The Double Dividend of a Joint Tariff and VAT Reform: Evidence from Iran

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Abstract

A rich theoretical literature discusses whether replacing tariffs with value added tax (VAT) improves efficiency. We provide empirical evidence on a novel complementarity between VAT and trade taxes. Downstream domestic firms require VAT receipts from importers to claim purchases VAT increasing incentives for honest reporting of imports. We use the trade gap, the difference between mirror and domestic trade reports in Iran at 6-digit HS disaggregation, to measure this complementarity. Iran introduced VAT in 2008 and increased its rate from 3 to 9 percent since then. Difference-in-differences estimations show that a 1 percentage point increase in the VAT rate reduces the trade gap by 6.7 percent. Consistent with the compliance mechanisms of VAT, we observe a smaller effect for the consumer products that have a shorter value chain. Our results suggest that replacing tariffs with VAT results in a double dividend. Tax revenue could increase due to better tariff compliance and a broader VAT base.

Keywords: Value Added Tax, Trade Liberalization, Tariffs, Chains Effect, Tax Compliance

JEL Classification codes: H26, F13, F14

1 Introduction

Developing countries raise a small amount of tax revenue due to low state capacity and high informality. They also rely on highly distortionary but easier to enforce tax instruments such

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as tariffs and corporate taxes. The advent of value added tax (VAT) and its adoption in many developing countries changed this pattern. VAT provided an avenue for revenue neutral tax reforms that improve efficiency in developing countries. Besides, VAT is collected along the production chain often with an invoice-credit system which creates opposite evasion incentives for the two sides of a transaction. It also leaves a paper trail along the production chain which enables tax authorities to cross check tax reports. The invoice credit system also withholds taxes at upstream firms which creates an incentive for honest reporting (Keen (2008); Waseem (2020b)). Given the enforcement properties of VAT, a reform package that replaces tariffs with VAT could maintain tax revenue and improve economic efficiency.

The theoretical literature on the effectiveness of a joint tariff and VAT reform is inconclusive. Keen and Ligthart (2002) argue that the broad base of VAT allows for a smaller increase in VAT rate to offset a reduction in tariffs which creates further efficiency gains. Besides, in a destination-based system, VAT is imposed on imports and the informal firms purchasing from formal ones would receive a non-refundable VAT burden (Keen (2008)). This mechanism provides a more efficient burden on the informal sector compared to the de facto burden of tariffs discussed by many scholars, including Emran and Stiglitz (2005). An under investigated aspect of a joint tariff and VAT reform is the bilateral spillovers. Formal firms purchasing from importers would require VAT receipts to reclaim purchases VAT. They would also need valid receipts to claim expenses for corporate tax purposes. This creates a backward linkage that incentivizes importers to truthfully report imports (De Paula and Scheinkman (2010)). Therefore, the introduction of VAT is expected to reduce trade tax evasion and hence improve the collection efficiency of trade taxes. This suggests that tariffs and VAT could be complementary instruments in improving economic efficiency and raising tax revenue.

In this paper, we study the complementary relation between tariffs and VAT in Iran. Specifically we aim to measure the impact of a VAT rate increase on trade evasion. The empirical evidence on the effectiveness of a joint tariff and VAT reform is sparse. In one of the few empirical studies, Baunsgaard and Keen (2010) show that tax revenue losses due to trade liberalization are offset by domestic taxes like VAT for middle and high-income countries but not for poor countries. We did not find any studies on the complementarity between tariffs and VAT. Empirical evaluation of this complementarity is impossible under a joint reform because a uniform tariff reduction also affects trade evasion (Fisman and Wei (2004)). In our context, the government introduced VAT in 2008 without any significant trade liberalization. Many product codes were exempted from VAT, creating a natural control group. Initially the VAT rate was 3 percent and then gradually increased to 9 percent. At the same time, the government has been continuously changing tariffs before and after the introduction of VAT at individual product categories. Therefore, we have an ideal setting to separate the impact of tariffs and VAT on trade evasion.

To construct a measure of trade evasion, we subtract reported exports to Iran by the World Integrated Trade System (mirror reports) from reported imports by Iran Customs Agency at the Harmonic System (HS) 6-digit level. This is called the trade gap in the literature (Fisman and Wei (2004)). We employ a difference-in-differences strategy and control for HS6 product and year fixed effects to estimate the impact of VAT on the trade gap. The quasi-random variation created by the introduction and changes of VAT on a subset of HS6 codes allows us to compare the evolution of the trade gap for VATable products to others over 2005 - 2016. The identification assumption is that in the absence of VAT, the evolution of the trade gap for the two groups would be identical.

Our results indicate that a one percentage point increase in the VAT rate reduces trade gap by 6.7 percent. This estimated elasticity is robust to multiple tests such as controlling for mean reversion, and exclusion of sanction years. VAT chain effects are stronger for longer value chains. Consumer goods have shorter value chains compared to non-consumer ones (e.g. raw, intermediary, and capital goods[1]). Therefore, we expect a weaker impact of VAT on consumer goods. Our results corroborate this conjecture. A one percentage point increase in the VAT rate reduces trade gap by 2.6 percent for consumer goods. But for non-consumer goods this effect is 7.4 percent. Finally, we observe an interesting non-linearity for this complementarity. For products with a larger initial trade gap, the VAT is more effective in reducing the trade gap. Interpreting the initial trade gap as a measure of informality for a given product, we can claim that VAT has a stronger effect for products with higher degrees of informality.

Our paper makes four contributions. First, we provide evidence on a novel complementary mechanism that links VAT and trade taxes. Studying the inter-relation of taxes is rare in the literature and involves real empirical challenges. The richness of our context allows us to identify this complementarity. Second, there is a nascent literature that studies the impact of VAT on tax evasion. Most of these studies rely on independent audits and experimental variation to tease out evasion responses (e.g. Pomeranz (2015); Carrillo et al. (2017)). These studies often require mobilization of significant resources and are hard to conduct. The existence of mirror reports for trade flows allow us to easily construct evasion proxies. Therefore, we are able to add empirical support to the idea that VAT can reduce tax evasion but from a novel angle, i.e. its impact on trade tax evasion. Third, we shed light on the significance of VAT chain effects by looking at products with shorter and longer value chains. Finally, we provide suggestive evidence that VAT is even more effective for product codes that have higher initial informality.

The rest of the paper is organized as follows. First, we briefly discuss the relevant literature. Section 3 provides a short description of the Iranian context. Section 4 describes our data.

[1]The categorization of consumption, raw, intermediary, and capital goods, is referred to as the Broad Economic Classification (BEC).

Section 5 presents the estimation strategy. Section 6 discusses the results and a final section concludes.

2 Literature

Our work relates to three branches of the literature. First, the theoretical literature that discusses the pros and cons of a joint tariff and VAT reform. Keen and Ligthart (2002) argue that VAT is more efficient because it has a broad base and unlike trade taxes does not distort trade flows. In contrast, Emran and Stiglitz (2005) claim that the presence of a large informal sector erodes the revenue gains of VAT. Therefore the results derived in the earlier literature are "unhelpful at best and potentially misleading as the basis of indirect tax policy reform in developing countries". This argument relies on the fact that tariffs are better suited for imposing a de facto burden on the informal firms. Emran and Stiglitz (2005) ignore the fact that VAT is also levied at the port of imports making it almost similar to tariffs from the perspective of the informal sector (Keen (2008)). Davies and Paz (2011) use simulation method with a model of heterogeneous firms to show that VAT does not necessarily expand the informal sector but tariff reduction reduces the informal sector. To summarize, the theoretical debate is inconclusive as there are special cases under which the joint tariff and VAT reform is not welfare improving.

The second literature which relates to our study is the empirical literature on the intersection of tariffs and VAT. This part of the literature is surprisingly thin. Baunsgaard and Keen (2010) is the only study that looks at the impact of domestic tax reforms in offsetting tariff revenue losses after trade liberalization. Their findings show that poor countries are unable to recoup the lost revenue while the rich countries actually improve revenue after trade liberalization. For middle income countries there does not seem to be a decrease in revenue after tariff reduction. The empirical literature provides no guidance on the potential mechanisms that might become operative under a joint reform. This is where our paper fits in. We provide evidence on the complementary effect of VAT on trade evasion. We empirically quantify the role of VAT in reducing trade evasion and hence improving the collection efficiency of tariffs.

The third literature related to our study is the growing literature on the enforcement properties of VAT. We contribute to this literature by looking at the spillover of VAT on trade taxes. This literature identifies three mechanisms that improve the enforcement properties of VAT (Keen and Lockwood (2010); De Paula and Scheinkman (2011, 2010)). First, VAT is collected through the production chain. Receipts from seller and purchaser of a product could be cross-checked. These receipt leaves a paper trail for tax agencies that reduces fraud. Second, VAT creates opposite incentives for the two sides of a transaction which reduces the likelihood of collusion. Third, purchases VAT is effectively withheld at the upstream firm. Even if the

downstream firm evades VAT, it bears some of the VAT burden on purchases. The literature has shown that the proper operation of these mechanisms relies on the extent of the informal sector (De Paula and Scheinkman (2011, 2010). Recently, a series of well-identified empirical studies have shown that VAT chain effects and mechanisms are quite strong in improving compliance. For example, Pomeranz (2015) reports on an audit experiment in Chile and shows firms subject to the VAT paper trail respond less to additional audit threats. Waseem (2020b) provides strong evidence in support of the withholding effect of VAT from Pakistan. Hoseini and Briand (2020) also report on the importance of chain effects in the Indian context and show forward and backward linkages matter for the efficiency gain of replacing sales taxes with VAT. Li and Wang (2020) use the expansion of VAT in China to show better compliance with VAT than a turnover tax, especially for B2B transactions. Finally, Waseem (2020a) report on extensive VAT evasion in Pakistan which is weaker for upstream stages of the production chain. Our paper also contributes to the VAT literature by looking at the compliance effect of VAT on trade taxes.

3 Context

The Iranian tax system features five main instruments: corporate income tax, personal income taxes, consumption taxes, import taxes, and wealth taxes. Iran does not have a comprehensive personal income tax system and treats various sources of income separately. The tax law has been reformed several times during the past four decades with little impact on the government tax revenue. Iran collects a very small share of GDP in taxes compared to other developing countries. Figure 1 shows that tax revenue as a percentage of GDP in Iran never exceeds 10 percent. If anything there is a gentle declining trend over time. The figure also shows the share of tax revenue from consumption and import taxes. Consumption taxes include sales taxes, excise taxes, and VAT. In 2008 the sales tax was replaced by VAT. However other excise taxes are available both before and after 2008. Prior to 2008 consumption taxes had a share of between 5 to 22 percent of total tax revenue. But after the introduction of VAT, we see a peculiar increase in the share of consumption taxes. After 2012, consumption taxes raise a higher share of revenue relative to import taxes. The reform seems to have a small effect on total tax revenue as tax to GDP increases from around 6 percent to 7 percent. But the importance of import taxes has declined around the time VAT introduction.

Figure 2 shows the evolution of maximum statutory VAT rate and its mean over the sample period. In mid-2008 the government introduced VAT with a 3 percent rate[2]. In the three following years, the rate stayed at 3 percent and then it saw one or two percentage point

[2]We take the VAT rate to be 1.5 percent in 2008 because VAT was not collected for the first half of the year.

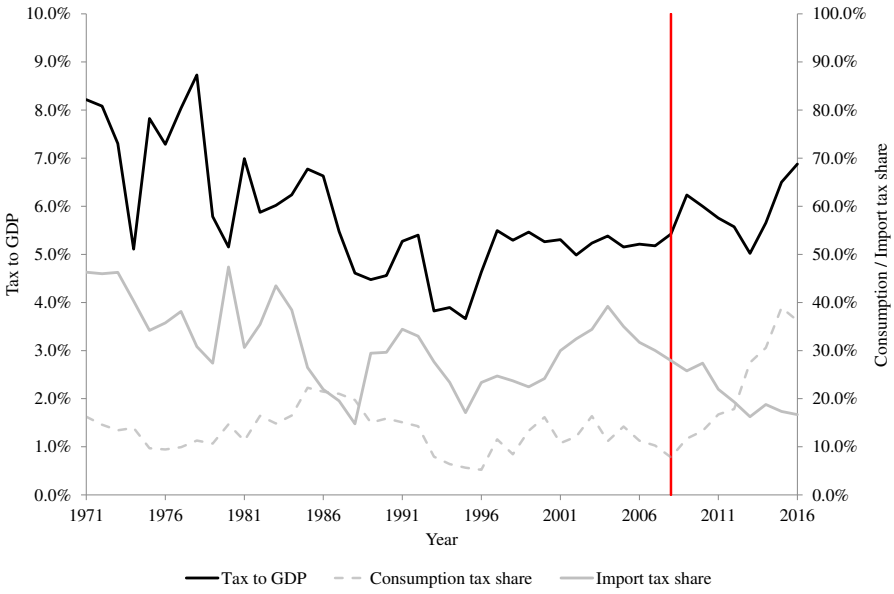

Figure 1: Tax to GDP and share of consumption and import taxes in tax revenue

Notes: Solid black line shows tax revenue as a percentage of gross domestic product (GDP) over 1971 - 2016. The vertical axis for this series is the left axis. The gray solid line shows the share of import tax revenue in total tax revenue. The dashed gray line shows share of consumption tax revenue in total tax revenue. Both these series are show on the right vertical axis. The red line shows introduction of VAT in 2008. The tax revenue figures include only central government levies. Source: Tax data is from Iran National Tax Administration and GDP figures are from the Central Bank of Iran.

increases in the following years. The figure also shows mean statutory VAT rate which is always below the maximum, because many products are either exempt or zero-rated. VAT exemption means that product is outside the VAT net. Therefore, producers of that product cannot reclaim any purchases VAT paid on their inputs and bear some burden of VAT. Zero-rated products are eligible for VAT and hence their producers can reclaim any VAT paid on inputs while they do not pay VAT on their sales. Thus, zero-rated producers receive no burden of VAT. This distinction was not well understood in Iran and the VAT law passed in 2008 effectively leaves zero-rating only for exports. Since we focus on imports, zero-rating does not apply to any of our goods. We only have VATable products that are subject to the statutory VAT rate or non-VATable products that are exempt from VAT. This translates to a zero tax rate at the port of imports and no outstanding purchases VAT for the downstream firms. Finally, Iran's VAT does not have a registration threshold[3].

[3]During the implementation of VAT, Iran Tax Administration issued notices between 2008 to 2015 which called firms in specific sectors or above specific turnover thresholds for VAT registration. By 2015 all firms were called to register. This procedure is not reflected in our dataset because notices cannot be mapped to HS6 product codes. Furthermore, the import VAT, which is the topic of this study, was enforced from the first day.

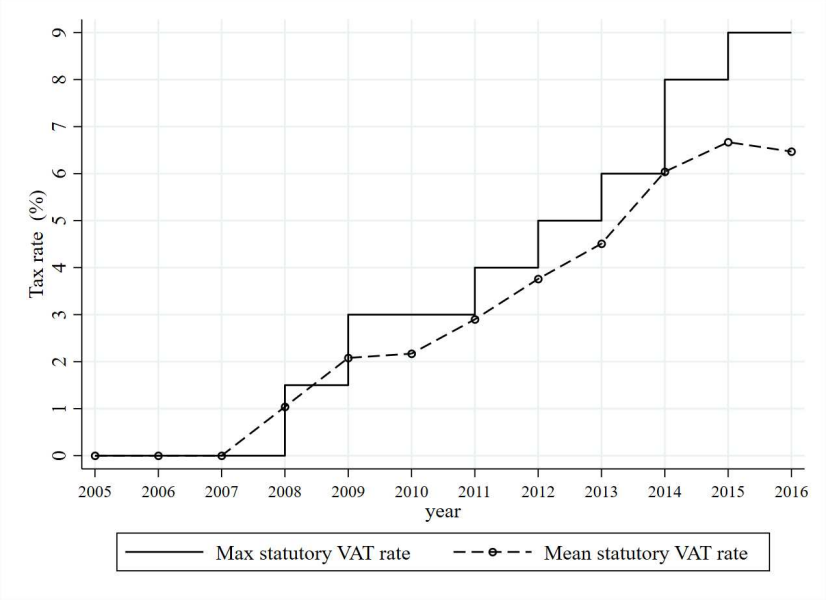

Figure 2: Evolution of max and mean statutory VAT rates

Notes: Solid black line shows maximum applicable VAT rate in the given year. VAT was introduced in mid-2008 and hence the reported maximum rate is half of the maximum rate. Black dashed line with hollow markers shows mean statutory VAT rate for each year. The mean rate is the simple mean of VAT rates for HS6 codes available in our data in each year.

4 Data

Our data comes from three different sources. First, we use Iran Customs Administration (ICA) reported imports and collected tariffs at 8-digit harmonized system classification (HS8). We merge this data with the world's reported exports to Iran from the World Integrated Trade Solution (WITS) database at 6-digit HS codes (HS6). Finally, statutory tariffs and VAT rates at HS8 disaggregation are taken from the Handbook of Customs Regulations (also known as Iran Imports and Exports Tariff Book), published annually by the Ministry of Industry, Mine and Trade.

Since WITS data is at HS6 level we collapse the two other sources to this level. We trim the data by excluding observations with trade values below the 1st and above the 99th percentile of its distribution in each year.. Besides, observations with negative tariff rates are excluded as data errors. The final cleaned dataset contains 37,456 observations from 2005 to 2016. For the purpose of aggregation and merging, the VAT and tariff rates are simply averaged for HS8 codes inside a given HS6 code[4]. The trade gap is calculated as the difference between the log of world reported exports to Iran and the log of reported imports by ICA: Trade Gap:$= \ln(\text{export}_{it}) -$

[4]In 2012, following the UN sanctions and economic downturn in Iran, the government introduced *priorities* in order to manage the foreign currency quota for the import of goods within each priority. Besides, the so called luxury products categorized as *priority 10* and their statutory tariffs folded by two. We consider *priorities* in the cleaned dataset.

Table 1: Summary Statistics

	No. obs.	Mean	Median	Standard Deviation		
				Overall	Within	Between
	(1)	(2)	(3)	(4)	(5)	(6)
Exports to Iran ($, WITS)	37,456	8,113,167	1,586,263	36,628,383	29,048,142	30,449,418
Imports ($, ICA)	37,456	4,119,427	1,065,818	7,302,459	3,707,549	6,952,125
VAT Rate (%)	37,456	2.94	1.50	3.30	2.75	2.10
VAT dummy	37,456	0.55	1.00	0.50	0.37	0.37
Statutory Tariff Rate (%)	36,891	21.34	12.00	23.66	9.45	28.92
Trade gap	37,456	0.31	0.23	2.12	1.50	1.97
Tariff Gap (%)	36,891	4.93	0.29	14.12	10.12	15.91

Notes: Table shows summary statistics of variables reported in the rows. Column (1) reports number of non-missing observations. Column (2) reports mean of the variable. Column (3) shows the median. Columns (4) to (6) respectively report the overall, within and between standard deviation of variables.

$\ln(\text{import}_{it})$[5]. To control for tariff exemptions we rely on the tariff gap which is defined as the gap between statutory and effective tariff rates. The latter is the sum of collected tariffs for a given HS6 code divided by the sum of reported value of imports (Yousefi et al. (2020)).

Table 1 reports summary statistics for the main variables. Average reported exports stand at around 8.1 million USD while average reported imports are 4.1 million USD. There is significant standard deviation both within and between HS6 codes. The VAT rate also shows plausible within and between variations due to exemptions and temporal changes in the max statutory rate. Average statutory tariff is relatively high and stands at 21.3 percent. This variable has a large between standard deviation and a significant within variation. Average trade gap is 0.31 which means reported exports to Iran are on average 31 percent more than reported imports. This is despite the fact that import values are based on CIF prices while exports are based on FOB. Figure 3 shows the distribution of trade gap for VATable and non-VATable HS6 codes. Apart from the greater dispersion of the trade gap for VATable goods, the two distributions are similar. They are slightly right-skewed with more mass on the positive numbers of the trade gap but they both well extend to the negative numbers. Figure 4 plots the evolution of the average tariffs for VATable and non-VATable goods. The average tariffs are smaller for VATable goods but this has been the case from the start of the sample. The gap widens toward the end of the sample years but seems fairly stable between 2005 to 2014.

5 Method

We use the difference-in-differences (DID) strategy to identify the impact of VAT on the trade gap. The introduction of VAT in 2008 and the rate increases afterward create quasi-random variations that allow us to tease out the impact of VAT from tariffs. Figure 5 shows the

[5]All observations with zero exports or imports are excluded from the analysis.

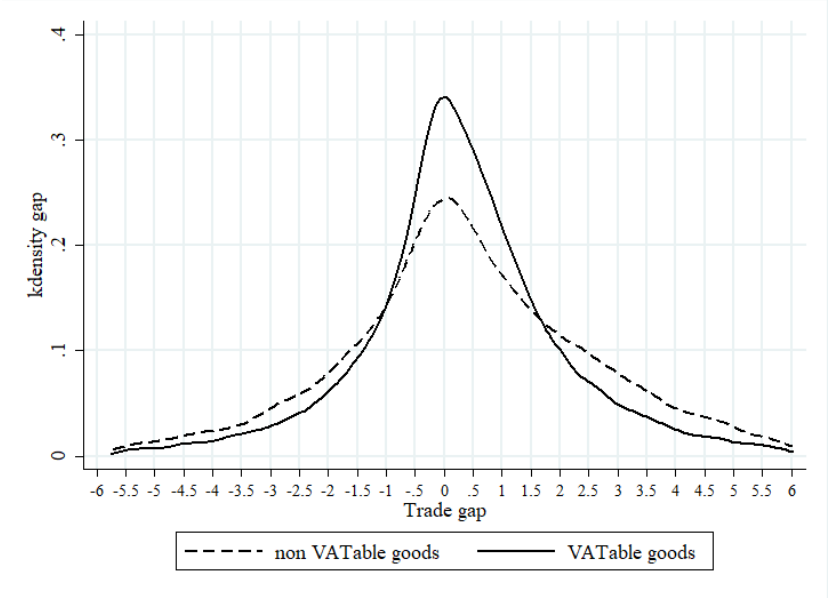

Figure 3: Kernel density of the trade gap for VATable and non-VATable goods

Notes: Solid black line shows kernel density estimation of distribution of trade gap for VATable goods. Dashed line shows a similar distribution for non-VATable goods. We have excluded observations below the first percentile and above the ninety ninth percentile of trade gap distribution in this plot.

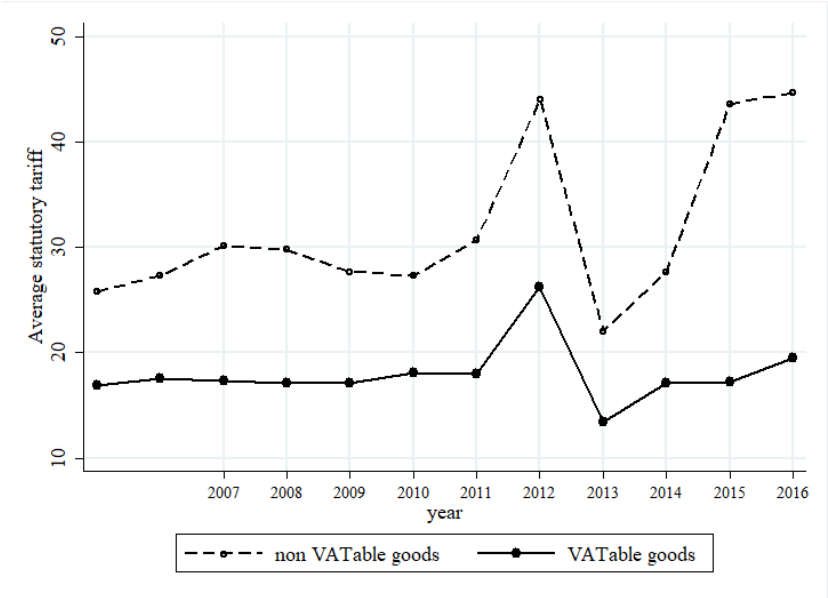

Figure 4: Evolution of average tariff rates for VATable and non-VATable goods

Notes: Solid black line shows average tariff rates for VATable goods in each year. Dashed line shows average tariff rates for non-VATable goods in each year. The mean rate is the simple mean of tariff rates for HS6 codes available in our data in each year.

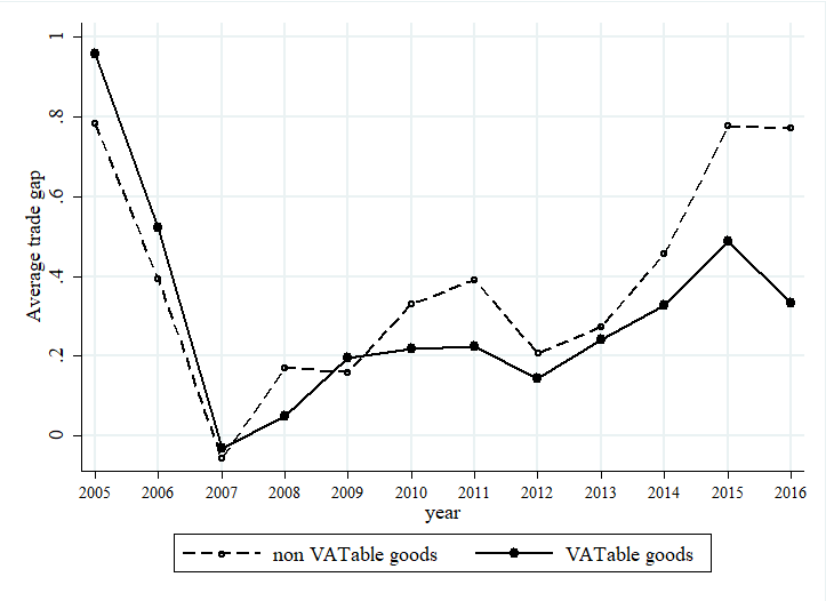

Figure 5: Evolution of the trade gap for VATable and non-VATable products

Note: Solid black line with solid markers shows average trade gap for VATable goods over the sample years. Dashed black line with hollow markers shows average trade gap for non-VATable goods. We have excluded observations below the first percentile and above the ninety ninth percentile of trade gap distribution in this plot. The vertical red line shows the year of VAT introduction (2008).

evolution of the average trade gap for VATable and non-VATable HS6 codes. The trade gap for both categories is decreasing prior to 2008, but starts to diverge after 2008. This figure shows does not control for confounders but still is suggestive of parallel trends prior to VAT introduction and a divergence between VATable and non-VATable products after VAT. simple averages which means controlling for confounding factors like simultaneous changes in tariffs could change the pattern. Next, we discuss several regression specifications that control for potential confounders to establish causality.

The first regression specification we estimate is as follows:

$$\ln(\text{export}_{it}) - \ln(\text{import}_{it}) = \alpha_i + \delta_t + \beta \text{VAT}_{it} + \gamma \tau^s_{it} + \psi \left(\tau^s_{it} - \tau^e_{it}\right) + \epsilon_{it} \tag{1}$$

here, the dependent variable is trade gap ($\ln(\text{export}_{it}) - \ln(\text{import}_{it})$) for product i (HS6) in year t. VAT_{it} is either a dummy variable that equals 1 if commodity i is VATable after 2008, or the VAT rate for commodity i in year t. The latter variable has more variation and is preferred. τ^s_{it} is the statutory tariff rate for product i in year t and $\tau^s_{it} - \tau^e_{it}$ reflects tariff exemptions, i.e. the difference between statutory and effective tariff rates. α_i and δ_t indicate HS6 and year fixed effects. The coefficient of interest is β. When VAT_{it} is a dummy, β shows the average percentage change in the trade gap for VATable commodities relative to non-VATable ones after VAT introduction. Similarly when we use the VAT rate as the explanatory variable, this

coefficient shows the percentage change in the trade gap in response to a 1 percentage point increase in the VAT rate.

The identification assumption in (1) is that in the absence of VAT the evolution of the trade gap for VATable and non-VATable products would be similar. The inclusion of HS6 fixed effects removes the influence of any time-invariant product characteristics that correlate with the VAT and the trade gap. For example, the government might have exempted necessities that are harder to misreport.Year fixed effects control for flexible global trends in the trade gap that are common to both VATable and non-VATable products. For example, the ICA might have been implementing enforcement reforms that prevents misreporting. Furthermore, the parallel trend of the trade gap for VATable and non-VATable products supports our identification (Figure 5). Albeit, all these specifications (e.g., (1)) are vulnerable to events that occur after 2008 and affect VATable and non-VATable products deferentially.

To study the heterogeneous effect of VAT on products with a short and long value chain, we use the Broad Economic Classification (BEC). BEC splits HS codes into capital, intermediate, and consumer goods. Since consumer goods are products that are intended for the final consumer, they have the shortest value chain. The following specification measures this heterogeneity:

$$\ln(\text{export}_{it}) - \ln(\text{import}_{it}) = \alpha_i + \delta_t + \beta \text{VAT}_{it} + \eta \text{VAT}_{it} \times 1[cons]_i + \gamma \tau^s_{it} + \psi \left(\tau^s_{it} - \tau^e_{it}\right) + \epsilon_{it} \qquad (2)$$

here, $1[cons]_i$ shows whether product i is categorized as a consumer good under BEC. The omitted category is non-consumer products. Therefore, the coefficient estimate for η reflects the additional impact of VAT on consumer goods relative to non-consumer ones. η is expected to be negative if the effect of VAT is stronger for longer value chains. Finally, we look at the heterogeneity of the VAT effect in HS6 codes with a large initial trade gap by estimating the following specification:

$$\ln(\text{export}_{it}) - \ln(\text{import}_{it}) = \alpha_i + \delta_t + \beta \text{VAT}_{it} + \zeta \text{VAT}_{it} \times \text{Trade Gap}_{0,i} + \gamma \tau^s_{it} + \psi \left(\tau^s_{it} - \tau^e_{it}\right) + \epsilon_{it} \qquad (3)$$

here, $\text{Trade Gap}_{0,i}$ reflects the average of the trade gap for HS6 code i during 2005 to 2007 (before VAT introduction). Some products have higher trade evasion during that time period. The impact of VAT on these products might go either way. Entrenchment of informal links might be the cause of high initial trade gaps. If these links have no formal downstream connections, VAT would not be effective in luring them into the formal sector. On the other hand, a large initial trade gap might reflect better trade evasion opportunities due to product characteristics or ineffective customs regulations. The imposition of VAT in this case would result in a stronger effect as VAT enforcement technology would shift large parts of imports to the formal sector. An alternative interpretation is that products with a small trade gap are those with a small share of informal importers that are most likely linked with the informal domestic producers. The sign of ζ would determine which of these stories are relevant in our context.

6 Results

This section provides the estimation results for the impact of VAT on illegal trade. We first look at the main results, including the average effect of VAT on the trade gap and its heterogeneity across consumer and non-consumer products. Then, we conduct several robustness checks to see the sensitivity of the results.

6.1 Main results

Table 2 shows the coefficient estimates from regressions of the trade gap on VAT and other covariates. Columns (1) and (2) use the VAT dummy which is equal to one for VATable products after 2008 and zero otherwise. Column (1) shows that the trade gap for VATable products decreases by more than 50 percent (significant at 1 percent) after the introduction of VAT. In column (2), we control for statutory tariffs and tariff exemption and the VAT dummy coefficient barely changes. This suggests that tariffs are almost independent of VAT. This was predictable from Figure 4 where VATable and non-VATable products show similar tariff trends. Columns (3) and (4) use the VAT rate which varies from 0 to 9. These columns exploit a richer variation by using the introduction and rate changes of VAT. The coefficient estimate from our preferred specification in column (4) suggests that a 1 percentage point increase in the VAT rate results in a reduction of 6.7 percent in the trade gap[6]. The effect of the VAT rate is the opposite of statutory tariffs. A one percentage point increase in statutory tariffs increases the trade gap by 2.6 percent. This means that a uniform one percentage point reduction in tariffs combined with a one percentage point increase in VAT has a double dividend in reducing the trade gap. The combined effect is 9.3 percent with VAT playing the main role in reducing the trade gap.

Table 3 looks at the heterogeneity of the VAT impact across different product categories. Columns (1) and (5) report coefficient estimates from columns (2) and (4) of Table 2 for comparison. Again we report estimates from the VAT dummy and the VAT rate regressions. We only discuss the results for the VAT rate regressions. Column (6) adds in the interaction of the VAT rate with the consumer product dummy. Those products experience a smaller decrease in the trade gap compared to other products. A one percentage point increase in the VAT rate results in a reduction of 2.6 and 7.4 percent respectively for consumer and non-consumer products (both coefficients are significant). This confirms the earlier conjecture that products with a longer value chain receive a larger impact from the VAT implementation.

Column (7) of Table 3 looks at the role of initial trade gap in mediating the effect of VAT. The negative coefficient estimate suggests that products with a larger initial trade gap receive

[6]Since the VAT rate increased from 0 to 9 percent, this coefficient suggests a total effect of 60 percent which is in line with the coefficient estimate from the VAT dummy.

Table 2: Regression results for the impact of VAT on the trade Gap

Dep. var: Trade Gap	VAT Dummy		VAT rate	
	(1)	(2)	(3)	(4)
VAT	-0.52***	-0.51***	-0.066***	-0.067***
	0.091	0.1	0.011	0.013
τ^s		0.026***		0.026***
		0.002		0.002
$\tau^s - \tau^e$		-0.017***		-0.018***
		0.0019		0.0019
Obs.	40674	36891	40674	36891
$\overline{R}^2$	0.46	0.46	0.46	0.46

Notes: Table shows coefficient estimates and standard errors from four regressions. In all regressions the dependent variable is trade gap (difference between log of exports to Iran reported by WITS and log of imports reported by ICA). Columns (1) and (2) include a VAT dummy that is equal to 1 for VATable goods after 2008. Columns (3) and (4) include the VAT rate in the regression instead. τ^s is the statutory tariff rate. $\tau^s - \tau^e$ is tariff exemption defined as the difference between the statutory and effective tariff rates. All regressions include constant variable, HS6 and year fixed effects. Standard errors are corrected for clustering at HS4 level and are reported in parenthesis below coefficients. There are 1125 clusters. *, ** and *** respectively show significance at 10, 5, and 1 percent level.

a stronger impact from VAT. A 100 percent increase in the initial trade gap intensifies the impact of VAT on the trade gap by 7.3 percentage points. Evaluated at the mean of initial trade gap (52 percent), the estimated impact of VAT on the trade gap is 6.3 percent which is close to the average effect in column (5). Including the two interactions in a single specification does not change the pattern of results (column (8)). An important point emerges from this specification. After controlling for the initial trade gap, the impact of VAT on the trade gap of consumer products is positive (+5.4 percent). Consumer products have a higher initial trade gap and therefore, the estimated coefficient in column (6) has a downward bias because two opposing mechanisms are lumped together. Higher initial trade gap increases the impact of VAT on the trade gap, but a shorter value chain works in the opposite direction. Overall, these patterns are in line with the idea that the VAT chain effects are very important in bringing the informal traders into the formal sector.

In order to investigate the time profile of the VAT effect, we estimate the following specification

$$\ln(\text{export}_{it}) - \ln(\text{import}_{it}) = \alpha_i + \Sigma_{s=2006}^{2016}\theta_s \text{VAT}_i \times \text{T}\left[t=s\right]_t + \gamma\tau_{it}^s + \psi(\tau_{it}^s - \tau_{it}^e) + \epsilon_{it}. \quad (4)$$

This specification is identical to the main specification except for a complete set of interaction term. VAT_i is a dummy variable that is equal to one for VATable HS6 products across all years of the sample. $\text{T}\left[t=s\right]_t$ is a dummy variable that is equal to one if we are in year s and zero otherwise. The coefficient estimates for the interaction terms show the differential evolution of VATable products relative to non-VATable ones in each year relative to the base year (2005). Figure 6 plots the coefficient estimates and 95 percent confidence intervals from

Table 3: The heterogeneity of the impact of VAT on the trade Gap

Dep. var: Trade Gap	VAT Dummy				VAT rate			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VAT	-0.51***	-0.52***	-0.13	-0.20**	-0.067***	-0.074***	-0.026**	-0.038***
	0.1	0.1	0.097	0.097	0.013	0.013	0.012	0.012
VAT × 1[*cons*]		0.12		0.55***		0.048***		0.092***
		0.14		0.1		0.017		0.014
VAT × Trade Gap_0			-0.69***	-0.71***			-0.073***	-0.075***
			0.022	0.022			0.0026	0.0026
Observations	36891	36891	35126	35126	36891	36891	35126	35126
$\overline{R}^2$	0.46	0.46	0.5	0.5	0.46	0.46	0.47	0.48

Notes: Table shows coefficient estimates and standard errors from 10 regressions. All regressions include τ^s (statutory tariff rate), $\tau^s - \tau^e$ (tariff exemption) , and HS6 and year fixed effects. For the columns including factors interactions, the factors are controlled (but not reported). Standard errors are corrected for clustering at HS4 level and are reported in parenthesis below coefficients. There are 1125 clusters. *, ** and *** respectively show significance at 10, 5, and 1 percent level.

(4). The coefficients are not statistically different from zero in 2006 and 2007 suggesting that the difference in trade gap of VATable and non-VATable products is stable prior to the introduction of VAT. The difference between the two product categories emerges right in 2008 and remains stable afterward. This result alleviates concerns regarding the parallel trends assumption.

6.2 Robustness regressions

In order to check the robustness of the results we conduct three tests. First, during 2012 and 2013 the tightening of the economic sanctions resulted in a recession and a significant exchange rate depreciation. Year fixed effects would absorb the effect of sanctions as far as they are uniform across VATable and non-VATable products. However, it might be that the luxury products, which are VATable, are hit harder by the UN sanctions in 2012. To see the sensitivity of our results to this event, we exclude 2012 and 2013 from the sample and re-estimate the coefficients. Columns (1) to (4) in Table 4 show the results for this sample restriction. Coefficient estimates and their significance barely change.

Second, as discussed in section 3, the VAT law implementation phased in through the issuance of 6 notices by Iran National Tax Administration. These notices applied to domestic firms; notably, the importers were required to register for the VAT from the beginning. Even though this is unlikely to affect imports, it might weaken the chain effects. To address this issue, we exclude 2008 to 2014 (phase-in years) and estimate coefficients with the remaining years in columns (5) to (8) of Table 4. This is a stringent test as we are left with 5 years. However, the

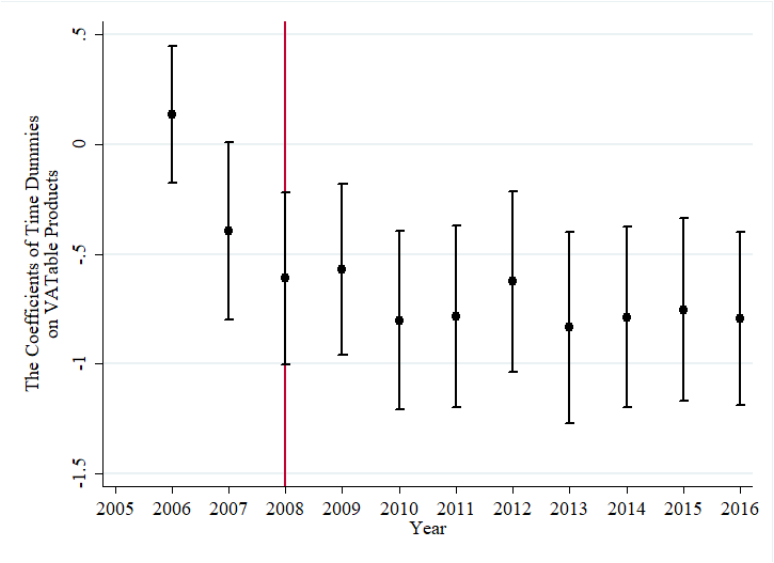

Figure 6: Evolution of the difference in trade Gap by VATable and Non-VATable products
Notes: Figure shows coefficient estimates and 95 percent clustered confidence interval from a regression of trade gap on a full set of year interactions with VATable dummy, statutory tariff rate, tariff gap, HS6 and year fixed effects (specification (4)). The vertical line shows the year 2008 when the VAT was introduced.

new results are stronger and patterns do not change. The heterogeneity of the results remains the same as well; products with a shorter value chain and an initially smaller trade gap receive a smaller impact from the VAT.

Third, trade gap might be mean reverting in the sense that when trade gap is high it tends to follow a declining trend. This threat is particularly important for us because the VAT rate increases almost linearly after 2008. In other words, any trends in trade gap might be confounded with the effect of the VAT rate increases because the variation in the latter is simply uniform over the years. We conduct two robustness checks to alleviate mean reversion concerns. First, we drop observations with outlier trade gap which are more likely to be far from the mean . The results from this regression is shown in column (1) of Table 5. Coefficient estimates and their significance is unchanged[7]. Second, we allow the trade gap to have a heterogeneous linear trend with respect to initial trade gap. Column (2) shows the coefficient estimates from this specification. Coefficient estimates for the VAT rate and its interaction with consumption dummy are similar to the main results. However, the coefficient estimate for the interaction of VAT and trade gap changes sign and becomes smaller. This change is due to the fact that we do not have a rich variation in the VAT rate. Therefore, it is virtually impossible to interpret this coefficient estimate once we include the interaction of the linear trend with initial trade gap. The two other coefficients are, however, robust even to quadratic and cubic trends (columns (3) and (4)).

[7]The pattern of results are also robust to stricter exclusion of extreme observations.

Table 4: Robustness of the impact of VAT on the trade gap to exclusion of specific years

Dep. var: Trade Gap	Excl. 2012-13				Excl. 2008-14			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VAT rate	-0.066***	-0.071***	-0.026**	-0.036***	-0.080***	-0.083***	-0.032**	-0.041***
	0.012	0.013	0.012	0.012	0.015	0.015	0.014	0.014
VAT × 1[*cons*]		0.037**		0.080***		0.023		0.072***
		0.016		0.014		0.019		0.014
VAT × Trade Gap_0			-0.071***	-0.073***			-0.084***	-0.086***
			0.0027	0.0026			0.0027	0.0027
Observations	31006	31006	29607	29607	15753	15753	15160	15160
$\overline{R}^2$	0.45	0.45	0.46	0.46	0.4	0.4	0.45	0.45

Notes: Table shows coefficient estimates and standard errors from 10 regressions. All regressions include τ^s (statutory tariff rate), $\tau^s - \tau^e$ (tariff exemption) , and HS6 and year fixed effects. Standard errors are corrected for clustering at HS4 level and are reported in parenthesis below coefficients. There are 1125 clusters. *, ** and *** respectively show significance at 10, 5, and 1 percent level.

Table 5: Robustness of the impact of VAT on the trade gap

Dep. var: Trade Gap	Gap$\in [p5, p95]$	Mean reversion		
	(1)	(2)	(3)	(4)
VAT rate	-0.033***	-0.041***	-0.041***	-0.041***
	0.011	0.012	0.012	0.012
VAT × 1[*cons*]	0.086***	0.091***	0.091***	0.091***
	0.012	0.014	0.014	0.014
VAT × Trade Gap_0	-0.061***	0.016***	0.016***	0.016***
	0.0025	0.0049	0.0049	0.0049
Linear Trend ×Trade Gap_0		Y	Y	Y
Quadratic Trend ×Trade Gap_0			Y	Y
Cubic Trend ×Trade Gap_0				Y
Observations	20777	35126	35126	35126
$\overline{R}^2$	0.48	0.5	0.5	0.5

Notes: Table shows coefficient estimates and standard errors from 4 regressions. All regressions include τ^s (statutory tariff rate), $\tau^s - \tau^e$ (tariff exemption) , and HS6 and year fixed effects. Standard errors are corrected for clustering at HS4 level and are reported in the parenthesis below the coefficients. There are 1125 clusters. *, ** and *** respectively show significance at 10, 5, and 1 percent levels.

Table 6: Placebo test of the impact of VAT on the trade gap

Dep. var: Trade Gap	All products		non-VATable products		VATable products	
	(1)	(2)	(3)	(4)	(5)	(6)
VAT	-0.013	-0.022	0.003	-0.001	-0.001	-0.005
	(0.018)	(0.020)	(0.007)	(0.008)	(0.003)	(0.003)
VAT × 1[*cons*]		0.071		0.021		0.035***
		(0.079)		(0.022)		(0.012)
Observations	36,891	36,891	8,957	8,957	27,934	27,934
$\overline{R}^2$	0.457	0.457	0.517	0.517	0.428	0.428

Notes: Table shows coefficient estimates and standard errors from 6 regressions. In columns (1) and (2), the VAT dummy is assigned randomly for 56% of observations. This date of the VAT introduction is still assumed to be 2008. In columns (3) and (4), we keep non-VATable products and randomly assign half of them the actual VAT rate in the given year. In columns (5) and (6), we keep VATable products and randomly assign the VAT rate to zero for half of them. Again the date of reform is assumed to be 2008. All regressions include τ^s (statutory tariff rate), $\tau^s - \tau^e$ (tariff exemption) , and HS6 and year fixed effects. Standard errors are corrected for clustering at HS4 level and are reported in parenthesis below coefficients. There are 1125 clusters. *, ** and *** respectively show significance at 10, 5, and 1 percent level.

We also conduct three placebo regressions to further validate the results (Table 6). First, we randomly assign a VAT dummy to 56 percent of HS6 products irrespective of whether they are actually VATable or not. The results reported in columns (1) and (2) of Table 6 show no significant result. Second, we keep non-VATable HS6 codes and again randomly assign half of them to be VATable. As the results in columns (3) and (4) show we still do not pick up any significant effect. Finally, we keep VATable products and randomly assign half of them to be non-VATable. Here the only significant effect is the interaction of VAT and consumption dummy. This is to be expected because in all placebo tests we keep the reform date to be 2008 and we do not randomize the assignment to consumer products. Therefore, post 2008, consumer products among VATable products show an expansion in their trade gap.

7 Conclusions

In this paper we identify a novel interaction between VAT and tariffs. We find that the introduction of the VAT significantly reduces the trade evasion. In our preferred specification, a one percentage point increase in the VAT rate reduces the trade gap by 6.7 percent. Three points are worth emphasizing. First, the introduction of VAT has complementary effects on other tax bases. In our context, the backward linkages activated by the VAT incentivize importers to truthfully reveal their imports. The fact that consumer products with a shorter value chain are less affected by the introduction of VAT further confirms this hypothesis. This channel could be extended to other types of taxes, including the corporate tax. VATable firms would require VAT invoices for purchases and sales. These receipts are available from other trading partners as well (paper trail). Therefore, it becomes harder to evade on the corporate

tax. Such inter-tax base mechanisms are yet to be studied in the empirical literature. Second, the magnitude of the VAT effect on the trade gap is 2.5 times that of the tariff rate. The trade evasion literature has largely focused on tariffs (Fisman and Wei (2004)) or other product characteristics (Javorcik and Narciso (2008); Mishra et al. (2008)). Our finding shows that the overall enforcement environment including the existence of efficient tax instruments such as the VAT could create large spillovers. Third, we add support for a joint tariff VAT reform by shedding light on the complementarity between VAT and tariffs which has not been studied in the literature (Emran and Stiglitz (2007, 2005); Baunsgaard and Keen (2010); Keen and Ligthart (2002); Keen (2008)). Our findings suggest a double dividend from replacing tariffs by VAT. Tax revenue increases by reduced imports misreporting and by a broader VAT base.

VAT is an effective tax instrument because it creates opposite evasion incentives for the two sides of a transaction, leaves a paper trail, and withholds taxes at the upstream (Waseem (2020b); Keen and Lockwood (2010)). Such properties are operative at the point of imports as well because this is the first point that VAT is levied for production chains that rely on imported commodities (Keen (2008)). Therefore, VAT creates an incentive for honest reporting of imports. In the presence of VAT, import tax evasion affects both the importers (risk of getting caught) and the downstream firms. If downstream firms have some exposure to the formal sector, e.g. through VAT registration or corporate taxes, they would need valid VAT receipts. This backward pressure creates incentives for honest reporting of imports. Theoretically speaking, VAT may push firms into either formal or informal sectors, depending on how large is the informal sector (De Paula and Scheinkman (2010, 2011)). The larger the informal sector, the higher the likelihood of pushing firms into the informal sector. However, many empirical studies suggest that the overall effect is in favor of the formal sector (Pomeranz (2015); Carrillo et al. (2017)). Our findings adds support to the effectiveness of VAT in a middle country with pervasive tax evasion.

Our study faces two limitations. First, the variation in the VAT rate is close to linear. Therefore, we do not have enough statistical power to control for product-level differential trends. Had the VAT rate been reduced or increased dramatically in our context, we would have had stronger identification to support our findings. While, we have conducted several robustness tests and showed similar pre-trends, our results might still suffer from non-VAT related differential trends that are specific to VAT products. Second, we do not observe tax revenue (for the VAT and tariffs). Therefore, we cannot show the impacts on the final variable of interest. Here, aggregate figures support the idea that the tax revenue has gone up after VAT introduction but the evidence is far from convincing.

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