Trade Effects of Customs Reform: Evidence from Albania*

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Abstract

Despite enormous academic interest in international trade costs and keen policy interest in efforts to reduce them, little is known about the effects of trade facilitation measures. We study a significant Albanian reform that sharply reduced physical inspections of import shipments. Using an estimation strategy that isolates quasi-random variation in the allocation of shipments to physical inspections, we find that reduced inspections significantly increase imports. Import flows that are observed least frequently see the largest trade responses to reduced inspections. The effect of inspections on imports is virtually independent of changes in clearance time and clearance time uncertainty. Tariff and other tax revenues collected at the border rise in direct proportion to growth in declared import value. We find no compelling evidence that reduced inspections increase evasive behavior, perhaps because most of Albania's imports are tariff-free.

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JEL classification codes: F13, F14, F15.

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1. Introduction

An enormous literature attempts to measure the size of implicit international trade costs and to explain them.[1] Despite all this research activity there is little hard evidence on the effectiveness of policy changes that might be expected to mitigate implicit trade costs.[2] But the dearth of hard evidence has not restrained policy-makers, who signed an ambitious World Trade Organization (WTO) trade facilitation agreement that requires substantial reforms in developing countries and commits developed countries to support such reforms with hundreds of millions of US dollars of international aid.[3] An important trade facilitation measure contained in the WTO agreement, and one that is challenging for developing countries to implement, is the adoption of risk-based methods of selecting shipments for inspection.[4] These methods combine information technology and statistical targeting procedures to sharply reduce the frequency with which traded goods are physically inspected.

This paper estimates the impact of a substantial decline in physical inspection rates that occurred as the Albanian customs authority introduced substantial improvements to its risk-based system for inspecting import shipments. Specifically, we study the effects of sharply reduced rates of physical inspections of import shipments on clearance time, clearance time uncertainty, import value and on tax revenues collected at the border. During the period for which we have comprehensive import transaction data, 2007-2012, the rate of physical inspections conducted by Albanian customs fell from 43 percent of shipments to just 12 percent. This dramatic reduction in

[1] Anderson and van Wincoop (2004), a survey article on the topic, had been cited more than 3900 times in Google Scholar as of November 2018. A topic of particular concern in this literature is the impact of national borders for trade, as in McCallum (1995), which had over 3100 citations at that point in time.

[2] Typically, implicit trade costs are estimated in cross-sectional studies, and so are unable to estimate the impact of specific reforms. Some studies offer rough evidence on high-level policy changes such as the introduction of a preferential trade agreement, but offer little guidance as to the effects of particular policies that might or might not be included in such agreements.

[3] World Trade Organization (2013) indicates that 1.2 billion US dollars in aid had been disbursed in support of trade facilitation reforms in developing countries since 2006. The document also pledges support by 27 national and international agencies.

[4] Of the 36 countries receiving support for their implementation of trade facilitation measures from the World Bank's Trade Facilitation Support Program in 2017, 22 are receiving assistance for improvements in risk-based approaches to border clearance.

the frequency of inspections - together with an identification strategy that exploits the properties of risk-based strategies for selecting shipments for inspection - allow credible estimates of the causal impact of the customs reform on our outcomes of interest. The exercise relies on detailed administrative data that report inspection type and time spent in customs at the level of an import declaration, and the value and quantity of imports as well as tax revenues collected at the level of an import transaction. Systematic variation in the frequency of inspections across combinations of importing firms, products, countries of origin, and years is purged by a rich vector of fixed effects. We treat the remaining variation in inspections as random, and estimate the effect of changes in random inspections on changes in the distribution of customs clearance times and on import value. We also estimate the empirical model of import growth while including differences in clearance time and in clearance time uncertainty as controls, in order to identify an effect of inspections on trade that is independent of the normally hypothesized channels. Finally, we study the implications of reform for tax collection. We replace import value with tax revenue collections in the causal regression model to estimate reform-induced changes in tax revenue collection along an intensive margin of trade. In order to consider the consequences of reform for evasive behavior, we also study unit value gaps using mirror statistics from Albania's trade partners.

Our main findings are as follows. First, we show that conditional reductions in annual physical inspection rates (measured as a change from 50% or more shipments inspected to less than 50% for imports of a given importing firm-HS6-digit product-origin country triplet) produce reductions in various measures of clearance time and uncertainty about clearance time, and increases in import value and tax revenues collected.[5] Second, the response of trade to reduced inspections varies with the frequency of trading activity, trade responses are larger on firm-HS6

[5] Henceforth we will abbreviate HS 6-digit to HS6.

product-origin country-year flows with fewer shipments. Third, the impact of reduced inspections on import growth is virtually independent of observed changes in clearance times or clearance time uncertainty. Fourth, we find that total tax revenues collected at the border rose in direct proportion to increases in declared import value. Investigation of mirror statistics reveals a downward shift in the distribution of unit value gaps over the period, an outcome that is consistent with rising compliance. The empirical relationship between unit value gaps and tariffs is non-monotonic and weak.

Ours is one of a number of very recent papers that moves away from the cross-section to study the impact of individual trade facilitation reform episodes.[6] Our paper is most similar to Volpe Martincus et al. (2015), who use Uruguayan export transaction data to link physical inspections to customs delays, and customs delays to export growth in an instrumental variables (IV) framework. Our study differs from theirs in several important ways. First, our analysis covers a period of substantial reductions in the probability of physical inspection due to a significant trade facilitation reform.[7] Second, we focus on imports rather than exports. As countries are generally more interested in controlling imports than exports, inspections are much more common for imports, and reforms in customs are likely to have more impact on imports than exports. Third and most significantly, we study the direct effects of inspections on trade outcomes, whereas Volpe Martincus et al. (2015) use the techniques to estimate a causal effect of inspection-related delays on exports. As in that paper, we find that reduced inspections reduce median clearance times.

[6] Carballo et al. (2016a) study a transit regime in Central America; Carballo et al. (2016b) an electronic single window in Costa Rica; Carballo et al (2016a) a postal reform in Peru; Carballo et al. (2016b) an authorized economic operator program in Mexico; and Fernandes et al. (2016) an in-house clearance program in Serbia.

[7] Volpe Martincus et al. (2015) link some of the variation in inspection activity to reduced availability of inspectors in Uruguayan customs. The reform we study in Albania were much larger in scope and scale.

We also extend on Volpe Martincus et al. (2015) by considering effects of reform on clearance time uncertainty. Clark et al. (2014) use deviations from expected port arrival times to estimate an effect of supply chain uncertainty on U.S. imports. We link reduced inspections to reductions in the Clark *et al.* uncertainty measure, as it applies to customs clearance times, and to an alternative measure of clearance time uncertainty. As with median clearance times, we find that controlling for changes in clearance time uncertainty does not materially affect our estimate of reduced inspections on import growth. In the Albanian setting, where clearance times were already low and reasonably predictable, inspections seem to have an effect on trade flows that is independent of their effects on the distribution of clearance times.

A further innovation of the paper is the consideration of the effects of a trade facilitation reform on tax revenue collections. We show that as the frequency of inspections falls, tax revenues collected grow in line with import value. Using tools from the literature that applies mirror statistics to study tariff evasion, we investigate the possibility that inspection reductions increased evasion. Albania's low tariffs, which are frequently zero, make it difficult to link evasive behavior to tariff rates, or to observe differential changes in evasive behavior across the reform episode.

The paper is organized as follows. Section 2 describes risk management procedures in the Albanian setting. Section 3 describes the data and provides evidence about changes in inspection patterns and time in customs. Section 4 discusses the methodology for identifying a causal effect of inspections on trade, and reviews the literature using mirror statistics to study tariff evasion. Our main results on the effects of reduced inspections on time and trade are discussed in Section 5. Section 6 estimates consequences of reform for tax revenue collection and for evasion. Section 7 concludes.

2. Background

Our choice of Albania is motivated by the depth and speed of changes that occurred there over a short six-year period when the unconditional probability of an import shipment undergoing a physical inspection fell by a factor of four (as will be shown in Section 3). The sharply reduced rates of physical inspection occurred because of a reform that implemented *risk management* procedures in the Albanian customs authority. While such administrative reform has been implemented in other settings, the rapid, large and well-documented changes in inspection rates in Albania offer an unusually good setting for studying its impact.[8]

The application of risk management in inspection regimes is considered modern best practice (Widdowson and Holloway, 2011). The adoption of risk-based inspections regimes is an important component of the World Trade Organization's Trade Facilitation Agreement. Risk management systems like those used in Albania employ statistical targeting of shipments based upon several variables that are retrieved automatically from the import declaration as well as news about non-compliance risks.

Although the actual risk model employed by the Albanian customs authority is confidential, we sketch its broad outlines within the context of our identification strategy. When an import declaration is submitted to the customs agency, the risk management system retrieves a vector of variables that are used in the risk model. The risk management system assigns a vector of predetermined weights to the variables retrieved by the system and generates a risk score, which

[8] In an earlier version of this paper, Fernandes et al. (2015), we reviewed the somewhat peculiar Albanian setting that set the stage for reform. Albania moved relatively quickly from a near-autarky situation to WTO membership, and soon afterward became an applicant for membership in the European Union. Tariff liberalization reduced incentives for corruption, while rapidly growing imports put pressure on an ineffective inspection regime that had relied on high rates of physical inspection. Aided by technical and financial support from the EU, the Albanian customs agency was able to apply already well-developed technologies and management practices in their risk management reform. Since improved border management was a necessary precondition for EU accession, domestic political economy challenges that might normally inhibit comprehensive reform were muted. The circumstances supporting major reforms to inspection regimes in developing country customs agencies are not always so favorable.

is used to determine the probability of inspection and the rigor of the inspection should it occur.[9] High-risk shipments face a high degree of scrutiny including physical inspection. Low-risk shipments are given less scrutiny, except when they are randomly selected for physical inspection.[10]

In the Albanian customs' risk management system, there are two dominant levels of scrutiny, designated as yellow and red channels. Allocation to the red channel causes a shipment to undergo physical inspection. The intensity of physical inspection can vary from a tailgate examination (visual inspection; opening truck, looking at markings, etc.) to an intensive examination (opening truck, opening boxes, unloading of goods), or the taking of samples for subsequent laboratory testing. Allocation to the yellow channel implies that the shipment only requires inspection of import documents before clearance.[11] Irregularities in the documentation can mean a reallocation of the shipment to the red channel.

An important feature of risk management for our econometric identification strategy is that selection for physical inspection occurs for two reasons. As discussed above, some shipments are selected because their risk score is high enough to merit a "targeted" inspection. Other shipments are selected randomly, in order to monitor compliance among shipments deemed to be low-risk. Unfortunately, our data does not identify the shipments that were selected randomly, which would provide an exogenous source of random variation that would be useful for identification. Instead, our identification strategy mimics the systematic components of the risk model with a rich vector

[9] Geourjon et al. (2013) describe how simple statistical scoring techniques exploiting shipment characteristics are used by the customs agency in Senegal to assess risk and thus effectively limit physical inspections. Also using Senegalese customs data, where the focus of risk management is improved revenue collection, Laporte (2011) compares several simple statistical targeting models, demonstrating that the effectiveness of targeting is not overly sensitive to the functional form of such models.

[10] Random selection is an enforcement tool used to occasionally check compliance as well as a strategy to facilitate the updating of risk parameters used to target shipments for inspection.

[11] There is also a barely used blue channel (0.003% of import declarations) from 2007 to 2010 that indicates no inspection, with a probability of post-clearance audit. We will ignore the blue channel in our analysis. Most developed countries also have a green channel through which goods are released directly to the market, without even a documentary inspection. Albania did not have a green channel during the reform period that we study.

of fixed effects, thereby isolating pseudo-random variation in inspection probabilities for our estimating equation. This portion of our identification strategy follows closely Volpe Martincus *et al.* (2015).

Volpe Martincus *et al.* (2015) study risk-based inspections in an export setting, where the number of variables entering the risk model should be relatively small. An import risk management system like the one in Albania would use a large number of variables (in a setting like this one, the number of variables would usually be in the low double digits). Some examples of included variables would be the goods' country of origin, the country of loading of the shipment, a detailed HS code, the tariff rate, other tax rates, the transport mode, the importing firm, the exporting firm, the transporting firm, and the customs agent. Without access to the risk model itself (and the full range of data that fill it), it is impossible to fully replicate the risk model with an econometric model, as we are attempting to do. But the collinearity of variables in the risk model means that a rich vector of fixed effects is likely to approximate the risk model quite well. For example, a product-country dummy variable in an econometric model can control for the product and country variables in the risk model, but also the tariff rate or any other variables in the risk model that are collinear with product, country or the product-country combination. The weakest point of our estimating strategy is that the only information on trading firms that we have is the identity of the importing firm. Our identifying strategy will implicitly assume that the importing firm maintains a single supply chain (exporting firm, transporter, freight forwarder, customs agent) for every HS6 product-origin country-year combination.[12] This estimating strategy would not be materially

[12] While this is unlikely to be strictly true for all firms in our data we note that the risk management system itself gives incentives to maintain stable supply chains. Under best practices in risk management, any change to the structure of previously observed supply chains will generate a targeted, and intrusive, physical inspection of the first shipment after the change. Most of the effects we observe are among import flows made up of 10 or fewer shipments, and infrequent shipments may be less likely to support multiple supply chains. While we lack comprehensive evidence on import supply chains, evidence from developed and developing countries alike suggest that the majority of importing firms import a given product from a single firm in the exporting country.

affected if two alternate firms participating at one stage of a given supply chain generate roughly equivalent risk scores. While the absence of a full set of conditioning data requires a caveat about the identification strategy, we show in an appendix that the vectors of fixed effects that we include successfully isolate variation in the inspection decision that is orthogonal to variables that would be of critical importance to the Albanian risk management system.

The effects we estimate of reduced inspections on increased imports require some interpretation in terms of firm behavior. Our preferred interpretation is that a) sharply reduced rates of inspection are a 'surprise' for participating firms, but b) firms learn quickly and increase imports within the same year. Firms' surprise at the lower inspection rate is plausible because this period is one of relatively rapid and unprecedented reform to the risk management protocols. The large number of infrequent traders in Albania might also justify a role for surprise, since these firms may be relatively ill-informed about customs' operations. If firms are to learn and respond within the year, they would need to ship at least two shipments so they can observe reduced inspections and respond. For this reason, our main estimating sample is limited to firm-HS6 product-origin country-year observations with at least two shipments observed.

Customs agencies responsible for border management face sometimes competing objectives. In principle, a well-implemented risk management reform could improve the speed and reliability of a customs control process for firms that comply with import regulations, while freeing up resources for greater scrutiny on shipments where compliance is less likely. It is thus possible that rapid reform will improve compliance outcomes. But of course, a rapid reduction in inspection behavior may also reduce compliance, as firms that are subject to fewer inspections may become

Carballo et al. (2014) show that 90% of Peruvian importers import a given HS 10-digit product from a single exporting firm. Martin et al. (2018) show that when trading a given HS6 product with France, nearly 70% of importing firms in EU countries have a single partner firm in France.

more likely to evade taxes or other tariffs. In the Online Appendix D we provide a formal mathematical framework to highlight these tradeoffs.

3. Data and Descriptive Evidence

3.1 Data

From the Albanian customs authority we obtained administrative data tracking imports at the transaction level for the period 2007-2012. This highly disaggregated customs transaction data covers a large number of variables that describe each import transaction: an importing firm numeric identifier, the dates (day/month/year) of the registration/submission of administrative documents and of the release/clearance of goods from customs, an Harmonized System (HS) 8-digit product code, the exporting country, import value, weight (in kilograms), total tax revenues collected, the mode of transportation, the border post of entry, the inspection channel, customs infractions and penalties.

The Albanian customs transaction data is recorded at the HS 8-digit level, using different revisions of the HS classification (HS2002 for data in 2007-2008, HS2007 for data in 2009-2011, and HS2012 for data in 2012). To obtain a consistent product classification over time, we first aggregate the raw transaction data to the HS6 level and concord HS2012 product codes to HS2007 product codes using a concordance table provided by the World Integrated Trade Solution (WITS). Then we concord these (HS2002 or HS2007) codes to a set of 'consolidated' HS6 codes consistent over time following the approach developed by Schott and Pierce (2012).[13]

At its most disaggregated level, the raw customs transaction dataset includes 3,097,103 observations covering five types of imports - imports for consumption, goods in transit, re-imports,

[13] The specific consolidated HS6 codes we use are described in Fernandes et al. (2016).

warehouse, and other. Our analysis focuses on the 2,694,837 observations (87%) that are imports for consumption.[14] The data cover the universe of Albanian formal import transactions.[15] Different parts of our analysis will rely on different aggregations of the observations in the raw customs transaction dataset: (i) the descriptive statistics in Section 3.2 will mostly employ data at the declaration level while (ii) the econometric estimation of the effects of inspections on customs clearance time, imports, and tax revenue collected will rely on data aggregated to the importing firm-HS6 product-origin country-year level. Each firm-HS6 product-origin country-year cell is based on the set of import shipments delivered to that particular firm, of that same product, from that same country over the year.

Armenter and Koren (2014) show that trade data is very sparse, even for a large country such as the U.S., in that the typical number of shipments for a firm-product-country triplet in a year is often 1. Not surprisingly this is also true in Albania, where 61 percent of the 716,225 observations at the importing firm-HS6 product-origin country-year level represent a single shipment, and the average number of shipments per observation is 2.9. As discussed earlier, we base our main estimates on a sample that excludes the observations made up of a single shipment since those observations' annual imports are unlikely to be affected by the inspection rate.

The key policy variable in our analysis, the inspection rate, is measured at the import declaration level - formally designated as single administrative document (SAD) - which is the level at which the risk management system decides the allocation to the red or yellow channel.[16] We focus on red channel inspections, which involve inspection of documents and physical

[14] By observation here (often designated as shipment) we refer to each item registered on an import declaration.
[15] The sum of import values across the five types of imports from our raw import dataset matches closely the total import values reported for Albania by the WITS over the period 2007-2012.
[16] A single SAD may contain more than one item/shipment (e.g. more than one type of good is being declared for import). But the inspection type (and clearance times) are always available for the entire SAD, and so it applies to each of multiple shipments if the SAD contains more than one shipment.

examination of goods. Like earlier authors (Volpe Martincus et al., 2015), the main variable we use to measure inspection activity is an indicator variable - the median allocation to the red channel - that identifies observations that saw inspection probabilities fall (from more than 50% inspection rates to less than 50% inspection rates). But we also consider inspection rates as a robustness check (in the Online Appendix) even though such rates contain the number of shipments per observation in the denominator, which could be a source of bias when inspection rates are used to predict outcomes that depend on the number of shipments per observation.

One of the outcome variables in our analysis - the time spent under control of the customs agency - is also measured at the declaration level. Clearance times are calculated as the difference between the time stamp associated with the submission of the import declaration and the time stamp for the release of the goods to the market. Since over the 2007-2012 period in Albania an import declaration could only be submitted upon arrival of the freight to the customs office (electronic submission ahead of time was not possible), the variable defined above captures accurately the time spent in customs. The ASYCUDA++ system capturing these data in the first half of our sample period only retained the dates of submission and clearance. The introduction of ASYCUDAWorld in 2009 allowed for a finer recording of submission and clearance in numbers of hours rather than days. The bulk of our analysis will use clearance times measured in number of days for 2007-2012, but we will also provide results for clearance times measured in hours for 2010-2012.

Our primary data source also contains an inclusive measure of tax revenues associated with each import transaction that includes Albania's value added tax, tariffs, and excise taxes. We use tax revenues collected as an outcome variable. Under the same causal interpretation as we apply

to growth in import value, our main regression model estimates the tax revenue growth that can be attributed to the customs reform, through the channel of increased import flows.

We also use two additional sources of data representing taxes. From the Albanian customs authority we obtained annual tariff schedules for years 2007-2012. The schedules report both most-favored nation and preferential *ad valorem* tariff rates, at the HS8 level, and we take simple averages of these to generate tariffs at the HS6 product-origin country-year level. We also obtained a list of items that are subject to Albanian excise taxes.[17]

From WITS we obtain for the period 2007-2012 data on exports to Albania (value and weight) for each HS6 product-origin country-year included in our sample to be used as mirror trade statistics for the imports (value and weight) by Albania from the customs transaction data aggregated at that HS6 product-origin country-year level in order to construct gaps in unit values, in value, and in weight at the HS6 product-origin country-year level.

3.2 Descriptive Evidence

In this section, we present descriptive statistics characterizing changes in the rates of physical inspection, the days required to clear customs, and the compliance with import regulations, import flows, and tax revenue collected over the sample period. The share of Albanian import declarations allocated to the red channel declines dramatically from 42.9% in 2007 to 11.9% in 2012. The absolute number of declarations allocated to the red channel also declines four-fold from 2007 to 2012. The share of declarations taking more than one day to clear customs

[17] We are grateful to Ljubica Nedelkoska for providing us with the list of goods subject to excise taxes: gasoline, tires, accumulator batteries, lubricant oil, cigarettes, beer, wines, liqueurs, energy drinks, perfumes and coffee.To understand the contributions of each tax to overall tax revenue collected we estimated a simple regression of the *ad valorem* equivalent of tax revenues collected on a constant term (to capture average VAT rates), the statutory *ad valorem* tariff rate, and an excise dummy. In this regression we estimated coefficients of 0.22, 0.96 and 0.12, as well as an R-squared of 0.28. These estimates are approximately consistent with our tax revenue variable capturing Albania's 20 percent VAT rate, tariff revenues rising proportionally with the statutory tariff rate, and revenue from excise taxes averaging an *ad valorem* equivalent rate of 12 percent.

is cut in half, declining from 12.8% in 2007 to 6.8% in 2012. The distribution of the number of days required to clear customs shown in the Online Appendix (Table A1) reveals that in 2007 about 10 percent of import declarations cleared customs in 2-3 days, but that share declined to 5 percent in 2012, as more declarations were cleared in a single day.[18] The share of declarations clearing in 2 days saw the largest decline over the period.[19] From 2008 onwards both the average time to clear customs for imports and its standard deviation decline. Interestingly, most of the reduction occurs after 2009, when the ASYCUDAWorld system was installed. Declarations allocated to the red channel spend more time in customs on average and exhibit larger standard deviations in their time in customs than declarations allocated to the yellow channel. These differences are statistically significant according to unreported tests.[20]

The comprehensive customs reforms discussed in Section 2 produced substantial unconditional reductions in physical inspections from 2007 to 2012. But as discussed in Section 2, modern risk management systems condition the probability of inspection on information from the import declaration. It is thus important to condition on such criteria when describing changes in inspection probabilities over the period. Using the data at the importing firm-HS6 product-origin country-year level, we estimate OLS regressions of the share of shipments allocated to the red channel on year fixed effects controlling for importing firm-HS6 product-origin country fixed effects. Column (1) of Table 1, Panel A shows that the conditional probability of a red channel declines steadily and substantially over the period. By 2012 the conditional inspection rate is 21

[18] If goods are released on the same day as the declaration is submitted, we code the variable clearance time as 1 day. If they clear customs on the day following the submission, we code that variable as 2 days, etc. For our main specification in which time enters linearly, the choice of units is not important. We also conducted robustness exercises with time measured in log days for which it is useful not to define same day clearance as zero days.

[19] We identified a small set of declarations taking an unreasonably large number of days to clear customs, 19 or more, that we drop from the dataset for our main analysis (they account for 0.1% of the declarations) but the findings in Sections 5-6 are robust to the inclusion of those declarations.

[20] The null hypothesis that average times are similar for declarations in the red channel versus declarations in the yellow channel was rejected, the p-value of the t-test was 0. The null hypothesis that the variances in times are similar for declarations in the red channel versus declarations in the yellow channel was rejected, the p-value of the variance ratio F-test was 0.

percentage points lower than in 2007. This dramatic variation in conditional inspection probabilities underpins our subsequent analysis.

Our econometric analysis will allow for heterogeneous treatment effects, with effect sizes allowed to vary with the frequency with which shipments of a given importing firm-HS6 product-country triplet arrive in the initial year of our differencing. Our shipment frequency bins are: 2-5, 6-10, 11-20, 21-100, and 101 or more. Table 1, Panel B reports annual statistics – both shares of shipments in the red channel and the proportion of observations with the indicator for the median allocation to the red channel equal to one – for the universe of import flows, for the observations in the estimating sample, and for each of the frequency bins. Inspection rates are reasonably similar across the frequency bins in 2007, approximately 40% in each bin. Inspection rates fall across all the frequency bins, but fall more quickly for frequently observed shipments.

Suggestive evidence from the customs transaction data provided in the Online Appendix (Table A2) indicates that compliance with import regulations was high in Albania, based on two indicators of non-compliance. The first indicator is the number of declarations allocated to the yellow channel but subsequently upgraded to the red channel upon decision of the customs agent. Such an upgrade does not necessarily indicate non-compliance, but it implies that there are unexpected grounds for physical inspection. The share of Albanian import declarations upgraded from yellow to red is low (0.4%-1.6% during the period).[21] The second indicator is the existence and amount of a penalty for a given import declaration as a result of an infraction (i.e., a violation of customs regulations). Penalties are infrequent, they are imposed in less than 0.27% of yellow channel declarations and in less than 0.4% of red channel declarations in any sample year. This high degree of measured compliance was maintained throughout the period and suggests that most

[21] In such cases, we consider the shipments to be allocated to the highest level of scrutiny, the red channel.

of the physical inspections prove to be unnecessary *ex-post*. Conditions like these are amenable to rapid reductions in inspections once risk management systems are in place and operating normally.

Table 2, Panel A reports statistics on the estimating sample at the importing firm-HS6 product-origin country level (with observations containing more than one shipment).[22] The median number of shipments per firm-HS6 product-origin country-year is 5 and the average is 14. The number of importing firms in Albania grows over the period while the number of products and origin countries is relatively stable after 2008. The number of firm-product pairs is stable while the number of firm-country pairs and product-country pairs increase. The net impact of all this change is a nearly 16% increase in the number of firm-product-country cells that contain two or more shipments. Table 2, Panels B and C provide summary statistics on the dependent and independent variables in first-differences that will be used in the regressions to obtain the average effect (Panel B) or to estimate separate effects across shipment frequency bins (Panel C). Similar summary statistics for the variables in levels are provided in the Online Appendix (Table A5).

4. Estimating Framework

4.1 Causal effects of inspections

In this section, we describe the estimation strategy that links changes in the probability of inspection to outcomes of interest at the importing firm-HS6 product-origin country-year level. While the risk model generates both targeted and random (red channel) inspections, we lack the data to distinguish among those, and thus cannot separately estimate the causal effects of changes in the rate of both inspection types. But the causal effects of reduced random inspections are the more interesting of the two types, for at least two reasons. First, the rate of random inspections is

[22] Similar statistics for the full sample are shown in the Online Appendix (Table A3). Eliminating the observations representing a single shipment implies excluding from the sample a large number of importing firms, but a small proportion of total annual imports (ranging from 8.4% in 2012 to 11.6% in 2008).

the rate that is relevant for the compliant firm, which would be both the object of standard trade theory and the most common type of firm in a well-run system. Second, implementation of risk management beginning from very high rates of unconditional inspection (such as Albania's) will tend to reduce rates of random inspections far more than rates of targeted inspections, so the overall effects of the reform should be felt through reduced rates of random inspections.[23] Our identification strategy applies a very rich set of fixed effects to sweep out changes in the conditional probability of inspection: firm-HS6 product-origin country fixed effects, firm-year and HS6 product-origin country-year fixed effects in all our specifications (and firm-HS6 product-year and firm-origin country-year in robustness specifications). Treating the residual variation as random allows us to generate an estimate of the causal effect of (reform-induced) reductions in the frequency of random inspection.

In level terms the model for causal effects of red channel inspections is given by:

$$Y_{ijct} = \beta Red\_channel_{ijct} + \gamma_{ijc} + \gamma_{it} + \gamma_{jct} + \varepsilon_{ijct} \qquad (1)$$

where *i* stands for an importing firm, *j* for an HS6 product, *c* for an origin country, and *t* for a year, Y is a clearance time or an import outcome, and ε_{ijct} is an independent and identically distributed (i.i.d.) error. In most specifications $Red\_channel_{ijct}$ is the median allocation to the red channel (as defined in Section 3), which is an indicator variable equal to 1 if more than 50 percent of import shipments of a firm-HS6 product-origin country in a year are allocated to the red channel and 0 otherwise. In robustness specifications $Red\_channel_{ijct}$ is either the share of shipments allocated to the red channel or an allocation to the red channel defined with thresholds of 75 or 25 (rather than 50) percent or more of shipments being physically inspected.

[23] Put simply, targeted inspection rates should stay reasonably steady in such a setting, while random inspection rates should fall. The purpose of the customs reform is to shift inspection resources to the risky shipments and away from the compliant shipments, so it is random inspections that fall in a significant reform.

The various types of fixed effects included in Eq. (1) play a crucial role. First, firm-HS6 product-origin country fixed effects γ_{ijc} allow the effect of inspections on customs clearance time or imports to be identified based on the within (time-series) variability in inspection probabilities for a given firm-HS6 product-origin country. Second, firm-year fixed effects γ_{it} account for importing firms' evolving probabilities of being inspected and/or any firm time-varying shocks to profitability or performance or year-to-year changes in the firms' choice of agents in the logistics chain which could affect their clearance times and their import decisions. Third, HS6 product-origin country-year fixed effects γ_{jct} account for the possibility that different product-origin country pairs face a different probability of being subject to inspections by customs and account also for any trade policy, transport, or demand shocks hitting differentially product-origin country pairs. In particular, these fixed effects control for tariff declines occurring during the period at different speeds for different products originating in different countries as well as for other policy harmonization measures. These fixed effects also subsume changes in macroeconomic environment arising from the global financial crisis that took place during our sample period.

For computational feasibility Eq. (1) is first-differenced so as to sweep out the firm-HS6 product-origin country fixed effects γ_{ijc} thus becoming:

$$\Delta Y_{ijct} = \beta_1 \Delta Red\_channel_{ijct} + \gamma_{it} + \gamma_{jct} + v_{ijct} \quad (2)$$

where all variables are defined as above and v_{ijct} is an i.i.d. error term.[24] This specification compares changes in the time to clear customs or in imports across different firms importing a given HS6 product from a given origin country in a given year, with one firm experiencing a

[24] Due to the presence of a very large set of fixed effects, we estimate our equations using the *reghdfe* Stata command drawing on Guimaraes and Portugal (2010) and Correia (2015). The current version of the command eliminates from the number of observations singleton groups and adjusts standard errors for their exclusion. A singleton group is a group with only one observation: e.g., for HS6 product-country-year fixed effects, a singleton group is an HS6 product-country-year cell that is imported by a single firm.

reduction in the probability of physical inspection while the other not, while controlling for time-variant heterogeneity at various levels of disaggregation (firm and product-country).

We interpret the results of the OLS estimation of Eq. (2) as unbiased estimates of β_1. Our identification assumption is that the vector of fixed effects in Eq. (2) is sufficient to remove any systematic (non-random) sources of variation in inspection behavior. By emphasizing *conditional* reductions in the probability of assignment to the red channel - where *conditional* means conditional on the fixed effects - we are conceptually limiting the analysis to identification via changes in the probability of pseudo-random assignment to the red channel.

Acknowledging that our estimation model lacks all the variables one would need to isolate truly random variation in inspections, we believe that our fixed effects should control for the vast majority of systematic variation in inspection activity. If so, our econometric specification isolates pseudo-random variation in inspection probabilities that can be used to identify the effect of reduced inspections on the outcome variables we study. In order to bolster our case, we conduct two exercises first proposed by Volpe Martincus *et al.* (2015) (described in detail in Online Appendix B). These exercises use the more disaggregated, shipment-level data. The exercises provide evidence that, after including our vector of fixed effects, two plausible sources of endogeneity are not present in the more disaggregated data. First, we show that, after conditioning on our vector of fixed effects, allocation of a single shipment to the red channel is independent of import value, quantity, and unit value. Thus, the evidence shows that larger or less expensive per unit shipments (which could indicate under-valuation to pay lower tariffs) are not more likely to be inspected. Second, we show that, after conditioning on our vector of fixed effects, allocation to the red channel is independent of the previous allocation decision for an import declaration of the same firm-product-country triplet. These exercises support the argument that the vector of fixed

effects included in our specifications captures systematic variation in the decision to physically inspect the shipments, and thus is effective in removing non-random variation in inspection behavior. We therefore proceed under the assumption that, conditioning on importing firm-HS6 product-origin country, importing firm-year and HS6 product-origin country-year fixed effects, the reason for an allocation to physical inspection by Albanian customs is either random or triggered by unexpected (arguably exogenous) compliance news about the shipment.

The hypotheses that we test with the estimation of Eq. (2) are that reductions in the frequency of inspections: (i) reduce the time to clear customs for import shipments, (ii) reduce uncertainty in the time to clear customs for import shipments, and (iii) increase imports.[25]

4.2. Effects of reduced inspections on tax revenue collection

Although Albania substantially reduced tariffs prior to the risk management reform, the Albanian government still relies on the customs agency to collect substantial revenues at the border. The lower frequency of inspections led to import growth (as will be shown in Section 5), but there is a risk that lower frequency inspections produce revenue losses because it becomes easier to evade tariffs and other taxes. At the same time a major capacity improvement – such as the introduction of sophisticated IT systems that facilitate effective risk management – can make it possible for the agency to improve enforcement outcomes and reduce inspections at the same time. In Online Appendix D, we propose an objective function for the customs agency that

[25] Eq. (2) relates pseudo-random reductions in physical inspections to changes in customs clearance time and in imports. An alternative approach to identifying such impacts - used in Fernandes *et al.* (2015) – would be to follow the IV strategy proposed by Volpe Martincus *et al.* (2015) that estimates the impact of changes in the median allocation to the red channel on median clearance time in the first stage and the impact of (instrumented) median clearance time on imports in the second stage. This IV strategy is useful for estimating an effect of time reductions on trade, but it is not well-suited to estimate impacts of reform more broadly. The reason is that the IV strategy constrains the reform to affect imports through a single channel, reduced inspections reduce increase trade by reducing median clearance time. Other channels, including reduced uncertainty arising from reduced variability in clearance time, are shut down by assumption. Since the pseudo-random variation isolated by the vector of fixed effects is the only viable instrument in this strategy, an IV strategy is not viable when there are two or more channels through which reductions in random rates of inspections affect imports.

formalizes these ideas. In this section, we describe our framework for investigating the effects of reform on tax revenue collection. We study two separate channels.

First, we estimate the change in tax revenues that is associated with the changes in import activity resulting from the reform. We estimate Eq. (2) again, except this time the left-hand-side variable is total tax revenues collected rather than clearance times or imports. The main explanatory variable of interest is once again the median allocation to the red channel.

Second, we ask whether tariff evasion appears to be prevalent, and whether it changes over time, using mirror statistics analysis. Studies such as Fisman and Wei (2004), Javorcik and Narciso (2008, 2017), and Rijkers et al. (2017), among many others, use the gap between the unit values of bilateral exports reported by a country's trading partners and the unit values of imports reported by the country itself as an indicator of tariff evasion. The standard regression in the mirror statistics literature relates unit value gap statistics to the relevant tariff rate. A positive estimated coefficient on the tariff rate is consistent with the hypothesis that tariff evasion is more common when tariff rates are higher; by declaring lower import values on goods with ad valorem tariffs, firms are able to pay lower absolute values of tariff revenue. A large number of studies have indeed found evidence of tariff evasion using these methods.

Following much of the literature, we focus on the gap in unit values of Albania's trade flows as the outcome measure of interest. Since mirror data is available at the HS6 product-origin country-year level only, we aggregate the Albanian customs transaction data to that disaggregation level (thus ignoring the firm-level dimension in this exercise). We define the unit value gap for imports by Albania from origin country j of HS6 product k in year t as:

$$gap_{jkt} = \ln\left(\frac{export\ value_{jkt}}{export\ quantity_{jkt}}\right) - \ln\left(\frac{import\ value_{jkt}}{import\ quantity_{jkt}}\right) \qquad (3)$$

In practice there are reasons to believe that, even in the absence of evasive behavior, the unit values in import and mirror export data will not align. Import values will typically include transport and other costs of moving the goods from one country to the next, even as quantities stay constant. Thus, we might expect that, absent evasive behavior and/or statistical noise, unit value gaps would be negative. When *ad valorem* tariffs or other proportional taxes are assessed on imports, one might expect the unit value gap proposed in Eq. (3) to become less negative. Firms that can successfully declare lower unit values to importing country officials will pay lower total tax rates. There are not similar incentives to misreport export value, so evasive behaviors can raise the value of the unit value gap in Eq. (3). Sufficiently high levels of evasion could even push the value of gap_{jkt} into positive territory.

The canonical regression in the mirror statistics literature relates the levels of gap_{jkt} to the tariff rate applied at the jkt level, after including product and country fixed effects. Javorcik and Narciso (2008) argue that the effects should be strongest among differentiated products. These authors also sometimes limit the sample to imports from rich countries with a strong rule of law, under the supposition that export value will be accurately declared in such countries.

In principle, the reduced rates of inspection resulting from the customs reform in Albania could lead to relatively higher rates of underreporting of import value, suggesting a regression of changes in gap_{ikt} on an interaction between changes in inspection rates and tariffs. But the discussion of the customs agency's objective function in Online Appendix D shows that improvements in the capacity of the customs agency can improve enforcement outcomes. In Section 6 we find that Albania's low statutory tariff rate makes it difficult to find persuasive evidence of evasion in the levels regression, and this further complicates efforts to interpret coefficients patterns in a model that estimates interactions of changing inspection frequency with

tariff variables that very often take the value of zero.[26] Hence, our approach will focus on the examination the distribution of unit value gaps over time as the risk management reform unfolded and on correlations between unit value gaps and statutory tariff rates.

5. Effects of Inspections on Customs Clearance Time and on Imports

Table 3 shows baseline OLS estimates of Eq. (2) with standard errors robust to heteroscedasticity. Columns (1)-(5) provide results for various moments of the customs clearance time distribution (measured in days in 2007-2012 in Panel A and in hours in 2010-2012 in Panel B). The estimates show that a reduction in the median allocation to the red channel leads to a statistically significant decline in the median, the average, the 75th percentile of customs clearance time as well as declines in two measures of uncertainty, the interquartile range and the standard deviation of clearance time.[27] Specifically, the coefficient estimates in columns (1), (2), and (3) of Panel A imply that a representative firm-product-country cell affected by the reforms (i.e., changing its status from 1 to 0 in the median allocation of its import shipments to the red channel) exhibits a decline in, respectively, median clearance time of 0.07 days (or about 2 hours), 0.05 days in average clearance time, and 0.08 days in the 75th percentile of clearance time.[28] Columns (4) and (5) show that reduced inspections for the typical firm-product-country observation decrease the interquartile range by 0.06 days and reduce the standard deviation by 0.3 days. Finally, column (6) shows that

[26] Another complicating factor for unit value gap regressions (in levels or in changes) is that the inspection rate is endogenous to the tariff rate, because of risk management, which represents a specification error for the standard mirror statistics regressions.
[27] Unreported estimates where outcomes are measured as log of number of days give qualitatively similar results.
[28] For clearance time we also estimate a regression at the declaration level to determine how it is affected by an inspection. We regress, in levels rather than changes, clearance times (measured in days) on a dummy variable indicating that the declaration was sent to the red channel. The results reported in the Online Appendix (Table C2) show across a range of specifications that an allocation to the red channel raises the customs clearance time by 0.12 to 0.14 days, or approximately 3 hours. Our estimates suggest much smaller impacts of changes in inspections on changes in median days in customs in Albanian imports (0.07) than what Volpe Martincus *et al.* (2015) estimate for Uruguyan exports (2.726 – based on their specification for a measure of clearance time in days). The vast majority of Albanian import shipments clear within one day even prior to the risk management reform (Online Appendix Table A1), so reductions in clearance times of the magnitude estimated in Volpe Martincus *et al.* are not possible in the Albanian context.

a decline in the allocation to the red channel generates a significant increase in imports. Specifically, a representative firm-product-country observation affected by the customs reform sees an increase in its logged import value of 0.23, with all else constant.

When time is measured in hours in Panel B, the estimates also show a statistically significant reduction in all moments of the distribution as physical inspections decline. For example, the coefficient estimate in column (1) of Panel B implies that a firm-product-country cell moving from having the majority of its shipments physically inspected to having only a minority inspected exhibits a decline in median clearance time of almost 2 hours.

Across several variants of the regression specification, we find large estimated effects of reduced inspections on imports. Our other regressions show that reduced inspections lead to a decline in clearance times and in uncertainty about clearance times. Firms may see other benefits from reduced inspections that we are unable to measure. Hence, one should view the impact on import flows as inclusive of all these effects, measured and unmeasured. Our preferred estimate (-0.230) indicates that changing the median allocation to the red channel for an importing firm-HS6 product-origin country triplet in a given year raises the expected import value by 26%.[29] A treatment effect of this size may seem implausibly large, but it is useful to recall that the base from which this import expansion occurs is small. In the estimating sample, the median number of shipments per observation (an import flow in an importing firm-HS6 product-origin country triplet) is only 5 and the average 14. Increasing the typical import flow by a single shipment (holding the average shipment size fixed) would increase import value by 7 percent. Our estimate of 26 percent increase in import value therefore implies that the average observation sees about 4

[29] The magnitude is calculated as $(e^{-(-0.23)*(-1)})-1$.

more shipments per year when the probability of physical inspection falls from more than 50 percent to less than 50 percent.

We modify Eq. (2) to allow the trade effects of reform to vary with shipment frequency, which we define as the number of shipments for that firm-HS6 product-origin country occurring in the year prior to the inspection reduction. We interact the main explanatory variable of interest in Eq. (2), the annual difference in the inspection variable, with five dummy variables linked to the number of shipments in the first year of the annual difference. The results of this regression, reported in Table 4, show that the effects of the reform vary over different shipment frequencies. This is especially true for import value; among firm-HS6 product-origin country cells with 2-5 initial shipments, reduced inspections cause imports to grow by 30 percent. But trade responses are smaller for categories with larger shipment frequencies and become statistically insignificant for firm-HS6 product-origin country cells with more than 100 initial shipments. These estimates help us to understand the rather large average trade responses seen in column (6) of Table 3. In Table 2, Panel C we see that half of the observations contain 2-5 shipments, with another 22 percent containing 6-10 shipments per year. When we estimate trade responses accounting for baseline shipment frequency we average across a large number of low-frequency trade flows and a much lower number of high-frequency trade flows.

So far, we have estimated separately the effects of inspection reductions on changes in clearance time, clearance time uncertainty, and import growth. There is a sizable literature linking time savings to trade growth. Volpe Martincus *et al.* (2015) find that time savings in customs that arise because of reduced inspection activity contribute significantly to trade growth. Clark *et al.* (2017) show that uncertainty in arrival times reduces trade. Using our estimation strategy that is quite similar to that in Volpe Martincus *et al.* (2015), we find that inspection reductions generate

modest reductions in clearance time and clearance time uncertainty, but rather large effects on import growth. We consider the possibility that in our setting, inspections affect trade growth through channels that are not related to time savings. Table 5 reports results from re-estimating Eq. (2) adding first-differences in clearance time and clearance time uncertainty as control variables in the model linking reduced inspection activity to import growth. Across several specifications (including time savings, reduced clearance time uncertainty, or both) we find that the effect of reduced inspections on import growth is maintained.

In the Albanian context that we study, clearance times are relatively low and reasonably predictable and inspections have a direct effect on trade that is largely independent of clearance time and clearance time uncertainty. We lack specific data that would allow us to quantify the specific sources of these trade costs that are not related to time. But those familiar with Albanian import clearance procedures offer a number of other trade costs that arise from physical inspection.[30] The importer must arrange to have a representative present during the physical inspection. The importer must also secure workers for unloading and reloading the vehicle. Physical inspections sometimes damage the goods. When time costs are low, as they appear to be in the Albanian setting, costs such as these appear to be much more relevant. It is also quite plausible that such costs are more relevant when trade is less frequent, as our strong impacts in the smaller frequency bins in Table 5 suggest.

We consider a number of robustness checks to our basic specification. While there is no natural clustering of standard errors for Eq. (2), we show in the Online Appendix (Table C1) that the findings are robust to a variety of clustering structures: firm-product-country (to account for serial correlation in outcome variables), firm, firm-product, firm-country and product-country

[30] We thank Lazar Ristic, a World Bank operations officer specialized in customs procedures in the Balkans, for the suggestion of these sources of trade costs arising from physical inspection.

levels.[31] Despite potential advantages of using median allocation to the red channel, we show in the Online Appendix (Table C3) that our qualitative findings on import growth are robust to the use of the share of shipments allocated to the red channel or of allocations to the red channel defined with a threshold of 75 or 25 (rather than 50) percent or more of shipments being physically inspected.

Our estimates are very stringent in that they identify the effects of the decline in physical inspections from the firm-HS6 product-country variation over time while controlling for firm-year unobserved shocks and product-country-year unobserved shocks. Our identifying assumptions are that these fixed effects are sufficient to remove non-random variation in the inspection decision. But omitted variable biases could arise if differential firm-HS6 product or firm-origin country time trends correlated with changes in the probability of physical inspections. To check our estimating assumptions, we include further fixed effects as robustness checks. In particular, we replace firm-year fixed effects by either firm-HS6 product-year or firm-origin country-year fixed effects, while continuing to control for HS6 product-origin country-year fixed effects or we omit these but control for both firm-HS6 product-year and firm-origin country-year fixed effects. The additional fixed effects soak up additional variation in the inspection allocation, but also substantially reduce the number of observations available for estimation.[32] Columns (1)-(3) of Table 6 show estimates of an average effect across frequency bins (as in Table 3) and columns (4)-(6) show estimates of separate effects across the frequency bins (as in Table 5). Additionally, we estimate another variant of Eq. (2) where firm-HS6 product-country fixed effects are added and account for differential

[31] In unreported results we show that the findings in Table 3 are robust to adding to the sample import declarations taking longer than 18 days to clear customs (that were excluded from the raw dataset before aggregating it to the firm-HS6 product-origin country-year level) and to the exclusion from the estimating sample of HS6 products on which excise taxes are imposed in Albania.
[32] The reduction in the number of observations with finer sets of fixed effects is due to the fact that singleton observations within any of the fixed effects cells are dropped.

time trends at that very disaggregated level (as the equation itself is in first-differences). We show in the Online Appendix (Table C4) that the findings remain unchanged.

Our estimates so far suggest a contemporaneous (within a given year) effect of reduced inspections on trade growth. We might expect the effects to emerge over a longer time period. We might also be concerned about the persistence of the effects of reduced inspections on trade. In columns (7) and (8) of Table 6 we report results from re-estimating Eq. (2) using differences defined over the entire sample period (2007-2012) rather than defined as annual first-differences. The average effects are somewhat larger in magnitude than using first-differences, the coefficient is -0.296 rather than -0.230. Considering the effects across frequency bins (in column (8)) we find that the effects on infrequent shipments are much stronger in the long-differences, but the effects on intermediate shipment frequency bins are not statistically different than zero. Additionally, in the Online Appendix (Table C5) we show lagged responses to reform, by re-estimating Eq. (2) including the one-year lagged and/or two-year lagged change in the allocation to the red channel, in addition to the contemporaneous change. The evidence indicates that the contemporaneous change in the red channel allocation maintains its significant effect on import growth on average and across initial shipment frequency bins.

6. Effects of reform on tax revenue collection

In our first exercise with respect to tax revenue collection we ask if reform-induced increases in imports that we estimate in Section 5.1 were accompanied by increases in tax revenue collection. We estimate Eq. (2) using tax revenues collected as the dependent variable, in place of the measures of time or (declared) import value variables that appeared in earlier regressions. These results are reported in Table 7. The two sets of estimates are nearly identical to the

counterparts that were estimated for declared import value. The estimate of increases in revenue collection in column (1) mimics that of the average effect on import value (in column (6) of Table 3, Panel A). When we estimate revenue effects across shipment frequency bins, the estimates closely follow their counterparts for import value in column (6) of Table 4. The broad lesson is that collected revenues grow in almost direct proportion to the growth in (declared) import value.

We begin our assessment of tariff evasion by reporting summary statistics of the gap_{ikt} statistic for each year of our data. Table 8 reports the median, mean, and standard errors of the unit value gaps, as well as number of observations - for all Albanian imports (Panel A) and for imports from Germany alone (Panel B).[33] Mean and median unit value gaps decline throughout the reform period, whether we look at all imports or for imports from Germany. This is consistent with improved reporting accuracy in Albanian import data over the course of the reform episode and suggests lower rates of evasion. In the imports from Germany we see both mean and median unit value gaps move from positive to negative values. The changing sign on the unit value gap is even stronger evidence for declining evasion (because evasion is a likely reason for positive gaps, and we expect negative gaps if there is no evasion). One last piece of evidence that reporting accuracy is rising is the falling standard deviation of the unit value gap, which is observed for the data representing all imports in Panel A.

The mirror gap literature typically seeks to identify evasive behavior by relating cross-sectional variation in the gaps to variation in the levels of *ad valorem* tariffs. We estimate a local polynomial model between unit value gaps purged of origin country and year fixed effects and statutory tariff rates to allow flexibility in this relationship. The results are shown in Figure 2. The figure displays little if any evidence indicating that tariff evasion is an important phenomenon in

[33] Germany is a large trading partner where we might expect reasonably accurate reporting of export value and quantity. Javorcik and Narciso (2008) report similar statistics for imports from German for a number of East and Central European countries.

these data. The overall gaps are negative at all tariff rates, and there is not the monotonic upward slope that is expected from the theory. There is some upward movement in the unit value gaps at higher levels of tariffs, but the conditional mean of the gap variable at the highest tariff rates in the sample is roughly similar to what is observed at zero tariff rates.

The lack of a strong link between tariffs and unit value gaps in Figure 2 may be surprising, given Albania's reputation for endemic corruption. But as Figure 1 indicated, Albania substantially liberalized tariffs prior to the reform episode. The absence of extremely high tariffs and the dominance of zero tariff lines in the tariff code should limit evasion.[34] For Albanian imports a large share face zero tariffs, more than 80% of observed import flows paid no duties in the final two years of our sample. Considering statutory rates rather than observed trade flows, 48% of Albania's MFN tariffs were zero in 2012, as were 97% of tariff lines on imports from EU partners.

We find little evidence in the non-parametric levels regression that evasion is linked to tariff rates. Using simple summary statistics, we show that trade gaps are low, and fall over time as the reform is implemented. In unreported regressions of changes in unit value gaps on changes in inspections and their interaction with tariffs, we find erratic and often counterintuitive sign patterns.[35] This together with our other evidence leads us to conclude that the data are consistent with relatively low levels of tariff evasion overall, and that there is no compelling evidence that reduced inspections led to increased tariff evasion.[36]

[34] Reduced incentives for evasion can also limit corruption aimed at facilitating evasion. Using data from Mozambique, Sequeira (2016) shows that tariff evasion is a central reason for bribery when tariffs are high, and that tariff liberalization between South Africa and Mozambique reduced substantially the frequency and size of bribes paid by importers to public officials.

[35] Specifically, we estimate parametric regressions of changes in unit value gaps on changes in inspection rates and interactions of changing inspection rates with the tariff rate and with a dummy for products subject to excise taxes (as well as various fixed effects controlling for product and country variation).

[36] Albania's 20% value added tax (VAT) represents a larger source of revenue than the relatively low tariffs. But, since it does not vary across products, evasion of the VAT is not as amenable to study with the mirror statistics as is tariff evasion. It is perhaps even more likely that excise taxes represent a source of evasion. We used a dummy variable for excise taxes in several unreported exercises and found no compelling evidence that evasion is common (or that it changed significantly) for those products during the sample.

7. Conclusion

One of the rare successes so far of the Doha "development" round of WTO negotiations is the comprehensive agreement on trade facilitation, which entered into force in 2017. Most of the reform activities resulting from this agreement will occur in developing countries. Yet little is known, formally, about the impacts of such reforms. Albania's reforms - which are already well under way because of the demands of its prospective EU accession - offer important evidence on the effects of trade facilitation measures in a middle-income country. In this study, we use a dramatic reduction in physical inspections of imported goods by the Albanian customs authority to estimate the impact of inspections on time, on imports, and on tax revenues collected at the border. An important feature of the Albanian inspection regime is that it employs risk-based selection procedures. These procedures underpin the reduction in inspections we observe, and they are central to our strategy for econometric identification.

Our estimates show that conditional reductions in physical inspection rates by the Albanian customs authority lead to faster customs clearance times and reduced uncertainty about customs clearance time. We also find evidence that reductions in the frequency of physical inspection lead to a significant increase in imports. Import flows that are observed least frequently saw the largest import responses to reduced inspections. The effect of inspections on imports is virtually independent of changes in clearance time and clearance time uncertainty, suggesting an important role for other inspection-related trade costs. We also found that tariff and other tax revenues collected at the border rose in direct proportion to growth in declared import value. But we found no compelling evidence that reduced inspections increased evasive behavior, perhaps because most of Albania's imports are tariff-free.

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Figure 1. Simple average applied tariffs, all goods, Albania and middle-income countries

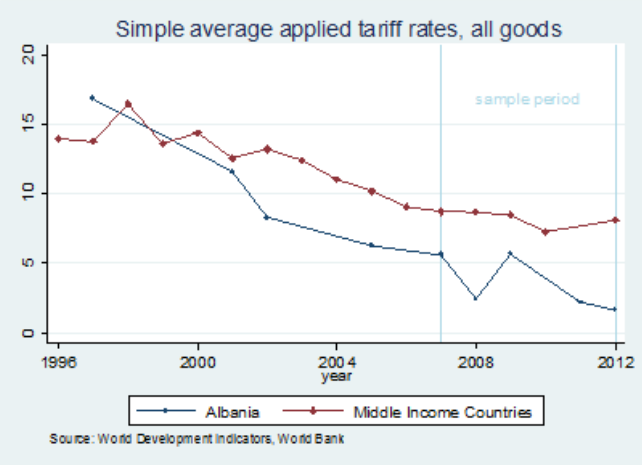
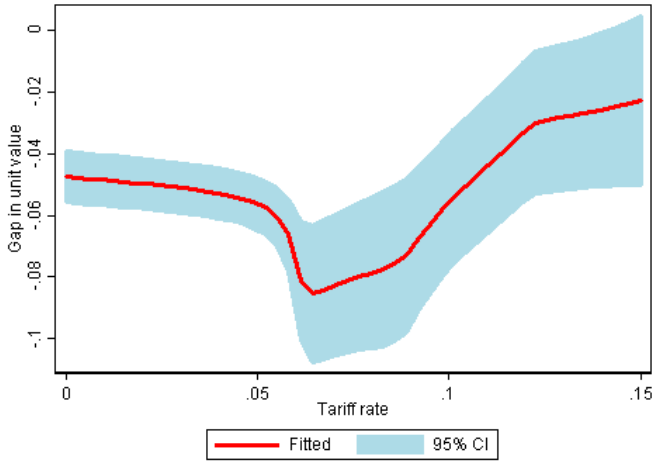


Figure 2. Gaps in unit values and tariff rates



Note: gaps in unit value are defined as the difference between unit values (value/weight) based on WITS data on exports to Albania as reported by partner countries and unit values based on Albania customs import data. The values reported in the Y-axis are for unit value gaps purged of origin country and year fixed effects.

Table 1. Changes in inspections over the sample period

Panel A. Conditional change in inspections

	Data at firm-HS6 product-origin country-year level	
	Dependent variable is:	
	share of shipments in red	median allocation to red
	(1)	(2)
Year 2008	-0.039***	-0.031***
	(0.002)	(0.004)
Year 2009	-0.118***	-0.103***
	(0.003)	(0.004)
Year 2010	-0.155***	-0.149***
	(0.003)	(0.004)
Year 2011	-0.190***	-0.198***
	(0.003)	(0.004)
Year 2012	-0.198***	-0.209***
	(0.003)	(0.004)
Constant (Year 2007)	0.443***	0.450***
	(0.002)	(0.003)
Firm*HS6 product*origin country fixed effects	Yes	Yes
Observations	173,752	173,752
R-squared	0.639	0.579

Panel B. Summary statistics

	All observations	Estimating sample (2 or more shipments)	2-5 shipments	6-10 shipments	11-20 shipments	21-100 shipments	101 or more shipments
			Share of shipments in red channel				
2007	46.2%	44.6%	45.0%	42.9%	44.8%	44.3%	42.8%
2008	42.3%	40.7%	40.7%	40.2%	41.0%	41.3%	43.4%
2009	32.2%	32.6%	32.5%	32.2%	32.8%	34.1%	37.0%
2010	28.5%	29.1%	28.9%	29.1%	28.7%	31.7%	36.7%
2011	25.2%	26.0%	26.1%	26.1%	25.6%	26.3%	17.5%
2012	24.4%	24.6%	25.0%	24.0%	23.7%	24.0%	17.3%
			Median allocation to red channel				
2007	47.1%	47.2%	50.3%	40.1%	39.6%	37.3%	27.1%
2008	43.3%	43.5%	45.8%	38.7%	37.6%	35.3%	27.2%
2009	33.9%	37.0%	39.9%	29.8%	27.6%	28.8%	33.5%
2010	29.8%	32.4%	34.9%	27.1%	22.5%	26.6%	39.8%
2011	26.1%	28.2%	31.2%	22.2%	18.3%	20.7%	7.4%
2012	25.0%	26.3%	29.9%	19.8%	15.7%	15.0%	7.3%

Notes: In Panel A, standard errors are in parentheses and *** indicates significance at the 1% confidence level. The estimating sample excludes firm-HS6 product-origin country-year observations that represent a single shipment (as in the estimating sample).

Table 2. Statistics for estimating sample

Panel A. Numbers of firms, HS6 products, and origin countries

	2007	2008	2009	2010	2011	2012
Total number of importing firms	4,745	4,914	5,038	5,118	5,051	4,930
Total number of imported HS 6-digit products	2,772	2,923	2,990	2,958	2,952	2,919
Total number of origin countries	109	115	122	120	117	125
Total number of importing firm-HS6 product pairs	34,401	37,492	39,137	38,931	38,413	37,180
Total number of importing firm-origin country pairs	9,184	10,121	10,567	11,430	11,482	11,323
Total number of HS6 products-origin country pairs	11,382	12,868	13,531	14,372	14,498	14,189
Total number of importing firm-HS6 products-origin country triplets	39,661	44,164	46,622	47,699	47,129	45,879

Panel B. Dependent and independent variables in first-differences - baseline

	Average	Median	Standard dev.
First-differences with respect to firm-HS6 product-origin country-year (75,225 observations)			
Median clearance time	-0.02	0	0.55
Average clearance time	0	0	0.56
75^{th} perc. of clearance time	-0.05	0	0.99
IQR of clearance time	-0.04	0	0.92
Std. dev. of clearance time	-0.03	0	0.68
Log import value	-0.05	-0.03	1.15
Log tax revenue collected	-0.05	-0.04	1.18
Median allocation to red channel	-0.04	0	0.48
Share of shipments in red channel	-0.04	0	0.32
75^{th} perc. allocation to red channel	-0.04	0	0.39
25^{th} perc. allocation to red channel	-0.04	0	0.39

Panel C. Dependent and independent variables in first-differences - depending on initial shipment frequency

	2-5 shipments	6-10 shipments	11-20 shipments	21-100 shipments	101 or more shipments
First-differences with respect to firm-HS6 product-origin country-year (75,225 observations)					
Share of observations	49.9%	22.4%	14.4%	11.5%	1.8%
			Average for each shipment frequency bin category		
Median clearance time	-0.04	0.00	-0.01	0.00	0.01
Average clearance time	-0.04	-0.03	-0.03	-0.02	0.00
75^{th} perc. of clearance time	-0.08	-0.03	-0.03	-0.01	0.00
IQR of clearance time	-0.06	-0.03	-0.02	-0.02	-0.02
Std. dev. of clearance time	-0.02	-0.05	-0.05	-0.04	-0.04
Log import value	0.23	-0.26	-0.34	-0.39	-0.47
Log tax revenue collected	0.23	-0.25	-0.34	-0.41	-0.52
Median allocation to red channel	-0.05	-0.02	-0.03	-0.04	-0.05
Share of shipments in red channel	-0.04	-0.04	-0.04	-0.05	-0.06
75^{th} perc. allocation to red channel	-0.05	-0.03	-0.04	-0.05	-0.07
25^{th} perc. allocation to red channel	-0.04	-0.03	-0.03	-0.04	-0.11

Notes: The estimating sample excludes firm-HS6 product-origin country-year observations that represent a single shipment. IQR is the interquartile range.

Table 3. Effect of inspections on customs clearance time and imports

Panel A. Period 2007-2012 and clearance time measured in days

	Data at firm-HS6 product-origin country-year level. Dependent variable is first-difference with respect to firm-HS6 product-origin country in:					
	median clearance time	average clearance time	75th perc. clearance time	IQR clearance time	standard dev. clearance time	log import value
	(1)	(2)	(3)	(4)	(5)	(6)
First-difference in median allocation to red channel	0.070***	0.050***	0.079***	0.056***	0.027***	-0.230***
	(0.006)	(0.006)	(0.011)	(0.010)	(0.007)	(0.013)
Firm*year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
HS6 product*origin country*year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	75,225	75,225	75,225	75,225	75,225	75,225
R-squared	0.486	0.517	0.481	0.457	0.491	0.418

Panel B. Period 2010-2012 and clearance time measured in hours

	Data at firm-HS6 product-origin country-year level. Dependent variable is first-diff. with respect to firm-HS6 product-origin country in:					
	median clearance time (hours)	average clearance time (hours)	75th perc. clearance time (hours)	IQR clearance time (hours)	standard dev. clearance time (hours)	log import value
	(1)	(2)	(3)	(4)	(5)	(6)
First-diff. in median	1.995***	1.690***	3.076***	2.393***	1.154***	-0.199***
	(0.168)	(0.172)	(0.315)	(0.301)	(0.221)	(0.018)
Firm*year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
HS6 product*origin country*year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	31,490	31,490	31,490	31,490	31,490	31,490
R-squared	0.459	0.497	0.470	0.451	0.495	0.400

Notes: Robust standard errors in parentheses. *** indicates significance at the 1% confidence level. IQR is the interquartile range. The estimating sample excludes firm-HS6 product-origin country-year observations that represent a single shipment.

Table 4. Effect of inspections on customs clearance time and imports, depending on initial shipment frequency

	Data at firm-HS6 product-origin country-year level. Dependent variable is first-difference with respect to firm-HS6 product-origin country in:					
	median clearance time	average clearance time	75th perc. clearance time	IQR clearance time	standard dev. clearance time	log import value
	(1)	(2)	(3)	(4)	(5)	(6)
First-diff. in median allocation to red channel *						
2-5 initial shipments	0.079***	0.048***	0.076***	0.051***	0.020**	-0.278***
	(0.008)	(0.008)	(0.013)	(0.013)	(0.009)	(0.016)
6-10 initial shipments	0.045***	0.048***	0.075***	0.058***	0.040***	-0.192***
	(0.010)	(0.010)	(0.018)	(0.017)	(0.013)	(0.024)
11-20 initial shipments	0.094***	0.072***	0.111***	0.079***	0.045***	-0.147***
	(0.015)	(0.015)	(0.027)	(0.024)	(0.018)	(0.029)
21-100 initial shipments	0.037***	0.035**	0.070***	0.054**	0.019	-0.087**
	(0.014)	(0.014)	(0.027)	(0.025)	(0.018)	(0.037)
101 or more shipments	0.009	0.007	0.045	0.075	0.032	0.151
	(0.030)	(0.032)	(0.066)	(0.067)	(0.043)	(0.098)
Firm*year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
HS6 product*origin country*year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	75,225	75,225	75,225	75,225	75,225	75,225
R-squared	0.486	0.517	0.481	0.457	0.491	0.419

Notes: Robust standard errors in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% confidence levels, respectively. The estimating sample excludes firm-HS6 product-origin country-year observations that represent a single shipment.

Table 5. Effect of inspections on imports, controlling for customs clearance time

	Data at firm-HS6 product-origin country-year level					
	Dependent variable is first-difference with respect to firm-HS6 product-origin country in log import value					
	(1)	(2)	(3)	(4)	(5)	(6)
First-diff. in median allocation to red channel	-0.223***	-0.232***	-0.222***			
	(0.013)	(0.013)	(0.013)			
First-diff. in median allocation to red channel *				-0.271***	-0.280***	-0.269***
2-5 initial shipments				(0.016)	(0.016)	(0.016)
				-0.187***	-0.195***	-0.190***
6-10 initial shipments				(0.024)	(0.024)	(0.024)
				-0.138***	-0.151***	-0.139***
11-20 initial shipments				(0.029)	(0.029)	(0.029)
				-0.083**	-0.088**	-0.083**
21-100 initial shipments				(0.037)	(0.037)	(0.037)
				0.152	0.148	0.148
101 or more shipments				(0.098)	(0.098)	(0.098)
First-diff. in median clearance time	-0.096***		-0.157***	-0.095***		-0.156***
	(0.014)		(0.015)	(0.014)		(0.015)
First-diff. in std. deviation of clearance time		0.087***	0.134***		0.087***	0.133***
		(0.011)	(0.011)		(0.011)	(0.011)
Firm*year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
HS6 product*origin country*year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	75,225	75,225	75,225	75,225	75,225	75,225
R-squared	0.419	0.420	0.422	0.420	0.420	0.423

Notes: Robust standard errors in parentheses. *** and ** indicate significance at 1% and 5% confidence levels, respectively. The estimating sample excludes firm-HS6 product-origin country-year observations that represent a single shipment.

Table 6. Effect of inspections on imports, robustness

	Data at firm-HS6 product-origin country-year level							
	Dependent variable is first-difference with respect to firm-HS6 product-origin country in log import value						Dependent variable is long-diff. 2007-2012 with respect to firm-HS6 product-origin country in log import value	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
First-diff. in median allocation to red channel	-0.247***	-0.230***	-0.165***				-0.296***	
	(0.041)	(0.012)	(0.029)				(0.064)	
First-diff. in median allocation to red channel *								
2-5 initial shipments				-0.320***	-0.278***	-0.216***		-0.548***
				(0.059)	(0.018)	(0.043)		(0.086)
6-10 initial shipments				-0.134	-0.195***	-0.158***		-0.239**
				(0.083)	(0.026)	(0.056)		(0.103)
11-20 initial shipments				-0.200**	-0.162***	-0.020		0.098
				(0.098)	(0.032)	(0.070)		(0.130)
21-100 initial shipments				-0.136	-0.088**	-0.030		0.100
				(0.102)	(0.039)	(0.091)		(0.128)
101 or more shipments				-0.408	0.197*	-0.448**		0.326
				(0.285)	(0.106)	(0.190)		(0.290)
Firm*HS6 product*year fixed effects	Yes		Yes	Yes		Yes		
Firm*origin country*year fixed		Yes	Yes		Yes	Yes		
HS6 product*origin country*year fixed effects	Yes	Yes		Yes	Yes			
Firm fixed effects							Yes	Yes
HS6 product*origin country fixed effects							Yes	Yes
Observations	11,637	66,656	15,828	11,637	66,656	15,828	4,884	4,884
R-squared	0.662	0.458	0.657	0.662	0.459	0.657	0.528	0.534

Notes: Robust standard errors in parentheses. *** and ** indicate significance at 1% and 5% confidence levels, respectively. The estimating sample excludes firm-HS6 product-origin country-year observations that represent a single shipment. The sample period in columns (7) and (8) includes only 2012 (and a difference relative to 2007).

Table 7. Effect of inspections on tax revenue collected

	Data at firm-HS6 product-origin country-year level Dependent variable is first-difference with respect to firm-HS6 product-origin country in log tax revenue	
	(1)	(2)
First-diff. in median allocation to red channel	-0.231***	
	(0.013)	
First-diff. in median allocation to red channel *		-0.276***
2-5 initial shipments		(0.017)
		-0.193***
6-10 initial shipments		(0.024)
		-0.155***
11-20 initial shipments		(0.030)
		-0.104***
21-100 initial shipments		(0.037)
		0.134
101 or more shipments		(0.101)
Firm*year fixed effects	Yes	Yes
HS6 product*origin country*year fixed effects	Yes	Yes
Observations	73,830	73,830
R-squared	0.441	0.441

Notes: Robust standard errors in parentheses. *** indicates significance at the 1% confidence level. The estimating sample excludes firm-HS6 product-origin country-year observations that represent a single shipment.

Table 8. Unit value gaps over the sample period

Panel A. All Imports

	Gap in unit value relative to mirror exports - all imports			
	Median	Mean	Standard deviation	Number of HS6-country-year observations
2007	-2.8%	3.2%	51.2%	11,677
2008	-4.4%	-1.0%	43.5%	12,369
2009	-4.7%	-1.5%	36.5%	13,959
2010	-6.6%	-7.2%	25.6%	14,789
2011	-6.5%	-8.6%	23.9%	14,927
2012	-6.8%	-11.3%	20.7%	14,720

Panel B. Imports from Germany

	Gap in unit value relative to mirror exports - imports from Germany			
	Median	Mean	Standard deviation	Number of HS6-country-year observations
2007	8.1%	22.2%	134.5%	933
2008	6.9%	15.7%	127.3%	1,013
2009	2.2%	7.3%	122.9%	1,130
2010	-6.3%	-2.9%	110.9%	1,035
2011	-4.3%	0.2%	108.1%	1,027
2012	-5.5%	-7.1%	121.1%	1,288

Note: gaps in unit value are defined as the difference between unit values (value/weight) based on WITS data on exports to Albania as reported by partner countries and unit values based on Albania customs import data.