ISSN 1471-0498

DEPARTMENT OF ECONOMICS

DISCUSSION PAPER SERIES

IN-BOND DIVERSION

Lorenzo Rotunno and Pierre-Louis Vezina

Number 664
July 2013

Manor Road Building, Manor Road, Oxford OX1 3UQ

In-bond Diversion*

Lorenzo Rotunno†
Pierre-Louis Vézina‡

June 2013

Abstract

We show that the US in-bond system of imports may be used by firms to illegally avoid trade barriers, a practice known as in-bond diversion. Digging into official Chinese and Mexican trade statistics, we uncover traces of US quota-hopping in-bond diversion by Chinese exporters of textiles and apparel. This is because the illicit scheme involves declaring Chinese exports bound for Mexico but diverting them to the US market while in transit, thus creating a gap between Chinese and Mexican reports. Using the phaseout and removal of US quotas at the end of the Multifibre Agreement as a policy experiment, as well as variation in quota bindingness across products, we show that quota-bound products were associated with larger trade gaps which shrunk following the quota removals. We also find that quotas were associated with larger shares of US imports aimed for transit warehouses, confirming the use of the in-bond system for illegal quota hopping.

JEL CODES: F13, O17, O19
Key Words: textile and apparel, illegal trade, trade barriers.

*We are grateful to a Richard Baldwin, Beata Javorcik, Peter Neary, Kevin O'Rourke, Tony Venables and seminar participants at Oxford and Geneva for many constructive comments.
†Graduate Institute, Geneva. email : lorenzo.rotunno@graduateinstitute.ch
‡University of Oxford. email: pierre-louis.vezina@economics.ox.ac.uk

1 Introduction

Illegal behavior by firms is widespread in international trade. To avoid corporate taxes, US multinationals engage in transfer pricing (Bernard, Jensen and Schott, 2006) while in Europe entrepôt trade is used to evade value-added taxes (Baldwin, 2007). To avoid import tariffs in China, Hong Kong exporters underinvoice or misdeclare their shipments, for example passing frozen chicken as turkey (Fisman and Wei, 2004). Weapon makers in corrupt countries export to areas of civil conflicts despite arms embargoes (DellaVigna and Ferrara, 2010). More generally, Dutt and Traca (2010) show that when tariffs are high, bribes grease the wheels of commerce.

In this paper we show that the US in-bond system of imports may also be used as a means to avoid trade barriers. The in-bond system is a key component of US commerce. The Government Accountability Office (GAO, 2007) estimates that between 30% and 60% of shipments enter the country under this regime at the biggest coastal ports (GAO, 2007). The system allows merchandize to enter the US at its port of arrival without duties or quotas being assessed, and be shipped in-bond to another US port for US entry or export. While the system facilitates trade by allowing importers to avoid congestion and delays at US ports, poor data collection and the unusual flexibilities it grants to traders has posed threats to enforcement of trade policies (GAO, 1994, 2004, 2007)[1].

According to government reports, illicit-minded traders have exploited these loopholes to avoid tariffs and quotas, especially in the highly-protected apparel and textile industry. The practice has been dubbed "in-bond diversion" (GAO, 2004); after entering the US territory as in-bond, goods are diverted in transit and never reach their purported port of entry or export but rather enter the US market without being subject to tariffs or quotas. A 2003 investigation found that 5,000 containers of apparel, falsely declared as in-bond for Mexico, had illegally entered the US, avoiding quota restrictions and payment of $63 million in duties (GAO, 2004). According to the same report, the ports of Long Beach and El Paso made 120 seizures involving textiles between May and October 2003. A similar scheme

[1]Among these flexibilities, importers or shipping agents have the ability to initiate and close in-bond transactions, to extend transportation time frames and to make revisions in their port of destination (GAO, 2007).

involving a custom broker in Laredo (Texas) was uncovered by the US Immigration Customs and Enforcement (ICE) (Laredo Morning Times, 2006). A report from CustomsInfo (2012) highlights a major US customs fraud operation was detected whereby over 90 container shipments of clothing from China, cigarettes from India and Germany, and packages of the Mexican cactus dish nopalitos, evaded $10 million in tariffs at the Long Beach Port-of-Entry. The paperwork indicated the goods were not intended for sale in the US but "en route to another country.

How could in-bond diversion be so prevalent? Frittelli (2005), in a report to the US congress on port and maritime security, puts it simply: "The US has more than 3700 ports and receives more than 6 million cargo containers per year, but only 2% of them are physically inspected by customs agents." Back in 1984, US authorities tried to tackle this issue by detailing the type of information (e.g. quantity description, net weight and total value of the textile shipment) that customs officers at the port of arrival could use to approve in-bond status for imported textiles (U.S. Customs Service - Department of the Treasury, 1984). However, these measures were not able to halt in-bond diversion as the importers could provide such information on a voluntarily basis and failing to do so wouldn't necessarily result in denial of the in-bond movement (GAO, 2004)[2].

We show that traces of in-bond diversion can be found in official trade statistics. Following the above anecdotal evidence, we focus on quota-hopping by Chinese exporters during the period of the Multifiber Agreement (MFA) when strict quotas were imposed on Chinese textile and apparel[3]. Our analysis is based on that fact that shipments from China

[2]The importer or shipping agent has to submit CBP Form 7512 (a copy is available here: http://www.cbp.gov/xp/cgov/toolbox/forms/) to obtain approval for in-bond movement. While there is a value field in the form, the value provided is most often what is referred to as "shipper's valuation" for insurance purposes and does not reflect the actual value of the good (GAO, 2007). Crucially, the importer is not required to indicate the products' official tariff classification, e.g. its HS code.

[3]Quotas on apparel and textiles were imposed under the MFA until 2005 (we use MFA to refer to its continuation, the Agreement on Textile and Clothing (1995-2005)) and under the Chinese Safeguards until 2008. This US trade policy vis-á-vis China was highly restrictive. In a detailed empirical study, Brambilla, Khandelwal and Schott (2010) showed that China's quotas, when compared to those imposed by the US on other countries, were more likely to be binding, grew at a slower rate, and were harder to shift across categories of goods or across years. Our focus on Chinese apparel is also justified by the fact that fighting illegal imports of textiles is a Priority Trade Issue for US Customs and Border Protection. Textiles represent 43% of all tariff revenue collected and the textile industry is one of the largest manufacturing employers in the US, making it is a sensitive political issue (Homeland-Security, 2006).

diverted to the US while declared for "Transportation & Exportation" (T & E) to Mexico should appear in Chinese export statistics as exports to Mexico but should be missing from Mexico's import statistics, as they never reach that destination. Traces of in-bond diversion should thus appear in the trade gap between Mexico and China. While the trade gap itself is too noisy as a measure of diversion as it includes shipping costs, exchange-rate mistakes and omissions, we can uncover illegal behavior in its correlation with trade barriers, as suggested by Fisman and Wei (2004). Indeed, if we find that more Chinese exports to Mexico go 'missing' when incentives for US quota-hopping are present, this should ring the alarm. We thus show that missing Mexican imports from China, i.e. the log difference between Chinese exports and Mexican imports measured at the HS 6-digit level, are correlated with US quota barriers on Chinese exports. The gradual phaseout and removal of quotas at the end of the MFA in 2005 allow us to identify this correlation within products. To put it simply, we find that decreasing quota fill rates and quota removals have both resulted in a shrinking of missing imports.

To investigate further, we examine the behavior of US apparel imports from China that are bonded for a warehouse, a free-trade zone or exportation (henceforth, 'in-bond imports'). If the in-bond system is indeed linked to illegal diversion activities, its use should be abnormally prevalent for products covered by quotas. For each of the 2259 apparel products at the HS 10-digit level, we thus compute an 'in-bond ratio', i.e. the share of imports that are 'in-bond', and show that it is significantly higher when products are subject to strict quotas. We also show that it dropped most for the products that saw their quota removed in 2005 at the end of the MFA. This result indicates the presence of in-bond diversion as there is no other reason the use of bonded warehouses should be linked to trade barriers. This method was used by Fisman, Moustakerski and Wei (2008) to show that entrepôt trade via Hong Kong is in part a tariff-evasion scheme. Indeed, they showed that the use of Hong Kong warehouses was abnormally high for products with high tariffs in China. It's also close to Golub (2012) who shows that transhipment via Benin and Togo into Nigeria occurs precisely in those products which are heavily protected in Nigeria, such as used cars, cloth and rice.

By focusing on the case of US quotas on Chinese apparel, this paper contributes to the vast literature on the effects of MFA quotas. Harrigan and Barrows (2009) uses this policy experiment to test trade theory, looking at the price and quality effects of the US quota removal in 2005. Bernhofen, Upward and Wang (2012) highlights the firm-level dynamics of these effects, while (Khandelwal, Schott and Wei, 2011) show that a substantial share of the productivity gain in the Chinese textile industry associated with quota removal can be ascribed to the elimination of the inefficient quota institutions. Yet, one consequence of the quotas that has not yet been looked at empirically is the resulting illegal quota hopping. Our study aim to fill this gap by investigating the practice of in-bond diversion. Our paper also contributes to the forensic economic literature (Zitzewitz, 2012) in three main ways. First, we provide evidence for illegal in-bond diversion in the US, bringing attention to the in-bond system which plays a vital role in US commerce and may be understudied. Second, by focusing on quota hopping rather than tariff evasion as in previous illicit-trade studies by Fisman and Wei (2004), Javorcik and Narciso (2008), and Mishra, Subramanian and Topalova (2008), we bring attention to another type of trade barrier. Last but not least, on the methodology front, we show that illegal trade in one country can be identified by looking at missing trade between two foreign countries.

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

2 Data and Empirical Strategy

We look at illegal diversion of Chinese apparel and textile products from 1996 to 2008, the last years of the MFA quotas, when China was facing strict quotas and its presence in international trade was growing (The MFA ended in 2005 but some quotas were re-imposed until 2008). Our empirical strategy is two-pronged.

2.1 Mexican missing imports

First, we focus on the 'Mexican' scheme where Chinese goods are declared for Mexico but diverted to the US market. To uncover it empirically, we explore the evolution of Mexican missing imports, i.e. the (log) difference between what China reports as exports to Mexico and what Mexico reports as imports from China. This measure, which we refer to as 'missing imports', is computed for both trade values and quantities as follows[4]

$$(1) \quad \text{Missing imports}_{it} = ln(1 + \text{Chinese exports}_{it}) - ln(1 + \text{Mexican imports}_{it})$$

where i indicates a textile or apparel product measured at the HS 6-digit level and t denotes the year[5]. We add one to the logs to include flows where one of the partners has no trade reported[6]. If products are diverted while in transit between an arrival port in the US and a Mexican port of entry, they should be recorded in the Chinese statistics as exports to Mexico without showing up in the mirror Mexican import statistics. Therefore, positive missing imports can be suggestive of quota-hopping in-bond diversion where goods are diverted in the US while in transit from China to Mexico. To test this hypothesis statistically, we estimate the following regression model:

$$(2) \quad \text{Missing imports}_{it} = \alpha + \beta\,(\text{Quota}_{it}) + \text{prod}_i + \text{year}_t + \epsilon_{it}$$

where 'Quota' is a measure of quota restrictiveness. In our baseline specification, it is a dummy variable equal to one if an apparel product is subject to a US quota in a given year. In robustness checks, we use the quota fill rate (i.e. the ratio between the imported quantity and the allowed quota) as a more continuous measure of quota bindingness. The terms 'prod' and 'year' indicates product and year fixed effects, respectively, and α is a constant term. The identifying variation for the coefficient of interest, β, comes from variation in the quota

[4]To ease comparison of results between trade values and quantities, we restrict the sample to product categories where we observe the same unit of quantity in China and Mexico.

[5]The universe of textile and apparel products is defined according to the OTEXA (office of Textile and Apparel) classification, available at this webpage.

[6]We purposefully exclude cases of double zeros and explore the implications in robustness checks.

status of an apparel product over time. Specifically, a positive and significant β implies that more Mexican apparel imports from China are 'missing' when products are subject to a quota.

To delve further into the in-bond diversion scheme, we extend the baseline specification in 2 to include the US ad-valorem tariff rate on Chinese imports as the illegal practice could be used also to avoid payment of import tariffs on top of circumventing quotas. Perhaps more importantly, the illicit-trade literature has found a positive and significant correlation between missing imports and the tariff of the importing country, unveiling tariff evasion (see Fisman and Wei, 2004; Javorcik and Narciso, 2008). To control for possible correlation between the patterns of protection in Mexico and the US that could bias our coefficient of interest, we thus also add to our baseline specification the Mexican ad-valorem import tariff.

We also estimate a difference-in-difference specification where we exploit the 2005 end of the MFA quotas as a policy experiment (see also Harrigan and Barrows, 2009). More specifically, we restrict our time frame to 2004-2005 and compare changes in missing imports between quota-bound and quota-free products. We estimate the following model:

$$\text{(3)} \quad \Delta\text{Missing imports}_{it} = \alpha + \text{year}_{2005} + \beta\,(\text{Quota-bound}_i \times \text{year}_{2005}) + \text{prod}_i + \epsilon_{it}$$

where the Δ term indicates changes between year $t-1$ and t, i.e. between 2003 and 2004 or 2004 and 2005. The variable 'Quota-bound' takes the value of one for products that were covered by a quota in 2004 that got removed in 2005, and zero otherwise (i.e., for products that still faced quotas in 2005 or that were not constrained in 2004). The coefficient β here gives the difference-in-difference estimate. More precisely, it gives the average difference in differences in missing imports (between 2003-2004 and 2004-2005) between products subject to quota removals in 2005 and the rest. A negative and significant coefficient suggests that, as quotas were removed in 2005, there were less incentives for in-bond diversion and hence we observe a bigger drop in Mexican missing imports for products that were subject to a quota in 2004. The inclusion of product fixed effects ('prod_i') to a specification in first-difference controls for pre-existing product-specific trends in missing imports that might drive the difference-in-difference estimate (see Khandelwal, Schott and Wei, 2011).

While our empirical strategy exploits missing imports as a possible proxy for in-bond diversion, discrepancies in mirror statistics can be due to plenty of other causes. For trade values, differences may reflect transport costs as imports include the cost of insurance and freight (CIF), while exports are recorded "free on board" (FOB). Different accounting procedures, exchange-rate miscalculations and simple statistical errors can also create non-zero missing imports. However, these elements should not affect our empirical strategy. Some can be considered orthogonal to the quota status of a product or others (like CIF-FOB differences) are likely to have little or no variation within the apparel and textile sector and over time.

Data on Mexican imports from China and Chinese exports to Mexico come from the UN COMTRADE database and are disaggregated at the HS 6-digit level. Quota data is from Brambilla, Khandelwal and Schott (2010) from 1996 to 2004 and from US Customs and Border Protection from 2005 to 2008. Since our analysis requires quota data at the HS6 digit level, we follow the procedure of Bernhofen, Upward and Wang (2012) to convert the fill rates from the original US 10-digit HS categories to the HS 6-digit level[7]. Consequently, the quota dummy equals one if at least one product within an HS 6-digit category is subject to quota in a given year. Figure 1 plots an histogram of fill rates at the HS 6- and HS 10-digit level. In both cases about half of the product-year observations have a zero fill rate, while, conditional on being subject to quota, the fill rate tend to be close to one, suggesting that the quota system was indeed restrictive.

US MFN ad-valorem tariffs on Chinese goods come from USITC and are HS 6-digit simple averages of the tariffs at the HTS 8-digit level. We also use tariff data from UN TRAINS to supplement the USITC data when tariff were missing. To measure tariff protection by Mexico vis-á-vis China, we need to consider both MFN ad-valorem tariffs (simple averages at the HS 6-digit level) and the "compensatory" tariffs that the country could impose on China. Under Annex 7 of the WTO China Accession Protocol, Mexico could keep its high antidumping tariffs on Chinese textile and apparel products, which started in 1994. For products subject

[7] Quota limits and fill rates are reported for each three-digit textile category as defined by OTEXA. We use their conversion table to map fill rates to the HS 10-digit level (see also Brambilla, Khandelwal and Schott, 2010).

to compensatory tariffs (75% of apparel and textile products in our sample), the Mexican tariff is thus the anti-dumping duty as reported in the Global Antidumping Database (Bown, 2012)[8]. Crucially, these tariffs were revoked in 2008 and thus do not vary during our sample period. As such, the identifying variation for the Mexican tariff variable comes only from those (few) products that could be imported from China under the MFN regime.

As a preliminary check on our empirical strategy, we estimate the distribution of missing imports (Figure 2), comparing products that faced US quotas to those who didn't. Whether the trade gap is measured in values or quantities, the distribution of quota-bound products is clearly to the right of the other and the Kolmogorov-Smirnov test rejects the null of equality of the two distributions. This suggests that Mexican missing imports may indeed capture illegal diversion.

2.2 The US in-bond ratio

In an alternative empirical strategy, we measure the prevalence of US apparel imports from China that enters 'in-bond' and relate this to indicators of quota restrictiveness. This approach is thus complementary to the previous empirical strategy as it explores quota-hopping in-bond diversion by looking at overall in-bond imports rather than only the Mexico-based illegal diversion.

To proxy for in-bond imports, we rely on data on US imports from China intended for bonded warehouses or free-trade zones (Rate Provision Code - RPC - "00" in the USITC classification) and those to be processed for exports under bond (RPC 13), both classified as duty- and quota- free. We take the sum of these flows as our measure of in-bond imports[9]. Anecdotal evidence suggests that in many detected cases of illegal in-bond diversion warehouses were used as 'black holes' where in-bond shipments would go before getting lost in the US market (GAO, 2004).

Similarly to the previous strategy, we test whether our measure of in-bond imports (in

[8] The compensatory tax rates are 54%, 331%, 501% and 553%, well above the maximum MFN tariff in the sample, at 35%. Since these do not vary over time, their exact level is inconsequential to our within-product estimates.

[9] Since there is no data on in-bond shipments separately, this measure can proxy for the amount of actual in-bond shipment (GAO, 2004, 2007).

both values and quantities) is significantly correlated with the quota status. To this end, we first compute in-bond ratios:

$$\text{(4)} \quad \text{In-bond ratio}_{it} = ln(1 + \text{In-bond Imports}_{it}) - ln(1 + \text{Total Imports}_{it})$$

Taking the ratio of in-bond imports over overall imports allows us to net out any confounding effect on the aggregate flow. We add one to the logs to include flows where no in-bond trade is reported[10].

We then estimate the following regression model[11]:

$$\text{(5)} \quad \text{In-bond ratio}_{it} = \alpha + \beta\,(\text{Quota}_{it}) + \text{prod}_i + \text{year}_t + \epsilon_{it}$$

Here the subscript i indicates a HS 10-digit apparel and textile product. The variable 'Quota' and the terms 'prod' and 'year' are defined as above (see also equation 2), with a product being a HS 10-digit code. A positive and significant coefficient β would provide suggestive evidence for in-bond diversion. To control for tariff evasion, we add to this baseline specification the US MFN ad-valorem tariff as define at the HS 8-digit level[12].

This method is similar to Fisman, Moustakerski and Wei (2008) who show that entrepôt trade via Hong Kong is in part a tariff-evasion scheme and Golub (2012) who shows that transhipment via Benin and Togo into Nigeria occurs precisely in those products which are heavily protected in Nigeria, such as used cars, cloth and rice.

As in the previous empirical strategy, we also estimate the difference-in-difference specification (see equation 3) where the dependent variable is the change in the US in-bond ratio.

As a preliminary check on this second part of our empirical strategy, we estimate the distribution of the in-bond ratio (Figure 3), comparing products that faced US quotas to those who didn't. Whether the ratio is measured in values or quantities, the distribution of

[10] In robustness checks we use alternate estimators where the in-bond ratio is defined as a share rather than logs.

[11] All US import data come from USITC Dataweb.

[12] The US granted MFN (or "Normal Trade Relations") treatment to China also before WTO accession in 2002.

quota-bound products is clearly to the right of the other and the Kolmogorov-Smirnov test rejects the null of equality of the two distributions. This suggests that the in-bond ratio, as Mexican missing imports, may also capture illegal diversion.

3 Results

3.1 Results using Mexican missing imports

Results for Mexican missing imports are in Table 1. Column (1) reports the estimate of our baseline specification (1), using the quota dummy as a measure of quota restrictiveness. The β coefficient is positive and significant for both trade values and quantities, suggesting that the trade gap between China and Mexico can indeed identify quota-hopping in-bond diversion in the US. The estimates imply that the China-Mexico trade value gap (in ratio) drops by 25% ($\exp(0.22) \approx 1.25$) when a quota is removed. The effect appears much higher when the trade gap is in quantities. Missing Mexican imports drop by 90% when a US quota is removed. This may be because quantities are more precise as a measure of quota-hopping in-bond diversion, where goods simply do not show up in the Mexican statistics, rather than, say, under-invoicing practices, which could be identified in missing import values.

In Column (2), we add the US ad-valorem tariff rate to control for possible tariff-hopping in-bond diversion[13]. The estimates imply that missing Mexican imports are indeed higher when apparel face a higher US tariff, but this effect is significant only when we use trade values. In this case, a 1% increase in US tariff (i.e. half of the average within-product spread) would lead to a 12.5% in the trade gap. The evidence is however not confirmed when we use the more reliable missing import quantity as dependent variable.

In Column (3), we add Mexican tariffs to the specification to control for possible tariff evasion in Mexico. We don't find evidence for this, the coefficient being not significant. The

[13] Some product-year observations representing less than 2% of the sample have implausibly high tariffs (5000 and 10000%). These come from a 10000% tariff imposed on some apparel at the HS 8-digit level throughout the sample period. We cap those tariffs at 60% or double the maximum of the remaining US tariffs and include a separate dummy for these problematic observations. These high tariffs do not vary over time at the more detailed HS 10-digit level and hence do not affect the estimates in the in-bond ratio strategy.

very little variation over time of the Mexican tariff variable might well explain this pattern. Importantly, the coefficient on the quota dummy stays positive and significant, with no changes in size across all three specifications.

In Columns (4) to (6), we repeat the same steps but use the quota fill rate instead of a quota dummy. Results are broadly confirmed, with the coefficient on the fill rate variable being positive and significant for all three specifications in values and quantities. The magnitude of the effect is again important. An increase in the quota fill rate of 60 percentage point, (i.e. the average within-product spread of the fill rate) would lead to an increase in the quantity trade gap by 55%. This is twice the effect on missing import values and of similar magnitude of a quota removal. Similarly, if a quota that had a binding fill rate of 95% is suddenly removed, estimates suggest the quantity trade gap would by 100%.

To see whether our results are robust to 'double zeros', i.e. instances where both Chinese exports and Mexican imports are reported as zero, we run our regression including these zero observations in our dependent variable (the sample size increases by one third) and add a dummy for double zeros as an explanatory variable that we interact with the other regressors. Results reported in Table 1 of a separate Web Appendix[14] confirm the evidence of the baseline regressions, with the coefficients on quota variables being positive and larger when the trade gap is measured in quantities.

Table 2 reports the results of the difference-in-difference regressions. Estimates in Columns (1) to (3) confirm the in-bond diversion result. The average change in the trade-values gap for quota-bound products between 2004 and 2005 is around one third deeper than the underlying trend (Column (1)), a result that is confirmed when we control for changes in US and Mexican tariffs. In other words, less Mexican imports went missing with the end of the MFA, and this even more so for quota-bound products. As in previous regressions, the results are stronger when the trade gap is measured in quantities. To make sure that this effect can be ascribed to the end of the MFA in 2004, we run a "placebo" regression where the 'after' period is 2004 rather than 2005. Results reported in Columns (4) to (6) confirm that this 'diversion' effect is indeed specific to the MFA removal and not

[14]The Web Appendix can be accessed online here.

to pre-existing trends.

In sum, the results from our analysis of missing Mexican imports provide supportive evidence of quota-hopping in-bond diversion whereby apparel were declared as Chinese exports to Mexico but did not reach Mexico, being diverted in the US market. There were significantly more Chinese apparel missing from the Mexican accounts when products were subject to US quotas.

3.2 Results using the US in-bond ratio

We now turn to the results of our second approach which makes use of US imports from China declared for bonded warehouses, free-trade zones or exportation.

Table 3 reports the estimates of the baseline specification in 5, for both trade values and quantities. Results in Column (1) suggest that the share of apparel imports declared as in-bond when the product is subject to a quota is more than twice ($\exp(0.819) = 2.26$) the same share when the same product is quota-free. This systematic difference in the share of in-bond imports between quota-bound and quota-free products is suggestive of in-bond diversion. In Column (2), we include the US MFN tariff to see whether the effect of the quota status is somehow influenced by tariff protection. Results suggest that this is not the case. The coefficient on the quota dummy stays positive and of similar size, while the tariff coefficient is insignificant.

In Columns (3) and (4), we replace the quota dummy with the fill rate. The coefficients are again positive and significant significant and suggest that a drop the quota fill rate of 60 percentage points (i.e. the average within-product spread of the fill rate) leads to a 60% drop in the in-bond ratio in value levels.

Columns (5) to (8) report the estimates of the same regressions when we measure the in-bond ratio in quantities. Similarly to the results of the previous empirical strategy, we find evidence for in-bond diversion, with the effects being even stronger in magnitude than the ones found with value flows.

Since defining the in-bond ratio in logs after adding one to the numerator and the denominator might be arbitrary, Table 4 provides the results of robustness checks where we define the in-ratio in levels. Column (1) show that the benchmark results hold even when the in-bond ratio is in levels and the quota elasticity is estimated linearly. The in-bond ratio is estimated to be 1.3 percentage-points higher when the product is subject to a quota. The magnitude of this effect is non-negligible since the average in-bond ratio in the sample is about 3.5%. Column (2) shows that the results also hold if we use the fill rate as a measure of quota bindingness.

Yet, the estimates in Columns (1) and (2), being from an OLS estimator, might not capture important non-linearities in the in-bond ratio. This is likely to be the case as almost 70% of our sample has no in-bond imports and thus zero in-bond ratio. One way to deal with this high number of zeros is the Poisson pseudo-maximum likelihood estimator suggested by Silva and Tenreyro (2006). While some observations are dropped because of all zero outcomes, this model yields positive and significant coefficients in all specifications (Columns (3) and (4)).

Given that the dependent variable is bound between zero and one (with 1.5% of the sample being at the upper bound), we can also estimate our baseline specification using the two-limit Tobit estimator with fixed effects proposed by Alan et al. (2011). The results reported in columns (5) and (6) again confirm the baseline findings. As shown in Honoré (2008), a consistent estimate of the marginal effect in this model is given by the product of the estimated coefficient and the share of uncensored observations (29.5%). The estimates of Column (5) imply that the in-bond ratio is 8 percentage-points higher when the product faces a quota, which is an even higher impact than the one estimated with linear model.

Another suitable estimator for this type of fractional dependent variable is the fractional probit discussed in Wooldridge (2010*b*, Chapter 18). To control for unobserved heterogeneity at the product level, we adopt the correlated random-effects model for unbalanced panel proposed by Wooldridge (2010*a*). This amounts to a probit model where we augment the set of explanatory variables by adding their time averages interacted with dummies for the number of years within each product (i.e. this is how we model the product "fixed effects"). To take into account the unbalanced nature of the data, the variance of the unobserved effects is further modeled as a linear function of dummies for the number of years within each product. The results from this "heteroskedastic probit" model are reported in columns (7) and (8). Whether we measure quota restrictiveness with a quota dummy or the fill rate, its coefficient stays positive and significant, confirming the in-bond diversion result.

To test further the in-bond diversion mechanism, we turn to the results of the difference-in-difference estimator that exploits the end of the MFA quotas in 2005. Table 5 reports the results for both value and quantity flows. The estimates provide evidence for in-bond diversion as the ratio of imports declared as in-bond to total imports drops significantly between 2004 and 2005 and even more for products that became quota-free with the end of the MFA (see Columns (1) and (5)). The results are robust to controlling for US tariffs (Columns (2) and (6)). Importantly, the placebo regressions that shift the quota drop to 2004 yield no significant coefficients (Columns (3), (4), (7) and (8)), supporting the identification strategy.

Finally, we explore possible heterogeneity in the positive correlation between the in-bond ratio and quota status across US customs districts. The fragmented data collected by the General Accounting Office (GAO, 2007) show that the US customs districts with the highest number of total (not only apparel) in-bond transactions (i.e. where the shipments arrive and are declared as in-bond) are Los Angeles (CA), New York (NY), Miami (FL), Laredo (TX) and Seattle (WA). A cursory glance at the body of anecdotal evidence on cases of in-bond diversion (GAO, 2004; Laredo Morning Times, 2006) suggest that the districts of Los Angeles and Laredo and El Paso in Texas were most affected by this illegal practice, mainly because of the pervasiveness of the Mexican scheme. To examine the location of diversion more carefully, we use district-level US data on in-bond and total apparel imports from China and augment our baseline specification by adding district fixed effects and interacting the quota policy variable with those district dummies[15]. Figure 4 summarizes the main findings. The strongest evidence for in-bond diversion is observed at Laredo (TX). Here the in-bond ratio is on average 23 percentage points higher when apparel products are subject to a quota. Importantly, three out of the four districts that border with Mexico (San Diego (CA), Nogales

[15] To ease interpretation of the coefficients, the in-bond ratio is in levels (i.e. shares). Data are aggregated at the HS 6-digit level. The districts of Duluth (MN) and Port Arthur (TX) are dropped from estimation because of the small number of non-missing observations (less than 50).

(AZ), El Paso (TX) and Laredo (TX)) are among the top ten diversion hubs. This evidence, while purely illustrative, corroborates the previous evidence for in-bond diversion whereby goods are declared as in-bond for exportation to Mexico and are then illegally diverted in the US market.

4 Conclusion

In this paper we describe and provide empirical evidence for in-bond diversion, an illicit quota-hopping scheme. We show that it is possible to track this quota evasion using official trade statistics from China and Mexico. This is because Chinese exporters engage in in-bond diversion by declaring goods bound for Mexico but in reality selling them in the US. Furthermore, we find traces of quota evasion by Chinese exporters of textiles and apparel in US data on imports for bonded warehouses and free-trade zones, showing that the share of imports covered by this trade regime is significantly higher when the imported product is subject to quota.

We thus shed light on a possible catch in the much-used in-bond system that allows goods to transit between US ports before paying duties or being assessed for quota purposes. While the incentives for quota-hopping disappeared with the last quotas removed in 2008, anecdotal evidence (CustomsInfo, 2012) suggests that the high import tariffs on textiles and apparel may still lead illicit-minded importers to dodge the system in order to avoid payment of duties. More generally, our paper warns public authorities against the unintended consequences of protectionist trade policies.

References

Alan, Sule, Bo E. Honoré, Luojia Hu, and Søren Leth-Petersen. 2011. "Estimation of panel data regression models with two-sided censoring or truncation." Federal Reserve Bank of Chicago Working Paper Series WP-2011-08.

Baldwin, Richard. 2007. "EU VAT fraud Part 1-5." VoxEU.org.

Bernard, Andrew B., J. Bradford Jensen, and Peter K. Schott. 2006. "Transfer Pricing by U.S.-Based Multinational Firms." National Bureau of Economic Research, Inc NBER Working Papers 12493.

Bernhofen, Daniel, Richard Upward, and Zheng Wang. 2012. "Quota as a Sorting Machine: Quantity Restrictions and Price Adjustments of Chinese Textile Exports to the US." University of Nottingham Mimeo.

Bown, Chad P. 2012. "Global Antidumping Database." World Bank database.

Brambilla, Irene, Amit K. Khandelwal, and Peter K. Schott. 2010. "China's experience under the Multi-Fiber Arrangement (MFA) and the Agreement on Textiles and Clothing (ATC)." In *China's Growing Role in World Trade.* , ed. Robert Feenstra and Shang-Jin Wei, 345–387. Chicago:University of Chicago Press.

CustomsInfo. 2012. "Ten Million dollars in Customs Fraud Discovered in California." CustomsInfo Industry Blog.

DellaVigna, Stefano, and Eliana La Ferrara. 2010. "Detecting Illegal Arms Trade." *American Economic Journal: Economic Policy*, 2(4): 26–57.

Dutt, Pushan, and Daniel Traca. 2010. "Corruption and Bilateral Trade Flows: Extortion or Evasion?" *The Review of Economics and Statistics*, 92(4): 843–860.

Fisman, Raymond, and Shang-Jin Wei. 2004. "Tax rates and rax evasion: evidence from missing imports in China." *Journal of Political Economy*, 112(2): 471–500.

Fisman, Raymond, Peter Moustakerski, and Shang-Jin Wei. 2008. "Outsourcing Tariff Evasion: A New Explanation for Entrepot Trade." *The Review of Economics and Statistics*, 90(3): 587–592.

Frittelli, John F. 2005. "Port and Maritime Security: Background and Issues for Congress." Congressional Research Service - The Library of Congress CRS Report for Congress.

GAO. 1994. "Control Weaknesses Limited Customs' Ability to Ensure That Duties were Properly Assessed." US Government Accountability Office Report to the Commissioner, U.S. Customs Service.

GAO. 2004. "U.S. Customs and Border Protection Faces Challenges in Addressing IllegalTextile Transshipment." US Government Accountability Office Report to Congressional Committees.

GAO. 2007. "Persistent Weaknesses in the In-Bond Cargo System Impede Customs and Border Protection's Ability to Address Revenue, Trade, and Security Concerns." US Government Accountability Office Report to the Committee on Finance, U.S. Senate.

Golub, Stephen S. 2012. "Entrept Trade and Smuggling in West Africa: Benin, Togo and Nigeria." *The World Economy*, 35(9): 1139–1161.

Harrigan, James, and Geoffrey Barrows. 2009. "Testing the theory of trade policy: evidence from the abrupt end of the Multifiber Arrangement." *The Review of Economics and Statistics*, 91(2): 282–294.

Homeland-Security. 2006. "US. Customs and Border Protection has Seized 10 Million in Misdescribed Textile Products since October." Homeland Security Press Release.

Honoré, Bo E. 2008. "On Marginal Effects in Semiparametric Censored Regression Models." Princeton University.

Javorcik, Beata S., and Gaia Narciso. 2008. "Differentiated products and evasion of import tariffs." *Journal of International Economics*, 76(2): 208–222.

Khandelwal, Amit K., Peter K. Schott, and Shang-Jin Wei. 2011. "Trade Liberalization and Embedded Institutional Reform: Evidence from Chinese Exporters." National Bureau of Economic Research, Inc NBER Working Papers 17524.

Laredo Morning Times. 2006. "Customs broker sentenced for smuggling." Newspaper article.

Mishra, Prachi, Arvind Subramanian, and Petia Topalova. 2008. "Tariffs, enforcement, and customs evasion: Evidence from India." *Journal of Public Economics*, 92(10-11): 1907–1925.

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

U.S. Customs Service - Department of the Treasury. 1984. "Customs Regulations Amendments Relating to Textiles and Textile Products; In-Bond Movements; Foreign-Trade Zones." [T.D. 84-207] 49 FR 38245.

Wooldridge, Jeffrey M. 2010*a*. "Correlated random effects model with unbalanced panels." Mimeo.

Wooldridge, Jeffrey M. 2010*b*. *Econometric Analysis of Cross Section and Panel Data.* . Second ed., The MIT Press.

Zitzewitz, Eric. 2012. "Forensic Economics." *Journal of Economic Literature*, 50(3): 731–69.

Table 1: In-bond diversion: Evidence from missing Mexican imports

	(1)	(2)	(3)	(4)	(5)	(6)
			Trade values			
Quota	0.225**	0.232**	0.227*			
	(0.114)	(0.114)	(0.117)			
FR				0.310**	0.318**	0.326**
				(0.139)	(0.139)	(0.142)
Quota drop						
US tariff		12.43**	9.959*		12.54**	10.09*
		(5.490)	(5.721)		(5.505)	(5.736)
MEX tariff			-0.412			-0.221
			(1.723)			(1.705)
Obs	6,366	6,220	6,148	6,366	6,220	6,148
R2 (Within)	0.069	0.067	0.069	0.069	0.067	0.070
			Trade quantities			
Quota	0.645***	0.660***	0.607***			
	(0.208)	(0.209)	(0.214)			
FR				0.754***	0.771***	0.728***
				(0.262)	(0.264)	(0.270)
Quota drop						
US tariff		17.08	12.60		17.17	12.72
		(11.66)	(12.16)		(11.70)	(12.19)
MEX tariff			-4.379			-4.257
			(3.201)			(3.177)
Obs	6,366	6,220	6,148	6,366	6,220	6,148
R2 (Within)	0.108	0.106	0.101	0.108	0.106	0.101

Note: All regression include year dummies. Regressions with US tariff include a dummy for product-year with extreme tariffs (see text). Product-clustered s.e. in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 2: In-bond diversion: Evidence from missing Mexican imports - DD Specification

	(1)	(2)	(3)	(4)	(5)	(6)
			Trade values			
Quota-bound × $year_{2005}$	-1.178***	-1.269***	-1.254***			
	(0.335)	(0.334)	(0.336)			
Quota-bound × $year_{2004}$				0.482	0.418	0.396
				(0.353)	(0.351)	(0.360)
$year_{2005}$	-0.246	-0.312	-0.329			
	(0.225)	(0.279)	(0.282)			
$year_{2004}$				0.0662	0.137	0.168
				(0.233)	(0.233)	(0.251)
Δ US tariff		55.65	56.13		157.1	157.8
		(56.86)	(57.07)		(191.3)	(191.9)
Δ MEX tariff			2.819			2.359
			(4.992)			(6.509)
Obs	1,104	1,083	1,083	1,051	1,029	1,029
R2 (within)	0.070	0.073	0.074	0.010	0.012	0.012
			Trade quantities			
Quota-bound × $year_{2005}$	-1.635**	-1.775***	-1.735***			
	(0.661)	(0.663)	(0.670)			
Quota-bound × $year_{2004}$				0.292	0.212	0.230
				(0.690)	(0.692)	(0.715)
$year_{2005}$	-0.0853	-0.208	-0.251			
	(0.452)	(0.596)	(0.609)			
$year_{2004}$				0.395	0.489	0.465
				(0.490)	(0.496)	(0.539)
Δ US tariff		92.49	93.78		319.9	319.4
		(111.7)	(112.4)		(395.6)	(396.0)
Δ MEX tariff			7.467			-1.860
			(11.80)			(13.02)
Obs	1,104	1,083	1,083	1,051	1,029	1,029
R2 (within)	0.027	0.029	0.030	0.006	0.007	0.007

Note: Product-clustered s.e. in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: In-bond diversion: Evidence from the US in-bond ratio

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Trade values				Trade quantities			
Quota	0.819***	0.802***			0.878***	0.854***		
	(0.0923)	(0.0930)			(0.0821)	(0.0821)		
FR			0.862***	0.839***			1.017***	0.987***
			(0.110)	(0.111)			(0.0956)	(0.0958)
US tariff		0.000240***		0.000238***		0.000190***		0.000186***
		(5.68e-05)		(5.61e-05)		(5.11e-05)		(5.05e-05)
Obs	28,006	27,695	28,006	27,695	28,005	27,694	28,005	27,694
R2 (within)	0.024	0.024	0.022	0.023	0.060	0.061	0.059	0.060

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

Table 4: In-bond diversion: Evidence from the US in-bond ratio - Non-linear estimators

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS in levels		Poisson PML		Two-limit tobit		Fractional probit	
	Trade values							
Quota	0.0136***		0.585***		0.291***		0.344***	
	(0.00395)		(0.108)		(0.0574)		(0.0608)	
FR		0.00784*		0.419***		0.171**		0.318***
		(0.00456)		(0.128)		(0.0799)		(0.0644)
Obs	28,005	28,005	19,827	19,827	28,005	28,005	28,005	28,005
R2 (Within)	0.007	0.006						
	Trade quantities							
Quota	0.0142***		0.621***		0.350***		0.345***	
	(0.00407)		(0.111)		(0.0639)		(0.0608)	
FR		0.0105**		0.516***		0.256***		0.318***
		(0.00469)		(0.129)		(0.0854)		(0.0644)
Obs	28,005	28,005	19,827	19,827	28,005	28,005	28,005	28,005
R2 (Within)	0.008	0.008						

Note: All regression include year dummies. In Columns (5) and (6), product-bootstrapped (200 replications) s.e. are in parentheses. Columns (7) and (8) include time averages of year dummies and of the variable(s) of interest interacted with dummies for the number of years within each product. Product-clustered s.e. in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Table 5: In-bond diversion: Evidence from the US in-bond ratio - DD Specification

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Trade values				Trade quantities			
Quota-bound × $year_{2005}$	-0.713*	-0.758**			-0.800***	-0.832***		
	(0.379)	(0.386)			(0.300)	(0.305)		
Quota-bound × $year_{2004}$			0.127	0.0881			0.169	0.116
			(0.383)	(0.388)			(0.300)	(0.303)
$year_{2005}$	0.216	0.281			-0.216	-0.165		
	(0.268)	(0.284)			(0.212)	(0.227)		
$year_{2004}$			0.184	0.213			0.0254	0.0706
			(0.275)	(0.279)			(0.214)	(0.217)
Δ US tariff		-8.215		31.96		-8.576		27.85
		(26.10)		(31.21)		(23.35)		(26.85)
Obs	4,176	4,126	4,001	3,957	4,176	4,126	4,001	3,957
R2 (Within)	0.002	0.002	0.001	0.001	0.013	0.013	0.000	0.001

Note: Product-clustered s.e. in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 1 Distribution of US quota fill rates on Chinese apparel products

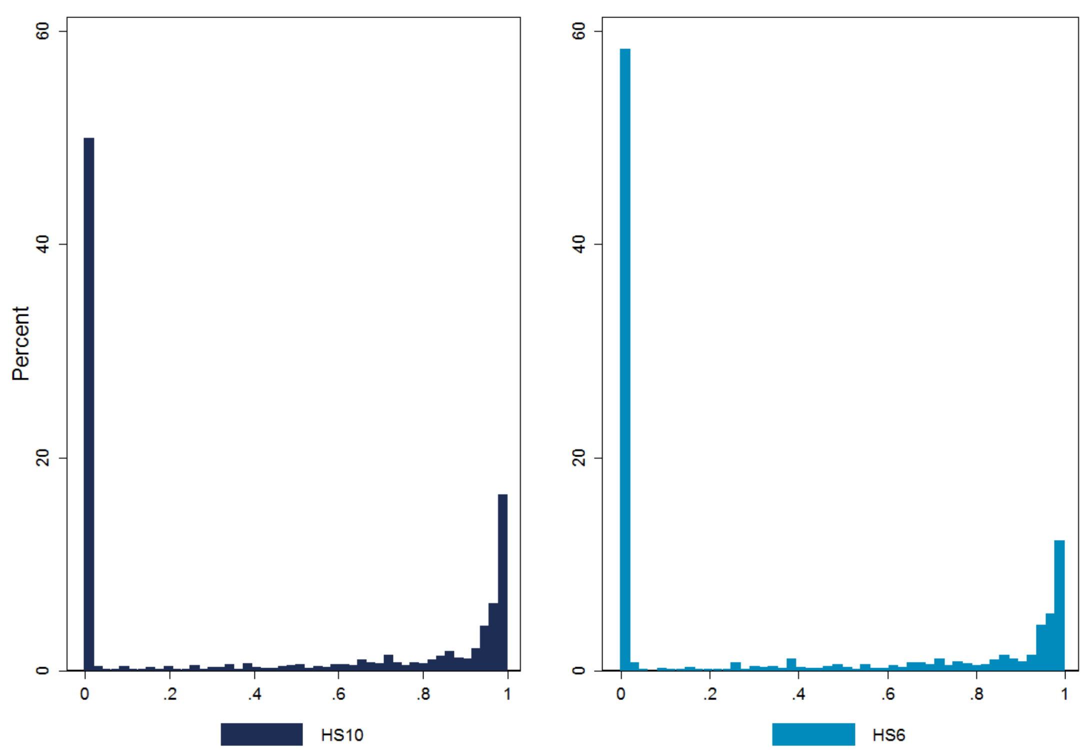

Figure 2 Density estimates of missing Mexican imports from China

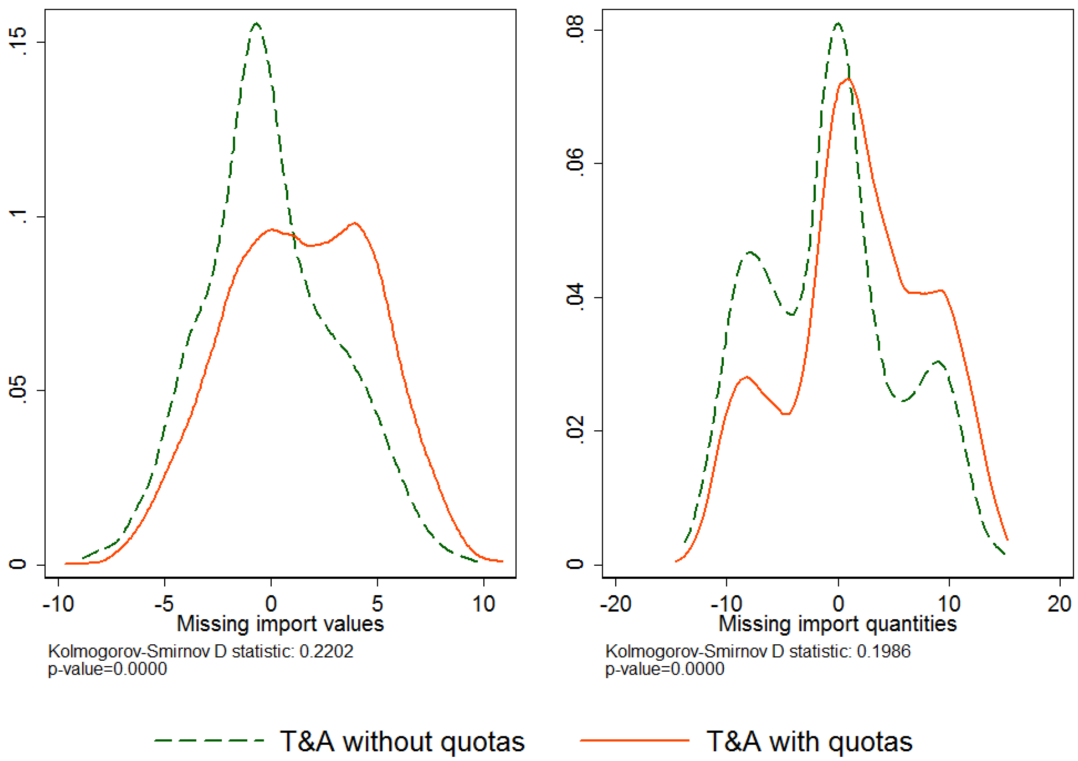

Figure 3 Density estimates of US in-bond ratios

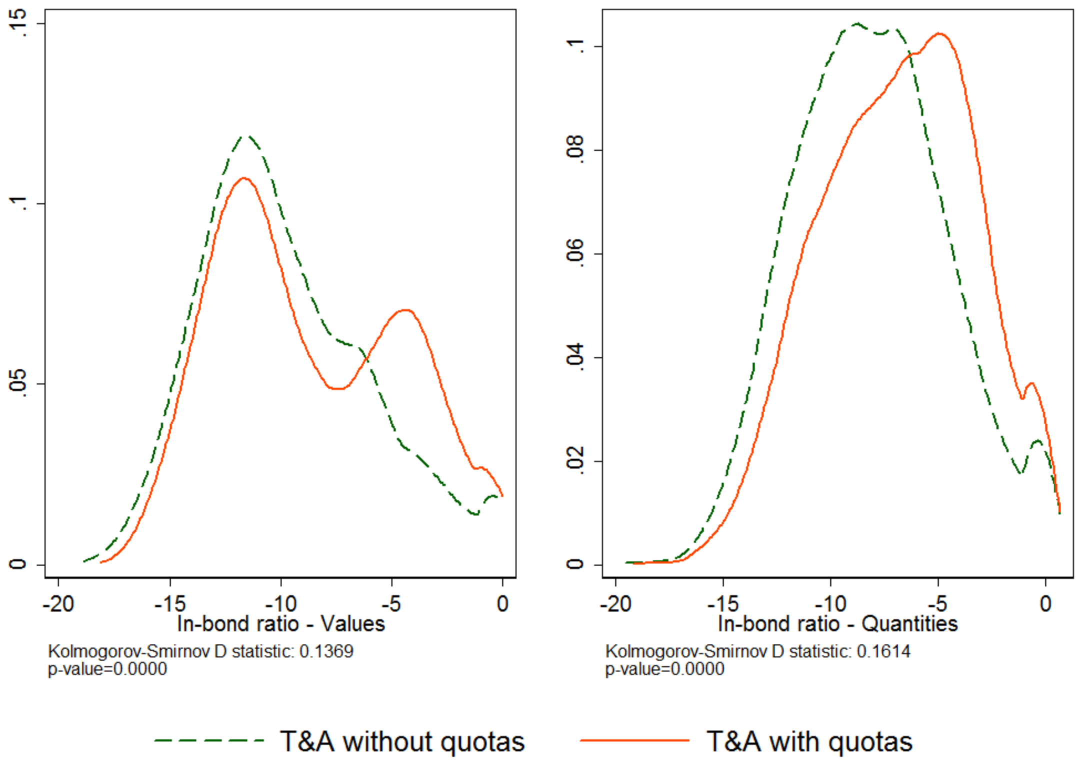

Figure 4 In-bond diversion: District-level evidence