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Research Article

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Corruption and International Trade: A Re-assessment with Intra-National Flows

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Abstract: This study re-examines the impact of corruption on international trade accounting for both inter- and intra-national flows in line with the latest advances in the gravity equation literature. Using a wide sample of countries for the period 1995–2017, our results show that the non-inclusion of internal trade flows drastically biases the estimations. Additionally, we find that the negative impact of corruption on trade is reduced, ceteris paribus, in poorer countries. We also find non-linearities, more corrupt countries present a more harmful impact of corruption on trade. Moreover, we perform a general equilibrium analysis to investigate the impact of a given reduction in perceived corruption on a selected group of countries' economic growth and prices. We find that these effects are far from being negligible, especially when there is a "synchronized" reduction in corruption in most corrupt countries.

Keywords: corruption, gravity, intra-national trade flows, general equilibrium

1 Introduction

Conventional wisdom considers that corruption hinders economic activity. The literature aimed at quantifying the consequences of corruption on economic performance was pioneered by Mauro (1995). This author found a significant negative impact of corruption on investment and growth. Wei (2000) and Lambsdorff (2003) extended the analysis to foreign direct investment and productivity, respectively, documenting that the increase in corruption via higher uncertainty exerts adverse effects on capital inflows and productivity of capital. Another strand of the literature investigates the link between corruption and trade, which is the focus of this study.

The studies that examine the relationship between corruption and international trade can be framed within the literature that assesses the impact of institutions on foreign trade flows. The quality of institutions may shape a country's comparative advantage (Nunn & Trefler, 2014). More specifically, corruption can be considered a governance failure that affects the effectiveness of contracts among parties raising trade frictions and reducing international trade (Anderson & Marcouiller, 2002). However, corruption could also help to improve efficiency in a second-best world since it may alleviate the distortions caused by inefficient bureaucratic institutions (Méon & Weill, 2010). This argument is commonly known as the grease the wheels hypothesis, advanced by Huntington (1968), Leff (1964), and Leys (1965). In the case of trade, the empirical literature supporting this hypothesis argues that bribes can serve to overcome difficulties that firms face at the time of crossing the borders in a context with both high bureaucracy and high barriers to trade.[1]

The extant literature has commonly found a detrimental effect of corruption on international trade (Horsewood & Voicu, 2012; Jong & Bogmans, 2011; Knack & Azfar, 2003; Levchenko, 2007; Masila & Sigue, 2010; Pomfret & Sourdin, 2010; Thede & Gustafson, 2009; Zelekha & Sharabi, 2012). However, some studies find an ambiguous or even a positive effect (Akbarian & Shirazi, 2012; Dutt & Traca, 2010; Gil-

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1 Some papers also find support for the greasing the wheels hypothesis for foreign direct investment (Egger & Winner, 2005), firm entry into markets (Dreher & Gassebner, 2013), economic growth (Ahmad, Ullah, & Arfeen, 2012) and efficiency (Méon & Weill, 2010).

Pareja, Llorca-Vivero, & Martínez-Serrano, 2019; Voraveeravong, 2013). In a context of high barriers to trade and weak institutions, a positive correlation between corruption and trade is likely to arise. Notwithstanding, all these studies estimate gravity equations using international trade flows only (i.e., with no domestic trade flows), which does not allow them to accurately identify the impact of country-specific corruption levels on international trade.

This study makes two main contributions to the literature. The first contribution is to examine the impact of corruption on international trade using both inter- and intra-national trade flows within the structural gravity estimation framework (Yotov, Piermartini, Monteiro, & Larch, 2016). It allows us to identify the direct effect of country-specific corruption levels on international trade (relative to intra-national trade flows). The identification of the effects of country-specific characteristics on bilateral trade flows is not possible when we estimate the gravity equation including only international trade flows. The reason is that these effects are country-specific, and thus absorbed by the exporter-time and by the importer-time fixed effects that need to be used to control for the multilateral resistances in the structural gravity model. However, when domestic flows are included, country-specific variables become bilateral in nature, making their identification and estimation possible (Beverelli, Keck, Larch, & Yotov, 2018).[2]

The second contribution of this study is to examine the welfare effects (on GDP, consumer, and producer prices) of a reduction in country-specific corruption levels following the General Equilibrium PPML counterfactual analysis (*GEPPML*) proposed by Anderson, Larch, and Yotov (2018).

The estimation of structural gravity models using both domestic and international trade flows is essential for the goals of this study. We capitalize on Yotov's (2021) thorough discussion on the significant benefits of estimating gravity equations with domestic and international trade flows. In particular, the inclusion of intra-national trade flows is important for this study for the following reasons. First, it is consistent with theory. Domestic trade flows are featured in all theoretical gravity models from Anderson (1979), the first theory foundation of gravity in economics, to Arkolakis, Costinot, and Rodríguez-Clare (2012), who established the power of the structural gravity model as representative of a very wide class of trade models. Second, the inclusion of domestic trade flows may lead to significant differences in the estimates of the impact of corruption on trade. Third, as previously discussed, it allows us to identify country-specific corruption effects on trade that cannot be identified in a gravity equation that only relies on international trade flows. Finally, domestic trade flows are required to perform general equilibrium counterfactual simulations with the gravity model.

The empirical work is carried out through the estimation of structural gravity equations and further performing a *GEPPML*. To that end, we use data consistently constructed including international and intra-national manufacturing trade flows for 69 countries over the period 1995–2017. Regarding our variable of interest, we rely on the Corruption Perception Index (CPI) elaborated by Transparency International as a proxy for country-specific corruption levels.

To preview our results, we find evidence of sizable biases in the estimates of the impact of corruption on trade when domestic trade flows are not included. In particular, we find a negative and significant effect of perceived corruption on international trade, once domestic flows are taken them into account. Moreover, we find that the level of income (GDP per capita) and the degree of corruption influence the relationship between corruption and trade. The GE estimations reveal that a reduction in corruption for big countries (e.g., the United States and China) benefits both home producers and the rest of the countries' consumers but, rather interestingly, does not benefit home consumers. Yet, when corruption is reduced for most corrupt countries, producers gain, consumers lose, and the World's GDP increases. The inclusion (or not) of China does not significantly alter the results.

The rest of the study is organized as follows. Section 2 is devoted to sketching out the methodology and describing the data. Section 3 presents and discusses the empirical results. Finally, Section 4 concludes the study.

2 Methodology and Data

This study estimates the relationship between corruption and trade relying on the gravity equation, which has been considered as the workhorse for examining the determinants of bilateral trade flows for near 60 years since it was introduced by Tinbergen (1962). Recently, Yotov et al. (2016) discuss and formulate a series of recommendations to obtain reliable estimates of the structural gravity model, capitalizing on the latest developments in the gravity literature. These authors recommend to account for (i) multilateral resistance terms (Anderson & van Wincoop, 2003); (ii) bilateral trade supporting or impeding factors (distance, contiguity, language, membership to economic integration agreements, bilateral tariffs etc.);

2 Beverelli et al. (2018) propose this approach to identify the direct effect of country-specific national institutions on international trade within a structural gravity estimation framework.

(iii) endogeneity of trade policy (Baier & Berstrand, 2007); (iv) heteroskedasticity of trade data (Santos Silva & Tenreyro, 2006); and (v) the existence of zeros in bilateral trade flows (Felbermayr & Kohler, 2006; Helpman, Melitz, & Rubinstein, 2008; Santos Silva & Tenreyro, 2006). Moreover, (vi) they also recommend to estimate the structural gravity model including international and intra-national trade flows (Yotov, 2012, 2021).

This study follows all the aforementioned recommendations. In particular, we control for the multilateral resistance terms with exporter-time and importer-time fixed effects as well as for unobservable constant bilateral heterogeneity and endogeneity with county-pair-fixed effects (Baier & Berstrand, 2007; Baldwin & Taglioni, 2007; Gil-Pareja, Llorca-Vivero, & Martínez-Serrano, 2008). Moreover, we deal with both heteroskedastic residuals and the presence of zeros in bilateral trade flows by estimating the gravity equation applying the Poisson Pseudo Maximun Likelihood (PPML) estimator proposed by Santos Silva and Tenreyro (2006). Finally, we use a dataset that covers both international and intra-national trade flows as suggested by Baier, Yotov, and Zylkin (2019), Bergstrand, Larch, and Yotov (2015), and Yotov (2012).

Yotov (2012) was the first to include intra-national flows in the gravity equation trying to solve "the distance puzzle". Nevertheless, domestic trade flows were calculated as the difference between GDP (values added) and total exports (final values). Ever since, other studies have used more accurate measures of domestic trade flows. Dai, Yotov, and Zylkin (2014) measure intra-national flows as total sectoral output minus total sectoral exports, where output is measured in gross terms. The inclusion of domestic sales allows Dai et al. (2014) to estimate trade diversion effects of regional trade agreements. Bergstrand et al. (2015) obtain more reliable estimates for integration agreements, border effects, and distance elasticities, whereas Esteve-Pérez, Gil-Pareja, Llorca-Vivero, and Martínez-Serrano (2020) and Larch, Wanner, and Yotov (2018) for the EMU impact and Anderson and Yotov (2016) for terms of trade. Finally, inter- and intra-national trade flows are used to investigate the impact on trade of both non-discriminatory trade policies, such as the Most Favoured Nation Clause and export subsidies (Heid, Larch, & Yotov, 2017), and deep agreements (Mattoo, Mulabdic, & Ruta, 2017).

To the best of our knowledge, only Beverelli et al. (2018) utilize domestic flows to analyze the impact of institutions on international trade. As these authors establish, the methodology can be generalized to any country-specific characteristic. The inclusion of intra-national trade flows is critical in this study because it enables us to identify country-specific corruption effects on trade. It is worth noting that all previous studies that try to estimate the effect of corruption on trade cannot properly account for multilateral resistance terms since country-specific variables like corruption are colinear with the full set of exporter-time and importer-time fixed effects.

In this research, we have considered for the first time the unilateral corruption variable $corrup_{i(j)t}$, that is, the value of the respective index for the $i(j)$ country. It is indifferent to include the corruption measure (CPI, in our case) of the origin or the destination country because the estimated coefficient will be the same. Beverelli et al. (2018) demonstrate that it is not possible to identify the impact of the country-specific variable on exports versus imports. Therefore, we can only estimate the impact of countries' corruption on international trade relative to internal trade.

We have also incorporated two bilateral corruption variables[3]: $corrup_{ij,t}$ represents the geometric mean of the values of the respective corruption variables for the exporter "i" and the importer "j" and $difcorrup_{ij,t}$ measures the absolute value of the difference between the corruption indexes of the countries in the pair.[4] Therefore, we use proxies for the average bilateral "volume" of corruption and for "distance" in corruption levels between them. Horsewood and Voicu (2012) show that trade is reduced as the corruption gap widens.

The database used for the inclusion of both intra-national flows as well as international bilateral trade flows is the balanced panel dataset gathered by Thomas Zylkin for the period 1986–2006 that has been updated till 2017. The data consist of international and intra-national manufacturing trade flows for 69 countries. The cost of considering domestic flows is to drastically reduce the number of countries under consideration and the period of analysis. For instance, in a similar study, Gil-Pareja et al. (2019) estimate the model with data for 139 countries over the period 1975–2012. Table 1 shows some descriptive statistics for both samples. As it is shown, although the number of observations is strongly reduced in the current sample, there are no significant differences between the two samples. In particular, only the mean is slightly higher in this study, whereas the rest of descriptive statistics are fairly similar. In Appendix A, we present the list of countries in the sample.

3 See Gil-Pareja et al. (2019) for the analysis of perceived corruption indices versus an "structural index." In this case, we do not introduce the "structural index" because we have only data for 2 years and it is not enough to obtain reliable estimates.

4 No multicollinearity problems arise between both variables of corruption.

Table 1: Descriptive Statistics of CPI: Current sample vs sample used by Gil-Pareja et al. (2019)

	Countries	Period	Obs.	Mean	Std. Dev.	Min.	Max.
Current sample	69	1995–2017	99,004	5.33	2.30	0.69	10
Gil-Pareja et al. (2019), sample	139	1995–2012	262,988	4.42	2.29	0.40	10

Note: Authors' own elaboration.

This dataset has been updated for the period 2006–2017 relying on data from the IMF Direction of Trade dataset. According to the procedure in the original dataset, domestic sales are constructed as the difference between total production and total exports of manufacturing products. For consistency reasons, gross production values are used to build up intra-national trade flows. We also include a dummy for Regional Trade Agreements (RTAs), which has been collected from Mario Larch's Regional Trade Agreements Database (Egger & Larch, 2008).

Regarding our variable of interest, we rely on a standard measure of corruption to perform our research, which belongs to the family of perception-based indexes: CPI, built by Transparency International.[5] Data are available from 1995 onwards. Therefore, our sample goes from 1995 to 2017. The index ranges from 0 (maximum corruption) to 10 (no corruption). However, in last years the scale goes from 0 to 100. We have homogenized this index to 0–10 for the entire period. This indicator is based on opinions by experts in the area (such as analysts and business people). The number of countries ranked has increased over the years, and nowadays, it encompasses 180 countries.

We estimate the gravity equation using the PPML estimator, including country-year fixed effects (CYFE) and country-pair fixed effects (CPFE). With only international flows, this specification would exclusively allow us estimating coefficients for bilateral variables with time variation. In particular, in addition to our variables of interest, we include a dummy variable for RTAs. Rather importantly, it is possible to incorporate into the model unilateral corruption variables if intra-national flows are taken into account. Therefore, our first estimation equation takes the following form:

$$X_{ijt} = \exp^{(\beta_1 \mathrm{RTA}_{ijt} + \beta_2 \mathrm{corrup}_{i(j)t} + \mu_{ij} + \delta_{it} + \gamma_{jt})} u_{ijt}, \tag{1}$$

where μ_{ij} is CPFE and δ_{it} and γ_{jt} are CYFE. The variable corrup is country specific (CPI) and it does not matter whether it is the exporter or the importer, as stated above. When using bilateral variables, the estimation is

$$X_{ijt} = \exp^{(\beta_1 \mathrm{RTA}_{ijt} + \beta_2 \mathrm{corrup}_{ijt} + \beta_4 \mathrm{difcorrup}_{ijt} + \mu_{ij} + \delta_{it} + \gamma_{jt})} u_{ijt}, \tag{2}$$

again, the corruption variables are constructed using the CPI. We have changed the sign of the values of our variable of interest to facilitate the interpretation of the estimated coefficient. Therefore, a negative sign of the corresponding parameter will imply that more corruption reduces trade. Similarly, a smaller value for corruption (a more negative one) implies less corruption and the inverse. We perform estimations with and without intra-national flows to assess the size of the bias incurred when omitting domestic trade flows.

Additionally, we carry out a GE analysis of the impact of corruption on trade. In particular, following Anderson et al. (2018), we perform a *GEPPML*. This GE analysis allows us to derive welfare effects (on GDP, consumer, and producer prices) of a reduction in perceived corruption. Anderson et al. (2018) take advantage of the theoretical developments of the gravity equation (Anderson, 1979; Anderson & van Wincoop, 2003), the econometric contribution of Santos Silva and Tenreyro (2006) with the well-known PPML estimation, and the properties of this estimator as shown by Fally (2015).

More concretely, we analyze the impact of a standard deviation reduction in perceived corruption for the two largest economies (USA and China) and for the group of countries with the highest level of corruption (above average), both including and excluding China.

3 Results

We estimate the impact of corruption on trade using the PPML with CYFE and CPFE. The results are displayed in Table 2. The estimations for the unilateral corruption measure are presented in column 1. In this case, it is necessary the inclusion of domestic flows because, otherwise, only bilateral variables can be estimated in the presence of the full set of CYFE. In columns 2 and 3, we present the estimation of our bilateral corruption variable both when domestic flows are not included and when they are included, respectively. Finally, in column 4 we

5 See https://www.transparency.org/en/cpi/2020/index/nzl.

Table 2: Trade and Corruption. Unilateral index and bilateral index (geometric mean and difference in corruption levels). Period 1995–2017**

Dependent variable	(1) Nominal trade flows in current US dollars	(2) Nominal trade flows in current US dollars	(3) Nominal trade flows in current US dollars	(4) Nominal trade flows in current US dollars
RTA_{ijt}	0.231***	0.041	0.223***	0.223***
	(0.049)	(0.049)	(0.049)	(0.049)
$Corrup_{i(j)t}$	−0.063***			
	(0.026)			
$Corrup_{ijt}$		0.122*	−0.522***	−0.569***
		(0.070)	(0.138)	(0.206)
$Difcorrup_{ijt}$				0.009
				(0.023)
Constant	12.951***	10.627***	9.965***	9.679***
	(0.047)	(0.442)	(0.823)	(1.235)
Observations	98,881	89,921	91,343	91,343
Country pair FE	Yes	Yes	Yes	Yes
Importer-year and exporter-year FE	Yes	Yes	Yes	Yes
Intra-national trade	Yes	No	Yes	Yes
Pseudo R^2	0.99	0.99	0.99	0.99

Note: *significant at 10% level, **significant at 5% level, ***significant at 1% level.

introduce our variable measuring "distance" in corruption levels.

As reported in column 1, we observe a sensible (average) positive effect for membership in a regional trade agreement with a significant impact of around 25% (exp(0.23) − 1). Regarding our variable of interest, the estimation of the impact of country's corruption on international trade relative to intra-national trade is negative and highly significant. The parameter obtained is −0.063. This implies that the difference in the volume of international trade, *ceteris paribus*, between the country on the average (−5.25) and a more corrupt country with one standard deviation (2.36) is around 14%.

As previously stated, the other three columns of Table 2 present the estimations considering the bilateral corruption index. In column 2, we do not consider intra-national flows, whereas they are included in columns 3 and 4. As observed, a clear difference emerges in the estimated parameters when excluding intra-national flows (column 2) compared with the case in which we include them (column 3). In this first case, the parameter of RTAs is not significant at conventional levels. In contrast, our measure of average corruption has a counter-intuitive sign, although significant only at the 10% level. When considering international and intra-national flows (column 3), we see that the parameter for RTAs is now quite similar to that reported in column 1 and highly significant. The parameter for corruption in the pair is negative and significant (now, in line with expectations) with an order of magnitude greater than in the case considering just individual corruption (−0.522 vs −0.063). That is, on average, the combination of corruption has a powerful amplified effect. Considering the same values as before for the average and one standard deviation measures,[6] the pair of countries with the average "combined" corruption level trade around 71% more than the pair of countries with one standard deviation more corrupt. Finally, we have additionally introduced the distance in "corruption" levels across countries (column 4). As shown, this variable is far from significant and almost does not alter the coefficient for the bilateral corruption variable.

Moreover, we can expect a different behavior about the impact of corruption on trade depending on countries' income or the level of corruption.[7] On the one hand, richer countries have more tools to fight against corruption as, for instance, stronger institutions. These countries are also less corrupt in general terms. On the other hand, the "grease the wheels" argument mainly applies to poorer, more corrupt countries (Gil-Pareja et al., 2019). Therefore, the actual effect of corruption

6 In fact, the values for the geometric mean are −5.063 and 1.615, respectively.

7 We are grateful to an anonymous referee for rising this point.

on trade depending on these two variables is an empirical matter.

In order to analyze these points, in Table 3 we present the results including three additional independent variables. First, we introduce an interactive regressor consisting of the individual level of corruption times the respective GDP per-capita (column 1). Second, we introduce another interactive regressor containing a dummy for more corrupt countries, those with a CPI value above average (column 2). Third, we introduce the square of the corruption level to identify non-linearities (column 3).

As shown in column 1 of Table 3, now the unilateral variable is positive and significant, whereas the interactive one becomes negative and significant. This implies that given a level of perceived corruption in a country, poorer countries have a weaker negative impact of corruption on trade than richer countries, which supports the "grease the wheel" hypothesis.

When introducing a dummy for more corrupt countries, column 2 of Table 3, the respective coefficient is negative (with a relatively high value) and significant. Interestingly, the coefficient for the "main" variable completely losses its significance. This implies that the detected negative impact of corruption on trade is mainly related to most corrupt countries, which may suggest the existence of non-linearities. Therefore, in column 3 of Table 3, we introduce non-linearities by including the square of our variable of interest. As shown, both coefficients are negative. This means that when corruption increases, the negative impact of corruption on trade becomes lower until a point (turning point) in which the contrary occurs.[8] This turning point is in a level of corruption of around −6. More corrupt countries with a level of corruption lower than this and with relatively low values of GDP per capita are candidates for the "grease the wheels" hypothesis. Romania, Senegal, or Tunisia would be examples of this in our sample.

Turning to the general equilibrium analysis, we have considered three interesting cases: two individual cases and an aggregated one. The two individual ones are the most obvious: China and USA. They are the biggest economies in the world. Moreover, China is the main exporter and the USA is the largest importer. As it is well known, the size of an economy greatly influences the impact of the variation in barriers to trade on multilateral resistances (Anderson & van Wincoop, 2003) and then on international trade and, as a result, on welfare. This is why the measured border effect for the USA–Canada border is much larger for Canada than for the USA.

In addition, the perceived average corruption for China in the sample (−3.38) is much greater than that of the USA (−7.36). We compare the welfare effect of a reduction in corruption in a big country with a high level of (perceived) corruption with a considerable relatively lower (perceived) corrupt country. The third case is formed by the group of countries with a perceived corruption greater than the average of the sample.

The results are summarized in Figures 1–4. We have assumed a standard deviation reduction in average corruption in all the cases. An improvement in welfare would imply an increase in GDP, a reduction in prices for consumers, and an increase in prices for producers. We consider the impact on the own country, OECD countries, and the sample as a whole. Rather interestingly, both for China and the USA, domestic consumers lose

Table 3: Trade and Corruption. Unilateral index. Effect of income and degree of corruption. Period 1995–2017**

Dependent variable	(1) Nominal trade flows in current US dollars	(2) Nominal trade flows in current US dollars	(3) Nominal trade flows in current US dollars
RTA_{ijt}	0.100***	0.214***	0.181***
	(0.038)	(0.049)	(0.048)
$Corrup_{i(j)t}$	0.691***	−0.021	−0.851***
	(0.113)	(0.028)	(0.095)
$Corrup_{i(j)t}$ *$Incpc_{i(j)t}$	−0.067***		
	(0.010)		
$Corrup_{i(j)t}$_Dmcc		−0.308***	
		(0.066)	
$Corrup_{i(j)t}$_Sq			−0.067***
			(0.008)
Constant	13.164***	13.275***	12.412***
	(0.067)	(0.088)	(0.074)
Observations	79,972	98,881	98,881
Country pair FE	Yes	Yes	Yes
Importer-year and exporter-year FE	Yes	Yes	Yes
Intra-national trade	Yes	Yes	Yes
Pseudo R^2	0.99	0.99	0.99

Note: *significant at 10% level, **significant at 5% level, ***significant at 1% level. $Corrup_{ijt}$ *$Incpc_{ijt}$, is an interactive variable consisting in our measure of corruption times the GDP per-capita of each country. $Corrup_{i(j)t}$_Dmcc, is an interactive variable consisting in our measure of corruption times a dummy for more corrupt countries, $Corrup_{i(j)t}$_Sq, is the square of our measure of corruption.

8 It is important to bear in mind that in the regression analysis the corruption variable goes from −10 (minimum corruption) to 0 (maximum corruption).

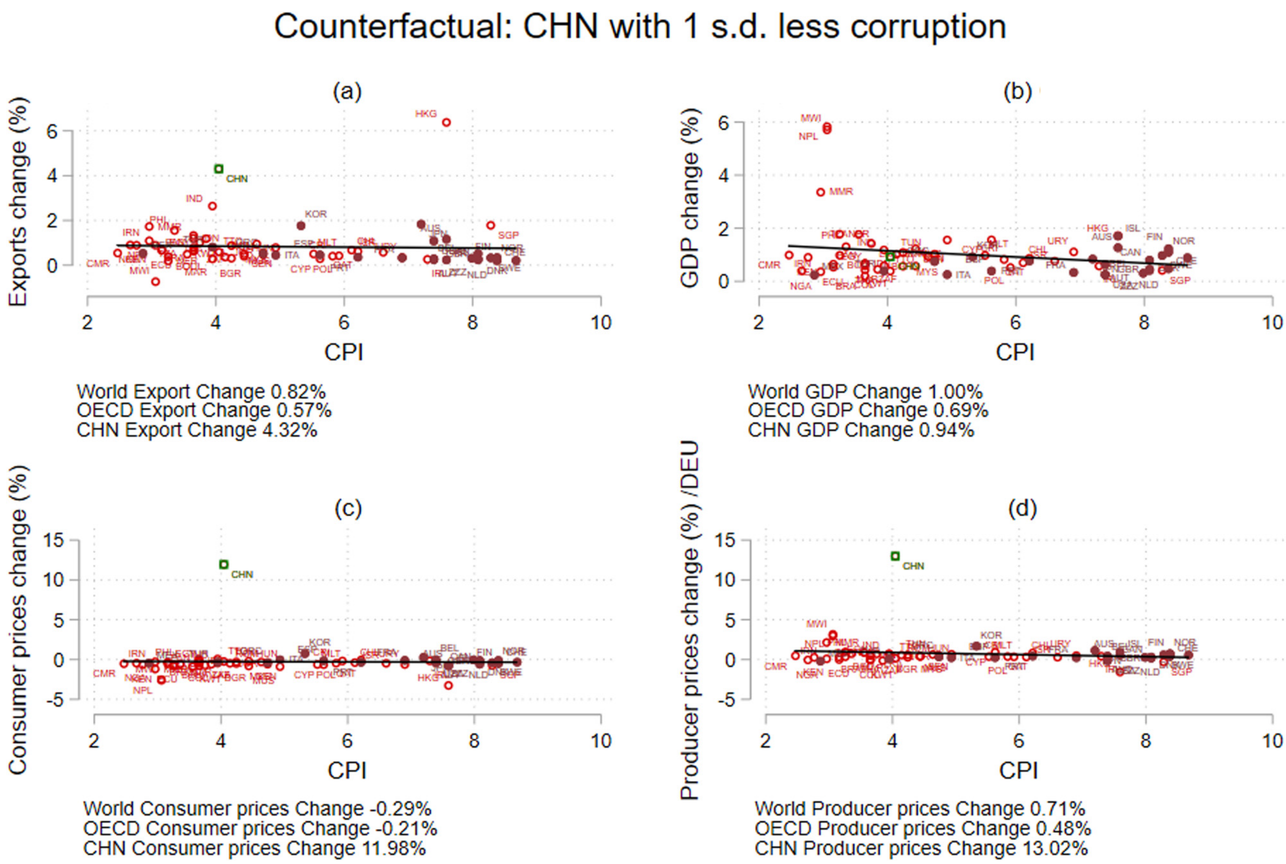

Figure 1: Reduction in perceived corruption in China. (a) Exports change, (b) GDP change, (c) consumer prices, and (d) producer prices.

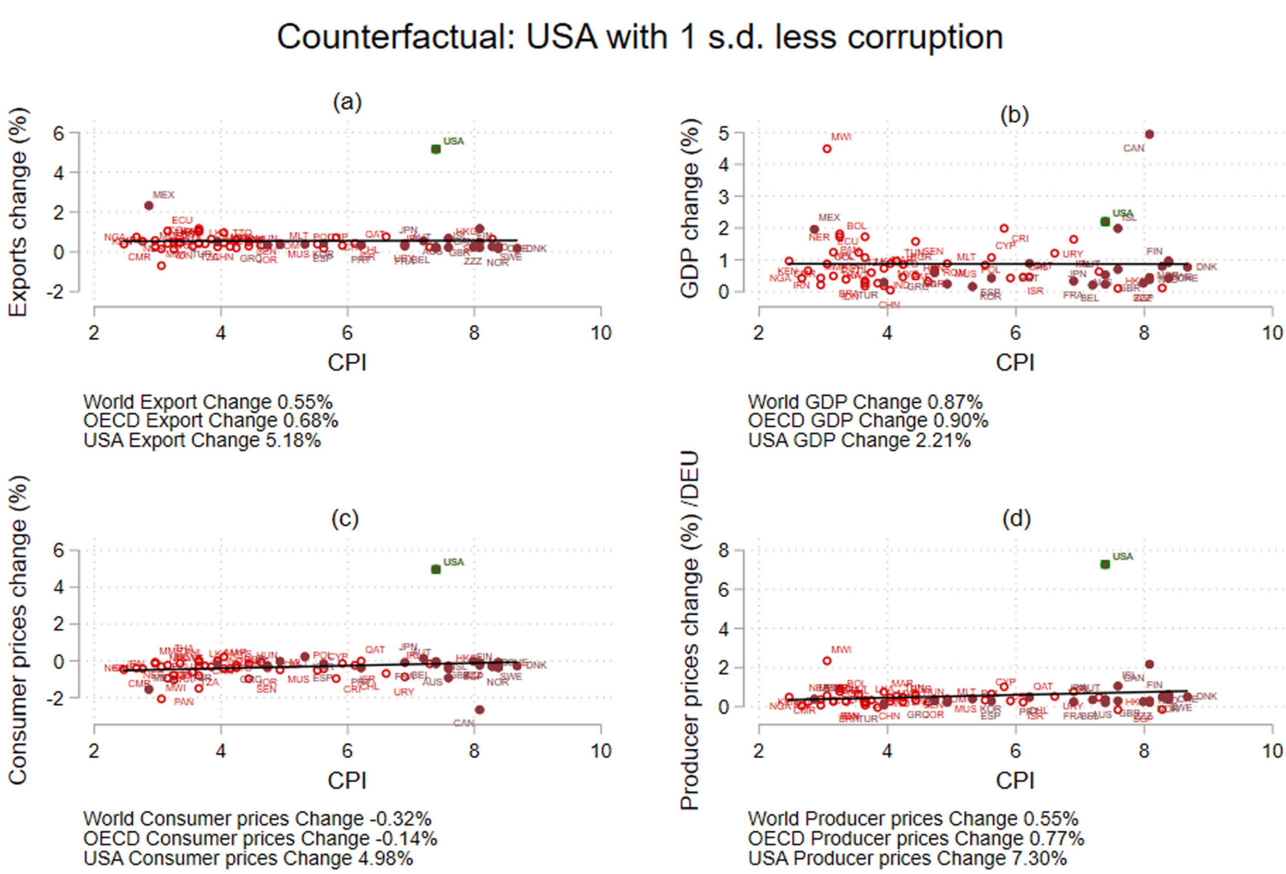

Figure 2: Reduction in perceived corruption in the USA. (a) Exports change, (b) GDP change, (c) consumer prices, and (d) producer prices.

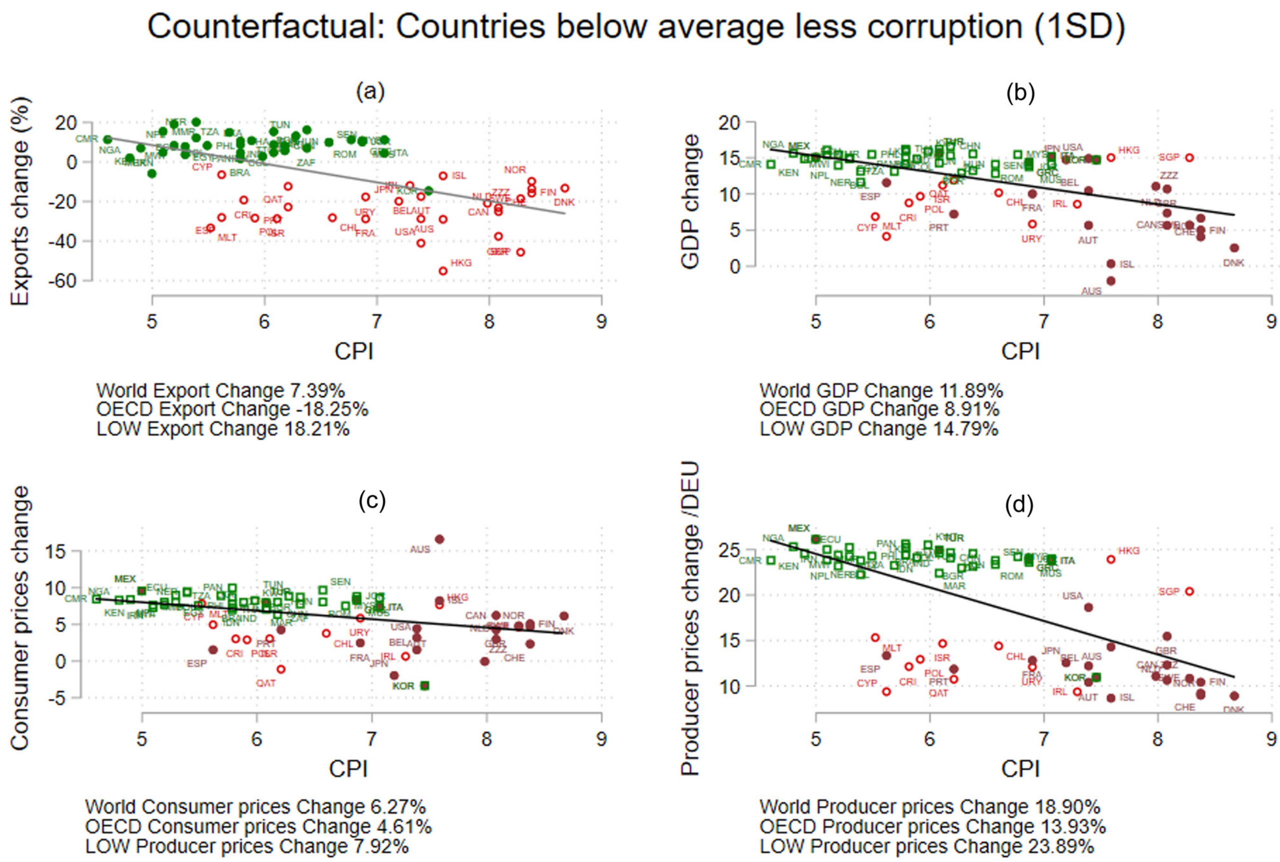

Figure 3: Reduction in perceived corruption in more corrupt countries (with China). (a) Exports change. (b) GDP change, (c) consumer prices, and (d) producer prices.

to a greater extent for the former. However, consumers from the rest of the world gain, but somewhat. The increase in domestic GDP is limited for China but relevant for the USA (2.2%). Interestingly, world's GDP increases more when China reduces corruption than when the USA does. The contrary occurs with OECD countryies' GDP. In both cases, there is a substantial increase in exports.

However, the most interesting result is when corruption is (a standard deviation) reduced for the group of countries with average corruption above the mean. We have alternatively considered China's inclusion (Figure 3) or not (Figure 4). World (and own) GDP increases notably when the most corrupt countries reduce corruption, around 11%, with no significant change if China does not reduce corruption at the same time. Additionally, regardless of whether China is part of this "synchronized" reduction in corruption, there is a net increase in welfare. The mechanism behind the GE analysis is a tariff-equivalent reduction via trade costs. When trade costs are reduced, exporters can sell goods to foreign destinations at a higher price. The change in welfare in the countries facing lower exporting costs is the net increase of producers' welfare and a decrease of consumers' welfare, who now face higher prices. The total effect is positive because the increase in producers' welfare is higher than the decrease in consumers' welfare. Our analysis shows the distributional effects of trade policy. It highlights the difficulty of implementing these measures if countries have frictions in the redistribution of welfare from producers to consumers. The less corrupt countries (mainly OECD members) show opposite distributional effects. The consumers from these countries benefit from relatively cheaper imports, whereas producers sell products at (relative) lower prices. In most of them, there is an increase in welfare, but through a net increase in welfare through consumption.

4 Conclusions

This study analyses the impact of (perceived) corruption on international trade considering the inclusion of domestic flows along the micro-foundations of the gravity equation for the first time in this literature. Additionally, we perform a GE analysis to estimate the impact on welfare for a given reduction in corruption in particular cases.

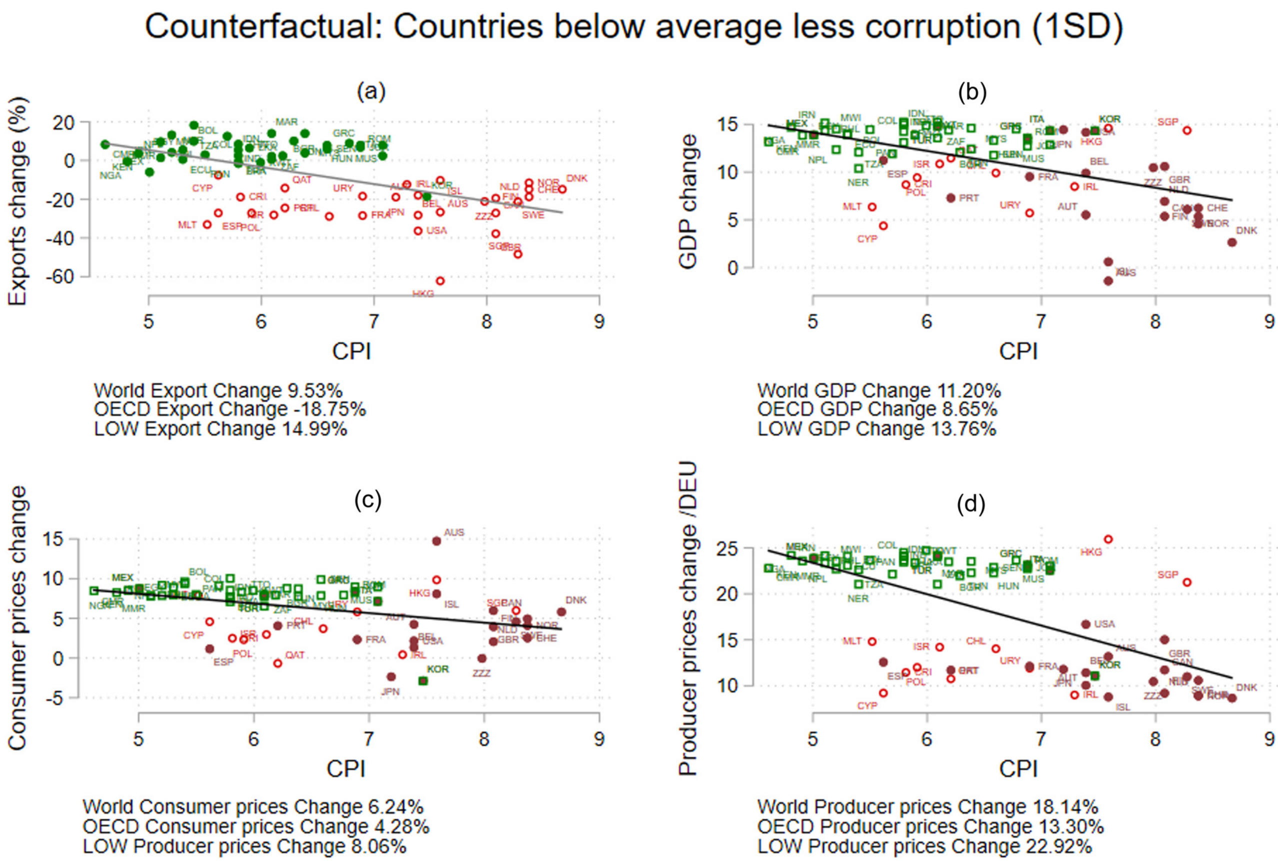

Figure 4: Reduction in perceived corruption in more corrupt countries (without China). (a) Exports change. (b) GDP change, (c) consumer prices, and (d) producer prices.

The results point out the existence of a different impact of our variable of interest compared with the case in which no internal flows are considered. In particular, a sensible negative impact is obtained when domestic flows are measured, whereas no impact is detected if this is not the case. Therefore, the non-inclusion of internal flows leads to a considerable bias in the estimations. In addition, we find that the negative impact of corruption on trade is reduced *ceteris paribus*, in poorer countries. We also find non-linearities: more corrupt countries present a harmful impact of corruption on trade.

The GE analysis shows that less corruption implies more GDP and welfare for producers but not for consumers except for foreign consumers (and not so much) if the USA or China reduce corruption. If there is a generalized reduction in corruption in more corrupt countries again, producers gain and consumers (all consumers) lose. In this case, OECD exports fall. That China forms part or not of this process does not make a real difference.

In sum, it seems that actions directed to reduce corruption have positive effects on the supply side (GDP and welfare of producers), especially for most corrupt countries, which should be the first interested in this type of policies. However, our GE analysis suggests that consumers do not gain directly from reducing corruption. Further research into internal redistribution policies in these countries is worthwhile.

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References

Ahmad, E., Ullah, M. A., & Arfeen, M. I. (2012). Does corruption affect economic growth? *Latinamerican Journal of Economics*, *49*(2), 277–305.

Akbarian, R., & Shirazi, H. (2012). The effect of corruption on trade volumes of selected countries in the Middle East and Latin America (2002–2008). *Quarterly Journal of Quantitative Economics*, *8*(4), 29–46.

Anderson, J. E. (1979). A theoretical foundation to the gravity equation. *American Economic Review*, *69*(1), 106–116.

Anderson, J. E., & van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review*, *93*(1), 170–192.

Anderson, J., & Marcouiller, D. (2002). Insecurity and the pattern of trade: An empirical investigation. *Review of Economics and Statistics*, *84*(2), 342–352.

Anderson, J., Larch, M., & Yotov, Y. V. (2018). GEPPML: General equilibrium analysis with PPML. *The World Economy*, *41*(10), 2750–2782.

Anderson, J., & Yotov, Y. V. (2016). Terms of trade and global efficiency effects of free trade agreements, 1990–2002. *Journal of International Economics*, *99*, 279–298.

Arkolakis, C., Costinot, A., & Rodríguez-Clare, A. (2012). New trade models, same old gains. *American Economic Review*, *102*(1), 94–130.

Baier, S. L., & Berstrand, J. H. (2007). Do free trade agreements actually increase members´ international trade? *Journal of International Economics*, *71*, 72–95.

Baier, S. L., Yotov, Y. V., & Zylkin, T. (2019). On the widely differing effects of free trade agreements: Lessons from twenty years of trade integration. *Journal of International Economics*, *116*, 206–226.

Baldwin, R., & Taglioni, D. (2007). Trade effects of the euro: A comparison of estimators. *Journal of Economic Integration*, *22*(4), 780–818.

Bergstrand, J. H., Larch, M., & Yotov, Y. V. (2015). Economic integration agreements, border effects, and distance elasticities in *the gravity equation*. *European Economic Review*, *78*, 307–327.

Beverelli, C., Keck, A., Larch, M., & Yotov, Y. V. (2018). Institutions, trade and development: A quantitative analysis. *School of economics working paper series 2018–3*. LeBow College of Business, Drexel University.

Dai, M., Yotov, Y. V., & Zylkin, T. (2014). On the trade-diversion effects of free trade agreements. *Economics Letters*, *122*(2), 321–325.

Dreher, A., & Gassebner, M. (2013). Greasing the wheels? The impact of regulations and corruption on firm entry. *Public Choice*, *155*(3–4), 413–432.

Dutt, P., & Traca, D. (2010). Corruption and bilateral trade flows: Extortion or Evasion? *Review of Economics and Statistics*, *92*(4), 843–860.

Egger, P., & Larch, M. (2008). Interdependent preferential trade agreement memberships: An empirical analysis. *Journal of International Economics*, *76*, 384–399.

Egger, P., & Winner, H. (2005). Evidence on corruption as an incentive for foreign direct investment. *European Journal of Political Economy*, *21*(4), 932–952.

Esteve-Pérez, S., Gil-Pareja, S., Llorca-Vivero, R., & Martínez-Serrano, J. A. (2020). EMU and trade: A PPML re-assessment with intra-national trade flows. *The World Economy*, *43*(10), 2574–2599.

Fally, T. (2015). Structural gravity and fixed effects. *Journal of International Economics*, *97*(1), 76–85.

Felbermayr, G. J., & Kohler, W. (2006). Exploring the intensive and extensive margin of world trade. *Review of World Economics*, *142*(4), 642–674.

Gil-Pareja, S., Llorca-Vivero, R., & Martínez-Serrano, J. A. (2008). Assessing the enlargement and deepening of the European Union. *The World Economy*, *31*(9), 1253–1272.

Gil-Pareja, S., Llorca-Vivero, R., & Martínez-Serrano, J. A. (2019). Corruption and international trade: A comprehensive analysis with gravity. *Applied Economic Analysis*, *27*, 3–20.

Heid, B., Larch, M., & Yotov, Y. V. (2017). Estimating the effects of non-discriminatory trade policies within structural gravity models. *CESifo Working Paper No. 6735*.

Helpman, E., Melitz, M., & Rubinstein, Y. (2008). Estimating trade flows: Trade partners and trade volumes. *Quarterly Journal of Economics*, *123*(2), 441–487.

Horsewood, N., & Voicu, A. M. (2012). Does corruption hinder trade for the new EU members. *Economics E-Journal*, *6*, 1–28.

Huntington, S. P. (1968). *Political order in changing societies*. New Haven: Yale University Press.

Jong, F., & Bogmans, C. (2011). Does corruption discourage international trade? *European Journal of Political Economy*, *27*(2), 385–398.

Knack, S., & Azfar, O. (2003). Trade intensity, country size and corruption. *Economics of Governance*, *4*(1), 1–18.

Lambsdorff, J. G. (2003). How corruption affects productivity. *Kyklos*, *56*(4), 457–474.

Larch, M., Wanner, J., & Yotov, Y. V. (2018). Bi-and unilateral trade effects of joining the Euro. *Economics Letters*, *171*, 230–234.

Larch, M., Wanner, J., Yotov, Y. V., & Zylkin, T. (2019). The currency Union Effect: A PPML re-assessment with high-dimensional fixed effects. *Oxford Bulletin of Economics and Statistics*, *81*(3), 487–510.

Leff, N. H. (1964). Economic development through bureaucratic corruption. *American Behavioral Scientist*, *8*(3), 8–14. In A. J. Heidenheimer, M. Johnston, & V. T. LeVine (Eds.), *Reprint in political corruption: A handbook* (1989, pp. 389–403). Oxford: Transaction Books.

Levchenko, A. (2007). Institutional quality and international trade. *Review of Economic Studies*, *74*(3), 791–819.

Leys, C. (1965). What is the problem about corruption? *Journal of Modern African Studies*, *3*(2), 215–230. In A. J. Heidenheimer, M. Johnston, & V. T. LeVine, (Eds.), *Reprint in political corruption: A handbook* (1989, pp. 51–66). Oxford: Transaction Books.

Masila, J. W., & Sigue, S. P. (2010). Corruption and international trade: An empirical investigation of African countries. *The World Economy*, *33*(1), 129–146.

Mattoo, A., Mulabdic, A., & Ruta, M. (2017). Trade creation and trade diversion in deep agreements. *Policy Research Working Paper, 8206*.

Mauro, P. (1995). Corruption and growth. *Quarterly Journal of Economics*, *110*(3), 681–712.

Méon, P. G., & Weill, L. (2010). Is corruption an efficient grease? *World Development*, *38*(3), 244–259.

Nunn, N., & Trefler, D. (2014). Domestic institutions as a source of comparative advantage. In G. Gopinath, E. Helpman, & K. S. Rogoff (Eds.), *Chapter 5, Handbook of international economics* (Vol. 4, pp. 263–316). Oxford: Elsevier.

Pomfret, R., & Sourdin, P. (2010). Why do trade costs vary? *Review of World Economics*, *146*(4), 709–730.

Santos Silva, J. M. C., & Tenreyro, S. (2006). The log of gravity. *The Review of Economics and Statistics*, *88*(4), 641–658.

Thede, S., & Gustafson, N. (2009). The multifaceted impact of corruption on international trade. *International Trade Working Papers*. Lund University.

Tinbergen, J. (1962). *Shaping the world economy*. New York: Twentieth Century Fund.

Voraveeravong, P. (2013). Corruption impacts on bilateral trade between ASEAN countries during 2006 to 2011: Gravity model approach. *World Journal of Social Sciences*, *3*, 27–44.

Wei, S. J. (2000). Local corruption and global capital flows. *Brooking Papers on Economic Activity*, *2*, 303–346.

Yotov, Y. V. (2012). A simple solution to the distance puzzle in international trade. *Economic Letters*, *117*(3), 794–798.

Yotov, Y. V. (2021). *The variation of gravity within countries* (*or 15 reasons why gravity should be estimated with domestic trade flows*) *CESifo Working Paper No 9057*.

Yotov, Y. V., Piermartini, R., Monteiro, J. A., & Larch, M. (2016). *An advanced guide to trade policy analysis: The structural gravity model*. Geneva: World Trade Organization.

Zelekha, Y., & Sharabi, E. (2012). Corruptions, institutions and trade. *Economics of Governance*, *13*(2), 169–192.

Appendix A

Table A1: List of countries

Australia	India	Panama
Austria	Indonesia	Philippines
Belgium-Luxembourg	Iran	Poland
Bolivia	Ireland	Portugal
Brazil	Israel	Qatar
Bulgaria	Italy	Romania
Cameroon	Japan	Senegal
Canada	Jordan	Singapore
Chile	Kenya	South Africa
China	Kuwait	South Korea
Colombia	Macao	Spain
Costa Rica	Malawi	Sri Lanka
Cyprus	Malaysia	Sweden
Denmark	Malta	Switzerland
Ecuador	Mauritius	Tanzania
Egypt	Mexico	Thailand
Finland	Morocco	Trinidad and Tobago
France	Myanmar	Tunisia
Germany	Nepal	Turkey
Greece	Netherlands	United Kingdom
Hong Kong	Niger	United States
Hungary	Nigeria	Uruguay
Iceland	Norway	