Online Appendix to

WTO Accession and Tariff Evasion

Beata S. Javorcik[*]

and

Gaia Narciso[**]

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* University of Oxford, CEPR and CESifo, Department of Economics Manor Road Building, Manor Road, Oxford OX1 3UQ, United Kingdom. Email: beata.javorcik@economics.ox.ac.uk.
** Trinity College Dublin and CReAM, Department of Economics, Arts Building, College Green, Dublin 2, Ireland. Email: narcisog@tcd.ie.

Appendix A. Robustness Checks

Table A1. Alternative sample: Non-differentiated products

	(1)	(2)	(3)	(4)	(5)
	Unit value gap pre and post WTO accession				
Tariff	**0.0029***	**0.0028***	0.0015	0.0015	**0.0031***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Tariff x WTO	0.0021	0.0019	-0.0002	-0.0004	-0.0023
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
WTO	-0.0945***	-0.0895***	-0.0864***	-0.0817**	-0.0569
	[0.028]	[0.028]	[0.031]	[0.031]	[0.035]
Test Tariff+TariffxWTO=0					
F statistic	7.20	6.63	0.63	0.39	0.23
p-value	0.02	0.02	0.44	0.54	0.64
Observations	104,824	104,824	104,736	104,736	104,591
Adjusted R-squared	0.027	0.028	0.106	0.108	0.091
Year FE	Yes	yes	yes	yes	yes
Exporter FE	Yes	no	yes	no	no
Importer FE	Yes	no	yes	no	no
Country-pair FE	No	yes	no	yes	no
6-digit HS product FE	No	no	yes	yes	no
Importer*Exporter*2-digit HS product FE	No	no	no	no	yes

Notes: The dependent variable is the unit value gap as defined in equation 1 in the text. Standard errors, clustered by year and importer-exporter pair, are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table A2. Strict exogeneity test

	(1)	(2)	(3)	(4)	(5)
	Specifications with leads				
Tariff	**0.0081***	**0.0083***	**0.0064***	**0.0067***	**0.0064***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]
Tariff x WTO	**-0.0069***	**-0.0073***	**-0.0081***	**-0.0086***	**-0.0084***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Tariff lead	0.0009	0.0006	0.0002	-0.0001	-0.0007
	[0.003]	[0.003]	[0.002]	[0.002]	[0.003]
Tariff x WTO lead	-0.0009	-0.0011	-0.0028	-0.0029	-0.0013
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
WTO	-0.0051	-0.0053	-0.0027	-0.0037	0.0146
	[0.040]	[0.043]	[0.038]	[0.041]	[0.037]
WTO lead	-0.0157	-0.0092	0.0032	0.0084	-0.0082
	[0.051]	[0.052]	[0.042]	[0.043]	[0.043]
Observations	206,091	206,091	206,031	206,031	205,858
Adjusted R-squared	0.031	0.034	0.114	0.117	0.088
	Specifications with leads and lags				
Tariff	0.0005	0.0005	0.0001	0.0000	0.0011
	[0.002]	[0.004]	[0.001]	[0.003]	[0.004]
Tariff x WTO	-0.0021	-0.0021	-0.0030	-0.0029	-0.0047
	[0.003]	[0.005]	[0.002]	[0.003]	[0.004]
Tariff lag	**0.0075***	**0.0078***	**0.0061***	**0.0064***	**0.0056***
	[0.001]	[0.003]	[0.001]	[0.002]	[0.003]
Tariff x WTO lag	**-0.0046***	-0.0051	**-0.0059****	**-0.0063****	-0.0043
	[0.002]	[0.003]	[0.002]	[0.002]	[0.003]
Tariff lead	0.0017	0.0014	0.0013	0.0010	-0.0005
	[0.003]	[0.003]	[0.002]	[0.002]	[0.003]
Tariff x WTO lead	-0.0019	-0.0020	-0.0034	-0.0035	-0.0018
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
WTO	0.0131	0.0099	0.0163	0.0123	0.0326
	[0.026]	[0.024]	[0.027]	[0.026]	[0.023]
WTO lag	-0.0101	-0.0117	-0.0134	-0.0153	-0.0065
	[0.046]	[0.052]	[0.047]	[0.051]	[0.046]
WTO lead	0.0012	0.0079	0.0186	0.0236	0.0073
	[0.050]	[0.050]	[0.045]	[0.045]	[0.044]
Observations	171,800	171,800	171,720	171,720	171,568
Adjusted R-squared	0.035	0.038	0.128	0.131	0.094
Year FE	yes	yes	yes	yes	yes
Exporter FE	yes	no	yes	no	no
Importer FE	yes	no	yes	no	no
Country-pair FE	no	yes	no	yes	no
6-digit HS product FE	no	no	yes	yes	no
Importer*Exporter*2-digit HS product FE	no	no	no	no	yes

Notes: The dependent variable is the unit value gap as defined in equation 1 in the text. The specifications in the top panel mirror the bottom panel in terms of fixed effects. Standard errors, clustered by year and importer-exporter pair, are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table A3. Unit value gap pre- and post-WTO accession. Robustness checks

	(1)	(2)	(3)	(4)	(5)
	Subsample with unchanged tariff rates				
Tariff	**0.0087****	**0.0085****	**0.0058****	**0.0057****	**0.0063*****
	[0.003]	[0.003]	[0.002]	[0.002]	[0.002]
Tariff x WTO	-0.0054	-0.0059	**-0.0072****	**-0.0075***	**-0.0062***
	[0.003]	[0.003]	[0.003]	[0.004]	[0.003]
WTO	0.0436	0.0455	0.0655	0.0661	0.0574
	[0.052]	[0.052]	[0.048]	[0.049]	[0.041]
Test Tariff +Tariff x WTO=0					
F statistic	4.20	2.51	0.30	0.43	0.00
p-value	0.06	0.13	0.59	0.52	0.99
Observations	87,751	87,751	87,751	87,751	87,751
Adjusted R-squared	0.031	0.034	0.134	0.138	0.096
	Only products traded before and after				
Tariff	**0.0084*****	**0.0084*****	**0.0065*****	**0.0064*****	**0.0057*****
	[0.002]	[0.002]	[0.001]	[0.001]	[0.001]
Tariff x WTO	**-0.0055****	**-0.0060****	**-0.0072*****	**-0.0074*****	**-0.0071*****
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
WTO	-0.0033	-0.0006	0.0047	0.0056	0.0141
	[0.044]	[0.044]	[0.043]	[0.044]	[0.041]
Test Tariff +Tariff x WTO=0					
F statistic	2.80	2.13	0.15	0.27	0.40
p-value	0.11	0.16	0.70	0.61	0.54
Observations	186,970	186,970	186,970	186,970	186,970
Adjusted R-squared	0.037	0.040	0.128	0.130	0.094
	Dropping small product flows				
Tariff	**0.0063*****	**0.0064*****	**0.0046*****	**0.0046*****	**0.0035****
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Tariff x WTO	**-0.0052***	**-0.0057***	**-0.0059****	**-0.0061****	**-0.0088*****
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
WTO	-0.0423	-0.0399	-0.0458	-0.0450	-0.0093
	[0.053]	[0.054]	[0.052]	[0.054]	[0.043]
Test Tariff +Tariff x WTO=0					
F statistic	0.42	0.17	0.32	0.47	3.64
p-value	0.52	0.69	0.58	0.50	0.07
Observations	110,622	110,622	110,483	110,483	110,381
Adjusted R-squared	0.043	0.044	0.190	0.191	0.106
Year FE	Yes	yes	yes	yes	Yes
Exporter FE	Yes	no	yes	no	No
Importer FE	Yes	no	yes	no	No
Country-pair FE	No	yes	no	yes	No
6-digit HS product FE	No	no	yes	yes	No
Importer*Exporter*2-digit HS product FE	No	no	no	no	Yes

Notes: The dependent variable is the unit value gap as defined in equation 1 in the text. Standard errors, clustered by year and importer-exporter pair, are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table A4. Unit value gap pre- and post-WTO accession. Non-WTO members as the control group

	(1)	(2)	(3)	(4)	(5)
Tariff	0.0091***	0.0086***	0.0050***	0.0045***	0.0051***
	[0.002]	[0.002]	[0.001]	[0.001]	[0.001]
Tariff x WTO	-0.0065**	-0.0066**	-0.0095***	-0.0094***	-0.0065**
	[0.002]	[0.002]	[0.003]	[0.003]	[0.002]
WTO	-0.0656	-0.0672	-0.0538	-0.0563	-0.0555
	[0.044]	[0.046]	[0.041]	[0.043]	[0.044]
Test Tariff +Tariff x WTO=0					
F statistic	2.33	1.48	4.62	5.41	0.40
p-value	0.15	0.24	0.05	0.03	0.54
Observations	396,565	396,564	396,540	396,539	396,179
Adjusted R-squared	0.035	0.041	0.103	0.108	0.092
Year FE	Yes	yes	yes	yes	Yes
Exporter FE	Yes	no	yes	no	No
Importer FE	Yes	no	yes	no	No
Country-pair FE	No	yes	no	yes	No
6-digit HS product FE	No	no	yes	yes	No
Importer*Exporter*2-digit HS product FE	No	no	no	no	Yes

Notes: The dependent variable is the unit value gap as defined in equation 1 in the text. Standard errors, clustered by year and importer-exporter pair, are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Appendix B. Event Study

We conduct an event study analysis to address the possibility of a confounding trend. We want to gain confidence that our findings on the impact of WTO accession on tariff evasion are not simply picking up a downward trajectory in the relationship between the unit value gap and the tariff rate happening for a completely unrelated reason. To do so we estimate the following equation:

$$Unit\ value\ gap_{kcpt} = \sum_{j=-s}^{S} \beta_{1j}\, 1[t - \tau_c = j] * tariff_{kcpt} \ + \sum_{j=-s}^{S} \beta_{2j}\, 1[t - \tau_c = j] \ \ + \theta_{kc} + \theta_p +$$
$$\theta_t (+\theta_{kcHS2} + \theta_t) + \epsilon_{kcpt} \ (3)$$

where *1[]* is the indicator function, τ_c is the year in which WTO accession occurs for country *c*, and *s* is the number of years around WTO accession considered in the analysis. The set of fixed effects mirrors the two most stringent specifications included in our study: (i) importer-exporter, 6-digit HS product and year fixed fixed effects, or (ii) importer-exporter-2-digit-HS-product and year fixed effects. We focus on a sample of balanced trade flows observed the time window considered. We consider the case of *s* = 4 as well as two asymmetric windows.

The results, presented in Table B1 below, support the message of our paper. The relationship between the unit value gap and the tariff rate clearly changes at the point of the WTO accession. There is no indication of this relationship weakening in the pre-accession years. This message comes across quite clearly from Figure B1 below graphing the estimated *β* and the corresponding 90% confidence intervals.

Table B1. Unit value gap pre- and post-WTO accession. Event study

	(1)	(2)	(3)	(4)	(5)	(6)
SAMPLE	[-4,+5]	[-4,+5]	[-4,+4]	[-4,+4]	[-3,4]	[-3,+4]
Tariff x 4 yrs before WTO	0.0030	0.0047	0.0022	**0.0051***		
	[0.002]	[0.003]	[0.002]	[0.003]		
Tariff x 3 yrs before WTO	0.0072	0.0093	0.0061	0.0096	0.0055	**0.0075***
	[0.006]	[0.005]	[0.004]	[0.005]	[0.004]	[0.004]
Tariff x 2 yrs before WTO	**0.0067***	0.0091	**0.0053****	**0.0090***	0.0050	**0.0070****
	[0.003]	[0.005]	[0.002]	[0.004]	[0.003]	[0.003]
Tariff x 1 yr before WTO	**0.0071***	**0.0090***	0.0056	**0.0089***	0.0049	**0.0065****
	[0.003]	[0.004]	[0.003]	[0.004]	[0.004]	[0.002]
Tariff x WTO year 1	0.0038	0.0068	0.0012	0.0065	-0.0004	0.0020
	[0.005]	[0.005]	[0.005]	[0.005]	[0.006]	[0.003]
Tariff x WTO year 2	0.0060	0.0090	0.0034	0.0086	0.0039	0.0061
	[0.007]	[0.007]	[0.006]	[0.007]	[0.006]	[0.005]
Tariff x WTO year 3	0.0007	0.0040	-0.0014	0.0043	-0.0006	0.0018
	[0.005]	[0.004]	[0.004]	[0.004]	[0.006]	[0.002]
Tariff x WTO year 4	0.0023	0.0054	0.0002	0.0059	-0.0002	0.0024
	[0.007]	[0.006]	[0.006]	[0.006]	[0.004]	[0.003]
Tariff x WTO year 5	0.0020	0.0045				
	[0.007]	[0.007]				
Observations	19062	19062	17368	17368	15806	15806
Adjusted R-squared	0.260	0.095	0.262	0.094	0.270	0.105
Year FE	yes	yes	yes	yes	yes	yes
Country-pair FE	yes	no	yes	no	yes	no
6-digit HS product FE	yes	no	yes	no	yes	no
Importer*Exporter*2-digit HS product FE	no	yes	no	yes	no	yes

Notes: The dependent variable is the unit value gap as defined in equation 1 in the text. The estimated model is described in equation 3 in the text. The estimates corresponding to β_2's in equation 3 are not reported. The estimation was conducted on a balanced panel. Standard errors, clustered by year and importer-exporter pair, are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Figure B1. Graphic representation of the event study
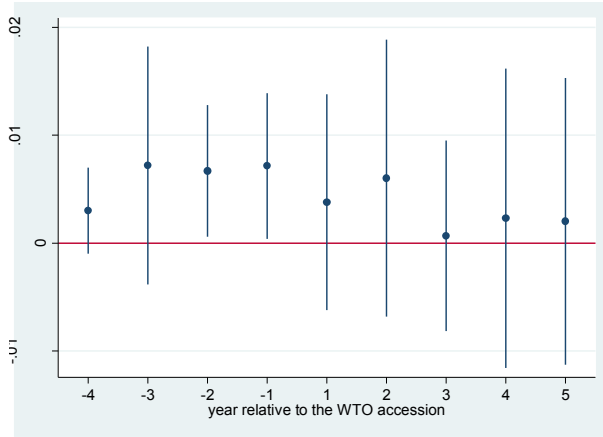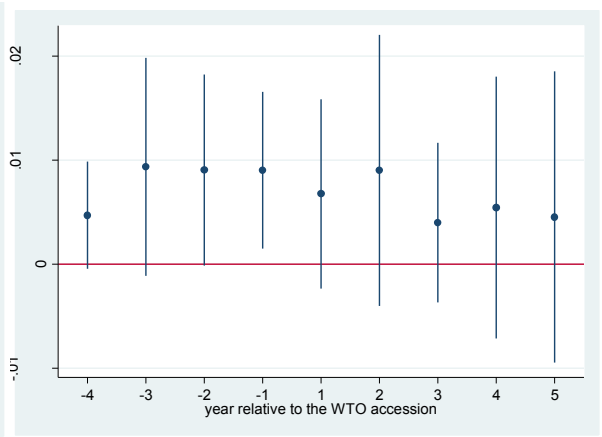
Table B1 column 1
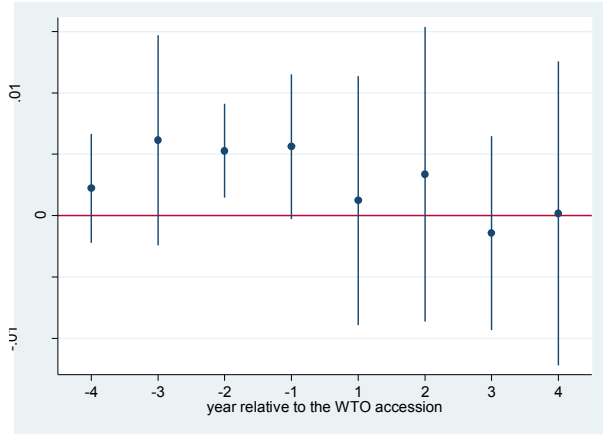

Table B1 column 2

Table B1 column 3

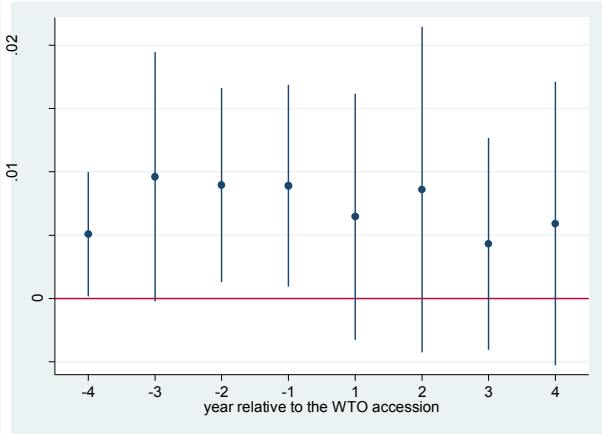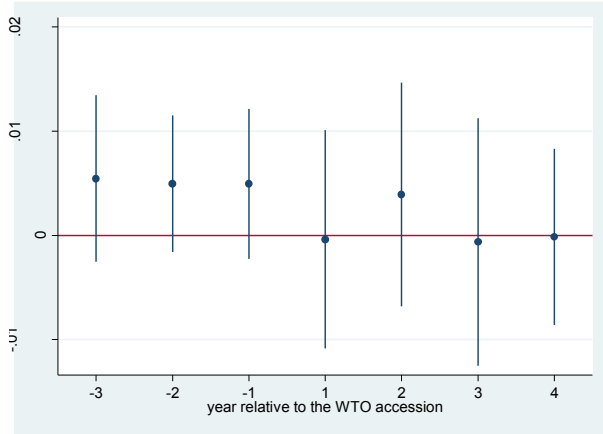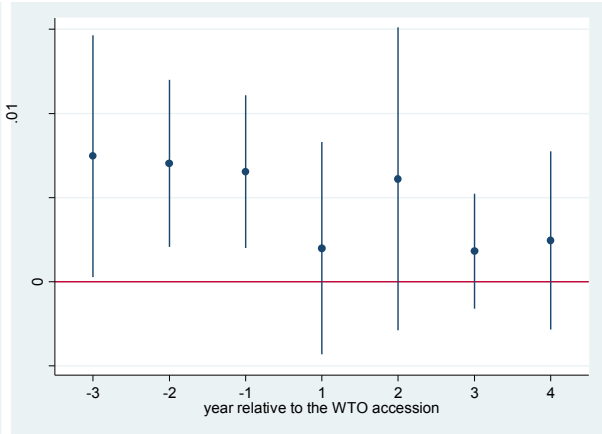## Table B1 column 4

Table B1 column 5

Table B1 column 6

Notes: Each figure corresponds to a single regressions and graphs the coefficients on the tariff variable specific to a particular year before or after the WTO accession and the corresponding 90% confidence interval.

Appendix C. Controlling for Computerization

In this appendix, we address the possibility that our findings are capturing computerization of customs services, which may have taken place around the time of the WTO accession. We do so by controlling for countries adopting the ASYCUDA system and examining whether the effect of the tariff rate changed in the post-adoption period.

ASYCUDA is a computerized customs management system which covers most foreign trade procedures. It handles manifests and customs declarations, accounting procedures, transit and suspense procedures. The software was developed by UNCTAD and is often offered to developing countries as part of an aid package, where it may be co-financed by international organizations such as the World Bank or the IMF. ASYCUDA takes into account the international codes and standards developed by ISO (International Organisation for Standardisation), WCO (World Customs Organization) and the United Nations. It can also be configured to suit the national characteristics of individual customs administrations. We collected information on the year of ASYCUDA adoption from the www.asycuda.org webpage, IMF documents, European Commission documents, and books.

Our baseline results are not affected by this augmentation to the model. We find that introduction of ASYCUDA lowers the responsiveness of the quantity gap to the tariff rate, as we would expect, but it does not have a similar effect on the unit value gap (see Table B1 below).

Table C1. Introduction of ASYCUDA

	(1)	(2)	(3)	(4)	(5)
	Unit value gap				
Tariff	**0.0086***	**0.0085***	**0.0061***	**0.0061***	**0.0055***
	[0.002]	[0.002]	[0.001]	[0.001]	[0.001]
Tariff x WTO	**-0.0057**	**-0.0063**	**-0.0080***	**-0.0084***	**-0.0074***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Tariff x ASYCUDA	-0.0010	-0.0008	0.0015	0.0019	0.0036
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
WTO	-0.0067	-0.0020	0.0034	0.0072	0.0150
	[0.041]	[0.043]	[0.041]	[0.043]	[0.036]
ASYCUDA	0.0030	0.0133	0.0013	0.0117	-0.0007
	[0.063]	[0.065]	[0.067]	[0.068]	[0.062]
Test Tariff+TariffxWTO=0					
F statistic	2.73	1.98	1.15	1.83	0.82
p-value	0.12	0.18	0.30	0.19	0.38
Observations	246,009	246,009	245,969	245,969	245,770
Adjusted R-squared	0.030	0.034	0.109	0.112	0.085
	Quantity gap				
Tariff	0.0047	0.0046	0.0019	0.0018	0.0008
	[0.004]	[0.004]	[0.003]	[0.003]	[0.002]
Tariff x WTO	**0.0177**	**0.0186**	**0.0115***	**0.0127**	**0.0146**
	[0.008]	[0.008]	[0.006]	[0.006]	[0.006]
Tariff x ASYCUDA	-0.0024	-0.0019	**-0.0123***	**-0.0123***	-0.0110
	[0.006]	[0.006]	[0.006]	[0.006]	[0.007]
WTO	-0.1261	-0.1517	-0.0887	-0.1164	-0.1667**
	[0.088]	[0.089]	[0.069]	[0.070]	[0.070]
ASYCUDA	0.0575	0.0432	0.0688	0.0554	0.0509
	[0.104]	[0.102]	[0.097]	[0.095]	[0.099]
Test Tariff+TariffxWTO=0					
F statistic	10.15	11.39	7.97	9.62	5.74
p-value	0.00	0.00	0.01	0.01	0.03
Observations	246,009	246,009	245,969	245,969	245,770
Adjusted R-squared	0.020	0.023	0.104	0.108	0.082
Year FE	Yes	yes	yes	yes	Yes
Exporter FE	Yes	no	yes	no	No
Importer FE	Yes	no	yes	no	No
Country-pair FE	No	yes	no	yes	No
6-digit HS product FE	No	no	yes	yes	No
Importer*Exporter*2-digit HS product FE	No	no	no	no	Yes

Notes: Standard errors, clustered by year and importer-exporter pair, are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Appendix D. A Simple Framework

Here we present a simple framework following Yang (2008). A representative firm intending to import a fixed amount M chooses to misreport a fraction of imports δ in order to evade import duties equal to τ per unit of imports. A firm may choose evasion through underreporting of prices or underreporting of quantities (smuggling). Both methods require a fixed cost F and a variable cost c. The variable and fixed costs vary between the two evasion methods (being equal to c_p and F_p for the former, and c_q and F_q for the latter method). Fixed costs may include setting up and maintaining smuggling facilities. Bribes paid to customs officials may have both fixed and variable component. The variable component may also include legal penalties which rise in expectation if the probability of being detected increases in the value of the goods concealed.

The importer must decide which evasion method to use. Without loss of generality, assume that evasion through underpricing was the method of choice initially. The importer maximizes the benefit of evasion through underpricing (B_p) which is the difference between the tariff payment avoided ($M\tau\delta_p$) and the evasion costs:

$$max\ B_p\ \equiv M\tau\delta_p - c_p\big(M\delta_p\big)^2 - F$$

The variable cost is convex in the square of the import value being underreported ($M\delta_p$), as authorities are likely to devote more effort to fighting large-scale underreporting, or perhaps because it is more difficult to hide evidence of large scale underreporting.

The optimal rate of evasion is thus

$$\delta_p^* \equiv \frac{\tau}{2Mc_p}$$

yielding the benefit of

$$B_p^* \equiv \frac{t^2 M^2}{4c_p} - F_p$$

The WTO accession increases the cost of evasion through underreporting of prices from c_p to c_p^{wto} because prior to the accession a customs official has authority to determine the value of goods imported, while after the accession discretion in this respect is taken away and thus any deviation from the invoice price may be considered illegal and raise suspicions of corrupt behavior.

The importer may respond to the increased cost of underreporting of prices by lowering the evasion rate (δ_p^*) or by switching to the alternative evasion method. The importer will switch to the alternative method if

$$B_q^* > B_{p,WTO}^*$$

$$\frac{\tau^2 M^2}{4c_q} - F_q > \frac{\tau^2 M^2}{4c_p^{WTO}} - F_p$$

In the plausible case where underreporting of quantities has lower variable costs and higher fixed costs, the inequality becomes

$$\tau M > 2\sqrt{\frac{c_p^{WTO} c_q}{c_p^{WTO} - c_q}(F_q - F_p)}$$

Thus displacement of evasion from underreporting of prices to underreporting of quantities will take place if the total tariff payment due ($M\tau$) is above some threshold determined by the fixed and variable costs of both methods. Whether the new optimal rate of evasion will be higher, lower or equal to the original one will depend on the relative variable costs. For instance, in the case where c_q is the same as the original c_p, the evasion rate will remain unchanged.