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Corruption and Export Diversification:

Is there a relationship?

Bachelor Thesis
Spring 2014
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Abstract

Does corruption have an impact on export diversification? Despite a growing interest from the international community regarding the detrimental effects of corruption, the consequences it may have for export diversification remain largely unexplored. The purpose of this thesis is to investigate if there is a relationship between the two and, if so, to determine if certain groups of countries have relatively more to gain from combatting corruption.

I conduct my empirical investigation using panel data covering the period 2002-2012 for 157 economies at different levels of development. The baseline regression is estimated with the Poisson-pseudo-maximum-likelihood estimator and several robustness controls using alternative measures of diversification and other estimators are performed.

My results imply that corruption has a significant and negative impact on export diversification. Moreover, my findings indicate that the magnitude of the effect differs depending on the exporter's level of income and that corruption may be especially detrimental in sub-Saharan Africa. However, these results are less robust. Finally, I also find empirical evidence supporting a non-linear relationship between corruption and diversification.

Key words: *Corruption, Export diversification, sub-Saharan Africa, Poisson-pseudo-maximum-likelihood*

Thank you

I would like to thank my supervisor, Maria Persson, for always finding time to answer my questions and for providing helpful comments. You have been a great support.

Any mistakes are my own.

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1. Introduction

The potentially harmful consequences of corruption for economic development have received increasingly more attention during recent years from international organisations, governments and aid-donors worldwide. However, while a substantial and growing body of research supports a negative relationship between corruption and economic growth, few have investigated whether corruption also inhibits export diversification.

There are several reasons to why export diversification may be an attractive development objective for low- and middle-income countries. For instance, it provides an efficient way of mitigating economic risks related to trade shocks. Moreover, exporting a wider range of products is associated with dynamic spill-over effects that increase productivity and contribute to economic growth. In addition, for countries whose exports are concentrated to the natural resource sector, diversification is considered to be an important way of generating employment opportunities and thereby alleviating poverty. Finally, diversifying the export base is sometimes presented as an option for overcoming the notorious *curse of natural resources*. Despite these beneficial aspects, little is known about which factors that determine export diversification. This applies to institutional variables in particular.

The purpose of this thesis is to investigate whether corruption has an impact on export diversification. To my knowledge, only three studies have treated the issue before¹ and these come to different conclusions. While Starosta de Waldemar (2010) and Héredia Caldeira Cabral & Veiga (2010) find that corruption impedes diversification, no specific effect is identified by Parteka & Tamberi (2013). Apart from providing more empirical evidence and thereby make a contribution to the limited amount of research conducted on the topic, I will seek to determine if certain groups of countries have relatively more to gain from combatting corruption in terms of export diversification. I consider this to be the key contribution of this thesis.

More specifically, my empirical investigation aspires to answer the following questions:

- Does corruption have an impact on export diversification?
- Does the effect of corruption on export diversification differ depending on the exporter's level of income?
- Is corruption especially detrimental to export diversification in sub-Saharan Africa?

¹ Starosta de Waldemar (2010) "How Costly is Rent-seeking to Diversification: An Empirical Approach", Héredia Caldeira Cabral & Veiga, (2010) "Determinants of Export Diversification and Sophistication in sub-Saharan Africa" and Parteka & Tamberi (2013) "What Determines Export Diversification in the Development Process? An Empirical Assessment".

- Is there a non-linear relationship between corruption and export diversification? In other words, does the magnitude of the effect vary depending on the level of corruption?

Since the existing literature makes no distinction between the impact of corruption for countries at different levels of income or allow for non-linearities in the relationship between corruption and export diversification, my study is the first of its kind. From a policy perspective, identifying which groups (if any) that have the potential to make significant gains from combatting corruption is highly relevant. The focus on sub-Saharan Africa is reasonable since the commodity-led growth of the 21:st century has largely failed to create jobs and reduce poverty. Hence, diversification may be especially important in this region.

In order to conduct my empirical investigation I use panel data covering the period 2002-2012 for 157 countries at different levels of development. Since no established theoretical model with the purpose of explaining which factors that determine diversification exist, my choice of control variables and estimation technique is largely guided by previous empirical studies within the field. The baseline regression is estimated with the Poisson-pseudo-maximum-likelihood estimator, which is has numerous desirable robustness properties. In addition, a substantial sensitivity analysis is conducted in order to determine whether the results are robust. For instance, controls using other estimators and alternative measures of diversification are undertaken.

My empirical results imply that corruption has a negative and robust impact on horizontal and vertical export diversification. Furthermore, I find that both low- and middle-income countries can achieve substantial diversification gains by combatting corruption, but that the effect is more pronounced for low-income. Similarly, corruption appears to be especially harmful to diversification in sub-Saharan Africa. However, these results are less robust and should be verified by future research. Finally, I find that the magnitude of the elasticity depends on the degree of corruption in the exporting country, thus indicating a non-linear relationship between corruption and diversification.

The thesis proceeds as follows. In the next section I define export diversification and discuss why it can be a desirable strategy for promoting development in low- and middle-income countries. Afterwards, I provide theoretical arguments to why corruption may have an impact on export diversification and discuss problems related to quantifying corruption. An overview of the existing literature and a description of data and methodology are then presented. Finally, I conduct my empirical investigation and analyse the results.

2. Export diversification as a strategy for development

I initiate the following chapter by defining export diversification and briefly discuss how it can be measured. After that I provide several arguments to why export diversification can promote development in low- and middle-income countries. Finally, a section is devoted to sub-Saharan Africa since diversification may be especially important on this continent.

2.1 Definition of export diversification

In the empirical literature, export diversification is often defined as a broadening of the range of products that a country exports (Dennis & Shepherd, 2007, p.5) or as an increase in the number of destination markets (Bacchetta et al., 2009, p.81). In addition, diversification is sometimes associated with a more even distribution of value across an exporter's goods (Starosta de Waldemar, 2010, p.8). In my thesis, I will not treat the geographical dimension.² A distinction can be made between horizontal diversification and vertical diversification. Horizontal diversification takes place within the same sector (primary, secondary or tertiary) by introducing new products of approximately the same level of sophistication to the export mix. For example, if a country specialised in exporting fresh fruit also starts exporting cut flowers, horizontal diversification can be said to have occurred. In contrast, vertical diversification generally entails moving up the value chain. Structural transformation, during which production gradually shifts from agricultural activities into manufacturing, is an example of vertical diversification (Samen, 2010, p.4-5). For development purposes, both horizontal and vertical diversification are considered to be of importance (Herzer & Nowak-Lehmann, 2006, p. 1-2).

2.2 Measuring diversification

The level of export diversification can be measured in various ways. One method consists of simply counting the number of products that a country exports a given year. This approach is attractive since it directly measures diversification as a widening of the export base and is unaffected by price changes on the world market. In addition, the technique captures, though imperfectly, both horizontal and vertical diversification (Dennis & Shepherd, 2011, p. 103, 107). A potential drawback may be that it treats all products as equally important (Persson & Wilhelmsson, 2013, p. 12-13).

An alternative approach entails using a concentration index. In the empirical literature, the Herfindahl-Hirschman index (HHI) is frequently used. Ranging from 0 to 1, where values close to 1 indicate a high level of concentration, the HHI takes on the following form:

² I acknowledge the importance of geographical diversification for income (Bacchetta et al., 2009) and output (Malik & Temple, 2009), but whether corruption has an impact on this dimension of export diversification will have to be a topic for future research.

$$HHI_j = \frac{\sqrt{\sum_{i=1}^n \left[\frac{x_{ij}}{X_j}\right]^2} - \sqrt{1/n}}{1 - \sqrt{1/n}}$$

where:

HHI_j is the country's index

x_{ij} the value of exports for country j and product i

$$X_j = \sum_{j=1}^n x_{ij}$$

and n the number of exported products

Source: UNCTAD (2014)

The HHI measures the dispersion of trade **value** across an exporter's range of products. Hence, a country whose export revenues depend heavily on just a few items, and who is therefore more vulnerable to trade shocks, will receive a score close to 1 (World Bank, 2013, p.24). Despite the level of vulnerability being an interesting, and for development policies relevant, factor to analyse, using a concentration index as a measure of export diversification has its limitations. For example, cyclical fluctuations in relative prices can have a substantial impact on the index (Persson & Wilhelmsson, 2013, p.13). Rising prices of primary commodities make countries who export these appear to be increasingly more concentrated, hence less diversified, even though the physical composition of their exports remain exactly the same.

For the purpose of my thesis I find both measures to be of relevance. The *number of exported products* will be my main choice of dependent variable, but I will also run a regression with the *Herfindahl-Hirschman index*. Due to the fact that they measure slightly different aspects of export diversification, the econometric results may differ. In addition, even though my count variable captures vertical diversification to a certain extent, it reveals nothing regarding the composition of the export base. Since this type of diversification is typically associated with a shift from exporting primary products into manufactured goods, I will run a separate regression where I use *Manufactures as share of total exports* as dependent variable. These estimates, along with the ones from the Herfindahl-Hirschman-regression, will serve as robustness controls for my baseline regression.

Another factor to take into account when measuring export diversification is the level of aggregation of the data used. Highly aggregated data may understate the degree of diversification that has taken place whereas the opposite has the potential to yield results that are of little economic importance. In the latter case a minor modification of a certain item, such as reducing the amount of sugar in strawberry jam, may be counted as a new product all together. In my empirical investigation I use data of the three-digit level of disaggregation, classified according to the Standard International Trade Classification (SITC). Such products often represent more than 0.3% of a country's total exports or have an export value higher than 100.000 dollars (UNCTAD, 2014). In consequence, an increase in the number of exported products implies that significant export diversification has taken place.

2.3 Why diversify?

Why discuss export diversification in the first place? According to the supposedly most dominating theory within the trade literature, countries should specialise in producing those goods in which they have a comparative advantage. By doing so and engaging in trade, resource allocation will become more efficient and each country will benefit in terms of higher growth and increased welfare (Krugman & Obstfeld, 2007, p.28-29, 36-37). Diversifying the export base appears to contradict the Ricardian theory described above³. However, even though specialisation increases efficiency, there are numerous reasons to why developing countries may be interested in diversifying⁴.

First and foremost, diversification is a way of mitigating economic risks. This is a well-known fact within the finance literature and is especially relevant for exporters with a comparative advantage in primary commodities. For instance, countries whose exports are concentrated to a very narrow range of products become vulnerable to external shocks such as a price falls on the world market. The instability of exports revenues exacerbates macroeconomic uncertainty and may have a negative impact on economic planning and investment, as well as the capacity to import and repay public debts (al-Marhubi, 2000; Herzer & Nowak-Lehmann, 2006; Hesse, 2008; Agosin, 2007). Furthermore, volatile export earnings are associated with higher variance of GDP growth. This is problematic since many developing countries have little access to global financial markets and hence may not be able to smooth consumption (Osakwe, 2007; Agosin, 2007; Amurgo-Pacheco & Pierola, 2008). In addition, boom-and-bust-cycles can have a more long-term effect on unemployment. During an economic down-turn, when unemployment rises, the skills of the labour force deteriorate, a tendency that often cannot be fully compensated for during the next boom. The effect of a temporary contraction may therefore result in hysteresis (Agosin, 2007). Since the prices of primary commodities tend to experience more fluctuations than those of manufactures (Bacchetta et al., 2009), commodity-exporters are relatively more vulnerable to external shocks. Diversification, both

³ It also contradicts the Heckscher-Ohlin theory. For more information please consult Krugman & Obstfeld (2007).

⁴ Hesse (2008) argues that developing countries gain from export diversification whereas richer countries typically benefit from specialising.

vertical and horizontal, provides a way of stabilising export revenues since it reduces the dependence on a few items that, in developing countries, often are subject to high volatility.

In the long term, it is also believed, even though there is no consensus on the matter, that primary product-exporters face declining terms of trade. The so-called Prebisch-Singer hypothesis from the 1950's states that long term economic growth requires a structural shift away from depending on exporting primary commodities into exporting manufactures (Prebisch, 1950; Singer, 1950). This process is identical to vertical diversification.

Several researchers have emphasized the dynamic effects associated with successful export diversification. Herzer & Nowak-Lehmann (2006) suggest that vertical and horizontal export diversification in Chile positively contributed to economic growth through learning-by-doing and learning-by-exporting externalities. For instance, the exposure to international competition and the interaction with foreign buyers entails knowledge-transfers regarding production techniques, efficient organisational structures and use of new technology. When entering the international market, the productivity of the export-oriented firms is therefore likely to be enhanced. Moreover, due to spill-over effects, the efficiency of other industries within the domestic economy often rises too (Herzer & Nowak-Lehmann, 2006). A similar line of reasoning can be found in Al-Marhubi (2000) who emphasises the positive role of knowledge-externalities accrued from export diversification. Furthermore, a study by Agosin (2007) postulates that countries which broaden their comparative advantage, i.e diversify, experience higher growth rates than those whose production is restricted to a limited range of low-technology goods. One reason to this would be that diversification increases the skills of labourers within the new sector, who in turn will train others, whereby productivity increases. Due to the higher levels of human capital the probability also rises that people employed within the new sectors will come up with new production ideas, which will lead to the start-up of additional industries. Learning externalities arising from vertical and horizontal export diversification thus facilitate the emergence of new sectors and are a key to getting the growth process started (Agosin, 2007).

Another aspect of export diversification, also relevant for development purposes, concerns job creation. In many low- and middle-income countries, exports are highly concentrated to natural resources. In general, the extractive industries (oil exploration and mining) are capital-intensive and generate few employment opportunities. Moreover, the linkages with the rest of the economy are limited and the revenues typically accrue to a restricted enclave if no redistribution takes place (UNECA, 2012, p.39, 50). As I will elaborate on at a later stage in this thesis, commodity-led growth has for example largely failed to alleviate poverty and reduce unemployment in sub-Saharan Africa. Diversifying into sectors that use a higher ratio of labour is an option for achieving more inclusive growth.

Finally, during the last thirty years a vast amount of research has treated the so-called *natural resource-curse*. For example, in an influential paper Sachs & Warner (1995) argue that countries with an abundance of natural resources, mineral and fuels in particular, grow more slowly and have worse development outcomes. Grossly simplified, the curse works through both economic and political mechanisms. The economic ones include *Dutch disease*⁵ and income volatility, whereas the political ones are associated with various dimensions of worsened governance. Collier & Hoeffler (1998) also find a link between the presence of natural resources and a higher incidence of civil war. However, research conducted by Lederman & Maloney put the existence of the resource curse into question. They argue that it is not natural resources in themselves that are detrimental to economic development, but a high concentration of exports (Lederman & Maloney, 2007). Though opinions on the matter differ, diversifying the export base is likely to be an important way of overcoming the (elusive?) resource-curse.

In conclusion, though specialization may increase efficiency and be optimal for countries at higher levels of development, low- and middle-income economies often have much to gain from diversifying the export base.

2.4 The case of sub-Saharan Africa

While I initially investigate whether corruption has an effect on export diversification in general, I will at a later stage test if corruption is especially harmful in sub-Saharan Africa. The regional focus is relevant since export diversification is increasingly regarded as an option for promoting inclusive and sustainable development on the continent.⁶

Since the early 2000's Sub-Saharan Africa has experienced relatively rapid economic growth and talk of an "African economic renaissance" is frequently heard. However, in general growth has not been inclusive and rests on rather fragile foundations. Sub-Saharan exports remain heavily concentrated to primary commodities and despite improvements in economic management and increased domestic demand, rising commodity prices have been the main driver of the growth-surge (UNECA, 2012, p.33-40, 65- 67; World Economic Forum, 2013, p. 1-10).

While impressive growth rates look good on paper, they have little value if they do not translate into better living standards for the people. In sub-Saharan Africa, poverty and unemployment remain rampant (UNECA, 2014). In 2010, the poverty headcount ratio of people living on less than 1,25 dollars a day (PPP) was 48,5% of the sub-Saharan population. In 1990 the figure was 56,5% (World Bank, 2014), so

⁵ Exporting natural resources leads to an appreciation of the real exchange rate, which makes other exports less competitive on the world market (Collier, 2007, p. 39)

⁶ For instance, the United Nations Economic Commission for Africa refers to diversification as "a new paradigm for Africa's development" (UNECA, 2007)

some improvement can be observed, but the reduction is not proportional to the economic growth that the continent experienced during the period (World Economic Forum, 2013, p. 4). One of the reasons behind this disappointing trend is that growth has mainly been driven by capital-intensive sectors. The extractive industries provide few employment opportunities and have limited linkages with the rest of the economy. Moreover, productivity in the African agricultural sector remains low and a general trend of deindustrialisation, where the share of manufactures relative to GDP has deteriorated, can be observed on the continent (UNECA, 2012, p. 29, 50; UNECA, 2013, p.4). There are exceptions, but in general export diversification remains weak on the continent and compared to other regions sub-Saharan Africa lags behind. Similarly, though positive trends within the service and tourism sector can be observed, the dependency on exporting natural resources prevails (UNECA, 2013, p.50; UNECA, 2011, p.30).

As emphasised in the Economic report on Africa from 2012, the commodity driven growth has hence so far failed to create an adequate amount of jobs and reduce poverty on the continent. The situation becomes more acute given the fact that sub-Saharan Africa has a young and rapidly increasing population. According to calculations made by the International Monetary Fund, by 2020 more than half of the region's population will be under 25 years of age (IMF, 2014, p.35). In order to avoid social and political unrest, sufficient employment opportunities must be generated. The report, along with several others, argues that sub-Saharan economies should promote horizontal and vertical diversification⁷ in order to create jobs and thereby reduce poverty (UNECA, 2012; UNECA, 2011).

As has been noted earlier in this thesis, lack of export diversification also leaves countries vulnerable to external shocks. Fuels and mining-products still dominate sub-Saharan exports, both of which are subject to high price volatility on the global market. Even though many countries in region have experienced relatively strong economic growth during the 21:st century (largely due to an increasing demand of commodities from emerging economies) the variance in the growth rates has been significant (UNECA, 2011, p. 4, 11-14, 29-33). Furthermore, the depletion of natural resources such as fossil fuels and minerals makes a growth strategy based on exporting these unsustainable in the long run. For reasons described above, export diversification may be especially important in sub-Saharan Africa, even though other things certainly are needed too. In my thesis I aim to investigate whether corruption matters more for export diversification in SSA than in other parts of the world.

⁷ The report speaks of both export diversification and economic diversification (which does not necessarily involve exporting) as important strategies for development.

3. Corruption as a determinant of export diversification

In this section I provide a few examples of how corruption can be defined and describe some of the problems associated with quantifying the concept. Being aware of these difficulties is important when analysing and drawing conclusions from studies that, like my own, uses data on corruption. Afterwards I will describe some of the mechanisms through which corruption may affect export diversification.

3.1 What is corruption?

The meaning of corruption is manifold and still no universally accepted definition of the phenomenon exists. The World Bank defines corruption as “the abuse of public office for private gain” (World Bank, 2014a). These gains can be in direct monetary terms in form of a bribe or, for example, involve acquiring a desirable position through patronage (OECD, 2013, p.6; Rohwer, 2009, p. 42-43; Tanzi, 1998, p.9). While the World Bank’s definition is rather broad, it directly implies that corruption is connected to the activities of the state. The economist Vito Tanzi uses a more general definition; “corruption is the intentional non-compliance with [the] arm’s-length principle aimed at deriving some advantage from this behaviour for oneself or for related individuals” (Tanzi, 1998, p.8). The arm’s-length principle implies that all economic agents should be treated the same, regardless of personal or other relationships that may interfere. Tanzi also stresses the necessity of intent and that of acquiring an advantage in order for corruption to have taken place. Finally, the Swedish International Development Cooperation Agency, Sida, uses the following definition of corruption; “[the] abuse of trust, power or position for improper gain. Corruption includes, among other things, the offering and receiving of bribes – including the bribery of foreign officials – extortion, conflicts of interest and nepotism.” (Sida, 2014)

Corruption takes on different forms and often affects many levels of society. Due to its illicit nature, it is also extremely hard to measure. This is a point I will return to further on. In order to make the concept more comprehensible, corrupt activities can be divided into three broad categories; *bribery*, *theft of public assets* and *patronage* (OECD, 2013, p.6). Bribery⁸ takes place when an item of value is given or taken with the purpose of altering the judgement and behaviour of the recipient. The exchange typically involves a state agent and a civilian, where the former misuses his or her position of power. The items of value can, for instance, be in form of money, insider information or company shares (Rohwer, 2009, p.42-43; OECD, 2013, p.6). Theft of public assets often occurs in the form of embezzlement, which can broadly be defined as the “theft of resources by people who are responsible for administering them” (Rohwer, 2009, p. 42). For instance, if an employee steals from his or her employer, this can be regarded as a type of embezzlement. Another example is when a state leader siphons funds out of public coffers and places them on his own over-seas bank account. Moreover, political patronage consists of public resources being

⁸ Equivalent terms to bribery are kick-backs and pay-offs (Rohwer, 2009, p.42)

used to reward individuals or specific groups for their electoral support. Related concepts are nepotism and cronyism which entail granting special favours to relatives and friends (OECD, 2013, p. 6-7; Rohwer, 2009, p.42-43).

Furthermore, corruption can be classified as grand or petty depending on its magnitude. Grand corruption typically refers to acts taking place high up in the political hierarchy that affect policies and the functioning of the state. Petty corruption, on the other hand, mainly involves transactions of relatively lower value where public officials abuse their position in the interaction with ordinary citizens. This kind of street-level corruption often takes place in hospitals, schools, police stations and other bureaucratic offices. Even though the scale of the monetary transaction tends to be smaller than in the case of grand corruption, petty corruption can have devastating consequences for the affected individuals. According to the United Nations Development Programme, corruption affects the poor disproportionately (UNDP, 2008; Transparency International, 2014). Similarly, some researchers make a distinction between political corruption, which involves the political leadership, and bureaucratic corruption that occurs when the bureaucracy engages in corrupt activities (Tanzi, 1998, p.9).

3.2 Measuring corruption

Due to the fact that most aspects of corruption are illegal and that it often takes place in the hidden, it was long withheld that corruption is impossible to measure. However, during recent years numerous indices with the purpose of quantifying and ranking corruption have emerged. Among these, the most well known are Transparency International's *Corruption perceptions index* (CPI), the World Bank's *Control of Corruption* (CC) and an index sold by the International Country Risk Guide (ICRG) (OECD, 2013, p. 7-9).

Even though it is beneficial for both researchers, policy-makers and ordinary citizens that some measurement tools are now available, the indicators should be used with caution. Apart from that the word "corruption" is generally included in the title, the indices capture different aspects of corruption and the methodologies employed when constructing them vary significantly from case to case. The CPI and World Bank's Control of Corruption are based on the public's perceptions regarding the extent of the problem (UNDP, 2008, p.3-34). Some argue that subjective metrics like these are unreliable and do not adequately capture reality. However, in most cases corruption leaves no trail and therefore perceptions may be the best, or only, alternative. Kaufmann, Kraay and Mastruzzi, the architects behind the Control of Corruption index, also argue that perceptions, impressions and views shape the actions of citizens and firms. For example, if people regard the police force as corrupt, they will to a lesser extent seek their services if subject to crime. In addition, objective and fact-based measures may appear attractive, but tend to be based on legal text and fail to capture what takes place on the ground. For these reasons, an indicator

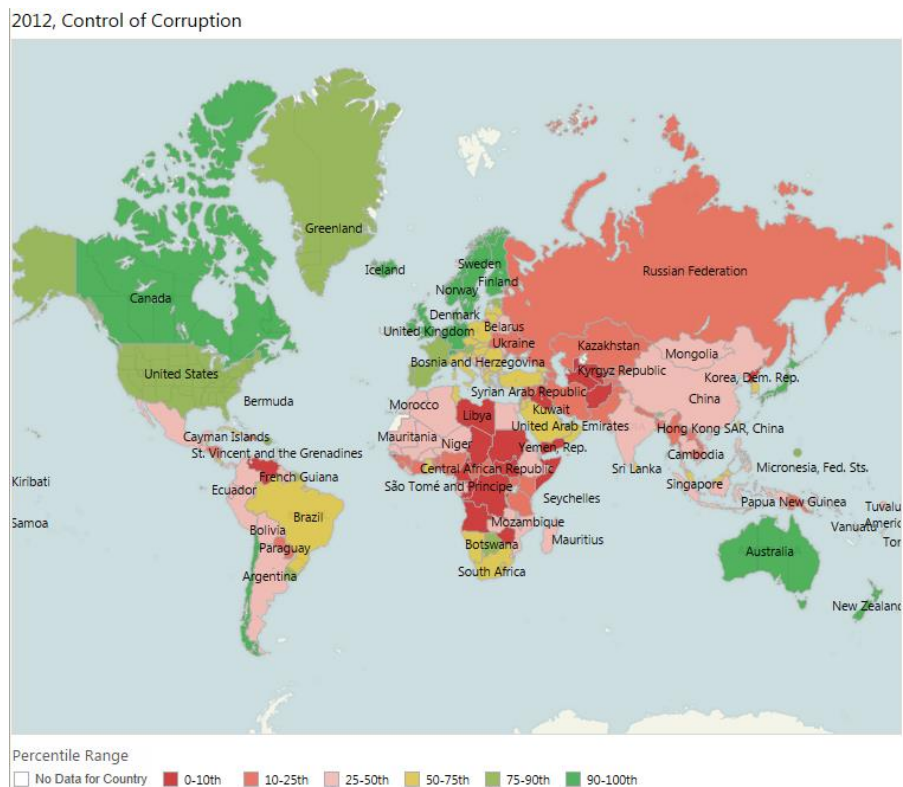
based on perceptions may be desirable when seeking to measure the degree of corruption (Kaufmann et al., 2010, p. 16-20).

However, since no international consensus regarding the precise definition of corruption exists, cross-country comparisons using indicators like those described above can be misleading and it can be hard to identify what is being assessed (UNDP, 2008, p. 11-15). It is often the case that a specific form of corruption is legal in one country but illegal in another. Obviously this will have an impact on the answers given in surveys and opinion polls. Similarly, cultural norms regarding what is considered to be normal behaviour are likely to influence the outcome (Kaufman et al., 2010, p.18-20).

For the purpose of my empirical investigation I have chosen to use the World Bank's Control of Corruption (CC) indicator. This is a composite index based on 21 different surveys and assessments, where answers from both households, experts and firms have been included. The index ranges from -2,5 to +2,5 where a higher score signifies a higher control of corruption, i.e. a lower degree of overall corruption. The CC seeks to measure "the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests." (Kaufman et al., 2010, p.4) It also assesses how effectively a country's policy and institutional framework combats corruption (Millennium Challenge Corporation, 2014).

The Control of Corruption indicator is frequently used in the empirical literature. See for example Starosta de Waldemar (2010) and Méon & Sekkat (2005). The index is available for 215 economies during the period 1996-2012, enabling comparisons between countries and over time. Nevertheless, minor differences and changes in the index should be interpreted with caution. Depending on the availability of data, the sources used may differ from country to country. In addition, even when focusing on one economy, the composition of the sample may have been modified over time by adding a new source or removing an out-dated one. The weights used to aggregate different individual sources could also have changed. Hence, if one country receives a slightly lower score than another, this does not guarantee that corruption is more prevalent in the former. Similarly, an improvement from one year to another in the variable may not reflect an actual decrease in the level of corruption (Kaufman et al. 2010, p.5-20). Kaufmann, Kraay and Mastruzzi (2010) recommend using the index in order to identify broad trends over a longer period of time, such as a decade.

3.3 Corruption around the world



Graph 1 – the geographical distribution of corruption

Source: The World Bank (2014), World Wide Governance Indicators

The image above displays the prevalence of corruption around the world, where countries are ranked according to their score on the Control of Corruption index in the year 2012. As can be observed, sub-Saharan Africa exhibits the highest levels, but corruption is a widespread phenomenon in Asia and South America too.

3.4 Corruption and export diversification

A substantial body of research has found that corruption hampers economic output and growth through various transmission mechanisms. For instance, studies conducted by Mauro (1995), Davoodi & Tanzi (1997) and Mo (2001) point to a negative relationship between the two. However, very few have sought to investigate whether corruption also affects the level of export diversification. With this thesis I hope to shed light on this particular question and thus make a contribution to the existing literature on the consequences of corruption. My theory postulates that corruption can be detrimental to export diversification through the following channels:

- Private investments

- Innovation, entrepreneurship and human capital
- Public expenditures
- The legitimacy of the state

However, it is likely that several other mechanisms exist that I do not account for in this thesis.

Private investments

Numerous researchers have investigated the link between corruption and private investment, which is considered to be one of the main mechanisms through which corruption hampers economic activity. In a widely cited report, Mauro (1995) finds a robust negative relationship between the two. Studies by Pellegrini & Gerlagh (2004) and Mo (2001) have come to the same conclusion. The additional costs caused by corruption act as an arbitrary tax on private investment. However, the corruption-tax is more harmful than a normal tax due to the secrecy and the large amount of uncertainty involved (Shleifer & Vishny, 1993). Another, obvious, difference is that the money does not go into the state budget and is then used for providing public goods. Apart from the direct bribe, corruption increases transaction costs since it causes delays and entails unnecessary procedures put in place with the sole purpose of extending the number of opportunities for graft (OECD, 2013). Moreover, due to the illegal nature of corrupt activities, contracts produced under these premises are unenforceable, which creates additional uncertainty (Boycko et al., 1996). Corruption hence reduces the profitability of investment by creating additional costs and increasing uncertainty, which will, all else equal, result in a reduced volume of overall private investment. This adverse effect of corruption also applies to foreign direct investment, which is regarded as an import way of transferring technology between countries (OECD, 2013).

Higher, and especially unpredictable, costs of investing and doing business are likely to influence the number of products that are exported. Moreover, limited access to new technology due to lower levels of FDI may have an impact on the ability for countries to move up the value chain and start exporting more sophisticated products.

Innovation, entrepreneurship and human capital

As has been argued above, corruption acts as a capricious tax on investment. Furthermore, according to research by Murphy et al. (1993), public rent-seeking, which often takes on the form of corruption, affects innovation disproportionately. The reason is that entrepreneurs generally need a considerable amount of licences, permits and tax documents provided by the state in order to set up a new business. Since the demand for these is highly inelastic, the entrepreneurs become a natural and attractive target for public rent-seeking.

In contrast, established producers have in general already acquired the necessary documents and even if the state was to demand additional permits they tend to be less affected by public corruption for several reasons. For instance, it is more probable for them to be part of, or to have influential lobbies within, the ruling elite. Entrepreneurs, on the other hand, are outsiders without the necessary contacts, which will probably increase the likelihood of expropriation, or of them having to pay bribes. In addition, unlike established producers, entrepreneurs tend to be credit-constrained and may therefore find it difficult to raise the extra money required to pay these bribes. In consequence, they might be unable to enter the market at all. Furthermore, due to the risky nature of starting up a new business, the uncertainty of being allowed to keep future gains makes innovation overall less attractive. If the innovative project succeeds, the returns might be expropriated by the state, whereas in case of failure the entrepreneur has to bear all the costs (Murphy et al., 1993).

Corruption can also hamper innovation by allocating talent from productive activities into rent-seeking behaviour. When entrepreneurs start a firm they improve and spread new technology, which promotes economic growth and potentially also leads to a higher degree of export diversification. However, as the pay-off of innovation falls and the gains from rent-seeking increases, entrepreneurs will have no incentive to invest in, and launch, new projects. Instead, they too will engage in corrupt activities since this is where the returns are the highest. In consequence, technological progress will stagnate (Murphy et al., 1991). When rent-seeking becomes a more lucrative business than productive work, the incentives for getting an education will also erode (Mo, 2001; Pellegrini & Gerlagh, 2004). This matters for export diversification since a high level of human capital is likely to facilitate a shift from producing and exporting commodities into goods with higher value-added, i.e. vertical diversification.

Public expenditures

While there exists a substantial amount of literature supporting the negative link between corruption and the overall volume of private investments, the same relationship does not hold for public expenditures. In fact, as argued by Davoodi & Tanzi (1997), countries that exhibit high levels of corruption are associated with a **larger** share of public investments to GDP. However, the productivity of these investments are low, which suggests that corrupt decision makers tend to choose the items from which they can levy the largest bribes or which serve their particular political interest, regardless of the project's productivity. The most "bribe-generating" investments are typically large, complex and capital-intensive infrastructure projects, so-called "white elephants". Once completed, some of the new roads, bridges etc. are never used, while others are of such inadequate quality that they will be in need of constant reparation. In consequence, the ratio of public expenditure to GDP increases while the quality of the investments decreases.

Furthermore, due to the restriction of the public budget, large expenditures on unproductive items allocate resources away from other types of investments, such as in health or education. According to a report by Mauro (1998), public expenditure distortions caused by corruption have an especially negative impact on investments in the educational sector. This constitutes another channel through which widespread corruption may affect the level of human capital, which, as argued previously, probably influences the capacity to diversify. Likewise, public investments in the maintenance of existing infrastructure tend to be severely overlooked due to that these in general constitute a less lucrative target for graft in comparison with new grandiose projects (Davoodi & Tanzi, 1997; Mauro, 1998). For these reasons, a high share of public investments in corrupt countries does not automatically promote economic activities.

Hence, corruption does not necessarily hamper the quantity of public expenditures, but rather distorts the way the money is used. Instead of building schools and allocating funds to other productive items such as building **decent** roads, projects are chosen out of political and/or economic self-interest. This distortion is likely to have a negative effect on a country's ability to innovate and export new products. In some cases though, the quantity of public expenditures will be affected too. For instance, corruption directly reduces tax revenues, so if the public budget has few other sources of income than from taxes, the state will find it hard to finance projects and other assigned activities (OECD, 2013). Furthermore, the embezzled funds often end up in a foreign bank account, negating any productive use they might have had in the country. For instance, billions of dollars in Nigeria have disappeared in this way during past decades (Kaufmann, 1997, s. 117).

The legitimacy of the state

Last but not least, corruption erodes trust in public institutions and can ultimately lead to a complete delegitimization of the state. In this scenario, political and economic instability is likely to increase which may have a negative effect on investments and productivity (Mo 2001; OECD, 2013). It is probable that an environment of great uncertainty also has an impact on the capacity to produce and export new products.

Could corruption promote export diversification?

The discussion above implies that there exist several channels through which corruption may hamper export diversification. However, most of the research within the field does not take other institutional factors into consideration and the debate regarding the perceived adverse effects of corruption on economic development has no trivial outcome. For instance, a strand of literature argues that corruption can enhance efficiency in countries where the institutional setting is poor. In this case, graft is regarded as a way of circumventing cumbersome regulations and excessive bureaucracy, which impede economic

activity. According to this so-called *grease the wheels*-hypothesis, which was first advanced by Huntington (1964) and Leff (1969), bribery serves as a necessary lubricant in an otherwise malfunctioning economic machinery. In this second-best world, corruption is considered as a way, sometimes the only way, of getting things done (Méon & Sékkat, 2005).

The economic success of several highly corrupt countries in Asia has likewise put the harmful consequences of corruption into question. China, Indonesia and Thailand have all experienced rapid economic growth during the last decades, despite the endemic corruption that prevails. In the literature this phenomena is referred to as the Asian paradox (OECD, 2013, p. 14). Characteristically for many of these countries is that they also export a wide array of goods. For instance, China is considered to be the world's largest manufacturing power (The Economist, 2012).

4. Previous studies

In the following section I provide an overview of the research that has treated the link (if one) between corruption and export diversification.

In spite of having received substantially more attention during the last couple of years, the literature on export diversification remains limited. Unlike the case with economic growth, there exists no clear theoretical model with the purpose of explaining which factors determine a country's level of overall specialisation. Previous studies within the field have relied on empirical experiments and these have mainly focused on the link between economic development, measured by the per capita income, and the level of product concentration. Two of these are Imbs & Wacziarg (2003) and Cadot et al. (2011), both of which have found a U-shaped pattern between the two. In contrast, the research conducted by de Benedictis et al. (2009) suggests that the relationship is monotonically decreasing; i.e. as a country moves along the path of development its exports will become increasingly less concentrated.

A few researchers have sought to include additional variables in their analysis. See for instance the work of Agosin et al. (2012) and Osakwe (2007). However, very little research has been conducted on the perceived relationship between corruption and export diversification. Below follows a review of the existing literature.

Parteka & Tamberi (2013) analyse which additional factors, apart from the level of economic development, that determine the degree of overall specialisation at the national level. The variables included range from proxies for the level of human capital and quality of institutions to measurements linked to a country's trade situation and geographical location. All in all, their research encompasses 33 independent variables among which corruption figures as one of the institutional factors. Their results

indicate that country size and distance to major markets are significant determinants of (sectoral) export diversification. In addition, countries with lower barriers to trade, in the form of for example restricted use of tariffs and quotas, demonstrate a lower concentration of exports. However, corruption does not appear to have a significant impact. In order to measure the degree of diversification, Parteka & Tamberi use the *relative Theil* index as well as the *relative Gini* index. Their data covers manufacturing exports for 60 countries at different levels of economic development during the period 1985 to 2004. They employ several econometric estimation techniques in order to obtain their results, among them OLS and LSDV. Finally, instrumental variables are utilised in order to control for potential endogeneity.

In his study from 2010, Starosta de Waldemar analyses to what extent rent-seeking, which often takes the form of corruption, affects product diversification. Covering 130 countries during the period 1995 to 2007 and using a GMM estimation technique in order to control for endogeneity, he finds that rent-seeking has a significantly negative impact on a country's ability to diversify its product base. Starosta de Waldemar mainly builds his case on the research conducted by Murphy et al. (1993), who explore the channels through which corruption hampers innovative activities and thus, growth. Starosta de Waldemar suggests that the same mechanisms that influence growth can be applied to the process that determines product diversification. The index *Control of Corruption*, compiled by the World Bank, is used as a proxy for rent-seeking while the *Theil* and *Herfindahl-Hirschman* index serve as measures of export diversification.

Héredia Caldeira Cabral & Veiga (2010) specifically focus on the factors that determine export diversification (and sophistication) in sub-Saharan Africa. In addition, they seek to investigate whether these have contributed in a significant way to the improvement in fulfilling the Millennium Development Goals. Their study encompasses 48 countries between 1960 and 2005. The *Herfindahl-Hirschman* and *Theil* index are used as dependent variables in their regressions, along with several economic, geographical and institutional independent variables. The econometric method employed is pooled OLS with robust standard errors as well as estimation techniques including fixed effects and instrumental variables. Héredia Caldeira Cabral & Veigas' results indicate that institutional factors such as corruption, transparency and accountability play a significant role for African countries' ability to diversify. Moreover, the level of human capital appears to be an important determinant as well as the size of the economy and endowment structure. Oil producers, for example, tend to have less diversified exports. In line with similar studies, they find that higher levels of economic development are associated with a higher degree of diversification.

Due to the fact that the reports mentioned above treat different time-periods, include different countries and employ different econometric estimation techniques, their results are not directly comparable. Moreover, it is possible that the type of index used in order to measure diversification affects the results as well as the choice of independent variables. The limited amount of research devoted to the subject also

adds to the fact that no general conclusion yet can be drawn regarding the impact of corruption on diversification. The studies conducted by Starosta de Waldemar, Parteka & Tamberi and Héredia Caldeira Cabral & Veiga provide different results on the matter. Whereas two of them find a significant negative link between corruption and diversification, the relationship is not robust in the third study.

With this thesis I aim to shed further light on the impact of corruption on export diversification. My study differs from the existing research in several ways. For instance, I use a larger sample, which reduces the risk of bias and enables me to draw more general conclusions. I also differentiate between the effects of low, medium and high levels of corruption, which to my knowledge has not been done before. In addition, I test if corruption is more detrimental in sub-Saharan Africa relative the rest of the world. Similarly, I distinguish between the effect of corruption on export diversification for low-, medium- and high-income economies. This is important since low- and middle-income countries are considered to gain the most from export diversification (Hesse, 2008). Finally, in order to capture different dimensions of export diversification I utilise three proxies; a count of the *number of exported products* per country and year, the *Herfindahl-Hirschman* index and *Manufacturing as share of total exports*.

5. Data and methodology

In this chapter I present the data and econometric model used in order to conduct my empirical investigation. Moreover, a rather extensive discussion regarding the choice of estimation technique is provided.

5.1 Sample and data

The sample used in order to conduct my empirical investigation consists of 157 economies⁹ at different levels of development. The availability of data has been the only criteria for selection, but I have strived to make the sample as large as possible since this generally leads to better estimates. Excluding observations does not necessarily cause problems if it is done in a random way. However, selection on the basis of existing data may result in a sample that is not representative for the population I intend to study (Wooldridge, 2009, p.323). For instance, it is more likely that data is missing for poor countries than for rich. Since low-income countries tend to have relatively more concentrated export structures (Imbs & Wacziarg, 2003), this is likely to affect the results. However, due to that a large share of the 157 economies in my sample are developing countries, whereof 41 of them are located in sub-Saharan Africa, I do not consider sample selection bias on the basis of income to be a major concern. The geographical

⁹ I follow the World Bank and use “country” interchangeably with the words “economy” or “exporter”. Please note that the term does not necessarily imply political independence (World Bank, 2014).

dispersion is also rather satisfactory, though the Middle East is slightly underrepresented. A list of the countries included in the study can be found in the appendix.

The period of investigation ranges between the years 2002 and 2012 and hence encompasses eleven years. The choice of time period is also largely based on the accessibility of data. For example, my proxy for corruption is only available on a yearly basis from 2002. In order to identify broader trends over time, and thereby draw more general conclusions regarding the effect of corruption on export diversification, it would have been desirable to examine a longer time period. However, a study covering eleven years will be able to provide some insights on the matter. For many countries, significant variation in both the degree of export diversification and the level of corruption can be observed, despite the relatively short time period.

The data on export diversification is taken from the website of the United Nations Conference on Trade and Development (UNCTAD). In contrast to studies involving the Gravity Model, which treats bilateral trade flows, my data is of unilateral sort. The main reason for this is that I want to use data of the same level of aggregation and not restrict my empirical investigation to flows between for example Africa and the EU. A detailed list of all the variables and their sources can be found in the appendix.

5.2 Model specification and estimation technique

5.2.1 Model specification

In order to investigate whether corruption has an impact on export diversification I will use the following formula in my baseline regression:

$$ExpDiv_{i,t} = \exp(\beta_1 + \gamma_t + \beta_2 * D_{landlocked} + \beta_3 * (\ln GDPpc_{i,t})^2) * GDPpc_{i,t}^{\beta_4} * Investments_{i,t}^{\beta_5} * Infrastructure_{i,t}^{\beta_6} * Openness\ to\ trade_{i,t}^{\beta_7} * GDP_{i,t}^{\beta_8} * Corruption_{i,t}^{\beta_9} * \varepsilon_{i,t}$$

where the dependent variable, *ExpDiv*, stands for export diversification. As mentioned earlier, a count of the number of products that an economy exports per year is my main dependent variable, but I will also run regressions with the *Herfindahl-Hirschman index* and *Manufactures as share of total exports*. An important thing to note is that the HHI seeks to measure export **concentration** and a value close to 1 would hence imply a very low degree of diversification. This regression is therefore likely to generate the opposite coefficient signs than when using the other proxies as dependent variables.

GDPpc denotes the real level of per capita income and is included in order to control for the exporter's level of economic development. According to Imbs & Wacziarg (2003) there is a U-shaped relationship

between domestic sectoral concentration and the level of per capita income. At the early stages of development countries diversify but after having reached a certain level of income they specialize again. In order to catch this non-linearity I have included the quadratic form of GDP per capita in the equation. Both the normal and the quadratic form are expressed in terms of purchasing power parity, which enables comparability between countries (Jones, 2002, p.6).

Investments, here proxied as gross capital formation relative to GDP, are considered to be of great importance for export diversification (UNECA, 2007) and I expect to find a positive relationship between the two. However, one could hypothesize that the effect largely depends on where the resources are allocated. Investments in the educational sector would probably lead to a higher level of export diversification whereas more capital to the industry in which the economy has a comparative advantage would have the opposite effect. There could also be a difference between the impact of public and private investment. Gross capital formation relative to GDP measures only the quantity of investments (public and private summed together), hence the allocation of expenditures is a factor I will not be able to control for.

Research conducted by Osakwe (2007), Parteka & Tamberi (2013) and Caldeira Cabral & Veiga (2010) suggest that high transport costs hamper export diversification. Certain geographical characteristics, such as being landlocked, are often associated with increased costs of this sort. I have therefore included a dummy variable in my econometric equation that takes on the value of 1 if a country does not have access to the sea. However, well-developed infrastructure can substantially reduce transportation costs and may therefore also counteract unfavourable features related to geographic location (Limao & Venables, 1999). Lower transportation costs obviously benefit countries that have access to the sea as well. I follow Osakwe (2007) and use *the density of telephone lines per 100 people* as a proxy for the quality of infrastructure.¹⁰

Openness to trade is measured as the share of total trade (imports plus exports) relative to GDP. This variable is included with the purpose of capturing, however imperfectly, aspects of the exporting country's trade policy (UNECA 2007) and the trade barriers its exports face on the international market. The effect of trade liberalisation on export diversification is ambiguous and there is no consensus among researchers on the matter. On the one hand, a world without barriers might promote specialisation according to comparative advantage. Indeed, Agosin et al. (2012) find that openness to trade hampers export diversification. On the other hand, the opposite could also be argued.

The size of the domestic economy is likely to influence the degree of export diversification, where a larger number of producers and a bigger internal market would lead to a more differentiated product base (Starosta de Waldemar, 2010). I use the country's real Gross Domestic Product in order to control for this,

¹⁰ It would have been desirable to also include density of roads or a similar variable, but this was not possible due to lack of data.

which is a standard method within the empirical literature on diversification (Parteka & Tamberi, 2013; Persson & Wilhelmsson, 2013). Population size is sometimes used as an alternative measure¹¹, but due to problems arising from multicollinearity I will not incorporate this in my model.

As mentioned earlier in this thesis, the World Bank's index *Control of corruption* is used as a proxy for the level of corruption. For ease of interpretation, I have rescaled it so that it now ranges from 0 to 5, where a higher score still signifies a lower level of corruption¹².

Finally, in order to control for major global events that have occurred during the period of my investigation and which are likely to have had an impact on export diversification, I have included dummy variables for the years 2003 to 2012. In the econometric equation, these dummies are written as γ_t . An example of such an event is the financial crisis.

Since no clear theoretical model with the purpose of explaining the determinants of export diversification exists, my choice of control variables has largely been guided by previous empirical studies conducted within the field. However, due to (yet again) the insufficiency of the data available, some variables that I consider to be of relevance have been left out. For instance, factors such as human capital, macroeconomic stability and the endowment structure are likely to influence export diversification. Nevertheless, including all potentially relevant variables in the econometric equation would have reduced the sample size dramatically where the least developed countries would have been the first to go. Confronted with this trade-off I chose to keep as many countries as possible in the sample, to the detriment of a larger number of explanatory variables. To a certain extent the omission will be compensated for by the inclusion of country-specific fixed effects, something I will elaborate on under the heading "estimation technique".

5.2.2 Estimation technique

Choice of estimator

The Gravity Model is often used for analysing bilateral trade flows. My econometric equation differs from the traditional model in the sense that I use unilateral data and include several additional explanatory variables. However, both models focus on trade flows and the estimation technique employed is basically the same. The standard way of estimating the Gravity model, and constant-elasticity models in general, is to transform the multiplicative equation by taking the logarithms. This procedure will yield the following log-linear model, which can be estimated with OLS:

¹¹ See, for example, Héredia Caldeira Cabral & Veiga (2010) and Starosta de Waldemar (2010)

¹² Or, put differently, a higher **control** of corruption.

$$\ln \text{ExpDiv}_{i,t} = \beta_1 + \gamma_t + \beta_2 * D_{\text{landlocked}} + \beta_3 * \ln \text{GDPpc}_{i,t}^2 + \beta_4 * \ln \text{GDPpc}_{i,t} + \beta_5 * \ln \text{Investments}_{i,t} + \beta_6 * \ln \text{Infrastructure}_{i,t} + \beta_7 * \ln \text{Openness to trade}_{i,t} + \beta_8 * \ln \text{GDP}_{i,t} + \beta_9 * \ln \text{Corruption}_{i,t} + \theta_{i,t}$$

where $\theta = \ln(\varepsilon_{i,t})$

However, in my case, there are numerous reasons to why OLS is only the second (or third) best estimator. The first reason concerns the nature of my main dependent variable, the *number of exported products*, which is a count. OLS assumes that the error terms are normally distributed, but in models such as mine where the dependent variable is discrete, this assumption rarely holds. Normality generally applies to continuous variables that can take on approximately all values, whereas counts take on few and figure within a limited range¹³ (Wooldridge, 2009, p. 117, 596). Instead, when analysing count data it is common to presuppose that the dependent variable follows a Poisson distribution with mean and variance equal to μ . The Poisson regression is estimated by maximum likelihood, or pseudo-maximum-likelihood if the main assumption of the model, that of *equi-dispersion*, is violated. Equi-dispersion is something I will return to.

Furthermore, regardless of whether the dependent variable is a count or not, several researchers have argued against estimating the Gravity model, and other constant elasticity models, in their log-linear form using OLS. See for example the work of Santos Silva & Tenreyro (2006), Wilhelmsson & Westerlund (2011) and Burger et al. (2009). They argue that the logarithmic transformation undertaken in order to make the model linear in parameters, which is a prerequisite for OLS, may result in biased and inefficient estimates. For instance, there is a possibility, even though it is rather small in my case, for the dependent variable to take on the value zero. Since the natural logarithm of zero is undefined, the observations where the dependent variable takes on this value will have to be dropped or slightly modified. This could potentially lead to inconsistent estimators of the variable coefficients (Santos Silva & Tenreyro, 2006, s.643). Maintaining and estimating the equation in its multiplicative form eliminates the problem.

Another complication arises when the data exhibits heteroskedasticity, which is often the case with count data and trade flows in general (Wooldridge, 2009, p.596; Santos Silva & Tenreyro, 2006). Heteroskedasticity occurs when the variance of the error term is not constant for all observations. If this is the case, OLS is generally inefficient and the standard errors of the coefficients will be invalid. Hypothesis testing will thus not be possible (Dougherty, 2011, p.283). However, Santos Silva & Tenreyro argue that in the case where constant elasticity models exhibit heteroskedasticity, but are nevertheless transformed and estimated with OLS, the estimators may not only be inefficient, but also inconsistent. This is a direct consequence of Jensen's inequality which states that $E(\ln y) \neq \ln E(y)$ (Santos Silva & Tenreyro, 2006,

¹³ However, since I use a large sample where my dependent variable figures within the range 4-260, the distribution may in fact not be that different from the normal distribution.

p. 644, 641). Instead the authors suggest preserving the equation in its multiplicative form and employing a Poisson Pseudo-Maximum-Likelihood estimation technique. This is something Westerlund & Wilhelmsson (2011) and Burger et al. (2009) also recommend. The PPMLE¹⁴ will be consistent in the presence of heteroskedasticity as well as eliminate the problem with zero values. This estimator is the same as the one I referred to when discussing count data.

In order for the PPMLE to be consistent, all that is required is for the conditional mean to be correctly specified. Hence, the data does not even have to follow the Poisson distribution (Silva & Tenreyro, 2006, p. 644). In fact, this is seldom the case due to the restrictive nature of the Poisson. In particular, for a variable to follow this distribution its variance has to equal its mean (equi-dispersion):

$$Var(ExpDiv, x) = E(ExpDiv, x) = \mu$$

If the variance is larger than the mean there is over-dispersion in the data, which will cause the standard errors of the coefficients to be invalid. The normal Poisson MLE would still be a consistent estimator, but inference would generate biased results. A common way of estimating count data models in the presence of over-dispersion is to run a Negative Binomial regression instead of the Poisson, since this model is less restrictive. An alternative way, as mentioned above, is to use the Poisson **pseudo**-maximum likelihood estimator.

In summary, since the PPMLE has several advantages over OLS and is more appropriate for analysing count data, this will be my main choice of estimator. My model will therefore be preserved in the original, multiplicative form:¹⁵

$$ExpDiv_{i,t} = \exp(\beta_1 + \gamma_t + \beta_2 * D_{landlocked} + \beta_3 * (\ln GDPpc_{i,t})^2) * GDPpc_{i,t}^{\beta_4} * Investments_{i,t}^{\beta_5} * Infrastructure_{i,t}^{\beta_6} * Openness\ to\ trade_{i,t}^{\beta_7} * GDP_{i,t}^{\beta_8} * Corruption_{i,t}^{\beta_9} * \varepsilon_{i,t}$$

Furthermore, as pointed out by Westerlund & Wilhelmsson, the PPMLE can also be applied to non-counts (2011, p. 642) and can therefore be employed when my model is estimated with alternative proxies for export diversification. However, to facilitate comparisons with earlier results in the literature, OLS will be used as a robustness control along with the Negative Binomial-MLE.

¹⁴ Poisson-pseudo-maximum-likelihood-estimator.

¹⁵ As recommended by Santos Silvana & Tenreyro (2006), the model is estimated using STATA's *poisson* command, with robust standard errors. The variables *GDPpc*, *Investments*, *Infrastructure*, *Openness to trade*, *GDP* and *Corruption* are estimated in their logarithmic form.

Controlling for unobserved heterogeneity

The data used in order to investigate if corruption has an effect on export diversification covers 157 countries during the period 2002-2012. This type of data, which contains both cross-sectional and time series dimensions, is called panel data, or longitudinal data. Panel data allows the researcher to examine the same units (people, firms, countries etc.) multiple times and has several benefits. For instance, the use of panel data can reveal patterns and behaviour that are difficult to identify when solely utilizing cross-sectional data. In addition, and perhaps more importantly for this thesis, it provides a solution to the problem of omitted variable bias due to unobserved heterogeneity (Dougherty, 2011, p.514). In my case, unobserved heterogeneity can be described as country-specific factors that influence the level of diversification, but that for some reason have not been incorporated in my model. Some relevant examples are geographical location (where the distance to major markets could be of importance), the level of human capital and the country's endowment structure (such as being land-abundant or having oil). Not including these in the regression may give rise to a specific kind of omitted variable bias.

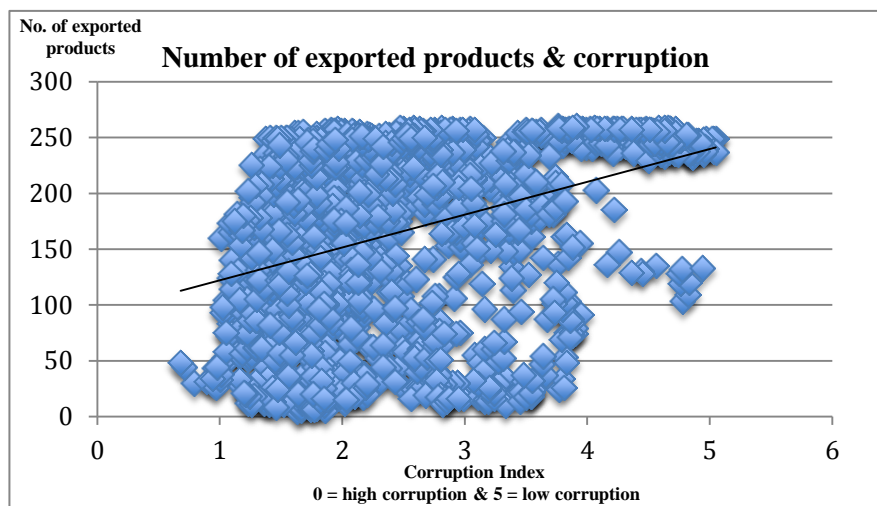
In order to solve the problem with unobserved heterogeneity, a regression using a fixed effects estimation technique can be employed. Doing so permits the equation to undergo a transformation where the individual mean is subtracted from the original form. In consequence, the country-specific, unobserved, effect will be erased if it does not vary over time. The procedure is called the *fixed effects transformation*, or *the within transformation*. However, using the fixed effects approach comes at a price. Most importantly, all variables that remain constant over time, including dummy variables, will be erased in the same way as the unobserved heterogeneity (Dougherty, 2011, p.518-519). Due to the fact that my model includes several dummy variables and that the level of corruption varies relatively little over the time-period analysed, I will not employ the fixed effects estimation technique initially. However, in order to control for potential omitted variable bias due to unobserved heterogeneity this will be done as a robustness control.

6. Empirical results and analysis

In this chapter I present and analyse my econometric results. The effect of corruption on export diversification is first tested on the whole sample. Afterwards I investigate if the elasticity differs depending on the country's level of income and whether corruption is especially detrimental in sub-Saharan Africa. Finally, I differentiate between low-, medium- and high levels of corruption.

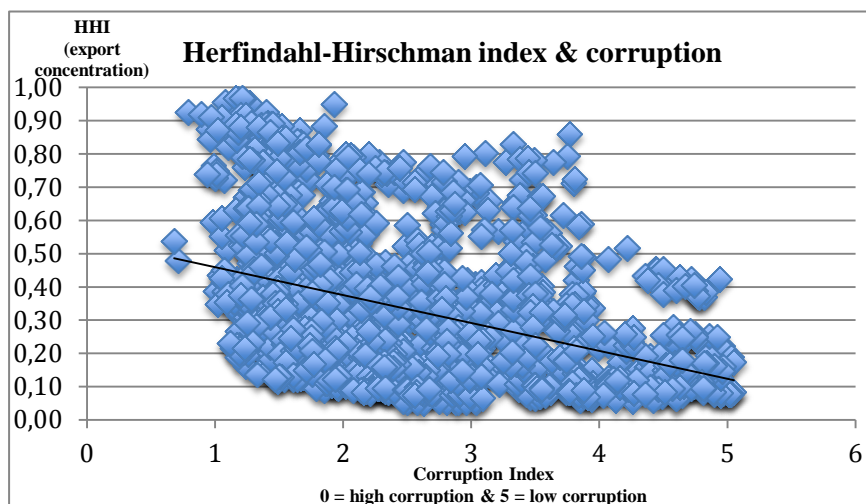
6.1 Non-parametric indications and the results of my baseline regression

I begin my empirical investigation by simply plotting the relationship between corruption and export diversification. In the first graph I use *the number of exported products* as a proxy for diversification and in the second the *Herfindahl Hirschman index*. As can be observed in both graphs, the correlation between the two variables appears to be relatively pronounced, where higher levels of corruption are associated with lower degrees of export diversification. Obviously, correlation does not imply causality, but as has been argued earlier in this thesis, there exist several mechanisms through which corruption may affect export diversification. Note that in the first graph the upward slope implies that low corruption is correlated with a larger number of exported products. However, in the second graph a score close to one on the vertical axis signifies a high **concentration** of exports. The downward slope hence indicates that low corruption is correlated with a lower degree of export concentration, i.e. a higher level of diversification.



Graph 2 – Corruption and Export Diversification

Sources: UNCTAD (2014) and World Wide Governance Indicators, the World Bank (2014b)



Graph 3- Corruption and Export Diversification

Sources: UNCTAD (2014) and *World Wide Governance Indicators, the World Bank* (2014b)

I move on to the regression analysis where I control for the impact of other variables in order to conduct a more thorough examination. The White's test indicates that my data is subject to heteroskedasticity, which constitutes a strong argument for choosing the PPMLE¹⁶ as my main estimator.

The first column of Table 1 shows the output of my baseline regression. The results indicate that the exporter's level of income, which is measured as GDP per capita expressed in terms of purchasing power parity, is an important determinant of diversification. An interesting thing to note is that both the regular and the quadratic form are significant, which implies that export diversification indeed follows the hump-shaped pattern, as proposed by Imbs and Wacziarg (2003). The coefficient before investments is negative and statistically significant at the 1%-level. As argued earlier in this thesis, investments probably play a critical role in promoting export diversification. However, *where* and *how* the money is invested is likely to be more important than the quantity. This is something that my proxy does not take into consideration, which may explain the negative sign¹⁷. Furthermore, having well-developed infrastructure and an open economy appears to promote export diversification. My results of also confirm that countries with a large domestic market export a wider range of goods.

In the baseline regression, corruption is statistically significant at the 1%-level and the magnitude of the coefficient is 0,101. Even if export diversification is expressed in levels in the Poisson-equation, the independent variables written in logarithmic form can be interpreted as elasticities (Shepherd, 2012).

¹⁶ A likelihood ratio test also detects over-dispersion in the data, so it will be appropriate to use the Poisson-**Pseudo**-Maximum-Likelihood-Estimator (PPMLE) and not the normal Poisson-MLE.

¹⁷ Moreover, the level of investment shifts significantly from year to year and may affect export diversification only after some time. Using a lagged variable or the average rate of investment over a five-year-period may generate an effect that lies closer to reality.

Hence, my results imply that an amelioration of 10% in the control of corruption index¹⁸ leads to an increase of roughly 1% in the number of products exported. However, due to the rather arbitrary scaling of the index and the difficulties encountered when trying to quantify corruption, too much attention shall not be devoted to the exact magnitudes of the coefficients. Instead, my emphasis will lie on the coefficient signs (does corruption have a negative or positive effect on export diversification?) and on the p-values. The size of the estimates will mainly be used when comparing the effects of different levels of corruption, which will be done at a later stage in this thesis.

Finally, being landlocked does not seem to inhibit export diversification. On the contrary, the coefficient sign is statistically significant and positive, which indicates that not having access to the sea promotes diversification. This rather un-intuitive finding may be a consequence of the wide range of economies included in the sample. For instance, a country like Switzerland does not have access to the sea but has a highly diversified export base. As emphasised in Collier (2007), the potential disadvantage of being landlocked probably depends on the infrastructure and the political stability of surrounding neighbours (Collier, 2007, p.53-57). While Uganda suffers from its geographical location, Switzerland does not.

¹⁸ An increase in the index signifies better **control** of corruption, which in reality would imply a reduction in the degree of corruption.

Table 1.
Baseline
regression

Regression:	Baseline Regression	Robustness Control	Robustness Control	Robustness Control	Robustness Control	Robustness Control	Robustness Control	Robustness Control
		Fixed effects	OLS	Negative Binomial	IV (2SLS)	Lagged endogenous variable	HHI	Man. Exports
Dependent variable:	No. exported products (levels)	No. exported products (log-form)	No. exported products (log-form)	No. exported products (levels)	No. exported products (log-form)	No. exported products (levels)	The HHI (levels)	Man. % of total exports (levels)
Estimator:	PPMLE	PPMLE - FE	OLS	Negative Binomial MLE	OLS (IV)	PPMLE	PPMLE	PPMLE
GDPpc	0,921*** (0,000)	2,137*** (0,000)	0,836*** (0,000)	0,780*** (0,000)	3,098 (0,214)	0,892*** (0,000)	0,506*** (0,003)	1,662*** (0,000)
GDPpc, quadratic	-0,059*** (0,000)	-0,132*** (0,000)	-0,059*** (0,000)	-0,056*** (0,000)	-0,201 (0,217)	-0,057*** (0,000)	-0,007 (0,470)	-0,105*** (0,000)
Investments	-1,222*** (0,000)	0,022 (0,275)	-0,099** (0,021)	-0,120*** (0,001)	-0,090 (0,676)	-1,130*** (0,000)	-0,061 (0,114)	0,025 (0,755)
Infrastructure	0,073*** (0,000)	-0,003 (0,854)	0,078*** (0,000)	0,074*** (0,000)	0,046 (0,069)	0,074*** (0,000)	-0,225*** (0,000)	0,076** (0,044)
Openness to trade	0,026*** (0,000)	0,044 (0,186)	0,415*** (0,000)	0,369*** (0,000)	0,275*** (0,002)	0,261*** (0,000)	-0,158*** (0,000)	0,379*** (0,000)
GDP	0,189*** (0,000)	0,311*** (0,000)	0,297*** (0,000)	0,259*** (0,000)	0,266*** (0,000)	0,186*** (0,000)	-0,141*** (0,000)	0,129*** (0,000)
Corruption	0,101*** (0,001)	0,105* (0,063)	0,114** (0,017)	0,123*** (0,002)	1,240 (0,430)	0,100*** (0,002)	-0,584*** (0,000)	0,751*** (0,000)
Landlocked	0,066*** (0,000)	-	0,154*** (0,000)	0,009*** (0,000)	0,010 (0,908)	0,065*** (0,000)	0,054* (0,094)	0,027 (0,491)
Constant	-3,994*** (0,000)	-	-6,784*** (0,000)	-4,426*** (0,000)	-	-3,750*** (0,000)	0,103 (0,898)	-8,249*** (0,000)
Number of observations	1626	1626	1626	1626	130	1473	1625	1344
R-squared	0,599	-	0,690	-	0,658	0,593	0,053	0,254

***Significant at the 1%-level **Significant at the 5%-level *Significant at the 10%-level. Year dummies are included in all regressions except when performing the IV-estimation. Robust standard errors are used in all regressions and the P-values are reported within brackets.

The results from the baseline regression hence suggest that corruption has a detrimental effect on export diversification, which is here measured as a count of the number of exported products per country and year. However, before drawing any conclusions, the robustness of these preliminary findings should be tested, which I will do in the following three sections.

Robustness control with the fixed effects model

As discussed at length earlier in this thesis, the exclusion of relevant variables from the econometric model may give rise to omitted variable bias. When using a large panel, like the one employed in my empirical investigation, it is likely that country-specific factors have an impact on the behaviour of the dependent variable. For instance, the level of human capital and the presence of natural resources may promote or hamper export diversification. By performing a fixed-effects regression I aim to control for these. Note that the fixed effects approach only takes into account factors that do not vary over the specific time-period, i.e. the years 2002 to 2012.¹⁹

The estimates from the fixed effects regression can be found in the second column of Table 1. GDP per capita still carries the expected sign and is statistically significant both in the regular and quadratic form. However, several of the other control variables (investments, infrastructure and openness to trade) are no longer significant. A possible explanation for this could be that some of them do not vary much over the time-period studied. In consequence, the effect they may have on diversification will be erased by the within-transformation. For instance, this is likely to be the case for my infrastructure-proxy. Corruption, on the other hand, still carries the expected sign and is statistically significant at the 10%-level. The size of the coefficient is also roughly the same as in the pooled regression. This strengthens the results derived from the baseline regression.

Robustness control with OLS and the Negative Binomial-MLE

Since the Poisson-pseudo-MLE is robust in both the presence of heteroskedasticity and over-dispersion, I have no direct reason to question the appropriateness of this estimator. I will, however, as an additional robustness control, test my results using OLS and the Negative Binomial-MLE. Estimation with OLS facilitates comparisons with previous studies since this technique is the traditional way of analysing trade flows with the Gravity Model. While the Negative Binomial-MLE does not have the same robustness properties as the Poisson-pseudo-MLE, it may be more efficient if the data exhibits over-dispersion, which mine does (Dennis & Shepherd, 2007, p. 20, 27; Persson & Wilhelmsson, 2013, p.19).

The estimates of these regressions are presented in the third and fourth columns of Table 1. Since all variables are statistically significant and carry the same signs as in the baseline regression I will not elaborate on their interpretation. In some cases the magnitudes of the coefficients differ. For instance, OLS and the Negative Binomial-MLE yields significantly higher estimates regarding the effect of GDP

¹⁹ Obviously, the level of human capital in an economy can increase or deteriorate. However, since my panel only covers eleven years I do not expect significant changes occur. Therefore the fixed effects regression will to a large extent be able to account for this factor.

and openness to trade on export diversification relative when estimation is done with the PPMLE. However, since the dependent variable does not undergo a logarithmic transformation in the Negative Binomial regression, this is probably not a consequence of heteroskedasticity²⁰. The coefficient of the main variable of interest, corruption, is positive and statistically significant at the 1%-level with the Negative Binomial-MLE and at the 5%-level with OLS. This robustness towards the use of different estimators strengthens the results of the baseline regression.

Robustness control using instrumental variables

The aim of this thesis is to investigate whether corruption has an impact on export diversification. However, the direction of causality is sometimes hard to determine. Under certain conditions, it is possible that a high concentration of exports breeds corruption and not just the other way round. For instance, as touched upon briefly at an earlier stage, countries whose exports are dominated by a narrow range of natural resources often exhibit various institutional deficiencies, among which corruption figures. The rationale behind this is that many of these resources (oil and minerals in particular) are associated with large rents, which reduces the government's need to raise taxes for income. When citizens do not pay for the provision of social services, their capacity to claim accountability of their leaders erodes. Without efficient checks and balances in place, rulers of *rentier states* may be tempted to buy electoral support and maintain their political power through patronage instead of winning it by providing public goods (Collier, 2007, p. 40-49). Lack of diversification facilitates the capture of the rents by a powerful elite, which reinforces and creates additional rent-seeking (Starosta de Waldemar, 2010).

The discussion above matters for my econometric results since endogeneity due to reverse causality may yield biased estimates and invalidate the standard errors. In order to control for this rather serious issue, an instrumental variable estimation can be undertaken. However, finding an appropriate instrument to replace the endogenous variable is no easy task. Most importantly, the instrument should be correlated with the endogenous variable, which is corruption in my case, but not with the model's disturbance term. Furthermore, it should not be an explanatory variable in its own right (Dougherty, 2011, p.318). Within the empirical literature on corruption, an index of ethnic fractionalization has sometimes been used as an instrumental variable. While the logic does not apply to all, or perhaps even most, countries, it can be argued that in some regions such as many places in Africa, South-East Asia and the Middle East, cleavages based on ethnicity may be correlated with a higher degree of corruption. History provides several examples of when an ethnic minority or majority, currently holding the position of power over a certain territory, governs in a way that benefits the own group to the detriment of other minorities/majorities. Ruling and maintaining political power through patronage and cronyism instead of

²⁰ As argued in Santos Silva & Tenreyro (2006), estimating the log-linear model with OLS may yield biased and inconsistent estimates in the presence of heteroskedasticity.

representing the whole “nation” has rather been the norm than exception in many cases. This is the rationale behind the possible correlation between ethnic fractionalization and corruption. On the other hand, there is no reason to believe that ethnic fractionalization should have any kind of impact on export diversification.

The most up-to-date data on ethnic fractionalization I could find was of the year 2002²¹. Therefore I reduce my sample considerably²² and run a cross-sectional IV-estimation only on this specific year. The results are thus not directly comparable with those obtained from my baseline regression. In addition, the correlation between the index and corruption is rather small (-0,2486), implying that the degree of ethnic fractionalization is a relatively weak instrument. For these reasons, the estimates of the IV-regression should be interpreted with caution. The output can be found in the fifth column of Table 1. The coefficient before corruption carries the expected sign but is not statistically significant at the 10%-level. As mentioned above, this could be attributed to the fact that ethnic fractionalization is a weak instrument, but could also point to that the results of my baseline regression are not robust.

An alternative technique for addressing the problem of reverse causality is to lag the potentially endogenous variable. Since the current level of export diversification does not affect corruption in the past, the issue of endogeneity may be reduced. I therefore lag the corruption variable one period and exclude the first year of investigation from the sample²³. In contrast to the instrumental variable approach, the sample size remains relatively large.²⁴ According to results of this regression, corruption inhibits export diversification and is significant at the 1%-level. The elasticity is also approximately of the same magnitude. Note that I have only controlled for reverse causality in the relationship between corruption and export diversification. Other variables, such as GDP per capita, may also be subject to endogeneity.

Robustness control using alternative measures for diversification

Finally, I run two regressions where I use the *Herfindahl-Hirschman* index and *Manufacturing as share of total exports* as proxies for export diversification. As mentioned in the beginning of my thesis, the HHI measures the dispersion of trade value across an exporter’s range of products and economies that depend heavily on just a few items will receive a score close to 1. *Manufacturing as share of total exports* is included in order to more adequately account for vertical diversification. Due to lack of data, several countries are excluded from the sample whereof most of them are located in sub-Saharan Africa. The estimated coefficients can be found in the last two columns of Table 1. Corruption is statistically

²¹ See Bauhaug et al. (2014) in order to access the data

²² From 1626 observations to 130.

²³ One period equals one year and the first year of observation is 2002.

²⁴ 1473 observations.

significant and carries the expected sign regardless of which proxy for diversification that is used²⁵. Hence, corruption both appears to promote export concentration and hinder the transition into exporting goods of higher value added.

Discussion

The results of the empirical investigation indicate that corruption has a negative impact on export diversification. This is consistent with the research conducted by Starosta de Waldemar (2010) and Héredia Caldeira Cabral & Veiga (2010). I consider my results to be relatively robust since corruption carries the expected sign and is statistically significant in seven out of the eight regressions. The result from the IV-estimation, where no effect of corruption could be identified, may be attributed to the fact that the index of ethnic fractionalization was a relatively weak instrument and that the sample had been drastically reduced. The estimated coefficient for corruption, when measured as a count of the number of exported products, ranges between 0,101 and 0,123. This implies that an amelioration in the control of corruption index by 10% increases the degree of export diversification by roughly 1%. However, as mentioned previously, the exact size of the elasticity is of little interest. What is of more importance is that the results of the baseline regression and those of the robustness controls point in the same direction and indicate that combatting corruption can play an important part in promoting both horizontal and vertical export diversification.

Nevertheless, even though I consider my results to be robust, some caution should be taken before drawing too strong conclusions. For instance, despite the fact that I control for the impact of country-specific fixed effects, the model used might be incorrectly specified. Moreover, it is rather likely that corruption is correlated with other institutional deficiencies. This may unintentionally cause my index to be a proxy for “bad institutions in general”, rather than just corruption. In addition, the difficulties encountered when constructing the control of corruption index should be kept in mind when interpreting the results.

In summary, the core result of my empirical investigation indicates that corruption has a robust and negative impact on export diversification. Due to the limited amount of empirical evidence previously available, this finding makes a rather valuable contribution to the existing literature and may help to shed further light on the harmful consequences of corruption. I now move on to answer the other questions I posed in the beginning of this thesis.

²⁵ A reminder to the reader; the *Herfindahl-Hirschman* index measures export **concentration**. I therefore expect corruption to have a negative sign.

6.2 Does the effect of corruption differ depending on the level of income?

After concluding that corruption appears to have a negative impact on export diversification in general, I investigate if the magnitude of the effect differs depending on the exporter's level of income. This is important since low- and middle-income economies are considered to gain the most from export diversification, whereas rich countries typically benefit from specialising (Hesse, 2008). In order to differentiate between the magnitudes of the elasticities, I construct a dummy-variable for the group "low-income" and another for "high-income". I also create interaction-terms between these dummies and the corruption variable. The classification of what constitutes a "low-income" and "high-income" country is taken from the World Bank.²⁶ Note that the parameters before the interaction-terms are the **extra** effects for low- and high-income countries whereas their elasticities are $\beta_{11} + \beta_{12}$ (low-income) and $\beta_{11} + \beta_{13}$ (high-income). The estimates can be found in the first column of Table 2.

$$\begin{aligned} ExpDiv_{i,t} = & \exp\left(\beta_1 + \gamma_t + \beta_2 * D_{landlocked} + \beta_3 * (\ln GDPpc_{i,t})^2 + \beta_4 * D_{Low-income} + \beta_5 * D_{High-income}\right) * GDPpc_{i,t}^{\beta_6} \\ & * Investments_{i,t}^{\beta_7} * Infrastructure_{i,t}^{\beta_8} * Openness\ to\ trade_{i,t}^{\beta_9} * GDP_{i,t}^{\beta_{10}} * Corruption_{i,t}^{\beta_{11}} \\ & * (D_{Low\ income} * Corruption)^{\beta_{12}} * (D_{High\ income} * Corruption)^{\beta_{13}} * \varepsilon_{i,t} \end{aligned}$$

The results suggest that the elasticity of corruption varies depending on the exporter's level of income and the effect is greater the poorer the country. Comparing the magnitudes of the estimated coefficients demonstrates this tendency, where the elasticity is 0,204 for low-income countries, 0,144 for middle-income and 0,015 for high-income economies²⁷. The results are statistically significant for both low- and middle-income countries, but not significant at the 10%-level for high-income countries²⁸. This means that while corruption impedes export diversification in low-and middle-income economies, no specific effect can be identified in high-income. The robustness of these findings will be tested in the following sections.

²⁶ The World Bank (2014) uses the following classification:

Low-income countries: GNI per capita of 1,045\$ or less

Middle-income countries: GNI per capita of more than 1,045\$ but less than 12,746\$.

High-income countries: GNI per capita of more than 12, 746\$

GNI per capita is calculated according the *Atlas method*. For more details, please consult the World Bank's website.

²⁷ 0,144+0,060=0,204 (low income) 0,144-0,129=0,015 (high income).

²⁸ I perform a test of joint significance in order to determine whether the coefficients for the interaction-variables are statistically significant.

Table 2.
Different
levels of
income

Regression:	Baseline Regression	Robustness control	Robustness control	Robustness control
		Fixed Effects Model	OLS	Negative Binomial Model
Dependent variable:	No. exported products (levels)	No. exported products (levels)	No. exported products (log-form)	No. exported products (levels)
Estimator:	PPMLE	PPMLE-FE	OLS	Neg. Bin
GDPpc	0,680*** (0,000)	2,273*** (0,000)	0,636*** (0,001)	0,596*** (0,000)
GDPpc, quadratic	-0,044*** (0,000)	-0,140*** (0,000)	-0,045*** (0,000)	-0,042*** (0,000)
Investments	-0,136*** (0,000)	0,022 (0,263)	-0,111*** (0,008)	-0,133*** (0,000)
Infrastructure	0,078*** (0,000)	-0,003 (0,848)	0,079*** (0,000)	0,077*** (0,000)
Openness to trade	0,267*** (0,000)	0,044 (0,179)	0,417*** (0,000)	0,371*** (0,000)
GDP	0,192*** (0,000)	0,140*** (0,000)	0,301*** (0,000)	0,263*** (0,000)
Corruption	0,144*** (0,000)	0,075 (0,202)	0,115* (0,091)	0,145** (0,012)
Low-income	-0,024 (0,644)	-0,011 (0,797)	-0,066 (0,349)	-0,045 (0,486)
High-income	0,056 (0,439)	-0,048 (0,436)	0,004 (0,971)	0,051 (0,645)
Low-income* Corruption	0,060 (0,373)	0,060 (0,425)	0,193* (0,051)	0,133 (0,103)
High-income* Corruption	-0,129** (0,032)	0,067 (0,294)	-0,099 (0,318)	-0,134 (0,136)
Landlocked	0,068*** (0,000)	-	0,154*** (0,000)	0,095*** (0,000)
Constant	-3,118*** (0,000)	-	-6,143*** (0,000)	-4,764*** (0,000)
Number of observations	1626	1626	1626	1626
R-squared	0,601	-	0,693	

***Significant at the 1%-level **Significant at the 5%-level *Significant at the 10%-level. Year dummies are included in all regressions and robust standard errors are used. The P-values are reported within brackets.

Robustness control with the fixed effects model

According to the results of the fixed effects model, corruption does not hamper export diversification in low- and middle-income economies. However, it does seem to have a negative impact in high-income countries.²⁹ These findings highly contradict the results of the pooled Poisson regression, according to which corruption is most detrimental to diversification in the low-income countries. The estimates of the fixed-effects model can be found in the second column of Table 2.

The discrepancy of the results may indicate that country-specific factors, not accounted for in the pooled regression, caused the PPMLE to be biased. It was not corruption that hampered export diversification in low- and middle-income countries, but some unobserved parameter. However, in contrast to the regression used initially, the fixed-effects-estimator explains to what extent the dependent variable deviates from its **individual** mean and not how these means differ between countries. Put differently, the fixed effects model focuses on variations within the specific economy (Verbeek, 2012, p. 379). Hence, if the level of corruption in a country significantly falls between the years 2002 and 2012, this will be captured by the FE-estimator. This fact has important implications for my results. For instance, it is rather likely that rich countries have managed to reduce the level of corruption more during the period than low- and middle-income countries due to more resources and better institutions. In some cases, the degree of corruption may have stayed the same during the eleven years of investigation. This does not imply that it is less detrimental to diversification, but that it simply has not been captured by the model.

Robustness control with OLS and the Negative Binomial-MLE

The estimates of the OLS and Negative Binomial regression can be found in the third and fourth columns³⁰ of Table 2. In contrast to the fixed effects model, these robustness controls strengthen the results of the pooled Poisson regression. Corruption carries the expected, positive, sign and is statistically significant for both low- and middle-income countries. No effect can, however, be observed for high-income economies. The magnitude of the coefficient for middle-income countries is roughly the same regardless of estimation technique, but OLS estimates a relatively higher elasticity than the PPMLE and the Negative Binomial-MLE for the least developed countries. Hence, in accordance with the results of the pooled Poisson regression, estimation with OLS and the Negative Binomial-MLE suggest that the effect of corruption on export diversification differs depending on the level of income and that the magnitude of the elasticity is largest for low-income countries.

²⁹ The result is statistically significant at the 5%-level while the estimated coefficients for low-and middle-income countries are not significant at the 10%-level.

Discussion

The empirical results indicate that the effect of corruption on diversification depends on the exporter's level of income. While corruption impedes diversification in low- and middle-income economies, the effect in high-income countries is unclear. From a policy perspective, the finding is relevant since low- and middle-income economies are typically those who want to diversify. Making combatting corruption a priority in these countries, can potentially lead to significant diversification gains. The elasticity for low-income countries is also higher than for middle-income, which indicates that reducing corruption is especially lucrative for this group of economies. However, since the results are not quite robust, further research is needed before drawing too strong conclusions.

6.3 Is corruption especially harmful in sub-Saharan Africa?

A special focus of this thesis lies on investigating whether corruption is especially detrimental to export diversification in sub-Saharan Africa. In order to test this, I follow the same procedure as earlier and construct a dummy variable for countries located in SSA. An interaction-term between this dummy and the corruption-variable is also created.

$$\begin{aligned} \text{ExpDiv}_{i,t} = & \exp(\beta_1 + \gamma_t + \beta_2 * D_{landlocked} + \beta_3 * (\ln \text{GDPpc}_{i,t})^2 + \beta_4 * D_{SSA}) * \text{GDPpc}_{i,t}^{\beta_5} * \text{Investments}_{i,t}^{\beta_6} \\ & * \text{Infrastructure}_{i,t}^{\beta_7} * \text{Openness to trade}_{i,t}^{\beta_8} * \text{GDP}_{i,t}^{\beta_9} * \text{Corruption}_{i,t}^{\beta_{10}} * (D_{SSA} * \text{Corruption})^{\beta_{11}} * \varepsilon_{i,t} \end{aligned}$$

The output of the regression can be found in the first column of Table 3. The results suggest that corruption has a negative impact on export diversification in sub-Saharan Africa and that the effect is relatively pronounced. In comparison with the elasticity for low-income countries estimated in the previous regression, which was 0,204, the equivalent for sub-Saharan Africa is 0,527³¹. This implies that an amelioration of the control of corruption index by 10% would increase the degree of export diversification by roughly 5% in countries located in SSA. When controlling for this regional effect, corruption does not appear to inhibit export diversification in the rest of the world. Hence, these preliminary findings point towards that corruption is especially detrimental to diversification in sub-Saharan Africa.

³¹ The elasticity for SSA: $-0,031+0,558=0,527$.

I perform a test of joint significance in STATA using the following command:

Test `lncorruption+ssa*lncorruption=0` which generates $\text{Chi}^2=73,25$ (0,000)

Table 3.
Sub-Saharan
Africa

Regression:	Baseline Regression	Robustness control Fixed Effects Model	Robustness control OLS	Robustness Control Negative Binomial Model
Dependent variable:	No. of exported Products (levels)	No. of exported Products (levels)	No. of exported Products (log-form)	No. of exported Products (levels)
Estimator:	PPMLE	PPMLE-FE	OLS	Neg. Bin - MLE
GDPpc	0.675*** (0,000)	2,145*** (0,000)	0,482*** (0,001)	0,475*** (0,000)
GDPpc, quadratic	-0.043*** (0,000)	-0,132*** (0,000)	-0,035*** (0,000)	-0,034*** (0,000)
Investments	-0.148*** (0,000)	0,022 (0,275)	-0,125*** (0,002)	-0,143*** (0,000)
Infrastructure	0.054*** (0,000)	-0,004 (0,843)	0,052*** (0,009)	0,068*** (0,000)
Openness to trade	0.272*** (0,000)	0,044 (0,200)	0,418*** (0,000)	0,375*** (0,000)
GDP	0.190*** (0,000)	0,309*** (0,000)	0,295*** (0,000)	0,260*** (0,000)
Corruption	-0.031 (0,307)	0,115** (0,057)	-0,135*** (0,006)	-0,077* (0,067)
SSA	-0.404*** (0,000)	-	-0,568*** (0,000)	-0,426*** (0,000)
SSA* Corruption	0.558*** (0,000)	-0,042 (0,776)	0,826*** (0,000)	0,676*** (0,000)
Landlocked	0.044*** (0,001)	-	0,117*** (0,000)	0,062*** (0,001)
Constant	-2,898*** (0,000)	-	-5,157*** (0,000)	-4,001*** (0,000)
Number of observations	1626	1626	1626	1626
R-squared	0,610	-	0,707	-

***Significant at the 1%-level **Significant at the 5%-level *Significant at the 10%-level. Year dummies are included in all regressions and robust standard errors are used. P-values are reported within brackets.

Robustness control with the fixed effects model

When estimating the model with the FE-estimator, no effect can be observed for sub-Saharan Africa. However, in contrast to the results of the pooled Poisson regression, corruption now appears to hamper

export diversification in the rest of the world. The coefficient is statistically significant at the 10%-level. As discussed at length when employing the FE-estimator on different levels of income, a possible explanation for the contradictory results could be that the estimator focuses on differences within the unit of observation, which is “country” in my case.

Robustness control with OLS and the Negative Binomial-MLE

Estimation with the Negative Binomial-MLE and OLS reinforce the core result of the pooled Poisson regression; namely that corruption is especially detrimental to export diversification in sub-Saharan Africa. However, in the Poisson regression the elasticity for the rest of the world was not statistically significant, which meant that no particular effect of corruption could be identified outside SSA. In contrast, when estimation is done with OLS and the Negative Binomial-MLE, this coefficient is negative and statistically significant³², which suggests that corruption still inhibits diversification in SSA but **enhances** diversification in the rest of the world.

Discussion

Estimation with the pooled PPMLE, the Negative Binomial-MLE and OLS strongly imply that the elasticity of corruption on diversification is larger for sub-Saharan Africa than in the rest of the world. The magnitude of the coefficient ranges between 0,527 and 0,694³³, which implies that countries in sub-Saharan Africa can make significant diversification gains by reducing corruption. When controlling for the effect in SSA, corruption does not appear to impede export diversification elsewhere. In fact, according to the estimates provided by OLS and the Negative Binomial-MLE increasing the level corruption would promote diversification in the rest of the world and not the other way round.

Since corruption appears to be especially detrimental to export diversification in sub-Saharan Africa, it may be the case that other factors determine whether corruption is harmful or not. The institutional setting in general, as well as the intentions and capacity of the state may for instance play a role. Despite high levels of corruption, several Asian economies have diversified their exports and grown rapidly during recent decades. These countries have been characterised by the presence of a strong and growth-oriented government, often referred to as the *developmental state*. Even if corruption was, and still is, widespread, it is likely that it was controlled to a larger extent than in SSA and possibly even used for fulfilling the growth-objectives of the Asian state leaders (Milelli & Sindzingre, 2010).

³² The coefficient is statistically significant at the 1-% level with OLS and at the 10%-level with the Negative Binomial-MLE.

³³ 0,527 when estimating with the PPMLE and 0,694 with OLS.

Yet again, the level of corruption *is* very high in sub-Saharan Africa (the highest in the world) and it may simply be that this is the reason to why its impact on export diversification is so seemingly large in the region. In the next section I will explore the issue further by testing whether the effect of corruption differs depending on the prevalence of corruption in the exporting country.

To conclude, my empirical results suggest that reducing corruption could have a significant impact on export diversification in Sub-Saharan Africa. This is in line with the research conducted by Héredia Caldeira Cabral & Veiga (2010) who also focused specifically on the region. However, since the corruption-variable for SSA is not significant in the fixed effects-model, further research ought to be undertaken in order to draw any strong conclusions. In addition, due to the heterogeneity of the sub-Saharan countries, some economies are likely to gain more than others from combatting corruption in terms of export diversification. Hence, the results of my empirical investigation should be interpreted as preliminary implications and serve as a base for further research on the topic.

6.4 Is there a non-linear relationship between corruption and diversification?

The final question this thesis aspires to answer is whether there is a non-linear relationship between corruption and export diversification. In other words, I seek to investigate if the magnitude of the effect differs depending on the degree of corruption in the exporting country. An intuitive line of reasoning would be that high levels of corruption are most detrimental to diversification and that the elasticity is the largest for this group of countries. This could be due to that higher corruption probably entails relatively higher costs and more uncertainty than lower levels and that it may to a larger extent affect all levels of society as well as the functioning of the state. In contrast, low degrees of corruption may involve increased costs related to delays and having to pay bribes, but probably does not alter the decisions of policy-makers and create other profound distortions in society. Combatting corruption in countries with the highest levels could therefore entail large diversification gains. However, to my knowledge no empirical evidence exists in support of this theory and it is therefore relevant to investigate the issue further.

I pursue two different strategies. The first one consists of simply dividing my sample into three groups of roughly the same size according to their degree of corruption (low, medium and high). I then construct dummy-variables for the different levels and multiply them with the original corruption term.³⁴ This will enable me to distinguish between their elasticities and see whether they differ. In previous sections I have left the original corruption-term in the regression to serve as a reference category (for medium corruption) but now I exclude this variable. Therefore the estimated coefficient before each level of corruption (low, medium and high) can be interpreted as the elasticity for this specific group. The results indicate that the

³⁴ For example: low corruption*Incorruption is the interaction-term for countries with a low degree of corruption.

degree of corruption plays an important role for the impact of corruption on export diversification. The elasticity for economies with low levels of corruption is 0,181 whereas the effect is 0,348 for those with medium levels and 0,522 for those with the highest. The output of this regression can be found in Table 5. in the appendix.

The second strategy consists of sorting the sample according to the score they have received on the control of corruption index. Economies with a score higher than 3,34 are classified as having a low degree of corruption and those with a score under 1,67 as having a high degree. The range of countries with a score between 1,67 and 3,34 are classified as having a medium degree. Note that there will not be an equal amount of observations in each group, which was the case in the first regression. The results from the second strategy of classification point to the same conclusion as in the previous regression, namely that the magnitude of the elasticity significantly differs depending on the prevalence of corruption in the exporting country. Hence, there seems to be a non-linear relationship between corruption and diversification. In this regression the least corrupt countries have an elasticity of 0,161 whereas those with medium levels have 0,301 and those with the highest 0,540. This implies that the countries with the highest degree of corruption have the most to gain from curbing it, in terms of export diversification. The estimates can be found in the first column of Table 4.

Table 4.
Different levels
of corruption
(Strategy 2.)

Regression:	Baseline Regression	Robustness Control	Robustness Control	Robustness Control
		Fixed- effects Model	OLS	Negative Binomial Model
Dependent variable:	No. of exported products (levels)	No. of exported products (levels)	No. of exported products (levels)	No. of exported products (levels)
Estimator:	PPMLE	PPMLE-FE	OLS	Negative Binomial MLE
GDPpc	0,725*** (0,000)	2,134*** (0,000)	0,643*** (0,000)	0,622*** (0,000)
GDPpc quadratic	-0,047*** (0,000)	-0,132*** (0,000)	-0,047*** (0,000)	-0,045*** (0,000)
Investments	-0,119*** (0,000)	0,022 (0,246)	-0,092** (0,025)	-0,116*** (0,000)
Infrastructure	0,075*** (0,000)	-0,003 (0,877)	0,079*** (0,000)	0,077*** (0,000)
Openness to trade	0,262*** (0,000)	0,043 (0,191)	0,413*** (0,000)	0,365*** (0,000)
GDP	0,191*** (0,000)	0,321*** (0,000)	0,299*** (0,000)	0,259*** (0,000)
Low Corruption	0,161*** (0,000)	0,106* (0,062)	0,135*** (0,000)	0,168*** (0,000)
Medium Corruption	0,301*** (0,000)	0,115** (0,043)	0,288*** (0,000)	0,322*** (0,000)
High Corruption	0,540*** (0,000)	0,148** (0,028)	0,484*** (0,001)	0,543*** (0,000)
Landlocked	0,061*** (0,000)	-	0,1500*** (0,000)	0,092*** (0,000)
Constant	-3,363*** (0,000)	-	-6179*** (0,000)	-4,867*** (0,000)
Number of observations	1626	1626	1626	1626
R-squared	0,606	-	0,695	-

***Significant at the 1%-level **Significant at the 5%-level *Significant at the 10%-level.
Year dummies are included in all regressions and robust standard errors are used. P-values
are reported within brackets.

Robustness control with the fixed effects model

The elasticities of corruption in countries with high and medium levels of corruption are not significant in the fixed effects model, when the classification is done according to the first strategy³⁵. However, when the countries are divided after their score on the Control of Corruption-index, all levels are statistically significant. Moreover, in line with the results of the pooled Poisson regression, high corruption appears to be most detrimental to diversification.

Robustness control with the Negative Binomial-MLE and OLS

Estimation with OLS and the Negative Binomial-MLE yield similar results to those of the pooled Poisson regression, therefore I will not elaborate on their interpretation.

Discussion

According to my empirical results, all degrees of corruption (low, medium and high) hamper export diversification. However, the magnitude of the effect is the largest for highly corrupt countries. This is in accordance with what I expected and I consider the result to be robust. Even the difference between countries with medium levels of corruption and those with low levels is relatively pronounced. Hence, there are significant diversification gains to be made from reducing corruption for the “medium” category too. From a policy perspective, this finding is important since it suggests that not exclusively high levels of corruption are detrimental to diversification. Note that in countries with low corruption, such as in Finland, Denmark and Sweden, there is not much corruption left to eliminate. In conclusion, the relationship between corruption and export diversification appears to be non-linear and the magnitude of the elasticity is the largest for countries with a high degree of corruption.

³⁵ A reminder to the reader: the first strategy consisted of dividing the countries into three groups of the **same size** according to their level of corruption. The second strategy consisted of dividing them after their score on the index, regardless of how many that landed in each group.

7. Summary and conclusions

In this section I summarise my empirical results and draw conclusions.

The purpose of this thesis is to investigate whether corruption has an impact on export diversification. In addition, I seek to determine if certain groups of countries have relatively more to gain from combatting corruption. More specifically, I analyse whether the magnitude of the elasticity varies depending on the exporter's level of income and if corruption is especially detrimental to diversification in sub-Saharan Africa. I also allow for non-linearities in the relationship between corruption and diversification. My sample consists of 157 economies at different levels of development and the period of investigation ranges between the years 2002 and 2012. The baseline regression is estimated with the Poisson-pseudo-maximum-likelihood estimator.

The results of my empirical investigation suggest that corruption is inversely related to diversification. I find that an amelioration of 10% in the World Bank's Control of Corruption index translates into an increase of roughly 1% in the number of exported products. This core result is relatively robust to alternative estimation techniques and measures of diversification. Moreover, it is consistent with previous research conducted by Starosta de Waldemar (2010) and Héredia Caldeira Cabral & Veiga (2010).³⁶ However, due to the problems associated with quantifying corruption and to the rather arbitrary scaling of the Control of Corruption-index, the exact magnitudes of the estimated coefficients should be interpreted with caution³⁷. From a policy perspective, the conclusion can hence be drawn that combatting corruption has the potential promote export diversification.

Furthermore, I investigate if the effect of corruption on export diversification varies depending on the exporter's level of income. This is an aspect that, to my knowledge, has not been analysed before. My findings indicate that both low- and middle-income countries gain from reducing corruption, but that the elasticity is especially high for low-income countries. However, these results are less robust and should be verified by future research.

Similarly, I test if the elasticity of corruption on diversification is greater for sub-Saharan Africa than for other parts of the world. I find that an amelioration of the control of corruption index by 10% increases the number of exported products by roughly 5% for countries located in the region. In Ethiopia, for instance,

³⁶ Note that Starosta de Waldemar and I both use the World Bank's Control of Corruption indicator as a proxy for corruption/rent-seeking but that he mainly uses the Theil index and the Herfindahl-Hirschman index as measures of diversification, whereas I use a count of the number of exported products. We also employ different estimation techniques and size of the sample differs. Héredia Caldeira Cabral & Veiga (2010) find that corruption hampers diversification, but their sample only includes countries in sub-Saharan Africa.

³⁷ Alternative estimation techniques used also generate slightly different results regarding the size of the elasticity. This is another reason for not devoting too much weight to the exact magnitudes of the estimated coefficients.

such a reduction of corruption would translate into seven³⁸ more exported products. The figure does not sound impressive, but considering the relatively high aggregation of trade data used (3-digit according to SITC) and that these goods often represent an export value of more than 100 000 dollars (UNCTAD, 2014), the diversification is of economic importance. When controlling for the effect in SSA, corruption does not appear to impede diversification elsewhere. My results hence point towards that corruption is especially detrimental in sub-Saharan Africa and that significant diversification gains could be achieved by reducing it. Nevertheless, even these results should be confirmed by further research.

Finally, I investigate if there is a non-linear relationship between corruption and export diversification. I find that corruption impedes diversification at all levels, but that the elasticity is the largest for countries with high levels of corruption. Hence, I find empirical evidence supporting a non-linear relationship between corruption and diversification, where especially the most corrupt countries have to potential to make large diversification gains.

A relevant aspect to emphasise is that the results of the last three regressions, though in need of verification, all imply that sub-Saharan Africa can achieve significant diversification gains by reducing corruption. This is due to that the continent both exhibits the highest levels of corruption in the world **and** contains the majority of *least developed countries*³⁹ (LDC's). The notion of corruption being a significant determinant of export diversification in sub-Saharan Africa is consistent with previous research conducted by Héredia Caldeira Cabral & Veiga (2010) and can have important policy implications. However, due to its multidimensional and all-encompassing nature, combatting corruption is obviously easier said than done. In addition, a plausible explanation to why high levels of corruption persist, despite the harmful consequences, is that the people in power benefit from the situation. Altering their incentive structure is likely to be of great importance in order to achieve any significant improvements in curbing corruption. Initiatives with the scope of increasing the transparency of public expenditures, such as the EITI⁴⁰, have for some countries yielded positive results and can therefore, for instance, be promoted at a larger scale. Transparency is considered to be an important way of combatting corruption since it enables ordinary citizens to scrutinise the allocation of funds and thus hold their governments accountable (EITI, 2014).

As emphasised, an important topic for future research is to further investigate the consequences of corruption for diversification in sub-Saharan Africa and to construct efficient policy tools that may help governments and other agents combat corruption. In addition, certain kinds of corruption are potentially more harmful than others and distinguishing between these is a relevant topic for future research. Moreover, corruption is not a phenomenon that acts in isolation. In contrast, it is highly likely that other

³⁸ 7,45 ≈ 7

³⁹ LDC stands for least developed countries and denotes those with lowest income. To see a list, please see UN (2014)

⁴⁰ EITI stands for *Extractive Industries Transparency Initiative*, for more information visit EITI.org

institutions either reinforce or curb the effects it may have on export diversification. In order to make meaningful policy recommendations, placing corruption into the context in which it figures is important, in my opinion. An extensive cross-sectional econometric study may not be the best way of doing this. In fact, studies of a more qualitative nature that go deeper in untangling these institutional linkages would be a preferable next step.

To conclude, in this thesis I find robust empirical evidence suggesting that corruption has a negative impact on export diversification. Furthermore, though in need of verification, my results indicate that both low- and middle-income countries gain from reducing corruption but that the effect is more pronounced for low-income economies. Similarly, I find that corruption has an especially detrimental impact on diversification in sub-Saharan Africa. However, even this result should be interpreted as preliminary and serve as a base for further research. Finally, I find that the magnitude of the elasticity of corruption on diversification varies depending on the degree of corruption in the exporting country. A relevant aspect to note is that all my empirical results point to that combatting corruption may translate into substantial diversification gains for countries in sub-Saharan Africa.

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- "GDP per capita, PPP constant 2005 international \$"
- "Gross capital formation as % of GDP"
- "Manufactures exports (% of merchandise exports)"
- "Poverty Headcount Ratio at 1,25\$ a day (PPP), % of population"
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- "Trade as % of GDP"
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9. Appendix

Variables and sources

Variable	Source
No. of exported products <i>A count – 3-digit SITC</i>	UNCTAD (2014) <i>Trade Indicators</i>
The Herfindahl-Hirschman Index <i>Concentration index, 3-digit SITC</i>	UNCTAD (2014) <i>Trade Indicators</i>
Manufactures as share of total exports <i>Manufactures exports (% of merchandise exports)</i>	The World Bank (2014b) <i>World Development Indicators</i>
GDP per capita, PPP <i>GDP per capita, PPP constant 2005 international \$</i> Estimated in the logarithmic form	The World Bank (2014b) <i>World Development Indicators</i>
Investments <i>Gross capital formation as % of GDP</i> Estimated in the logarithmic form	The World Bank (2014b) <i>World Development Indicators</i>
Infrastructure <i>(Telephone lines per 100 people)</i> Estimated in the logarithmic form	The World Bank (2015b) <i>World Development Indicators</i>
Openness to Trade <i>Trade as % of GDP</i> Estimated in the logarithmic form	The World Bank (2014b) <i>World Development Indicators</i>
GDP <i>GDP (constant 2005 US\$)</i> Estimated in the logarithmic form	The World Bank (2014b) <i>World Development Indicators</i>
Corruption <i>Control of Corruption Indicator</i> Estimated in the logarithmic form	The World Bank (2014c) <i>World Wide Governance Indicators</i>
Landlocked <i>I = The country is landlocked</i>	The author consulted a map
Y_t <i>Year dummies 2003-2012</i>	Created in STATA

Exporters

Albania	Dominica	Lao People's Dem. Rep.	Saudi Arabia
Algeria	Dominican Republic	Latvia	Senegal
Angola	Ecuador	Lesotho	Seychelles
Antigua and Barbuda	Egypt	Liberia	Sierra Leone
Armenia	El Salvador	Lithuania	Singapore
Australia	Equatorial Guinea	Luxembourg	Slovakia
Austria	Eritrea	Macao	Slovenia
Azerbaijan	Estonia	Madagascar	Solomon Islands
Bahamas	Ethiopia	Malawi	South Africa
Bahrain	Fiji	Malaysia	Spain
Bangladesh	Finland	Mali	Sri Lanka
Barbados	France	Malta	Saint Kitts and Nevis
Belarus	Gabon	Mauritania	Saint Lucia
Belgium	Gambia	Mauritius	Saint Vincent and the Grenadines
Belize	Georgia	Mexico	Sudan
Benin	Germany	Moldova	Swaziland
Bhutan	Ghana	Mongolia	Sweden
Bolivia (Plurinational State of)	Greece	Morocco	Switzerland
Botswana	Grenada	Mozambique	Tajikistan
Brazil	Guatemala	Namibia	Thailand
Brunei Darussalam	Guinea	Nepal	Togo
Bulgaria	Guinea-Bissau	Netherlands	Tonga
Burkina Faso	Guyana	New Zealand	Trinidad and Tobago
Burundi	Haiti	Nicaragua	Tunisia
Cambodia	Honduras	Niger	Turkey
Cameroon	Hong Kong	Nigeria	Uganda
Canada	Hungary	Norway	Ukraine
Central African Republic	Iceland	Oman	United Kingdom
Chad	India	Pakistan	United States
China	Indonesia	Panama	Uruguay
Colombia	Ireland	Paraguay	Uzbekistan
Comoros	Israel	Peru	Vanuatu
Dem. Rep. of the Congo	Italy	Philippines	Venezuela (Bolivarian Republic of)
Congo	Japan	Poland	Viet Nam
Costa Rica	Jordan	Portugal	Yemen
Côte d'Ivoire	Kazakhstan	Qatar	Zambia
Croatia	Kenya	Romania	Zimbabwe
Cyprus	Korea, Republic of	Russian Federation	
Czech Republic	Kuwait	Rwanda	
Denmark	Kyrgyzstan	Sao Tome and Principe	

Table 5.
Different
levels of
corruption
(strategy 1)

Dependent variable:	No. of exported products (levels)	No. of exported products (levels)	No. of exported products (log-form)	No. of exported products (levels)
Estimator:	PPMLE	PPMLE-FE	OLS	Neg Bin-MLE
GDP pc	0,785*** (0,000)	2,145*** (0,000)	0,657*** (0,000)	0,636*** (0,000)
GDP pc quadratic	-0,049*** (0,000)	-0,133*** (0,000)	-0,046*** (0,000)	-0,044*** (0,000)
Investments	-0,121*** (0,000)	0,020 (0,299)	-0,091*** (0,026)	-0,116*** (0,001)
Infrastructure	0,063*** (0,000)	-0,005 (0,801)	0,067*** (0,000)	0,067*** (0,000)
Openness to trade	0,261*** (0,000)	0,044 (0,186)	0,410*** (0,000)	0,340*** (0,000)
GDP	0,185*** (0,000)	0,310*** (0,000)	0,291*** (0,000)	0,254*** (0,000)
Low Corruption	0,181*** (0,000)	0,107** (0,056)	0,173*** (0,000)	0,202*** (0,000)
Medium Corruption	0,358*** (0,000)	0,090 (0,128)	0,408*** (0,000)	0,407*** (0,000)
High Corruption	0,522*** (0,000)	0,104 (0,109)	0,583*** (0,000)	0,597*** (0,000)
Landlocked	0,065*** (0,000)	-	0,151*** (0,000)	0,089*** (0,000)
Constant	-3,601*** (0,000)	-	-6,213*** (0,000)	-4,937*** (0,000)
Number of observations	1626	1626	1626	1626
R-squared	0,608	-	0,699	-

***Significant at the 1% level **Significant at the 5% level *Significant at the 10% level. Year dummies are included in all regressions and robust standard errors are used. P-values are reported within brackets