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Vézina, Pierre-louis

DOI:
10.1016/j.inteco.2014.09.001

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Document Version
Peer reviewed version

Citation for published version (Harvard):
Vézina, P 2014, 'Illegal trade in natural resources: evidence from missing exports', *Review of International Economics*. https://doi.org/10.1016/j.inteco.2014.09.001

www.elsevier.com/locate/inteco

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Pierre-Louis Vézina

PII: S2110-7017(14)00048-1
DOI: http://dx.doi.org/10.1016/j.inteco.2014.09.001
Reference: INTECO46

To appear in: *International Economics*

Received date: 28 January 2014
Revised date: 19 May 2014
Accepted date: 30 September 2014

Cite this article as: Pierre-Louis Vézina, Illegal trade in natural resources: Evidence from missing exports, *International Economics,* http://dx.doi.org/10.1016/j.inteco.2014.09.001

Illegal trade in natural resources: Evidence from missing exports

Pierre-Louis Vézina

September 30, 2014

Abstract

Countries restrict the export of natural resources to lower domestic prices, stimulate downstream industries, earn rents on international markets, or on environmental grounds. This paper provides empirical evidence of evasion of such export barriers. Using tools from the illicit trade literature, I show that exports of minerals, metals, or wood products are more likely to be missing from the exporter's statistics if they face export barriers such as prohibitions or taxes. Furthermore, I show that this relationship is significantly higher in countries with high levels of corruption. The results have implications for the design of trade policies and environmental protection.

JEL CODES: F13, O17, O19
Key Words: natural resources, illegal trade, trade barriers.

Dept. of Economics, University of Birmingham, and Oxford Centre for the Analysis of Resource Rich Economies, University of Oxford. email: p.vezina@bham.ac.uk.

1 Introduction

Trade in natural resources is highly regulated, mostly on the export side. According to the World Trade Organization (WTO, 2010), about one-third of all export taxes cover natural resource sectors. Countries restrict the export of natural resources to lower domestic prices, promote downstream industries, earn rents on international markets, or on environmental grounds. For example China recently restricted the export of rare earth metals, the US has been restricting oil and gas exports, and Nigeria bans the export of timber.[1] In this paper I show that the illegal avoidance of such barriers is rife and leaves traces in official statistics. To do so, I follow the literature on tariff evasion (e.g. Fisman and Wei (2004)) and show that the trade gap, i.e. the log difference between imports and mirror exports, is significantly correlated with export barriers. To put it simply, exports are more likely to be missing from the exporter's official statistics when export barriers are in place, suggesting part of the reported imports have illegally circumvented export barriers.

My results suggest that the trade gap is as much as 87% larger for products facing export taxes. In other words, illegal exports may amount to as much as reported exports when taxes are in place. The biggest effect by far is found for export prohibitions; the trade gap is around 12 times larger for prohibited exports than for all other products. In the case of prohibition, practically all recorded imports may reflect illegal exports. These effects are strongest in countries facing corruption problems where bribes may hinder barrier enforcement. Interestingly, I do not find a significant effect for export license requirements. This may point to export licenses as the most adequate tool to fight evasion on restricted exports.

This paper contributes to the literature in two main ways. Firstly, while the trade and environmental consequences of export restrictions on natural resources have been studied for a long time (e.g. Dean and Gangopadhyay (1997), Fung and Korinek (2013), and Korinek and

[1] For a review of recent trends in export restrictions, see Kim (2010).

Kim (2010)), this paper is the first to look empirically at their impact on illegal behavior.[2]
As the WTO (2010) puts it, natural resources present particular challenges for policymakers, in part because they are both essential to the production process and potentially exhaustible. Designing efficient trade polices is thus of upmost importance. This paper highlights that attention also needs to be given to the unintended consequences of such polices. Second, I add to the previous illicit-trade studies by Berger and Nitsch (2012), Fisman and Wei (2004), Javorcik and Narciso (2008), and Mishra et al. (2008), by bringing attention to export barriers rather than import tariffs.[3]

The next section (2) describes the data and my empirical strategy. Section (3) discusses the results. A last section (4) concludes.

2 Data and Empirical Strategy

I use data on export restrictions collected by the Organization for Economic Cooperation and Development (OECD) and covering 51 countries in the years 2009-2010 (Fliess and Mard, 2012) (my matching with trade data allows me to run regressions using information on 43 countries. These are listed in Figure 3). It covers most minerals and metals, as well as wood products, in their unprocessed as well as in their semi-processed form. Waste and scrap metal is also included. Commodities covered belong mainly to Chapters 25-28, 44-46, 71-72, and 74-81 of the HS 2007 classification.[4] Among the 780 products within the HS chapters covered, 390 face an export barrier. On average a product faces barriers in 1 country, and

[2] This adds to a wide array of case studies though. For example, Aning (2003) examines the behavior of 'spoilers' who circumvent governments' domestic regulation of trade in natural resources in West Africa. Bleischwitz et al. (2012) examines illicit exports of coltan in the Democratic Republic of Congo in an attempt to draw lessons for certification. In related work Morcom and Kremer (2000) have looked at policies aimed at deterring ivory trade.

[3] A previous study by Fisman and Wei (2009) did look at the illegal evasion of export barriers yet it focused specifically on an export ban on antiques. It found that more antiques exports were likely to be missing in corrupt countries.

[4] The database does not cover all 5,000+ products in the HS classification. This is one more reason for this paper's focus.

at most in 20 countries. A large share of the recorded export measures (42% of measures in 2009 and 46% in 2010) concern waste and scrap of metal. This is followed by metal ores and minerals, precious metals and stones, and ferrous metals. The intensity of export barriers by country is displayed in Figure 1. China, India, South Africa, and Argentina appear as the biggest users of such barriers.

The export barriers may be export taxes, VAT tax reductions, export quotas, export licences, prohibitions, domestic market obligations, captive mining, minimum export prices, and other measures. In my empirical analysis I use 4 dummy indicators. One for any type of export barrier, one for export taxes, one for export licenses, and one for prohibitions. I choose these 3 measures as they are the most widespread.

To uncover illegal exports empirically, I first compute 'missing exports', i.e. exports missing from the exporter's official statistics, as these are likely to include illegal exports that have circumvented export barriers at customs. To do so I use data on trade flows from UN Comtrade at the HS 6-digit level. More precisely, this measure is computed for both trade values and quantities (kilograms) as follows:

(1) $$\text{Missing exports}_{ijt} = \ln(\text{WorldImports}_{ijt}) - \ln(\text{Exports}_{ijt})$$

where Exports_{ijt} indicate total exports of product i, measured at the HS 6-digit level, from country j in year t. $\text{WorldImports}_{ijt}$ is the mirror image of Exports_{ijt} as reported by all importing countries.

Yet 'missing exports' are not by themselves a good proxy for illegal exports. Indeed, import values include cost-insurance and freight (cif) costs whereas export values are free on board (fob), so the difference in reports also reflects transport costs. Trade may also be missing due to exchange-rate miscalculations, different accounting procedures, or statistical errors. For this reason, 'missing exports' may not be used to quantify illegal exports precisely.

Nevertheless, as Fisman and Wei (2004) argue, 'missing trade' still allows us to identify correlation patterns and uncover the causes of illicit flows. In the absence of illegal behavior, there should be no correlation between export barriers and the trade gap. Yet if the trade gaps is significantly higher for exports facing trade barriers, it is highly likely that missing exports include illegal exports that have circumvented customs. In other words, the difference in trade gaps between exports facing barriers and other exports most likely captures illegal exports.

To test for illegal evasion of export barriers hypothesis statistically, I thus estimate the following regression model:

(2) $$\text{Missing exports}_{ijt} = \alpha_{njt} + \beta \ \text{Barrier}^{k}_{ijt} + {}_{ijt}$$

where 'Barrier' is a dummy indicating an export barrier, k stands for the type of export barrier, i stands for product defined at the HS 6-digit level, j for exporting country, t for year, and n for industry, defined at the HS 2-digit level. I choose to include industry-country-year fixed effects, i.e. α_{njt}, to account for country-, year-, or industry-specific attributes that could be driving the relationship between barriers and trade gaps. The identifying variation is thus the most precise across-products as possible, i.e. within country-industry-year.[5]

3 Results

The benchmark results are in Table 2. Whether I take missing exports in dollars or kilograms, I find a positive and significant coefficient on the export-barrier dummy, the prohibition dummy, and the export tax dummy. These suggest that the trade gap is between 36% and 50% larger for products facing any type of export barrier (exp(β)-1). In other words,

[5] I do not include country-product fixed effects as Javorcik and Narciso (2008) and Mishra et al. (2008) as there is too little variation across the two years covered. I thus opt for an identification across products as in Fisman and Wei (2004).

illegal exports may amount to as much as a third of legal exports. For export taxes the trade gap may be as much as 87% larger. Yet the biggest effect by far is found for export prohibitions; the trade gap is around 12 times larger for prohibited exports than for all other products. Interestingly, I do not find a significant effect for export license requirements. This may suggest that this type of export barrier is most adequate in avoiding illegal exports. Another explanation is that the illegal activity is displaced from border circumvention to license acquisition. In this case illegal exports would not appear in the trade gap but rather in a illegal licenses.

In robustness checks I take into account zero trade flows by taking inverse hyperbolic sine rather than logs as the former are defined at zero (see Rotunno et al. (2013) for more on this method). The results in Table 3 confirm the benchmark results. Finally, as the trade gap and export barriers may also be correlated with import tariffs I also run regressions controlling for the simple average of tariffs on the product across all importing countries, using tariff data from TRAINS. The export-barrier evasion results are robust to this additional control variable (Table 4). Furthermore, I find the usual tariff-evasion results where more imports are missing when tariffs are high, when measuring trade in dollars.

I also examine the role of corruption in illegal export. The idea here is that in the presence of corruption it should be even more likely for exporters to evade barriers, for example by paying bribes. Dutt and Traca (2010) showed that when tariffs are high, corruption greases the wheels of commerce, i.e. make it more likely for tariffs to be avoided. Similarly, Fisman and Wei (2009) showed that banned antique exports were more likely to be missing from corrupt countries. More generally, Berger and Nitsch (2012) showed that missing imports were correlated with measures of corruption around the world. An example comes from The Economist (2014) which describes a massive scam in India where a mafia made profits of about $2 billion shipping illegal iron ore to China. The bank details found on computers taken into custody created a trail of 70 families who had bribed officials and politicians to make the exports possible. Hence, if the correlation between missing exports and export barriers indeed captures illegal exports, it should be even higher in countries where circumvention of barriers via bribes is widespread. One way to test for this is to look at how the missing exports-export barrier relationship varies across countries with different levels of corruption.

In Table 5 I show results of regressions where the export-barrier dummy is interacted with corruption in the exporting country (using the 2-year average negative of the World Governance Indicator for control-of-corruption). I find a positive and significant interaction of corruption with export barriers and prohibitions. These suggest that missing exports are higher for product facing such barriers and even more so in corrupt countries. I still find no effect of export licenses on missing exports, no matter the level of corruption. And while the interaction of corruption and export taxes is insignificant, the relationship between corruption and the effect of export taxes is similar to that of the other barriers. This is illustrated in Figure 2 which shows that missing exports of taxed products are only significantly higher than those of non-barrier-facing products when corruption is above the world average. This thus provides further evidence that the relationship between export barriers and missing exports captures illegal behavior.

To investigate further how the missing export-export barrier relationship varies across countries, I also estimate the barrier semi-elasticity of missing export values by country by estimating the following model:

(3) $\text{Missing exports}_{it} = \alpha_{nt} + \beta \ \text{Barrier}^{k} + {}_{it}$

which is the equivalent of model 2 yet without the subscript. Results in Figure 3 indicate that Nigeria, Kenya, Bolivia, Kazakhstan, and Jamaica may have the highest level of illegal behavior. The ranking of countries confirms that corruption is linked to illegal exports. Nigeria in particular appears as an outlier with a semi-elasticity of missing exports as high as 8.5.

4 Conclusion

This paper has shown that the illegal avoidance of export barriers on natural resources is alive and well and that corruption plays a role. This suggests that if the trade is to be controlled for environmental reasons, more effort needs to be put in tackling corruption, which allow for barrier circumvention. More research is also needed to understand how trade policies can be better designed to minimize illegal avoidance in the presence of corruption in the exporting country. One possibility is for the importing country to ban imports of illegal exports. One such example is the US Lacey Act of 1900, amended in 2008 to make it unlawful to import, export, transport, sell, receive, acquire, or purchase in interstate or foreign commerce any plant in violation of any foreign law that protects plants.[6] Similar initiatives could be extended to all natural resources for which trade is restricted for environmental reasons.

[6] The Lacey Act was invoked in a 2009 raid on Gibson which was using hardwoods that had been illegally exported from Madagascar for its guitar manufacturing.

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Table 1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Missing dollars	22452	0.035	2.407	-15.6	16.2
Missing KG	21773	-0.114	2.751	-18.0	19.0
Export barrier	22452	0.065	0.246	0	1
Prohibition	22452	0.002	0.041	0	1
Export tax	22452	0.046	0.209	0	1
License	22452	0.016	0.127	0	1

Table 2: Export-barrier evasion: Evidence from missing exports

	(1)	(2)	(3)	(4)	(5) Missing
			dollars		
Export barrier	0.413***				0.182
	(0.125)				(0.154)
Prohibition		2.533***			2.328***
		(0.724)			(0.715)
Export tax			0.628***		0.503***
			(0.127)		(0.169)
License				-0.221	-0.484**
				(0.188)	(0.193)
Observations	22,452	22,452	22,452	22,452	22,452
R-squared	0.130	0.131	0.131	0.129	0.132
			Missing kilograms		
Export barrier	0.307**		0.0684 (0.126)		(0.174)
Prohibition		2.200***		2.111*** (0.606)	
					(0.607)
Export tax		0.464***	0.425** (0.123)		(0.179)
License				-0.151	-0.300
				(0.223)	(0.233)
Observations	22,077	22,077	22,077	22,077	22,077
R-squared	0.130	0.130	0.130	0.130	0.131

Note: All regression include country-industry-year fixed effects. Product-clustered s.e. in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Export-barrier evasion: Robustness to zeros

	(1)	(2)	(3)	(4)	(5)
	Missing dollars				
Export barrier	0.622***				-0.212
	(0.172)				(0.241)
Prohibition		2.064***			2.228***
		(0.454)			(0.441)
Export tax			0.902***		1.079***
			(0.151)		(0.219)
License				0.118	0.0738
				(0.228)	(0.253)
Observations	42,742	42,742	42,742	42,742	42,742
R-squared	0.433	0.433	0.433	0.432	0.434
	Missing kilograms				
Export barrier	0.769***				-0.362
	(0.258)				(0.399)
Prohibition		3.628***			3.919***
		(0.796)			(0.793)
Export tax			0.916***		1.205***
			(0.222)		(0.358)
License				0.155	0.202
				(0.334)	(0.393)
Observations	42,742	42,742	42,742	42,742	42,742
R-squared	0.474	0.475	0.474	0.474	0.475

Note: All regression include country-industry-year fixed effects. Product-clustered s.e. in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Export-barrier evasion: Robustness to controlling for tariffs

	(1)	(2)	(3)	(4)	(5)
	Missing dollars				
Export barrier	0.378***				0.178
	(0.112)				(0.146)
Prohibition		3.054***			2.851***
		(0.666)			(0.674)
Export tax			0.580***		0.459***
			(0.121)		(0.162)
License				-0.273	-0.518***
				(0.171)	(0.183)
Import tariff	-0.107***	-0.112***	-0.109***	-0.119***	-0.110***
	(0.0251)	(0.0255)	(0.0253)	(0.0257)	(0.0249)
Observations	20,748	20,748	20,748	20,748	20,748
R-squared	0.139	0.140	0.140	0.138	0.142
	Missing kilograms				
Export barrier	0.300**				0.0340
	(0.119)				(0.165)
Prohibition		2.910***			2.845***
		(0.592)			(0.607)
Export tax			0.449***		0.436**
			(0.120)		(0.172)
License				-0.164	-0.281
				(0.210)	(0.217)
Import tariff	-0.0401	-0.0428	-0.0417	-0.0488	-0.0410
	(0.0293)	(0.0296)	(0.0295)	(0.0296)	(0.0291)
Observations	20,325	20,325	20,325	20,325	20,325
R-squared	0.136	0.137	0.137	0.136	0.138

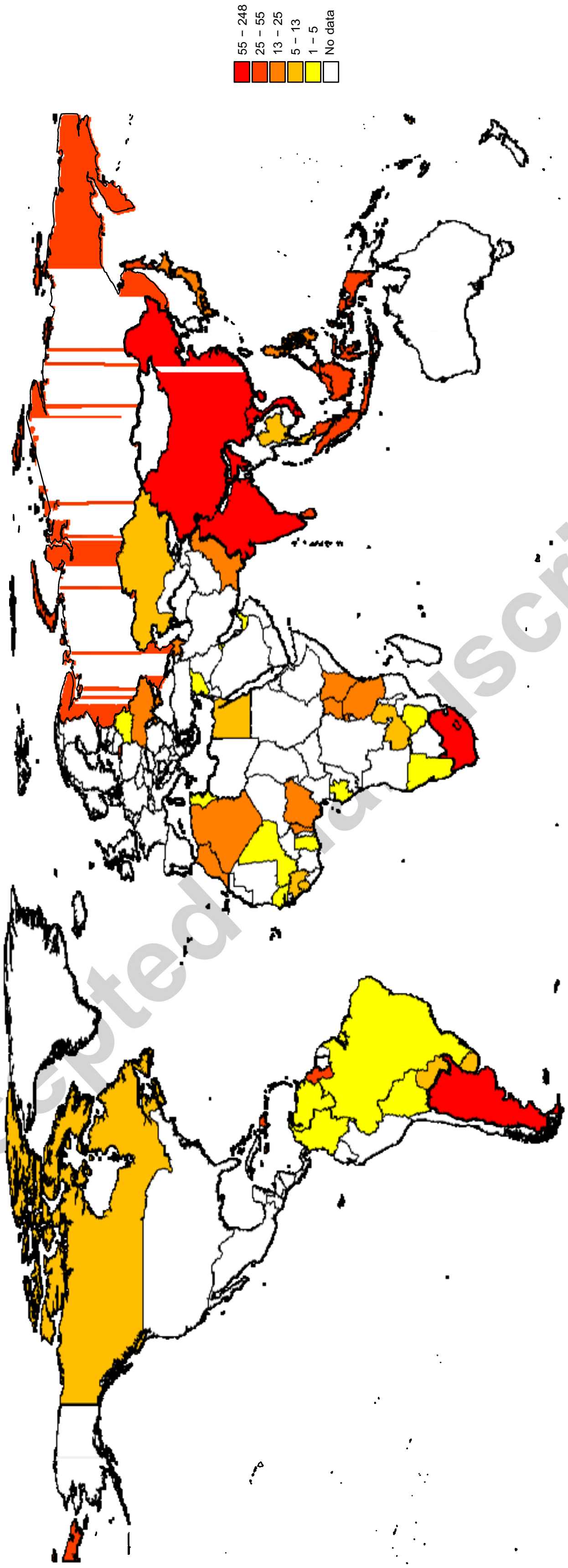
Note: All regression include country-industry-year fixed effects. Product-clustered s.e. in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Export-barrier evasion: The role of corruption

	(1)	(2)	(3)	(4)
	Without zeros		With zeros	
	Dollars	Kilograms	Dollars	Kilograms
Export barrier	0.106	0.0303	0.326*	0.460
	(0.133)	(0.162)	(0.177)	(0.305)
× Corruption	0.725***	0.642***	0.654***	0.679*
	(0.186)	(0.225)	(0.169)	(0.379)
Prohibition	1.432*	1.092	1.612***	3.103***
	(0.809)	(0.670)	(0.475)	(0.914)
× Corruption	1.917**	1.930**	0.898***	1.042
	(0.852)	(0.816)	(0.341)	(0.740)
Export tax	0.560***	0.635***	0.568**	0.492
	(0.191)	(0.216)	(0.264)	(0.393)
× Corruption	0.121	-0.303	0.561	0.712
	(0.304)	(0.347)	(0.440)	(0.655)
License	-0.259	-0.219	0.0444	0.101
	(0.186)	(0.227)	(0.220)	(0.359)
× Corruption	0.309	0.490*	0.347	0.259
	(0.193)	(0.272)	(0.219)	(0.565)

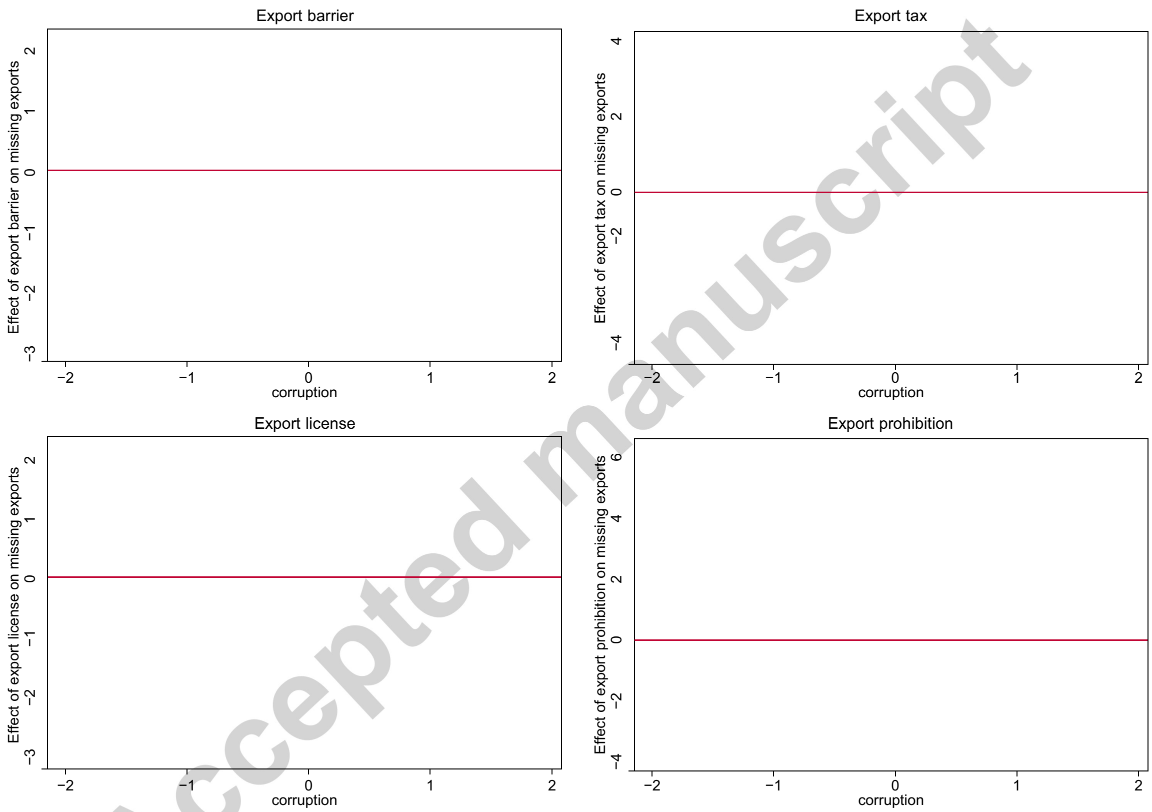
Note: All regression include country-industry-year fixed effects. Product-clustered s.e. in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Figure 1: Export barriers by country



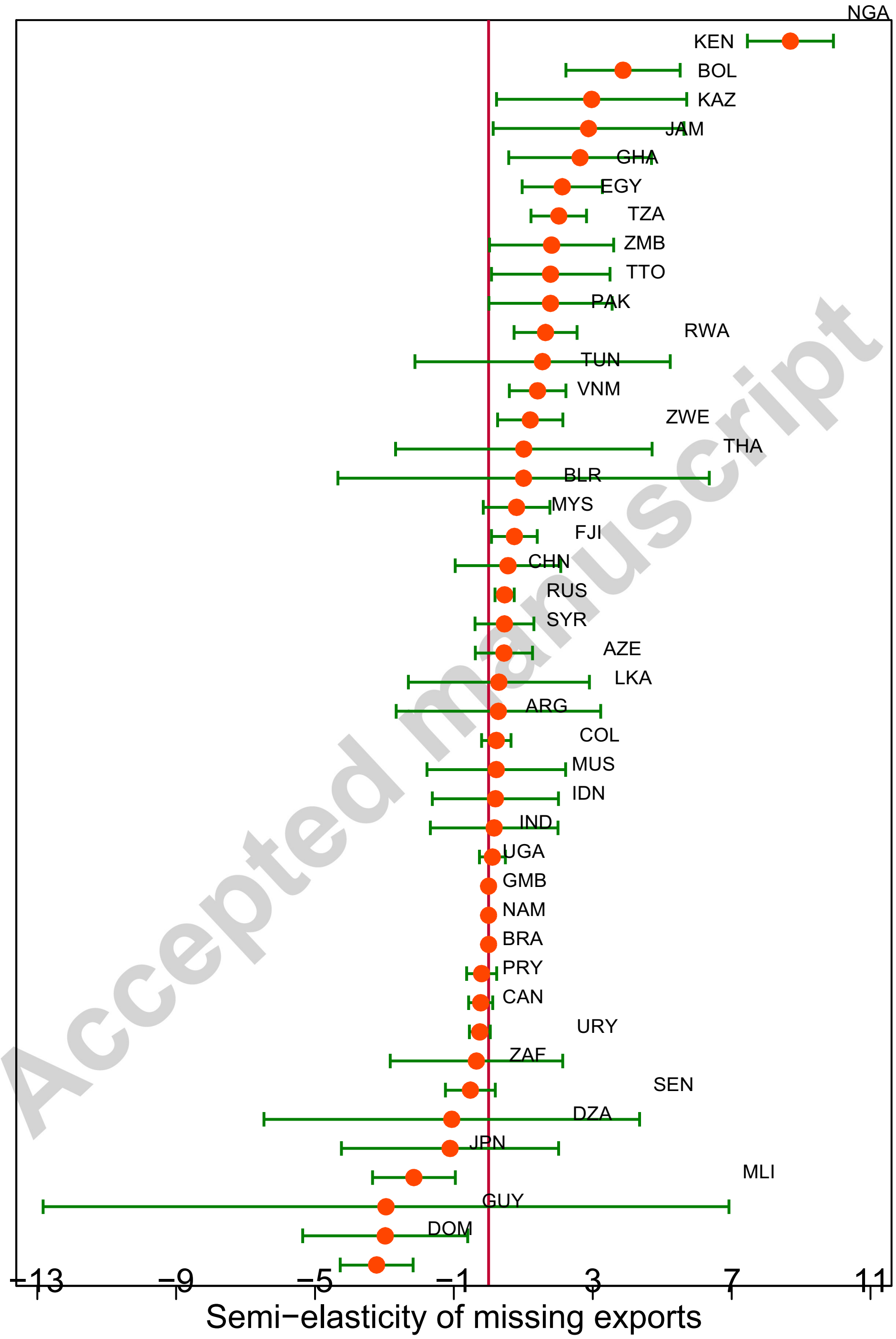
Source: Fliess and Mard (2012).

Figure 2: The role of corruption



Note: Thick dashed lines give 95% confidence interval. Thin dashed line is a kernel density estimate of corruption. These figures are based on regressions in Table 5.

Figure 3: Semi-elasticity of missing export values



Note: The semi-elasticities are obtained by estimating model 3 by country. A higher semi-elasticity suggests a higher illegal response to trade barriers.