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Differentiated products and evasion of import tariffs☆

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ABSTRACT

An emerging literature has demonstrated some unique characteristics of trade in differentiated products. This paper contributes to the literature by postulating that differentiated products may be subject to greater tariff evasion due to the difficulties associated with assessing their quality and price. Using product-level data on trade between Germany and 10 Eastern European countries during 1992–2003, we find empirical support for this hypothesis. We show that the trade gap, defined as the discrepancy between the value of exports reported by Germany and the value of imports from Germany reported by the importing country, is positively related to the level of tariff in 8 out of 10 countries. Further, we show that the responsiveness of the trade gap to the tariff level is greater for differentiated products than for homogeneous goods. A one-percentage-point increase in the tariff rate is associated with a 0.4% increase in the trade gap in the case of homogeneous products and a 1.7% increase in the case of differentiated products. Finally, the data indicate that tariff evasion takes place through misrepresentation of the import prices rather than underreporting of quantities or product misclassification.

1. Introduction

As many developing and transition countries rely on import tariffs as an important source of revenue,[1] evasion of customs duties has attracted a lot of attention from policy makers. For instance, a report released by the state's budgetary watchdog, the Audit Chamber, found that the Russian customs service was plagued by corruption which was costing the state billions of dollars annually (Baumgartner, 2001). An investigation by the Supreme Board of Inspection (NIK) in Poland suggested that importers used various methods to artificially lower the value of imported goods, including fake invoices and double invoicing (Polish News Bulletin, 2000). Revenue loss aside, there are other undesirable effects of tariff evasion. It boosts the profitability of well-connected firms at the expense of honest producers and importers. It may hinder the accession process to the World Trade Organization and hurt the image of the country as an attractive location for foreign direct investment.

The purpose of this study is to enhance our understanding of tariff evasion—concealment of dutiable imports by private parties (individuals or private firms). It aims to do so in three ways. First, it documents the existence of tariff evasion in transition countries by demonstrating that in 8 out of 10 Eastern European economies, the discrepancy between the export figures reported by Germany and the import data recorded by the importing economy is systematically related to the tariff level.[2] In this way, it shows the generality of

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[1] Customs and other import duties accounted for 62% of tax revenue in the Maldives, 55% in Lesotho, 50% in Madagascar, 42% in Bangladesh, 16% in Tajikistan and 10% in Ukraine (2004 figures from the World Bank's World Development Indicators).

[2] Note that while some discrepancy in trade data may be due to lower quality of data recording in Eastern European countries, in the absence of evasion such discrepancy would not be systematically related to the tariff rate.

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the pattern found for China by Fisman and Wei (2004). It also improves on Fisman and Wei's work by relying on panel data rather than mostly cross-sectional information. Second, it finds that tariff evasion is more prevalent for differentiated products, as defined by Rauch (1999). This result is intuitive as it is more difficult to accurately assess the price of differentiated products, which means that honest customs officers find it more difficult to detect an invoice stating an incorrect price and corrupt customs officers have a plausible explanation for why they did not detect the problem with the invoice.[3] Third, the study shows that tariff evasion takes place through misrepresentation of the import prices rather than underreporting of quantities or product misclassification.

Eastern Europe is a suitable environment for this study for three reasons. First, the weakness of its institutions, including the customs service, makes it prone to tariff evasion. For instance, in a 1999 survey 51% of firms in Romania, 45% in Lithuania and 44% in Ukraine believed that there was a need to make "additional payments" when dealing with customs.[4] Second, trade liberalization taking place during the period under study gives us a significant variation in tariff rates across time and across products. During the period under study the average tariff rate in Poland declined from 8.7% to 1.5%. The corresponding figures for Hungary were 12.6% and 4.7%, while for Slovenia the change was from 10.7% to 0.60%. Third, as all but two of the countries in the sample were preparing for their accession to the European Union during the time under study, the changes in their tariff rates were determined by the pre-accession agreements (European Agreements) and thus are not subject to endogeneity problems.

Taking Fisman and Wei's work as our starting point, we analyze the sensitivity of tariff evasion to tariff rates and identify the type of products which are subject to greater evasion. We use data on 10 Eastern European countries over the time period 1992–2003. We measure the trade gap as the difference between the value of exports from Germany to each country in the sample as reported by Germany and the value of imports from Germany as reported by each importing country. Considering the same trading partner for all importers in the sample ensures that the export data are measured consistently. In particular, Germany is chosen as a partner country because of its high level of governance and its role as a major trading partner of all countries in the sample. Germany accounted for 33% of total imports in the Czech Republic, a quarter of imports in both Hungary and Poland and 19% in Slovenia. The lowest share of German imports was registered in Ukraine where they constituted only 8% of the total. The trade figures come from the United Nations' COMTRADE database and are available at the product level (6-digit category in the Harmonized System (HS) classification HS1988/92). Depending on the country, our data set includes information on between 3132 and 3509 products for years between 1992 and 2003. The tariff data, applied by each importing country to imports from Germany, measured also at the 6-digit HS level, have been obtained from the UNCTAD's TRAINS database.

We find a positive and significant relationship between the tariff level and the trade gap. This relationship holds for 8 out of 10 countries as well as for the pooled sample. It is robust to including 6-digit-product dummies and country-year fixed effects. The responsiveness of the trade gap to the tariff level is found to be the highest for Ukraine and the Russian Federation, both of which appear to have a high level of corruption in the customs service according to the BEEPS survey mentioned earlier. It is also interesting to note that no statistically significant relationship is found for Slovenia which is the country with the lowest incidence of customs corruption as reported in BEEPS.

In addition to testing the relationship between tariff levels and evasion, we ask what kind of products are more likely to be subject to evasion. We consider Rauch's (1999) definition of differentiated products and argue that for such products it may be easier to conceal their true value. We confirm our hypothesis by showing that the trade gap is more responsive to the tariff level in the case of differentiated goods than in the case of homogeneous products. This result holds for both a liberal and a conservative definition of differentiated products and is robust to several specifications. The magnitude of the effect is economically meaningful. A one-percentage-point increase in the tariff rate is associated with a 0.4% increase in trade gap in the case of homogeneous products and a 1.7% increase in the case of differentiated products.

A series of robustness checks gives us confidence in the above findings. We show that our results hold when we estimate a specification in first differences, use instrumental variables to take into account possible measurement error and include a proxy for transport costs. Moreover, we demonstrate that no evidence of evasion can be found when we consider trade between countries with a high level of governance, such as Germany and the United States. Further, we find that the governance level in the importing country is the key determinant of tariff evasion. There is no evidence of tariff evasion in the case of German imports from Central and Eastern Europe. Similarly, in the case of bilateral flows within Central and Eastern Europe the extent of evasion is negatively related to the quality of governance in the importing country.

Finally, we consider three channels through which tariff evasion may take place. These are: (i) undercounting physical quantities of imported products, (ii) misrepresenting the price of imported products; and (iii) misclassification of high tariff products as a lower tariff variety. Our data show no evidence suggesting that the gap in the quantities of exports reported by Germany and imports reported by the destination country (which captures reporting a lower than the actual quantity of imports) is positively correlated with the tariff level. More interestingly, we find strong evidence of price misrepresentation in the case of differentiated products but not for all other goods. We conclude that the difficulties associated with assessing the price of differentiated products make them particularly prone to tariff evasion. Finally, we find no indication of product misclassification when we consider misclassification within the same 4-digit HS sector.

Our study is related to the literature documenting evasion of import duties in developing countries. In their 1970 volume, Little, Scitovsky and Scott (1970) pointed out that evasion of import duties through smuggling was a major problem in Mexico, Argentina

[3] An investigation into customs import control launched by the Polish Supreme Board of Inspection showed that the value of imported goods, as included in customs declarations, was often ridiculously low, which went unnoticed by customs officers (Polish News Bulletin, 2000).

[4] The data come from the Business Environment and Enterprise Performance Survey (BEEPS), conducted jointly by the World Bank and the European Bank for Reconstruction and Development. The statistics pertain to the percentage of firms which answered always, mostly, frequently, "sometimes" or "seldom" to the question "How frequently do firms in your line of business have to pay some irregular "additional payments" to deal with customs and imports?"

and the Philippines. Bhagwati (1964) discussed the prevalence of under-invoicing as a method of tariff evasion. The type of corruption that involved import duty evasion in which briber and bribee collude to rob the public was referred by Shleifer and Vishny (1993) as "corruption with theft." Pritchett and Sethi (1994) examined the data from three developing countries (Jamaica, Kenya and Pakistan) and found that collected and official tariff rates are only weakly related, the variance of the collected rate increases strongly with the level of the official rate and the collected rate increases much less than one-for-one with increases in the official rate. The relationship between evasion and tariff rates was analyzed by Fisman and Wei (2004) who found that import duty evasion rises with the tariff rate. Comparing the values of imports from Hong Kong as reported by China with the Hong Kong data on its exports to China at the product level for 1998 they demonstrated that a one-percentage-point increase in the tariff rate was on average associated with a 3% increase in underreporting. In a related study, Fisman et al. (in press) used data on direct exports to mainland China and indirect exports taking place via Hong Kong and found that the indirect export rate rises with the Chinese tariff rate, even though there is no legal tax advantage to sending goods via Hong Kong. They concluded that tariff evasion is an important motivation for indirect trade in world commerce. The authors distinguished between homogeneous and differentiated products but did not find a statistically significant difference between the two groups.[5]

Our study also contributes to the emerging literature on differentiated products. In his seminal work, Rauch (1999) classified goods into three categories. He defined homogeneous goods as products whose price is set on organized exchanges. Goods which are not traded on organized exchanges, but possess a benchmark price, were defined as reference priced. Finally, products whose price is not set on organized exchanges and which lack a reference price because of their intrinsic features were labeled as differentiated. Rauch argued that search costs tend to be higher for differentiated products relative to homogeneous goods and showed that colonial ties and common language are more relevant for trade in differentiated products than trade in homogeneous goods. In subsequent work, Rauch and Trindade (2002) found that the positive impact of ethnic Chinese networks on bilateral trade is greater for differentiated products relative to homogeneous ones. In line with this result, Rauch and Casella (2003) showed that the higher the degree of product differentiation the larger the impact of international ties between wholesalers on bilateral trade. Fink et al. (2005) provided evidence that the effect of communication costs on trade is larger for differentiated products. Feenstra et al. (2001) showed that home market effects are more pronounced for differentiated than for homogeneous products, while Evans (2003) found that the higher the degree of product differentiation, the smaller the border effect. In a recent paper, Besedes and Prusa (2006) showed that transactions in differentiated goods tend to start involving smaller values than transactions of homogeneous goods and that trade relationships tend to be longer for differentiated products than for homogeneous ones.

While our study does not explicitly analyze the effects of customs reform, its results suggest that a system which gives custom officials discretion and does not involve effective audits or secondary inspections is likely to lead to tariff evasion. Corrupt behavior aside, the ability of the customs official to evaluate invoice prices may be greatly enhanced by computerization and international agreements that allow them to obtain verification from foreign institutions about the validity of documents presented by importers.

This study is structured as follows. Section 2 describes the data. Section 3 explores the relationship between tariff rates and evasion, while Section 4 presents the empirical results on tariff evasion for differentiated products. Robustness of the results is explored in Section 5. Section 6 examines the channels through which such evasion takes place. Section 7 concludes.

2. Data

Our first data source is the World Bank's World Integrated Trade Solution (WITS) database. This database contains information on MFN and preferential tariff rates specific to pairs of countries and years, derived from the UNCTAD's Trade Analysis and Information System (TRAINS). The tariff information is available at the 6-digit Harmonized System level. We focus on 8 Eastern European countries acceding to the European Union (Bulgaria, Czech Republic, Hungary, Latvia, Lithuania, Poland, Romania and Slovenia) as well as on the Russian Federation and Ukraine.[6] As most of these countries have preferential trade agreements with the European Union, we use information on applied tariffs.

As illustrated in Table 1, tariff rates differ substantially across the countries considered. Bulgaria, Poland and Lithuania have the lowest average tariff rates ranging from 3.5 to 3.7%, while Russian Federation shows the highest average tariff rate of 12.2%. Both Poland and Lithuania have a large number of zero tariffs as indicated by the median tariff of 0%. It is relevant to note that all countries in the sample undertook trade liberalization during the time period under study and their tariff rates decreased significantly over time. For instance, the average tariff rate in Poland declined from 8.7% to 1.5%. The corresponding figures for Hungary were 12.6% and 4.7%, while in the case of Slovenia the change was from 10.7% to 0.6%.

Our second data source is the United Nations' COMTRADE database which includes information on trade flows expressed in thousands of current US dollars and reported also at the 6-digit HS level. The data are collected by the United Nations from national agencies which transmit figures in national currencies or US dollars. Figures in national currencies are converted into US dollars

[5] Our work is also related to a more general literature on tax evasion. While many theoretical models have analyzed the impact of tax rates on evasion, Slemrod and Yitzhaki (2002) concluded in their survey paper that theoretical findings are not clear-cut, as they strongly depend on modeling assumptions. Contrasting results are provided by empirical studies as well. Clotfelter (1983) and Feinstein (1991), who studied the impact of tax rates on tax evasion by using the U.S. Taxpayers Compliance Measurement Program data, ended up drawing opposite conclusions. Clotfelter found a positive relationship, while Feinstein, who employed a subset of the dataset, provided evidence of a negative relationship.

[6] Data constraints prevent us from including other post-Soviet transition countries in the sample.

Table 1
Tariff rates and trade gap by country

Country	Mean	Median	Standard Deviation	Obs.
		Tariff rates		
Bulgaria	3.517	1.5	6.389	4715
Czech Republic	4.046	3.0	5.926	21,937
Hungary	7.881	6.2	10.618	31,080
Latvia	4.280	0.5	7.260	17,387
Lithuania	3.727	0.0	7.353	13,730
Poland	3.588	0.0	12.890	19,478
Romania	6.817	5.3	8.349	13,592
Russian Federation	12.235	10.0	7.717	22,255
Slovenia	6.730	5.5	7.039	14,349
Ukraine	8.444	5.0	8.741	15,883
		Trade gap		
Bulgaria	0.114	0.012	1.186	4715
Czech Republic	0.120	0.061	1.096	21,937
Hungary	0.063	0.051	1.315	31,080
Latvia	−5.937	−6.771	2.741	17,387
Lithuania	−0.067	−0.041	1.245	13,730
Poland	−0.534	0.028	2.236	19,478
Romania	0.005	−0.033	1.297	13,592
Russian Federation	−5.458	−6.333	2.978	22,255
Slovenia	0.154	0.010	1.344	14,349
Ukraine	−2.880	−1.649	3.855	15,883

Notes: Trade gap = $\ln(\text{exports reported by Germany})_{pt} - \ln(\text{imports reported by the importing country})_{pt}$ where p stands for a 6-digit HS product and t for year.

using monthly exchange rates. The data on tariffs and trade flows are available for the period 1992–2003, though the coverage differs by country.[7]

Using COMTRADE data we calculate the trade gap, which is defined as the log difference between the value of exports from Germany to each country in the sample as reported by Germany and the value of imports from Germany as reported by each partner country. As can be seen in the lower panel of Table 1, there are significant differences in the trade gap across countries. A discrepancy between the value of exports recorded by the exporting country and the value of imports recorded by the importer is to be expected. The first reason is that export prices are expressed in f.o.b. terms while imports are recorded including the cost of insurance and freight (c.i.f.). The second reason is that countries tend to monitor imports more carefully than exports. Thus, in the absence of tariff evasion one would expect the discrepancy to be negative. And indeed the reported value of imports exceeds that of exports in 5 out of 10 countries. The largest difference is observed in Latvia, Russia and Ukraine, which are located farther away from Germany than Poland, the Czech Republic or Hungary and thus their imports may need to incur higher transport costs. However, as illustrated in Table 1, in half of the countries we observe a positive gap which means that on average Germany recorded higher exports of a particular product line than the imports recorded by a transition country. The extent of underreporting (i.e., the positive gap) ranges from the average of 0.05% in Romania, 6% in the case of Hungary to 12% in Bulgaria, 13% in the Czech Republic and 16% in Slovenia.[8] Focusing on the median gap paints a similar picture.

3. Tariff rates and trade gap

It is reasonable to expect that the incentive of importers to evade import duties increases with the tariff rate. And indeed Fisman and Wei (2004) find a positive relationship between the trade gap and the tariff rate in China. But does this relationship hold in other countries or are Chinese importers unique in their ability to conceal imports? As many transition countries had significantly lower tariffs than the average rate of 17.6% imposed by China on imports from Hong Kong in 1998, the year considered by Fisman and Wei, does the relationship between evasion and tariff level hold in transition economies?

To shed some light on these questions, we start by presenting simple summary statistics of the trade gap for each country in our sample. In each country, we split the products into those with the tariff above the median rate and those with the tariff below the median (Table 2). In all countries, except for Poland, the trade gap is higher for products whose tariffs are above the median. For instance, while in Hungary there is no trade gap for products with low protection, in the case of goods with above median tariff rate

[7] The data coverage for individual countries is as follows: Bulgaria 2001–2002; Czech Republic 1996–2001; Hungary 1992–2001; Latvia 1996–2003; Lithuania 1995–2000; Poland 1996–2003; Romania 1999–2003; Slovenia 1999–2003; Russian Federation 1996–2003; Ukraine 1996–2002. Tariff data are not available for all years. In case of missing data, we keep the tariff rate constant until a new tariff rate is available. We fill in the tariff rates for a maximum of three periods. In the WITS database, Hungarian imports are reported only if the value is above US$1000. In order to keep a similar structure, we drop all the exports from Germany to Hungary whose value is below this threshold. A similar problem arises for Poland. No imports below US$50,000 are reported by Poland. We apply the same strategy as before by dropping all the exports from Germany whose value is below this cutoff.

[8] Note that these percentages are calculated by taking the exponent of the values reported in Table 1 and subtracting one.

Table 2
Trade gap by tariff rate

Country	Median trade gap		
	Tariff below median	Tariff above median	Difference
	(1)	(2)	(2)–(1)
Bulgaria	−0.06	0.11	0.17***
	(2405 obs.)	(2310 obs.)	
Czech Republic	0.04	0.10	0.06***
	(13,778 obs.)	(8159 obs.)	
Hungary	0.00	0.13	0.13***
	(16,101 obs.)	(14,979 obs.)	
Latvia	−6.84	−6.62	0.22***
	(10,860 obs.)	(6527 obs.)	
Lithuania	−0.07	.03	0.10***
	(9974 obs.)	(3756 obs.)	
Poland	0.04	−0.01	−0.05***
	(15,146 obs.)	(4332 obs.)	
Romania	−0.07	0.04	0.11***
	(8164 obs.)	(5428 obs.)	
Russian Federation	−6.53	−6.09	0.44***
	(12,197 obs.)	(10,058 obs.)	
Slovenia	−0.01	0.07	0.08***
	(10,543 obs.)	(3806 obs.)	
Ukraine	−1.88	−1.25	0.63***
	(9670 obs.)	(6213 obs.)	

Notes: Trade gap = ln(exports reported by Germany)$_{pt}$ − ln(imports reported by the importing country)$_{pt}$ where p stands for a 6-digit HS product and t for year. The median tariff values are calculated for each country and each year. Test for equality of medians: *significant at 10%; **significant at 5%; ***significant at 1%.

the discrepancy increases to 14%.[9] In Bulgaria, the value of exports of products with a below median tariff rate is 6% lower than the value of imports, but in the case of above median tariff rates, imports are underreported by 11%. These summary statistics are consistent with the idea that the gap value is a proxy for tariff evasion. We obtain similar results when we split the sample between products with the top 25% tariff rates versus the rest. The puzzling result regarding Poland may be explained by the high percentage of products subject to zero tariffs. The percentage of products exempt from tariffs increased from 13% in 1998 to 90% in 1999 and remained well above 90% in the following years.

Next we estimate a simple model of the trade gap as a function of the tariff rate and year fixed effects. We do so for each country c in the sample separately.

$$ln\ Export\ value_{Germany,cpt} - ln\ Import\ value_{cpt} = trade\ gap_{cpt} = \delta + \beta\ tariff_{cpt} + \alpha_t + \varepsilon_{cpt} \quad (1)$$

where p stands for a 6-digit product and t for year. We cluster standard errors on 6-digit products. Our prior is that if the gap value is a good proxy for tariff evasion then the estimated coefficient of the tariff rate should be positive and significant.

The results, reported in the top panel of Table 3, are consistent with the summary statistics presented earlier. The estimated coefficient on the tariff rate is positive and significant at the 1% level for all the countries but Slovenia and Poland. The higher the tariff rate, the lower the value of imports reported by the importing country relative to the reported exports (i.e., the higher the trade gap). A one-percentage-point increase in the tariff level is associated with a 4.5% increase in the trade gap in Ukraine, 3.8% increase in the Russian Federation and 0.9% increase in Hungary. These results are in line with Fisman and Wei's study which finds a 3% increase.[10]

It is interesting to note that Ukraine, the country with the highest estimated elasticity, has the second highest prevalence of corruption in customs as reported in the BEEPS survey. Slovenia, a country for which there is no statistically significant relationship, is ranked as the cleanest country in terms of corruption in customs according to BEEPS.[11] The insignificant coefficient found in the case of Poland is likely to be driven by the high percentage of products which are subject to zero tariff.

To take into account differences in transport and insurance costs across products as well as in other unobservable product characteristics, we add to 6-digit-product fixed effects to specification (1). The statistical significance of the results decreases, but, remarkably, we still find a positive and statistically significant coefficient in five specifications. We also check whether the results could be driven by outliers. Removing potential outliers does not alter the results so we do not report these specifications.

4. Trade gap, tariff rates and differentiated products

As mentioned earlier, differentiated products may lend themselves more readily to tariff evasion than homogeneous goods as their price depends on many attributes some of which may not be easily verifiable by a person unfamiliar with the product.

[9] Note that these percentages are calculated by taking the exponent of the values reported in Table 2 and subtracting one.
[10] Note that these calculations do not take into account the direct effect an increase in a tariff rate may have on the volume of imports.
[11] This correlation suggests that the Fisman–Wei methodology could potentially be used to derive an index capturing the extent of corruption in customs.

Table 3
Trade gap and tariff rate by country

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Bulgaria	Czech Republic	Hungary	Latvia	Lithuania	Poland	Romania	Russia	Slovenia	Ukraine
Trade gap										
Tariff	0.011***	0.015***	0.009***	0.021***	0.013***	−0.000	0.010***	0.038***	−0.005	0.045***
	[0.003]	[0.002]	[0.001]	[0.004]	[0.002]	[0.001]	[0.003]	[0.004]	[0.003]	[0.004]
Obs.	4715	21,937	31,080	17,387	13,730	19,478	13,592	22,255	14,349	15,883
Adj. R^2	0.004	0.008	0.007	0.004	0.009	0.694	0.004	0.013	0.000	0.011
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Bulgaria [a]	Czech Republic	Hungary	Latvia	Lithuania	Poland	Romania	Russia	Slovenia	Ukraine
Trade gap										
Tariff	NA	0.007*	0.007***	0.012*	−0.019	−0.002	0.013	0.040***	−0.016***	0.022**
	NA	[0.004]	[0.002]	[0.007]	[0.024]	[0.002]	[0.008]	[0.010]	[0.003]	[0.009]
Obs.	4715	21,937	31,080	17,387	13,730	19,478	13,592	22,255	14,349	15,883
Adj. R^2	NA	0.005	0.005	0.002	0.009	0.769	0.001	0.009	0.004	0.001

Upper panel: All regressions include year fixed effects and a constant. Standard errors, clustered on 6-digit products, are listed in parentheses.
Lower panel: All regressions include year fixed effects and 6-digit-product fixed effects. Standard errors, clustered on 6-digit products, are listed in parentheses.
*Significant at 10%; **significant at 5%; ***significant at 1%.
[a] Data for Bulgaria are available for two years only so we do not estimate a specification with product fixed effects.

Therefore, in the case of differentiated products it is more difficult for honest customs officers to detect an invoice stating an incorrect price and corrupt customs officers have a plausible explanation for why they failed to detect the problem with the invoice.

In our analysis, we use the classification of differentiated products developed by Rauch (1999). Rauch defined differentiated products as those not having a reference price or those whose price is not quoted on organized exchanges. Wheat and diamonds are classified as homogeneous goods, while coats and jackets are considered to be differentiated products. Rauch suggested two definitions, a conservative and a liberal one in order to account for the ambiguities arising in the classification. The conservative definition minimizes the number of commodities that are classified as homogeneous goods, while the liberal definition maximizes this number.[12] We employ both classifications, although the results do not differ substantially between the two. Rauch's definitions are based on the 4-digit SITC Rev. 2 classification, and we use the concordance provided by WITS to make it compatible with the 6-digit HS 1988/92 classification used in our data set.

A comparison of the median trade gap for differentiated and homogeneous goods (not reported to save space) confirms our prior about differentiated products lending themselves more readily to tariff evasion. In all countries, the trade gap is larger for differentiated products than for homogeneous goods.[13] For instance in Hungary, there is no discrepancy for homogeneous products, but a trade gap of 8% is found for differentiated products. In the case of the Czech Republic, the gap increases from 1.5% for homogeneous goods to 9% for differentiated products.

To test whether differentiated products are more likely to be subject to underreporting, we pool all countries in the sample and regress the trade gap on the tariff rate and the interaction between the tariff rate and the differentiated product dummy.[14] Our specification is as follows:

$$trade\ gap_{cpt} = \beta_1 tariff_{cpt} + \beta_2 tariff_{cpt} * differentiated\ product_p + \alpha_{ct} + \alpha_p + \varepsilon_{cpt} \quad (2)$$

where trade gap_{cpt} is the gap value for the country c importing product p at time t; $tariff_{cpt}$ is the tariff rate imposed by country c on imports of product p from Germany at time t, differentiated $product_p$ is the differentiated product dummy based on Rauch's conservative or liberal definition, depending on the specification. To control for importing-country-specific changes that may occur in a particular time period, such as a reform of the customs service or a decline in the incidence of corruption, we include country-year fixed effects. Thus to the extent that the introduction of computerization or an increase of salaries in the customs service affects tariff evasion across the board, it will be captured by these fixed effects. To take into account time-invariant factors specific to particular products, we include fixed effects for 6-digit HS categories.

In line with the evidence shown in the previous section, we expect the estimated coefficient for the tariff rate to be positive and significant. The higher the tariff rate, the higher the incentive for tax evasion, and the higher the expected gap. We are, however, primarily interested in the interaction between the tariff rate and the differentiated product dummy. Our prior is that the effect of the tax rate is higher for differentiated products relative to homogeneous ones. This is because differentiated products may make it easier for importers or corrupt customs officials to misrepresent the price of the imports. Classifying homogeneous goods is relatively straightforward and there is little variation in prices, thus misrepresenting the price could be easily detected. With differentiated products the wide range of potential uses, product characteristics and quality levels make the assessment of price more difficult, thus creating more room for tax evasion. Therefore, we expect the estimated coefficient β_2 to be positive.

[12] A definition which is conservative with respect to homogeneous goods should be considered liberal with respect to differentiated products. However, as both the conservative and the liberal classifications developed by Rauch are widely used, we do not swap the names in the text to avoid confusion.
[13] Ukraine is an exception but only in the case of the conservative definition.
[14] Note that the need for a separate differentiated product dummy is obviated by the inclusion of product fixed effects.

Table 4
Trade gap, tariff rates and differentiated products

	Trade gap					
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff	0.010***	0.004**	0.004***	0.010***	0.002	0.003**
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Tariff*conservative dummy		0.013***			0.015***	
		[0.002]			[0.002]	
Tariff*liberal dummy			0.013***			0.014***
			[0.002]			[0.002]
Agricultural products	Included	Included	Included	Excluded	Excluded	Excluded
Obs.	174,406	174,406	174,406	169,472	169,472	169,472
Adjusted R^2	0.60	0.60	0.60	0.60	0.60	0.60

All regressions include country-year fixed effects and 6-digit-product fixed effects. Standard errors, clustered on 6-digit products, are listed in parentheses.
*Significant at 10%; **significant at 5%; ***significant at 1%.

The results, reported in Table 4, support our hypothesis that the positive relationship between the tariff rate and trade evasion is stronger for differentiated products. In the first column of Table 4, we confirm that the positive correlation between tariff levels and the trade gap holds in the pooled sample. In the second column, we employ the conservative definition and find that the estimated coefficient on the interaction term is positive and significant at the 1% level. This finding confirms our prior that the response of tariff evasion to the tariff rate is higher for differentiated products. As in the country regressions, the tariff coefficient remains positive and statistically significant, indicating that an increase in the tariff rate leads to an increase in the gap value, and hence to an increase in the evasion and underreporting of imports. The results hold when we consider the liberal definition of differentiated products (see column 3). Again, the responsiveness of evasion to an increase in the tariff rate is greater for differentiated products. The estimated coefficient of the interaction term is positive and statistically significant at the 1% level. The magnitude of the effect is economically meaningful. A one-percentage-point increase in the tariff rate is associated with a 0.4% increase in evasion in the case of homogeneous products and a 1.7% increase in the case of differentiated products.[15] Note that this magnitude is smaller than the effect found by Fisman and Wei (2004) who reported than in China a one-percentage-point increase in the tariff rate was on average associated with a 3% increase in underreporting.

To get a sense of the implications of these findings for the importing country's revenues, we perform a back-of-the-envelope calculation. An increase in the tariff rate from zero to the average level in Bulgaria (3.5%) would lead to a 3.465% increase in the trade value gap (based on the estimates from column 1).[16] If we believe that all missing trade in Bulgaria in 2001 was due to tariff evasion, then at an average tariff of 3.5%, tariff evasion was costing the state coffers 213,773 dollars.[17]

A potential concern is that our results may be driven by agricultural products which are homogeneous in nature and may be subject to non-tariff barriers. To check this possibility, in columns 4–6 we replicate the previous specifications excluding agricultural products (HS codes 010111 to 530599). The same results hold: the estimated coefficient of the tariff rate is still positive and statistically significant in two of three cases. Similarly, the interaction term between the tariff rate and the differentiated product dummy, both in the liberal and conservative definition, has a positive and highly significant impact on the trade gap.

5. Robustness checks

In this section, we present a series of robustness checks. We start by considering a specification in first differences. Then we use the instrumental variable approach to address the potential measurement error in tariff data. Next we ask whether trade costs and exchange rate fluctuations could be responsible for our findings. We also show that the results do not hold for an alternative product classification, which gives us confidence that our findings reflect properties of differentiated products rather than some other product attributes. As a final robustness check, we examine whether similar results could be found for trade between countries where evasion is unlikely to take place and whether there is a link between the level of governance in the importing country and tariff evasion. All of these robustness checks give support to our hypothesis of tariff evasion being responsive to tariff rates and being more prevalent for differentiated products.

5.1. First differences

Our initial robustness check is to estimate a model in first differences. This will allow us to eliminate the time-invariant effects specific to a particular product imported by a particular country. To control for importing-country-specific time trends, e.g., an

[15] These magnitudes refer to the specification in columns 2 and 3.
[16] Note that this calculation ignores the effect of tariff change on the volume of trade.
[17] This number was obtained by multiplying the actual trade gap for each product by the tariff rate applicable to that product.

Table 5
Trade gap, tariff rates and differentiated products

	Δ Trade gap					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Tariff	0.003	−0.003	−0.002	0.004*	−0.001	−0.000
	[0.002]	[0.004]	[0.004]	[0.002]	[0.004]	[0.004]
Δ Tariff*conservative dummy		0.010**			0.0083*	
		[0.005]			[0.0049]	
Δ Tariff*liberal dummy			0.009**			0.0076
			[0.005]			[0.0047]
Agriculture	Included	Included	Included	Excluded	Excluded	Excluded
Observations	137,049	137,049	137,049	133,608	133,608	133,608
Adj. R^2	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003

Specification in first differences.
All regressions include country fixed effects. Robust standard errors are listed in parentheses.
*Significant at 10%; **significant at 5%; ***significant at 1%.

improvement in the quality of the customs services over time, we include importing-country fixed effects. Our estimating equation takes the following form:

$$\Delta trade\ gap_{cpt} = \gamma_1 \Delta tariff_{cpt} + \gamma_2 \Delta tariff_{cpt} * differentiated\ product_p + \lambda_c + \varepsilon_{cpt}. \quad (3)$$

Again, the estimation results confirm our earlier findings (see Table 5). The interaction term is positive and statistically significant for both the liberal and the conservative definition of differentiated products when agricultural products are included and for the conservative definition when they are excluded. The coefficient on tariff level, however, loses its significance in all but one specification.

5.2. Instrumental variable approach

One may be concerned about a potential measurement error being present in the tariff data. To address this possibility we use the instrumental variable approach where the first and the second lags of tariffs as well as initial tariffs and their interactions with the differentiated product dummy serve as instruments. As reflected in the Shea partial R^2 statistics, the instruments are good predictors of the variables of interest. The Hansen test does not cast doubt on their validity. As evident from Table 6 below, using the instrumental variable approach produces results very similar to those obtained earlier. The interactions between tariff and the differentiated product dummy are positive and statistically significant at the 1% level in all specifications. The coefficients on tariff are positive in all cases and statistically significant in 4 of 6 regressions. Note that the coefficients estimated in this way are slightly larger than the coefficients obtained using the OLS, which is consistent with the measurement error biasing the estimated effects towards zero. While Table 6 is based on the full sample, estimating these models on the subsample excluding agricultural products (not reported here to save space) would lead to similar conclusions.

Table 6
Instrumental variable analysis

	Trade gap					
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff	0.011***	0.003*	0.004**	0.012***	0.002	0.003
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Tariff*conservative dummy		0.017***			0.020***	
		[0.002]			[0.003]	
Tariff*liberal dummy			0.016***			0.020***
			[0.002]			[0.003]
Hansen *J* statistic	2.429	1.733	1.630	0.157	0.257	0.614
p-value	0.119	0.420	0.443	0.692	0.880	0.736
Shea partial R^2, tariff	0.761	0.783	0.781	0.599	0.632	0.628
Shea partial R^2, interaction		0.749	0.748		0.583	0.581
Observations	146,956	146,956	146,956	121,438	121,438	121,438

All regressions include country-year fixed effects and 6-digit-product fixed effects. Standard errors, clustered on 6-digit products, are listed in parentheses. Agricultural products are included.
Instrumented variables: Tariff, Tariff*conservative (liberal) dummy.
Instruments in columns (1)–(3): Tariff lagged one period, Tariff lagged one period*conservative (liberal) dummy, Initial tariff, Initial tariff*conservative (liberal) dummy.
Instruments in columns (4)–(6): Tariff lagged two periods, Tariff lagged two periods*conservative (liberal) dummy, Initial tariff, Initial tariff*conservative (liberal) dummy.
Initial tariff is defined as the tariff pertaining to the first year for which the data are available (for a given country).
*Significant at 10%; **significant at 5%; ***significant at 1%.

Table 7
Trade gap, tariff rates, differentiated products and transport costs

	Trade gap					
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff	0.010***	0.003*	0.004**	0.010***	0.002	0.003*
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Transport cost	−0.016**	0.002	−0.003	−0.018***	−0.002	−0.007
	[0.006]	[0.012]	[0.011]	[0.007]	[0.012]	[0.011]
Transport cost*conservative dummy		−0.025*			−0.022	
		[0.014]			[0.015]	
Transport cost*liberal dummy			−0.019			−0.016
			[0.013]			[0.014]
Tariff*conservative dummy		0.014***			0.014***	
		[0.002]			[0.002]	
Tariff*liberal dummy			0.013***			0.013***
			[0.002]			[0.002]
Agricultural products	Included	Included	Included	Excluded	Excluded	Excluded
Observations	163,089	163,089	163,089	159,279	159,279	159,279
Adj. R^2	0.61	0.61	0.61	0.61	0.61	0.61

All regressions include 6-digit-product fixed effects and country-year fixed effects. Standard errors, clustered on 6-digit products, are listed in parentheses. Transport cost = ln(imports from Germany to Finland as reported by Finland)$_{pt}$ − ln(exports to Finland as reported by Germany)$_{pt}$ where p stands for a 6-digit HS product and t for year.
*Significant at 10%; **significant at 5%; ***significant at 1%.

5.3. Could transport costs be an alternative explanation?

As mentioned earlier, because import data are reported on c.i.f. basis while exports are recorded on f.o.b. basis, the trade gap captures the cost of insurance and freight. Thus one may be concerned about our results reflecting transport costs rather than tariff evasion.

We do not believe this is the case for several reasons. First, 6-digit-product fixed effects included in all models (other than the first difference specification where they are differenced out) capture time-invariant transport costs specific to a particular product. For instance, if it is more costly to transport steel tubes than shirts, 6-digit-product fixed effects will capture that. Similarly, in a first difference specification a time-invariant component of the transport cost specific to a product and a country-pair is differenced out. So if it is more costly to send cars from Germany to Russia than to Poland, this difference will drop out. Second, country-year fixed effects (or country trends in the first difference specification) control for improvements in national transport infrastructure that could potentially be correlated with trade liberalization. Third, as discussed below including a proxy for transport costs and its interaction with the differentiated product dummy does not alter the results. Fourth, as mentioned below including an interaction of distance with the differentiated product dummy does affect the results either.

While ideally we would like to have information on bilateral transport costs for countries in our sample, such data are not available to us. Therefore, we use information on trade between Germany and Finland to create a proxy for 6-digit-product-specific time-varying transport costs. As figures on Finnish imports from Germany are recorded including the cost of insurance and freight (c.i.f. basis) and figures on German exports to Finland exclude the cost of insurance and freight (f.o.b. basis), we can subtract the latter series from the former to obtain product-specific time-varying cost of transporting and insuring goods shipped from Germany to Finland. We choose Germany for this exercise because it is the exporting country in our analysis. We pick Finland as the importing country because it was ranked by Transparency International as the least corrupt country in the world in all but three

Table 8
Trade gap, tariff rates, and final versus differentiated products

	Trade gap					
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff	0.009***	0.003*	0.004**	0.009***	0.001	0.002
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Tariff*final product dummy	0.001	0.001	0.001	0.002	0.003	0.002
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Tariff*conservative dummy		0.013***			0.015***	
		[0.002]			[0.002]	
Tariff*liberal dummy			0.013***			0.014***
			[0.002]			[0.002]
Agricultural products	Included	Included	Included	Excluded	Excluded	Excluded
Obs.	173,047	173,047	173,047	168,146	168,146	168,146
Adj. R^2	0.6014	0.6016	0.6016	0.6014	0.6017	0.6016

All regressions include country-year fixed effects and 6-digit-product fixed effects. Standard errors, clustered on 6-digit products, are listed in parentheses.
*Significant at 10%; **significant at 5%; ***significant at 1%.

Table 9
Trade gap between Germany and United States

	Trade gap Germany–US					
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff	0.004	0.004	0.004	0.004	0.004	0.004
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Tariff*conservative dummy		−0.001			−0.001	
		[0.009]			[0.009]	
Tariff*liberal dummy			0.000			−0.000
			[0.009]			[0.010]
Agricultural products	Included	Included	Included	Excluded	Excluded	Excluded
Obs.	42,152	42,152	42,152	41,466	41,466	41,466
Adj. R^2	0.002	0.002	0.002	0.002	0.002	0.002

All regressions include 6-digit-product fixed effects and year fixed effects. Standard errors, clustered on 6-digit products, are listed in parentheses.
Note: Trade gap Germany–US = ln(exports to the US as reported by Germany)$_{pt}$ − ln(imports from Germany to the US as reported by the US)$_{pt}$ where p stands for a 6-digit HS product and t for year.
*Significant at 10%; **significant at 5%; ***significant at 1%.

years during the 1998–2007 period. In the other three years, it ranked second. This gives us confidence that Finnish import data are not contaminated by tariff evasion.

This proxy for transport costs is then included in our model together with its interaction with the differentiated product dummy. As evident from Table 7, our results are robust to this extension of the model. In all cases, the interaction term between tariff and the differentiated product dummy is positive and statistically significant. The coefficient on tariff is positive and significant in all but one specification. Transport costs by themselves or in an interaction with the differentiated product dummy do not appear to be statistically significant in most cases. In two cases where transport cost is statistically significant, its sign is intuitive. As we would expect, a higher transport cost leads to a lower trade gap.

In another robustness check, not reported here to save space, we rely on the fact that transport costs are related to distance. Hence, we include an interaction between the log of the distance from Germany to the importing country in Central and Eastern Europe and the differentiated product dummy. Note that we do not need to include the distance by itself as the specification includes importing-country-year fixed effects. Adding this new interaction term has no effect on the magnitudes and significance levels of our variable of interest (tariff*differentiated product dummy). The coefficient on the tariff rate is positive and statistically significant in 3 of 4 specifications.

5.4. Could exchange rate fluctuations affect our findings?

Our data source (COMTRADE) reports trade figures in current US dollars, so one may be concerned that exchange rate fluctuations could potentially affect our findings. We do not believe that this is the case. First, country-year fixed effects included in our regressions capture exchange rate changes. Thus to the extent that both homogeneous and differentiated products are affected in the same way by exchange rate movements, our results should not be affected. Second, in an additional robustness check (not reported to save space), we limited our analysis to Bulgaria for years 2001–2 and Hungary for 2001 as during these time periods each country had its national currency pegged to the euro. The results, estimated on this subsample, confirmed our earlier findings.

Table 10
Reverse trade gap, tariff and differentiated products

	Reverse trade gap					
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff	−0.003	−0.001	−0.001	−0.003	−0.000	−0.001
	[0.003]	[0.004]	[0.004]	[0.003]	[0.005]	[0.005]
Tariff*conservative dummy		−0.003			−0.003	
		[0.004]			[0.005]	
Tariff*liberal dummy			−0.002			−0.003
			[0.004]			[0.005]
Agricultural products	Included	Included	Included	Excluded	Excluded	Excluded
Obs,	79,723	79,723	79,723	77,400	77,400	77,400
Adj. R^2	0.008	0.008	0.008	0.008	0.008	0.008

All regressions include 6-digit-product fixed effects and exporter-year fixed effect. Standard errors, clustered on 6-digit products, are listed in parentheses.
Note: Reverse trade gap = ln(exports to Germany as reported by the exporting country)$_{pt}$ − ln(imports as reported by Germany)$_{pt}$ where p stands for a 6-digit HS product and t for year.
*Significant at 10%; **significant at 5%; ***significant at 1%.

Table 11
Bilateral trade and trade gap

	Trade gap					
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff	0.008***	0.004***	0.004***	0.008**	0.003	0.003
	[0.001]	[0.001]	[0.001]	[0.003]	[0.003]	[0.003]
Tariff* conservative dummy		0.007***			0.005***	
		[0.001]			[0.001]	
Tariff* liberal dummy			0.007***			0.005***
			[0.001]			[0.001]
Tariff* importer CPI				−0.004***	−0.004***	−0.004***
				[0.001]	[0.001]	[0.001]
Tariff* exporter CPI				0.004***	0.004***	0.004***
				[0.001]	[0.001]	[0.001]
Obs.	180,359	180,359	180,359	180,359	180,359	180,359
Adj. R^2	0.0564	0.0567	0.0568	0.0574	0.0576	0.0576

All regressions include 6-digit-product fixed effects, importer-year fixed effects and exporter-year fixed effects. Standard errors, clustered on 6-digit products, are listed in parentheses. Bilateral trade gap = ln(exports reported by the exporting country)$_{pt}$ − ln(imports reported by the importing country)$_{pt}$ where p stands for a 6-digit HS product and t for year. Governance is measured using the Corruption Perception index (CPI) where higher values are associated with less corruption.
*Significant at 10%; **significant at 5%; ***significant at 1%.

5.5. Is it really about differentiated products?

Our hypothesis of differentiated products being subject to more tariff evasion relies on special properties of such products. Namely, we conjecture that it is more difficult to accurately assess the price of differentiated products, which means that honest customs officers find it more difficult to detect an invoice stating an incorrect price and corrupt customs officers have a plausible explanation for why they did not detect the problem with the invoice. If our hypothesis is true, we would expect to see that an alternative classification of products would not produce similar results.

To check this we employ a classification of products by the stage of processing (raw materials, intermediate goods, capital goods, final goods) compiled by the WTO Trade Policy Review Division. Not all final products are differentiated goods (beer made from malt and tomatoes are a case in point). Similarly, not all differentiated products are final goods (examples include silk yarn and leather). We interact the tariff rate with a dummy for final products and include it in our model instead of or in addition to our usual interaction term. The results, reported in Table 8 produce no evidence of final goods being subject to greater tariff evasion than any other types of goods. Even when the additional term is included, our results on differentiated products being subject to more tariff evasion remain unchanged.

5.6. How do we know we are capturing tariff evasion?

We have demonstrated so far that the trade gap's responsiveness to the tariff rate is higher for differentiated goods, but how can we be sure that this finding indeed reflects tariff evasion? It is reasonable to believe that tariff evasion is linked to corruption. Hence we would expect to find no evidence of tariff evasion in the case of countries with a high level of governance. Showing that this is case would give us confidence that our results are capturing tariff evasion rather than some other factor such as, for instance, transfer pricing.

To check this possibility we estimate Eq. (2) using the data on export flows from Germany to the US during the period 1992–2005.[18] As expected, in none of the models estimated do we find a statistically significant relationship between tariff rates and the trade gap. Similarly, none of the interactions terms between tariff and the differentiated product dummy is statistically significant (Table 9).

Next we explore whether tariff evasion is driven by the corruption in the importing country, the exporting country or both. If what matters is corruption in the exporting country (or both countries), we would expect to see a link between tariff rates and trade gap when considering exports from Central Eastern Europe to Germany. However, as illustrated in Table 10, we find no evidence of tariff evasion taking place in Germany as none of the coefficients of interest is statistically significant. This suggests that the governance levels in the importing economy are mainly responsible for the extent of tariff evasion.

Finally, we consider bilateral trade flows within Central and Eastern European countries in our sample. Given their relatively low levels of governance, we expect to see evidence of tariff evasion. And indeed, as illustrated in Table 11, we find a positive and statistically significant relationship between tariff rates and the trade gap. As anticipated, this relationship is stronger for differentiated products suggesting tariff evasion may be easier when reference prices are not available and product attributes are more difficult to assess.

In columns (4)–(6), we add interaction terms between the tariff rate and the level of governance in the importing and the exporting country. Our measure of governance is the Corruption Perceptions Index compiled by Transparency International. The

[18] We needed to choose a trading partner outside the European Union because otherwise we would have no variation in the tariff data as all tariff rates would be equal to zero.

Table 12
Quantity gap

	Δ Quantity gap					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Tariff	0.000	0.001	0.001	0.000	0.001	0.001
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Δ Tariff*conservative dummy		−0.002			−0.001	
		[0.002]			[0.002]	
Δ Tariff*liberal dummy			−0.002			−0.001
			[0.002]			[0.002]
Agriculture	Included	Included	Included	Excluded	Excluded	Excluded
Observations	130,319	130,319	130,319	126,917	126,917	126,917
Adj. R^2	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003

Homogeneous versus differentiated products. Specification in first differences.
All regressions include country fixed effects. Robust standard errors are listed in parentheses.
*Significant at 10%; **significant at 5%; ***significant at 1%.

index is time-varying, and it is available for the 1998–2003 period for the set of countries considered.[19] Higher values of the index are associated with better governance. As illustrated in the last three columns of the table, we find a negative and statistically significant coefficient on the interaction between tariff rate and the level of governance in the importing country. This suggests that for a given tariff rate less evasion takes place in importing countries with better governance. In contrast, the estimated coefficient on the interaction between tariff rate and the level of governance in the exporting country is positive and statistically significant. Our speculation is that better governed countries are likely to keep more accurate export statistics which leads to higher discrepancies.

The findings presented in this section give us confidence about our results reflecting tariff evasion rather than some other phenomenon, such as transfer pricing. While Andrew Bernard et al. (2006) and Chen (2006) find that transfer pricing tends to take place through intra-firm trade in differentiated products, we do not believe that transfer pricing is likely to be captured in our results. First, even though multinationals may misrepresent the price of intra-firm trade, they will use the altered price consistently on all invoices. Hence the same information should be recorded by German customs and Polish customs and transfer pricing should not contribute to our trade gap. Second, we would expect transfer pricing to take place in both directions, i.e., intra-firm trade from a high tax to a low tax location would involve underpricing exports of final goods and overpricing imports of intermediates. Thus, if our results reflect transfer pricing rather than tariff evasion, we would expect to find similar results when considering German imports from Eastern Europe. Finally, we would expect to see a similar pattern when focusing on US imports from Germany. However, as we have shown, focusing on either German imports from Eastern Europe or US imports from Germany fails to produce significant results.

6. Channels of tariff evasion

In the light of our findings on the existence of tariff evasion, it is natural to ask how exactly this phenomenon takes place. There are three potential channels through which importers may attempt to avoid or to minimize their tariff payments: (i) undercounting physical quantities of imported products;[20] (ii) misrepresenting the price of imported products; and (iii) misclassifying high tariff products as a lower tariff variety. In this section, we explore each of these evasion methods.

6.1. Undercounting quantities of imported products

To examine the prevalence of undercounting the quantities of imports we calculate the difference between the quantity of exports reported by Germany and the quantity of imports recorded by the importing country. As before, the gap is calculated at the level of 6-digit HS product for each importing country and each year. We take care to make sure that both import and export flows are reported in the same units. The summary statistics, not reported to save space, give us no indication of this channel being used for tariff evasion. The mean quantity gap is negative in 8 out of 10 countries, and the median quantity gap is negative in all cases suggesting that the quantities recorded by the importing country are larger than those recorded by Germany. The negative value is consistent with the stylized fact that countries tend to monitor their imports more carefully than exports. However, when we compare the quantity gap for low (below median) and high (above median) tariff rates, we find that countries are 'less good at monitoring their import statistics' when import tariffs are high. The difference between the figures for high and low tariffs is statistically significant, suggesting that some evasion may be taking place. When we turn to a comparison between homogeneous and differentiated products, we find that the gap tends to be higher for the former.

As summary statistics do not take into account unobservable product characteristics and do not control for changing conditions within each country, next we estimate a specification outlined in Eq. (3) with the quantity gap being the dependent variable. The results are presented in Table 12. We find no support for the hypothesis that tariff evasion takes place through undercounting

[19] To make the results comparable across columns, in all regressions we restrict the sample to the same time period.
[20] Or simply smuggling goods through locations other than official border crossings.

Table 13
Unit value gap. Homogeneous versus differentiated products. Specification in first differences

	Δ Unit value gap					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Tariff	0.002	−0.005	−0.004	0.004*	−0.002	−0.002
	[0.002]	[0.004]	[0.004]	[0.002]	[0.004]	[0.004]
Δ Tariff*conservative dummy		0.012**			0.010**	
		[0.005]			[0.005]	
Δ Tariff*liberal dummy			0.011**			0.009**
			[0.005]			[0.005]
Agriculture	Included	Included	Included	Excluded	Excluded	Excluded
Observations	130,319	130,319	130,319	126,917	126,917	126,917
Adj. R^2	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002

Homogeneous versus differentiated products. Specification in first differences.
All regressions include country fixed effects. Robust standard errors are listed in parentheses.
*Significant at 10%; **significant at 5%; ***significant at 1%.

quantities. The coefficient on the tariff rate is positive, but it is not statistically significant in any of the specifications. Similarly, the interaction terms do not appear to be statistically significant.

6.2. Misrepresenting the price of imported products

Next we turn to another potential channel of tariff evasion, namely misrepresenting the price of imported products. To examine the prevalence this phenomenon, we calculate the difference between the unit value of exports reported by Germany and the unit value of imports recorded by the importing country:

$$value\_gap_{cpt} = ln\left(\frac{Export\_value_{Germany.cpt}}{Export\_quantity_{Germany.cpt}}\right) - ln\left(\frac{Import\_value_{cpt}}{Import\_quantity_{cpt}}\right). \quad (4)$$

As before, the gap is calculated at the level of 6-digit HS product for each importing country and each year.

In the absence of evasion, we would expect the unit value gap to be negative, as import statistics include the cost of freight and insurance, neither of which is captured by the export data. However, the summary statistics (not reported here to save space) indicate that the average gap in positive in 6 out of 10 countries, while the median gap is positive in 7 of 10 cases. The median unit value gap is larger for higher tariff rates. The difference between the median gap for high and low tariff rates is statistically significant in all but one country. It is even more striking that in most countries, the median unit value gap is larger for differentiated products. This is true for both the conservative and the liberal definition of differentiated products.

To test this relationship more formally, we regress the unit value gap on the tariff rate, and an interaction of the tariff rate with the differentiated product dummy estimating the specification in first differences outlined in Eq. (3). As evident in Table 13, we find no evidence of price misrepresentation (i.e., reporting unit values of imports as being lower than what they really are) being responsive to the tariff rate in general. The coefficient on the tariff rate is positive and statistically significant only in one of 6 specifications. However, we do find evidence suggesting that price misrepresentation is positively correlated with the tariff rate in the case of differentiated products. The estimated coefficient is positive and statistically significant in all specifications. The results suggest that a one-percentage-point increase in the tariff rate is associated with a 0.9 to 1.2% increase in the unit value gap of differentiated products.

6.3. Misclassification of imported products

Finally, we turn to misclassification of products as another potential channel of tariff evasion. We follow Fisman and Wei (2004) and include in our basic specification an additional regressor—the average tariff on similar products which are defined as all other 6-digit products belonging to the same 4-digit HS category. The average is weighted by the share of each product in German exports within each 4-digit HS category.[21] This additional regressor enters the estimated equation by itself as well as in interaction with the differentiated product dummy. If misclassification takes place, we expect to see a negative coefficient on the tariff on similar products, which would signify that holding the own tariff rate constant, a lower tariff on similar products creates more opportunities for misreporting. If such misclassification is easier for differentiated products, we would expect the coefficient on the interaction term to bear a negative sign.

[21] Note that using an unweighted average would lead to similar conclusions.

Table 14
Results with tariffs on similar products

	Δ Trade value gap				
	(1)	(2)	(3)	(4)	(5)
Δ Tariff	0.005	−0.001	−0.000	−0.000	−0.001
	[0.004]	[0.005]	[0.005]	[0.006]	[0.005]
Δ Tariff*conservative dummy		0.010*		0.009	
		[0.005]		[0.008]	
Δ Tariff*liberal dummy			0.009*		0.011
			[0.005]		[0.007]
Δ Tariff on similar products	−0.001	−0.002	−0.002	−0.002	−0.001
	[0.003]	[0.004]	[0.003]	[0.005]	[0.005]
Δ Tariff on similar products *conservative dummy				0.002	
				[0.007]	
Δ Tariff on similar products *liberal dummy					−0.002
					[0.007]
Observations	130,859	130,859	130,859	130,859	130,859
Adjusted R^2	0.0003	0.0003	0.0003	0.0003	0.0003

Specification in first differences.
All regressions include country fixed effects. Robust standard errors are listed in parentheses.
Agricultural products are included. *significant at 10%; **significant at 5%; ***significant at 1%.

In contrast to the findings of Fisman and Wei, we do not find that misclassification (at least not within the same 4-digit HS category) is prevalent in transition countries. As can be seen in Table 14, tariff on similar products does not appear to be statistically significant in any specification. Neither is its interaction with the differentiated product dummy statistically significant. Our basic result, suggesting that elasticity of missing trade is larger for differentiated products, remains unchanged in columns (2) and (3). The overall responsiveness of missing trade to the tariff rate is not statistically significant. This is not surprising, given a high correlation between own tariff rate and the tariff rate on similar products (0.86).

The lack of evidence on misclassification may be attributed to high correlation between own tariff and tariff on similar products or to the possibility that misclassification takes place outside the same 4-digit category. For example, when in 2000 Johnson & Johnson was importing to Russia their "2-in-1 Shower Gel" the company categorized it as a soap substitute, but customs decided to consider the product as a cosmetic and the company had to pay a 20% instead of a 15% duty (Aris, 2000). While soap is included in the 3401 HS category (HS 340120 is "soap in other forms"), cosmetics belong to HS 3304 ("beauty, make-up, skin-care, not elsewhere classified").

7. Conclusions

An emerging literature building on Rauch's (1999) paper has demonstrated some unique characteristics of trade in differentiated products. This paper contributes to the literature on differentiated products by postulating that such products may be subject to greater tariff evasion due to the difficulties associated with assessing the quality and thus the price of such products, which creates greater scope for tariff evasion on the part of importers and corrupt customs officials.

Using product-level data on German exports to 10 Eastern European countries we demonstrate empirical support for this hypothesis. We show that the trade gap, defined as the positive discrepancy between the value of exports reported by Germany and the value of imports from Germany reported by an Eastern European importer, is positively correlated with the level of tariff in 8 of 10 countries, thus generalizing the result of Fisman and Wei (2004) found for China. Further, we demonstrate that the responsiveness of the trade gap to the tariff level is greater for differentiated products than for homogeneous goods. A one-percentage-point increase in the tariff rate is associated with a 0.4% increase in trade gap in the case of homogeneous products and a 1.7% increase in the case of differentiated products. Finally, our results indicate that the greater tariff evasion observed for differentiated products tends to take place through misrepresentation of the import price.

While our study does not explicitly focus on the effects of customs reform, its findings suggest that limiting discretion of customs officials, introducing systems allowing for verification of import documents or price comparisons with similar products and introducing effective audits of customs officials are likely to lower tariff evasion.

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