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Newer ways for fewer stays: An economic evaluation of One-stop border posts in Uganda

by

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Abstract

High costs, time delays, inefficiency and complicated border procedures when engaging in cross-border trade hinders competitiveness and economic development in many developing countries, such as Uganda. To try to reduce these obstacles and challenges, Uganda has implemented One-stop border posts, intending to make international trade cheaper, quicker, and simpler. This paper investigates the efficiency of these reforms and more specifically in what way the implementation of One-stop border posts in Uganda has affected cross-border trade flows in relation to traditional border crossings. This is achieved by using a Difference-in-Differences framework accounting for two-way fixed effects to analyse cross-border trade flows between Uganda and its neighbours Kenya and Rwanda. The results show a significant positive effect of a 6.2 percent increase in trade flows obtained from One-stop border posts in relation to traditional border posts. Moreover, the results indicate that most of the effect is accounted for by traditionally time-sensitive products such as food and agricultural products, which have experienced a 22.9 percent increase in trade, while no significant effect is found on other types of products.

Keywords: *Cross-border trade, Difference-in-Differences, One-stop border post, Trade facilitation, Uganda*

Abbreviations and Acronyms

AfDB = African Development Bank

AU = African Union

CBM = Coordinated border management

CCZ = Common control zone

COMESA = Common Market for Eastern and Southern Africa

DD = Difference-in-Differences

DFiD = United Kingdom Department for International Development

EAC = East African Community

EU = European Union

IBM = Integrated border management

ICA = Infrastructure Consortium for Africa

ICT = information and communications technology

JBT = Joint Border Post

JICA = Japan International Cooperation Agency

NEPAD = New Partnership for Africa's Development

PAP = Priority Action Plan

PIDA = Programme for Infrastructure Development in Africa

TMEA = TradeMark East Africa

TWFE = Two-way fixed effects

UNCTAD = United Nations Conference on Trade and Development

WCO = World Customs Organization

WTO = World Trade Organization

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1. Introduction

The costs of transporting goods and trading internationally in East Africa are up to 70 percent higher than in other parts of the world, such as Europe and North America, which could be equivalent to decreasing annual GDP growth by 1 percent (TMEA, 2017). These costs together with time delays, poor infrastructure, logistical problems, and complicated and inefficient border procedures seriously reduce competitiveness and hinder development and welfare gains in the region (TMEA, 2017). Furthermore, landlocked African countries without direct access to harbours experience trade costs which in some cases are up to 50 times higher than for African coastal countries (Ben Barka, 2012). Uganda is a landlocked country in East Africa that struggles with high trade costs and time delays when engaging in cross-border trade and the country is looking for ways to decrease these barriers to trade.

One way to handle these trade challenges, and something that the World Trade Organization (WTO) has named a priority, especially for developing countries, is to lower trade costs through improved levels of trade facilitation (WTO, 2015a).

A commonly used definition of the trade facilitation concept is the definition by UNCTAD:

> *"Trade facilitation measures seek to establish a transparent, consistent and predictable environment for border transactions based on simple and standardized customs procedures and practices, documentation requirements, cargo and transit operations and trade and transport conventions and arrangements"* (UNCTAD, 2006, p. 6).

One of the newer concepts, which has become somewhat of a buzzword within the trade facilitation field, is the One-stop border post (OSBP) concept. A OSBP is an upgraded and improved type of border post with the goal of making the cross-border movement of goods and people cheaper, quicker, and more efficient. Many new OSBPs have been implemented in Africa, within the East African Community (EAC) and in Uganda. However, few studies evaluating and estimating the effects have been conducted. The research within the field is therefore not that comprehensive and there is room and a need for more relevant studies investigating the subject. The purpose of this research is to estimate the outcome from OSBPs in Uganda in relation to traditional border posts and to make a contribution to the research and literature within the subject.

This research paper aims to estimate how cross-border trade flows have been affected by border posts being transformed into OSBPs. The paper studies the specific case of Uganda, which – together with the neighbouring countries Kenya and Rwanda – has transformed some of its border posts into OSBPs during 2016, while other border posts remained unchanged. The data used in the paper contains detailed monthly trade data from Ugandan border posts between 2014-2017, both for the border posts that have been transformed into OSBPs, and the ones that remained unchanged. This creates a set-up in which the data are available for a before and after period for both the groups, which makes it suitable to use a Difference-in-Differences (DD) methodology accounting for two-way fixed effects (TWFE).

The author's hypothesis goes in line with previous research, which has found significant positive effects from OSBPs through shorter clearance times, lower costs and higher efficiency at the border. This is something the paper aims to examine *in relation to traditional border posts*, to obtain the causal effect on cross-border trade flows from the OSBPs in Uganda. This leads up to the main question to answer in this study:

"In what way has the implementation of One-stop border posts in Uganda affected cross-border trade flows, in relation to traditional border crossings?"

The results indicate that the OSBPs have experienced an increased cross-border trade that is 6.2% larger than for the traditional border posts, which shows the significant and positive effect from the implementation of OSBPs in Uganda. Furthermore, the results also indicate that the increased trade is mostly accounted for by food and agricultural products, while non-agricultural products have not been significantly affected.

The rest of this paper is structured in the following way: Chapter 2 explains the OSBP concept and the pillars on which the concept rests. Furthermore, this chapter presents the economic benefits that can be obtained from an OSBP, followed by an empirical overview of the use of OSBPs today. Chapter 3 introduces the OSBPs investigated in this paper. Chapter 4 provides a review of relevant literature and previous research within the field. In chapter 5, the empirical strategy and methodology are presented and explained, followed by a discussion about empirical challenges and a presentation of the data used in the paper. In chapter 6, all results and controls are presented, discussed, and analysed. Finally, chapter 7 provides the reader with a summary and a conclusion of the paper, together with suggestions for future research.

2. One-stop border posts

2.1 What is a One-stop border post?

A One-stop border post (OSBP)[1] is a concept implemented to facilitate trade, the movement of goods, people and vehicles, and to improve security at international borders through increased integration and cooperation. The workhorse source for the concept is the "*One Stop Border Post Sourcebook*[2]*"*, which presents the following narrow definition of a OSBP:

> *"… a OSBP is a border crossing point where travellers, goods, and means of transport stop once to undertake exit formalities from one country and entry formalities into the other."* (NEPAD et al., 2016, p. 2-3)

Another definition is given by the International Organization for Migration (IOM), which defines a OSBP as:

> *"A single, shared physical infrastructure in which the neighbouring countries' customs and border services operate side by side."* (International Organization for Migration, 2015, p. 1)

In a broader point of view, a OSBP is a trade facilitation tool that can be applied at border crossings to reduce costs and clearance times by creating a border point where it is only required for people and goods to stop once to take part in exit and entry procedures to travel from one country to another. The concept is an alternative to "traditional" border crossings in which goods and people often must stop twice to take on border procedures and formalities in both the country of origin and the country of destination. This double procedure contributes to increased costs and more paperwork, and to longer time spent at the border crossing (NEPAD et al., 2016).

In 2012, the African Union (AU) initiated the Programme for Infrastructure Development in Africa (PIDA) and the Priority Action Plan (PAP) which are continental programs highlighting Africa's relatively poor infrastructure, which seriously hinders the African

[1] The OSBP concept is in some parts of Africa instead equivalently referred to as a *joint border post (JBP).*

[2] The sourcebook is jointly produced by The New Partnership for Africa's Development Infrastructure (NEPAD), The Infrastructure Consortium for Africa (ICA), East African Community (EAC), The African Development Bank (AfDB) and Japan International Cooperation Agency (JICA).

competitiveness in global markets. JICA and AfDB are the initiators behind the OSBP concept in Africa, which is an essential part of the PIDA-PAP programs with the goal of increasing economic integration and competitiveness on the African continent (PIDA, 2017)[3].

Moreover, a OSBP can be established in accordance with different models presented and illustrated by NEPAD et al. (2016):

i) The Juxtaposed OSBP Model

The Juxtaposed model is a model in which each state has its own facilities for border procedures on its own state territory, which are jointly used by the other state, as seen in Figure 1. This model is the most used when it comes to constructing and implementing OSBPs in Africa today. One of the reasons behind this is due to already existing facilities in both states, and hence it is often more reasonable in terms of time and money, to upgrade these facilities rather than constructing new ones. Another reason can be due to natural barriers and/or borders between the states, e.g., rivers and lakes. Furthermore, a Juxtaposed OSBP model also requires that the national laws allow foreign officers and agencies to carry out their work and follow their laws in the common control zone (CCZ) in the other state.

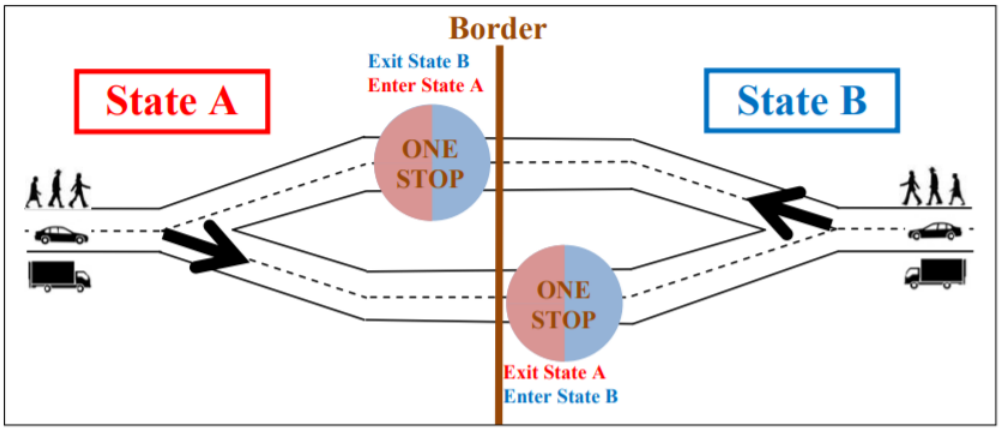

***Figure 1*: The Juxtaposed OSBP Model**

Source: (NEPAD et al., 2011, p. 4)

[3] The East Africa Community (EAC) developed a regulatory framework on OSBPs in the EAC in 2010. This led to the OSBP Act 2013 and the EAC One Stop Border Posts Regulations 2013 which finally resulted in the EAC OSBP Procedures Manual in 2018. The manual specifies guidelines and legal frameworks for establishing and implementing OSBPs in the EAC (Desiderio, 2019). TradeMark East Africa (TMEA), with funding and support from Global Affairs Canada and the United Kingdom Department for International Development (DFiD), has had the main responsibility to construct, implement and operationalize OSBPs in the EAC (TMEA, 2019).

ii) The Straddling OSBP Model

In this OSBP model, seen in Figure 2, the border facilities straddle across the border between the states. This could for instance be represented by a building that is built on the border and is used and shared jointly by agencies from both states. The construction of this type of OSBP requires a flat and open land area on the border, and an advantage associated with this OSBP model is the increased cooperation and information sharing between the agencies and the states.

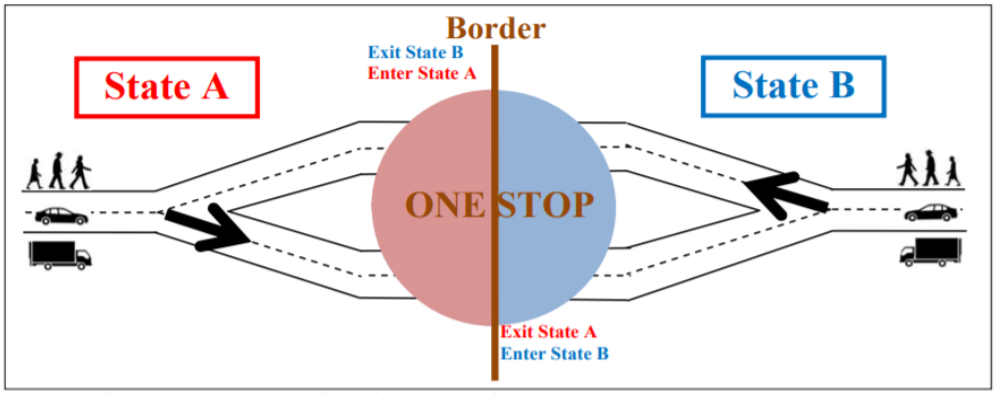

***Figure 2*: The Straddling OSBP Model**

Source: (NEPAD et al., 2011, p. 3)

iii) The Single Country (Wholly Located) OSBP Model

The single country model includes a common facility that is located entirely in the national territory of only one of the states. Another alternative is to locate the OSBP in a "neutral" area between the countries which will then be controlled by a neutral third-party organization. This type of OSBP is similar to seaports, bridges, and other hard infrastructure located in one country. An economic advantage of this model is the opportunity to use economies-of-scale when it comes to the utilization and efficient use of scarce resources since it is not necessary to construct and implement border facilities in both states. Nevertheless, this also requires adequate trust and cooperation between the states and their border agencies since only one of the states will construct and operate the OSBP on its territory. Consequently, the country hosting the OSBP will need the authority and legal framework to allow foreign officers to operate and carry out border procedures at the OSBP, which is illustrated in Figure 3 below.

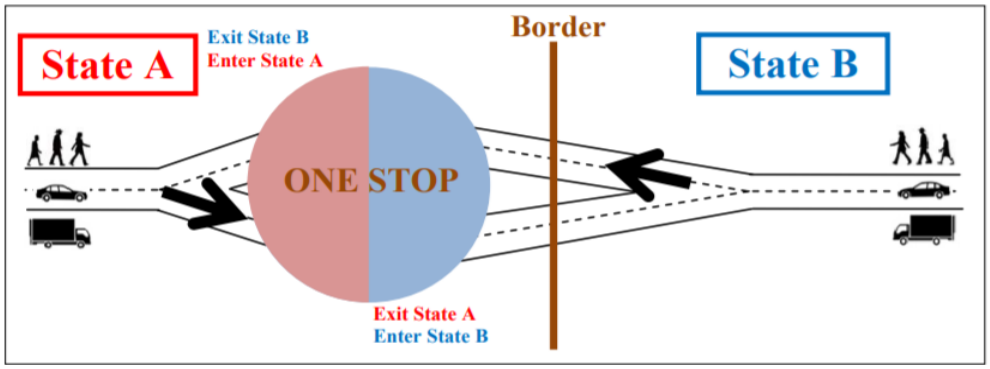

***Figure 3*: The Single Country OSBP Model**

Source: (NEPAD et al., 2011, p. 3)

These intuitive illustrations of the different models of the OSBP concept can be compared with a traditional border crossing with "double procedures". In this type of border post, exit procedures for goods, people, and vehicles leaving state A are carried out on one side of the border. However, similar entry procedures are then carried out on the other side of the border, in state B. This means that goods, people, and vehicles must go through several types of paperwork, payments, and time-consuming controls, only to proceed a few hundred meters and then perform the exact same procedures again, on the other side of the border (NEPAD et al., 2016). This is illustrated in Figure 4 below.

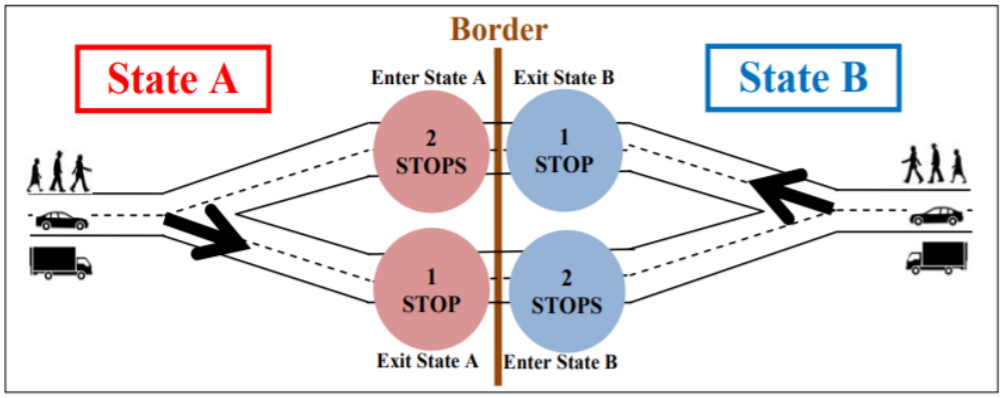

***Figure 4*: The Traditional Border Post**

Source: (NEPAD et al., 2011, p. 2)

As explained earlier in this chapter, a OSBP represents one single stop for *goods, people* and *all means of transport*, and one way to think about the concept is as being based around four pillars (NEPAD et al., 2016):

1) Legal and Institutional Framework

In accordance with international laws, it is, in general, agreed that national laws are limited by land or territory of the country. This obviously leads to challenges when it comes to OSBPs since these might be implemented in places and situations where the national laws must be extended to extraterritorial applications of the law. This requires a comprehensive and detailed analysis, as well as preparation and cooperation between different agencies present at the border, such as customs, migration services, health authorities, the police, etc. Today many border crossings in Africa have an average of 10 border agencies active in the area and therefore, integrated border management (IBM) and coordinated border management (CBM) are completely necessary when constructing OSBPs.

2) Simplification and Harmonization of Procedures

For a OSBP to be effective and successfully implemented, it is necessary to simplify and harmonize actions and procedures at the border crossing to ensure that the OSBP will operate smoothly. This requires continuous and joint cooperation, as well as a review of procedures and routines from both countries.

This pillar also contains a framework regarding the training and development of staff and border officials from all relevant agencies. In addition to this, a OSBP project should also include information and awareness campaigns targeting the local communities and the individuals who will be affected by the project.

3) Information and Communications Technology (ICT) and Data Exchange

Exchange of data and ICT is a critical part to be able to implement *single window systems*, something that enables traders to submit documents and information to a single standardized location which is much needed for simplification of administrative matters, logistics, and management and to be able to modernize the work carried out by the border agencies. Even though a single window system is not a necessary part, it certainly helps to reach the full potentials of the OSBP concept. Furthermore, ICT allows for efficient use of the limited resources available at borders, which are exposed to increasing volumes of travelers, vehicles, and goods, requiring a strategic balance between facilitation and control.

4) Hard Infrastructure

The final pillar of the OSBP concept is hard infrastructure such as offices, necessary equipment, trade centers, roads, bridges, parking lots, storage, etc. Hard infrastructure of some sort will always be necessary for constructing a OSBP. However, the level and extent differ a lot depending on the operation, the size, and the location.

The different foundations and elements of the OSBP concept could be further summarized as illustrated in Figure 5 below.

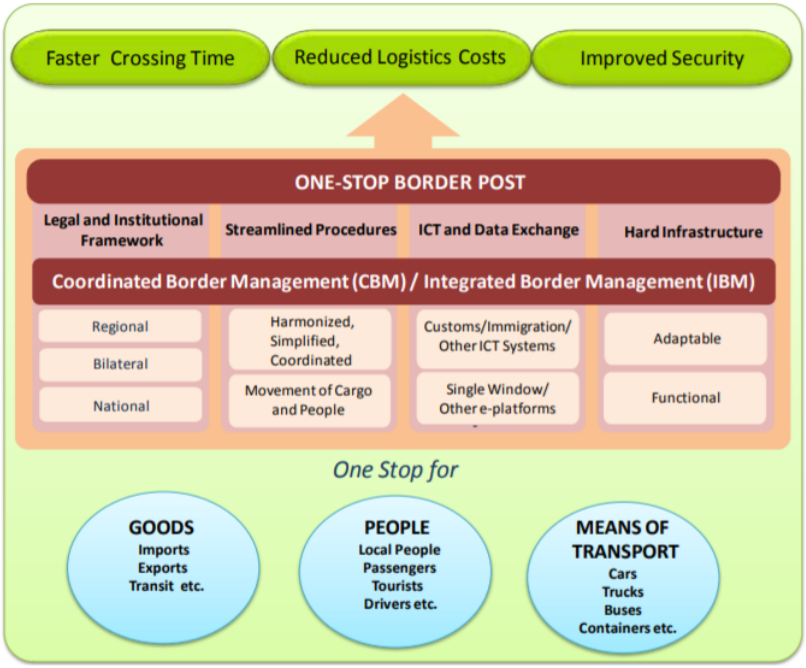

***Figure 5*: The OSBP concept**

Source: (NEPAD et al., 2016)

According to the Africa-EU Partnership, the implementation of OSBPs on the African continent will have special importance for landlocked countries. Landlocked countries are isolated from international markets in the way that they lack access to harbours and ports (AU and EU, 2013). These countries must therefore transport their goods by land to reach ports in countries with maritime borders to be able to export. This consequently leads to higher costs and trade barriers for the landlocked countries, and OSBPs therefore have extra importance in

decreasing trade costs and increasing competitiveness for these countries and regions (AU and EU, 2013).

A survey on time and traffic was conducted by TMEA in June 2016 (TMEA, 2017). The study found evidence of significant improvements achieved by transforming the Busia border crossing, between Uganda and Kenya, into a OSBP. The results show that average crossing times from Uganda to Kenya, and from Kenya to Uganda reduced by approximately 80% and 79%, respectively (TMEA, 2017). The results also found that custom clearance time decreased by 69% on the Ugandan side and by 98% on the Kenyan side of the border (TMEA, 2017). According to border officials in Uganda, the Busia OSBP contributed to increased tax revenue of 20 billion Ugandan shillings (appr. 5.66 million USD) between April and June 2016 (TMEA, 2017).

Furthermore, in 2009, the Chirundu OSBP opened between Zambia and Zimbabwe as a pilot for the OSBP concept in Africa (PIDA, 2017). After observing the significant positive effects that the Chirundu OSBP had on clearance times at the border - reducing time to import from 4-5 days down to somewhere around a few hours to 3 days depending on the product - the authorities realized the potentials from the concept and many new OSBPs were introduced (PIDA, 2017).

2.2 The economic benefits of OSBPs

As previously discussed, OSBPs are part of the trade facilitation field, intending to reduce costs and delays at the border, to increase trade flows and efficiency, and to reach welfare gains. Many economic theories can help explain these potential benefits from implementing OSBPs. This section will present some of these theories and how they relate to OSBPs, to provide the reader with a deeper theoretical understanding of the subject.

There are five main economic benefits that can be obtained from OSBPs: (1) Increased Customs efficiency, (2) Cost savings for Governments and Authorities, (3) Increased Trade and Revenue, (4) Reduced Import Prices for Goods, and (5) Job creation and Growth (Ben Barka, 2012). Furthermore, as outlined in Section 2.1, one of the main effects of the move from a traditional border post to a OSBP is that traders will need to spend less time at the border post than before (NEPAD et al., 2016). How does this convert into an effect on the value of cross-border trade flows?

Delays and waiting times create costs for firms in at least two ways. Firstly, if waiting times at the border are substantial, this can have direct negative effects on the value of some shipments, because the goods run the risk of physical depreciation (Milner et al., 2008)[4]. This represents a direct cost in the sense that the goods must be sold at a lower price, if sold at all. Secondly, time spent waiting at the border also represents an opportunity cost for firms. This is straightforward to see: if the business leader personally takes the goods across the border, time spent simply waiting could be used more productively and efficiently, for instance in production. However, the argument also holds if the firm pays a driver to take the products across the border. Drivers must be paid for their time, so the longer the wait, the higher the cost, and those resources could, as with the time argument, have been used more productively elsewhere in the company (Persson, 2012). Finally, there is also some sort of opportunity cost from the goods' perspective since no money can be earned until the goods reach the destination market and are offered to consumers (Persson, 2012).

Although the relationship between waiting time and cost is not necessarily linear, one might undoubtedly expect it to be positive - the longer the wait, the higher the cost. This could,

[4] Examples of sensitive products whose characteristics may change even with relatively limited waiting time are various kinds of agricultural products such as fresh fruits and vegetables. If the facilities at the border crossing do not enable refrigeration and appropriate storage opportunities, this exacerbates the problem, especially if the border post is located in a warm and humid climate, which is the case in the particular empirical context of this paper.

theoretically, have further effects on the value of trade in a direct sense if some part of the value of a shipment "melts away" in a classical "iceberg" type fashion (as introduced by Samuelson (1954) to explain transportation costs). Perhaps more importantly, it will affect firms' decision whether to send an individual shipment. If costs are too high relative to the value of the shipment, firms will not ship the products across the border. For products with very high depreciation costs, this will preclude trade altogether. For other types of products, while focusing on the opportunity costs, firms could to some extent compensate by sending few, large shipments, rather than more frequent, smaller shipments. After all, the opportunity cost of a person waiting is a fixed cost, and a large shipment could hence be worth the wait (Persson, 2012). However, there are both practical and business-related limits to how big shipments can be, due to the size of a truck or cost for storage facilities, etc. For many types of goods within the agricultural and food sector, which is considered time-sensitive, infrequent shipping may also not be an option since the goods must be shipped when they are harvested or otherwise ready. Furthermore, time delays are also related to a higher level of uncertainty, something resulting in firms having to waste scarce resources on larger safety margins (Persson, 2012).

Altogether, this theory suggests that long waiting times could lead to less aggregate cross-border trade flows than what would have happened in a counterfactual world with quick and effective border crossings. Therefore, if the introduction of a OSBP does lower waiting times at the border, one would theoretically expect a positive causal effect on aggregate cross-border trade. The magnitude of that effect could be expected to depend on the size of the waiting time reduction and the specific case.

Lastly, it is worth noting that the OSBP concept might also lower costs for firms in more ways than by just saving time. If the introduction of an OSBP is associated with a reduction in red tape (for instance through simplified documentation requirements), firms may be able to spend less time and resources organizing and preparing for the border crossing. This would again speak in favour of more potential shipments being able to exceed the threshold, where the value of shipping the goods exceeds the overall costs, implying a positive effect on aggregate cross-border trade flows.

Some of the previous arguments are consistent with a relatively new economic theory - the “New New Trade Theory” (see e.g. Melitz (2003)), which moves away from the classical theories, and assumes that firms are heterogeneous and accounts for diversity among firms and traders in regards to size and productivity and whether they participate in international or

solely domestic trade (WTO, 2015b). These models can help explain how the number of firms, and which firms that engage in cross-border trade, are affected by reducing trade costs through e.g. OSBPs. Many studies, such as (Bernard et al., 2007) find that most companies trade domestically while there are only a few companies that enter the export market. The main reason behind this is that the productivity levels differ between firms and low-productive firms will not survive on the market; more productive firms will survive and trade domestically while the firms with the highest levels of productivity can also enter and participate in cross-border trade internationally (WTO, 2015b). This hence results in two types of thresholds of productivity: one that represents the minimum productivity to survive and trade domestically, and another representing the minimum productivity needed for the firm to be able to trade internationally (WTO, 2015b). The New New Trade Theory literature suggests that decreasing trade costs will reduce the gap between these two thresholds, leading to an increase in the number of firms driven out of the market due to competition but also to an increase in the number of firms exporting since resources are allocated and used more efficiently (WTO, 2015b).

Furthermore, while it might be obvious that exports will increase if firms are more effective, WTO (2015b) discusses how the trade costs are related to two types of "margins" in international trade; the extensive margin represented by increased exports through new firms joining the exporting business, and the intensive margin represented by firms already exporting, increasing the amount of their exports (WTO, 2015b). When reducing variable costs of trade, the reduction affects both the extensive and intensive margin, and a reduction of fixed costs of trade affects the extensive margin only. Trade facilitation, such as OSBPs, has the advantage that it reduces both fixed and variable costs of trade, implying that one should expect a positive effect on trade in both the extensive and the intensive margin (WTO, 2015b). Due to the reduction in the trade costs obtained from the implementation of OSBPs, new firms will have the opportunities to engage in international and cross-border trade, while already existing firms can increase their exports. These increased trade flows have significant direct and indirect effects on welfare and economic development (WTO, 2015b).

2.3 Empirical overview of the use of OSBPs in Africa

Even though joint border posts and other concepts similar to OSBPs have been seen in different parts of the world for decades, there were no OSBPs on the African continent before 2009. That year, the Chirundu OSBP opened between Zambia and Zimbabwe as a pilot for the OSBP concept in Africa (PIDA, 2017). After observing the significant positive effects from implementing the Chirundu OSBP, many new OSBPs were introduced (PIDA, 2017). In 2010, the East African Community (EAC) committed to construct and implement 15 OSBPs between five of the member countries (AU and EU, 2013). Moreover, the AU-PIDA programme also suggested the implementation of up to 13 OSBPs in West Africa as a part of the development plans for Africa, Vision 2040 (AU and EU, 2013). In 2014, 27 OSBPs were either completed or under construction and in 2017, PIDA (2017), estimated that almost 80 border crossings in Africa had or were about to become OSBPs. Since the OSBP concept was adopted by the EAC, and until the end of 2019, TMEA has successfully supported the construction and implementation of 13 OSBPs in the EAC region (TMEA, 2019).

As mentioned in the introduction, the countries on the African continent and in the East African region experience trade costs which are considerably higher than those in the rest of the world (TMEA, 2017). These costs and the time it takes to import and export worldwide can graphically be seen in Figures 6, 7, 8 and 9. This further emphasizes the importance of reducing trade costs and time delays in Africa, something that the OSBP concept aims to do.

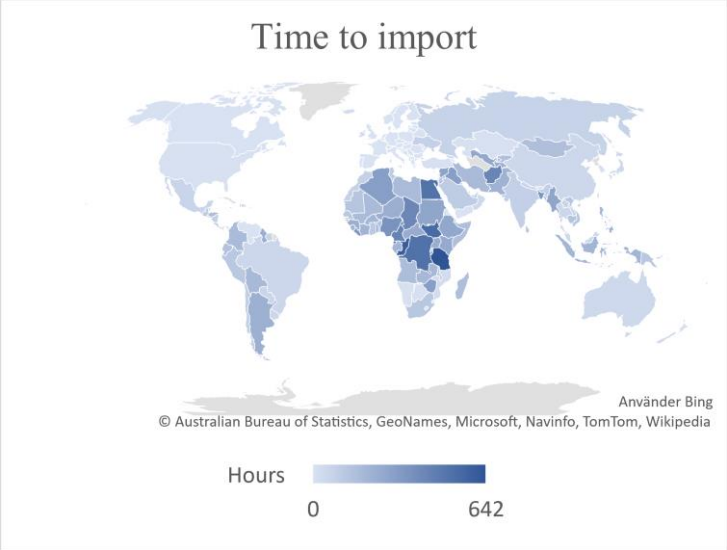

***Figure 6*: World import procedures: Time to import**

Source: (World Bank, 2019)

***Figure 7*: World export procedures: Time to export**

Source: (World Bank, 2019)

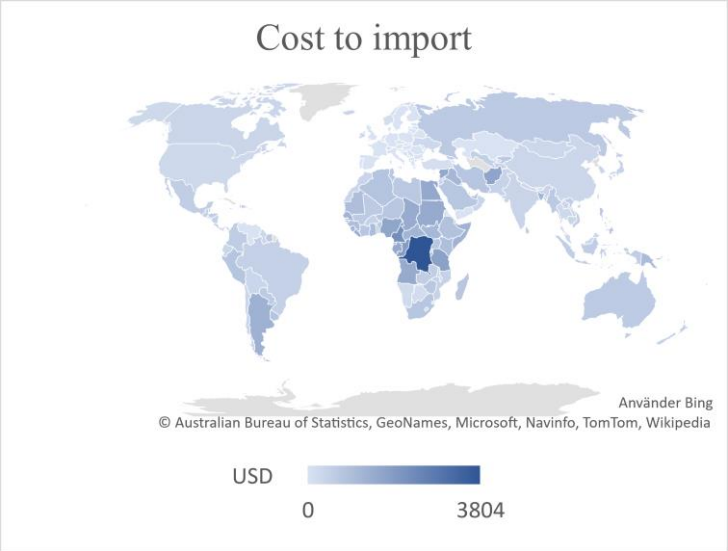

***Figure 8*: World import procedures: Cost to import**

Source: (World Bank, 2019)

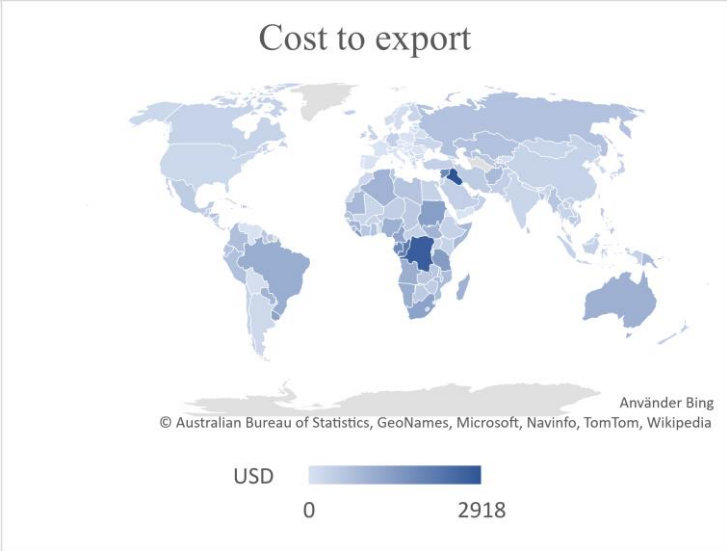

***Figure 9*: World export procedures: Cost to export**

Source: (World Bank, 2019)

3. Introduction to the Busia, Malaba and Mirama Hills OSBPs

This chapter will introduce the border posts in Busia, Malaba and Mirama Hills[5], which are the border posts that were transformed into OSBPs during the data period and hence act as treated and part of the treatment group in this paper. In Table 1 below, the most relevant information and statistics about the OSBPs are compiled. This includes e.g. what type of OSBP it is, between which countries the border post is located, the main type of traffic and trade handled, implementation and construction costs, geographical characteristics, the main funders of the projects, and which authorities are acting at the border crossing. An important part to focus on here is the opening time for the OSBPs. This is important for the rest of this research paper since this will decide when the treatment period will be set to start in the Difference-in-Differences framework, something that highly affects the results and conclusions from the paper. The treatment period is set to start in January 2016, since all the OSBPs were considered to be implemented and functional at the start of 2016. This will be further motivated and discussed in later chapters. It is also interesting to notice that all three of the OSBPs are of the Juxtaposed type, which is the most popular and convenient type to use when constructing and implementing OSBPs in East Africa.

[5] From the Rwandan perspective sometimes referred to as the Kagitumba OSBP.

Table 1: **OSBP information and statistics**

Border post	*Busia*	*Malaba*	*Mirama Hills*
Country A	Uganda	Uganda	Uganda
Country B	Kenya	Kenya	Rwanda
Type of OSBP	Juxtaposed	Juxtaposed	Juxtaposed
Geographic characteristics and challenges	A relatively small and crowded border area. Located inside a town with limited space and parking space	Bordering the Malaba River. Narrow and crowded road and bridge crossings	Hilly and somewhat difficult terrain area
Main type of trade and traffic	Intraregional (EAC) trade + trade intended for/originating from overseas	Large volumes of trade intended for/originating from overseas	Trade intended for/originating from overseas
Opening	January 2016	January 2016	December 2015
Average daily crossings	210 trucks crossing to Uganda, 30 trucks crossing to Kenya (2013)	600 trucks crossing to Uganda, 450 trucks crossing to Kenya (2013)	A total average of 40 trucks handled daily (2013)
Construction cost	12.04 million USD	11.88 million USD (not including the cost to construct a new bridge at the location)	7.8 million USD
Largest funders	JICA & TMEA	TMEA & WB	TMEA, WB & AfDB
Main authorities and agencies	Kenya Revenue Authority (KRA) & the Uganda Revenue Authority Customs (URA)	Kenya Revenue Authority (KRA) & the Uganda Revenue Authority Customs (URA)	Rwanda's Directorate General of Immigration and Emigration (DGIE) & the Uganda Revenue Authority Customs (URA)
Construction and implementation challenges	Construction delays and lack of administrative framework	Construction delays and lack of administrative framework	Construction delays and lack of administrative framework

Sources: (Fitzmaurice and Hartmann, 2013; NEPAD et al., 2016; Siu, 2019; TMEA, 2017)

4. Previous Research

The purpose of this literature and research review is to summarize relevant previous studies initially made on trade facilitation in general, followed by studies on the main subject covered in this paper - the OSBP concept. More specifically, the author has chosen to include studies that present evidence on how cross-border trade flows are affected by border costs and clearance times, and studies that estimate the potential benefits from OSBPs, to emphasize the importance and potential of the OSBP concept and improved levels of trade facilitation on the African continent. As discussed in the introduction, the research field within the subject is not that comprehensive and there is much potential to contribute to the literature. To the author's knowledge, no previous study has measured the causal effects from OSBPs in relation to traditional border posts, which this paper aims to do. Since the methodology and approach used here have not been previously widely used in this paper's context, the author has chosen to include research that has provided important insights and relevant results about the implementation of OSBPs using other methodologies and approaches.

A study by Djankov et al. (2010) uses a gravity model and data from 98 countries to try to estimate how time delays at the border affect cross-border trade. The results from the study indicate that time delays have a significant negative effect on trade volumes. A one-day delay of a product shipment or delivery reduces the trade volume of that product by more than 1 percent (Djankov et al., 2010). The authors also present a scenario in which time is transformed into distance suggesting that for every day a delivery is delayed, it would be equal to increasing the distance between two trading partners with 70 km on average (Djankov et al., 2010). Finally, the study suggests that delays and long handling processes at the border have a relatively larger impact on more time-sensitive products, such as agricultural goods and food (Djankov et al., 2010).

Another study focusing on time delays is the one by Nordås et al. (2006), which estimates the effect that time delays have on the traded volumes of three types of goods: electronics, fashion products, and intermediates. The authors claim that time acts as both a trade cost and an entry barrier to trade. Consequently, the authors use two different gravity models to try to estimate these claims (Nordås et al., 2006). The study concludes that time delays have a negative effect on trade volume, something that is especially valid for electronic products. Moreover, the study also shows that time has a significant negative correlation with the probability and opportunity to enter an export market (Nordås et al., 2006).

In a study by Fitzmaurice and Hartmann (2013), time delays' effect on cross-border trade is further estimated and it is found that transportation and cross-border delays along the Northern Corridor in Africa are equivalent to a total extra cost of 384,40 USD per 24-hour delay for a fully loaded truck. The authors use surveys and questionnaires at inland border crossings along the Northern Corridor to measure and collect data regarding crossing times, efficiency, costs, and other detailed trade information. In a case example, the authors estimated that over a full year, with 600 trucks being handled every single day, a 20-hour delay reduction could result in approximately 69 million USD in yearly savings (Fitzmaurice and Hartmann, 2013). In another estimation by Fitzmaurice and Hartmann (2013), the authors find that reducing time delays along transport corridors and at border crossings would save enough time for an average trader to be able to complete two more roundtrips per month. This increased efficiency and capacity could yield up to 42 million USD annually in extra tax revenue (Fitzmaurice and Hartmann, 2013).

A study by Willie and Chikabwi (2018) estimates the effects on cross-border trade in the COMESA region caused by border costs and delays. Using a gravity model on cross-sectional data for 16 countries, Willie and Chikabwi (2018) find evidence that a 1 percent increase in delays at the border results in a significant reduction in annual bilateral export flows. More specifically a reduction of up to 2 million USD. Furthermore, the study shows that national (unilateral) actions and reforms to try to reduce cross-border trade delays have smaller effects than if the reforms are a joint bilateral or regional cooperation (Willie and Chikabwi, 2018). The study hence recommends that African nations should focus on and prioritize bilateral reforms to facilitate trade, such as implementing OSBPs and single window systems (Willie and Chikabwi, 2018).

After presenting these studies, which show the significant benefits that can be obtained from decreasing cross-border costs and delays, the next section will shift the focus towards studies and papers which present evidence and discusses the potential and actual economic and social benefits which can be reaped from implementing OSBPs.

In a paper by Ben Barka (2012) at the African Development Bank (AfDB), it is explored how inefficient border posts between African countries contribute to lower levels of intra-African trade. The study presents how simplification and harmonization of cross-border trade procedures, as well as decreasing levels of corruption, could lead to significant reductions in trade costs and as a consequence result in increased revenues for the governments (Ben Barka, 2012). This is supplemented with the presentation of case studies which through interview

methodologies, observations, and documentary search, show the benefits from the implementation of OSBPs, such as the Chirundu OSBP between Zambia and Zimbabwe. The study also raises the OSBP concept as one of the most effective and best ways to reach these improvements on the African continent, and hence Ben Barka (2012) recommends, in line with AU-PIDA's visions and goals, to construct and implement more OSBPs along the main transportation corridors in Africa (Ben Barka, 2012). Finally, Ben Barka (2012) explains that Ugandan trade, to more than 50 percent, consists of intra-regional trade within the EAC. The successful implementation of more OSBPs in Uganda will significantly increase revenues to the Ugandan government (Ben Barka, 2012).

In a more descriptive paper by Kieck (2010), the importance and potential opportunities from reducing non-tariff barriers and facilitate legitimate trade are investigated. Kieck (2010) describes the increased cooperation and coordination at international borders and specifically focuses on OSBPs and the author means that these trade facilitation arrangements have large economic and enforcement benefits. These benefits come from the opportunities to reduce the costs and increase efficiency and cooperation when trading at shared borders (Kieck, 2010). However, Kiech (2010) raises awareness about the implementation of OSBPs and other coordinated border management and he argues that it is of importance that the development is resting on a stable pillar of legal frameworks and strategies that have the full support from all stakeholders involved (Kieck, 2010).

A study conducted by Siu (2019) examines the relationship and elasticity between informal trade and trade costs by using a Poisson pseudo-maximum likelihood estimation guided by a gravity model. Siu (2019) analyses border facilities - such as OSBPs - aimed to reduce trade costs at the border through reductions in delays and corruption and more specifically how the implementation of these affects the formalization of trade. Using data on OSBPs from Kenya and Uganda, Siu (2019) finds evidence that informal trade as a ratio of total trade reduced, but only in the quarter in which the border facilitation facilities were introduced. The results also show that only a small part of traders formalize their trading despite the reduced trade costs when trading formally. Also, trade costs and the choice of which border crossing to use is not only relying on official tax rates, but it is also a gender question (Siu, 2019).

In a report from TradeMark East Africa from 2019, it is outlined that after constructing a OSBP at the Holili border post between Tanzania and Kenya, border crossing times for cargo and trucks reduced by 89% and 90% respectively (TMEA, 2019). Similar results could be seen at other OSBPs in Tanzania, such as Mutukula and Kabanga. The report also shows that

Tanzanian border authorities now experience better working conditions and more efficient handling processes, something which has helped increasing tax revenue collection from between 1-2 billion TZS per year to up to around 4 billion TZS per year (TMEA, 2019).

Nugent and Soi (2020) look at the OSBP concept and investigate the progress and outcomes from four OSBPs in East Africa. Two main results are presented in the paper. Firstly, the authors conclude that while there have been improvements in data sharing between authorities and states, the process of constructing and managing the OSBPs reflects the perseverance of specific cultural norms and institutional cultures within each country. This sometimes leads to practical challenges which contradict the concept of having paperless borders (Nugent and Soi, 2020). Secondly, the paper finds that OSBPs are different from other types of border crossings and that OSBPs share similar elements with harbors and airports since they all have been constructed and implemented in order to be able to handle both people and cargo (Nugent and Soi, 2020). However, they also differ from harbors and airports as they are not as heavily protected and that OSBPs represent areas in which traders and local community members interact, which has resulted in common organizational patterns. This fusion results in a common mindset of service, bureaucracy, and local perceptions of ownership (Nugent and Soi, 2020).

Another article by Tyson (2018) presents a household survey that aims to examine how informal traders and workers have been impacted by the Busia OSBP between Kenya and Uganda. The article finds evidence supporting a positive effect for these people through increased accessibility to cross-border trade. Moreover, the article also finds negative effects, due to the increased demand for skilled labour at the OSBP, such as fewer work opportunities for low- or unskilled workers (Tyson, 2018).

5. Empirical Strategy

5.1 Outline of Strategy

This empirical chapter will be structured as follows: First, the general DD model will be introduced, and all variables of the model will be explained. This is followed by an application of the model containing cross-border trade flows, which will be used in this paper to analyse the effects of the implemented OSBPs between Uganda and its neighbouring countries. After the model has been introduced, the reliability of it and the challenges related to the estimations of the model will be discussed. This chapter will end by presenting the data and data sources used in the models and regressions.

This paper will investigate whether OSBPs have an effect on cross-border trade flows. To do this, the paper focuses on the specific case of Uganda, which – together with its neighbouring countries Rwanda and Kenya – transformed some of its traditional border crossings into OSBPs in late 2015 and early 2016. This is achieved by using disaggregated and detailed trade data from both the border posts that remained unchanged, and from the border posts that became OSBPs, covering the period 2014-2017. In other words, the data allows for a set-up in which there is a "before" and an "after" period for a control group, including border posts that remained unchanged, and for a treatment group, including the border posts that were transformed into OSBPs during the data period. The control group includes four "untreated" border posts, while the treatment group includes three "treated" border posts that became OSBPs. To measure the effects on trade flows caused by OSBPs in Uganda, the methodology of this research paper will build upon the theoretical framework around the Difference-in-Differences (DD) model and the Two-way fixed effects (TWFE) model, accounting for many dimensions of fixed effects. These models are well suited for the data set-up in the paper.

Uganda is a good case to study when looking at the potential effects from the implementation of OSBPs. This is due to the recent and relatively rapid development of trade procedures and economic integration in the country and the region. Several new OSBPs have recently been implemented in the country and this, as previously outlined, has brought many benefits to traders in the region. Thus, there is a need to investigate and estimate the effects of these new reforms and to compare this with the traditional border crossings, to obtain the causal effects from the OSBPs. Furthermore, Ugandan authorities, together with large trade organizations in the region, are providing a relatively detailed and comprehensive dataset covering most of

this, often small-scale, cross-border trade in the area. This allows for estimations and analyses, also on a more disaggregated and heterogeneous level, which further emphasizes why Uganda is a good and relevant case to study.

5.2 The general Difference-in-Differences (DD) model

The idea of the Difference-in-Differences method is to estimate the effects of exogeneous shocks on more aggregated levels, for instance a country or a region, using panel data (Angrist and Pischke, 2009). The authors further explain that the DD method is applied in a situation where a specific group is exposed to a *treatment* of some kind, while the other group is not (Angrist and Pischke, 2009).

The intuition behind this can be explained by a simple example in which there are two periods and two different groups. In period one, none of the groups receives any treatment. Then, in the next period, one of the groups receives a treatment while the other group does not, and hence we will have one *Treatment* group and one *Control* group from which it will be possible to measure the difference in outcomes. Schwerdt and Woessmann (2020) further explain the first difference in the DD model as the difference of the dependent variable between the different periods for each of the groups. The second difference is the difference between the calculated group differences in the previous stage and this second difference will compute how much the two groups differ from each other, interpreted as the causal effect of the treatment. This is illustrated in Figure 10.

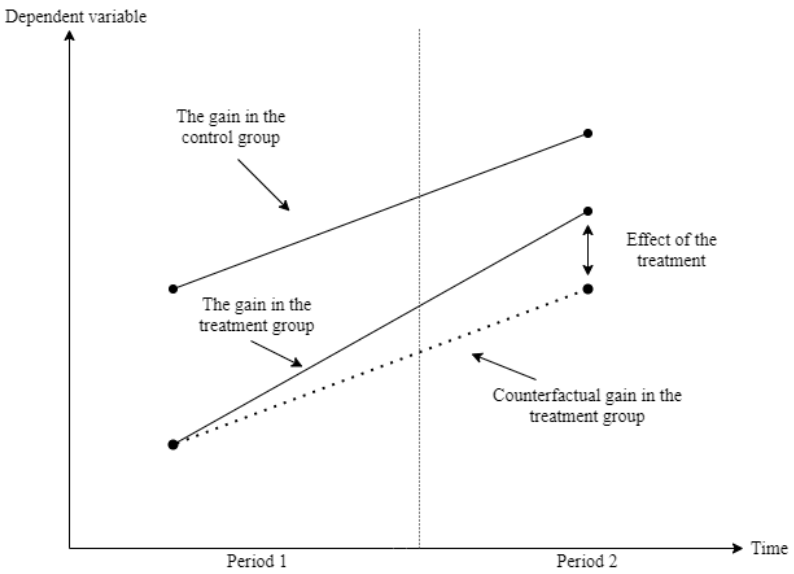

***Figure 10*: The treatment effect in the DD model**

Source: Author's illustration

A more formal derivation of the DD method is made by Khandker et al. (2009) in the following way: given a setting with two periods where t is a dummy variable such that $t = 0$ is the pre-treatment period and $t = 1$ is the post-treatment period, the outcome for the group receiving a treatment and the group not receiving a treatment in period t is Y_t^T and Y_t^C respectively and the treatment effect can then be estimated through:

$$DD = E({Y_1}^T - {Y_0}^T \mid T_1 = 1) - E({Y_1}^C - {Y_0}^C \mid T_1 = 0) \quad (1)$$

here T_1 is a dummy variable where $T_1 = 1$ indicates exposure to the treatment and $T_1 = 0$ indicates that the group is not exposed to the treatment, at period $t = 1$.

Furthermore, the estimated treatment effect, DD, can be measured through a regression framework as follows:

$$Y_{it} = \alpha {D_i}^{Treatment} + \beta {D_t}^{Post} + \delta({D_i}^{Treatment} * {D_t}^{Post}) + \varepsilon_{it} \quad (2)$$

where Y_{it} is the dependent variable, ${D_i}^{Treatment}$ is the treatment dummy variable (equals one if i is exposed to treatment and zero otherwise), ${D_t}^{Post}$ is the dummy variable for time (equals one if t is after the treatment period and zero otherwise), ε_{it} denotes the error term, α, and β are coefficients while δ is the coefficient for when the treatment dummy variable and the time dummy variable are multiplied with each other, which will give the average effect of the treatment on the outcome variable. Notable here is that the two variables ${D_t}^{Post}$ and ${D_i}^{Treatment}$ are both included separately in the regression. The reason for this is for the regression to be able to capture any effects of the time variable and any potential effects of being targeted for the treatment or not.

Finally, Khandker et al. (2009) provide the following calculations to better understand the intuition of the DD estimate by re-writing equation (2) with expectations:

$$E({Y_1}^T - {Y_0}^T \mid T_1 = 1) = (\alpha + \beta + \delta) - \alpha \quad (3)$$

$$E({Y_1}^C - {Y_0}^C \mid T_1 = 0) = \beta \quad (4)$$

Using equation (1), it follows that subtracting equation (4) from (3) gives δ, which is the DD estimate.

One of the most critical assumptions in this model is the *parallel-trend* assumption stating that different unobserved characteristics, which have an effect on the program participation, will not vary over time with the treatment. In other words, there should be no differences between the control and the treatment groups that vary over time (Khandker et al., 2009).

5.3 The DD model with Cross-border trade flows

The DD method has been used in hundreds of studies over many decades, and is well-suited for estimations of changes in economic and social environments and to measure potential impacts of policies and decisions from decision-makers (Angrist and Krueger, 1999). However, the model sometimes needs to be applied to better fit some research questions.

This research paper aims to evaluate the impact on trade flows the implementation of OSBPs in Uganda has had in relation to traditional border crossings and hence the model needs to be applicable to fit an analysis of international trade. Located in a strategic place in a region with busy trade routes, Uganda has many important and diverse trading partners. This might contribute to relevant variables which should have been included in the regression, being left out. This is referred to as the omitted variable bias and this could potentially lead to the estimator in the regression being inconsistent (Stock and Watson, 2020).

To catch these omitted and unobserved variables, it is reasonable to include fixed effects in the model, more specifically fixed effects controlling for units and time. Unit fixed effects (later referred to as border fixed effects) control for the variables that are constant over time but may differ between units, such as geographic locations. Similarly, time fixed effects control for those variables that are constant between units but may differ over time, for instance, business cycles (Stock and Watson, 2020). In some situations, one might have data containing both omitted variables that are constant over time but differ across units and other omitted variables that differ over time but are the same across units in a given time period. In

this situation, it could be appropriate to include both time and unit fixed effects in the regression (Stock and Watson, 2020).

Before introducing fixed effects in the model used in this paper, bilateral pairs were created where trade flows are disaggregated on the level: from Uganda to Kenya through Busia border post, and then also from Kenya to Uganda through Busia border post and so on. This results in 14 separate groups accounting for both imports and exports from both countries' perspectives through specific border posts, 6 treated groups and 8 untreated control groups.

The treatment period is set to start from January 2016 since the OSBPs acting as treated in this paper all were implemented and operational at different moments between the end of 2015 and January 2016 and it is therefore assumed that the potential effects from the OSBPs would be observable from the start of 2016.

This research paper will look at monthly observations over time with the goal to measure the treatment effect from the implemented OSBPs in relation to the traditional border posts. Hence, as earlier described by Stock and Watson (2020), the model used in this paper will include both time fixed effects and unit fixed effects, leading to the so-called Two-way fixed effects (TWFE) model in which the separate dummy variables are dropped. Moreover, the model will also include product fixed effects for every type of product traded, to account for the large differences in traded value among product types, which can be seen as γ_c in equation (5).

$$\ln(Y_{cit}) = \alpha_i + \beta_t + \gamma_c + \delta\left(D_i^{Treatment} * D_t^{Post}\right) + \varepsilon_{it} \qquad (5)$$

where ln (Y_{cit}) is the natural logarithm of the value of traded product c, through border post i, at time t. α_i represents the unit fixed effects, β_t represents the year fixed effects and γ_c represents the fixed effects for product types. δ is as before the DD estimate which represents the treatment effect of a border post becoming a OSBP while ε_{it} is an error term.

However, there are most likely more factors that affect the trade flows through Ugandan border posts and hence it is convenient to include control variables in the model to try to decrease the risk of omitted variable bias and further strengthen the results from the model. These control variables are non-fixed over time and hence not fully caught by the fixed effects, even though time fixed effects likely will capture parts of this. In this paper, the model will include the natural logarithm of GDP for the importing and exporting country and the

natural logarithm of the exchange rate for the exporting country. These control variables are referred to as *X*, leading to the main model used in this research paper:

$$\ln(Y_{cit}) = \alpha_i + \beta_t + \gamma_c + \delta\left(D_i^{Treatment} * D_t^{Post}\right) + X + \varepsilon_{it} \quad (6)$$

5.4 Estimation questions

The chosen model used to estimate coefficients and variables of interest has a significant impact on the results in a research paper. Most models also have both advantages and disadvantages which of course need to be considered to understand the significance and robustness of the generated results. In this part, the most common challenges and potential problems of the DD model and the TWFE model will be presented followed by some of the latest research in the field, with suggestions on how to overcome some of these challenges.

For the DD model to yield significant and relevant results that are not biased it is, as previously argued, important that the parallel trend assumption holds (Gertler et al., 2016). The parallel trend assumption cannot be proven, however, it is possible to test its validity (Gertler et al., 2016). This paper will conduct two placebo tests to test the validity of the DD estimate. One test will include a “fake” treatment period and the other will include a “fake” treatment group. In accordance with Gertler et al. (2016), if the parallel trend assumption holds, these placebo tests should yield an insignificant impact on the outcome.

Another important step to ensure a reliable result when using a DD model is to check and make sure that the control groups are not affected by the treatment. Transforming a border post and implementing a OSBP is a very individual and independent project for every specific occasion, and it is reasonable to assume that the transformation of one border crossing should not have a substantial impact on the day-to-day activities carried out at other border posts. This assumption could be further supported by the fact that most cross-border traders in the region are small-scale local entrepreneurs, and they would most likely continue to use the closest and most accessible border crossing regardless of it being a OSBP or not. One potential problem with the interpretation of the model could appear if general trade on a larger scale would reallocate from non-treated to treated border posts and hence show signs of the treatment having a direct negative effect on the control group. However, there are no tendencies of this in the data.

Furthermore, another issue that could make the parallel trend assumption questionable is the occurrence of endogeneity. This could be in a situation where border posts that are chosen to be transformed into OSBPs are chosen because these locations already are more important trading stations, and hence prioritized in another way than the border posts in the control group. This would result in the treatment and control group being systematically different and not similar enough for them to be considered a good comparison. This is an important issue. However, the author argues that the included Border fixed effect * Product fixed effect - which captures all fixed effects on the level of every specific product, traded through every specific border post – very likely will capture most of these potential issues and the inclusion of these types of fixed effects are hence considered as another support for the set-up for this study.

Most regressions in this paper are run using robust standard errors, apart from a control estimation using clustered standard errors. The reason for using robust standard errors is to deal with the potential problem of heteroscedasticity as discussed by Shepherd (2013) and to account for potential serial correlation in the data in accordance with recommendations from Bertrand et al. (2003).

Disaggregated trade data usually contain a large number of zero trade values. When log-transforming the data, one could obtain biases and inconsistency in the results as the zero-values will be dropped (Santos Silva and Tenreyro, 2006). Dropping these zero trade values could be misleading since the values could have been rounded to zero, but in reality be different from zero. Simply dropping these zeros can distort the results and lead to inconsistent outcomes. There is also a risk that one exposes the data to measurement errors and potential selection biases (Santos Silva and Tenreyro, 2006). Dropping actual zero-values could also lead to useful information being lost, since zero trade flow values could mean that e.g., there are barriers to trade for a specific product or through a specific border post (UNCTAD and WTO, 2012). Santos Silva and Tenreyro (2006) present a solution to this problem, to instead use a non-linear model such as a PPML which will keep all zero trade values included in the regression. This paper has access to a trade dataset containing the trade values that are non-zero, but also zero-trade values of products that are actually zero or rounded to zero. These zeros are dropped in the main model's regressions but are later kept in a robustness regression with a non-linear model, which is further described in section 6.2.2.

Unobserved heterogeneity can occur in a situation in which one has differences between the observations in the data which are not captured by the included variables in the model. This

could also lead to an estimator, which is biased and inconsistent (Bacchetta et al., 2012). One way to tackle this problem is to use a fixed effects model as in this paper and hence unobserved heterogeneity is assumed not to have any significant effects on the DD estimator.

Goodman-Bacon (2018) raises some critique and potential problems which can arise when moving from the canonical 2x2 DD model into much more commonly used DD models with variation in the treatment timing. Goodman-Bacons main result shows that the DD parameter in the TWFE model equals a weighted average of all available 2x2 DD parameters that estimate one group's exposure to treatment in relation to another, non-exposed, group. Firstly, this implicates that when the estimates rely on variation in the treatment timing, we will only receive the average treatment effect when individuals are exposed to a homogenous treatment. If the treatment effect is heterogeneous across individuals, some individuals with more variance in treatment status will be overestimated or over-weighted. Hence, to fully measure the average treatment effect in this situation, one must re-weight the data (Goodman-Bacon, 2018). Secondly, DD estimates will be biased when the treatment effect changes over time within individuals. This would be a situation in which an individual that has already been treated acts as a control in a 2x2 DD model which underlies the weighted average. Then, if the treatment effect is not constant over time, including already treated individuals will lead to biased estimates of the effect of the treatment. Goodman-Bacon (2018) argues that in such situations, other approaches should be considered instead of the TWFE.

Callaway and Sant'Anna (2020) discuss estimation and interference procedures to estimate the treatment effect with DD models deviating from the 2x2 DD model, having more than two periods and variations in the treatment timing. This is a very common setup in many empirical papers within economics today. Callaway and Sant'Anna (2020) present a *group-time average treatment effect, ATT (g,t),* which can estimate the average treatment effect in period t, for the group of individuals who were exposed to treatment in period g, in an unbiased and consistent way for every group's group-time ATT. This is a better and more precise way than when including a post-treatment dummy in a TWFE model. Moreover, they show that when different values for t and g have been obtained for the ATT, these values can be compacted into more aggregated parameters estimating the treatment effect considering different heterogeneity perspectives of interest or into one single overall effect parameter. Finally, Callaway and Sant'Anna (2020) discuss the suitability of their approach and conclude that the approach works in cases where; the important assumption of parallel trends holds only after conditioning on covariates; when using different types of groups for comparison and when an

individual has anticipated exposure to treatment and consequently adapt their behaviour already before the implementation of the treatment.

Another paper by de Chaisemartin and D'Haultfœuille (2020) further discusses the TWFE model and how the regressions estimate weighted sums of the effect of the treatment in each period and group. However, this also raises some potential challenges since some of these weights might be negative which is an issue when analysing data with heterogeneous treatment effects, either between groups or across time. In this situation, the regression could yield a negative coefficient while the effect of the treatment is positive in every group and period (de Chaisemartin and D'Haultfœuille, 2020). Instead, de Chaisemartin and D'Haultfœuille (2020) present a new estimator to deal with this potential problem. The estimator does not depend on any treatment effect homogeneity condition since it measures the effect of the treatment in the groups that change treatment, at the time they do the change. This estimator yields significant results and is different, economically speaking, from the DD estimator in the TWFE model (de Chaisemartin and D'Haultfœuille, 2020).

These recent papers and contributions to the research field by Goodman-Bacon (2018), Callaway and Sant'Anna (2020) and de Chaisemartin and D'Haultfœuille (2020) are important since they address, discuss and try to solve problems related to the increasingly popular - especially in the trade policy analysis field - DD methodology. The methods proposed by these authors open up for new and improved ways of using the DD model, especially when one has multiple time periods and variations in treatment timing between units. The importance of these papers is further supported by the fact that many econometrical and statistical data tools, such as *Stata* and *R*, are in the process of incorporating new econometrical packages into their programs, based on the findings and suggestions from these authors.

These problems are, however, not considered a major problem in this paper and are therefore not dealt with. The treatment timing of the border posts in this study is in one case set in late December 2015 while the other two cases are set in early January 2016. Since the data is covering monthly trade data and these treatment times are set almost insignificantly close to each other, the author argues that it is reasonable to set the general treatment timing of the border posts in this paper to January 2016, without having to worry about the problems with varying treatments, as previously discussed. The chosen treatment timing in the paper is further supported by later placebo tests in section 6.2.1. These placebo tests show that there were no anticipation effects before the implementation of the OSBPs. It is neither the case in

this paper that already treated border posts are included as controls in a later stage, as discussed by Goodman-Bacon (2018). To conclude, the problems and challenges discussed by these authors are not seen as major or significant problems in this paper. However, the challenges discussed are important for the development of the DD framework and it is included to provide the reader with a deeper understanding of the methodology, its potential pitfalls, and how to overcome these challenges in similar studies.

5.5 Data

The data for trade flows between Uganda and its bordering countries comes from COMESA Statistics created by the Common Market for Eastern and Southern Africa (COMESA) and is accessed through COMSTAT datahub, a statistical online resource sponsored by the African Development Bank. More specifically, the data contains small scale cross-border trade statistics covering total trade volume in USD passing through each of Uganda's border points separately and the data covers monthly statistics between 2014-2017, something that is necessary to be able to conduct this research since the data needs to be available both pre- and post-implementation of OSBPs. The treatment period for the border posts that have become OSBPs will start from January 2016, as previously described in chapter 3. The data sample is hence covering 24 months pre- and 24 months post-treatment. The regressions are based on a sample containing data on cross-border trade from Uganda, Kenya and Rwanda.

The Ugandan border posts included in the data sample are, as treated border posts; Busia (with Kenya), Malaba (with Kenya) and Mirama Hills (with Rwanda), and as control groups: Lwakhakha (with Kenya), Suam River (with Kenya), Cyanika (with Rwanda) and Katuna Customs (with Rwanda). The location of these border posts can be seen in Figure 11 below, together with all other official border crossings between Uganda and its neighbours. The triangle points represent border crossings which are now OSBPs.

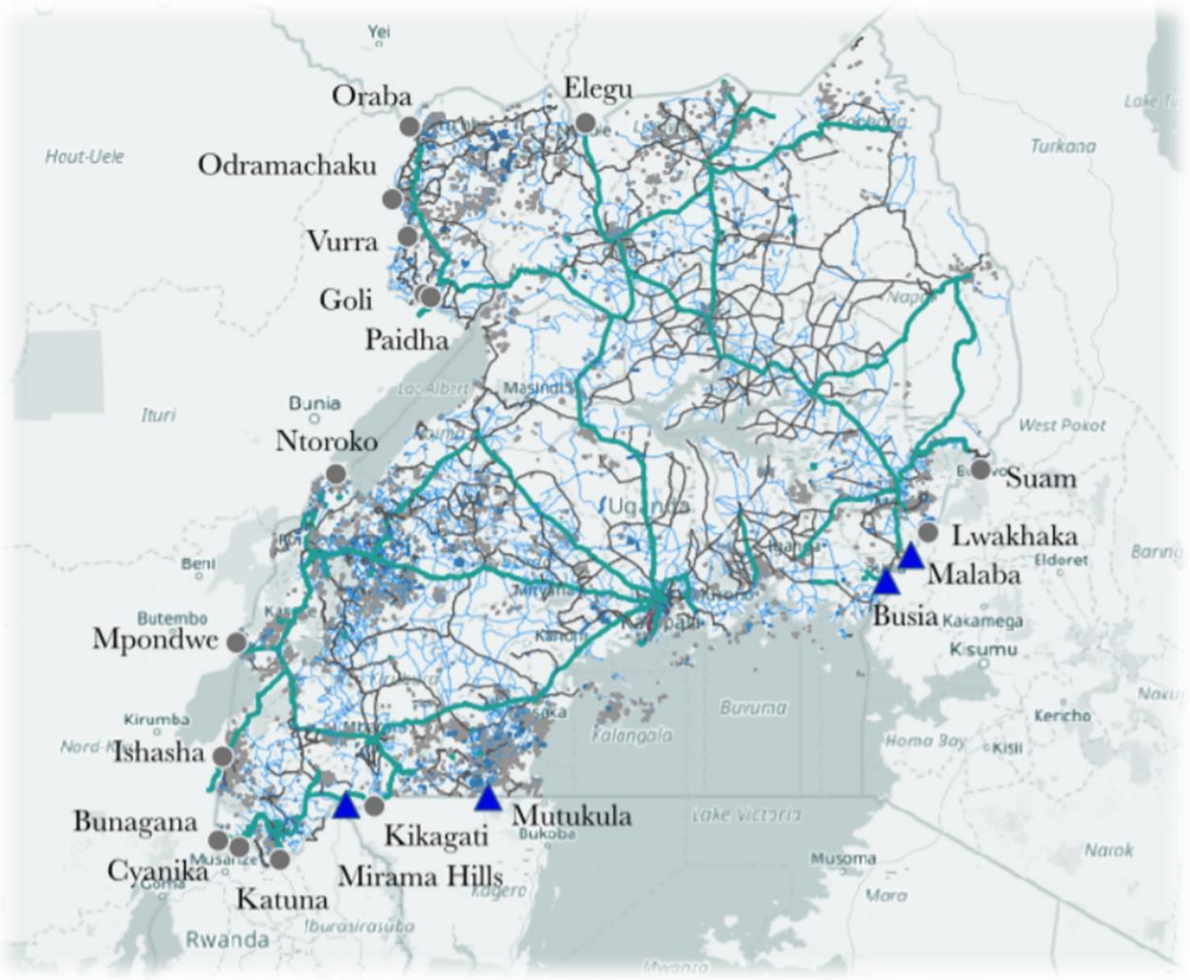

***Figure 11*: Border points in Uganda**

Source: (Siu, 2019)

Furthermore, through COMSTAT, it is also possible to access data for disaggregated product levels in accordance with the Harmonized systems, which is an internationally used classification system classifying products by assigning them numbers (WCO, 2012). This allows for a deeper and more comprehensive analysis in which it will also be possible to distinguish the potential effects of OSBPs on disaggregated product levels. The data on trade flow used in the model is on the Harmonized system level 6 of disaggregation, which is the most detailed disaggregation classification used.

The control variables included in the model are GDP for both the reporter and partner and the exchange rate for the reporter. These data are all collected online through the World Bank's World Development Indicators databank (WDI), which collects and presents data from the world regarding health, economics, equality, and development (World Bank, 2020).

6. Empirical Results

This chapter will start by presenting and discussing the main results from the econometrical analysis of the potential effects of the OSBPs, together with a heterogeneity analysis looking at the effects on different types of products. This will be followed by two placebo tests to ensure that the parallel trend assumption holds, and finally, by control tests and robustness checks to ensure the validity and strength of the main results. These controls will involve using other models than the main one, more specifically a non-linear Poisson model and a simpler regression for panel data, and finally, a test using clustered standard errors clustering for different border posts.

6.1 Regression results[6]

The regression results are presented in Table 2 below and will include results from different versions and extensions of the model in the following way:

(a) includes the results from the canonical 2x2 DD model

(b) includes the results from the canonical 2x2 DD model with added control variables

(c) includes the results from the DD model with added control variables absorbing Product fixed effects

(d) includes the results from the DD model with added control variables absorbing Product and Time fixed effects

(e) includes the results from the DD model with added control variables absorbing Product, Time, and Border fixed effects

(f) includes the results from the DD model absorbing Time fixed effects and Border fixed effects * Product fixed effects. The results from model (f) can be considered the main results of this research paper, and this is also mainly the model that will be used in later tests and robustness checks.

The estimated effect of the OSBPs is the coefficients on the row $\boldsymbol{D_i^{Treatment}} * \boldsymbol{D_t^{Post}}$.

[6] All the regressions of the models, controls and tests are done using Stata/SE 16.1

Table 2: Regression results, per model

Dependent variable: Value of traded products through Uganda's border posts (natural logarithm)

Model	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
$D_i^{Treatment} * D_t^{Post}$	0.259*** (0.000)	0.280*** (0.000)	0.224*** (0.000)	0.251*** (0.000)	0.135*** (0.000)	0.060** (0.021)
Time (Post-Treatment)	0.234*** (0.000)	0.196*** (0.000)	0.170*** (0.000)			
Treated (Exposed to treatment)	0.771*** (0.000)	0.851*** (0.000)	0.945*** (0.000)	0.908*** (0.000)		
ln_GDP (exporter)		-0.194*** (0.000)	0.197*** (0.000)	0.217*** (0.000)	-5.019*** (0.000)	- 4.070*** (0.000)
ln_GDP (importer)		-0.112*** (0.000)	-0.164*** (0.000)	-0.155*** (0.000)	-2.980*** (0.000)	- 1.473*** (0.000)
ln_Exchange rate		-0.060*** (0.000)	0.085*** (0.000)	0.104*** (0.000)	-0.096*** (0.000)	- 0.087*** (0.000)
Constant	5.148	12.638	4.106	3.500	199.671	140.433
Observations	63 239	63 239	63 111	63 111	63 111	62 115
R-squared	3.90%	3.90%	30.92%	31.32%	44.10%	73.47%
Adjusted R-squared	-	-	29.99%	30.35%	43.30%	71.53%
Within R-squared	-	-	5.56%	5.24%	0.37%	0.74%
Product fixed effects	NO	NO	YES	YES	YES	YES
Time fixed effects	NO	NO	NO	YES	YES	YES
Border fixed effects	NO	NO	NO	NO	YES	YES
Robust standard errors	YES	YES	YES	YES	YES	YES

*** = indicates that the variable is significant at a 1% level, ** = significant at a 5% level, * = significant at a 10% level and no star indicates that the variable is insignificant. P-values are reported in parentheses under each variable. All the continuous variables such as GDP and exchange rate have been log-transformed, whereas the dummy variables have not.

Throughout all the regressions with the different versions of the model, the coefficient of the DD estimator shows a significant and positive effect indicating that the OSBPs have been successful in increasing trade flows. The results from the full model (f) used in this paper show a significant positive effect from the OSBPs in Uganda. More specifically a positive effect of a 6.2 percent increase in trade flows through Ugandan OSBPs in relation to traditional border posts[7].

When it comes to the "Time" and "Treated" variables, they yield significant and positive coefficients before they are dropped in the models using fixed effects. This indicates that there is generally more cross-border trade in the post-treatment period and generally more cross-border trade at the border crossings exposed to the treatment and hence are chosen to become OSBPs.

Moreover, the control variables consisting of the natural logarithm of the GDP for both the importer and the exporter, and the natural logarithm of the exchange rate all yield fully significant coefficients. However, when it comes to these variables it is not completely given how to interpret the coefficients. The coefficients for the GDP variables are very large, but in this case that is not a problem since the GDP does not vary that much over the data set. Most of the variation is also accounted for by the multiple-way fixed effects and hence the coefficients are representing "outliners" that are not that common in the sample.

The reported R-squared values are increasing as the models gradually include control variables and account for more types of fixed effects. The main model has an adjusted R-squared value of 71.53 percent indicating that the model has a relatively large explanatory value for the data.

Noteworthy when it comes to the main results are that this is not a general result for OSBPs, but a very specific one for these particular countries trading with a certain set of products through these border posts. It is therefore likely the case that the increased trade is mainly an increase of already traded products. However, this is something that requires further analysis, which is discussed in the last chapter as a recommendation for future research.

[7] Variables' coefficients that are not logged are recalculated by $e^{coefficient} - 1$ when interpreted as a percentage change on the outcome variable.

Furthermore, the effects from the implementation of OSBPs on cross-border trade flows can be shown in an event study graph, which is illustrated in Figure 12. In this figure, the DD estimate showing the effect is separated on a quarterly basis around the time of the treatment and the start of the policy change.

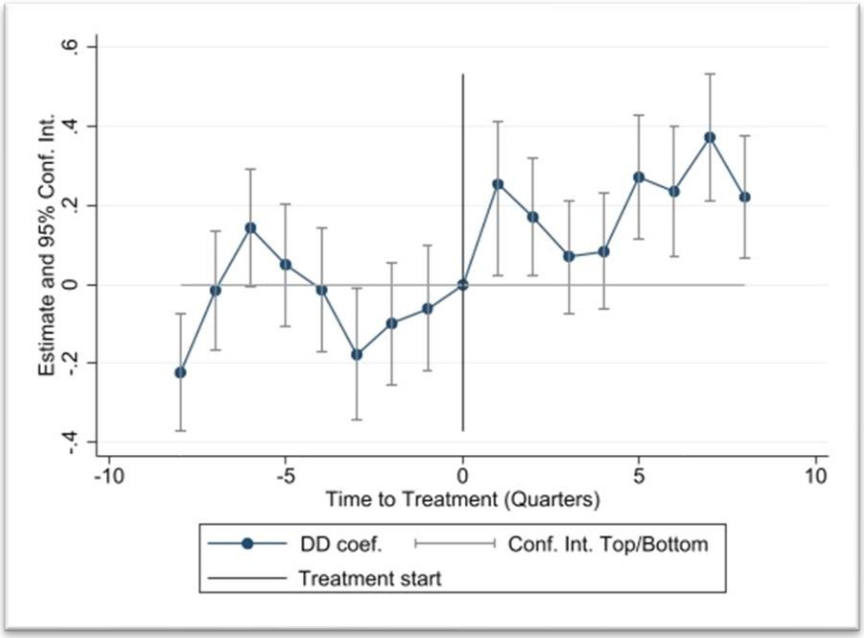

***Figure 12*: Event Study Graph of the DD effect, per quarter**

Source: Author's calculations

To reach a more detailed and deeper understanding of the results, they can be separated into categories. This can help draw conclusions and reach valuable insights about heterogeneity, which can help policymakers in future decision-making. More specifically, the regressions can be slightly modified to yield coefficients representing the effects on different types of products. This could be useful for different reasons. One of them is due to the large differences in traded volumes between different types of products, while another one is due to the fact that many products are handled in different ways and through different frameworks when crossing borders. This paper, in accordance with many previous studies, chose to separate the products into two groups: one group consisting of HS chapters 01-24 representing *Agricultural products*, such as food, and another group consisting of HS chapters 25-97 representing *Non-Agricultural products* such as Manufacturing products. These regression results can be seen in Table 3 below.

Table 3: Estimations for product sections

Dependent variable: Value of traded products through Uganda's border posts (natural logarithm)

	Agricultural products (HS chapter 01-24)	**Non-agricultural products (HS chapter 25-97)**
$D_i^{Treatment} * D_t^{Post}$	0.206*** (0.000)	-0.005 (0.119)
Observations	62 115	
R-squared	73.49%	
Adjusted R-squared	71.56%	
Within R-sq.	0.83%	
Product fixed effects	YES	
Time fixed effects	YES	
Border fixed effects	YES	
Robust standard errors	YES	

*** = indicates that the variable is significant at a 1% level, ** = significant at a 5% level, * = significant at a 10% level and no star indicates that variable is insignificant. P-values are reported in parentheses under each variable.

This heterogeneity analysis reveals an interesting insight, namely that the implementation of OSBPs in Uganda seems to have had a large, significant positive effect of 22.9 percent on Agricultural products and food while it has not had a significant effect on other types of products. This is an interesting result that goes in line with previous research by e.g., Djankov et al. (2010) who argue that food and agricultural products are more time-sensitive than other products. As previously described in chapter 2, one of the main goals and ambitions of a OSBP is to make cross-border trade more efficient and to reduce the time it takes to cross the border. Therefore, it is reasonable that the OSBPs have had the largest positive effect on trade flows consisting of food and agricultural products that are considered time-sensitive.

The other variables, which are not reported here, as well as R-squared values, yielded similar coefficients as in the main model.

A full list of all the HS chapters can be found in Appendix A.1.

6.2 Robustness tests

6.2.1 Placebo tests

As discussed in previous chapters, the main assumption that needs to hold for the Difference-in-Differences estimation to yield valid results is the parallel trend assumption. To test this, two placebo tests were conducted, one in time with "fake" treatment periods, and another in space with "fake" treatment and control groups. These tests use "fake" treatment periods or identify the wrong border posts as treated and control, which should yield insignificant results for the DD estimate. The first test with a placebo timing of treatment used three "fake" times as treatment start for the treatment groups in the data. The regression with placebo in space instead used a "fake" group of border posts acting as treated border posts, when they are actually untreated and instead should be considered part of the control group. Both tests yielded insignificant coefficients for the DD estimate, which supports the parallel trend assumption and hence strengthens the main result from this paper. The two placebo tests can be seen below in Tables 4 and 5.

Table 4: Regressions with placebo in time

Dependent variable: Value of traded products through Uganda's border posts (natural logarithm)

Placebo time	**August 2014**	**January 2015**	**June 2015**
$\boldsymbol{D_i^{Treatment} * D_t^{Post}}$	0.131 (0.313)	0.084 (0.483)	0.015 (0.931)
Observations	30 367	30 367	30 367
R-squared **Adjusted R-squared** **Within R-squared**	76.58% 73.82% 0.36%	76.57% 73.81% 0.34%	76,57% 73.81% 0.32%

*** = indicates that the variable is significant at a 1% level, ** = significant at a 5% level, * = significant at a 10% level and no star indicates that the variable is insignificant. P-values are reported in parentheses under each variable.

Table 5: Regressions with placebo in space (treatment group)

Dependent variable: Value of traded products through Uganda's border posts (natural logarithm)

$D_i^{Treatment} * D_t^{Post}$	0.161 (0.496)
Observations	32 000
R-squared	68.02%
Adjusted R-squared	65.56%
Within R-squared	0.63%

*** = indicates that the variable is significant at a 1% level, ** = significant at a 5% level, * = significant at a 10% level and no star indicates that the variable is insignificant. P-values are reported in parentheses under each variable.

Worth to mention here, except for the fact that the placebo regressions support the parallel trend assumption, is that the regression with the placebo timing of treatment in June 2015 indicates that there was no anticipation effect affecting the trade at this time, despite most people knowing about the border posts being transformed into OSBPs the following months. Hence, despite the exact timing of treatment being difficult to pinpoint, this result gives a clear and important signal that the chosen treatment period in this paper is reasonable.

6.2.2 Control estimations

To control the robustness of the yielded results in Table 2, further tests were conducted as controls. First, the author ran the same regressions that yielded the main results but instead using a non-linear Poisson (PPML) regression. As discussed earlier, taking the natural logarithm of the trade flow could lead to biases in the results due to the zero values being dropped. As argued by Santos Silva and Tenreyro (2006), one way to deal with this potential problem is to use a non-linear model, for instance, a PPML, which is used as a control model in this paper. In this regression, the zero-trade values for different products in the data, which are usually dropped (either actual zero-values or small values rounded to zero), are still included. The results from the non-linear regression, which can be seen in Table 6 below, show a significant positive effect of 2.1 percent on the cross-border trade flows in Uganda caused by OSBPs. Even though the effect is smaller than in the main model's regressions, the test gives support to the previous results, even when controlling with a different model, in accordance with recommendations from Santos Silva and Tenreyro (2006).

Table 6: Regression results with non-linear model (Poisson)

Dependent variable: Value of traded products through Uganda's border posts (natural logarithm)

$D_i^{Treatment} * D_t^{Post}$	0.021*** (0.000)
Observations	255 600
R-squared	13.65%
Product fixed effects	YES
Time fixed effects	YES
Border fixed effects	YES
Robust standard errors	YES

*** = indicates that the variable is significant at a 1% level, ** = significant at a 5% level, * = significant at a 10% level and no star indicates that the variable is insignificant. P-values are reported in parentheses under each variable.

Both as a control estimation and to obtain a rho-value, the author chose to run a regression using a simple panel data regression, which does not absorb multi-way fixed effects (xtreg in Stata). This regression, which can be seen in Table 7, supports the previous results by yielding a positive and significant coefficient for the DD variable, which goes in line with previous findings. Furthermore, the regression also provides a rho-value of 0.755, meaning that 75.5 percent of the variance in the data is due to differences across panels. This value also indicates that this regression explains 57 percent of the variables and data.

Table 7: Regression results using a simple panel data regression, not absorbing multi-way fixed effects

Dependent variable: Value of traded products through Uganda's border posts (natural logarithm)

$D_i^{Treatment} * D_t^{Post}$	0.066** (0.044)
Observations	63 239
Within R-squared	0.57%
Between R-squared	0.61%
Overall R-squared	0.13%
Rho-value	0.755

*** = indicates that the variable is significant at a 1% level, ** = significant at a 5% level, * = significant at a 10% level and no star indicates that the variable is insignificant. P-values are reported in parentheses under each variable.

Finally, the author also chose to run the original regressions using clustered standard errors on the border post level to further control the robustness of the result. However, all regressions run with these clustered standard errors yielded insignificant coefficients for all variables, including the DD estimate. This is an interesting result that might indicate that the “true” effect of the OSBPs is not significant when clustering on the border post level. However, using clustered standard errors in Difference-in-Differences estimations has been heavily discussed and it is not generally agreed on if, when, and how one should use clustered standard errors (Cameron and Miller, 2015). Cameron and Miller (2015) argue that if one uses clustered standard errors, the threshold for the number of clusters required for good and reliable analysis is around 20-50. The control regressions with clusters in this paper adjust the standard errors for just 14 cluster groups. Following the threshold argued by Cameron and Miller (2015), the number of clusters used in this paper might not be sufficient to draw any major conclusions from this particular regression. Due to this, the author argues that the insignificant results yielded from using clusters are not robust and reliable enough to reject the main results in this thesis. Nonetheless, the author admits that these results still are informative and could have meaning for the conclusion. The results in the paper should hence be taken with a small part of caution and the author recommends this to be investigated further in future studies.

7. Conclusion

This thesis sought to measure the effects on trade flows that OSBPs have contributed to in relation to traditional border crossings in Uganda. In accordance with previous research and economic theory, the author assumed a hypothesis that OSBPs would have a positive and significant effect on trade flows between Uganda and its neighbouring countries through e.g., shorter clearance times at the border and through a more efficient use of resources.

The results in this study show that the border posts in Busia, Malaba and Mirama Hills between Uganda and its neighbours Kenya and Rwanda have experienced an increase in trade flows that are 6.2 percent larger than at the traditional border posts during the data period 2014-2017. These results are significant and robust to controls and placebo tests. Moreover, the results also indicate that agricultural products, which are considered time-sensitive, are accounting for most of the increase. This indicates that these types of products are heavily benefited by the implementation of OSBPs, while other non-agricultural products are not as affected.

The results from this research are in line with both previous research and economic theory as they show that OSBPs have contributed to an increase in trade flows due to increased cooperation and integration, and consequently, reduced costs and times to trade. Based on this, the author can conclude the OSBP concept has brought many benefits to the intra-African and the Ugandan trading environment. Hence, policy and decision makers should continue to develop, implement, and expand the OSBP concept for regional and national development, to help the African continent catch up with the rest of the world regarding trade, development, and the movement of goods and people.

There are studies estimating and predicting the potential effects from improved levels of trade facilitation and the construction and implementation of OSBPs, both when it comes to costs and time. However, as previously argued, the field is relatively new and unexplored when it comes to estimating the actual results and outcomes of the OSBPs, especially in Uganda and the EAC region. To the author's knowledge, this study is one of the first to investigate these matters, and in particular to estimate the effects of OSBPs in relation to traditional border posts, to obtain the pure causality from these OSBP reforms. Therefore, the author hopes that this study can be a relevant contribution to the research field, and act as a support and inspiration to policymakers and for future research.

Finally, to further contribute to the research field, the author recommends future studies to look deeper into the potential challenges with having varying treatment times, as discussed further in section 5.4. When it comes to OSBPs, the concept is very comprehensive and involves many dimensions of implementation stages, with everything from the construction of physical facilities to the integration of technical systems. Hence, it is, in many cases, hard to pinpoint an exact time when the treatment period should be considered started, and it would be valuable to investigate these factors deeper in future studies, even though it is not really a problem in this paper.

It would also be interesting to analyse whether the number of Ugandan firms exporting has increased, as predicted by economic theory, or if the increased trade flows are represented by existing exporting firms increasing their export activities. Furthermore, it would be informative to investigate whether there exist any differences in outcomes between different types of OSBPs and if policymakers should focus more on which type of OSBP to construct and implement. Lastly, it would be useful for policymakers to investigate the effects on more disaggregated product levels to get a more profound understanding of the heterogeneous effect of different products, for instance, to see if there would be a higher likelihood of exporting a product after the implementation of a OSBP.

References

Angrist, J., Pischke, J.-S., (2009). Mostly Harmless Econometrics: An Empiricist's Companion, in: Mostly Harmless Econometrics: An Empiricist's Companion. https://www.sciencedirect.com/science/article/pii/S1573446399030047

Angrist, J.D., Krueger, A.B., (1999). Chapter 23 - Empirical Strategies in Labor Economics, in: Ashenfelter, O.C., Card, D. (Eds.), Handbook of Labor Economics. *Elsevier*, pp. 1277–1366. https://doi.org/10.1016/S1573-4463(99)03004-7

AU, EU, (2013). One Stop Border Posts Make Their Way in Africa. Retrieved June 26, 2021 from https://africa-eu-partnership.org/en/stay-informed/news/one-stop-border-posts-make-their-way-africa

Bacchetta, M., Beverelli, C., Cadot, O., Fugazza, M., Grether, J.-M., Helble, M., Nicita, A., Piermartini, R., (2012). A practical guide to trade policy analysis. World Trade Organization: Geneva. https://www.wto.org/english/res_e/publications_e/wto_unctad12_e.pdf

Ben Barka, H., (2012). Border posts, checkpoints, and intra-African trade: challenges and solutions. African Development Bank: Abidjan. Retrieved August 05, 2021 from https://www.semanticscholar.org/paper/Border-posts%2C-checkpoints%2C-and-intra-African-trade%3A-Barka/a581f7d5c5195ce3775f05eaaae57930f056ea5a

Bernard, A.B., Jensen, J.B., Redding, S.J., Schott, P.K., (2007). Firms in International Trade. *Journal of Economic Perspectives*. 21, 105–130. https://doi.org/10.1257/jep.21.3.105

Bertrand, M., Duflo, E., Mullainathan, S., (2003). How Much Should We Trust Differences-In-Differences Estimates? *The Quarterly Journal of Economics*. 119, 249–275. https://doi.org/10.1162/003355304772839588

Callaway, B., Sant'Anna, P.H.C., (2020). Difference-in-Differences with multiple time periods. *Journal of Econometrics*. https://doi.org/10.1016/j.jeconom.2020.12.001

Cameron, A.C., Miller, D.L., (2015). A Practitioner's Guide to Cluster-Robust Inference. *Journal of Human Resources*. 50, 317–372. https://doi.org/10.3368/jhr.50.2.317

COMESA, (2021). Small Scale Cross Border Trade Data. COMSTAT Data Hub. Lusaka. Retrieved April 10, 2021 from https://comstat.comesa.int/lslslue/small-scale-cross-border-trade-data

de Chaisemartin, C., D'Haultfœuille, X., (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *ArXiv180308807 Econ.* http://arxiv.org/abs/1803.08807

Desiderio, D., (2019). One Stop Border Posts in Africa. Retrieved April 20, 2021 from http://www.ddcustomslaw.com/index.php?option=com_content&view=article&id=338%3Aone-stop-border-posts-in-africa-&catid=1%3Aultime&Itemid=50&lang=en

Djankov, S., Freund, C., Pham, C.S., (2010). Trading on time. *The review of Economics and Statistics*. 92, 166–173. https://ideas.repec.org/a/tpr/restat/v92y2010i1p166-173.html

Fitzmaurice, M., Hartmann, O., (2013). Border crossing monitoring along the Northern Corridor. *Sub-Sahara Africa Transport Policy Program (SSATP)* 58. NO 96. Retrieved August 31, 2021 from https://www.ssatp.org/sites/ssatp/files/publications/SSATPWP96-border-crossing_1.pdf

Gertler, P.J., Martinez, S., Premand, P., Rawlings, L.B., Vermeersch, C.M., (2016). Impact evaluation in practice. The World Bank: Washington. D.C. Retrieved May 27, 2021 from https://openknowledge.worldbank.org/handle/10986/25030

Goodman-Bacon, A., (2018). Difference-in-Differences with Variation in Treatment Timing. *National Bureau of Economic Research*: *No. w25018*. Cambridge, MA. http://www.nber.org/papers/w25018.pdf https://doi.org/10.3386/w25018

International Organization for Migration, (2015). IOM and Integrated Border Management. Retrieved April 21, 2021 from https://www.iom.int/integrated-border-management

Khandker, S., B. Koolwal, G., Samad, H., (2009). Handbook on impact evaluation: quantitative methods and practices. The World Bank: Washington D.C. Retrieved April 25, 2021 from https://openknowledge.worldbank.org/handle/10986/2693

Kieck, E., (2010). Coordinated border management: unlocking trade opportunities through one stop border posts. *World Customs Journal*. 4, 12. https://worldcustomsjournal.org/Archives/Volume%204%2C%20Number%201%20(Mar%202010)/02%20Kieck.pdf

Milner, C., Morrissey, O., Zgovu, E., (2008). Trade Facilitation in Developing Countries. *Centre for Research in Economic Development and International Trade* 08, 34. https://www.nottingham.ac.uk/credit/documents/papers/08-05.pdf

NEPAD, ICA, JICA, AfDB, EAC, (2016). One Stop Border Post Sourcebook, 2nd edition. Midrand. Retrieved April 20, 2021 from https://www.trademarkea.com/onestopborderposts/wp-content/uploads/2019/12/OSBP-Sourcebook-2nd-Edition.pdf

NEPAD, ICA, JICA, AfDB, EAC, (2011). One Stop Border Post Source Book, 1st edition. Midrand. Retrieved April 20, 2021 from https://www.trademarkea.com/onestopborderposts/wp-content/uploads/2011/OSBP-Sourcebook.pdf

Nordås, H., Pinali, E., Grosso, M., (2006). Logistics and Time as a Trade Barrier. *OECD Trade Policy Papers*, No. 35. https://doi.org/10.1787/664220308873

Nugent, P., Soi, I., (2020). One-stop border posts in East Africa: state encounters of the fourth kind. *Journal of Eastern African Studies*. 14, 433–454. https://doi.org/10.1080/17531055.2020.1768468

Persson, M., (2012). From trade preferences to trade facilitation: Taking stock of the issues. IfW: Kiel. *Economics: The Open-Access, Open-Assessment E-Journal*. 6, 1–33. Retrieved August 10, 2021 from https://doi.org/10.5018/economics-ejournal.ja.2012-17

PIDA, (2017). One-Stop-Boarder-Posts (OSBP). Virtual PIDA Inf. Cent. Retrieved April 19, 2021 from https://www.au-pida.org/one-stop-boarder-posts-osbp/

Samuelson, P., (1954). The Transfer Problem and Transport Costs, II: Analysis of Effects of Trade Impediments. *Economic Journal* 64(254), (June), pp. 264-289.

Santos Silva, J.M.C., Tenreyro, S., (2006). The Log of Gravity. *Review of Economics and Statistics*. 88, 641–658. https://doi.org/10.1162/rest.88.4.641

Schwerdt, G., Woessmann, L., (2020). Chapter 1 - Empirical methods in the economics of education, in: Bradley, S., Green, C. (Eds.), The Economics of Education (Second Edition). *Academic Press*, pp. 3–20. https://doi.org/10.1016/B978-0-12-815391-8.00001-X

Shepherd, B., (2013). The gravity model of international trade: A user guide. United Nations: New York. Retrieved June 20, 2021 from https://vi.unctad.org/resources-mainmenu-64/digital-library?task=dl_doc&doc_name=810_the_gravity_

Siu, J., (2019). Trade costs, trade facilitation and formalisation of trade: Evidence from One-Stop-Border-Posts in Uganda. *IGC Working Paper F-43435-UGA-1*. https://cega.berkeley.edu/wp-content/uploads/2020/03/Siu_PacDev2020.pdf

Stock, J.H., Watson, M.W., (2020). Introduction to econometrics. https://public.ebookcentral.proquest.com/choice/publicfullrecord.aspx?p=5640381

TMEA, (2019). One Stop Border Posts: Transforming Trade And Lives. *Medium*. Retrieved July 14, 2021 from https://medium.com/@TradeMarkEastA/one-stop-border-posts-transforming-trade-and-lives-a9c95c371ca6

TMEA, (2017). 2017 Aid for Trade, Busia One Stop Border Post (OSBP). Nairobi. Retrieved August 08, 2021 from https://www.oecd.org/aidfortrade/casestories/casestories-2017/CS-71-TMEA-Busia-one-stop-border-post.pdf

Tyson, J.E., (2018). One-stop border posts and informal livelihoods in Busia, Kenya. *Development in Practice*. 28, 562–573. https://doi.org/10.1080/09614524.2018.1442813

UNCTAD, (2006). Trade facilitation handbook. United Nations: New York. https://digitallibrary.un.org/record/577375

UNCTAD, WTO, (2012). A practical guide to trade policy analysis. UNCTAD, WTO: New York, Geneva. https://www.wto.org/english/res_e/publications_e/wto_unctad12_e.pdf

WCO, (2012). What is the Harmonized System (HS)?. Retrieved April 16, 2021 from http://www.wcoomd.org/en/topics/nomenclature/overview/what-is-the-harmonized-system.aspx

Willie, A., Chikabwi, D., (2018). Impact of border delays and costs on COMESA cross border trade. COMESA. Retrieved August 27, 2021 from https://www.comesa.int/wp-content/uploads/2021/02/key-issues-on-intergration-vol-6_web.pdf

World Bank, (2020). World Development Indicators. The World Bank Group: Washington, D.C. Retrieved May 20, 2021 from http://datatopics.worldbank.org/world-development-indicators/

World Bank, (2019). Doing Business Database. The World Bank Group: Washington, D.C. Retrieved April 22, 2021 from https://www.doingbusiness.org/en/data

WTO, (2015a). World Trade Report 2015: Speeding Up Trade: Benefits and Challenges of Implementing the WTO Trade Facilitation Agreement. Geneva. Retrieved August 30, 2021 from https://read.oecd-ilibrary.org/trade-facilitation-and-customs-valuation/world-trade-report-2015_1cee73f9-en

WTO, (2015b). The challenges of implementing the Trade Facilitation Agreement 106–133. Geneva. Retrieved August 05, 2021 from https://doi.org/10.30875/f2985d96-en

Appendix

A.1, HS Product Chapter Descriptions

Chapter number	Product description	HS-6 interval	Chapter number	Product description	HS-6 interval
01	Live animals	010000-019999	50	Silk	500000-509999
02	Meat & Edible meat offal	020000-029999	51	Wool, fine or coarse animal hair; horsehair yarn and woven fabric	510000-519999
03	Fish & Crustaceans	030000-039999	52	Cotton	520000-529999
04	Dairy, Eggs, Honey & Ed, products	040000-049999	53	Vegetable textile fibres; paper yarn and woven fabrics of paper yarn	530000-539999
05	Animal originated products; not elsewhere specified or included	050000-059999	54	Man-made filaments; strip and the like of man-made textile materials	540000-549999
06	Trees and other plants, live; bulbs, roots and the like; cut flowers and ornamental foliage	060000-069999	55	Man-made staple fibres	550000-559999
07	Vegetables and certain roots and tubers; edible	070000-079999	56	Wadding, felt and nonwovens, special yarns; twine, cordage, ropes and cables and articles thereof	560000-569999
08	Fruit and nuts, edible; peel of citrus fruit or melons	080000-089999	57	Carpets and other textile floor coverings	570000-579999
09	Coffee, tea, mate and spices	090000-099999	58	Fabrics; special woven fabrics, tufted textile fabrics, lace, tapestries, trimmings, embroidery	580000-589999
10	Cereals	100000-109999	59	Textile fabrics; impregnated, coated, covered or laminated; textile articles of a kind suitable for industrial use	590000-599999
11	Products of the milling industry; malt, starches, inulin, wheat gluten	110000-119999	60	Fabrics; knitted or crocheted	600000-609999
12	Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit, industrial or medicinal plants; straw and fodder	120000-129999	61	Apparel and clothing accessories; knitted or crocheted	610000-619999
13	Lac; gums, resins and other vegetable saps and extracts	130000-139999	62	Apparel and clothing accessories; not knitted or crocheted	620000-629999
14	Vegetable plaiting materials; vegetable products not elsewhere specified or included	140000-149999	63	Textiles, made up articles; sets; worn clothing and worn textile articles; rags	630000-639999
15	Animal or vegetable fats and oils and their cleavage products; prepared animal fats; animal or vegetable waxes	150000-159999	64	Footwear; gaiters and the like; parts of such articles	640000-649999
16	Meat, fish or crustaceans, molluscs or other aquatic invertebrates; preparations thereof	160000-169999	65	Headgear and parts thereof	650000-659999
17	Sugars and sugar confectionery	170000-179999	66	Umbrellas, sun umbrellas, walking-sticks, seat sticks, whips, riding crops; and parts thereof	660000-669999
18	Cocoa and cocoa preparations	180000-189999	67	Feathers and down, prepared; and articles made of feather or of down; artificial flowers; articles of human hair	670000-679999
19	Preparations of cereals, flour, starch or milk; pastrycooks' products	190000-199999	68	Stone, plaster, cement, asbestos, mica or similar materials; articles thereof	680000-689999

20	Preparations of vegetables, fruit, nuts or other parts of plants	200000-209999	**69**	Ceramic products	690000-699999
21	Miscellaneous edible preparations	210000-219999	**70**	Glass and glassware	700000-709999
22	Beverages, spirits and vinegar	220000-229999	**71**	Natural, cultured pearls; precious, semi-precious stones; precious metals, metals clad with precious metal, and articles thereof; imitation jewellery; coin	710000-719999
23	Food industries, residues and wastes thereof; prepared animal fodder	230000-239999	**72**	Iron and steel	720000-729999
24	Tobacco and manufactured tobacco substitutes	240000-249999	**73**	Iron or steel articles	730000-739999
25	Salt; sulphur; earths, stone; plastering materials, lime and cement	250000-259999	**74**	Copper and articles thereof	740000-749999
26	Ores, slag and ash	260000-269999	**75**	Nickel and articles thereof	750000-759999
27	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	270000-279999	**76**	Aluminium and articles thereof	760000-769999
28	Inorganic chemicals; organic and inorganic compounds of precious metals; of rare earth metals, of radio-active elements and of isotopes	280000-289999	**77**	(No description)	770000-779999
29	Organic chemicals	290000-299999	**78**	Lead and articles thereof	780000-789999
30	Pharmaceutical products	300000-309999	**79**	Zinc and articles thereof	790000-799999
31	Fertilizers	310000-319999	**80**	Tin; articles thereof	800000-809999
32	Tanning or dyeing extracts; tannins and their derivatives; dyes, pigments and other colouring matter; paints, varnishes; putty, other mastics; inks	320000-329999	**81**	Metals; not elsewhere classified, cermets and articles thereof	810000-819999
33	Essential oils and resinoids; perfumery, cosmetic or toilet preparations	330000-339999	**82**	Tools, implements, cutlery, spoons and forks, of base metal; parts thereof, of base metal	820000-829999
34	Soap, organic surface-active agents; washing, lubricating, polishing or scouring preparations; artificial or prepared waxes, candles and similar articles, modelling pastes, dental waxes and dental preparations with a basis of plaster	340000-349999	**83**	Metal; miscellaneous products of base metal	830000-839999
35	Albuminoidal substances; modified starches; glues; enzymes	350000-359999	**84**	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	840000-849999
36	Explosives; pyrotechnic products; matches; pyrophoric alloys; certain combustible preparations	360000-369999	**85**	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles	850000-859999

37	Photographic or cinematographic goods	370000-379999	**86**	Railway, tramway locomotives, rolling-stock and parts thereof; railway or tramway track fixtures and fittings and parts thereof; mechanical (including electro-mechanical) traffic signalling equipment of all kinds	860000-869999
38	Chemical products not elsewhere classified	380000-389999	**87**	Vehicles; other than railway or tramway rolling stock, and parts and accessories thereof	870000-879999
39	Plastics and articles thereof	390000-399999	**88**	Aircraft, spacecraft and parts thereof	880000-889999
40	Rubber and articles thereof	400000-409999	**89**	Ships, boats and floating structures	890000-899999
41	Raw hides and skins (other than furskins) and leather	410000-419999	**90**	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories	900000-909999
42	Articles of leather; saddlery and harness; travel goods, handbags and similar containers; articles of animal gut (other than silk-worm gut)	420000-429999	**91**	Clocks and watches and parts thereof	910000-919999
43	Furskins and artificial fur; manufactures thereof	430000-439999	**92**	Musical instruments; parts and accessories of such articles	920000-929999
44	Wood and articles of wood; wood charcoal	440000-449999	**93**	Arms and ammunition; parts and accessories thereof	930000-939999
45	Cork and articles of cork	450000-459999	**94**	Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, not elsewhere classified; illuminated signs, illuminated name-plates and the like; prefabricated buildings	940000-949999
46	Manufactures of straw, esparto or other plaiting materials; basketware and wickerwork	460000-469999	**95**	Toys, games and sports requisites; parts and accessories thereof	950000-959999
47	Pulp of wood or other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard	470000-479999	**96**	Miscellaneous manufactured articles	960000-969999
48	Paper and paperboard; articles of paper pulp, of paper or paperboard	480000-489999	**97**	Works of art; collectors' pieces and antiques	970000-979999
49	Printed books, newspapers, pictures and other products of the printing industry; manuscripts, typescripts and plans	490000-499999			

Source: Author's compilation based on WCO (2012)