ESTIMATING THE EFFECTS OF FOREIGN BRIBERY LEGISLATION IN THE INTERNATIONAL ECONOMY

by

Kevin Lim

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Signature of Author..... Kevin Lim
Department of Political Science
May 21, 2010

Certified by..... Gabriel Lenz
Associate Professor of Political Science
Thesis Supervisor

Certified by..... David Andrew Singer
Associate Professor of Political Science
Second Reader

Accepted by..... Roger Petersen
Professor of Political Science
Chair, Graduate Program Committee

Accepted by..... Charles Stewart III
Professor and Head, Department of
Political Science

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Abstract

Foreign bribery – the payment of bribes across borders – poses a classic collective action problem in theory. A firm may extract benefits through the payment of bribes to foreign public officials without its own country bearing the associated costs of governmental corruption, and hence while eliminating foreign bribery may be in the best interests of all who are engaged with the global economy, there are few obvious incentives for any one national government to be the first to take action.

Over the last two decades, however, an unprecedented degree of multilateral cooperation on the issue of foreign bribery has been achieved. In particular, the Organization for Economic Cooperation and Development (OECD) has been a key institutional locus of activity, serving as the coordinating body for the monitoring and enforcement of a comprehensive anti-bribery convention that was adopted in 1997. This convention appears to have been largely successful at least in terms of spurring legislative change: all OECD member countries as well as several non-member nations have since adopted laws that explicitly criminalize the act of bribing foreign public officials, and the capacity of the state to monitor, detect, and prosecute the offence of foreign bribery has ostensibly been enhanced.

Given the potential for collective action problems to develop, it is thus important to ask whether the legislative action that has been taken thus far is meaningful in any measurable sense. I answer this question by constructing an original measure of the strictness of foreign bribery legislation, which I then employ as the main independent variable in an empirical study of export data, utilizing both difference-in-difference estimators and regression analysis. The results of my analysis provide support for the hypothesis that the enactment of stricter foreign bribery legislation amongst the countries party to the OECD convention has reduced exports to more corrupt countries more so than it has exports to less corrupt countries. These findings are robust to a variety of sensitivity tests, and I thus conclude that the OECD's multilateral anti-bribery initiatives have indeed had a meaningful impact on business decisions in the international economy.

Thesis Supervisor: Gabriel Lenz
Title: Associate Professor of Political Science

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Foreign bribery – the payment of bribes across borders – poses a classic collective action problem in theory. A firm may extract benefits through the payment of bribes to foreign public officials without its own country bearing the associated costs of governmental corruption, and hence while eliminating foreign bribery may be in the best interests of all who are engaged with the global economy, there are few obvious incentives for any one national government to be the first to take action. It is thus important to ask: can multilateral approaches to legislative reform make a meaningful difference to the prevalence of foreign bribery in the international economy?

In this thesis, I answer this question by assessing how international business transactions are affected when governments enact stricter legislation regulating the payment of bribes overseas, focusing in particular on a series of anti-bribery initiatives that have been coordinated through the formal structures of the Organization for Economic Cooperation and Development (OECD) since the mid-1990s. Since one might expect anti-bribery laws to be most pertinent precisely when bribery is most prevalent, I also consider whether the effects of such legislation are conditional on the extent of corruption in the countries where international business transactions take place. To do so, I first construct an original measure of the strictness of foreign bribery legislation, which I then employ as the main independent variable in an empirical study of the relationship between foreign bribery laws and the level of inter-country exports, utilizing both simple difference-in-difference estimators as well as regression analysis of export data.

The layout of this thesis is as follows. Section 1 provides an introduction to the issue of bribery in the international economy, discussing both the motivations for and the significance of the research topic explored in this thesis. Section 2 then describes the main features of the

OECD's anti-bribery initiatives since the mid-1990s, so as to establish the context for the subsequent analysis. Section 3 describes the research methodology adopted and constructs the main statistical model, while Section 4 discusses the sources of data as well as the treatment of missing data. Section 5 then presents the results of the empirical analysis and provides interpretations for the main findings. A series of robustness tests are also discussed, and alternative explanations are assessed. Finally, Section 6 concludes by considering the implications of the findings of this thesis.

1. Introduction: Bribery in the International Economy

On 19 January, 2010, the United States Justice Department announced its first-ever undercover operation targeting foreign bribery. Posing as representatives from the defense ministry of an African nation, agents from the Federal Bureau of Investigation (FBI) had approached corporate executives in the US arms industry to extend a highly profitable but also explicitly illegal offer. The proposed agreement would entail the payment of a "commission" to the representative, sales intermediaries, and the defense minister himself, in exchange for a $15 million deal to supply the African nation's presidential guard with military equipment. According to the Justice Department's report, 22 of these executives not only accepted the offers, but also confirmed their agreement in writing and in the form of more immediate "commissions". These 22 executives – including a former top Secret Service agent and the vice-president of sales from Smith & Wesson, the largest manufacturer of handguns in the US – have since been arrested.[1]

The legal basis for the Justice Department's operation was the Foreign Corrupt Practices Act (FCPA), enacted by the US Congress in 1977 following a series of investigations by the

[1] Henriques, Diana B. 2010. "F.B.I. Charges Arms Sellers with Foreign Bribes." *New York Times*, January 20.

Securities and Exchange Commission (SEC). The SEC had found that over 400 US companies had engaged in the act of foreign bribery so as to secure favors for the conduct of their enterprises, suggesting that the payment of bribes had become more a systemic problem within some sectors of business rather than merely the result of sporadic individual malfeasance. Consequently, as the Justice Department notes, the purpose of the FCPA was to "bring a halt to the bribery of foreign officials and to restore public confidence in the integrity of the American business system."[2]

Indeed, the passage of the FCPA and the subsequent investigations into foreign bribery that it has undergirded seem to be nothing out of the ordinary. Foreign bribery is illegal almost by definition, and thus should rightly be criminalized and subject to prosecution. Yet, for almost two decades after the adoption of the FCPA, the United States stood apart in its treatment of foreign bribes. No other country had enacted similar legislation establishing the criminality of the act, and some – Australia and Belgium, for example – even allowed tax deductions to be claimed for bribes paid overseas, as long as these were for the purpose of competing in export markets where the payment of bribes was understood to be common practice.[3]

This apparent laxity in anti-bribery laws may certainly come as a surprise to the outside observer, but from the point of view of the legislating governments, it is perhaps not altogether irrational. On the one hand, for the parties directly involved in a specific instance of bribery, the distinction between domestic and foreign bribery is slight: in either case, illegal transactions are motivated by interests on both sides that stand to reap benefits. For national governments, however, the interests at stake depend substantially on whether the bribery in question occurs wholly within their own borders, or whether it involves the officials of other nations as well.

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[2] United States Department of Justice. "Lay-Person Guide to the FCPA Statute." http://www.justice.gov/criminal/fraud/fcpa/docs/lay-persons-guide.pdf

[3] OECD Country Reports. See note 14.

In the former case, even if individual officials may benefit privately from illicit dealings, governments and the people under their charge generally suffer when their own ranks are rife with corruption, since rents are being extracted and resources are being diverted away from their most efficient employment. It is thus in the broad interests of the citizens and government of a country to seek the elimination of corruption within their own borders. When the bribers are domestic and the officials being bribed are foreign, however, the incentive structures are very much different. In particular, firms may still derive advantages by bribing the officials of other nations, but this imposes a cost only on the country whose officials are being bribed. Hence, for the governments of the bribing nations, such transactions represent an economic gain without the associated cost of corruption in their own administration, and in this sense, foreign bribery may be viewed as a negative externality, imposed by one nation on another through the interaction of their firms and governments.

That foreign bribery may be characterized as a negative externality also suggests that multilateral efforts at combating it may suffer from problems of collective action. Presumably, the entire world would be better off if firms from all countries refrained from bribing the public officials of all other countries. Yet, no national government has the incentive to be the first to take action, since doing so might put their own citizens and firms at a competitive disadvantage in overseas markets. Indeed, such problems of collective action were clearly evident from the difficulties that were initially faced in forming a meaningful consensus on the issue of foreign bribery within the international arena.

Prior to the mid-1990s, it was widely perceived that the legislative treatment of foreign bribery was most stringent in the United States, due in large part to the passage of the FCPA. While the FCPA was certainly an important step towards eliminating cross-border corruption,

however, it was also in theory a unilateral move that made doing business for US firms relatively more costly vis-à-vis the firms of other nations, where no such legislative action had been taken. Mark Pieth, currently Chairman of the OECD Working Group on Bribery in International Business Transactions, thus recounts the lukewarm response that was received by the US in 1989 when it put forward a proposal for an international agreement on foreign bribery. As Pieth notes, representatives from other OECD nations had long harbored suspicions that the US's push for greater international cooperation on the issue was motivated by trade concerns, and had also come to believe that the US had "maneuvered itself into a competitive disadvantage on world markets" with the passage of the FCPA. [4]

During the mid-1990s, however, the issue of corruption within the specific context of the international economy began to receive greater attention amongst the countries that comprise the OECD. An unprecedented degree of multilateral cooperation was achieved, as a working group on international bribery was formed, and non-OECD countries were also invited to participate in intergovernmental dialogue. Several important recommendations on the subject of foreign bribery were then jointly issued by the countries involved, and these initiatives eventually culminated in 1997 with the adoption of a formal convention obligating acceding parties to enact stricter anti-bribery legislation. Since then, all OECD member countries, as well as several non-member nations, have adopted legislation that explicitly criminalizes the act of bribing foreign public officials. The majority of these countries have also implemented a variety of legislative changes in other areas such as tax law, which have ostensibly enhanced the capacity of the state to monitor, detect, and prosecute the offence of foreign bribery.

Given this seemingly momentous shift in attitudes towards foreign bribery in recent years, it is thus important to ask whether these legislative changes have made any difference at all to

[4] Pieth (1997), pp.119-120

the way that firms operate in the global economy. In particular, given the theoretical potential for collective action problems to hinder multilateral efforts at combating foreign bribery, one must certainly wonder whether the legislative action that has been taken thus far is meaningful in any measurable sense, or whether it merely constitutes the payment of lip service while corrupt practices carry on to the same extent as before. For certain, there are those who believe that the impact of foreign bribery legislation on business decisions has been substantial. For example, David Johnson, an Assistant Secretary at the US Bureau of International Narcotics and Law Enforcement Affairs, stated before a Senate committee:

> In some countries, large government contracts are awarded on the basis of bribes rather than merit. U.S. companies are believed to have lost out on business opportunities worth about $27 billion in [2009], because they refused to violate honest business practices. Some have abandoned markets altogether, while some unscrupulous competitors take advantage of the corrupt environment to gain control of strategic markets and materials.[5]

Hence, to determine whether such perceptions are indeed supported by empirical reality, this thesis seeks in essence to answer the following research question:

> *What are the effects of legislation regulating foreign bribery on levels of international business transactions?*

A plausible hypothesis in response to this question may then be formulated by first recognizing that one might perhaps not expect anti-bribery legislation to have the same effect in all kinds of situations. If corrupt practices were never a feature of doing business in the first place, for example, then an increase in the stringency of anti-bribery laws should plausibly have little effect, or should in fact cause an increase in the levels of such transactions as their cost

[5] US Department of State, "Keeping Foreign Corruption Out of the United States: Four Case Studies," http://www.state.gov/p/inl/rls/rm/136527.htm.

decreases relative to dealings where bribes must frequently be paid. With this in mind, the main hypothesis to be tested by empirical analysis is as follows:

> H_1: *The enactment of stricter foreign bribery legislation reduces the level of international business transactions carried out with more corrupt countries more so than it does transactions carried out with less corrupt countries.*

Correspondingly, two versions of the null hypothesis can then also be specified:

> H_0: *The enactment of stricter foreign bribery legislation has the same effect on the level of international business transactions carried out with a country regardless of how corrupt that country is.*
>
> H_0': *The enactment of stricter foreign bribery legislation has no effect on the level of international business transactions carried out with a country regardless of how corrupt that country is.*

H_0 and H_0' are similar but presume different effects of foreign bribery legislation – the former predicts effects that are unconditional on levels of corruption, while the latter is a more restrictive hypothesis that predicts no effects unconditionally.

Determining which of these hypotheses best characterize the relationship between foreign bribery legislation and international business transactions will then serve two different but complementary purposes. First, estimating the effects of anti-bribery legislation will provide a direct evaluation of how effective the OECD's multilateral approach to combating foreign bribery has been thus far. While the effects of legislative changes on corruption per se are not considered, the analysis will provide important insights as to whether these initiatives have had a significant impact on business transactions carried out in countries where corruption is most

rampant. Second, since one might expect firms to be most affected by anti-bribery laws precisely when bribery is a common feature of their businesses, measuring how firms respond to such legislation also has the potential to make another equally-important contribution to the literature on corruption: developing an alternative means of measurement.

An Alternative Approach to Measuring Corruption

Corruption between government and business is a universal problem that has received much scholarly attention in recent years, with researchers having thoroughly investigated both its causes and effects. Oft-cited studies on the effects of corruption, for example, include that by Mauro (1995), who finds that corruption reduces economic growth, and that by Wei (2000), who finds that higher corruption is positively associated with lower foreign direct investment (FDI). On the causes of corruption, numerous explanatory factors have been studied, including governmental decentralization (Fisman and Gatti, 2002), democracy (Lederman et al, 2005), electoral rules (Persson et al, 2003), civil service wages (Van Rijckeghem and Weder, 2001), and natural resources (Leite and Weidmann,1999).

Despite this vast amount of literature, however, the study of corruption remains a daunting endeavor, in particular because the majority of corrupt acts are, by nature, deliberately clandestine affairs. Thus, while corruption is generally understood to be undesirable, it persists as a frustratingly amorphous affection that can rarely be observed directly, save for the occasional scandal involving only that politician or businessperson unfortunate enough to get caught. Vito Tanzi, former director of fiscal affairs at the International Monetary Fund, sums up the problem astutely, observing that "if corruption could be measured, it could probably be eliminated."[6]

[6] Tanzi (1998), p.576

Hence, measurement of the dependent variable is a serious challenge for any rigorous study of corruption.

At present, the most frequently adopted approach in the academic literature relies on the use of corruption perceptions measures as proxy indicators for actual corrupt behavior. These are scores that are constructed by aggregating survey responses from a variety of sources – including businesspersons, professional analysts, and ordinary citizens – regarding the extent to which corruption is believed to exist in a given country. These perceptions measures thus have the important advantage of being relatively straightforward to put together, and, since their appearance in the mid-1990s, have become widely used in existing research. All the studies on the causes and effects of corruption cited above, for instance, employ one or another index of corruptions perceptions as their dependent variable.

However, questions over the validity of these corruption perceptions measures remain, an issue that has itself become a focal point in the corruption literature. On the one hand, various arguments have been put forward justifying their use. Treisman (2000), for example, contends that corruptions perceptions indices are valid proxy measures for two reasons: first, scores from different sources that are constructed using different methodologies are highly correlated with one another; second, corruption perceptions indices yield predictions of countries' macroeconomic performance that are in accordance with what one might expect, along the lines of the findings by Mauro and Wei as cited above.[7]

On the other hand, it is still unclear to what extent information becomes distorted in the space between actual and perceived corrupt behavior. It is thus generally acknowledged that perceptions indices remain imperfect yet thus far unfortunately necessary substitute measures. Olken (2009), for instance, examines the level of correlation between perceptions indices and

[7] Treisman (2000), pp.410-412

direct measures of appropriated government funds at the village level in Indonesia, concluding that "perceptions data should be used for empirical research on the determinants of corruption with considerable caution."[8] Hence, while it is perhaps an inescapable fact that corrupt behavior cannot be observed directly, it is nonetheless useful to consider whether alternative approaches to measuring corruption can be developed.

In this regard, the analysis conducted in this thesis also serves as a preliminary exploration of precisely such an alternative approach, one that has hitherto not been thoroughly investigated. The logic on which this is based is as follows: rather than seeking to measure corruption or corruption perceptions directly, one might consider whether the behavior of firms in the international economy, reflected in the intensity of cross-border business transactions, may indirectly reveal the extent of corruption in a given country. Within the specific context of anti-bribery legislation, one might expect that when bribes to foreign officials become more costly for firms, the amount of business conducted in highly corrupt countries where demand for bribes is high will tend to decrease relative to the amount of business conducted elsewhere.

Consequently, if it can be shown that legislation targeting foreign bribery has an effect on international business transactions that is conditional on existing levels of corruption, then one might also consider the inverse scenario, and infer that the demand for bribes is more prevalent when international business transactions are most affected by foreign bribery laws. In this way, measuring the effect of foreign bribery legislation on international business transactions may help to develop an alternative (albeit still indirect) measure of corruption.

[8] Olken (2009), p.963

2. Background: Foreign Bribery and the OECD

Over the last two decades, the OECD has emerged as the central institutional locus for the promotion, implementation and enforcement of stricter anti-bribery legislation. The first recommendation issued by the OECD Council on the problem of *foreign* bribery in particular was adopted in May 1994, and encouraged member nations to "take effective measures to deter, prevent and combat the bribery of foreign public officials in connection with international business transactions." According to the text of the recommendation, the need for action on the issue was motivated by the recognition that whereas all OECD nations had already established laws making the bribery of their own public officials illegal, only a minority of member countries had in place legislation criminalizing the bribery of foreign public officials.[9]

Further agreements on the issue of bribes in international business transactions were soon to follow. In April 1996, the OECD Council adopted a second recommendation focusing more specifically on the tax treatment of foreign bribes (entitled the *Recommendation of the Council on Combating Bribery in International Business Transactions*, hereafter referred to as the "1996 Recommendation"). In particular, the recommendation addressed those nations in which tax deductions could be claimed for bribes paid to foreign officials, and encouraged these counties to "re-examine such treatment with the intention of denying this deductibility."[10]

As mentioned previously, disallowing tax deductions for foreign bribes was far from the standard practice prior to the mid-1990s. Until May 2007, for instance, the Belgian Income Tax Code allowed tax deductions to be claimed for "secret commissions" that were paid to facilitate export businesses not involving government contracts, as long as it could be proven that the commissions were standard practice in the sector of business and that they were necessary for

[9] OECD (1994)
[10] OECD (1996)

countering foreign competition.[11] In Australia, although the national parliament amended the country's tax laws in May 2000 to prohibit deductions for foreign bribes, it noted the following in the text of its implementing legislation:

> It is a longstanding principle that Australia's tax law allows deductions for expenditures incurred in deriving assessable income, *irrespective of whether the expenditure relates to legal or illegal activities*. Although disallowing bribes paid to foreign officials would be an exception to this principle, it can be justified on the ground that it will enable Australia to implement the OECD recommendation and align itself with the majority of OECD countries.[12]

Belgium and Australia were, in fact, no exceptions, and thus the legislative changes called for by the 1996 Recommendation signified not merely formalization of already established practices, but rather a meaningful change in the tax treatment of foreign bribes.

The issue of bribery then received more formal treatment in the OECD with the adoption in November 1997 of the *OECD Convention on Combating Bribery of Foreign Public Officials in International Business Transactions* (hereafter referred to as the "Anti-bribery Convention"). This document has since become the cornerstone of the OECD's efforts to curb foreign bribery, and has been acceded to by all thirty of the OECD countries, as well as by eight non-member nations.[13] The Anti-bribery Convention lays out specific obligations for acceding countries to adhere to, which primarily involve increasing the stringency of legislation in a variety of areas related to foreign bribery. The convention also establishes consistent standards for assessing the legislative treatment of foreign bribery, and thus, together with the 1996 Recommendation, has

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[11] OECD Country Reports (Belgium), Phase 1 Report, p.19; Phase 2, pp.48-49. See note 14.
[12] Commonwealth of Australia, "Taxation Laws Amendment Bill (No. 8) 1999 Explanatory Memorandum," Section 4.98, http://www.austlii.edu.au/au/legis/cth/bill_em/tlab81999285/memo1.html. Emphasis added.
[13] The eight non-member nations comprise Argentina, Brazil, Bulgaria, Chile, Estonia, Israel, Slovenia, and South Africa.

come to serve as the basis for evaluating compliance levels on the part of the participating countries.

Although neither the terms of the 1996 Recommendation nor of the Anti-bribery Convention are legally binding, implementation of the obligations that they specify is monitored by a comprehensive peer-evaluation process, whereby signatories to the convention are appointed as examiners to assess one another's compliance. This evaluation process is directed and supervised by the Working Group on Bribery, and is essentially carried out in two phases. The first phase focuses on the extent to which the laws of the country in question are in line with the relevant recommendations, while the second phase, which includes an on-site visit to the country being examined, evaluates the enforcement of these laws in practice.

In addition, an important feature of the monitoring process – one which makes the analysis of this thesis feasible – is that the evaluations are deliberately transparent, with each phase thoroughly documented by comprehensive reports for each of the 38 participating countries.[14] The availability of these evaluation reports thus allows both the timing of significant legislative changes as well as the overall stringency of foreign bribery legislation in each convention country to be comprehensively coded. These coded measures then serve as the primary independent variables considered in the analysis.

In general, since the adoption of the 1996 Recommendation and the Anti-bribery Convention, the OECD's anti-bribery initiatives appear to have been largely successful at least in terms of spurring legislative change. With regards to the issue of tax deductions for foreign bribes, for example, the Working Group on Bribery notes the following:

[14] These are available at: http://www.oecd.org/document/24/0,3343,en_2649_34859_1933144_1_1_1_1,00.html.

> The vast majority of Parties to the OECD Anti-Bribery Convention now prohibit companies from taking bribes to foreign public officials as tax deductions. This is due to the success of the *1996 Recommendation of the OECD Council on the Tax Deductibility of Bribes for Foreign Public Officials*, which aimed to put an end to this practice.[15]

While clearly new laws have been enacted to implement the obligations that were collectively agreed upon, however, the effects of these changes on the behavior of firms in the international economy is unclear. Hence, it is precisely such a question that this thesis seeks to answer.

3. Research Methodology

This section describes the main features of the adopted research methodology, first discussing the unit of analysis and the case selection process, and then describing the construction of the main statistical model for the regression analysis.

Unit of Analysis and Case Selection

This thesis aims to estimate the effect of changes in foreign bribery legislation on levels of international business transactions, and hence the relevant unit of analysis is that of a country dyad measured at some suitable time interval. Given that the legislative changes enacted by the countries party to the OECD Anti-bribery Convention have taken place over the span of slightly more than a decade, and that both international trade and investment data are most consistently available as annual observations, the unit of analysis in this thesis is thus chosen to be a dyad-year.

The process of case selection is then as follows. On one side of each dyad, the dataset contains data for all countries that have acceded to the Anti-bribery Convention. For convenience, these are referred to as "convention countries" throughout the remainder of this thesis. As noted

[15] OECD, "Denying Tax Deductibility of Bribes," http://www.oecd.org/document/38/0,3343,en_2649_37447_42220454_1_1_1_1,00.html.

previously, the convention countries include all thirty OECD countries as well as the eight non-member nations that have joined the OECD Working Group on Bribery. Until 1999, however, trade and investment data for Belgium and Luxembourg were available only as aggregated figures for the Belgium-Luxembourg Economic Union (BLEU), which was dissolved only in 2002. Hence, Belgium and Luxembourg are treated as a single entity in the analysis, resulting in 37 Convention Countries instead of 38, and the methods employed for combining the data of the two countries are described in detail in Annex A. While this methodological choice reduces the number of available observations by one, it allows for greater consistency in the data.

On the other side of each country dyad, the dataset should ideally include all possible countries with which the convention countries could engage in international business transactions. While the selection of "the entire world" may appear all-encompassing and thus unambiguous, there is still a need to define a consistent standard for case selection so as to avoid any possible selection bias. For this purpose, the 192 sovereign states recognized by the United Nations are referred to as a baseline universe of partner countries.[16] Serbia and Montenegro, which were not fully independent from each other until 2006, are then treated in this analysis as a single entity, with data for the countries combined as in the case of Belgium and Luxembourg. This selection process thus yields a total of 189 partner countries for each convention country (bearing in mind that a country cannot trade with itself).

Finally, the time frame that the dataset covers is determined by both the timing of the OECD's anti-bribery initiatives and the constraints imposed by the availability of data. Since the Anti-bribery Convention was adopted in 1997, and since data for the chosen corruptions

[16] Notable economic entities excluded by this method of case selection include Taiwan, Hong Kong, and the Vatican City. While it is certainly possible to perform the analysis with these entities included, their inclusion would also warrant the inclusion of a host of other entities such as Puerto Rico, American Samoa, and the Virgin Islands, which cannot be excluded on the basis of economic size alone (since this is highly correlated with the dependent variable). Thus, for the sake of consistency, the universe of partner countries is as defined above.

perceptions measure are available for only from 1996 onwards, the time frame for the analysis is thus chosen to begin in 1996 and end in 2008.

In sum, the dataset contains data for 37 countries party to the OECD Anti-bribery Convention, 189 possible trading partner countries, and 13 years – this gives rise to a total of 6,771 unique dyads and 90,909 unique dyad-year observations. The dataset is thus best characterized as panel data (rather than time-series cross-sectional), since the number of unique dyads is much larger than the number of years for which there are observations.

Model Selection and Estimation Procedure

The goal of the statistical analysis to be performed is to estimate the effects of anti-bribery legislation on levels of international business transactions between countries in a dyad. Hence, existing models of trade employed in the international economics literature provide a natural starting point for formulating the optimal estimating equation, and in this regard, the well-known gravity model is a particularly useful reference. This was first introduced in the literature by Tinbergen (1962), and essentially models trade as a function of economic size and distance according to a functional form that bears close resemblance to the Newtonian law of gravity. In its simplest specification, trade between a country pair (i, j) in time period t can be written as:

$$T_{i,j,t} = \alpha_0 Y_{i,t}^{\alpha_1} Y_{j,t}^{\alpha_2} D_{i,j}^{\alpha_3} \eta_{i,j,t} \,, \qquad (1)$$

where T is total trade, Y is gross domestic product (GDP), D is the distance between the country pair, and η is an error term with a log-normal distribution such that $E[\eta|Y, D] = 1$. One would also typically expect the model parameters to take on values $\alpha_1 > 0$, $\alpha_2 > 0$ and $\alpha_3 < 0$, such that trade increases with economic size and decreases with distance.

The analogy between trade and the physical force of gravity may seem elegant but somewhat arbitrary, and indeed, oddly enough, the theoretical foundations of the gravity model did not receive rigorous scrutiny until *after* it was introduced in the international trade literature.[17] Since then, however, formal theoretical treatments of the gravity model have been undertaken, and have convincingly showed that the general form of the equation can in fact be inferred from more elementary models of supply and demand.[18]

The basic gravity model has also been modified in various ways to include additional control variables that might account for unexplained variation in trade. For example, Mansfield and Bronson (1997) incorporate measures of international alliances into the model, while Li and Sacko (2002) investigate the effects of inter-state disputes on trade by similarly modifying the basic gravity equation. In general, dummy indicators for a host of other explanatory variables such as the existence of shared languages, common colonial relationships, or border contiguity can also be easily incorporated into the model by writing:

$$T_{i,j,t} = \alpha_0 Y_{i,t}^{\alpha_1} Y_{j,t}^{\alpha_2} D_{i,j}^{\alpha_3} e^{\bar{\alpha}_\gamma \cdot \bar{\gamma}} \eta_{i,j,t} \,, \qquad (2)$$

where in this case $\bar{\gamma}$ is a vector of the dummy variables of interest and $\bar{\gamma}_D$ is the corresponding vector of coefficients.

Given the relative difficulty of estimating equation (2) in its multiplicative form, however, the gravity model of trade is most commonly estimated in a log-linearized form, which is derived by taking the logarithms of both sides of the equation. This can then be written as:

$$\log T_{i,j,t} = \alpha_0 + \alpha_1 \log \mathrm{Y_{i,t}} + \alpha_2 \log \mathrm{Y_{j,t}} + \alpha_3 \log \mathrm{D_{i,j}} + \bar{\alpha}_\gamma \cdot \bar{\gamma} + \varepsilon_{i,j,t} \,, \qquad (3)$$

[17] Baier and Bergstrand (2007), p.75
[18] See, for example, Eaton and Kortum (2002) and Anderson and van Wincoop (2003).

where the error term $\varepsilon_{i,j,t}$ in this case is assumed to be normally distributed such that $E[\varepsilon|Y, D, \bar{\gamma}] = 0$. The log-linearized form of the gravity model has been employed in analysis of cross-sectional data by Frankel and Romer (1999), for instance, in their well-known study of the effects of trade on national income, and more recently by Irwin and Terviö (2002). Within a time-series context, the gravity model has been estimated by Bayoumi and Eichengreen (1995), Glick and Rose (2001), Rose (2004), and Baier and Bergstrand (2007), just to name a few examples.

Furthermore, the gravity model has been used to estimate not only levels of trade, but levels of investment and other financial flows as well. Rose and Spiegel (2004), for instance, construct and estimate a gravity model for international lending, while Gopinath and Echeverria (2004) study the relationship between trade and investment by incorporating a measure of FDI into the standard gravity model. Portes and Rey (2005) also utilize the gravity model to investigate the determinants of equity flows between countries, concluding that "a 'gravity' model explains transactions in financial assets at least as well as trade in goods."[19]

Hence, using the gravity model of trade as a basis, a plausible equation for estimating the effects of anti-bribery legislation on levels of international business transactions between a convention-partner country pair (c, p) in year t is as follows:

$$\begin{aligned}\log B_{c,p,t} = \alpha_0 + \alpha_1 I_{c,t} + \alpha_2 I_{c,t} * C_{p,t} + \alpha_3 C_{p,t} + \alpha_4 \log \mathrm{Y_{c,t}} + \alpha_5 \log \mathrm{Y_{p,t}} \\ + \alpha_6 \log \mathrm{N_{c,t}} + \alpha_7 \log \mathrm{N_{p,t}} + \alpha_8 \log \mathrm{D_{c,p}} + \varepsilon_{c,p,t}\end{aligned} \tag{4}$$

Here, the dependent variable $\log B$ is taken for the time being as the log of some measure of international business transactions (to be defined below) rather than total trade, and the populations (denoted by N) of both the convention and partner country have been included in the

[19]Portes and Rey (2005), p.290

model as well. I is a constructed measure of the strictness of anti-bribery legislation in the convention country (also to be defined below), and C is the corruptions perceptions score of the partner country. The interaction term $I * C$ thus allows testing of H_1 – namely, that stricter foreign bribery legislation reduces the level of international business transactions by a greater amount when corruption is more prevalent in the partner country.

In order to estimate equation (4), ordinary least-squares (OLS) regression offers the most straightforward approach. However, the standard OLS procedure is based on several assumptions that may not necessarily be valid for the analysis being considered, and hence corrections must first be made to the estimation procedure before OLS regression will be likely to yield unbiased estimates of both the regression coefficients and the standard errors.

First of all, a basic assumption of the OLS model is that there is no omitted variable bias, or, equivalently, that $E[\varepsilon|Y, D, I, C, \bar{\gamma}] = 0$ for all values of the independent variables. In practice, accounting for all possible omitted variables is difficult, and only the most obviously relevant controls such as GDP, population and distance are included in the model. For the time-series panel data being considered, however, if one assumes that the omitted variable bias stems from persistent differences across panels or across time, then these can easily be accounted for by controlling for fixed effects in both the dyad and year dimensions. This procedure is recommended by Mátyás (1997), Egger (2000), and Cheng and Wall (2005), for example, all of whom argue that estimating the gravity equation without fixed effects yields biased estimates.[20] Furthermore, the inclusion of dyad fixed effects effectively controls for all time-invariant

[20] Controlling for importer and exporter fixed-effects is also recommended by Anderson and van Wincoop (2003) as an alternative to including price factors in the gravity equation, which are deemed to be a necessary component of the model based on . With cross-sectional data, importer and exporter fixed effects must be estimated separately, but time-series panel data allows for the more thorough approach of including fixed effects for each dyad instead.

variables such as distance between countries, border contiguity, and other geographic indicators, and hence these controls are dropped from the model.

In addition, computation of the standard errors using the OLS procedure is also based on the assumption of a very specific relationship between the random error terms, $\varepsilon_{c,p,t}$, namely that these are uncorrelated with one another and have the same variance across all observations (homoscedasticity). Equivalently, this implies that the covariance matrix of the error terms is directly proportional to an identity matrix with dimension equal to the number of dyads. For time-series panel data, however, this assumption may be violated in several important ways, as described, for example, by Beck and Katz (1995).

First, there is no reason to expect that the error terms will be homoskedastic – for instance, transactions between the US and China may exhibit much greater fluctuations than transactions between Estonia and Ethiopia. This can be easily addressed by computing the regression results using Huber-White robust standard errors (also known as Eicker-White standard errors) clustered at the dyad level. This is in fact a more conservative correction than the use of panel-corrected standard errors, which is suggested by Beck and Katz, since the robust errors allow for non-constant variance across all units of observation as well as correlation between errors within dyads, while the panel-corrected errors assume homoskedasticity within dyads.

Second, the error terms may be serially correlated with one another, such that they exhibit dependence across time. For example, international business contracts may be negotiated and fulfilled over the span of several months, such that transactions in one year are not independent from transactions in the previous year.[21] In such situations, the error terms across years are also

[21] Keshk et al (2005), p.1162

unlikely to be independent. This problem is in fact taken into account by the use of robust standard errors clustered by dyad, since these allow for within-dyad correlation of the errors. However, the degree of serial correlation can also be reduced by incorporating a model of the error correlation into the estimating equation. As Beck and Katz note, the most common approach in this regard is to assume that the error terms are related according to a first-order autoregressive model, such that:

$$\varepsilon_{c,p,t} = \rho\varepsilon_{c,p,t-1} + \xi_t \,, \tag{5}$$

where the parameter ρ captures the relationship between the error terms in consecutive years, and ξ_t is Gaussian white noise.[22]

Based on this assumption, one method of correction is to then include the first lag of the dependent variable (DV) in the estimating equation, which may be interpreted as accounting for inertia in bilateral transactions. In fact, Eichengreen and Irwin (1996) have specifically examined the effect of including lagged trade in the gravity model, and have found that the lagged DV exhibits a large and statistically significant relationship with current trade, such that estimation of the gravity model without the lagged DV suffers from omitted-variable bias.[23] Hence, this method is also adopted to address the issue of serial correlation amongst the error terms.

[22] Beck and Katz (1995), p.636
[23] Eichengreen and Irwin (1996), p.37

With the above corrections implemented, the main estimating equation considered in the analysis is thus as follows:

$$\log B_{c,p,t} = \alpha_0 + \alpha_1 I_{c,t} + \alpha_2 I_{c,t} * C_{p,t} + \alpha_3 C_{p,t} + \alpha_4 \log \mathrm{B}_{\mathrm{c,p,t-1}} + \alpha_5 \log \mathrm{Y}_{\mathrm{c,t}} + \alpha_6 \log \mathrm{Y}_{\mathrm{p,t}} + \alpha_7 \log \mathrm{N}_{\mathrm{c,t}} + \alpha_8 \log \mathrm{N}_{\mathrm{p,t}} + \bar{\alpha}_{dyad} \cdot \overline{CP} + \bar{\alpha}_{year} \cdot \bar{T} + \varepsilon_{c,p,t} \quad (6)$$

Here, $\overline{CP}$ and $\bar{T}$ represent the dyad and year dummies respectively, with their corresponding vector of coefficients.

4. Discussion of Data

This section describes the data used to construct the variables included in the statistical model. The specification of the dependent variable is first discussed, following which the coding of main independent variable is explained in detail. Data sources for the remaining control variables are also specified, and various approaches for dealing with missing data and the log transform of zero values are considered.

Dependent Variable

Thus far, the dependent variable in this study has been deliberately and ambiguously characterized as the level of "international business transactions" between country pairs. To estimate the effects of anti-bribery legislation, however, it is necessary to consider precisely what kinds of transactions might be relevant to foreign bribery. With this in mind, at the broadest level of aggregation, the two most obvious ways in which the dependent variable can be specified are in terms of either trade or investment.

With regards to trade, a reasonable assumption to make is that only exports from a convention country to a partner country are relevant, since foreign bribes are typically paid to

gain a competitive advantage in overseas export markets rather than to find favor with particular sellers. That this is true is evident from the commentaries and debates that have accompanied the changes to foreign bribery-related legislation amongst the convention countries. Australia's parliament, for instance, offered its assessment that denying tax deductions for foreign bribes may cause trade to be "adversely affected when Australian *exporters* and other companies have to compete with countries that continue to allow a deduction for bribe payments."[24] As another illustrative example, Japan chose to implement the recommendations of the OECD's Anti-bribery Convention by legislating amendments to its Unfair Competition Prevention Law rather than to its Penal Code, based on the rationale that whereas criminalization of the domestic offence is meant to "maintain public trust in a fair and honest public service", criminalization of the foreign offence serves to ensure "fair competition in international business transactions."[25]

Hence, the value of exports from the convention country to the partner country in a dyad, rather than the value of total trade or imports, is the main dependent variable considered in the analysis. Export data at the dyad level is taken from the International Monetary Fund (IMF) Direction of Trade Statistics database, which is available as the free on board (f.o.b.) value of exports in millions of current US$.[26] Export data is also taken from the United Nations Commodity Trade (COMTRADE) database as a secondary source in order to test for robustness, and these measures are also provided as the f.o.b. value of exports in millions of current US$. In order to account for the effects of inflationary trends, the nominal export values are then converted to real values using the GDP deflator of the convention country.[27]

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[24] Commonwealth of Australia, "Taxation Laws Amendment Bill (No.8) 1999 Explanatory Memorandum," Section 4.82, http://www.austlii.edu.au/au/legis/cth/bill_em/tlab81999285/memo1.html. Emphasis added.
[25] OECD Country Reports (Japan), Phase 1 Report, p.1. See note 14.
[26] The f.o.b. value of exports does not include shipping or insurance costs, as opposed to the cost, insurance and freight (c.i.f.) value of the traded goods.
[27] See, for example, Baier and Bergstrand (2007), p.84.

With regards to investment, FDI from a convention country to a partner country may offer an alternative measure of "international business transactions" that are relevant to foreign bribery. FDI data for the thirty OECD member countries are available from the OECD statistics database, and are reported in million of current US$. However, FDI data is much more sparse than trade data, and is only sporadically available at the dyad level. This can be seen from Figure 1, which compares the completeness of export and FDI data for the 6,993 dyads in the analysis between 1990 and 2008. Primarily for this reason, the measure of exports rather than FDI is taken as the main dependent variable.

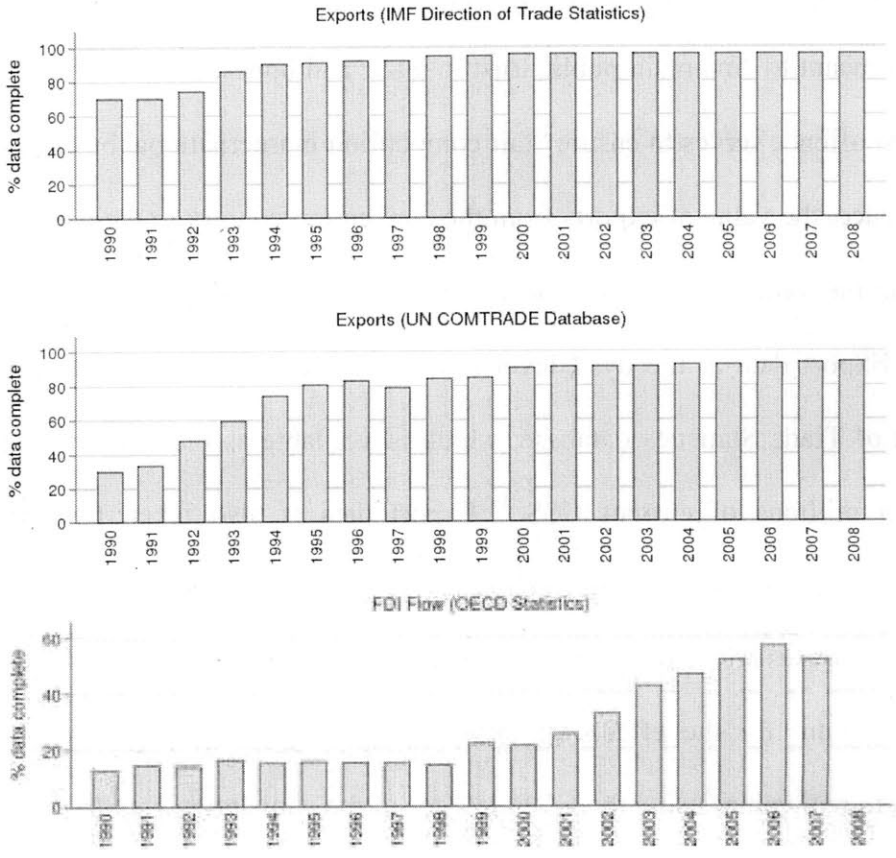

Figure 1: Completeness of Export and FDI Data at the Dyad Level

Coding of the Primary Independent Variable

In principle, the main independent variable of interest (hereafter referred to as the primary independent variable, PIV) should be constructed as an index that measures the overall strictness of a country's legislative treatment of foreign bribery. Hypothetically, one might then expect that a higher score on such an index would imply that firms face higher costs for the payment of bribes to foreign officials. In practice, however, countries seeking to clamp down on foreign bribery may do so in different ways, and the OECD's anti-bribery initiatives have in fact encouraged action on a variety of fronts. Hence, narrowly focusing on any one area of legislation would most likely provide an insufficiently nuanced picture of the regulatory environment that firms are facing, and coding of the PIV should thus account for changes across as many legislative areas as are relevant to the regulation of foreign bribery.

How such measures can be constructed is, of course, a somewhat open question. Nonetheless, a natural place to begin is with an analysis of the 1996 Recommendation and the Anti-bribery Convention, since, as mentioned previously, it is these documents that serve as the basis for evaluating the compliance of participating countries. Hence, the procedure adopted for coding of the PIV is as follows: first, the obligations specified by the 1996 Recommendation and the Anti-bribery Convention are identified; second, where possible, these obligations are translated into standardized and measurable outcomes that can be used to compare the level of compliance amongst convention countries; third, an unambiguous coding scheme for quantifying scores on these outcomes is formulated; fourth, the country reports prepared by the OECD Working Group on Bribery are analyzed to score the convention countries using the derived coding scheme.

Based on this procedure, six possible measures of the PIV have been developed, which are as follows:

- *Criminalization* measures whether or not foreign bribery has been criminalized by law.
- *Liability of legal persons* measures whether legal persons – that is, entities that are allowed under the law to act as persons – can be held responsible for the offence of foreign bribery. This is deemed to be an important aspect of anti-bribery legislation because it allows for companies to be prosecuted for foreign bribery offences even when specific individuals responsible for the offence cannot be identified or convicted.
- *Maximum sanction* measures the maximum number of years that an individual can be sentenced to for a foreign bribery offence. Since different degrees of foreign bribery offences have been criminalized in most of the convention countries, this measure is taken with respect to the most serious type of foreign bribery.
- *Nationality jurisdiction* measures whether a country's citizens can be prosecuted for foreign bribery offences committed abroad, and hence captures the scope of authority that governments have in enforcing anti-bribery legislation.
- *Statute of limitations* measures the maximum number of years after an occurrence of foreign bribery that the offence may be prosecuted.
- *Tax deductibility* measures whether or not tax deductions for foreign bribes are explicitly denied by existing legislation.

One noticeable absence from this list of variables is a measure of the number of investigations undertaken or convictions obtained for cases of foreign bribery. While this would certainly be a

useful measure of the strictness of anti-bribery legislation, such information is unfortunately kept confidential in most circumstances, and hence is unavailable.[28]

The exact coding schemes for each of the PIV measures, as well as the texts on which they are based, are then summarized in Table 1. The distributions of these variables over time and across the convention countries are also shown in Figure 2. As can be seen, the number of convention countries where foreign bribery has been criminalized increased rapidly after 1998, and by 2008 only one country (Israel) had still not implemented such legislation. The majority of convention countries were also quick to enact new laws establishing nationality jurisdiction for foreign bribery offences. However, the number of convention countries where tax deductions for foreign bribes are explicitly denied has increased much more slowly, and in 2008, seven of the convention countries still did not have such laws in place. The liability of legal persons for foreign bribery offences also had not been established in close to a third of the convention countries as of 2008.

With regards to both the maximum penalty and the statute of limitations for foreign bribery offences, there is a large variance in scores across the group of convention countries. The maximum term of imprisonment ranges from a low of two years in Austria to a high of life imprisonment in South Africa (which is coded as fifteen years imprisonment, the second-highest maximum term). The statute of limitations for foreign bribery offences ranges from a low of three years in France and Greece, to an unlimited period in Australia, Belgium, Canada, Ireland, New Zealand, and the United Kingdom (coded as twenty years, the second-longest statute of limitations).

[28] The OECD country reports occasionally mention specific investigations or convictions of foreign bribery, but these do not provide a comprehensive picture of overall numbers.

Table 1: Summary of Primary Independent Variable Codings

PIV Name	Coding Scheme	Basis
Criminalization	1: legislation expressly establishing criminality of foreign bribery has entered into force; 0: otherwise	Article 1, Anti-Bribery Convention
Liability of Legal Persons	1: legal persons can be held liable for foreign bribery offences under existing law 0: otherwise	Article 2, Anti-Bribery Convention
Maximum Sanction	maximum term of imprisonment for offences of foreign bribery	Article 3, Anti-Bribery Convention
Nationality Jurisdiction	1: nationals can be prosecuted for foreign bribery offences committed abroad under existing law; 0: otherwise	Article 4, Anti-Bribery Convention
Statute of Limitations	limitation period in years for foreign bribery offences	Article 6, Anti-Bribery Convention
Tax Deductibility	1: nationals can be prosecuted for foreign bribery offences committed abroad under existing law; 0: otherwise	1996 Recommendation

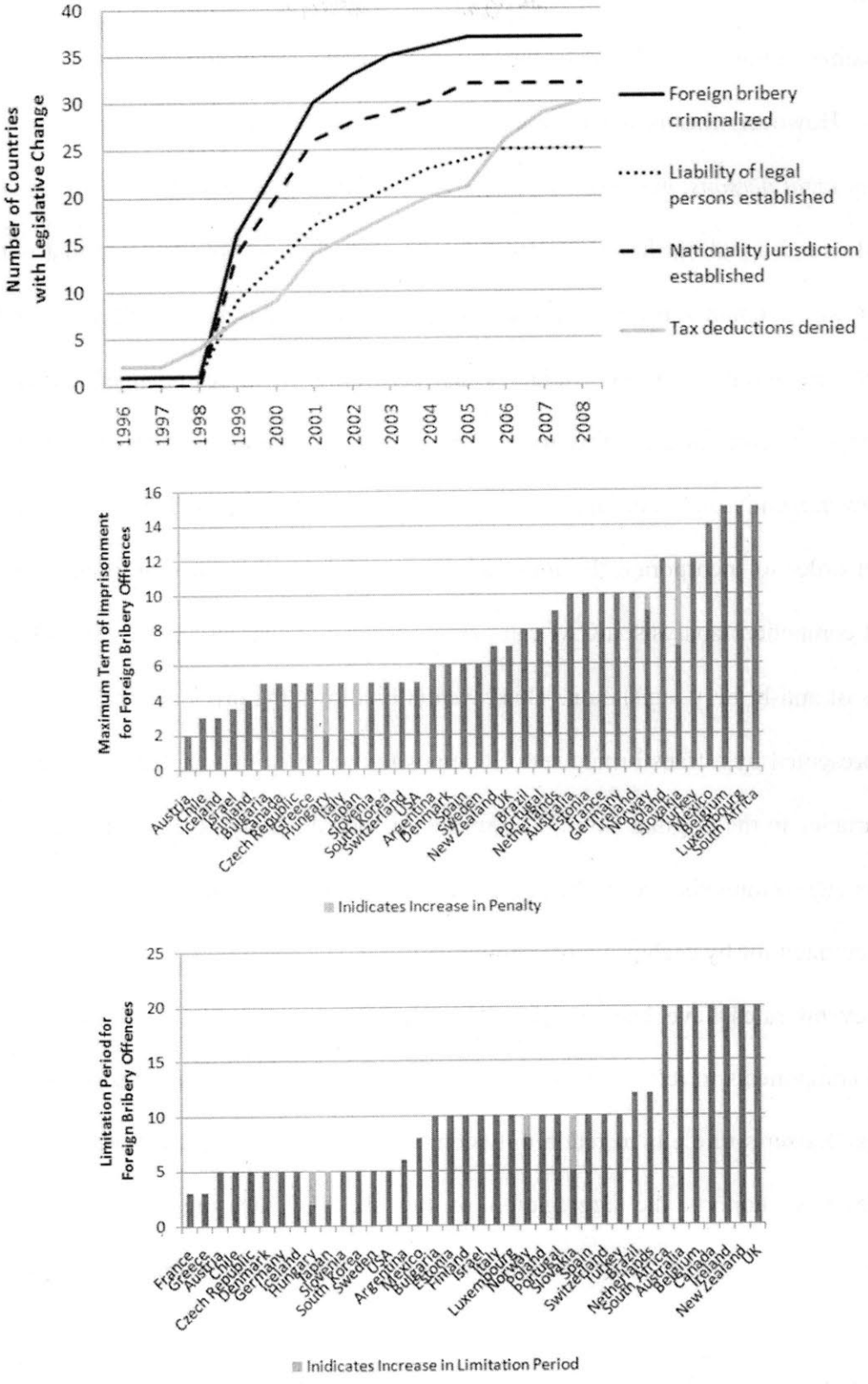

Figure 2: Summary of Primary Independent Variable Distributions

How then can these variables be used to measure the effects of anti-bribery legislation? One possible option is to estimate the statistical model separately for each of the six PIV measures. However, this is not only cumbersome, but in addition, four of these measures – *liability of legal persons*, *maximum sanction*, *nationality jurisdiction*, and *statute of limitations* – are strictly conditional on the criminalization of foreign bribery, in the sense that none of these measures can have non-zero scores if the *criminalization* score is zero. Hence, it is perhaps more reasonable to think of these variables as providing a more nuanced measure of the *criminalization* score, and for this reason, the statistical estimation performed focuses on the *criminalization* and *tax deductibility* variables rather than all six of the PIV measures.

In order to incorporate the information provided by the remaining variables, however, principal component analysis (PCA) can also be used to construct a composite measure of the strictness of anti-bribery legislation. This essentially allows the original set of six PIV measures to be represented by a transformed set of composite measures that capture a decreasing amount of the variance in the original data.[29] The results of such an analysis are summarized in Table 2, where the eigenvalues shown can be interpreted as the proportion of variance in the original data that is accounted for by each principal component.

Several rules have been proposed in the PCA literature for selecting the number of principal components to retain. In particular, one of the most frequently-used selection criterion, known as "Kaiser's rule", is to retain only components that have eigenvalues larger than one.[30] This rule thus supports the aggregation of the six PIV measures into a single principal component, which captures 67.6% of the original variance. The component loading for this

[29] This is equivalent to computing the discrete Karhunen-Loève transform of the original variables, which is accomplished by computing the eigenvalue decomposition of the data covariance matrix, using the associated eigenvectors to transform the data, and then retaining the transformed variables with the largest eigenvalues.
[30] Kaiser (1960). See also Kim and Mueller (1978), p.43, and Jolliffe (2002), pp.114-115.

aggregate measure, which represents the relative contribution of the original variables to the composite score, is shown in Table 3. As can be seen, the original variables contribute to the composite measure with approximately equal weight, which further suggests that the first principal component is a suitable aggregation of the six individual PIV measures. The composite score is thus treated as a third measure of the overall strictness of anti-bribery legislation.

Table 2: Principal Component Analysis Results

Component Number	Eigenvalue	Percent Variance Explained (%)	
		Absolute	Cumulative
1	4.06	67.6	67.6
2	0.68	11.3	78.9
3	0.54	9.0	88.0
4	0.34	5.6	93.6
5	0.26	4.3	97.9
6	0.13	2.0	100

Table 3: Component Loading of First Principal Component

Original PIV Measure	*criminalization*	*liability of legal persons*	*maximum sanction*	*nationality jurisdiction*	*statute of limitations*	*tax deductibility*
Component Loading	.460	.417	.417	.427	.359	.360

Corruption Perceptions Measure

The corruptions perceptions measure employed in this analysis is the "Control of Corruption" score ("CC score" hereafter) provided by the World Bank in its Worldwide Governance Indicators (WGI) database. The variable has been recoded such that a higher score indicates more perceived corruption, and normalized such that scores range from zero to one. The WGI CC score is the most comprehensive corruptions perceptions measure currently available in terms of the number of component sources utilized, which in 2008 encompassed 35

surveys from commercial business information providers (43% of data points), firms and households (24%), non-governmental organizations (14%), and public sector organizations (19%).[31]

Another corruptions perceptions measure that is widely used in the academic literature is the Corruptions Perceptions Index (CPI) constructed and maintained by Transparency International, a non-governmental organization that was founded in 1993 and that now operates internationally with local representation in more than 90 countries. TI's CPI data are available from 1995 onwards, and could plausibly be used as an alternative measure of corruptions perceptions. One of the major disadvantages of the CPI, however, is that it does not allow for reliable comparison of scores over time. In fact, Transparency International explicitly highlights the potential for such a problem to exist, noting the following:

> Given its methodology, the CPI is not a tool that is suitable for monitoring progress or lack of progress over time. The only reliable way to compare a country's score over time is to go back to individual survey sources, each of which can reflect a change in assessment.[32]

The methodology used to construct the WGI CC score, on the other hand, does in fact take such issues into consideration. For instance, Kaufmann et al (2009) do precisely as Transparency International's warning suggests, and examine how well changes in the aggregate WGI scores agree with changes in their respective underlying indicators. For the CC score in particular, they show that only 22% of underlying sources disagree with changes in the aggregate score between 1998 and 2008, and that when only changes significant at the 90% level are considered, the disagreement ratio is even lower at 10%. In addition, they point out that the

[31] Kaufmann et al (2009), p.30

[32]Transparency International, "Frequently Asked Questions," http://www.transparency.org/policy_research/surveys_indices/cpi/2009/faqs.

aggregate indices are reported in standardized units, whereby the scores within each period are normally distributed with mean zero and unit standard deviation, such that the aggregate scores "convey no information about trends in global averages of governance, but they are of course informative about changes in individual countries' relative positions over time." Hence, based on this analysis, Kaufmann et al argue that the WGI scores – including the CC measure – can indeed be used to chart how various aspects of governmental quality in a given country improve or deteriorate over time.[33]

A second compelling reason for relying on the WGI CC score rather than Transparency International's CPI simply concerns the availability of data, which is summarized in Figure 3. As can be seen, the WGI CC data are consistently available for almost all selected partner countries from 1998 onwards, except for hiatuses in 1999 and 2001 when no data were provided. On the other hand, the completeness of the CPI data is greater than 90% only after 2007, and is greater than 50% only after 2002. Hence, employing the WGI CC score as the measure of corruptions perceptions allows for the most complete analysis.

[33] Kaufmann et al (2009), pp.17, 19-22

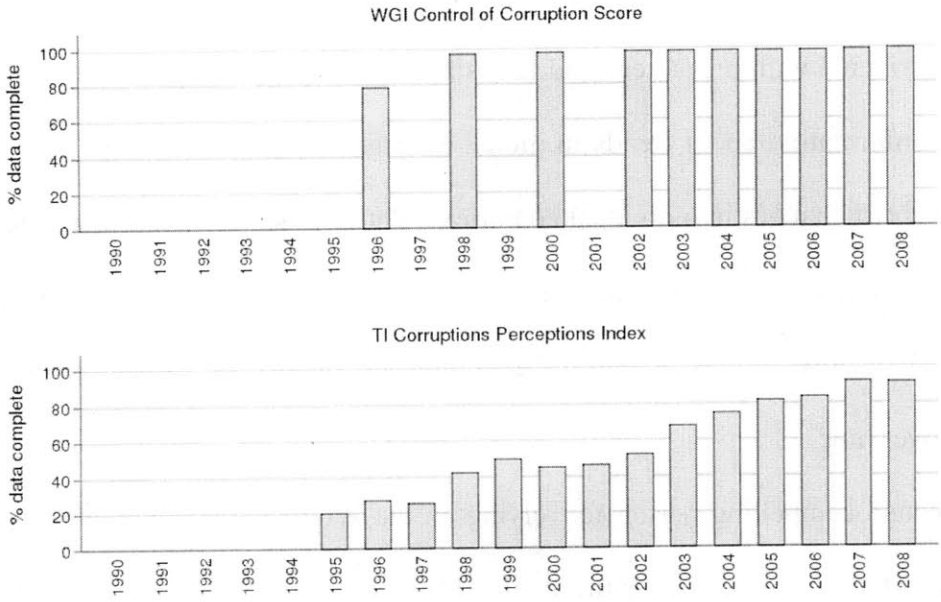

Figure 3: Completeness of Corruption Perceptions Data

Control Variables

The remaining independent variables included in the statistical model serve to control for other factors that are known to influence levels of trade and investment. In particular, since countries where corruption is perceived to be high are also more likely to be poor countries, controlling for GDP and population enables the effects of per capita wealth and corruption to be estimated separately. For the convention countries, one might also expect richer nations to be more likely to enact stricter anti-bribery legislation, and hence controlling for the GDP and population of the convention country is important as well.

GDP data are taken from the United Nations National Accounts Main Aggregates Database, and are measured in millions of constant 1990 US$.[34] Population data are also taken from the UN National Accounts Main Aggregates Database, and are measured in millions of persons.

[34] GDP data for one country (Macedonia) is not available from the UN database, and hence is taken from the World Bank World Development Indicators (WDI) database.

Treatment of Zero Values and Missing Data

Before proceeding with the analysis, two final problems related to the data must be addressed. The first is one that becomes immediately obvious from the log-linearized model of exports specified by equation (6), which is that the log transform of zero values of the dependent variable cannot be computed. There are thus several options for dealing with this issue. First, one may simply drop all observations with zero exports, which eliminates the problem of taking the log of zero values altogether. A second option for dealing with zero export values is to add a constant value to all observations, and then to take the log of the corrected values. A third option is to impute zero values using an imputation model – in essence, to treat these observations as though they are missing data. This last strategy is proposed by Irwin and Terviö (2002), for example, who suggest that data for trade between small and distant countries are likely to be unreliable.[35]

None of the above options are perfect: dropping all observations with zero values is equivalent to imposing an undesirable selection bias on the dependent variable; adding a constant is straightforward to implement, but raises the question of what the value of the constant should be; and imputing zero values is questionable because data are being destroyed and then subsequently recreated. The added constant method, however, is arguably the least intrusive, since it only transforms the data linearly by a small amount. The approach adopted in this thesis is thus to compute the log transform after adding a constant value of 1, and then to test the robustness of the results by recomputing the regression estimates using different values of the added constant.

[35] Irwin and Terviö (2002), p.5

The second problem that must be addressed is the treatment of missing data. Table 4 summarizes the completeness of data for all variables in equation (6) between 1996 and 2008, and as can be seen, only data for exports and the WGI CC score are incomplete.

Table 4: Summary of Data Completeness

Variable	% Data Missing, 1996-2008
Exports	3.3
PIV Scores	0.0
WGI CC Score	26.2
GDP	0.0
Population	0.0

For the WGI CC variable, the majority of missing observations stem from the complete unavailability of data in 1999 and 2001. Given that the WGIC CC score rarely changes rapidly over the period of one or two years, however, a reasonable approach to imputing missing data is to replace missing values in 1999 and 2001 with the average of the scores in the years before and after. This reduces the percentage of missing observations substantially from 26.2% to 5.3%.

For exports, such an imputation strategy is not feasible, since export data tend to be unavailable for all periods before a certain point in time. Hence, there are in general two possible ways of dealing with missing export values. The first is simple list-wise deletion, which omits all observations with missing values from the regression analysis. While this has the advantage of being straightforward to implement, it might also lead to biases in the computed estimates if the data are not "missing at random" (MAR) and "observed at random" (OAR). The first condition implies that the likelihood of data being missing on a variable must not depend on the value of

the variable itself, while the second condition implies that the likelihood of missingness must not depend on the values of other variables.[36]

In the context of the proposed analysis, these conditions are unlikely to be satisfied with regards to missing export data for several important reasons. First, export data are more likely to be missing for country pairs that have little or no trade between them, which violates the MAR condition. List-wise deletion in this case thus effectively imposes a selection bias on the dependent variable. Second, since the completeness of trade data has increased over the years, observations with missing export values are also more likely to be observations where the PIV is zero, which violates the OAR condition. Consequently, list-wise deletion is likely to bias the estimates of the PIV effect on exports downwards. Third, one might expect that countries that are more corrupt are also more likely to have missing export data, which again violates the OAR condition. Hence, list-wise deletion is also likely to underestimate the effect of corruption on exports.

The second option for dealing with missing export data is to impute missing values using a suitable imputation model, which should ideally contain only variables that are exogenous to the main estimating equation. Drawing on the geographical models of trade developed by Frankel and Romer (1999) and Irwin and Terviö (2002), which were constructed specifically to estimate the component of trade exogenous to national income, a possible model for imputing missing export data is as follows:

$$\begin{aligned} \ln E_{c,p,t} = {} & \alpha_0 + \alpha_1 \ln D_{c,p} + \alpha_2 \ln A_c + \alpha_3 \ln A_p + \alpha_4 (K_c + K_p) + \alpha_5 R_{c,p} \\ & + \alpha_6 L_{c,p} + \alpha_7 H_{c,p} + \alpha_8 X_{c,p} + \bar{\alpha}_{year} \cdot \bar{T} + \varepsilon_{c,p} \end{aligned} \tag{7}$$

[36] Rubin (1976)

Here, K, R, L, and H are dummy variables indicating whether or not the countries in the dyad are landlocked, share a common border, share a common language spoken by at least 9% of the population in each country, and had a colonial relationship after 1945, respectively. Data for these variables, as well as for the distance and area variables, are taken from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) distances database.[37] X is a measure of the hostility level between a country pair, which is taken from the Correlates of War Militarized Interstate Disputes dataset as the sum of the hostility score of all conflicts between 1945 and 1998. This model yields an R-squared value of 0.40, which is similar to the value of 0.36 reported by Frankel and Romer.[38]

Which of the two options for dealing with missing data is best? Clearly, list-wise deletion will introduce biases into the estimation since the data do not satisfy the MAR and OAR conditions. On the other hand, the imputation of missing values may also introduce biases – for example, if more corrupt countries receive less exports, then imputation using equation (7) will over-predict export values for corrupt countries, as no measure of corruption is included in the imputation model. This will tend to exert a downward bias on the estimated effect of corruption perceptions on exports. Since imputing missing values accounts for at least some of the non-randomness of the missingness likelihood, however, the approach adopted in this thesis is to perform the main statistical analysis using the imputed data, and then to test the robustness of the results obtained by recomputing the regression estimates using the original non-imputed data.

Summary of Data

Summary statistics for all variables included in equation (6) are shown in Table 5, while the pairwise correlation coefficients are shown in Table 6. These are computed after

[37] Data for Liechtenstein, Monaco and Serbia and Montenegro are not provided in the CEPII database, and are manually computed.

[38] Frankel and Romer (1999), p.384

implementing the added constant method for taking the log transform of exports and after imputing missing WGI CC and exports data, as discussed above.

Table 5: Variable Summary Statistics

Variable	Min.	Mean	Median	Max.
logged exports	-2.11	2.25	2.79	12.46
PIV: *criminalization*	0.00	0.66	1.00	1.00
PIV: *tax deductibility*	0.00	0.40	0.00	1.00
PIV: *composite score*	0.00	0.34	0.41	1.00
WGI CC Score	0.00	0.56	0.61	1.00
logged GDP (C)	8.32	12.23	12.27	16.06
logged GDP (P)	2.21	9.02	9.18	16.06
logged population (C)	-1.31	2.78	2.40	5.74
logged population (P)	-4.68	1.58	1.84	7.18

(C: convention country; P: partner country)

Table 6: Pairwise Correlation Table

		1	2	3	4	5	6	7	8
logged exports	**1**								
PIV: *criminalization*	**2**	.100							
PIV: *tax deductibility*	**3**	.098	.628						
PIV: *composite score*	**4**	.102	.927	.725					
WGI CC score	**5**	-.413	.005	.005	.005				
logged GDP (C)	**6**	.409	.180	.188	.188	.001			
logged GDP (P)	**7**	.697	.063	.005	.062	-.394	.005		
logged population (C)	**8**	.309	.080	-.019	.051	-.002	.825	-.001	
logged population (P)	**9**	.467	.029	.021	.028	.166	.001	.788	-.003

(C: convention country; P: partner country)

5. Results

This section presents the results of the empirical analysis. Simple difference-in-difference (DD) and difference-in-difference-in-difference (DDD) estimates of the effect of foreign bribery legislation on levels of exports are first computed, and the main results from the regression analysis of the model of exports constructed in Section 3 are then discussed. The robustness of these findings are examined, and alternative explanations are also considered.

Difference-in-difference Estimation

As a preliminary examination of the data, Figure 4 shows the time series trend lines of mean exports from 1996 to 2008, sorting the dyads by the quintile of the partner country's WGI CC score. There is a noticeable difference in the rate of growth of mean exports: exports to countries that had lower corruption perceptions scores grew much faster than exports to countries that were perceived to be more corrupt, which is consistent with what one might expect if the hypothesis H_1 is valid, since the strictness of foreign bribery legislation amongst the convention countries as a whole increased throughout this time period.

Of course, this differential growth rate of mean exports could well be due to factors other than the strictness of foreign bribery legislation. Hence, in order to obtain more tightly-controlled DD and DDD estimates of the effect of foreign bribery legislation on levels of exports, suitable treatment and control groups must first be identified, and the pre-treatment and post-treatment periods must also be clearly specified. In this regard, one possible approach is to consider each year in the analysis separately, comparing those dyads where a change in foreign bribery legislation in the convention country was observed with those dyads where no such change occurred. Differences in the levels of exports to countries with low and high corruption perceptions scores might then be compared. However, there are two problems with this approach.

First, the majority of convention countries enacted changes to their respective foreign bribery laws within several years of one another, which makes it difficult to clearly identify the pre- and post-treatment periods. Second, the treatment and control groups might differ significantly in terms of other factors such as GDP that are known to predict or affect levels of exports.

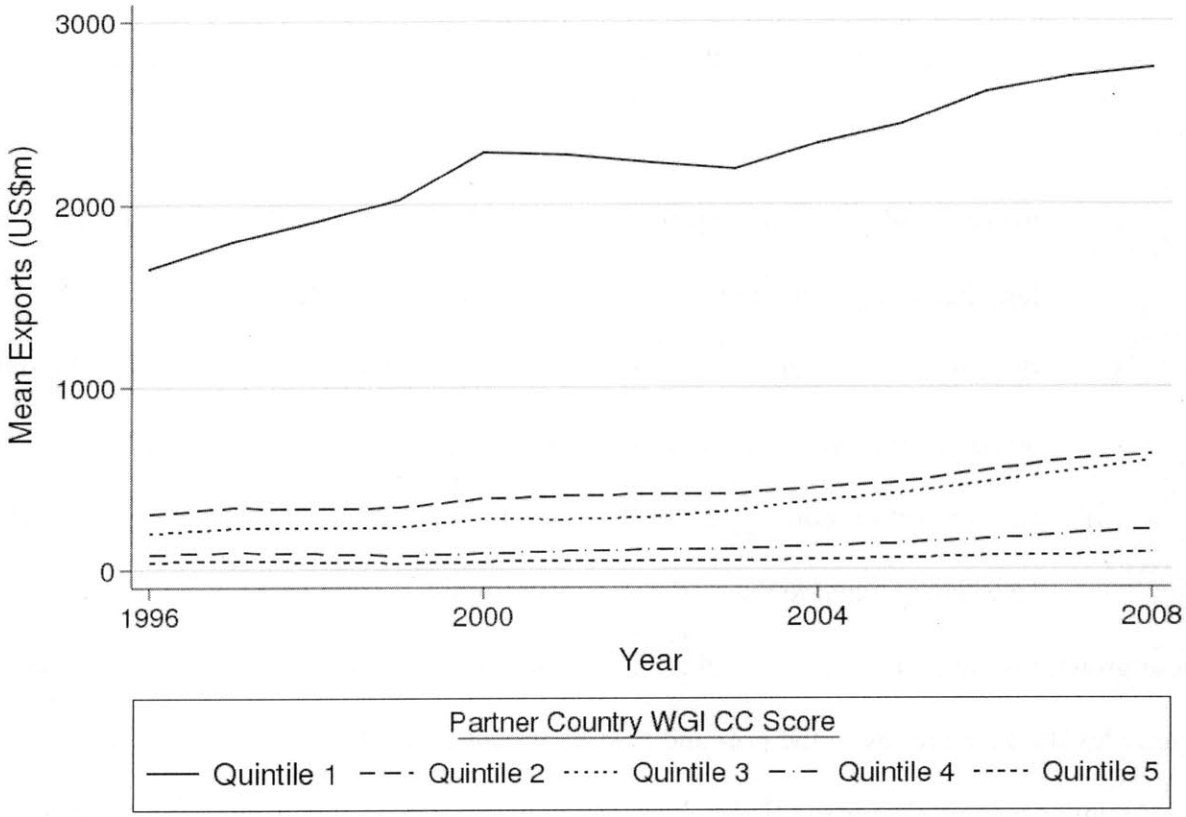

Figure 4: Time Series Trend Lines of Mean Exports by Partner Country WGI CC Score

Hence, a more restrictive analysis is performed here, comparing only levels of exports from the United States with levels of exports from the next four largest economies – Japan, Germany, France and the United Kingdom (denoted for brevity as the G4) – which thus helps to control for economic size. The countries in the G4 all enacted legislation criminalizing foreign bribery between 1999 and 2002 (that is, their *criminalization* score changed from 0 to 1 in this period), while the FCPA has been in existence in the United States since 1977 (its

criminalization score remained at 1). Thus, the pre- and post-treatment periods can be considered as the years before 1999 and after 2002 respectively.

Furthermore, since the analysis seeks to determine how the effects of foreign bribery legislation vary with levels of corruption, there are in fact four distinct groups that can be identified. First, the treatment group consists of all dyads where the convention country is from the G4 and the partner country has a WGI CC score above the median value ("more corrupt"). The three control groups then consist of all dyads where:

(1) the convention country is from the G4 and the partner country has a WGI CC score less than or equal to the median ("less corrupt");

(2) the convention country is the USA and the partner country has a WGI CC score above the median ("more corrupt"); and

(3) the convention country is the USA and the partner country has a WGI CC score less than or equal to the median ("less corrupt").

These groupings are summarized in Table 7, which also shows the five-year average of logged exports for the four groups in the pre- and post-treatment periods. As can be seen, these values are of similar magnitude for the two groups, although the US records slightly larger values of average logged exports in all cases.

Within the context of this set up, three different estimators can then be obtained, which are presented in Table 8. First, if we compare the change in logged exports between the pre- and post-treatment periods for the treatment group to the change in exports for the first control group (from the G4 to less corrupt countries), we obtain the estimator DD1, which suggests that the enactment of legislation criminalizing foreign bribery causes a decrease of 0.360 in average logged exports to more corrupt countries. This estimator is valid if we assume that any biases on

levels of exports resulting from changes in factors other than the treatment are equal for the two groups being compared.

Table 7: Setup of DD and DDD Estimation

Exports From:	Exports To:	Five-year Average of Logged Exports		Difference
		1994-1998 (pre-treatment)	2003-2007 (post-treatment)	
USA	Less corrupt countries (control group)	5.783	6.142	.360 $(D1)$
	More corrupt countries (control group)	4.209	4.553	.344 $(D2)$
Japan, Germany, France, UK	Less corrupt countries (control group)	5.240	5.711	.471 $(D3)$
	More corrupt countries (treatment group)	3.722	3.833	.112 $(D4)$

Note: "Less corrupt countries" are those with a WGI CC score below or equal to the median value, while "more corrupt countries" are those with a WGI CC score above the median.

Table 8: Summary of DD and DDD Estimators

Estimator	Formula	Value
Difference-in-difference Estimator 1: DD1	$(D4 - D3)$	-.360
Difference-in-difference Estimator 2: DD2	$(D4 - D2)$	-.233
Difference-in-difference-difference Estimator: DDD	$(D4 - D3) - (D2 - D1)$	-.344

Second, if we compare changes in logged exports for the treatment group with changes in logged exports for the second control group (from the USA to more corrupt countries), we obtain the estimator DD2, which implies that *criminalization* causes a decrease of 0.233 in average logged exports to more corrupt countries. Again, this estimator is valid only if we assume that any change in exogenous factors affects levels of exports for the two groups in the same way.

Neither of the assumptions that are necessary for DD1 and DD2 to be valid may hold, of course – exports from the G4 to less and more corrupt countries may be affected by different external shocks, for example, while exports from the USA and from the G4 to the same group of countries might also vary differently for reasons other than *criminalization*. However, a third estimator that requires less stringent assumptions for validity can be obtained by taking the difference estimation one step further – that is, by computing the difference in the differences of the change in exports for the four groups. This yields the DDD estimator, which is computed according to the symbolic formula shown in Table 8, and which suggests that the criminalization of foreign bribery causes a decrease of 0.360 in average logged exports to more corrupt countries. This estimator is valid as long as any change in exogenous factors between the pre- and post-treatment periods affects exports to less and more corrupt countries in the *same relative amount* for the USA and the G4, which is certainly plausible.

Furthermore, as a test of the reliability of this estimator, we can also perform the above analysis by looking at comparisons only *within* the treatment group, in which case we would expect to find no effect. For example, when we compare changes in exports from Germany and the UK to changes in exports from France and Japan, again differentiating between exports to less and more corrupt countries, we obtain a DDD estimate of -0.076, which is much smaller in magnitude than the estimate shown in Table 8. Hence, this suggests that the DDD estimator is indeed reliable.

In sum, then, the DD and DDD estimates are all found to be negative and of approximately the same magnitude. Even if the assumptions for validity of the DD estimates are not likely to hold, the DDD estimate offers a more reliable measure of the effect of *criminalization*. Hence, these results provide support for the hypothesis H_1 and for rejection of

the null hypotheses H_0 and H_0', since they suggest that the criminalization of foreign bribery reduces levels of exports to more corrupt countries by a larger amount, relative to exports to less corrupt countries.

Regression Analysis Results

The DD and DDD results nonetheless serve only as preliminary estimates of the effect of foreign bribery legislation, since only a small subset of the cases are considered and the treatment and control groups are not perfectly matched in terms of variables such as GDP. Estimation of the model of exports specified by equation (6) using OLS estimators thus provides for a more rigorous empirical approach, and the results of this regression analysis are summarized in Table 9, where the dependent variable is the natural log of exports from the convention country to the partner country in a convention-partner country dyad.

First of all, column [1] shows the results for the model estimated without any PIV measure included, which serves as a baseline for comparison. Most of the estimated regression coefficients in this specification have the expected sign: higher perceptions of corruption, lower GDP, and a larger population in the partner country are significantly associated with a lower amount of exports received. The coefficients on the logs of convention country GDP and population, however, are negative and positive respectively, which may seem somewhat surprising as this suggests that poorer convention countries export more.

Table 9: Regression Results (Dependent Variable: Logged Exports)

Variable	Model with PIV as:						
	none	*criminalization*		*tax deductibility*		*composite anti-bribery score*	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
PIV		-.016** (.007)	.020* (.012)	-.018*** (.006)	.006 (.013)	-.044*** (.012)	.014 (.022)
interaction between PIV and WGI CC score			-.064*** (.021)		-.043** (.022)		-.105*** (.038)
WGI CC score	-.336*** (.044)	-.335*** (.044)	-.294*** (.046)	-.336*** (.043)	-.318*** (.046)	-.336*** (.043)	-.299*** (.046)
first lag of logged exports	.522*** (.009)	.523*** (.009)	.522*** (.009)	.522*** (.009)	.522*** (.009)	.522*** (.009)	.522*** (.009)
logged GDP (convention country)	-.203*** (.036)	-.200*** (.036)	-.200*** (.036)	-.208*** (.036)	-.209*** (.036)	-.193*** (.036)	-.193*** (.036)
logged GDP (partner country)	.392*** (.024)	.393*** (.024)	.398*** (.024)	.393*** (.024)	.396*** (.024)	.393*** (.024)	.399*** (.024)
logged population (convention country)	.083 (.102)	.079 (.102)	.079 (.102)	.034 (.102)	.034 (.102)	.087 (.102)	.087 (.102)
logged population (partner country)	-.308*** (.052)	-.308*** (.052)	-.285*** (.052)	-.308*** (.051)	.298*** (.052)	-.308*** (.051)	-.287*** (.052)
constant	.675 (.562)	.848 (.579)	.729 (.437)	1.079** (.580)	1.020* (.582)	.539 (.539)	.433 (.568)
Observations	86316	86316	86136	86316	86316	86316	86136
R-squared	.977	.977	.977	.977	.977	.977	.977

Note: Robust Huber-White standard errors clustered by dyad shown in parentheses. Regression coefficients for dyad and year dummy variables not shown. Legend: *** $p < 0.01$,** $p < 0.05$, * $p < 0.1$.

This apparently counter-intuitive result can be explained by first noting that with both GDP and population included as controls in the model, an increase in GDP keeping population constant or a decrease in population holding GDP fixed is equivalent to an increase in per capita GDP. Furthermore, amongst the convention countries, which are selected from the richest tier of countries in the world, those with the highest GDP per capita tend to be countries such as Norway and Switzerland that have relatively smaller total GDP. Conversely, the five convention countries with the largest total GDP (the US, Japan, Germany, France, and the UK) rank 8th, 9th, 13th, 15th, and 17th out of the 37 convention countries in terms of GDP per capita. Hence, it is in fact to be expected that convention countries with lower GDP per capita will tend to export more, since these also tend to be the countries with the largest overall economic size. The signs of the coefficients are thus not unreasonable.

Columns [2] and [3] then show the results for the estimation of equation (6) with the *criminalization* score as the PIV. In column [2], the estimation is performed without inclusion of the interaction variable between *criminalization* and the WGI CC score, and thus the coefficient on *criminalization* in this specification of the model can be interpreted as measuring the overall relationship between logged exports and the PIV. This coefficient is negative and statistically significant at the 95% level, and implies that the criminalization of foreign bribery in the convention country of a dyad is associated with a 0.016 decrease in logged exports for the dyad, or, equivalently, a 1.6% decrease in non-logged exports.[39] This result thus provides support for rejection of the null hypothesis H_0', since the implied overall effect of *criminalization* on exports is non-zero. The magnitude of the coefficient is small, however, which suggests that legislation criminalizing foreign bribery only has a small overall effect on exports.

[39] A decrease in the natural logarithm by an amount X is equivalent to a decrease in the non-logged value of $(1 - e^X)\%$.

Column [3] of Table 9 then shows the results for the model with the interaction variable included. In this specification, the coefficient on *criminalization* should be interpreted as measuring the relationship between logged exports and the PIV *for dyads where the partner country has a score of zero on the WGI CC variable* – that is, dyads where the country receiving the exports is perceived to be the least corrupt. As can be seen, this coefficient is now positive, although its magnitude is small and it is statistically significant only at the 90% level, which suggests that the criminalization of foreign bribery increases exports to the least corrupt countries only slightly, if at all.

This result is in fact in accordance with what one might expect if the hypothesis H_1 is valid. If legislation criminalizing foreign bribery makes exports to more corrupt countries relatively more expensive (either monetarily or in terms of the risk of getting caught), then exports to less corrupt countries should *increase* as they become relatively cheaper, and the coefficient on the PIV should be positive. Since the criminalization of foreign bribery should only have an indirect effect on exports to countries with little corruption, however, the coefficient on the PIV should also be small in magnitude. This is in fact what is observed.

Furthermore, and more importantly, the results in column [3] also show that the estimated regression coefficient for the interaction variable between logged exports and *criminalization* is negative and statistically significant at the 99% level. In this case, the coefficient may be interpreted in one of two ways: as the additional effect of criminalizing foreign bribery on logged exports *when the partner country has the highest possible corruption perceptions score*, or as the additional effect of corruption on logged exports *when foreign bribery is criminalized in the convention country*. In the first interpretation, the magnitudes of the coefficients imply that the enactment of legislation criminalizing foreign bribery is associated with a 2.0% increase in

exports to the country with the least perceived corruption, but a 4.3% *decrease* in exports to the country with the most perceived corruption. In the second interpretation, the numbers imply that being the partner country with the most perceived corruption is associated with a 25.4% decrease in exports received when foreign bribery has not been criminalized in the exporting country, and an even larger 30.1% decrease when foreign bribery has been criminalized.

In either case, this result provides support for the hypothesis H_1 and for rejection of the null hypotheses H_0 and H_0', since it suggests that anti-bribery legislation is significantly associated with lower levels of exports to countries where corruption is perceived to be more extant, relative to levels of exports to countries where corruption perceptions are less lower.

Similar results are also obtained when the PIV is specified as either *tax deductibility* or as the composite anti-bribery score computed by principal component analysis, as shown in columns [4] to [7]. In both cases, the coefficient for the interaction variable is negative and statistically significant at least at the 95% level, which thus provides further support for H_1 and for rejection of H_0 and H_0'. The coefficients for *tax deductibility* and its interaction variable also have smaller magnitudes than the corresponding coefficients for *criminalization* and the composite score, which one might expect to be the case since the denial of tax deductions is arguably the weakest of the three treatments. On the other hand, since the composite anti-bribery score takes into account not only the criminalization of foreign bribery but also various other aspects of foreign bribery-related legislation, one would expect that the coefficient for its interaction variable should be the largest if H_1 is valid, and this is indeed the case.

Finally, one should note that for *tax deductibility* and the composite score, the coefficients on the PIVs in columns [5] and [7] are smaller in magnitude and are no longer statistically significant, which suggests that these measures of foreign bribery legislation are not

associated with any substantial change in exports for dyads where the partner country has low perceived corruption.

Sensitivity Analysis

To what extent are the regression results presented above a true reflection of the effects of anti-bribery legislation, as opposed to being the artificial product of certain methodological choices adopted in the analysis? To answer this question, a series of robustness tests are performed, and the sensitivity of the results are evaluated with respect to several variations in the analytical procedure. For brevity, only the regression coefficients for the interaction variables between the PIV measures and the WGI CC score from each robustness test are summarized in Table 10, while the detailed results are provided in Annex B.

First of all, as discussed in Section 4, the added constant method for computing the log transform of zero export values introduces an arbitrary parameter into the model, and hence the sensitivity of the regression results to the value of the added constant should be evaluated. This is carried out by estimating equation (6) using added constants of 0.1 and 10 for the log transform instead of 1, and the results of this test are provided in Table B1. With an added constant of 10, the coefficients for the interaction variables in all cases remain negative with little change in magnitudes, and are all statistically significant at the 99% level. With an added constant of 0.1, however, the results differ somewhat – the coefficients are all still negative but are of slightly smaller magnitude, and only the coefficient for the interaction between *criminalization* and the WGI CC score is statistically significant at the 90% level.

Table 10: Summary of Robustness Test Results
(Dependent Variable: Logged Exports)

Robustness Test	Regression Coefficient for Interaction between WGI CC Score and:		
	criminalization	*tax deductibility*	*composite anti-bribery score*
main results (Table 7)	-.064*** (.021)	-.043** (.022)	-.105*** (.038)
log-transform added constant = 10 (Table B1)	-.061*** (.013)	-.048*** (.014)	-.103*** (.024)
log-transform added constant = 0.1 (Table B1)	-.049* (.029)	-.023 (.031)	-.073 (-.053)
non-imputed data (Table B2)	-.058*** (.021)	-.033 (.022)	-.080** (.037)
alternative source for export data (Table B3)	-.062*** (.021)	-.034 (.034)	-.096** (.039)
polity controls included (Table B4)	-.102*** (.020)	-.092*** (.023)	-.179*** (.037)
Asian Financial Crisis countries excluded (Table B5)	-.064*** (.021)	-.041* (.022)	-.102*** (.039)
top 5% partner countries by GDP excluded (Table B6)	-.055** (.023)	-.041* (.024)	-.087** (.041)
lagged DV excluded (Table B7)	-.216*** (.037)	-.168*** (.039)	-.398*** (.069)
first-difference model (Table B8)	-.058** (.026)	-.045 (.028)	-.121** (.049)

Note: Robust Huber-White standard errors clustered by dyad shown in parentheses. Legend: *** $p < 0.01$,** $p < 0.05$, * $p < 0.1$.

Second, given that the imputation procedure used to correct for the non-randomness of missing export data may itself introduce biases into the data, it is useful to test whether similar results are obtained when the original non-imputed data is used instead. The results of this test are provided in Table B2, and show that the coefficients for the interaction variables are still negative and of similar magnitude to those obtained from the imputed data. The interaction coefficients for *criminalization* and the composite anti-bribery score in this case are also

statistically significant at least at the 95% level, but the interaction coefficient for *tax deductibility* is not.

Third, a simple robustness check of the results with regards to the reliability of data for the dependent variable can be easily performed by using an alternative source of data for the exports measure. In this case, export data are taken from the United Nations COMTRADE database, and the results of this test are provided in Table B3. Again, the interaction coefficients remain negative and are of similar magnitude to those in the original results. The interaction coefficients for *criminalization* and the composite anti-bribery score are also statistically significant at least at the 95% level, but the p-value for the *tax deductibility* interaction coefficient is once again much larger.

Fourth, given that the convention countries are comprised primarily of stable liberal democracies, one may also hypothesize that the regime type of the countries in a dyad might play an important role in determining levels of exports in ways that are distinct from the effects of foreign bribery legislation. If democracies tend to trade more with one another, for example, then the results obtained may be obfuscated by the fact that the level of democracy in a country is quite likely highly correlated with the level of corruption. Hence, taking this into consideration, equation (6) is re-estimated with the *POLITY2* score from the Polity IV Project database included in the model. This variable characterizes the regime type of the country in question according to a scale that ranges from -10 ("strongly autocratic") to +10 ("strongly democratic"), and thus serves to control for the level of democracy amongst both the convention and partner countries. The results of this analysis are provided in Table B4, and show that the regression coefficients on the interaction variables between the PIVs and the partner country WGI CC score remain negative, and are all statistically significant at the 99% level. The magnitudes of the coefficients

are also much larger than those in the original results, which is likely due in large part to the fact that data on the *POLITY2* variable is only 83% complete for the countries in the original dataset.

Fifth, given the time period considered in the analysis, it is plausible that anomalous results might be obtained due to the occurrence of the Asian Financial Crisis in 1997, which may have exerted temporary but significant effects on levels of international trade that are unrelated to foreign bribery. In order to test for this, equation (6) is also estimated after excluding from the analysis the six countries that were most obviously affected by the crisis: Japan, South Korea, Thailand, Malaysia, Philippines, and Indonesia. The results of this test are provided in Table B5, which shows that exclusion of these countries makes little difference to the results obtained: the regression coefficients on the interaction variables remain negative and are of almost the same magnitude as those in the original results, although the coefficient on the interaction variable for *tax deductibility* is significant only at the 90% level.

Sixth, in order to ensure that the results presented in Table 9 are not driven completely by a handful of outlier dyads with extremely large volumes of trade, the model is also estimated with the top 5% of partner countries by GDP excluded. The results of this analysis are provided in Table B6, and show that the regression coefficients on the interaction variables all remain negative and statistically significant at least the 90% level, although the magnitudes of the coefficients decrease slightly relative to the original results.

Finally, the sensitivity of the results to the form of the model is also assessed. In particular, there are two concerns that sometimes arise with regards to the estimation of time-series models: that controlling for the lagged DV may be incompatible with the inclusion of fixed-effects; and that the data may be non-stationary whereby the variance of the error terms

depends directly on time, which violates the OLS assumptions.[40] The first concern can be addressed immediately by simply excluding the first lag of logged exports from the model, and the results of this test are provided in Table B7. The regression coefficients on the interaction variables for all three PIVs in this case remain negative, and are statistically significant at the 99% level. Furthermore, the magnitudes of the coefficients are much larger than those in the original results.

With regards to the concern of non-stationary data, the problem arises when the random error terms are characterized by a unit-root, with the parameter ρ in equation (5) taking on values that are close or equal to one. Hence, one method that is then often adopted to correct for the unit-root problem is to estimate the model using first-differences.[41] If we denote $\Delta X_t = X_t - X_{t-1}$, the first-difference form of equation (6) is:

$$\begin{aligned}\Delta \log E_{c,p,t} = {} & \alpha_0 + \alpha_1 \Delta I_{c,t} + \alpha_2 \Delta\left(I_{c,t} * C_{p,t}\right) + \alpha_3 \Delta C_{p,t} + \alpha_4 \log \Delta \mathrm{E}_{\mathrm{c,p,t}} \\ & + \alpha_5 \Delta \log \mathrm{Y}_{\mathrm{c,t}} + \alpha_6 \Delta \log \mathrm{Y}_{\mathrm{p,t}} + \alpha_7 \Delta \log \mathrm{N}_{\mathrm{c,t}} + \alpha_8 \Delta \log \mathrm{N}_{\mathrm{p,t}} \\ & + \bar{\alpha}_{year} \cdot \bar{T} + \varepsilon_{c,p,t}\end{aligned} \tag{8}$$

As Bayoumi and Eichengreen (1995) point out, estimation of the model using first-differences eliminates "invariant sources of unobserved heterogeneity" across countries, which are otherwise controlled for in equation (6) by the dyad fixed-effects. Hence, equation (9) is estimated with fixed-effects only in the dimension of time. These results are provided in Table B8, and show that even when a first-difference model is used, the interaction coefficients remain negative and

[40] With regards to the former concern, see, for example, Joshua Angrist's post at: "Adding Lagged Dependent Variables to Differenced Models," http://www.mostlyharmlesseconometrics.com/2009/10/adding-lagged-dependent-vars-to-differenced-models/. For a discussion of the second concern, see Wooldridge (2000), p.447.

[41] This is employed, for example, by Bayoumi and Eichengreen (1995) and Baier and Bergstrand (2007).

are of similar magnitude to those in the original results. The coefficients for *criminalization* and the composite score are statistically significant at the 95% level, but the coefficient for *tax deductibility* is not.

In sum, the robustness tests that have been performed have evaluated the sensitivity of the results obtained to the following: the added constant used to compute the log transform of export values, the imputation of missing export data, the source data for the dependent variable, the inclusion of regime type controls, the exclusion of countries worst hit by the Asian Financial Crisis of 1997, the exclusion of the largest 5% of partner countries by GDP, and the form of the regression model. On the one hand, the results show that the coefficient for *tax deductibility* appears to be highly sensitive to variations in methodology, at least in terms of maintaining statistical significance. On the other hand, in all tests except for one (when an added constant of 0.1 is used for the log-transform of exports), the coefficients obtained on the interaction variables for *criminalization* and the composite anti-bribery score remain negative and statistically significant at least the 95% level, and are of similar magnitudes to the coefficients presented in Table 9. Taken as a whole, the sensitivity analysis thus suggests that the regression results obtained are reasonably robust.

Alternative Explanations

The interpretation offered for the results presented above is that the hypothesis H_1 is valid while the null hypotheses H_0 and H_0' are not: anti-bribery legislation reduces exports to more corrupt countries more so than it does exports to less corrupt countries. It is also important to ask, however, whether this is the only reasonable explanation for the observed results, or whether alternative interpretations may be reasonably put forward.

In this regard, one major concern is the issue of reverse causality: does the enactment of anti-bribery legislation reduce exports to corrupt countries, or do lower exports to corrupt countries make the enactment of such legislation more likely? In theory, this second explanation is certainly plausible. Downs et al (1996), for example, caution that optimistic evaluations of compliance with international agreements may be "dangerously contaminated by selection problems", whereby the countries that appear to comply most fully with treaty obligations are also those that are more likely to have acted in such a manner anyway even in the absence of the treaty.[42] In the context of this analysis, one might thus postulate that if a government knows that its country's firms do not export much to corrupt countries in the first place, then the expected costs of imposing stricter anti-bribery legislation are lower, and hence legislative changes are more likely to occur.

Given the timing of the legislative changes considered, however, the reverse causality argument is unlikely to be valid. As discussed in Section 4, the majority of convention countries enacted stricter legislation regulating foreign bribery within a few years after the adoption of the OECD Anti-bribery convention, which does not appear to reflect calculated decisions on the part of the legislating governments regarding the specific timing of when their obligations to the convention should be fulfilled. While it is possible that the convention countries *as a whole* had begun to export less to more corrupt countries by the mid-1990s and thus were more willing to accede to a multilateral anti-bribery initiative, the analysis presented above considers comparisons within the group of convention countries only, and hence this argument is not relevant.

Furthermore, even if a reduction in exports to more corrupt countries did indeed precede the adoption of the OECD anti-bribery convention, this does not necessarily imply that such

[42] Downs et al (1996), p.380

behavioral change is fully distinct from the effects of the convention itself. As Simmons and Hopkins (2005) point out, governments face reputational costs for behavior that is inconsistent with the obligations of any international agreement that they have previously ratified, and hence also have a rational incentive to seek ways of improving their ability to comply even before any formal commitment.[43] In this light, a reduction in exports to corrupt countries that is observed prior to the adoption of the OECD Anti-bribery Convention may be interpreted as *anticipatory* rather than causal behavioral change, and may reflect the effects of other policies that have been implemented by governments for the purpose of facilitating future compliance with an international agreement on foreign bribery.

In any case, a simple test of the reverse causality hypothesis can be performed by essentially reversing the DV and the PIV in equation (6). That is, instead of estimating how *criminalization* affects exports, we want to determine whether past exports to more corrupt partner countries predict *criminalization*. The results of such an estimation are shown in Table 11, where the five-year average of past exports is now taken as the main independent variable. As can be seen, the enactment of legislation criminalizing foreign bribery in the convention country of a dyad is more likely when the convention country is a larger exporter, but this does not depend significantly on whether the partner country in the dyad is highly corrupt or not (since the coefficient on the interaction variable is small and not statistically significant).[44] Also, as expected, *criminalization* is not significantly predicted by the *partner* country's characteristics. Hence, the reverse causality explanation can be safely rejected.

[43] Simmons and Hopkins (2005), p.624

[44] When the main independent variable is taken as the log of current exports rather than the five-year average of previous logged exports, the coefficient obtained on the interaction variable is statistically significant but positive, which again contradicts the reverse causality hypothesis.

Table 11: Test of Reverse Causality Hypothesis (Dependent Variable: *Criminalization*)

Independent Variable	Coefficient
five-year average of previous logged exports	.021** (.007)
interaction between 5-year average of previous logged exports and WGI CC score	.002 (.011)
WGI CC score	.001 (.037)
logged GDP (convention country)	.226*** (.021)
logged GDP (partner country)	-.010 (.012)
logged population (convention country)	.303*** (.083)
logged population (partner country)	.024 (.028)
constant	-1.870*** (.384)
Observations	86136
R-squared	.754

Note: Robust Huber-White standard errors clustered by dyad shown in parentheses. Regression coefficients for dyad and year dummy variables not shown. Legend: *** $p < 0.01$,** $p < 0.05$, * $p < 0.1$.

A second alternative explanation that should also be considered is that the PIV measures are not capturing what they are supposed to. In essence, this would constitute a form of omitted variable bias: if the PIVs are highly correlated with some other factor that affects exports, then omission of that factor from the model would tend to overestimate the relationship between what we assume to be the strictness of foreign bribery legislation and the level of exports. For example, one might argue that foreign bribery legislation is more likely to be adopted earlier when legislative systems are more efficient, and that it is the efficiency of the legislative system rather than the legislation itself that determines how levels of exports change over time. While the possibility for omitted variable bias cannot be eliminated completely, however, such lines of

reasoning are not very plausible. One would have to show not only that there is a third factor highly correlated with both exports and the PIVs, but also that this factor should have an effect on exports *conditional on corruption*. Since such factors are unlikely to exist, this alternative explanation can also be safely rejected.

6. Conclusions

In this thesis, I have set out to determine how levels of international business transactions are affected when countries enact stricter foreign bribery legislation, and the most immediate implication of my findings is that the multilateral anti-bribery initiatives led by the OECD have indeed had a meaningful impact on business decisions in the international economy. Legislative changes to foreign bribery laws have constituted more than mere hollow action, such that stricter regulation of international bribes appears to have made corruption more costly for both exporting firms as well as the importing countries, with the pattern of international business transactions responding accordingly.

With regards to exports between countries specifically, the results of both the difference-in-difference and the regression estimation lend credence to the main hypothesis being tested, implying that the criminalization of foreign bribery reduces exports to more corrupt countries more so than it does exports to less corrupt countries. Furthermore, the OLS estimates suggest that this effect is greater when other aspects of foreign bribery legislation – nationality jurisdiction, the criminal liability of legal persons, and the limitation period and maximum sanction for foreign bribery offences – are more stringent. The denial of tax deductions for foreign bribes alone, however, does not appear to have a significant effect on exports that is conditional on the level of perceived corruption in the country receiving the exports.

Whether these findings imply that stricter foreign bribery legislation will lead to a decrease in levels of *corruption*, however, is of course an entirely different matter. The OECD's anti-bribery initiatives have explicitly sought to address the supply side of the market for bribes, and it is unclear as to whether foreign bribery laws have any direct relevance for the extent to which bribes are demanded by the public officials of foreign governments. What is certainly plausible given the findings of this thesis, however, is that the supply of bribes in the international economy has been stemmed somewhat, as firms operating overseas have come under increasing pressure to conform to the legislative standards of their home countries regarding the legality of specific business practices. If the governments of highly corrupt countries then also become sensitive to how business decisions are being influenced by these pressures, the effects of foreign bribery legislation may thus possibly propagate over time from firms to governments, as foreign public officials reduce their demand for bribes in order to attract more business.

Finally, the finding that stricter foreign bribery laws appear to have a measurable effect on levels of exports suggests that the response of firms to such legislation may be further examined as a potential alternative method of measuring corruption. Certainly, the imprecision of the difference-in-difference and regression estimates computed in this thesis makes it unfeasible for these to be used directly as quantitative indicators of how corrupt a given partner country is. However, both qualitative and quantitative measures based on this approach *are* possible. For example, if investigations reveal that a major multinational company has decided to shut down its operations in a certain country because it cannot compete without the regular payment of bribes, then this constitutes qualitative information about the state of corruption in that country that should not be disregarded. One might also imagine that the number of firms

operating overseas in a given country that are investigated under the statutes of foreign bribery laws, or that decide to withdraw from doing business in that country because of such legislation, may also be utilized as a quantitative measure of corruption. Hence, this is an area of study that warrants greater attention, with the potential to make important contributions towards the study of corruption.

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Annex A: Combining Data (Belgium-Luxembourg and Serbia-Montenegro)

The procedure employed for combining data for Belgium-Luxembourg and Serbia-Montenegro is as follows:

- for the dependent variable, export values for the two countries are summed;
- for the primary independent variables (Belgium-Luxembourg only), they are taken as Belgium's score, since Belgium is the dominant economic entity in the pair;
- for GDP and population data, values for the two countries are summed;
- for the contiguity, common language, and colonial relationship variables used for imputing missing export data, these are coded as 1 if the variable has a score of 1 for either country; and
- for the distance variable used for imputing missing export data, the average of the distance for the two countries is used.

Annex B: Regression Estimates for Sensitivity Analysis

Table B1: Regression Results with Log-transform Added Constant (β) Varied (Dependent Variable: Logged Exports)

Variable	Model with PIV as:		
	criminalization	*tax deductibility*	*composite anti-bribery score*
$\beta = 1$			
PIV	.020* (.010)	.006 (.010)	.014 (.018)
interaction between PIV and WGI CC score	-.064*** (.016)	-.043*** (.017)	-.105*** (.029)
WGI CC score	-.294*** (.041)	-.318*** (.040)	-.299*** (.041)
$\beta = 10$			
PIV	.020** (.008)	-.014* (.008)	.027* (.014)
interaction between PIV and WGI CC score	-.061*** (.013)	-.048*** (.014)	-.103*** (.024)
WGI CC score	-.148*** (.027)	-.168*** (.026)	-.152*** (.027)
$\beta = 0.1$			
PIV	.011 (.017)	-.014 (.017)	-.021 (.031)
interaction between PIV and WGI CC score	-.049* (.029)	-.023 (.031)	-.073 (-.053)
WGI CC score	-.417*** (.068)	-.440*** (.066)	-.424*** (.068)

Note: Robust Huber-White standard errors clustered by dyad shown in parentheses. Regression coefficients for logged GDP variables, logged population variables, and dyad and year dummy variables not shown. Legend: *** $p < 0.01$,** $p < 0.05$, * $p < 0.1$.

Table B2: Regression Results without Imputing Missing Export Data (Dependent Variable: Logged Exports)

Variable	Model with PIV as:			
	none	***criminalization***	***tax deductibility***	***composite anti-bribery score***
PIV		.009 (.012)	-.002 (.013)	-.016 (.022)
interaction between PIV and WGI CC score		-.058*** (.021)	-.033 (.022)	-.080** (.037)
WGI CC score	-.356*** (.042)	-.318*** (.044)	-.343*** (.043)	-.328*** (.044)
first lag of logged exports	.514*** (.008)	.514*** (.008)	.514*** (.008)	.513*** (.008)
logged GDP (convention country)	-.214*** (.036)	-.209*** (.036)	-.219*** (.036)	-.199*** (.036)
logged GDP (partner country)	.412*** (.025)	.418*** (.025)	.415*** (.025)	.417*** (.025)
logged population (convention country)	.193** (.093)	.191** (.093)	.140 (.094)	.198** (.093)
logged population (partner country)	-.298*** (.051)	-.277*** (.051)	-.290*** (.051)	-.282*** (.051)
constant	.347 (.547)	.386 (.564)	.721 (.569)	.076 (.547)
Observations	84251	84251	84251	84251
R-squared	.979	.979	.979	.979

Note: Robust Huber-White standard errors clustered by dyad shown in parentheses. Regression coefficients for dyad and year dummy variables not shown. Legend: *** $p < 0.01$,** $p < 0.05$, * $p < 0.1$.

Table B3: Regression Results using UN COMTRADE Export Data (Dependent Variable: Logged Exports)

Variable	Model with PIV as:			
	none	***criminalization***	***tax deductibility***	***composite anti-bribery score***
PIV		.027** (.012)	-.003 (.012)	.017 (.022)
interaction between PIV and WGI CC score		-.062*** (.021)	-.034 (.034)	-.096** (.039)
WGI CC score	-.322*** (.043)	-.282*** (.045)	-.309*** (.044)	-.289*** (.045)
first lag of logged exports	.524*** (.009)	.523*** (.009)	.523*** (.009)	.523*** (.009)
logged GDP (convention country)	-.216*** (.036)	-.214*** (.036)	-.222*** (.036)	-.207*** (.036)
logged GDP (partner country)	.392*** (.024)	.398*** (.024)	.395*** (.024)	.397*** (.024)
logged population (convention country)	.018 (.101)	.015 (.101)	.041 (.101)	.021 (.101)
logged population (partner country)	-.294*** (.051)	-.272*** (.051)	-.286*** (.051)	-.275*** (.051)
constant	.984** (.416)	1.048* (.572)	1.382** (.574)	.775* (.559)
Observations	86136	86136	86136	86136
R-squared	.977	.977	.977	.977

Note: Robust Huber-White standard errors clustered by dyad shown in parentheses. Regression coefficients for dyad and year dummy variables not shown. Legend: *** $p < 0.01$,** $p < 0.05$, * $p < 0.1$.

Table B4: Regression Results with Polity Controls
(Dependent Variable: Logged Exports)

Variable	Model with PIV as:			
	none	*criminalization*	*tax deductibility*	*composite anti-bribery score*
PIV		.031** (.013)	.033** (.013)	.036 (.023)
interaction between PIV and WGI CC score		-.102*** (.020)	-.092*** (.023)	-.179*** (.037)
WGI CC score	-.419*** (.049)	-.359*** (.050)	-.387*** (.049)	-.364*** (.050)
polity score (convention country)	.004 (.005)	.003 (.005)	.002 (.005)	.001 (.005)
polity score (partner country)	-.0003 (.0009)	-.0001 (.0009)	-.0002 (.0009)	-.0001 (.0009)
first lag of logged exports	.538*** (.009)	.537*** (.009)	.537*** (.009)	.536*** (.009)
logged GDP (convention country)	-.202*** (.039)	-.195*** (.039)	-.205*** (.039)	-.182*** (.039)
logged GDP (partner country)	.373*** (.025)	.382*** (.025)	.380*** (.025)	.383*** (.025)
logged population (convention country)	.200* (.103)	.190* (.103)	.150 (.104)	.206** (.103)
logged population (partner country)	-.337*** (.052)	-.302*** (.052)	-.316*** (.052)	-.303*** (.052)
constant	.924 (.627)	.686 (.631)	.740 (.613)	.497 (.634)
Observations	71532	71532	71532	71532
R-squared	.979	.979	.979	.979

Note: Robust Huber-White standard errors clustered by dyad shown in parentheses. Regression coefficients for dyad and year dummy variables not shown. Legend: *** $p < 0.01$,** $p < 0.05$, * $p < 0.1$.

Table B5: Regression Results excluding Countries Worst Hit by Asian Financial Crisis: Japan, South Korea, Thailand, Malaysia, Philippines, and Indonesia (Dependent Variable: Logged Exports)

Variable	Model with PIV as:			
	none	*criminalization*	*tax deductibility*	*composite anti-bribery score*
PIV		.020 (.013)	.005 (.013)	.014 (.023)
interaction between PIV and WGI CC score		-.064*** (.021)	-.041* (.022)	-.102*** (.039)
WGI CC score	-.326*** (.044)	-.284*** (.046)	-.309*** (.045)	-.291*** (.046)
first lag of logged exports	.522*** (.009)	.521*** (.009)	.521*** (.009)	.521*** (.009)
logged GDP (convention country)	-.200*** (.037)	-.196*** (.037)	-.205*** (.037)	-.190*** (.037)
logged GDP (partner country)	.387*** (.024)	.393*** (.025)	.390*** (.024)	.393*** (.025)
logged population (convention country)	.075 (.105)	.070 (.105)	.027 (.104)	.078 (.105)
logged population (partner country)	-.304*** (.052)	-.282*** (.053)	-.294*** (.053)	-.284*** (.053)
constant	.677 (.573)	.739 (.591)	1.025* (.593)	.445 (.578)
Observations	83276	83276	83276	83276
R-squared	.976	.976	.976	.976

Note: Robust Huber-White standard errors clustered by dyad shown in parentheses. Regression coefficients for dyad and year dummy variables not shown. Legend: *** $p < 0.01$,** $p < 0.05$, * $p < 0.1$.

Table B6: Regression Results excluding Top 5% of Partner Countries by GDP (Dependent Variable: Logged Exports)

Variable	Model with PIV as:			
	none	*criminalization*	*tax deductibility*	*composite anti-bribery score*
PIV		.017 (.014)	.006 (.014)	.006 (.025)
interaction between PIV and WGI CC score		-.055** (.023)	-.041* (.024)	-.087** (.041)
WGI CC score	-.359*** (.044)	-.322*** (.047)	-.342*** (.046)	-.328*** (.047)
first lag of logged exports	.515*** (.009)	.515*** (.009)	.514*** (.009)	.514*** (.009)
logged GDP (convention country)	-.224*** (.038)	-.221*** (.038)	-.229*** (.038)	-.214*** (.037)
logged GDP (partner country)	.382*** (.025)	.386*** (.025)	.385*** (.025)	.386*** (.025)
logged population (convention country)	.084 (.107)	.080 (.107)	.037 (.106)	.088 (.107)
logged population (partner country)	-.281*** (.053)	-.264*** (.053)	-.272*** (.053)	-.266*** (.054)
constant	.967* (.580)	1.060* (.598)	1.320** (.600)	.759 (.585)
Observations	81911	81911	81911	81911
R-squared	.972	.972	.972	.972

Note: Robust Huber-White standard errors clustered by dyad shown in parentheses. Regression coefficients for dyad and year dummy variables not shown. Legend: *** $p < 0.01$,** $p < 0.05$, * $p < 0.1$.

Table B7: Regression Results without Inclusion of Lagged Dependent Variable (Dependent Variable: Logged Exports)

Variable	Model with PIV as:			
	none	*criminalization*	*tax deductibility*	*composite anti-bribery score*
PIV		.128*** (.022)	.058** (.022)	.168*** (.041)
interaction between PIV and WGI CC score		-.216*** (.037)	-.168*** (.039)	-.398*** (.069)
WGI CC score	-.594*** (.071)	-.453*** (.075)	-.524*** (.072)	-.455*** (.075)
logged GDP (convention country)	-.277*** (.064)	-.279*** (.064)	-.288*** (.064)	-.265*** (.064)
logged GDP (partner country)	.751*** (.042)	.770*** (.042)	.764*** (.042)	.772*** (.042)
logged population (convention country)	.112 (.197)	.115 (.195)	.017 (.195)	.117 (.196)
logged population (partner country)	-.761*** (.096)	-.684*** (.097)	-.720*** (.097)	-.681*** (.097)
constant	.496 (1.032)	.400 (1.057)	1.086 (1.063)	.069 (1.039)
Observations	86136	86136	86136	86136
R-squared	.967	.967	.967	.967

Note: Robust Huber-White standard errors clustered by dyad shown in parentheses. Regression coefficients for dyad and year dummy variables not shown. Legend: *** $p < 0.01$,** $p < 0.05$, * $p < 0.1$.

Table B8: Regression Results using First-Difference Model (Dependent Variable: First Difference of Logged Exports)

Variable (first differences)	Model with PIV as:			
	none	*criminalization*	*tax deductibility*	*composite anti-bribery score*
PIV		.020 (.015)	.030* (.016)	.049* (.027)
interaction between PIV and WGI CC score		-.058** (.026)	-.045 (.028)	-.121** (.049)
WGI CC score	-.184*** (.061)	-.147** (.064)	-.166*** (.062)	-.143** (.064)
logged GDP (convention country)	-.449*** (.070)	-.443*** (.070)	-.450*** (.070)	-.442*** (.070)
logged GDP (partner country)	.621*** (.049)	.622*** (.049)	.622*** (.049)	.622*** (.049)
logged population (convention country)	-.264 (.191)	-.273 (.191)	-.254 (.191)	-.265 (.191)
logged population (partner country)	-.754*** (.103)	-.734*** (.103)	-.744*** (.103)	-.732*** (.103)
constant	.051*** (.003)	.052*** (.003)	.051*** (.003)	.052*** (.003)
Observations	79217	79217	79217	79217
R-squared	.013	.013	.013	.013

Note: Robust Huber-White standard errors clustered by dyad shown in parentheses. Regression coefficients for year dummy variables not shown. Legend: *** $p < 0.01$,** $p < 0.05$, * $p < 0.1$.