adjustment entails uncertain financial returns given their high discount rates and relatively high risk aversion. This also concerns perceptions of typically disadvantaged groups regarding whether they feel that their voice is heard in the design and implementation of a standard. This type of fairness is often referred to as "procedural justice".

Another important aspect of fairness relates to the so-called "distributive justice"; the distribution of benefits (and costs) when the standard is implemented. Distributional justice can be examined at multiple levels. It might be that the costs of implementation of a particular standard affect small-scale firms disproportionately negatively (that subsequently struggle to maintain a positive profit margin and hence remain in production), or that firms that comply with the standard experience little improvement in the demand they face (and, hence, lose competitiveness with non-compliant producers). Fairness also relates to the distributional aspects of any anticipated benefits. It may be, for example, that any additional employment opportunities stemming from the implementation of the standard, only benefit specific groups of employees. In the case of trade standards with an environmental objective, the associated environmental benefits might largely accrue to others than those paying for the costs of implementation, and in many cases the beneficiaries might be located in other areas or even countries compared to those who bear the costs of implementation.

There are multiple ways to address issues of distributive injustice. In some cases, it might be possible that the additional cost initially borne by the implementing actor of the standard can be passed on to the ones ultimately enjoying the benefits accruing from the standard. This is not always easy, given that even in the case of agreed higher prices (e.g. passed to the final consumer), depending on the price elasticity of demand, those implementing the standard can face a substantially lower demand for their product and consequently a drastic reduction in profits. In other instances, the government or an international agency can compensate those who lose out from the implementation of the standard.

Perceptions of fairness, as to participation and distribution of benefits and costs, are often instrumental in the success of the implementation of and compliance with a standard. The legitimacy of new standards can, for this reason, depend on the following factors: (a) how involved actors are approached and how actively they become engaged in the process; and (b) the distribution of involved costs and

benefits, and compensatory schemes. In this sense, fairness perceptions are likely to relate to how involved actors reflect on the entire implementation process, from the beginning when the standard is designed extending to the stage when it is advertised, administered and monitored.

3. ISPM 15: findings based on qualitative interviews

This chapter will describe and critically analyse all the procedures put in place by the Botswana NPPO to implement and comply with ISPM 15. The material used in this section derives from qualitative interviews with a number of stakeholders involved in the ISPM 15 implementation and compliance, such as exporters and importers, inspectors, and WPM treatment facility personnel. Through our descriptions of the field research in Botswana, we will highlight the malpractices adopted by the ISPM 15 implementing agencies. Malpractices put in place by other agencies or organizations, either public or private, and that affect the correct implementation of ISPM 15, will be discussed too. Some of the malpractices are country-specific –i.e. are peculiar to the Botswana case- but in most cases the same challenge and mal-practises highlighted in Botswana can be detected in other countries too.

The rest of the chapter is organized in the following way. The next section will describe the field research undertaken in Botswana; first we introduce the missions followed by a brief description of the interviews carried out with the stakeholders and an elaboration of the main findings. The policy implications of our findings and the main recommendations are summarized and discussed in the last section, whereas the appendix shows photos taken during the missions to help illustrate the issues discussed in this chapter.

3.1 Field research

The mission to Gaborone, Botswana, took place from 25 to 31 October 2015.

Botswana is a relatively small inland country and most imported consignments arrive via South Africa. In 2012, Botswana and South Africa signed a memorandum of understanding to promote trade and investment between the two countries. In addition, Botswana is part of the Southern African Customs Union (SACU) together with Lesotho, Namibia, South Africa and Swaziland, which allows the duty-free movement of goods within the SACU. It is not clear whether this agreement extends to the free circulation of WPM, which would then not require any type of controls at the customs. For what concerns exports, Botswana exports a limited amount of goods, of which only a limited percentage to countries other than the neighbouring ones.

Interviews with the stakeholders

The first interview was with Mr Ranthoakgale, a former NPPO employee, who was also the contact point for all logistics related to this project and for the data collection process. A complete list of the interviewed stakeholders can be consulted in Table 1.

The meetings with Mr Modiakgotla, Director of the NPPO, and with Ms Mawere, second in command in the NPPO, were helpful in understanding the reason why Botswana decided to implement and comply with ISPM 15, notwithstanding the country's relatively low levels of exports. The NPPO believes that implementing the international standard will help the country develop a solid export sector in the medium and long term. Botswana's main exports are currently represented by precious stones and nickel articles, but the country plans to increase the agricultural production and exports.

Previously there were 15 WPM treatment facilities in Botswana, but 14 facilities stopped their activities as the market was not profitable anymore, and only one facility exists now. The lack of profitability is evident because the average demand for WPM treatments seems to be extremely low (about 200 pieces a month) and very variable over time. HT is not used in Botswana as it is considered too expensive both in absolute terms, in relation to the purchase of the HT chamber and the use of electricity, and in relative terms, compared to the MB treatment costs. In addition, the NPPO discourages the use of HT claiming it does not prevent the reinfestation of the WPM previously treated (although ISPM 15 clearly states that treated WPM, whether by heat or other approved treatment, does not need to be re-treated).

The NPPO has not launched a surveillance program to validate the impact of the standard by comparing the pre-ISPM 15 information with the post-ISPM 15 data. The lack of a proper data collection system prevents the country from understanding whether the implementation of the international standard has diminished the entry and establishment of pests. On a positive note, the NPPO is not aware of any pest interceptions by importing countries, which should indicate that the WPM leaving Botswana has been free from pests.[3] Despite the fact that Botswana has officially implemented ISPM 15, the NPPO does not inspect imported WPM directly nor has it instructed customs how to verify that the WPM is in compliance with ISPM 15. This questions how well the country complies with the standard at the import level.[4]

Mr Uglietti is the Manager of the U-Mac Import & Export (PTY) LTD, the only facility in Botswana authorized to treat WPM using MB. The facility treats approximately 200 pieces of WPM per month, even though the number may vary.

The quality of the stamp applied to WPM from this facility is debatable. According to ISPM 15, the stamp should be "sufficient to be both visible and legible to inspectors without the use of a visual aid", but this is not always the case for the stamps used on the WPM treated by U-Mac Import & Export (PTY) LTD (see Figure 3).

However, more importantly, this facility has never been audited by an NPPO inspector, despite the fact that the ISPM 15 prescribes that "treatment and application of the mark must always be under the authority of the NPPO. NPPOs that authorize the use of the mark should supervise (or, as a minimum, audit or review) […]".

Shakinah Investments is a company that manufactures and sells WPM. The company trained one employee to carry out MB treatments of WPM, in accordance to the ISPM 15, but then decided against undertaking treatments because MB is intended to be phased out in the country and thus there would not be a return on investments. At the same time, the company carried out a cost-benefit analysis for setting up an HT facility, but realized that the break-even point against the investment would be reached after treating at least 300 pallets a day, which would be way beyond the amount of WPM the company is selling nowadays.

[3] It is possible that countries may have intercepted pests, but they have not reported this to Botswana.
[4] The NPPO has currently posted inspectors at the borders with the objective to inspect whether imported WPM comply with ISPM 15. To date, these inspectors have not been given an inspection manual.

Both Mr Gopolang and Ms Selato, representatives of the Meteorological Services, brought up the issue of phasing out MB even for uses connected to the treatment of WPM. The "National Meteorological Service Act" published in 2014 and related to ozone depleting substances states that the use of MB has been phased out from 2010, but that it can still be used when a substitute is not available, as in the case of treating WPM (HT facilities do not exist in the country). When looking closer at the regulation imposed by the Meteorological Services some questions arise, such as why only one company – U-Mac Import & Export (PTY) LTD – can buy MB although other companies are interested in purchasing it. The Meteorological Services acknowledges the importance of stopping the use of MB, but does not have any resources to subsidize the transition from MB to heat treatments.

Botswana, as the other three countries involved in the project, has a number of facilities that repair WPM. In total, there are around 50 in the whole country; 25 in Gaborone, 13 in Francistown, four in Maun, four in Lobatse, two in Kanye and one in Selibe Phikwe. We visited two facilities – GP Pallets and Isaac Upholstery – located in the outskirts of Gaborone. Both these facilities buy broken WPM, which are either manufactured in Botswana or outside the country, repair the broken parts and reassemble the WPM. Their main customers are companies located in Botswana that use the repaired WPM mainly for moving goods within the country. The main problem related to the presence of repaired WPM is that although they consist of partially untreated WPM, they may appear to have treated WPM, as the stamp is present and legible.

The Botswana Unified Revenue Services is the institution in charge of conducting customs inspections. Being a landlocked country, imports arrive mainly via South Africa. During the interview with Mr Mokgwaela, the Principal Customs Officer, it was clear that customs lacks overall awareness about pest risk stemming from WPM entering the country and that the timber would need to be treated. While customs inspects to verify that timber arriving in Botswana has been treated there are no specific inspections carried out on WPM. It seems there is an unwritten rule that commodities arriving in Botswana from South Africa need a phytosanitary permit stating that the commodity is free of bacteria and fungi, but there is no clear indication from the local NPPO on inspecting WPM (

Figure 1).

The confusion on how to properly implement ISPM 15, has been confirmed by Mr Mazebedi, Director of the Horticultural Market. The market is organized as a cooperative of several farmers and is formally owned by the Government of Botswana. The market sells fruits and vegetables to Botswana's neighbouring countries, mainly Namibia and Zimbabwe. Mr Mazebedi is aware of ISPM 15, but noted that in practice the NPPO does not enforce its implementation. As an example, the board in charge of regulating the Horticultural Market never received any indication from the NPPO on matters related to ISPM 15 and how to implement it correctly. To partially prove what Mr Mazebedi disclosed, Figure 3 shows the WPM used to export fruits and vegetables. In the first case, the WPM used had a readable stamp while in the second the WPM displays a non-readable stamp.

Table 1: List of activities arranged for the mission to Botswana

Name of the Company / Organization / Institution	Contact person	Main activity
Independent consultant	Simane Ranthoakgale	Independent consultant
Ministry of Agriculture	Galeitsiwe T. Ramokapane	Director of Crop Production Department
NPPO	Hendrick Modiakgotla	Director of the NPPO
U-Mac Import & Export (PTY) LTD	Arthur Uglietti	Treat wood pallet materials using MB
Ultimo Designers PTY LTD	Altimo Hagi	Pallet Manufacturer
GP Pallets	Ditiro Motlhoiwa	Recycle and manufacture WPM
	Pontsho Motlhoiwa	
Isaac Upholstery	Isaac	Recycle and manufacture WPM
Botswana Unified Revenue Services	Olebile Mokgwaela	Principal Customs officer
CHEP Pty Ltd		Pallet Manufacturer
Nata timber	Ali	Former pallet manufacturer
Botswana Horticultural Market	Mazebedi	Vegetable import and export
Phytosanitary post at the horticultural market	Jacob Kalake	Government owned horticulture market
Botswana Meat Commission	Shirley Mmegwa	Beef exporter
Shakinah Investments	Buka Ntopo	Pallet Manufacturer
Pesterminate	Dave Neill	Treatments of small wood packaging material
Meteorological Services	Janet Selato and Balisi Gopolang	Training research division and chief meteorologist
Kgalagadi Breweries	Kagiso Matsila	Marketing service
Forestry Department		Natural resource management
DHL Exporters		Private company
Data collection company	Training on the questionnaires	

Note: The transcripts of the interviews are available upon request

Through the interviews with the stakeholders involved in the implementation of ISPM 15 at both the import and export levels, a number of interesting key points have emerged. These are summarized in the text that follows.

It is our impression that the NPPO could put in place a relatively small number of procedures to improve the implementation of the international standard, and to help stakeholders to comply with national regulations to ensure compliance. The main point being that all stakeholders (exporters and customs in particular) should be made appropriately aware of the national legislation in respect to ISPM 15, the trade agreements Botswana has with other countries and the potential consequences of these agreements, as well as how they relate to phytosanitary issues.

Furthermore, the NPPO should supervise the WPM treatment facility, for instance through regular audits, but there was no such mechanism in place, and that clearly poses a number of questions as to validity of the treatments, just as it is not in compliance with ISPM 15, which states that "treatment and application of the mark must always be under the authority of the NPPO. NPPOs that authorize the use of the mark should supervise (or, as a minimum, audit or review) the application of the treatments, use of the mark and its application, as appropriate, by producer/treatment providers and should establish inspection or monitoring and auditing procedures".

In addition, there is only one WPM treatment facility operating in the country. The facility uses MB although this chemical will be soon phased out for WPM treating purposes. It would be advisable that the NPPO encourages setting up a heat treatment facility for it to be operative when it will be no longer possible to use MB.

Finally, there are several facilities that repair WPM but that do not treat it. This means that some parts of the newly assembled WPM have not been treated, providing additional pest risks.

Figure 1 shows how the country as a whole and the NPPO in particular have organized the implementation process.

i) ISPM 15 is not being properly observed

ISPM 15 states that NPPOs of exporting and importing countries have specific responsibilities, and that treatment and application of the mark must always be under the authority of the NPPO. ISPM 15 also establishes that NPPOs that authorize the use of the mark should supervise or, as a minimum, audit or review the application of the treatments, use of the mark and its application. This normally means that WPM producers or treatment providers should be inspected or monitored, and audited by the NPPO.

In the case of Botswana, the NPPO fails to supervise the one and only WPM treatment facility operating in the country; manifested as the local NPPO does not inspects the facility when operating the treatment and does not audit it to check if the treatments have been done in compliance with ISPM 15. The representatives from the NPPO has stated that it is not a clear whether the WPM treatment facility actually applies the treatment or if the WPM is stamped without the treatment actually taking place.

ii) The NPPO does not provide any guidance to other stakeholders

Mr Uglietti – Manager of U-Mac Import & Export (PTY) LTD – highlighted that the NPPO does not provide the WPM treatment facility with clear guidance on how ISPM 15 should be implemented. In theory, this problem could be resolved easily, as there is only one WPM treatment facility in Botswana and it should be possible to organize training and capacity development for the staff and management of the facility.

iii) Should capacity building and training come from above?

The NPPO pointed out that it never received any training or capacity building to carry out its duties as supervising body. The NPPO felt that either the FAO-IPPC or IASPC should have organized a workshop on ISPM 15 in the country. However, it should be noted that the NPPO was unaware of capacity building material or opportunities provided in the past, such as, an explanatory document posted publicly,[5] and several workshops on ISPM 15 that have been held, the most notable being in 2005, in Vancouver.

iv) ISPM 15 is not enforced at the import level

For what concerns imports, ISPM 15 has not been enforced so far. This means that neither custom nor the NPPO inspect commodities arriving in the country. The local NPPO claims that there is no such need due to the agreement between Botswana and South Africa. In practical term, the agreement translates into a sort of a waiver by which commodities can travel freely between the two countries without having compliant WPM. A very superficial inspection of the trucks arriving at the Botswana border from South Africa demonstrated that the imported commodities arrived on both WPM that had the ISPM 15 mark and on WPM that did not have any stamp.

While it is reasonable that two countries that have a very similar environmental setting, and thus relatively low risk of being invaded by pests from the other country, develop such agreements, it would be expected that customs inspectors were at least aware of the existence of ISPM 15.

v) ISPM 15 is not always enforced at the export level

There are instances of export using non-treated WPM, such as the case of a brewery that exports beer to the neighbouring countries, mainly to South Africa, on non-treated WPM. Figure 5 the use of treated and non-treated WPM in the beer sector.

vi) Facilities repairing WPM without re-treating them

There are quite a number of facilities repairing WPM in Botswana. The main problem with the repaired WPM is that it looks exactly like treated WPM although some wooden components of this new WPM may have never been treated (Figure 4**Error! Reference source not found.**). ISPM 15 allows for reparation of broken WPM as far as each added component will be treated and marked in accordance with the standard.

The newly assembled WPM may present no ISPM 15 stamp, when none of the parts used had a stamp, or it may have one or more stamps, when one or more parts had stamps. In the first case, the WPM is not compliant, and should not be exported whereas in the other case, where the WPM presents all the

[5] For more information on the explanatory note, see http://www.afsca.be/exportthirdcountries/plants/_documents/2017-01-03_Annexe1ispm_15_explanatorydocument_withannexes_2014-04-30.pdf (last accessed: 27/06/2017).

features of a treated WPM, it might be exported (although, effectively, the WPM is not compliant). It should be noted that the amount of repaired WPM, which looks like it has been treated although it is not the case, is marginal in Botswana. The country has a limited export industry and one of the few companies exporting outside the African continent – Botswana Meat Commission – only uses new pallets.

vii) Existence of only one WPM treatment facility

In Botswana, there is only one WPM treatment facility; U-Mac Import & Export (PTY) LTD. This facility buys all the MB Botswana is allowed to use yearly, and there is therefore no competition in the WPM treatment industry given the fact that no other facility can operate without MB. This WPM treatment facility's unique identifier is "100" (Figure 6**Error! Reference source not found.**). There are several other facilities, such as Chep Pty Ltd, producing WPM that is not treated, which are then used for the internal market or for exporting commodities (
Figure 7).

There are no HT facilities in Botswana, and the local NPPO should consider the opportunity of subsidizing such treatment facilities considering that MB will soon be phased out, and Botswana-based companies may otherwise have to import treated WPM from neighbouring countries, if any local company wishes to export.

The opportunity to use solar energy to power a WPM treatment facility could be investigated, as the average temperature in Gaborone is between 30 °C and 35 °C throughout the year.

viii) Is the stamp readable?

According to ISPM 15, the mark must be legible, durable and not transferable. This requirement constitutes a challenge as the WPMs produced in loco as well as those received with imported consignments generally do not present a legible mark (Figure 3 and Figure 4).

ix) Does the MB treatment expire?

Botswana Meat Commission represents one of the largest exporting companies in Botswana, with its meat reaching several markets in Europe (mostly UK) and Middle East. The company buys brand-new WPM from U-Mac Import & Export (PTY) LTD each time there is an overseas order. Botswana Meat Commission never uses second-hand treated WPM thinking that second-hand WPM, which has been treated some time ago, may have been reinfested. This is not the correct understanding, as ISPM 15 prescribes that treated WPM does not need to be re-treated.

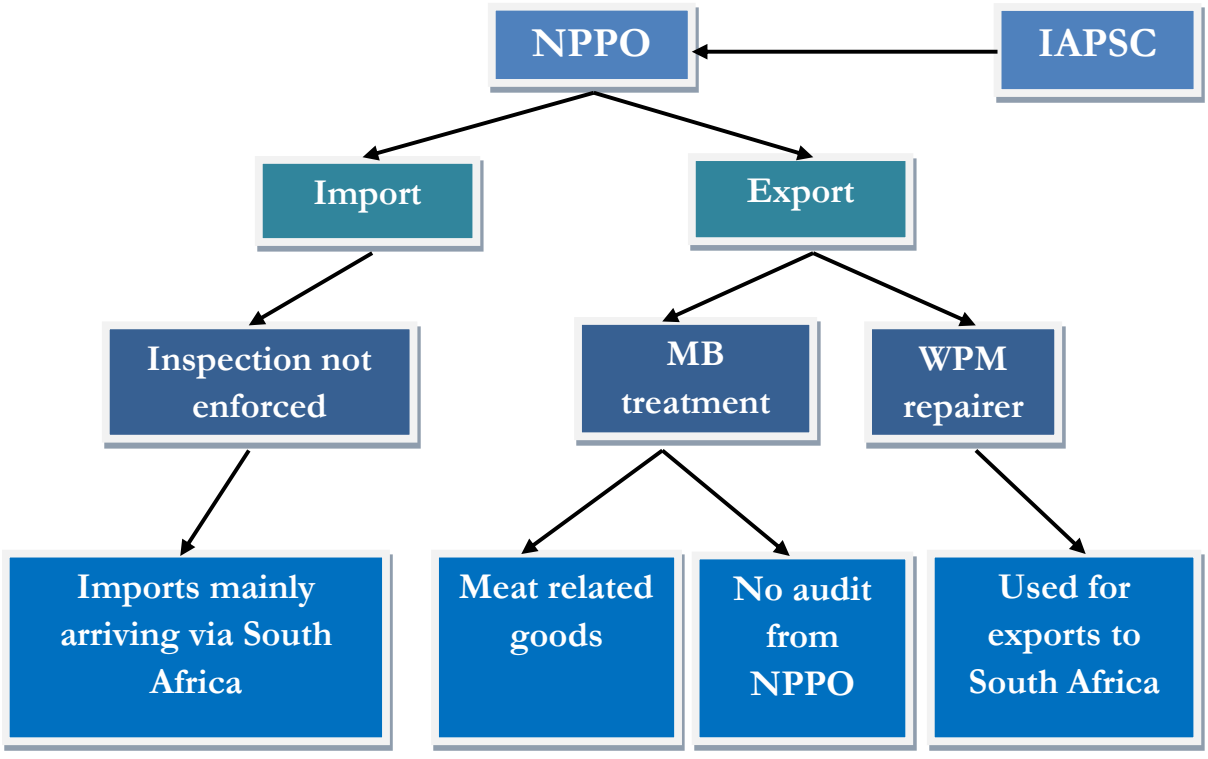
Conclusions

It is our impression that the NPPO could put in place a relatively small number of procedures to improve the implementation of the international standard, and to help stakeholders to comply with national regulations to ensure compliance. The main point being that all stakeholders (exporters and customs in particular) should be made appropriately aware of the national legislation in respect to ISPM 15, the trade agreements Botswana has with other countries and the potential consequences of these agreements, as well as how they relate to phytosanitary issues.

Furthermore, the NPPO should supervise the WPM treatment facility, for instance through regular audits, but there was no such mechanism in place, and that clearly poses a number of questions as to validity of the treatments, just as it is not in compliance with ISPM 15, which states that "treatment and application of the mark must always be under the authority of the NPPO. NPPOs that authorize the use of the mark should supervise (or, as a minimum, audit or review) the application of the treatments, use of the mark and its application, as appropriate, by producer/treatment providers and should establish inspection or monitoring and auditing procedures".

In addition, there is only one WPM treatment facility operating in the country. The facility uses MB although this chemical will be soon phased out for WPM treating purposes. It would be advisable that the NPPO encourages setting up a heat treatment facility for it to be operative when it will be no longer possible to use MB. Finally, there are several facilities that repair WPM but that do not treat it. This means that some parts of the newly assembled WPM have not been treated, providing additional pest risks.

Figure 1: Flow chart of the ISPM 15 implementation process in Botswana



Note: Authors' elaboration.

3.2 Policy implications and policy advice

Through the country missions and the stakeholder interviews, a number of malpractices were highlighted in relation to the working procedures of the NPPO and other organizations when implementing ISPM 15 (see Table 2). In some cases, these malpractices were generated from a misunderstanding of the standard. In other cases, the NPPOs are aware of the malpractice but they do not have the necessary resources or an adequate level of know-how to address it. It may also be that the NPPO is not aware of the specific issue.

Improvements in how ISPM 15 should be implemented should come from several directions. In the text that follows we propose possible solutions to the identified malpractices out. These proposals all stem from ISPM 15 or from procedures adopted by other NPPOs in other areas of the world. Some of these proposals will be discussed in more details in Chapter 6, where qualitative results will be merged with the macroeconomic evidence and with the results stemming from the microeconomic analysis.

Table 2: Overview of the malpractices observed when implementing the ISPM 15 in the four case-study countries

Malpractice	Botswana
Auditing the WPM treatment facility	V
Lack of inspections for imported goods	V
WPM repairers	V
Readability of the stamp	V
Duration of the treatment	V
Lack of guidance from the NPPO	V
Awareness of ISPM 15	V

Source: Authors' elaboration.

Note: "V" indicates that the malpractice is present in the country; whereas "X" indicates that it is not present

Regulation

An NPPO that needs to implement a standard should first develop a legislative and regulatory framework that will help explain it, to support delegation of functions as needed, and support auditing activities and inspections. In other words, each country should develop a number of laws to ensure that the standard is well described in its entireness and all the stakeholders are well aware of its existence. Efforts should be made to inform all stakeholders whose activities may be affected by the standard of its existence.

The legislative support is lacking in Botswana; the legislative support should be prepared by the NPPO and should explain all the steps needed to implement and to comply with the standard, and should therefore, among others, explain the approved treatments adopted and how to certify their uses, how WPM treatment facilities obtain license to operate, how to carry out audits, how to inspect imported consignments and how to disincentive fraud.

In what follows we try to enumerate all the information the legislative tool should have and we propose interactions and exchange of information between the public and the private sector.

Coordination

Awareness campaigns should be organized and informative brochures be prepared to promote the existence of the standard. As it stands several important stakeholders are still not aware of ISPM 15, including ministries regulating trade, agricultural activities, or in charge of safeguarding the environment.

It should be clear that the correct implementation of and compliance with the standard is not the responsibility of the NPPOs alone, but a joint effort of all the stakeholders, both public and private.

Import control

Since WPM is associated with almost all shipments, including those that are not the target of phytosanitary inspections, cooperation with custom agencies is a *sine-qua-non* requirement for a correct implementation of the standard. The way inspections for imported goods are organized are similar in the four countries; the NPPOs inspect plant-related imports, while customs inspect all imports for tax purposes. As there is no exchange of information between these organizations as to the arrival of consignments, which are not plant related, the WPM associated with these consignments are rarely inspected. Cooperation between customs and NPPOs should be reviewed to ensure effectiveness in detecting potential non-compliance of WPM.

In this chapter we mentioned that other countries overcome this challenge by establishing a database of commodities that are most likely to be associated with WPM. Customs then targets these commodities and the NPPO inspects the WPM. Overall, an inspection manual should be prepared to inform inspectors on the share of imports to be inspected and based on what principle, and which actions should be taken when cases of non-compliance occur. It should for instance be decided whether to inspect randomly or according to assessment of risks based on the exporting country or type of consignment.

Continuous training of all staff (customs and NPPO inspectors, port employees) should be organized. A number of countries rely on paper documentations to track consignments. This challenges sharing of knowledge and the identification of pest risks, as the data is not easily analysed. All steps of the implement process should be computerized (lessons should be drawn from the ePhyto system).[6]

Definition of all those measures related to the non-compliance at the point of entry

Where WPM does not carry the required mark, action should be taken unless other bilateral arrangements between countries have been put in place. This action may take the form of treatment, disposal or refused entry, and the NPPO of the exporting country should be notified (ISPM 13 *Guidelines on notification of non-compliance and emergency action*). However, the authors did not find evidence of NPPOs having set up guidelines for non-compliance situations.

[6] For more information on the ePhyto project see http://www.standardsfacility.org/PG-504 (last accessed: 28/06/2017).

Treatments used

In Botswana, the only treatment facility in the country (which uses MB) has not been inspected for years, as the NPPO does not have the necessary resources to carry out inspections. There is evidence of treatment facilities re-treating WPM few months after the initial treatment, as it is believed that treated WPM can be reinfested. This has a significant cost for the environment. There is also evidence of exporters that use only new WPM, as they fear treated but old WPM may be rejected in the importing country. These issues are mainly caused by a poor understanding of ISPM 15 by the NPPO, exporters and treatment facilities alike. They could be easily fixed by a more careful analysis of ISPM 15 by the NPPO, and through a continuous flow of communication between the NPPO and the stakeholders.

Content of the audits

Do the treatment facilities use the prescribed amount of MB? Is the tarp used for the treatment properly sealed? Such questions highlight the fact that appropriate auditing would help improve implementation of the standard. Many interviewees stressed that audits need to be more accurate more frequent and unexpected, and records of the treatment operations need to be seen and studied. The auditor needs to be able to answer questions related to the mark application, and if the mark is in line with the ISPM.

All this information is necessary to gather a complete view on different phases of the implementation process. As we have seen, malpractices can occur for a number of reasons; it is possible that WPM treatment facilities attempt to treat WPM according to ISPM 15 but that the treatment is not applied properly. This may be because the minimum required dose of fumigant or heat, or the time of the treatment are not adequate. The malpractices that may lead to non-compliance can be unintentional. As an example, a WPM treatment facility may follow the treatment schedules correctly based on sensors within the chamber, but because of cold pockets or uneven distribution of the fumigant not all wood is treated equally.

Understanding how the WPM treatment facilities apply MB is as important as defining what happens if inspections of those facilities find non-compliance. Is the facility interdict from operating for a limited period of time? Is it inspected more frequently? What happens to its stamp if the facility is suspended for some months? The NPPOs should take punitive action against the non-compliant companies and this information should be made public. NPPOs in other countries often take such action to incentivize other facilities to comply. As an example, Canada publishes the information of non-compliant facilities, thereby creating a deterrent for other producers. In our understanding, such actions are not being taken in the four case-study countries.

WPM treatment facilities

The MB treatment will be probably phased out soon. The NPPO should encourage those facilities to change the treatment to HT or DH and possibly recommend using solar panels, as the temperature in several months of the year in the African target countries may reach 40 C^{o}.

Fraud

Episodes of intentional ISPM 15 non-compliance or fraud can occur. This happens when the ISPM 15 stamp is knowingly applied to WPM that has not been treated, or not properly treated. Widespread usage of WPM with fraudulent marks, especially if infested, would reduce the apparent impact that the ISPM 15 has on reducing WPM infestation rates.

While we were not made aware of any intentional case of non-compliance, the issue of WPM repair facilities remain serious. These facilities repair broken WPM with an end result that appears to be treated WPM, as it has the ISPM 15 stamp. However, the repaired WPM may not necessarily comply with the ISPM 15; this is only the case when the repaired part is maximum a third of the total wood.

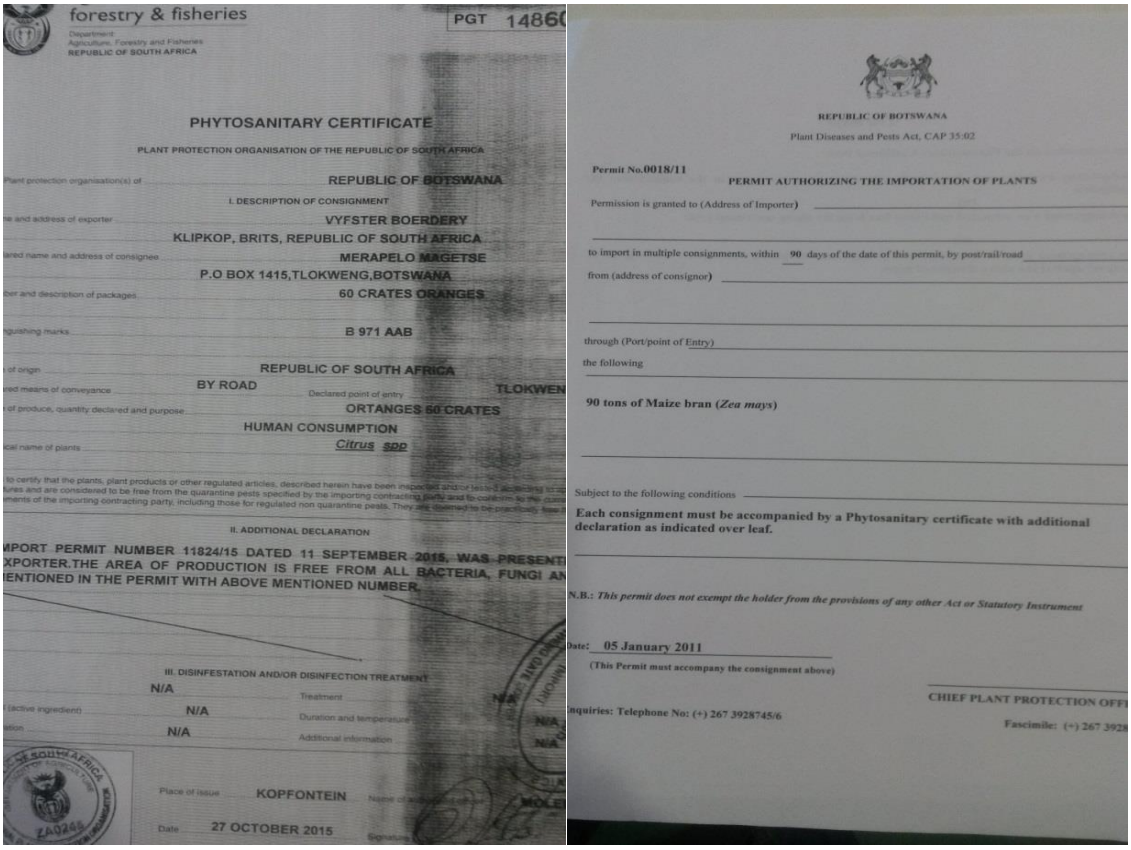
Database on pest interceptions

Several countries maintain databases of pests that are intercepted at their points of entry. Long-term pest interception databases have been developed by governments and NPPOs in Australia, Canada, Chile, Europe and North Africa (developed by the EPPO), Mexico, New Zealand, and the US. Typically, inspectors target high-risk products, countries of import or pathways, rather than conducting completely random inspections. In addition, interception records are usually included in a country's database only when pests are found although there are exceptions.

This type of database is not present in ether of the four countries. A centralised database including all the 55 countries under the umbrella of IAPSC would be advisable, as it would offer a comprehensive picture of the impact of the standard.

3.3 Appendix

Figure 2: Import transit certificates



Note: Import certificate issued to certify that oranges coming from South Africa are free from pests (left), and that maize can enter Botswana (right).

Figure 3: WPM used by the Horticultural Market to export fruits and vegetables

Note: The marks on the WPM used by the Horticultural Market are sometimes readable (left), sometimes not (right).

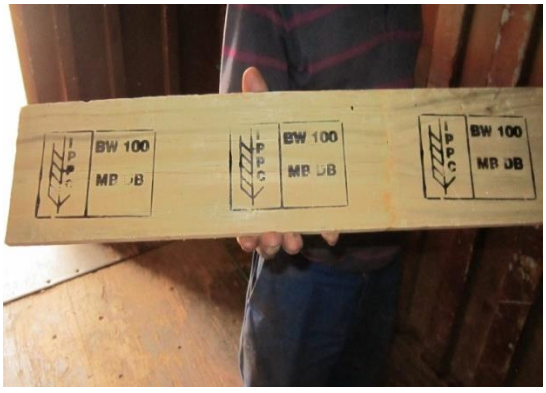
Figure 4: Repaired WPM and parts of treated WPM

Note: Reassembled WPM, which probably has non-treated parts but the presence of the stamp makes the WPM compliant with ISPM 15 (left). Treated, disassembled WPM that will be used to repair broken WPM (right).

Figure 5: WPM used by Kgalagadi Breweries Limited

Note: WPM used by Kgalagadi Breweries Limited (KLB) without any stamp and not in good condition (left) and WPM used by KLB displaying a non-readable stamp (right).

Figure 6: The stamp used by U-Mac Import& Export (PTY) LTD Extract



Note: The facility has the unique identifier "100"

Figure 7: WPM manufactured by Chep Pty Ltd

Note: WPM manufactured by Chep Pty Ltd are not treated according to ISPM 15 despite the fact that they may be used for exporting purposes.

Figure 8: The stamp applied by U-Mac Import & Export (PTY) LTD Extract and found on two pieces of WPM in the Botswana Horticultural Market

Note: The stamp is not legible in all its parts.

4 Description of Macroeconomic Analysis

The macroeconomic analysis employs econometric methods to assess changes in trade volumes (for a wide range of sectors) after the implementation of ISPM 15. We follow the conventional methodological approach used for such purposes in the empirical trade literature, which is the estimation of trade gravity models (see Clougherty and Grajek, 2014; De Santis, 2012). These allow estimating simultaneously the statistical correlation (association) of these bilateral trade flows with several socio-economic and geographical factors. Three gravity models were estimated for 86 different types of commodities:

1. A parsimonious (simple) "fixed effects" model, which can be summarized by the following specification:

$$V_{ijkt} = b0 + b1\ Income_{ijt} + b2\ ISPM\ 15_{it} + \varepsilon_{ijt}\ , \qquad \textbf{(1)}$$

where V_{ijkt} refers to the value of trade (imports/exports) in product type *k* from/to our case-study country (Botswana) *i* to/from any trade partner country *j* at time *t*, $Income_{ijt}$ captures the real GDP size of both trading partners *i* and *j* (which, hence, controls for the fact that trade tends to expand in accordance with the increasing size of both exporting and importing economies), and $ISPM\ 15_{it}$ is a time dummy taking the value of 1 for the years corresponding to the year Botswana implemented the standard. ε_{ijt} captures the unexplained component of the estimated statistical relationship (i.e. the part of the variation in the dependent variable, the sector-specific trade volume, that cannot be explained by either). All the *b*'s correspond to the estimated coefficients that capture the size of the correlation between trade flows and other explanatory variables. Fixed effect estimators control for the effects of time invariant variables (in other words, fixed effects models impose time independent effects for each entity, i.e. country combination, that are possibly correlated with the explanatory variables) and are typically the preferred analytical tool in econometric analysis, since they are able to control for often important (but often unobservable and hence omitted) time invariant factors (e.g. cultural characteristics).

Particular attention will be given to the coefficient *b2*, which measures changes in trade volumes during the periods before and after implementation of ISPM 15. We hypothesize that the sign of this coefficient can be either positive or negative, dependent on a number of factors. Implementation of ISPM 15 can harm some exporting sectors, assuming that compliance increases the costs of pallets and, hence, of exported products, rendering them less competitive in international markets. It can also be the case that the implementation has the opposite effect, for instance by creating opportunities for an increase in export volumes by allowing access to markets with stringent plant protection regulations. It can also reduce the volume of imports for specific commodities by permitting imports only from a reduced number of ISPM 15-compliant trading partners. Such a reduction in imports can be the combined result of reduced competition and higher import prices, of fewer trading partners to meet demands, of the higher WPM costs passed on to the price of the final product, or due to higher administrative (e.g. inspection) costs of the importing country. All trade volumes will be measured in a natural logarithmic scale, and, therefore, the *b2* coefficient will capture the percentage change between the periods before and after ISPM 15 implementation.

2. A richer "fixed effects" model, which includes a more sophisticated specification with additional explanatory factors:

$$V_{ijkt} = b0 + b1\ Income_{ijt} + b2\ ISPM\ 15_{it} + b3\ X_{jt} + \varepsilon_{ijt}\ , \qquad \textbf{(2)}$$

where again, the volume of bilateral trade will depend on (a) the size of economic activity (*Income*); (b) ISPM 15 implementation of Botswana and a vector *X* of additional control variables. These additional explanatory factors include: (c) an interaction variable that examines how non-implementation of ISPM 15 in Botswana can interact with ISPM 15 implementation in the export country to potentially reduce export volumes (variable: *ISPM 15 partner*). For the case of exports, this variable takes a value of 1 for the years when the trading partner implemented ISPM 15 but Botswana had not done so. For the case of imports, the corresponding variable takes a value of 1 when Botswana implemented ISPM 15 but the trading partner had not done so. Last, this richer model includes an institutional variable that relates to the extent of corruption in the export country (*Transparency*). The institutional variable aims to capture whether Botswana prefers to trade with countries characterized by higher levels of transparency in transactions (see Anderson and Marcouiller, 2002). Again, the fixed effect estimators control for the effects of time invariant variables (in other words, fixed effects models impose time independent effects for each entity (country combination) that are possibly correlated with the explanatory variables).

3. A random effects model, that includes, in addition to the variables of Model 2, an additional set of time-invariant factors:

$$V_{ijkt} = b0 + b1\ Income_{ijt} + b2\ ISPM\ 15_{it} + b3\ X_{jt} + b4\ Z_{ijt} + \varepsilon_{ijt}\ , \qquad \textbf{(3)}$$

where the vector *Z* captures the additional time-invariant variables, namely: (a) *Distance* which is a variable capturing distance between countries (distance between capital cities in km) – we expect distance to correlate negatively with trade flows, as a result of larger transportation costs; (b) a dummy variable taking a value of 1 when Botswana and each trade partner share borders (variable *Borders*) (we expect countries with common borders to trade more with one another, other things equal); (c) a dummy variable taking a value of 1 when trade partners share a common language as this may facilitate trade (variable *Language*); and (d) a dummy variable taking a value of 1 in cases of historical links between colonies and colonial powers, which may increase trade for involved parties (variable *Colony*). For gravity models using similar geographical variables see the papers by Gómez-Herrera (2013) and Lohmann (2013). All the other explanatory variables appearing in Model 2 (fixed effects richer model) are also included in the random effects model. Contrary to fixed effects estimators, random effects models do not impose time-independent effects for each entity (country combination) that are possibly correlated with the explanatory variables. In other words, we assume that variation in the explanatory variables arises from random causes and is not systematically related to the country-combinations over time.

The second model (fixed effects richer specification) provides the most reliable estimators (although results are shown also for the more parsimonious fixed effects and random effects specifications for key export and import commodities). Random effects estimations are based on the assumption that individual-specific effects are uncorrelated with independent variables, an assumption that is often violated in panel data settings (in other words, the corresponding Hausman tests conducted are in favour of the fixed effects estimators). The first model is likely to provide biased estimators as a result of an omitted variable bias (i.e. a restricted model with few variables is likely to omit key explanatory factors and, hence, bias either downwards or upwards of the estimated coefficients of the included variables). All models make use of robust standard errors that correct for any heteroscedasticity effects on statistical significance.

4.1 Description of Macroeconomic Data

The research team has compiled data from multiple sources such as UN Comtrade dataset, World Development Indicators, and World Governance Indicators. Below is a detailed description of all variables used in the macroeconomic analysis.

Trade flows: These have been captured by the value of imports and exports across 86 commodity categories from/to Botswana and to/from any trade partner country. These bilateral annual trade flows are expressed in a natural logarithmic scale and are available for the years 2000–2013. All data are available from the UN International Trade Statistics Database, commonly known as the Comtrade website (https://comtrade.un.org).

ISPM 15: Data on ISPM 15 implementation for all countries. The *ISPM 15* variable is a time dummy taking the value of 1 for the years corresponding to the implementation year of the standard by Botswana. The variable *ISPM 15(partner)* is an interaction variable that examines how non-implementation of ISPM 15 in Botswana can interact with ISPM 15 implementation in the export country to potentially reduce export volumes. For the case of exports, this variable takes a value of 1 for the years when the trading partner implemented ISPM 15 but Botswana had not done so. For the case of imports, the corresponding variable takes a value of 1 when Botswana adopted ISPM 15 standard but the trading partner had not done so.

Income: Data on real GDP in 2010 constant prices. In all regressions, the natural logarithm of the product of the GDP size (of pairs of trading partners) has been used. Data are available from the World Development Indicators (http://data.worldbank.org/data-catalog/world-development-indicators).

Transparency: An institutional variable that relates to the extent of corrupt practices in the export partner economy. This is a control of corruption index that captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" (appropriation) of the state by elites and private interests. It is measured in a −2.5 to 2.5 scale where 2.5 corresponds to the lowest level of corruption and −2.5 corresponds to the highest level of corruption. Data are available from the Worldwide Governance Indicators (www.govindicators.org).

Borders: A dummy variable taking a value of 1 when Botswana and each trading partner share borders.

Language: A dummy variable taking a value of 1 when the trading partners share a common language.

Distance: A variable capturing distance between the capital cities of partner countries (expressed in km and logarithmic scale).

Colony: A dummy variable taking a value of 1 in cases of historical links between colonies and colonial powers.

The descriptive statistics for all variables are available in Table 3.

Table 3: Descriptive statistics - Botswana

Variable	Mean	Standard Deviation	Minimum	Maximum
Trade flows (exports)	8.37	3.84	0	22.03
Trade flows (imports)	8.89	3.67	0	20.97
ISPM 15	0.47	0.50	0	1
ISPM 15 (export partner)	0.17	0.37	0	1
ISPM 15 (import partner)	0.01	0.09	0	1
Income	48.81	2.42	41.52	53.68
Transparency	0.41	1.13	−1.83	2.50
Borders	0.11	0.32	0	1
Language	0.53	0.50	0	1
Distance	8.65	0.87	6.56	9.59
Colony	0.05	0.21	0	1

4.2 Empirical Analysis

A total of 516 models were estimated (i.e. 86 sectors × 2 trade categories (imports/exports) × 3 model specifications). Results are presented below.

Exports

Tables 22 and 23 present detailed results for the two most important export sectors in Botswana (in terms of export value); precious metals and stones (Table 4) and nickel articles (Table 5). We present estimates for all three empirical models (column 1 for the parsimonious fixed effects specification, column 2 for our preferred richer fixed effects specification, and column 3 for the random effects specification).

According to Table 4 (Model 2), there was a (non-statistically significant) increase by 112% in the exports of precious metals and stones during the period after the implementation of ISPM 15 (101% and 173% according to Models 1 and 3). For what concerns nickel articles (Table 5, Model 2), there was a statistically significant increase in export value by 185% during the same period (101% and 109% according to Models 1 and 3).

Table 4: Exports of precious metals and stones (Botswana)

Dependent variable:	FE (1)	FE (2)	RE (3)
Constant	−140.10	−153.15	−32.20
Income	3.06***	3.33**	0.69**
	(1.24)	(1.49)	(0.32)
ISPM 15	1.01*	1.12	1.73***
	(0.58)	(0.88)	(0.64)
ISPM 15 (partner)		0.22	0.29
		(0.90)	(0.71)
Transparency		−0.72	−0.39
		(1.85)	(0.55)
Borders			0.17
			(2.40)
Language			0.89
			(1.27)
Distance			0.75
			(1.24)
Colony			10.79***
			(1.41)
R^2 overall	0.12	0.12	0.27
(within; between)	(0.16; 0.08)	(0.18; 0.07)	(0.13; 0.28)
Countries	66	66	57
N	278	269	237

*Note: Robust standard errors of coefficients in parentheses. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance.*

Table 5: Exports of nickel articles (Botswana)

Dependent variable:	FE (1)	FE (2)	RE (3)
Constant	−217.71	−23.01	7.34
Income	4.76	0.78	−1.42***
	(4.95)	(0.89)	(0.54)
ISPM 15	−1.01	1.85***	1.09
	(1.04)	(0.60)	(0.69)
ISPM 15 (partner)		4.41***	2.32***
		(0.56)	(0.75)
Transparency		−9.50***	−1.14
		(1.32)	(1.24)
Borders			16.25*
			(9.14)
Language			−7.05
			(6.55)
Distance			8.63***
			(1.16)
Colony			−5.06
			(5.94)
R^2 overall	0.01	0.01	0.36
(within; between)	(0.18; 0.02)	(0.68; 0.01)	(0.60; 0.49)
Countries	16	16	12
N	48	48	31

*Note: Robust standard errors of coefficients in parentheses. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance.*

Figure 9 provides in graphical form the distribution of the size of effect of ISPM 15 implementation (b2) across all export sectors (based on the estimates of our preferred Model 2). Effects are presented in descending order, with the sectors experiencing the largest increases in export volumes during the post-ISPM 15 period appearing at the top. The majority of the sectors experienced an increase in export volumes. The largest increases were in dairy products (+349%) and synthetic filaments (+287%), while the largest decreases were in copper articles (−469%) and fertilizers (−366%).

Figure 9: Distribution of ISPM 15 effects across all exporting sectors

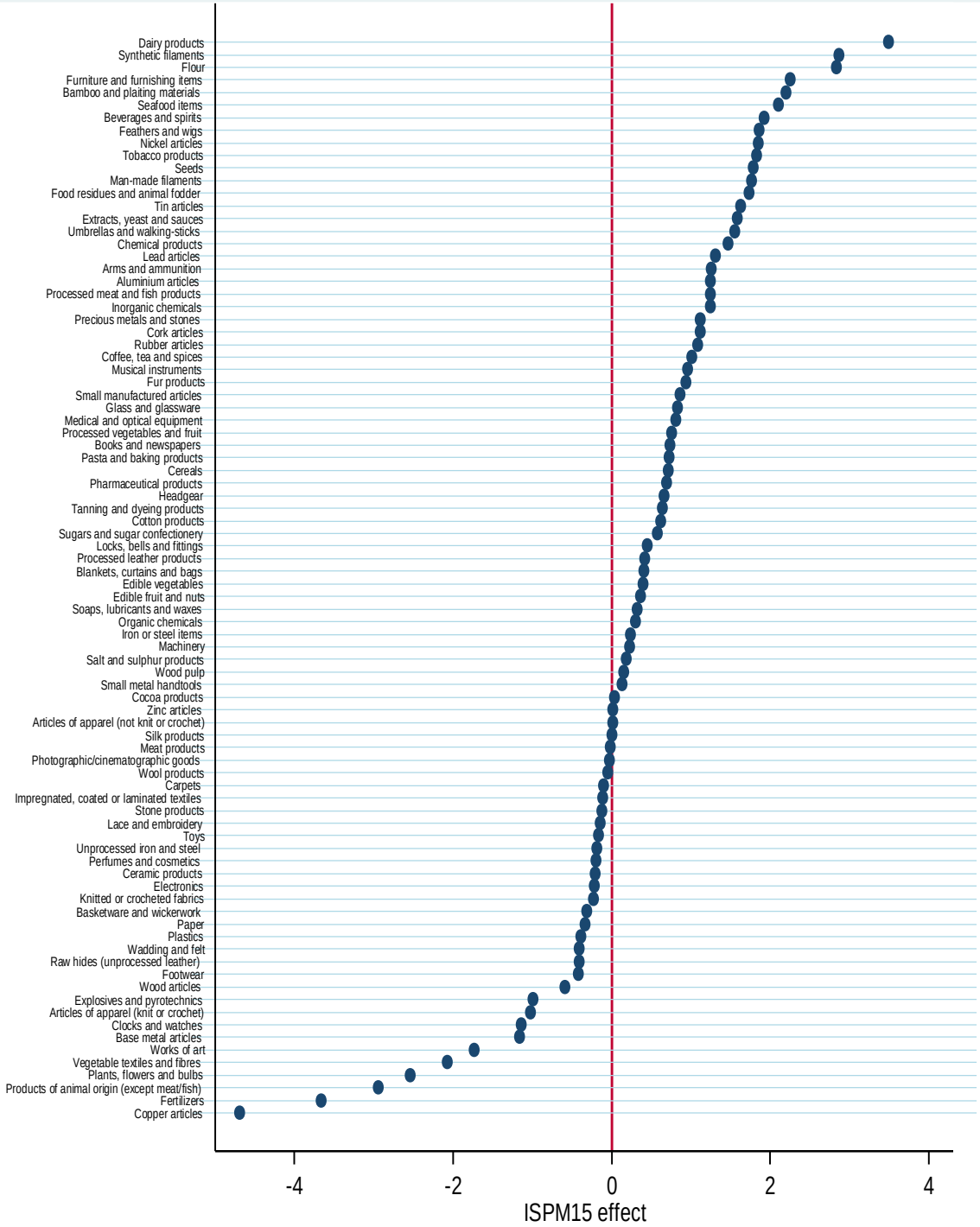
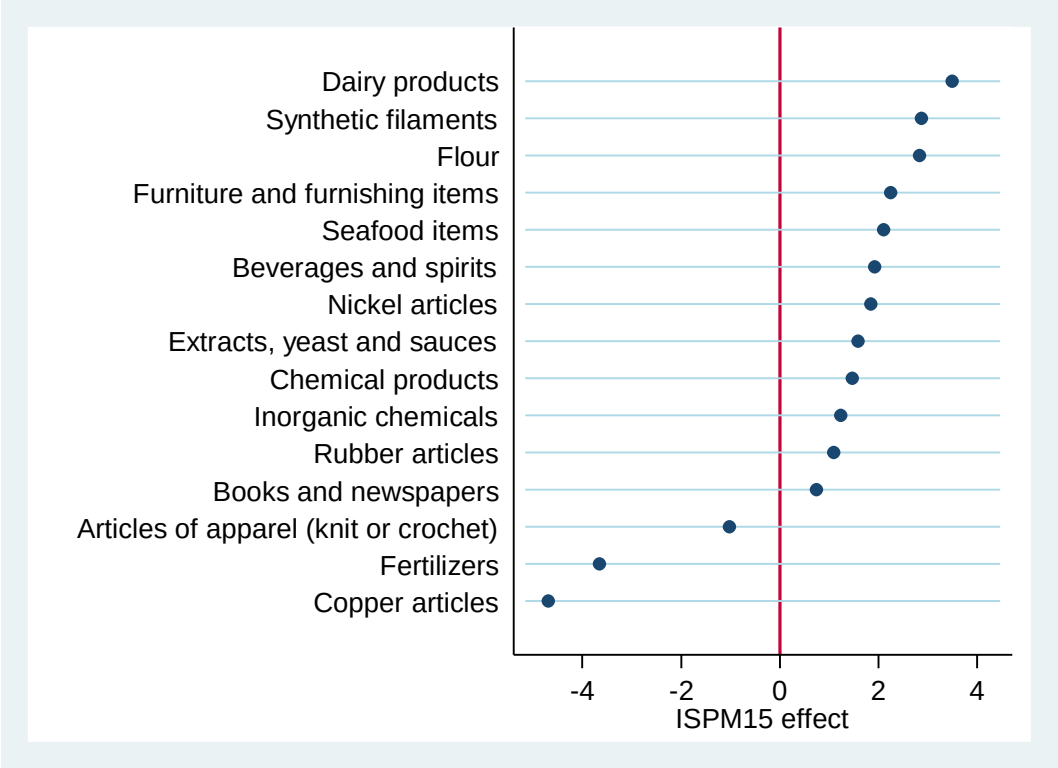


Figure 10 provides in graphical form the distribution of the size of effect of ISPM 15 implementation (b2; Model 2) only for those export sectors where the effect was found to be statistically significant (at least at the 10% level of significance). The vast majority of sectors experienced an increase in export volumes. The largest increases in the period after ISPM 15 implementation were in dairy products (+349%) and synthetic filaments (+287%), while the largest decreases were in copper articles (−469%) and fertilizers (−366%).

Figure 10: Distribution of only statistically significant ISPM 15 effects (exports)



Imports

Tables 24 and 25 present detailed results for the two most important import sectors in Botswana (in terms of import value); precious metals and stones (

Table 6) and machinery (Table 7). We present estimates for all three empirical models (column 1 for the parsimonious fixed effects specification, column 2 for our preferred richer fixed effects specification, and column 3 for the random effects specification).

According to

Table 6 (Model 2), there was a non-statistically significant increase by 14% in the imports of precious metals and stones during the period after ISPM 15 implementation (35% and 86% according to Models 1 and 3). For the case of machinery (Table 7, Model 2), there was a non-statistically significant increase in export value by 30% during the same period (33% and 22% according to Models 1 and 3).

Table 6: Imports of precious metals and stones (Botswana)

Dependent variable:	FE	FE	RE
	(1)	(2)	(3)
Constant	−139.46	−151.37	−33.87
Income	3.03***	3.29***	1.02***
	(0.87)	(0.97)	(0.37)
ISPM 15	0.35	0.14	0.86**
	(0.52)	(0.54)	(0.42)
ISPM 15 (partner)		0.39	0.32
		(1.26)	(1.18)
Transparency		−2.38	−0.12
		(1.75)	(0.59)
Borders			0.13
			(2.06)
Language			1.52
			(1.24)
Distance			−1.10
			(1.26)
Colony			5.98***
			(1.47)
R^2 overall	0.07	0.05	0.16
(within; between)	(0.13; 0.03)	(0.15; 0.01)	(0.09; 0.17)
Countries	59	59	51
N	324	313	280

*Note: Robust standard errors of coefficients in parentheses. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance.*

Table 7: Imports of machinery (Botswana)

Dependent variable:	FE (1)	FE (2)	RE (3)
Constant	−21.88	−18.46	−22.04
Income	0.68*	0.61	0.90***
	(0.38)	(0.39)	(0.15)
ISPM 15	0.33*	0.30	0.22
	(0.20)	(0.20)	(0.18)
ISPM 15 (partner)		1.47**	1.59**
		(0.69)	(0.77)
Transparency		0.05	0.88***
		(0.52)	(0.22)
Borders			2.01*
			(1.25)
Language			1.04**
			(0.47)
Distance			−1.32***
			(0.51)
Colony			1.33**
			(0.62)
R^2 overall	0.28	0.29	0.48
(within; between)	(0.04; 0.26)	(0.04; 0.26)	(0.05; 0.46)
Countries	116	116	95
N	860	817	718

*Note: Robust standard errors of coefficients in parentheses. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance.*

Figure 11 provides in graphical form the distribution of the size of effect of ISPM 15 implementation (b2) across all import sectors (based on the estimates of our preferred Model 2). Effects are presented in descending order, with the sectors experiencing the largest increases in import volumes during the period after ISPM 15 implementation appearing on the top. Approximately half of all sectors experienced an increase in import volumes. The largest increases in the aftermath of ISPM 15

implementation were in cereals (+184%) and tobacco products (+174%), while the largest decreases were in explosives and pyrotechniques (−219%) and fertilizers (−165%).

Figure 11: Distribution of ISPM 15 effects across all importing sectors

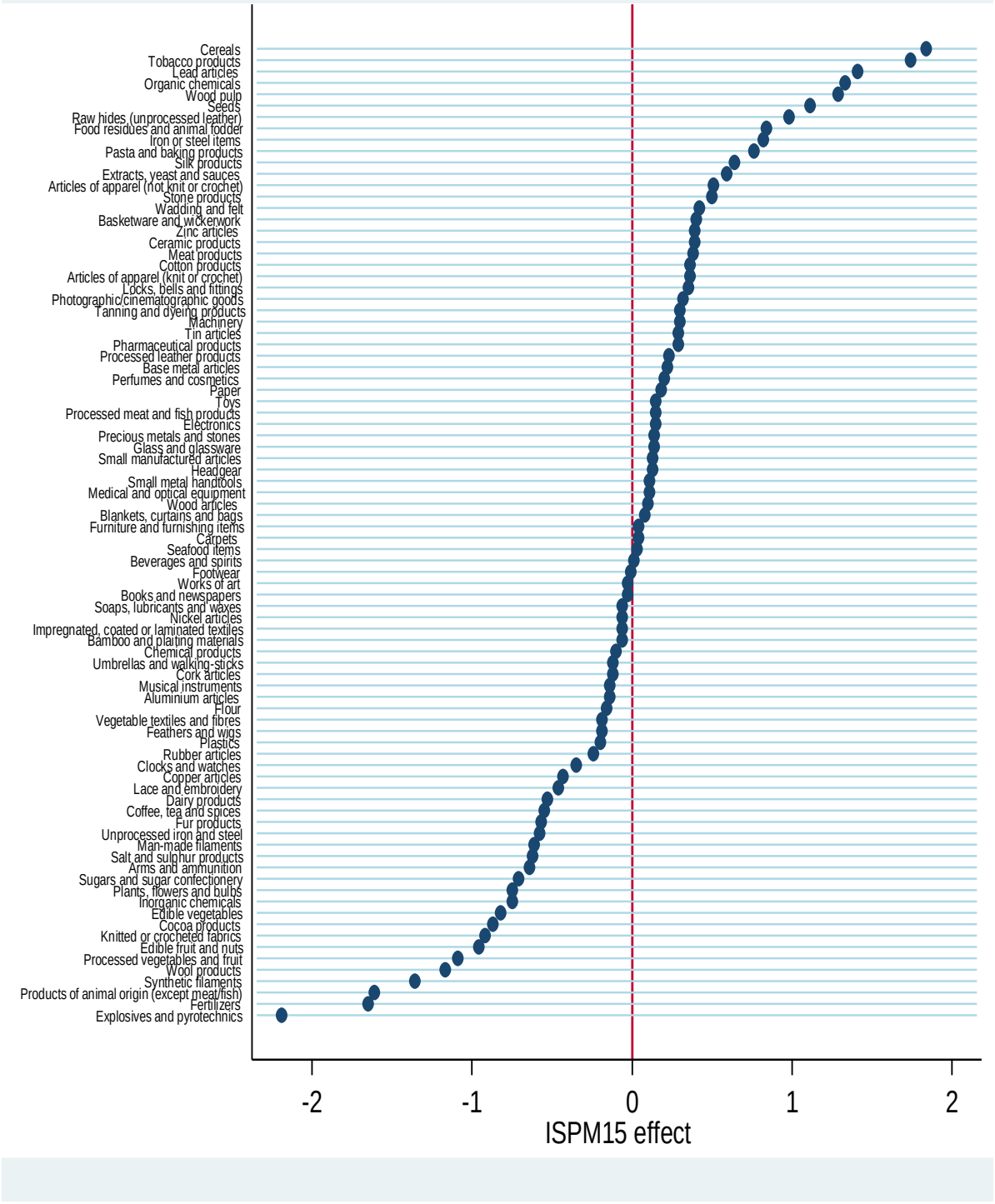
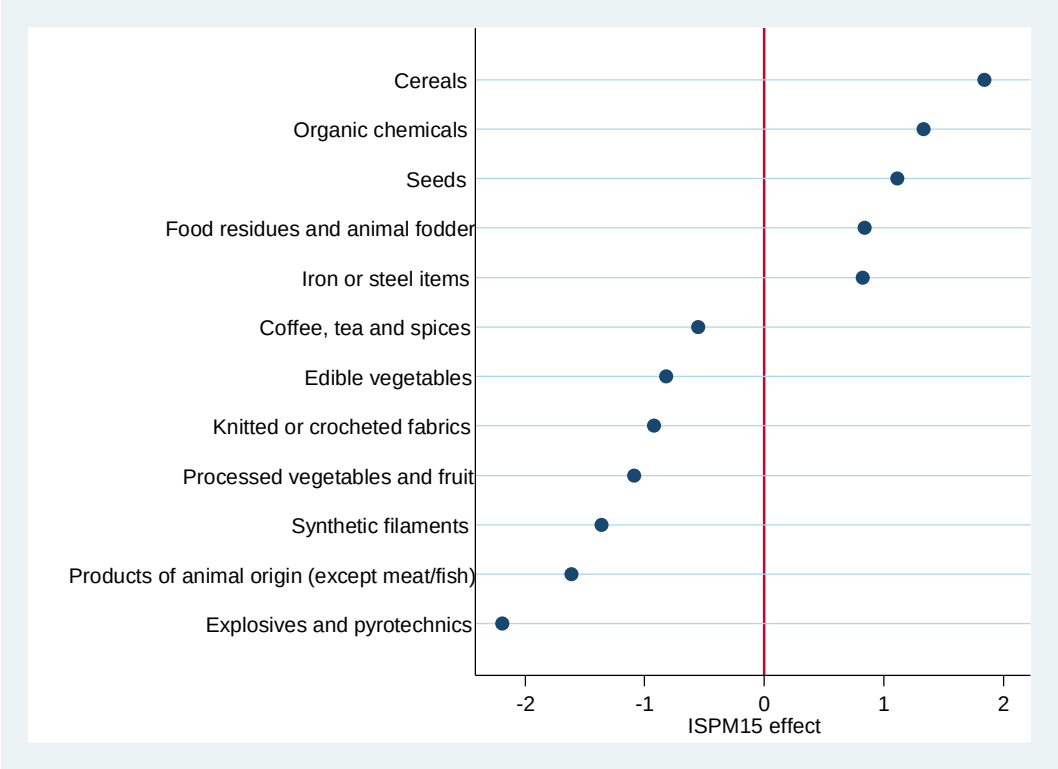


Figure 12 provides in graphical form the distribution of the size of effect of ISPM 15 implementation (b2; Model 2) only for those import sectors where the effect was found to be statistically significant (at least at the 10% level of significance). Approximately half of the sectors experienced an increase in import volumes. The largest increases in the aftermath of ISPM 15 implementation were in cereals (+184%) and organic chemicals (+133%), while the largest decreases were in explosives and pyrotechnics (−219%) and products of animal origin (−161%).

Figure 12: Distribution of only statistically significant ISPM 15 effects (imports)



Change in trade balance

Multiplying the sector-specific coefficient of the ISPM 15 with the value of the corresponding sector (2013 values) provides an estimate of the change in value for the particular exporting/importing sector between the periods before and after ISPM 15 implementation (after controlling for other determining factors, such as the size of economic activity, transparency levels, etc.). We do this for all sectors where the ISPM 15 effect is statistically significant (i.e. those listed in Figure 10 for exports and Figure 12 for imports). Tables Table 8 and Table 9 display the change in export and import value (in million USD) per sector. The largest drop in export values was in copper articles (−20.17 million USD) and articles of apparel (USD −6.73 million). The largest drop in import values was in processed vegetables and fruit (USD −58.86 million) and edible vegetables (USD −35.26 million).

Aggregating these values across all these exporting and importing sectors provides the overall change in value for all exports and imports. Overall, exports increased by USD 831,457,000, while imports increased by USD 275,596,000. As a result of this, the trade balance improved by USD 555,861,000 (Figure 13).

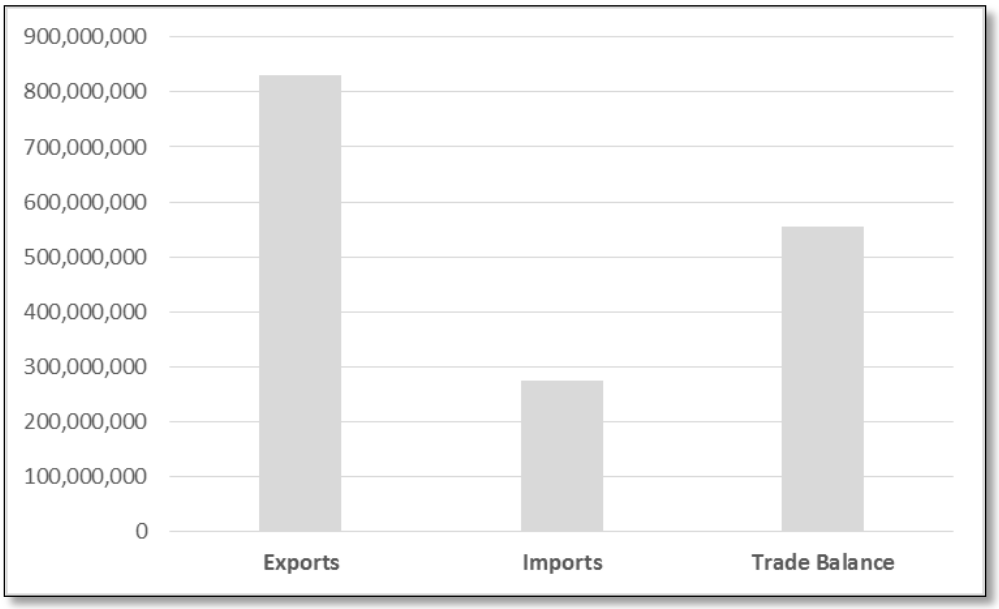
Table 8: Change in export values per sector (in million USD)

Copper articles	−20.17
Articles of apparel (knit or crochet)	−6.73
Fertilizers	−0.07
Seafood items	0.14
Extracts, yeast and sauces	0.57
Chemical products	0.61
Rubber articles	1.20
Dairy products	1.29
Synthetic filaments	1.79
Books and newspapers	3.77
Flour	8.49
Beverages and spirits	9.02
Furniture and furnishing items	9.90
Inorganic chemicals	44.64
Nickel articles	777.00

Table 9: Change in import values per sector (in million USD)

Processed vegetables and fruit	−58.86
Edible (fresh) vegetables	−35.26
Explosives and pyrotechnics	−26.28
Coffee, tea and spices	−14.30
Synthetic filaments	−4.76
Knitted or crocheted fabrics	−2.12
Products of animal origin (except meat/fish)	−0.95
Seeds	6.22
Organic chemicals	14.63
Food residues and animal fodder	26.88
Iron or steel items	131.20
Cereals	239.20

Figure 13: Changes in values of exports/ imports/ trade balance in Botswana (USD)



Summary of findings

The purpose of this macroeconomic analysis is to estimate changes in trade volumes (exports/imports) during the periods before and after ISPM 15 implementation across multiple commodity sectors. We followed the conventional methodological approach used for such purposes in the empirical trade literature, which is the estimation of trade gravity models. These allow estimating simultaneously the statistical correlation (association) of these bilateral trade flows with several socio-economic and geographical factors. Overall, we found that:

- The vast majority of sectors experienced an increase in export volumes. The largest increases in the aftermath of ISPM 15 implementation were in dairy products (+349%) and synthetic filaments (+287%), while the largest decreases were in copper articles (−469%) and fertilizers (−366%). The decrease in the value of exports of copper articles could have been facilitated by fluctuations in copper prices on global markets.
- Approximately half of the sectors experienced an increase in import volumes. The largest increases in the aftermath of ISPM 15 implementation were in cereals (+184%) and organic chemicals (+133%), while the largest decreases were in explosives and pyrotechnics (−219%) and products of animal origin (−161%).
- Overall, exports increased by USD 831,457,000, while imports increased by USD 275,596,000. As a result of this, the trade balance improved by USD 555,861,000.

Policy Recommendations

Given the unequal distribution of effects across sectors, the authorities in Botswana should pay attention to those sectors that experienced an economic contraction in the aftermath of the ISPM 15 implementation. The export sectors with the largest percentage decreases were: copper articles (−469%) and fertilizers (−366%). In total, three export sectors experienced a statistically significant drop in export revenues (Figure 10). A more qualitative-based analysis per sector needs to identify the extent to which the drop in export revenues for each sector has been associated with the administrative burden and costs associated with the ISPM 15 implementation in combination with other underlying internal and external factors (e.g. changes in prices locally and globally, emergence of new competitors, constraints in domestic productive capacity, or exchange rate volatility). The same should also apply in the context of import sectors.

In Botswana, the implementation ISPM 15 appears to be associated with an overall increase in both exports and imports. Overall, exports increased by USD 831,457,000, while imports increased by less (USD 275,596,000). As a result of this, the trade balance improved by USD 555,861,000. This is quite encouraging, given that Botswana has been running an overall trade deficit until recently (2015). Supporting those exporting industries that experienced a contraction in the aftermath of ISPM 15 implementation could further sustain the process of turning the past trade deficits into trade surpluses. Alternatively the government could support those sectors that grew substantially after the implementation of ISPM 15, as long as these industries can expand further and compensate for the value and employment loss that other sectors experienced.

5. ISPM 15: findings based on microdata

The precise assessment of the costs and the benefits related to implementation of ISPM 15 does not constitute an easy task. Available studies on the subject have not been able to go beyond rough estimates, as a number of hypothetical and sometimes unquantifiable factors are often involved. There are no studies, to our understanding, trying to quantify the costs and the benefits related to the implementation of ISPM 15 in developing countries, which makes the present research of particular importance for its contribution to the subject matter.

The available evidence – mostly based on country case studies and regional assessments conducted in developed areas of the world – suggests that:

- **i.** The burden of the compliance cost is imposed on exporting countries.
- **ii.** WPM treatment facilities (i.e. private businesses) have to bear the implementation costs. Those costs are later transferred to the exporters and to the final consumers via the importers.
- **iii.** The cost of compliance is relatively high if put in relation to the income level of the low income and least developed countries.
- **iv.** While the cost of compliance is high, the short- and long-term costs related to the lack of compliance is enormous, in terms of potential foregone export, income and employment.
- **v.** The cost and efficiency of the compliance depend, *inter alia*, on the organization of the supply chain.

Although the implementation and compliance costs relate to both imports and exports, the majority of the costs burden the exporter. For this reason, this chapter will assess the costs and the burden of compliance from the perspective of the WPM treatment facilities, which were very likely to experience a number of new fixed and variable costs and benefits since implementation of ISPM 15 became compulsory in the country.

Implementation of and compliance with ISPM 15 may, however, also generate costs on stakeholders other than the WPM treatment facilities. For instance, the NPPO may incur additional costs related to the organization of training courses, or there may be the need for additional phytosanitary inspectors (Table 10).

Table 10: Costs and benefits related to the ISPM 15 implementation

Implementation at the export level		Implementation at the import level
Costs	*Benefits*	*Costs*
Fixed costs for the WPM treatment facilities Inspections/audits costs for the WPM treatment facilities Variable costs for the WPM treatment facilities Validation checks	Revenues from the sale of treated WPM	Legislative changes Hiring of inspectors and inspections Training inspectors Adminstrative costs Purchase of the necessary equipment
Overall benefits for the country	Being able to export Reduction in the introduction and spread of economically devastating pests Agricultural yields not affected by economically devastating pests	

Source: Authors' elaboration.

Those costs are not taken into account here when computing the overall costs that compliance with the standard may have generated. In this chapter we limit our analysis to estimating the costs the WPM treatment facilities are facing and comparing them to the revenues. For the time being we will disregard all the costs related to organizing the import inspections.

From the perspective of the WPM treatment facilities, the compliance costs can be high in absolute and relative terms, especially for those developing countries lacking the know-how, resources and specific competencies related to ISPM 15. According to the available literature on this issue, the cost of compliance is the sum of all expenses that are directly and indirectly related to the standard's implementation. Those costs include the funds disbursed for purchasing components of the supply chain (fixed costs) for instance to purchase a heat chamber or the necessary equipment to apply MB. In addition, the cost analysis should take into account a number of variable costs too; costs related to hiring workers with the necessary technical expertise of the treatment, to carrying out inspections, to obtaining the license to operate, and so forth.

The revenue benefits for the WPM treatment facilities relate to the mark-up price WPM treatment facilities can charge for their treated WPMs. If there is a positive difference between the benefits and the costs it would indicate that the WPM treatment facilities are economically viable entities. In addition, it would indicate that the whole system created ad-hoc for implementing and complying with the standard is generating revenues and that there is enough demand for treated WPM. However, if the costs are higher than the financial benefits this may indicate that the overall chain is not profitable enough. In this case, it would be important to understand which are the system bottlenecks, why a loss exists and which potential remedies could be put in place.

The cost-benefit analysis of ISPM 15 cannot be limited to the assessment of the economic profitability of the WPM treatment facilities. There are a number of other direct and indirect economic consequences the implementation of the standard may generate. For the sake of completeness, we have supported the results of the cost-benefit analysis with the analysis of the procedures put in place by the NPPO, and with a macroeconomic analysis of the trade position of the country.

The stakeholders of ISPM 15 implementation, and especially the NPPO, should take the results of the three types of analysis into consideration to increase their understanding of the effects the standard has generated. Therefore, the three analyses may be read as stand-alone or as three different components of the same phenomena.

The rest of this section is organized in the following way. The next section introduces and describes the survey tool used for the data collection process. The questionnaire was given to all the WPM treatment facilities operating in the country, and the rate of responsiveness, any missing data problems as well as data quality will be discussed too. The presentation of the descriptive statistics and the costs and benefits analysis is presented in Section 5.3, followed by the conclusions.

5.1 Description of the survey tool

There are many ways to conduct a cost-benefit analysis related to the implementation of ISPM 15. One way could be to examine all the expenditures the central government faced to guarantee the correct implementation of the standard. Those costs may relate to the research needed to understand and correctly apply the treatments, to the change in the regulation adopted by the country in matters related to trade and in the management of the "new" supply chain, or to the hiring of phytosanitary inspectors. Another strategy could be to assess the aforementioned costs and compare them with the number of pests that have been introduced in the country before and after the standard was implemented; this comparison would help quantifying the funds saved as a consequence of the reduction of such pests. This analysis would also help understanding the impact the standard has had at the phytosanitary level and, possibly, on the agricultural yield and productivity. Data for assessing these costs and impacts are scarce, if not completely lacking.[7] As previously discussed, the activity of keeping up-to-date records of pests in the country is not conducted in any of the four case-study countries.

In what follows, we will assess the costs WPM treatment facilities have faced, and if the costs will outcast the benefits coming from the sale of the treated WPM. For this purpose, we prepared a survey tool consisting of a detailed questionnaire directed at the WPM treatment facilities operating in each of the four case-study countries. The questionnaire comprises several different sections, each of which relates to different aspects of the WPM treatment facilities' business cycle.[8] The seven sections the questionnaire are composed as following:

i. Section 1: Questions regarding the wood treatment facility

ii. Section 2: Wood treatment facility: general information

iii. Section 3: Wood treatment information

[7] The lack of data is related to the fact that it is extremely difficult to know, with a high degree of certainty, that a particular species was introduced by a particular commodity. Usually, such information is largely based on assumptions. Furthermore, it is computationally complicated to assess the economic and environmental impact of the pest in a particular region.

[8] The questionnaires used in the four countries differ slightly to reflect country-specific situations. However, the content of the four questionnaires, as well as the data collected, are in any case comparable. A copy of the master questionnaire, which was developed before the country missions, is attached to this study. Copies of the four country-specific questionnaires are available upon request.

iv. Section 4: Wood treatment training

v. Section 5: Costs related to the wood treatment

vi. Section 6: Benefits related to the wood treatment

vii. Section 7: General comments.

Section 1 includes general questions about the respondent and its role within the facility, the year the facility started to operate as a treatment facility, and all the requirements needed to obtain the license to operate. The section also queries the number of employees and whether there was an increase in the number of employees following the implementation of the standard.

The second section, investigates the main activities performed by the facility. For instance, whether the facility also manufactures the WPM it will later treat, or if it repairs broken WPM. Given some types of packaging material is made of different materials, the section also queries if the facility only produces WPM or also other packaging material. Also the capacity of the facility in terms of number of treated WPM per year is queried, as are details as to potential repetition of treatments, and which companies buy the final product and for what purpose. In other words, the section aims at understanding the core businesses of the facilities and their capacity.

The third section poses questions regarding the wood treatments used. We query which treatment the facility uses and the main reasons for choosing that instead of another treatment. We also query whether the facility is planning to invest in another treatment and the reasons behind that choice. Lastly, we inquire about any cases where their ISPM 15 mark has been used by other facilities without them knowing.

Section 4 outlines questions regarding the training received by the WPM treatment facility. In this section, we gather information about the type of training received and the organization offering the training, to understand if guidelines have been given to the treatment facility. Furthermore, we ask whether the treatment facilities receive updates on how to comply with ISPM 15 considering its various revisions. The section also seeks information on the time the facility spent purchasing new equipment or adapting old equipment for implementing the international standard. This part tries to assess whether the implementation process is time consuming, for instance in terms of permits required. The section then moves on to gather information on the audits the NPPO does of the facility; the frequency and the type of audit, whether they are done unexpected, and the result of the audits.

Section 5 gathers a series of financial data related to the costs the facility has to cover every year in order to run the treatment business. These are the fixed costs (e.g. investment costs, costs for equipment, license cost) and the variable costs (costs of labour, energy, maintenance, timber, and administration). We also query if the company received any Government subsidy.

Section 6 examines the sources of revenues of the facilities. In this section we gather data on the pieces of treated WPM sold, the unit price and the amount of the unit price for each WPM before ISPM 15 was implemented. The respondent is also asked to indicate the overall economic benefits and costs of ISPM 15 at the facility level.

Section 7 deals with perceptions and gathers data on the knowledge the interviewee has on the possible costs and benefits of the ISPM 15. Here, we try to differentiate between socio-economic impacts (both positive and negative), the main implementation challenges, and the main environmental consequences of the implementation.

5.2 Description of the respondents

Table 11 lists the WPM treatment facility currently operating in Botswana and that has answered the questionnaire. The collection of the data was delegated to a team of enumerators working for the NPPO of the given country. The connection between the enumerators and the NPPO served to make sure that the enumerators were knowledgeable about ISPM 15 and to help ensure that the respondents (the WPM treatment facility employees) would trust the enumerators when providing any type of data, especially those pertaining to financial aspects. This strategy was successful in many cases, but failed in a few.

Table 11: List of WPM treatment facilities for which microdata have been collected, divided by country

Name of the WPM treatment facility	District	City
U-Mac Import and Export	South East District	Gaborone

Table 42 and Table 43 show that for Botswana five additional facilities were interviewed; two WPM manufacturers and three WPM repairers.[9] For those facilities, a modified version of the original questionnaire was developed, as many of the issues covered in the original questionnaire did not apply to their cases. These facilities were interviewed for a number of reasons. First, in Botswana there is only one official WPM treatment facility and in order to better understand the WPM situation in the country we wished to look at the issue using different angles. Second, there are a number of WPM repairers in the country, most of them located in the outskirts of the capital. As discussed already in Chapter 4, these facilities repair broken WPM (treated and untreated), and the resulting WPM looks exactly like treated WPM. The presence of WPM repairers poses a threat to the compliance with ISPM 15, and constitutes a risk in terms potential pests being moved internationally on what looks like treated WPM.

Table 12: List of WPM manufacturers in Botswana for which microdata have been collected

Progressive number	Name of the WPM manufacturer	District	City
	Botswana		
1	Shkinah Investment	South East	Gaborone
2	Altimo Pallets	South East	Gaborone

[9] A copy of the two questionnaires used for interviewing the WPM manufacturers and the WPM repairers is available upon request.

Table 13: List of WPM repairers for which microdata have been collected

Progressive number	Name of the WPM repairer	District	City
	Botswana		
1	n/a	South East	Gaborone
2	n/a	South East	Gaborone
3	n/a	South East	Gaborone

For what concerns the data collection process, the following should be noted.
It took the research team about three months to receive the lists of the WPM treatment facilities from the NPPO. For some European countries, such as Italy and the Netherlands, this list is published online, and only the WPM treatment facilities that have a valid license to operate are included (the list is updated regularly). Having an online list available to anyone is beneficial for several reasons, for instance exporters can check that the WPM treatment facility they buy treated WPM from has been authorized by the NPPO.

It is also crucial to highlight a few things about the quality of the data collected by the enumerators. The overall rate of responsiveness was relatively good. The questionnaires were well compiled by the enumerators and well answered by the respondents. However, the section, aimed at gathering data on the financial disbursements of the facilities, presented some issues, as in some cases respondents were not willing to disclose their costs and their revenues. This in spite of making it very clear to all the interviewed facilities that data would have been used in an anonymous way.

Some of the questions in the survey presented missing values where the respondents did not give an answer. In those situations we have not imputed the missing value but continued the analysis without that particular data point. In several cases the information gathered via the survey tool has been triangulated with the qualitative information collected during the country missions or with other information or data coming from third sources. This check has been necessary to verify the correctness of some of the microdata, and in some cases, the data collected tell a different story than that told in the qualitative interviews. As an example, the manager of the WPM treatment facility located in Botswana, mentioned that he had never been audited by the NPPO whereas the data collected using the questionnaire reports that he is audited once a year. We cannot always determine which version reflects the reality, and can therefore only make the reader aware of such inconsistency. However, most of the data collected is in line with data collected by third parties and published in academic publications, which underpins the quality of the data and of the analysis presented here.

5.3 Descriptive statistics

Each NPPO, at its own discretion, sets a number of requirements each of the applicant facilities should present to obtain authorization as a legitimate WPM treatment facility. These requirements are not well communicated to the facilities. The respondents' answers within each country highlight that there is no consistency in the type of requirements requested from the facilities, even within the same country (Table 14). This feature can be better seen in countries different from Botswana where the comparison among facilities is not feasible due to the presence of only one WPM treating facility.

Generally speaking, the NPPOs should have clear requirements that apply to all applicants for WPM treatment authorization, and they should communicate these publicly. The NPPO could achieve this by preparing a document to be published in the country's official gazette or on its official website. This issue will be discussed more in details in the next concluding chapter.

Table 14: Requirements for becoming a legit WPM treating facility

Requirement	**Req.**	**Req.**	**Req.**
Certificate of MB knowledge	Health inspection report	Env. assessment report	Trading license

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

The facility operating in Botswana is a small one, having in total 3 employees working in the company (Table 15). The implementation of ISPM 15 has not influenced the number of employees hired. The facility only deals with treating WPMs as it does not manufacture nor repair them.

Table 15: Size and employees number of the WPM treating facilities and type of business

Average number of employees working in the WPM treating facility	Share of WPM treating facility which had an increase in the number of employees after ISPM 15 implementation (in %)	Average increase in the number of employees	Share of WPM treating facilities manufacturing WPM (in %)	Share of WPM treating facilities repairing WPM (in %)	Share of WPM treating facilities repairing treated WPM (in %)	Share of the WPM produced/ treated in the facility made of wood (in %)
3	0	0	0	0	0	100

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

Table 16 presents the amount of WPM treated monthly by the treatment facility, and at the use and destination of the treated WPM.

However, it should be noted that these numbers may be inflated; Botswana facility believe that already treated WPM needs to be re-treated after a month, if not used. The belief that treated WPM may be reinfested is shared by other stakeholders too; the company Botswana Meat Commission, which exports meat-related products mostly to the UK, does not keep treated WPM in stock as it fears re-infestation. For this reason, it only uses newly and freshly treated WPM.

This contradicts ISPM 15 that instead provides that "[…] a unit of wood packaging material that has been treated and marked in accordance with this standard and that has not been repaired, remanufactured or otherwise altered does not require re-treatment or reapplication of the mark throughout the service life of the unit".

The treated WPM is in most cases used for exports, mainly United Kingdom. The facility, as previously indicated, only uses the MB treatment. The choice of MB is driven by the fact that is a less expensive treatment, easier to implement and more effective if compared to the HT.

Table 16: Number of WPM treated, their use and type of treatment

Average number of WPM being treated per month	Internal or international customers	Use of the treated WPM	Treatment used	Reason for choosing that treatment	Share of facilities thinking of adopting a new treatment (in %)
333	External United Kingdom	Meat products	MB (100%)	1. Less expensive 2. Easier to implement 3. More effective	0

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

One of the main activities the NPPOs have to organize when the country decided to implement ISPM 15 is training of stakeholders. In Botswana, an initial training was offered to the WPM treatment facilities (

Table 17). The data on the training clashes with the information gathered via non-structured interviews, where the owner of the WPM treating facility stated that no training had been received.

It is also crucial that the NPPOs notify all stakeholders, and particularly the WPM treatment facilities, on matters related to compliance with the standard. In fact, according to the data collected the facility in Botswana is aware of changes adopted to ISPM 15.

ISPM 15 clearly prescribes that the NPPO should audit all the facilities present in the country. The data indicate that the NPPOs inspect the facilities randomly, and that the inspections are carried out either by the NPPO or by the Ministry of Agriculture (

Table 17). The frequency of the inspections is yearly or biannual. Three main observations arise from this. First, ISPM 15 does not clearly specify the frequency of inspections, leaving it up to the NPPO to decide. The NPPO in Botswana has decided for one or maximum two inspections per year, and this is in line with ISPM 15.

Second, the content of the inspections is unclear and varies between the inspections. The NPPO do not have guidelines or standard operating procedures for the inspections to guide the inspectors. This presumably leads to the result that different inspectors carry out the inspections different ways. ISPM 15 also prescribes that "[…] for the purpose of auditing, the treatment provider keeps records of heat treatments and calibrations for a period of time specified by the NPPO", but the interviewed NPPOs did not show any indication that they comply with this.

Third, which relates to the quality of the data, the WPM facility in Botswana when interviewed mentioned that the facility had never been audited by the NPPO, but provided evidence of the contrary during the data collection process, stating here that his facility was inspected once a year.

Table 17: Types of training received and inspections being made

Share of WPM treating facilities which have received training	Agency which organized the training	Share of WPM treating facilities which are receiving updates about the standard	Share of WPM treating facilities having random inspection (in %)	Organization in charge of organizing the random inspection	Number of random inspection per year
100	NPPO (100%)	100	100	NPPO (100%)	1 (100%)

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

The last section of the questionnaire refers to the consequences, at many different levels, the implementation of ISPM 15 may have had in the country. This section has the objective to understand the knowledge of the interviewees have of the standard and its spillover effects. The first question sought details on the effects on the WPM treating facilities (Table 18). The respondent from Botswana does not think the ISPM 15 implementation will generate any social impact.

For what concerns the environmental impacts, the respondent focuses on the negative aspects, and stress that the persistent use of MB will likely deplete the ozone layer, which is indeed the reason why the use of MB has been banned in several other countries.

Finally, the respondent was asked to mention few positive and negative impacts the standard may have generated in the country. The positive aspect relates to the employment generation is sectors related to the WPMs; on the other side the standard has increased the competition in the timber sector.

Table 18: Main social, environmental and overall impacts of the ISPM 15

Main social impacts
No effect
Environmental impacts
Ozone depletion for MB use
Change in weather pattern
Positive (p) and negative (n) impacts of the ISPM 15
Increase in employment (p)
Increase in competition (n)
WPMs may be substituted with plastic ones (n)

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

Table 19 lists the types of costs borne by the WPM treatment facility. The costs, which were originally measured in the local currency of the country, are expressed in USD in the table.[10] First, we query the amount spent for all the equipment and the number of years that equipment should be used for. The costs here are higher if the facility uses HT, just as the number of years the equipment will last for is higher than for MB treatments. The life expectancy of the equipment will serve to discount the amount spent for the equipment and allocate a share of those expenses to the next years.

Equipment and license costs constitute the fixed costs each facility has every year. The table indicates that, on average, the variable costs constitute the majority of the yearly costs. Both sources of the fixed costs, discounted by the number of years, represent a very limited share of the total costs. This means that the perception that opening up a WPM treatment facility is extremely costly does not match with the microeconomic data.

Table 19: Average annual cost –in USD- for the WPM treating facilities, disaggregated by the source

Cost	Botswana
Equipment cost	897
(Life expectancy of the equipment)	(30)
License	103
Costs for repairing equipment	0
Administrative cost	595
Timber costs	30
Salaries	991
External costs	0
Energy related costs	30
Other material cost	0
Other cost	0
Total	**2,676**

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

[10] The costs, as well as the revenues, refer to the year before the year when the interview has taken place. The interviews took place in 2016, hence the financial data refer to 2015.

The process of estimating the costs related to the implementation of and compliance with ISPM 15 should consider the time needed to set up a WPM treatment facility This period relates to the time needed for the facility to purchase or update equipment, present all the necessary documentation, be inspected by the NPPO, and obtain authorization to operate. In the questionnaire, this was tackled through two questions; the first pertained to the time needed to purchase any equipment needed for treating the WPM, and whether the facility needed to update existing machines; the second related to the number of months needed to become fully operational. The facility operating in Botswana did not need much time to update and buy machineries and to fully become operational (2 months in total) (Table 20).

The questionnaire also queried the revenues the WPM treatment facilities have realized in the current year. In order to compute this figure, we first queried the maximum capacity of the facility, (i.e. the maximum number of WPM the facility is able to treat per year). In Botswana, the maximum capacity amounts to about 12,000 WPM per year, while the actual number of WPM the facility treats every year amounts to 4,000. Those statistics are in line with the information gathered during the qualitative interviews; Botswana does not have an extensive export sector, hence the low number of WPMs being treated.

The last part of Table 20 gathers all the different data previously analysed to assess whether the WPM treatment business is a profitable one.
The first number presents the estimated annual cost each WPM treatment facility will bear to be operational. The second column indicates the number of WPM the facility treats every year. Based on the price each treated WPM is sold for –approximately 1,2 USD - we can infer what would be the ideal amount of WPM to be treated and sold every year for the revenues to cover the total costs. This information is in the third column.
Results indicate that the facility operating in Botswana would only need to treat about 1,500 WPMs per year to be in a break even point position. Given the number of WPMs the facility actually treat, then it can be inferred that the facility is operating in a surplus.

Table 20: Time needed for updating/purchasing equipment, total WPM capacity and total costs

Average number of months needed to update/buy machineries	Average number of months needed to become operational	Share of WPM treating facilities undergoing a verification process (in %)	Maximum number of WPM the facility can treat, per year	Number of WPM being treated in the current year	Number of WPM being treated in the previous year
1	1	100	14,304	4,768	4,768
Total cost	# of WPM treated	# of WPM treated for to break even			
2,676	4,768	1,752			

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

After having investigated whether the facility operates in a loss or in a surplus, we will now examine whether it would be more profitable to close the facility and instead invest the money. To answer this, we need to know the current interest rates on savings in Botswana. Table 21 shows two different interest rates, one that is more conservative with lesser return, and the other less conservative with higher potential return on the investment. The interest rates relate to a deposit investment for a period of 24 months. The last two rows of the table show that in either case, whether a more conservative

interest rate or a more speculative one is chosen, the revenues coming from the investments would be lower than the surplus coming from the facility.

Table 21: Cost-benefit analysis for the WPM treatment facilities

	Botswana
Costs	2,676
Revenues	4,863
Surplus/deficit	+ 3075
Interest rate (lower band)	3.28
Interest rate (higher band)	4.47
Revenues with no investments in WPM (lower band)	48.9
Revenues with no investments in WPM (higher band)	67

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.
Regarding the interest rate part, data on Botswana interest rate come from Barclays and Stanbic bank.

5.4 Conclusions

Is implementing ISPM 15 sustainable for the WPM treatment facilities? Does it offer a good return on the investments disbursed by the facility? Is it necessary for the central government to subsidize the facilities? Would it be better to disinvest from the WPM treatment business and invest in a 24-months bank deposit?
This chapter has tried to answer these questions by using the microeconomic data gathered from the WPM treatment facilities located in the four case-study countries.

The objective of this chapter goes beyond the mere measurement of the costs and the revenues of the facilities. Instead it examines the implementation of the standard by looking at it from the perspective of the facilities. To do this, the facilities were studied with a magnifying glass to understand how they are organized, which have been their choices of treatments and why, and what is the demand of treated WPM. Furthermore, we wished to understand whether the information the facility gets from the NPPO is clear, if any training is provided and what the overall level of knowledge the facilities have of ISPM 15 is.

With this in mind, we designed a facility-level questionnaire with questions ranging from the documentation needed to be presented when requesting authorization from the NPPO to operate in the WPM business, the employment rate of those facilities, the treatments the facilities use, to the training organized to instruct the facility appropriate in how to comply with ISPM 15. In addition, we asked the respondents to elaborate on possible effects – environmental, social and economic – they feel ISPM 15 may have caused. Lastly, an entire section of the survey tool looked at the financial costs the facilities bear when operating, and at their annual revenues. We looked at all the costs related to the treatment process, both fixed and variable costs, and after assessing the costs related to the equipment, to

obtaining authorization, and to salaries and energy, we compared them with the revenues from the sale of the treated WPM.

The analysis highlighted a number of interesting key points. First, there is no homogenous approach to what is requested from applicants wishing to obtain authorization as a WPM treatment facility. While ISPM 15 does not set requirements around this, there should be clarity within the country on the documentation requested from the applicant facilities to provide for transparency, equality and efficiency, and help ensure that the facilities meet all the requirements for operating the treatments set out in ISPM 15.

The authorization process is rather fast; overall the process from purchasing all the necessary equipment to receiving the license may take up to two months. The NPPOs should improve the process by providing clearer indications and ad-hoc training.

On the financial side, the content of this chapter, discussed in combination with the qualitative evidence and the macroeconomic analysis, will help understand the overall costs and benefits of implementing the standard. There has recently been controversy over whether it is economically viable to implement and comply with the standard. Those in disagreement with the standard presents the argument that most introduced pests are innocuous whereas ISPM 15 implementation is costly and usually only delays pest introductions, rather than eliminating them.

This chapter demonstrates that the only WPM treatment facility operating on Botswana is self-sustainable and that the costs are off-set by the revenues from the sale of treated WPM.

We also presented the hypothetical scenario in which the average investment spent on a facility would be put in the bank for two years. This hypothesis demonstrated that investing in the facilities is more profitable than investing in a bank. The exercise shows the viability of the WPM treatment business in the four countries, and that the costs related to implementing the standard at the export level are off-set by the revenues. In the next and concluding chapter, we will incorporate the results from all the different analyses to offer a more complete view on the sustainability of the international standard, considering here also other benefits, such as the possibility to export to countries implementing the standard, which have not been considered in this chapter.