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The Incidence of VAT Evasion

Abstract

Who benefits from the evasion of value added taxes (VAT)? Using a reform that enforced VAT on previously non-compliant large retailers in Armenia, we estimate a one-third passthrough of the tax burden on prices. This suggests that pre-enforcement evasion rents were broadly shared with consumers through lower prices. Our theoretical and empirical results explain this low passthrough rate by the supply-chain effects and second-order compliance responses of firms to VAT enforcement. Our distributional analysis shows that households at the bottom of the income distribution benefit more from the rents of evasion.

JEL-Codes: D110, H220, H260.

Keywords: value added tax, incidence, passthrough, evasion, enforcement, distributional effects.

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1 Introduction

In public economics, passthrough parameters are important for the theory of tax incidence and distributional equity (Kotlikoff and Summers 1987). More generally, the economic analysis and policy evaluation of how cost shocks affect prices is important across a number of fields in economics, such as macroeconomics (Nakamura and Zerom 2010), trade (De Loecker, Goldberg, Khandelwal, and Pavcnik 2016), monetary economics (Cravino and Levchenko 2017, Dornbusch 1987), and labor economics (Harasztosi and Lindner 2019), among others. Although it is well recognized that the evasion and avoidance of taxes are large and universal phenomena (Slemrod 2019, Slemrod and Yitzhaki 2002), the study of tax incidence in the presence of tax evasion is still rare. The question we ask in this paper is: how are the rents of value added tax (VAT) evasion shared among market participants?

Standard theories of tax incidence assume away any issues of tax enforcement. Empirical estimates of VAT incidence also typically ignore distortions created by non-compliance opportunities because the VAT is generally believed to be self-enforcing.[1] Most previous work estimates a full passthrough of indirect taxes on to consumers (see, e.g., Poterba (1996), or Bird and Gendron (2007) for a review), and interprets this estimate in light of the standard competitive model (Fullerton and Metcalf 2002) that supply and demand elasticities are sufficient to determine the proportion of the tax borne by each agent. Some evidence even estimates over-shifting of indirect taxes to prices (e.g., Besley and Rosen 1999, Kenkel 2005) which is consistent with models of imperfect competition (Weyl and Fabinger 2013), but may also arise due to general equilibrium effects in a perfectly competitive framework (Agrawal and Hoyt 2019). However, with an average passthrough estimate of above unity (see our quantitative literature summary in Table App.1 and Figure App.1 of the Appendix),

[1] See De Paula and Scheinkman (2010), Naritomi (2019), Pomeranz (2015), Waseem (2020) for evidence on the self-enforcing properties of VAT. Keen and Smith (2006) review the various mechanisms of VAT non-compliance, and Waseem (2019) presents evidence on the extent of non-compliance.

rarely has previous work estimated substantial under-shifting[2] of VAT to flexible prices[3] in non-monopoly settings.[4]

In this paper we study the incidence of VAT both empirically and theoretically, and show that the case of substantial under-shifting is a plausible result in contexts which include significant evasion opportunities. This is an important result rather than an outlier case since it is now increasingly being recognized that despite the self-enforcing properties of VAT, evasion from the tax can be substantial (Waseem 2020).[5]

The standard incidence results may not hold with evasion opportunities for several reasons. First, incidence will be mechanically lower than assumed if the effective tax burden is much smaller than the nominal tax burden due to evasion. Second, evasion opportunities may be different between the sides of the market paying the statuary tax, making the equilibrium price and quantity to be dependent on who remits the tax. Third, as we discuss more in detail below, evasion and enforcement may introduce other less obvious incentives for economic agents and respective behavioral responses. Such potential responses have implications for agents' demand and supply curves more generally, and are thus relevant for equilibrium incidence. For a broader discussion of the fundamentals of a theory of evasion incidence, including implications on allocational and distributional aspect of taxation, see, Martinez-Vazquez (1996).

Our empirical strategy exploits a large enforcement episode in Armenia which brought previously non-compliant segments of the economy into the VAT system. As in many developing countries, agriculture is exempt from VAT in Armenia (for a review of the treatment of agriculture under VAT, see, Cnossen 2018), while indirect taxation has a two-tiered system where larger firms operate under VAT of 20% and smaller firms operate under a sales tax of

[2]There is also a more general literature studying the passthrough of cost shocks to prices often finding undershifting (Ganapati, Shapiro, and Walker 2020, Koujianou Goldberg and Hellerstein 2012).

[3]Conlon and Rao (2019) shows that price rigidity can explain both incomplete and excessive passthrough estimates.

[4]See Edgeworth's taxation paradox for the special case of a monopoly where a tax hike reduces prices (Hotelling 1932).

[5]Self-enforcing properties of VAT break down, for example, when most countries exempt certain segments of the economy from VAT, such as through exemption thresholds for small firms or exemptions for certain industries like agriculture.

5%. Because of the exemption of agriculture from VAT, large formal retailers who operate under VAT cannot have VAT input invoices on agricultural products supplied by local farmers, making the VAT on these products effectively a sales tax with a very high effective tax rate. In order to circumvent this high tax rate on local agricultural products,[6] the government used to allow large formal retailers to register thousands of postbox firms (i.e. firms only existing on paper) falling just below the VAT exemption threshold and book the sales of local agricultural products happening in these large retailers on the accounts of these non-VAT postbox firms.[7] Figure 1 presents clear evidence of such bunching behavior below the VAT registration threshold. The enforcement episode, essentially a crackdown on these bunchers, started to fully enforce VAT on the large retailers increasing the statutory tax rate on their sales of local agricultural goods from a sales tax of 5% to a VAT (but due to no deduction possibilities effectively a sales tax) of 20%.

We use data on product and store level prices at 10-day frequencies, and apply a triple-difference design to estimate the incidence of enforcing VAT on prices. One difference comes from within firms by comparing prices of agricultural goods that happen to be fully produced by local farmers and thus were not VAT-liable (treatment products) to agricultural goods that are either imported or produced by formal firms and thus were VAT-liable (control products). The second difference comes from between firms by comparing the large formal retailers affected from the enforcement reform to a control group of small retailers which were not VAT-liable either before or after the reform. The third difference exploits the time series data before and after the reform, which was largely an unanticipated event.[8] Our baseline regressions control for good-by-time, good-by-store and store-by-time fixed effects. We show that in this setting the average passthrough of taxes to consumers is only about a third of the tax burden.

[6]The motivation of the government behind this policy was to avoid high inflation and to protect local farmers from foreign competition. Meckel (2020) provides an example of unintended effects of government policy (food stamps) in which authorities' attempt to prevent retailers from making extra profits by price discriminating against a certain group, led to overal price increases for all consumers.

[7]We call this tax planning strategy of splitting firms tax evasion rather than tax avoidance because the Armenian law on the VAT clearly states that splitting a firm into several firms which are engaged in the same activity with the intention to avoid the VAT threshold is illegal.

[8]The absence of pre-trends in our data of days and weeks before the reform is consistent with the claim that the reform was unanticipated.

This one-third incidence estimate is much smaller than previous empirical estimates of VAT incidence, which we quantitatively summarize in Table App.1. Likewise, as discussed in Appendix B, the estimate is smaller compared to a second incidence parameter obtained from Armenia that is based on VAT and excise tax rate changes in the fuel market where evasion is not a first order issue. Additionally, we ask the question of who beared the remaining two-thirds of the tax burden. We provide suggestive evidence that firm owners did not fully bear the remaining tax, but were able to shift some of the burden to employees as well as to farmers.

Our identification strategy benefits from the specifics of the fairly unique enforcement episode in Armenia, in particular from the opportunity to exploit both between and within firm variation. However, we believe that our evidence may be generalizable to a wider class of VAT reforms that happen in various countries. The most closely related type of enforcement reform would be one that enforces VAT on firms that failed to register for example by bunching below the VAT exemption threshold to avoid the VAT. Such bunching behavior is the norm rather than the exception, as shown by the studies on Armenia (Asatryan and Peichl 2017), Finland (Harju, Matikka, and Rauhanen 2019), Japan (Onji 2009), South Africa (Boonzaaier, Harju, Matikka, and Pirttilä 2019), UK (Liu, Lockwood, Almunia, and Tam 2019), among several other countries (for a theoretical treatment of VAT threshold optimality, see, Kanbur and Keen 2014, Keen and Mintz 2004). Our evidence may be relevant to other types of VAT reforms as well, for example, to reforms that extend VAT liability to new firms due to the inclusion of new sectors into the VAT system, or due to other legal and de-facto tightenings of VAT exemption rules.

In order to understand the mechanisms behind our result, we build a very simple model of tax incidence with evasion opportunities in an economy with dual-tax regimes. The model generates predictions that help rationalize our baseline result of low passthrough with the more standard incidence result of near-full passthrough. We present suggestive evidence that is in line with these predictions. First, similar to Gadenne, Nandi, and Rathelot (2018) and Gerard, Naritomi, and Seibold (2018), VAT enforcement induces supply chain effects incentivizing

retailers to buy more from VAT rather than non-VAT firms. Consistent with this hypothesis, we find that immediately following the reform, the number of new VAT firms as well as aggregate sales by VAT firms in agriculture increases sharply compared to turnover taxpayers. These supply chain effects change the cost structure of firms and are relevant for equilibrium prices incidence. Second, we use data on thousands of mystery shopper and food security audits, and find that switching the tax scheme from turnover to VAT induces firms to become non-compliant with state regulations (in the form of not printing receipts for tax evasion purposes as well reducing standards of product quality). This result is consistent with theory and past evidence (see details in Section 6.2), and depresses the rate of passthrough by way of lowering costs that retailers face. Additionally, we study how the well known result that incidence depends on salience (see, Chetty, Looney, and Kroft 2009, Finkelstein 2009, Kroft, Laliberté, Vizcaíno, and Notowidigdo 2020, Taubinsky and Rees-Jones 2018) applies to our case where salience is about the presence of tax evasion rather than the presence of a tax. We hypothesize that salient information about the evasion behavior of firms generates consumer boycott towards firms who are susceptible to evasion. We show that this demand response changes the price-setting behavior of evading firms, and, similar to the two other mechanisms discussed above, results in lower equilibrium passthrough.

In the final part of the paper, we use diary reports from household expenditure surveys to show that the incidence of the enforcement episode was distributionally not neutral. In particular, we identify that the price changes mainly affected households at the bottom of the income distribution. We derive income-group-specific behavioral changes in consumption due to positive price elasticity of demand and cross elasticity of demand. We show that the tax incidence implied a negative transfer of about 0.33% of total expenditures for households at the bottom quintile of the income distribution, while the transfer was close to zero for those at the top quintile. The size of these transfers relative to total expenditures are on average small, owing to the fact that, unlike cases with general VAT changes, in our case expenditures affected by the enforcement reform make a relatively small fraction of total expenditures ranging from 5.5% to 3% along the income quintiles. The relative distributional

consequences are, however, clear. This analysis is related to the work by Bachas, Gadenne, and Jensen (2019) and Nygård, Slemrod, and Thoresen (2019) who show that the de-facto progressivity of taxes can be very different when evasion opportunities are taken into account.

Our paper is most directly related to the literature that studies the incidence of taxes in contexts where agents have access to evasion or avoidance opportunities. In general there is still very little such evidence. Alm and Sennoga (2010) analyze incidence and evasion in a CGE model and show that with free entry, benefits of evasion do not stay with the evader. Kopczuk, Marion, Muehlegger, and Slemrod (2016) study the passthrough of diesel taxes to retail prices in US states which have different rules as to which seller in the supply chain remits the tax. They reject the null hypothesis of the standard model, and show instead that the passthrough rate is substantially higher when suppliers rather than the retailers, who probably have much higher evasion opportunities, are responsible to remit the tax. Doerrenberg and Duncan (2019) conduct a lab experiment and find that sellers with access to evasion opportunities shift a smaller share of the nominal tax rate onto buyers. Wilking (2016) and Bibler, Teltser, and Tremblay (2018) estimate incidence exploiting Airbnb's tax enforcement agreements with US cities, and Bibler et al. (2018) additionally use this incidence parameter to derive a lower bound estimate of evasion. Dyreng, Jacob, Jiang, and Mueller (2019) study corporate tax avoidance, and show that the rate of incidence of corporate taxes on labor is a substitute for tax avoidance.

More generally, this paper is related to a large body of evidence that quantifies the economic incidence of taxes. The following papers, among many others, study the incidence of personal income (Kubik 2004, Ruf and Schmider 2015), payroll (Bozio, Breda, and Grenet 2018, Saez, Matsaganis, and Tsakloglou 2012), corporate income (Fuest, Peichl, and Siegloch 2018) taxes and that of benefits (Rothstein 2010). A bulk of evidence exists on the passthrough of consumption taxes such as VAT (Benedek, Mooij, Keen, and Wingender 2016, Carbonnier 2007, Kosonen 2015), sales taxes (Besley and Rosen 1999, Poterba 1996), and excice taxes on gasoline (Bajo-Buenestado and Borrella-Mas 2019, Doyle and Samphantharak 2008), alcohol (Carbonnier 2013, Kenkel 2005, Young and Bielinska-Kwapisz 2002), tobacco

(Barnett, Keeler, and Hu 1995, DeCicca, Kenkel, and Liu 2013, Harding, Leibtag, and Lovenheim 2012), or sugar (Bonnet and Requillart 2013), as well as subsidies (Hastings and Washington 2010, Kirwan 2009, Pless and van Benthem 2019) on consumers through prices. Additional findings show that incidence depends on salience (Chetty et al. 2009, Finkelstein 2009, Taubinsky and Rees-Jones 2018), can be asymmetric when considering tax increases and decreases (Benzarti, Carloni, Harju, and Kosonen 2019), varies with firms' pricing strategies (Harju and Skans 2018), can be different over time (Benedek et al. 2016, Buettner and Madzharova 2019), has distributional effects (Gaarder 2018), and can be shared more broadly with workers, firm owners, and suppliers of goods (Benzarti and Carloni 2019), among other findings.[9] Slemrod (2008) reviews this literature qualitatively, while in Table App.1 and Figure App.1 we quantitatively summarize the findings of this body of evidence on consumption tax incidence. Our summary shows that the mean (median) passthrough rate among the 67 baseline estimates collected from these 27 papers is 108% (92%), and, thus, far above our estimate of a one-third passthrough.

The remainder of the paper is structured as follows: Section 2 describes the relevant features of the Armenian tax system in general, and the reform that we exploit in particular. Section 3 presents the data and our empirical design. Section 4 describes our main empirical results on the passthrough of prices. Section 5 presents the model, and Section 6 shows the additional evidence supporting the predictions of the model. Section 7 estimates the demand responses of the average household, and presents calculations of relative transfers which the reform generates for households along the income distribution. Section 8 concludes.

[9] A related strand studies how consumption responds to taxes (see, e.g., Baker, Johnson, and Kueng 2018, Cashin and Unayama 2016). In this literature behavioral change is typically achieved through the price channel only. Rees-Jones and Rozema (2019) presents evidence on different mechanisms of how demand responds to tax changes other than through prices.

2 Setting

2.1 The enforcement episode

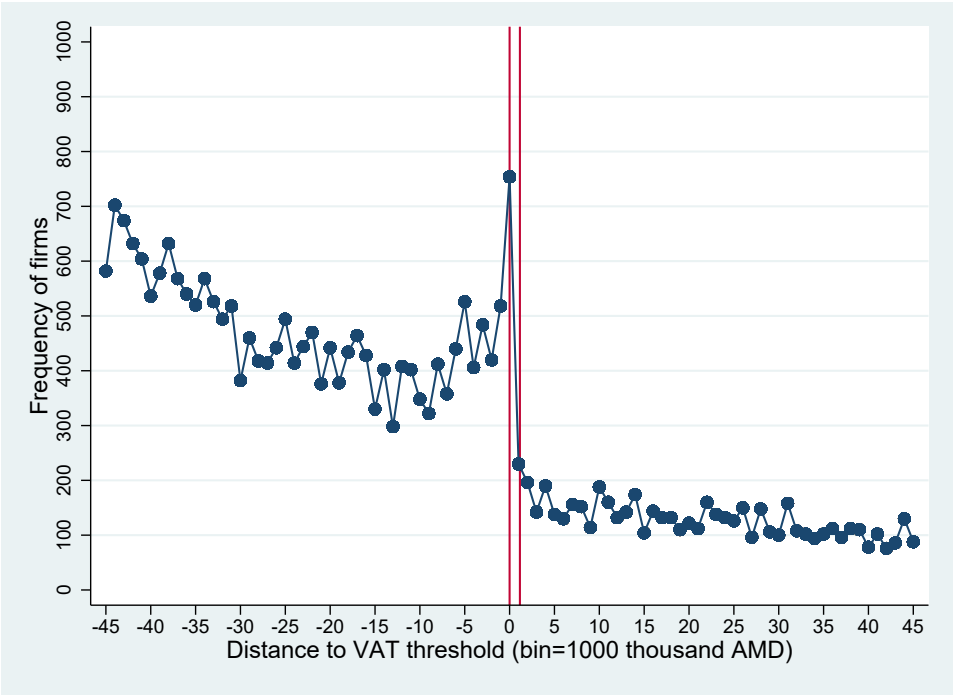
Enforcement reform in an example store: We use a sudden enforcement of the VAT regime on a sub-set of products on a sub-set of previously non-compliant retailers as a "natural experiment". For the sake of simplicity, we discuss how the enforcement reform affected one large retailer as an example. At the end of May 2018 the government said it discovered 461 "postbox" firms, i.e. firms that exist solely on paper, that were de-facto owned by the largest retailer in Armenia. Each of these postbox firms had a size of slightly less than the VAT registration threshold in Armenia, where a simpler and lower turnover-based sales tax of 5% replaces the VAT of 20%. Although these small firms were legally independent, it was announced that, in practice, they were being operated by the single retailer. This retailer used to channel its sales of agricultural products supplied from local farmers through these small firms. Since small agricultural holdings are exempt from paying VAT (and other taxes) in Armenia, the local agricultural products bought from these non-VAT sellers did not have VAT input invoices. Using these postbox firms, the retailer paid sales tax of 5% on the gross sales of these products rather than the standard VAT rate of 20%.[10] With the enforcement reform, the government closed all the small firms, and started to fully enforce the VAT on the retailer. Upon enforcement, the physical organization of stores and goods inside them did not change in any meaningful way.

Treated and control stores: It became apparent that this scheme was being used by ten other large retailers in Armenia. As discussed in Section 2.3 this information was released publicly. Consistent with this, Figure 1 shows strong evidence of bunching of firms below the VAT exemption threshold in Armenia.[11] As with the largest retailer discussed above, the

[10] More specifically, sales of agricultural goods supplied from local farmers were booked as if there is a separate firm which operates independently inside the large store. Once the aggregate sales reached the VAT exemption threshold, the retailer registered a second firm and started to book the sales on the account of that firm. This particular large retailer iterated this accounting process for 461 small firms.

[11] The VAT registration threshold is quite large in Armenia, summing to around $125 thousand of annual turnover in 2018 and increasing to about $250 thousand of annual turnover in 2019 (Asatryan and Peichl 2017).

Figure 1: Frequency of Firms around the VAT Registration Threshold



Notes : The figure plots the frequency of VAT and turnover taxpayer firms around the VAT registration threshold of 58,350 million AMD in income bins of 1 million AMD (equivalent to about $2000).

government fully enforced the VAT on these retailers too. We do not have information about the precise market share of these eleven retailers, but we know that they together dominate the retail market.[12] On ther other hand, small retailers that were below the VAT exemption threshold before the enforcement, were already benefiting from the availability of the sales taxes replacing the VAT, and thus were not directly affected by the reform. These smaller firms can thus serve as our control group of firms.

Treated and control products: This enforcement episode affected agricultural products supplied by local farmers to the large retailers. By the nature of the evasion scheme, we cannot directly observe the VAT status of a particular good in our data. However, the way

[12]We have firm-level data on the amount of indirect taxes (a variable that should correlate well with the sales of firms) paid by the largest thousand taxpayers in Armenia (which together pay about 80% of all taxes). Using these data we calculate that the eleven large retailers make 84% of the relevant retail market narrowly defined (NACE 47.1.1) and 56% of the more broadly defined retail market (NACE 47.1.1, 47.2.1, 47.2.2, 47.2.3 and 47.2.4).

Table 1: Animal Husbandry by the Legal Status of Holdings

	Treated		Control	
	Cattle	Pig	Poultry	Fish
Share of stock in holdings				
without legal status	99.14%	94.30%	52.02%	76.21%
with legal status	0.86%	5.70%	47.98%	23.79%
Total stocks	764,217	170,646	5,249,366	1,363,904

Notes : For cattle, pigs and poultry stock figures show heads/numbers, for fish stock figures show basins (m^2).
Source : ArmStat Agricultural Census 2014.

markets operate in Armenia and their structure allow us to make this distinction very clearly. In particular, as we explain in the following Section 2.2 in detail, the market for fresh beef and pork happened to be such that nearly all sales of these products in the pre-reform period were being supplied by local farmers who are not operating under VAT. On the other hand, there are agricultural products, such as poultry, fish, processed meat and a number of other mainyl packaged food items that we can reliably claim to be either imported from abroad or produced by local firms such that they are VAT-liable anyways. These treated and control products are listed in Table 4. Overall, we claim to have a clean first stage, where we can distinguish between products that are supplied by small farmers (non-VAT) from the ones supplied by large, legally registered entities (VAT firms), in addition to being able to cleanly differentiate between affected and unaffected retailers.[13]

2.2 Market structure of Armenian agriculture

Beef and pork: In this paragraph we discuss the treated products, and then proceed to the discussion of control products and products that we exclude from our analysis. Table 1 provides information on the stock of animals in Armenia by the legal status of holdings. The first two columns of Table 1 show that in the domestic market only a negligible share of cattle and pork stocks is owned by holdings which have legal status and are VAT-liable. Is it

[13]To substantiate these classification of products and stores into treatment and control groups, we have conducted confidential interviews with managers of few large retailers, and our interviews confirmed our classifications. The managers insisted on remaining confidential given that our questions had to do with evasion.

Table 2: Annual Imports of Meat by Categories

		All		Belarus	
	HS4	2017	2018	2017	2018
Meat of bovine animals; fresh	201	110.70	1,805.3	52.5	1,684.7
Meat of bovine animals; frozen	202	8,110.50	12,737.1	2.1	10.4
Meat of swine; fresh or frozen	203	16,045.50	15,358.6	14.6	1.6
Meat and edible offal of poultry	207	41,372.90	31,549	422.1	419.2

Notes : Figures are in thousand US dollars.
Source : Customs Service of the Republic of Armenia.

plausible that VAT-liable beef and pork still enter Armenian stores through imports? Table 2 presents total annual imports of different categories of meat at the 4-digit Harmonized System (HS) of product classification for 2017 and 2018. The HS 4 level allows us to distinguish fresh bovine animal meat from frozen. In 2017, before the policy change, the quantities of imported fresh meat are insignificant both in magnitude and when compared to frozen meat.[14] The picture is similar for swine. At the HS 4 level, it is not possible to distinguish frozen meat from fresh for swine meat; however looking at the HS 6 level reveals the same patterns as for bovine animals.[15] This description of the domestic and trade markets for cattle and pork substantiates our claim that nearly all of fresh beef and pork sold in Armenian stores used to escape the VAT before the reform.

Poultry and fish: These categories constitute one of the two control groups in our analysis. As shown in Table 1, unlike beef and pork, holdings with legal status own a significant share of poultry or basins where fish grows. Although significant share of poultry is produced by small farmers, we can confidently claim that Armenian retailers do not sell domestically produced poultry by small farmers. This becomes evident from Table 3 where we use the World Bank's Integrated Living Conditions Survey to construct sales to stock ratios for different categories of animal husbandry in 2018. Table 3 shows that sales of poultry make a negligible share of

[14] One reason is that Armenian consumers have strong preference for fresh local meat, while imported frozen meat is predominantly used in the production of processed meat products.

[15] Trade data at HS 6 level are available from UN Comtrade. However, we prefer to use the data provided by the Customs Service of the Republic of Armenia because after Armenia joined the Eurasian Economic Union, its trade with other members of the customs union is not reflected correctly in UN Comtrade.

Table 3: Share of Annual Sales to Stock of Animal Husbandry

	Cattle	Pig	Poultry
Share of sales relative to stock %	11.72	32.66	1.51

Notes : The table displays the share of annual sales in units relative to total holdings in percentages among small farmers.
Source : World Bank, Integrated Living Conditions Survey 2018.

their stocks.[16] Thus we conclude that there is very little, if any, poultry being supplied by local farmers to stores. Regarding trade, Table 2 shows that Armenia imports significant amounts of both fresh and frozen poultry products which, as discussed, are VAT-liable at the border. As to fish products, unfortunately, the Integrated Living Conditions Survey does not provide data on fish. Although we believe that it is a reliable control product given the landlocked nature of Armenia as well as the fact that most of local fish is farmed by relatively large legal holdings, we note that there are very few fish price observations in our sample (because it is not a popular product), so excluding them has negligible consequences for our results.

Processed meat and other packages products: The second and much larger control group includes processed meat and a variety of other packaged products. Given the processed nature of these products, they are either being supplied by firms rather than farmers or are imported.[17] The other packaged items, summarized in more detail in Table 4, include different types of cereals, several diary products, pastas, bottled oil, candies, among other food items.

[16] Unlike, the case of pigs and cattle, where sales account for, respectively, 33% and 12% of the stock. Note that cows are used for purposes of milk production and poultry is used to produce eggs, such that the number of slaughtered animals should be much lower compared with the stock of pig.

[17] Although sausage is made from pork and beef, in Armenia producers use imported frozen meat as an input for the production of such goods. See also large volumes of imports of frozen meat in Table 2. Furthermore, even if they were to use domestic meat, sausage producers are large processing plants which operate under VAT. Thus, the policy change would not affect these producers and the prices of their products.

Table 4: Summary Statistics

Product	Category	Treated stores		Control stores	
		n	mean	n	mean
Treated products					
Beef	with bones	231	2905	984	2716
	shankle/chuck	47	2793	207	2674
	rib/tomahawk	94	3237	111	3165
	brisket	273	3567	834	3222
	round/filet-tenderloin	81	3808	271	3438
	escalope	178	4145	124	3681
Pork	shoulder	224	2828	89	2656
	ham	171	2930	665	2860
	loin	59	3505	382	3037
	filet	230	3612	367	3193
Control products					
Poultry	fresh chicken	269	1280	1,091	1388
	fresh leg	214	1351	953	1330
	frozen chicken	218	1339	461	1310
Fish	fresh fish	293	2073	867	2199
Processed meat	ham (3 sub-categories)	765	9768	699	8914
	cooked sausages (3 sub-categories)	946	2233	1,764	2205
	hot dog (3 sub-categories)	454	2125	1,423	1950
Other food	rice (4 sub-categories)	500	818	1648	814
	wheat flour (2 sub-categories)	537	365	1655	376
	buckwheat (2 sub-categories)	284	1112	1216	972
	pasta-macaronis (3 sub-categories)	524	544	1706	562
	vermicelli (3 sub-categories)	528	543	1696	566
	letil (2 sub-categories)	347	1557	1061	1280
	pasteurized or sterilized milk (2 sub-categories)	717	404	1376	429
	joghurt (2 sub-categories)	718	672	1521	575
	sour cream (2 sub-categories)	718	1290	1666	1280
	curd (2 sub-categories)	719	2421	1462	2463
	butter (3 sub-categories)	952	4463	2486	4370
	melted butter (3 sub-categories)	346	1957	2547	686
	cheese of cow milk (3 sub-categories)	538	2323	1287	2321
	sunflower oil (3 sub-categories)	764	691	1155	1963
	sugar	362	347	1234	363
	chocolate candies	242	3852	1185	3787

Notes : Table shows summary statistics of price data of treated and control products separately in treated and control stores. Average values are in Armenian drams. For treated products we show summary statistics at the most granular level of sub-categories of products. In order to save space, for some of the control products we aggregate and show information at the level of sub-categories.

Fruits and vegetables: We drop this category of agricultural products from our estimations. Vegetable and fruit prices are very cyclical for several reasons, and this introduces significant noise into our estimations which we cannot reliably correct for given our data.[18]

2.3 The reaction of retailers

After the policy change took place, the retailers took actions to restore previous arrangements. They wrote an open letter to the prime minister, pointing at the negative consequences of the policy change.[19] In the letter they argued that the policy change can lead to substantial increases in imported agricultural products at the expense of local farmers and, thus, to the destruction of local jobs. Furthermore, the retailers jointly increased their prices by 20% immediately after the policy change and tried to blame the government. Figure App.2 in the Appendix displays a photo taken in the largest retailer during the episode which says in Armenian that the store had to start paying a 20% VAT.[20] This, however, lasted for a few days and eventually the retailers had to adapt to the new environment and resort to pricing strategies dictated by market conditions.

3 Data and research design

3.1 Data on prices

Retail price data comes from the Central Bank of Armenia. This is a confidential raw dataset used to calculate CPI statistics for internal use and conduct checks on the CPI statistics

[18] In our estimations we do include product-by-time fixed effects, but the peculiarities of the vegetable and fruit growing process and market structure are such that fixed effects are of little help. First, some vegetables, such as potato, cabbage, and carrot can be stored for one year. When the next harvest season starts there is still some stock left from the previous year. This means that every year there is some period when both new and old harvests are available in stores and prices are higher for new ones. Some stores sell both types, while others only one type. Our data does not allow us to clearly distinguish which store sells which harvest year crops in a given date. Second, similarly labelled local fruits and vegetables can be grown in different locations and altitudes as well as in greenhouses. Products from all these different sources have different qualities and prices. Again, our data does not allow us to clearly tell to which category a given type of a vegetable sold in a given store and date belongs to.

[19] "Supermarkets appeal to the prime minister: The stability of food prices is under threat" Yerkir Media, June 1st 2018.

[20] It is likely that the objective of this behavior was to trigger a social unrest against the government's actions. One argument speaking for this hypothesis is that the firms increased prices by 20%, that is the equivalent of the VAT rate, to make the reform more salient, while in the case of complete passthrough prices would have increased by 15% (the difference between the VAT rate and turnover rate).

reported by the Statistical Committee of the Republic of Armenia. The data are available at the level of detailed retail products (see Table 4) from 39 large, medium and small retailers operating in the 8 largest cities of Armenia on a 10-day frequency from March 2017 to December 2018. Among those stores four are in our baseline treated group.[21] Table 4 presents summary statistics of product prices separately for treated and control stores.

As discussed in Section 2, fresh beef and pork products comprise our treatment group. These products are nearly always supplied by small farmers and are almost never imported, so that we can claim that fresh beef and pork used to be sourced from non-VAT suppliers before the reform. We observe prices for six categories of fresh beef and for four categories of pork. However the availability of these sub-categories varies from store to store.

We have two control groups. One group comprises of remaining meat-related products including poultry, fish, and all varieties of sausages. This control group comprises of products that are relatively close substitutes to our treated products. This feature makes the two groups more comparable, but, on the other hand, we risk that the control group may be contaminated if substantial cross-product spillovers exist. Therefore, our second control group uses a much larger data on a number of food products, including mostly packaged items like cereals, diary products, pasta, etc. These products and their categories are summarized in Table 4.

3.2 Empirical specification

Our identification is based on a triple-difference design. We compare prices of agricultural goods produced by local farmers (not VAT liable before the reform) to the control group of other agricultural goods (VAT liable both before and after the reform) between large and small retailers (having turnovers that are, respectively, larger and smaller than the VAT exemption threshold), before and after the sudden enforcement decision of June 1st, 2018.

We estimate a distributed lag triple difference-in-difference model:

$$log(p_{i,s,t}/p_{i,s,t_0}) = \sum_{\tau=-k}^{\tau=k} \alpha_\tau 1[t=\tau] * VAT_i * Large_s + \gamma_{i,t} + \lambda_{i,s} + \eta_{s,t} + \epsilon_{i,s,t}, \quad (1)$$

[21] Two additional stores are excluded from the baseline but we display the results with all stores in Section 6.3.

where $p_{i,s,t}$ is the price of good i, in store s, at time t. prices are relative to the pre-reform base period. $1[.]$ is an indicator function of time periods, VAT_i is dummy for goods sourced directly from farmers, and $Large_s$ is a dummy for large retailers affected by the reform. $\gamma_{i,t}$, $\lambda_{i,s}$ and $\eta_{s,t}$ are good-by-time, good-by-store and store-by-time fixed effects respectively. The inclusion of good-by-time effects allows us to control for all changes in prices due to production costs and aggregate demand changes that affect the entire country. Good-by-store effects allow us to control for permanent differences in markups and pricing strategies used by different stores for different goods. Finally, store-by-time effects allow us to make sure that we do not capture some other shocks that affect specific stores. For example, one may argue that the overall tax enforcement was tightened at large stores. $\epsilon_{i,s,t}$ is the error term clustered at store and time level.[22]

The affected stores are all located in the capital city, and since they account for a substantial share of the retail market (Section 3.4 provides information on market shares), one cannot rule out the possibility that unaffected stores also respond to the policy change. In other words, we may observe some spillovers to those stores. If that is the case, then Equation 1 will potentially underestimate the effect of the policy change on prices.[23] For this reason, in the following we introduce an additional term into Equation 1 to capture price spillovers in the capital city:

$$log(p_{i,s,t}) = \sum_{\tau=-k}^{\tau=k} \alpha_\tau 1[t=\tau] * VAT_i * Large_s + \sum_{\tau=-k}^{\tau=k} \beta_\tau 1[t=\tau] * VAT_i * Capital_s + \gamma_{i,t} + \lambda_{i,s} + \eta_{s,t} + \epsilon_{i,s,t}. \quad (2)$$

where the additional term $Capital_s$ is an indicator variable that takes a value of one if the store is not affected by the policy change but is located in the capital city. By interacting this

[22] Benzarti et al. (2019) cluster errors at time level. Compared with their analysis we have an additional dimension reflected by stores, so we add this additional level of clustering. Our results change very little when we cluster errors at store-by-time level.

[23] See Agrawal and Hoyt (2019) for a theoretical treatment and empirical analysis of general equilibrium tax incidence with spillover effects. Our case is different from the standard case in that in addition to the variation among goods we can exploit variation among affected and unaffected stores for identification. Additionally, the segmentation of the market in Yerevan versus the rest of the country allows us to directly estimate the spillover effects.

term with affected goods we will be able to capture potential spillover in the capital city by β_τ coefficients.[24]

We believe that our triple-difference design with a rich set of fixed effects provides advantage over simpler diff-in-diff specifications. A framework that focuses only on variation across product groups may not capture our effect of interest on price, since it is not excluded that production costs or demand shocks may hit the treated group of products simultaneously at the time of our reform. Similarly, treatment effect estimates exploiting the variation only across stores, may be contaminated by, for example, simultaneously increasing levels of tax enforcement targeting our treatment stores or by changes in the demand preferences of consumers towards these stores. Nevertheless, in Figure 2 we transparently plot the development of prices in the four groups from where we gain our triple-difference identification.

3.3 Average effects

In addition to the distributed lag model, we also estimate the following standard triple difference-in-difference model to obtain the average effect of the policy change:

$$log(p_{i,s,t}) = \alpha * Post_t * VAT_i * Large_s + \beta * Post_t * VAT_i * Capital_s + \gamma_{i,t} + \lambda_{i,s} + \eta_{s,t} + \epsilon_{i,s,t}, \quad (3)$$

where $Post_t$ is an indicator variable that takes a value of 1 in all periods after the policy change and 0 otherwise.

3.4 Additional evidence from household expenditure surveys

To complement our analysis we use household expenditure survey data, which contain information on daily expenditure diaries of households. Using these diaries, we can study unit prices as before, but, importantly for our purposes, extend the analysis to quantities.

We obtain data from the World Bank's Integrated Living Conditions Survey for Armenia for years 2016-2018. This survey is conducted annually for about six thousand households.

[24] It should be emphasized that Armenia is a small country and traveling distances are not large, which is why retailers source their inputs from all regions. This implies that input costs faced by all stores in all locations move together and potential asymmetric price movements in the capital city are likely to capture price spillovers due to the market structure rather than changes in input prices of suppliers in areas closer to the capital city.

The dataset contains geographic information which we use to identify purchases made in the capital city where the affected stores are located. Furthermore, there is information about the type of the seller from which the purchase was made, such as stores, markets, street vendors, etc. Unfortunately this information does not allow us to identify the large stores treated under the reform that we exploit since the category "stores" also includes many small stores that were not affected by the policy change. Instead, we proxy the treatment status of stores by the geographic location of stores, in particular by assuming that all purchases made from stores in the capital region are made at the large treated retailers.

This assumption is not very restrcitive, since according to Melkumyan (2014), a report that studies the competition in the food retail market in Yerevan, large retailers account for 60% of the volume of purchases made in stores. Another report by Ameria Management Advisory (2016) suggests a 50% market share for supermarkets in the market for meat products. Both of these analyses are for the year 2014, and unfortunately we do not have more recent data on market shares. However, both reports suggest that supermarkets were on a strong upward trends in their market shares, and we believe that the shares in 2018 have increased significantly from the 60% level. Our calculations based on data from Integrated Living Conditions Survey for Armenia show that purchases from markets and streets accounts for only 6% of meat purchases. In the absence of information on exact store size, we think that it is likely that our analysis of the survey data will underestimate the passthrough coefficient because up to a third of the purchases are probably made in stores that were not directly affected by the policy change.

Regarding the treatment status of products, these Living Conditions Surveys contain detailed description of products, which we use to construct the sample of treated and control meat products. As in the specifications with store-level price data, fresh beef and pork are in the treatment group, while poultry, frozen and processed meat products are in the control

group.[25] In the survey we do not observe the brands of processed meat products but there are more categories of products than in the store-level dataset.

We estimate the following equation:

$$log(p_{i,r,t,j}) = \alpha * Post_t * VAT_i * Capital_r + \alpha X_{i,r,t,j} + \gamma_{i,t} + \lambda_{i,s} + \eta_{r,t} + \epsilon_{i,r,t,j}, \quad (4)$$

where we use the same notation that was introduced earlier. The only differences are that instead of store, we index purchases by their geographic location (r) and we add a j subscript to index transactions. The specification includes product-by-time, region-by-product and region-by-time fixed effects. We cannot include household fixed effects because households are generally surveyed within a month, and it is not possible to find transactions conducted by a given household before and after the policy implementation. However, we can include household characteristics such as aggregate household expenditures, household head's age, gender, level of education, number of household members, a dummy for rural households and place of purchase.

4 Main results

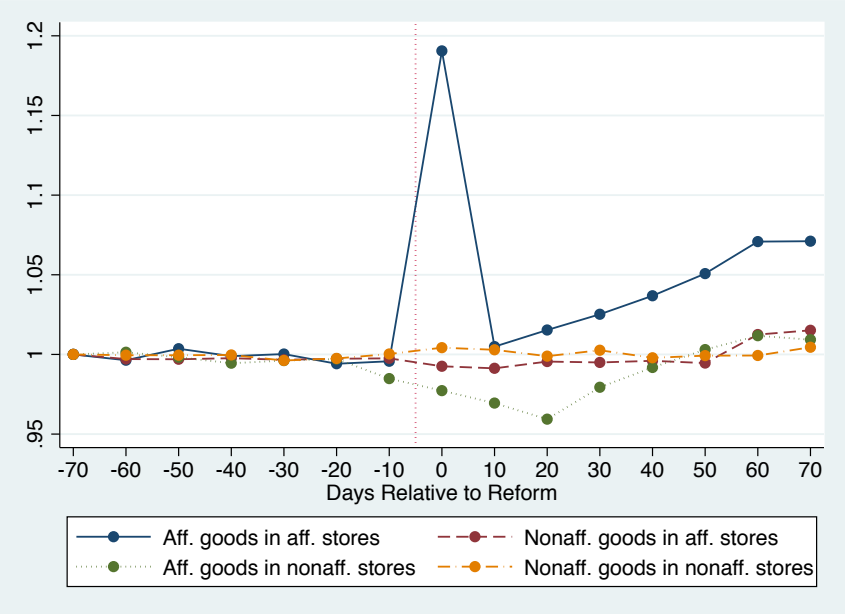
4.1 Raw data

Before presenting the results of formal estimations, in Figure 2 we show the dynamics of raw price levels by time in the four groups of stores and goods where our variation comes from. These groups are: affected goods in affected stores, unaffected goods in affected stores, affected goods in unaffected stores, and unaffected goods in unaffected stores. Price levels are normalized to one in the initial period.

Figure 2 visually hints to the observation that parallel trends assumption is satisfied. We notice that immediately after the policy change there is a large jump in the prices of affected goods in affected stores, however, they decline to around their initial levels in the following

[25] The survey also provides information on fresh lamb purchases which we include in the treatment group because according to the 2014 Agricultural Census, small farmers own the entire stock. It should be noted that there are very few transactions in this category and the results are almost indistinguishable when lamb is omitted.

Figure 2: Development of Raw Price Levels



Notes : This figure plots the levels of prices in different sets of stores and products. Abbreviation *aff.* and *nonaff.* mean affected and unaffected, respectively.

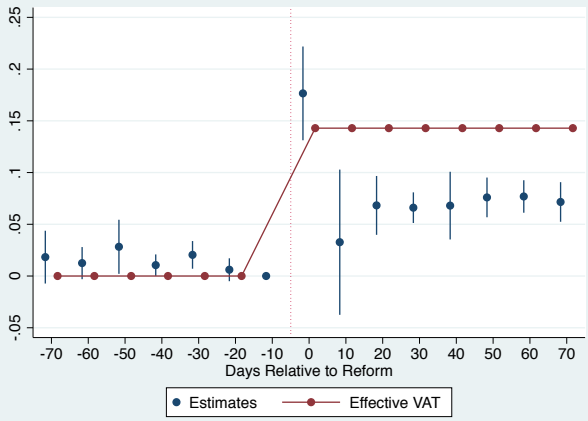
period. The massive price hike in the initial period is consistent with the anecdotal evidence that large firms tried to trigger social unrest among consumers by increasing prices (see the discussion in Section 2.3). In the consequent periods we observe that the price levels of affected goods in affected stores are higher than in control groups but it is clear that there is no complete passthrough.

4.2 Baseline results

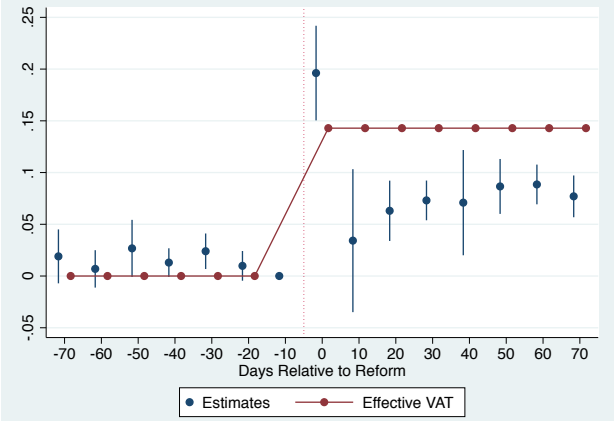
The results from formal estimations of Equations 1 and 2 are plotted in Figures 3(a) and 3(b), respectively, and the full estimation results are presented in Table App.3 of the Appendix. First, as we have seen in the raw data, these estimations show no evidence for trends in affected products and stores in the pre-reform period. The point estimates on the pre-trends are nearly zero and are precisely estimated. At the reform period, denoted by 0 on the x-axis of Figure 3, affected firms immediately increase the prices of affected goods by about 20% compared to the level of prices in the pre-reform period. This price response is an overshifting of the tax

Figure 3: Baseline Passthrough Estimates around the Reform

(a) Without spillovers



(b) With spillovers



$Notes$: These figures plot the estimated coefficients α_τ for Equation 1 (Panel a) and Equation 2 (Panel b). The coefficient α_τ captures the interaction of affected goods in affected stores after the policy change. Both specifications include good-by-time, good-by-store and store-by-time fixed effects. Standard errors are clustered at time and store level.

burden as compared to the hypothetical full passthrough rate implying a 14.29% increase ((1.2-1.05)/1.05=0.1429). This full passthrough rate is denoted by the red line in Figure 3.

As we discussed briefly above, it is likely that in the first period the objective of the retailers was to pass a large price increase on consumers to possibly induce a social unrest against the authorities and thus restore the privileges of the retailers. However, that did not happen, and in the next period retailers brought prices back to about the level of pre-reform prices. In the following periods, prices increase and stabilize roughly at a 5% higher level compared to the pre-reform prices. This price effect implies a passthrough rate of about one-third of the nominal tax increase.

When comparing Figures 3(a) and 3(b) we observe that the estimated coefficients are somewhat higher and more precise for the specification that controls for spillovers. This is intuitive because the affected firms account for rather large share of the market in Yerevan and are likely to follow market leaders by increasing their prices despite the fact that the effective

Table 5: Baseline Passthrough Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
Treatment group:	Fresh meat					Other meat
Control group:	All food				Other meat	All food
Period:	03.17-12.18			03.17-07.19	03.17-12.18	
α	0.047***	0.055***	0.045***	0.055***	0.048*	0.021
	(0.016)	(0.015)	(0.014)	(0.015)	(0.026)	(0.020)
β		0.019	0.014	0.019	0.040	
		(0.021)	(0.020)	(0.021)	(0.028)	
Incidence, %	32.89	38.49	31.49	38.49	33.59	
Adj. R-squared	0.996	0.996	0.996	0.996	0.991	0.996
Within R-squared	0.001	0.002	0.001	0.001	0.005	0.001
N	44861	44861	44074	49007	14178	39664

Notes: OLS regressions of equations 3. The coefficient α captures the interaction of affected goods in affected stores after the policy change. β captures the interaction of affected goods in other stores in the capital region after the policy change. Incidence is the passthrough parameter expressed in percent of the tax burden, where 0% and 100% denominate null and full passthrough, respectively. All specifications include good-by-time, good-by-store and store-by-time fixed effects. The specification in column 3 drops the first period after the reform with a large price increase. Standard errors are clustered at time and store level. * (**) (***) indicates significance at the 10 (5) (1) percent level.

tax rate they face did not change. We believe the specification that controls for spillovers is more appropriate, and adopt it as our preferred specification in the analysis that follows.

4.3 Robustness of baseline results

In this section we perform a number of robustness tests with respect to the period of our analysis and the definition of treatment and control products. To obtain the average effect of the policy beyond its short-term effects, we estimate Equation 3. As mentioned in Section 3, our baseline data runs until early December which implies that our estimations include 18 periods or about six months after the policy change. The results of the estimations are presented in Table 5. The first column estimates a specification without the interaction term for spillovers and the second one includes such a term. These two columns correspond to the

dynamic effects shown in, respectively, Figures 3(a) and 3(b). According to the specification in the second column of Table 5, the average increase in prices is about 5.5%. This estimate corresponds to a passthrough parameter of about 39% as shown in the row incidence. This estimate is close to the estimate obtained from equation 2 for short-run effects. We also can see that the spillover coefficient is positive but statistically insignificant. In column (3) we test for robustness of our finding by dropping the first period immediately after the policy change, where we observed a strong but temporary hike in prices. The estimated coefficient is only slightly smaller and implies a passthrough of 32%. To estimate longer-run effects, we obtain data extending until July 2019 for a sub-set of stores.[26] Column 4 estimates our baseline specification on the sample of this longer data. This result, which capture incidence for over a year after the enforcement reform, is very similar to the six-month incidence estimates reported in column 2.

Regarding to the definition of treatment and control groups, in column (5) of Table 5 we limit the control group only to poultry, fish and processed meat products. The motivation for this specification is to compare price changes with more comparable products. The estimated coefficient turns out to be somewhat smaller. This may suggest that there were spillovers such that the prices of processed meat as products that are substitutes for our treatment products have also increased. In column 6 we test this idea more directly by defining processed meat products as treatment group, and all other food products as our control group.[27] The estimated coefficient is positive but not significant, so that we cannot claim that that there were spillovers to substitute products.

5 Model

In this section we develop a simple theoretical framework in which firms operate either under VAT or turnover tax schemes, and they endogenously decide their evasion levels. The optimal level of tax evasion is related to the tax scheme because of the differential tax rate in the two

[26] The Central Bank of Armenia reduced the number of cities from which it collects data. The continuing cities include the capital and two other cities (Gyumri and Hrazdan).

[27] Fresh meat products are excluded from these estimations.

schemes. This simple stylized model helps us understand the mechanisms through which tax evasion affects the passthrough levels of taxes on prices. The model implies testable prediction on some of these mechanisms, which we then test empirically in Section 6.

5.1 Setting

Firms operate in a two-tier system with either simplified turnover taxes or a standard VAT. The tax scheme is defined by an exogenously given size threshold of $\overline{x}$. Firms decide how much to produce at price p which they take as given. All firms below the size threshold of $\overline{x}$ face a turnover tax with a rate τ. Firms above the threshold operate under a VAT system with a tax rate of t which is higher than τ. There are two inputs z_1 and z_2 with associated prices P_1 and P_2. Firms operating under VAT input z_1 can be credited against the VAT liability, while firms in the turnover tax system have no such option. The motivation is that the first input is produced by suppliers which themselves operate under the VAT scheme, while the second input is supplied by non-VAT firms (small farmers). For simplicity, we assume that the type of firm is determined exogenously. The second choice facing the firm is the evasion decision denoted by fraction β of its sales. Tax authorities can detect evasion with probability γ. When caught, the firm will face a penalty represented by a strictly positive and increasing function h. For now we assume that only VAT firms can evade, later extending this possibility to firms in the turnover scheme. As usual, we assume that the production function F is positive, increasing, and concave in all of its arguments.

5.2 Firms

The profit function of the firm depends on the the tax scheme in which it operates and can be written as:

$$\pi = \begin{cases} ((1-t)(1-\beta)p + \beta p)F(z_1, z_2) - \gamma h(\beta) - P_1(1-t)z_1 - P_2 z_2 \quad if \quad F > \overline{x} \\ (1-\tau)pF(z_1, z_2) - P_1 z_1 - P_2 z_2 \quad if \quad F < \overline{x} \end{cases}$$

5.3 Optimal evasion

Taking the derivative of the profit function of VAT firms with respect to evasion rate of β we obtain:

$$\frac{\partial \pi}{\partial \beta} = 0 \implies tpF(z_1, z_2) = \gamma h'(\beta)$$
$$\beta = (h')^{-1}\left(\frac{tp}{\gamma}F(z_1, z_2)\right)$$

Thus we have that:

Reaction of evasion to tax rate

$$h'' > 0 \Rightarrow \frac{\partial \beta}{\partial t} > 0 \quad \& \quad \frac{\partial \beta}{\partial \gamma} < 0$$

If the penalty function h is convex then the evasion rate increases after an increase in the tax rate and decreases after an increase in the probability of being caught.

5.4 Choice of suppliers

For notational simplicity, we denote $(1-t)(1-\beta)p + \beta p$ as $p(\beta, t)$. Turning to the derivative of the profit function F_i with respect to the input i gives:

$$\left.\frac{\partial \pi}{\partial z_1}\right|_{F<\overline{x}} = 0 \Rightarrow F_1 = \frac{P_1}{p(1-\tau)}$$
$$\left.\frac{\partial \pi}{\partial z_1}\right|_{F>\overline{x}} = 0 \Rightarrow F_1 = \frac{P_1(1-t)}{p(\beta, t)}$$

How does the firm react in terms of input it demands when it turns from the turnover tax scheme into VAT? First, we consider the simple case without any evasion, $\beta = 0$, and obtain:

$$\begin{aligned} F_1|_{F>\overline{x} \quad \& \quad \beta=0} &= \frac{P_1}{p} \\ 1-\tau &< 1 \\ \iff p(1-\tau) &< p \\ \iff \frac{P_1}{p(1-\tau)} &> \frac{P_1}{p} \\ \iff F_1|_{F<\overline{x}} > F_1|_{F>\overline{x}} &\quad \& \quad \beta=0 \end{aligned}$$

First prediction: Input demand reaction to VAT scheme

When a firm turns to the VAT tax scheme, the input demand toward the good already on a VAT scheme increases.

We now allow some positive level of evasion, and study the range of values of β where the first prediction holds. The ratio of both input demands is:

$$\frac{\frac{P_1}{p(1-\tau)}}{\frac{P_1(1-t)}{p((1-t)(1-\beta)+\beta)}} = \frac{1}{1-\tau}\frac{(1-t)(1-\beta)+\beta}{1-t}$$

When is this ratio below 1? Recall that below 1 would mean that $F_1|_{F<\overline{x}} < F_1|_{F>\overline{x}}$.

$$\begin{aligned} &\frac{1}{1-\tau}\frac{(1-t)(1-\beta)+\beta}{1-t} < 1 \\ \iff &(1-t)(1-\beta)+\beta < (1-\tau)(1-t) \\ \iff &\beta < \frac{-\tau(1-t)}{t} \end{aligned}$$

This last threshold is negative which means that it is never satisfied. Thus the first prediction under $\beta = 0$ can be generalized to all values of β.

5.5 Tax scheme and evasion

Finally, we extend the possibility of evading to the firms operating under the turnover tax. The evasion function is the same but with a different antecedent. As the only thing that

distinguishes both types of firms is the output threshold, they sell at the same equilibrium price since they sell the same good. We have:

$$t > \tau \quad and \quad y|_{F>\overline{x}} > y|_{F<\overline{x}}$$
$$\frac{tpy|_{F>\overline{x}}}{\gamma} > \frac{\tau py|_{F<\overline{x}}}{\gamma}$$

With the assumption that $h'' > 0$:

$$(h')^{-1}\left(\frac{tpy|_{F>\overline{x}}}{\gamma}\right) > (h')^{-1}\left(\frac{\tau py|_{F<\overline{x}}}{\gamma}\right)$$
$$\beta|_{F>\overline{x}} > \beta|_{F<\overline{x}}$$

Second prediction: Change in evasion after tax scheme change

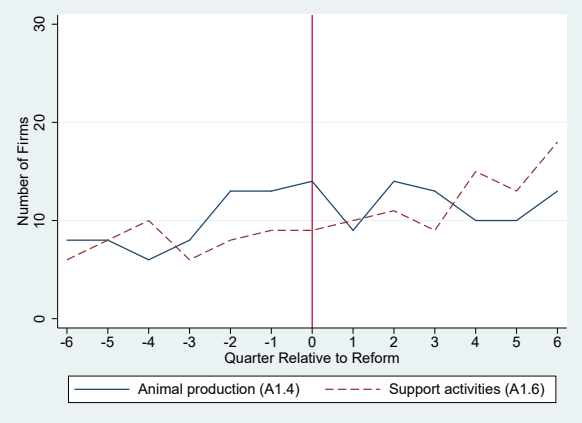
When a firm changes its tax scheme from turnover to VAT, the firm's evasion rate increases.

6 Extended results

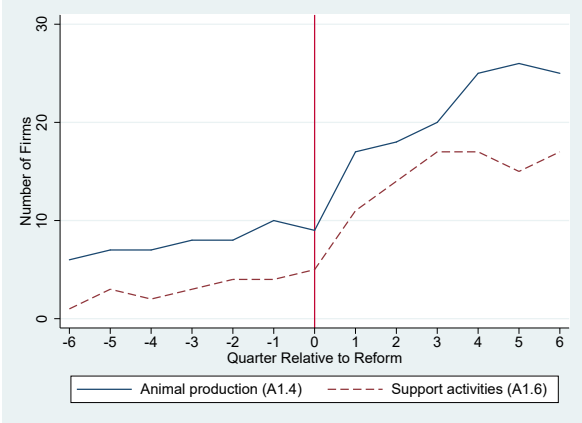
Our model described in Section 5 generates two predictions that help rationalize our baseline results of low passthrough in the presence of evasion possibilities with the more standard empirical result of almost full passthrough. In sub-sections 6.1 and 6.2 of below we present additional pieces of evidence which are consistent with these theoretical predictions. In particular, our empirical analysis characterizes the responses of demand for inputs to the VAT scheme, and the response of non-compliance behavior to changes in the tax scheme. Additionally, in sub-section 6.3 we descrbe how the well known mechanism of tax salience applies to our specific case of tax evasion, and present suggestive evidence showing that the salience of tax evasion leads to low passthrough of prices. In sub-section 6.4 we then extend the incidence analysis beyond consumer versus firm dichotomy to cover producers as well as employees of firms.

Figure 4: Number of Taxpayers per Tax Type and Sub-sectors of Agriculture

(a) Number of Turnover Taxpayers



(b) Number of VAT Taxpayers



Notes : X-axis denotes quarters starting from 2016:q1 to 2019:q2. Vertical line denotes the enforcement episode. Animal production represents the NACE sector A1.4, and Support activities is NACE sector A1.6.

6.1 Supply chain effects

As predicted by our model, the VAT induces supply chain effects incentivizing retailers to buy more from VAT rather than non-VAT firms. Gadenne et al. (2018) and Gerard et al. (2018) provide evidence for this hypothesis using data on firm-to-firm transactions in Brazil and India, respectively. We present two pieces of suggestive evidence to complement these papers.

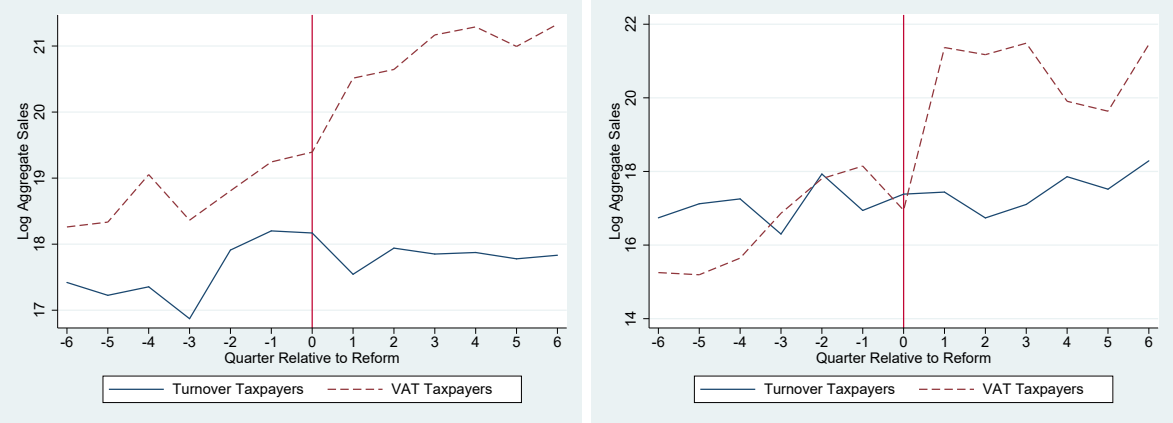
First, in Figure 4(b) we show that in the relevant sub-sectors of agriculture there are increases in the number of locally registered VAT firms around the time of the reform. Figure 4(a) shows that, consistent with our interpretation of supply-chain effects, this evidence holds only for VAT firms and not for firms operating in the turnover tax regime. Similarly, Figure 5 shows that (log) aggregate sales in the sector animal production and support activities[28] increase for VAT but not for turnover taxpayers.

Second, in our case of very limited number of local VAT suppliers (only several dozen as shown in Figures 4(b)), at least a short run response of retailers is to shift to importing

[28]These sectors are coded as A1.4 and A1.6, respectively, according to the NACE classification. For the list of sectors and NACE codes, see https://ec.europa.eu/competition/mergers/cases/index/nace_all.html.

Figure 5: Aggregate Sales per Tax Type and Sub-sectors of Agriculture

(a) Animal Production (A1.4) **(b)** Support Activities (A1.6)



Notes : X-axis denotes quarters starting from 2016:q1 to 2019:q2. Vertical line denotes the enforcement episode. Y-axis is in logs. Animal production represents the NACE sector A1.4, and Support activities is NACE sector A1.6.

products which are VAT liable at the border anyways. Table 2 presents total annual imports separately for fresh and frozen bovine animal meat. This is an important distinction since the reform primarily affected fresh local meat rather than frozen meat which, due to its longevity properties, could have also been imported. Table 2 shows an order of magnitude increase in the imports of fresh meat in 2018 compared to the pre-reform year of 2017. The increase is almost fully driven by imports from Belarus, which is compatible with the anecdotal evidence circulated in local media on the behavior of the large retailers.[29]

These two pieces of evidence are, of course, descriptive but they are consistent with the interpretation that the enforcement of VAT incentivizes retailers to shift their supply chains towards using inputs that are VAT liable. This evidence somewhat contrasts the findings of Benzarti and Tazhitdinova (2019) who estimate the elasticity of trade with respect to VAT to be very small. As before, this behavioral response of firms to VAT enforcement potentially changes the cost structure of the firms and thus results in lower equilibrium passthrough rate than the rate predicted under the standard case without evasion.

[29] "City is selling Belarusian meat..." Hayeli.am, February 14th 2019.

6.2 Tax regime and evasion

In this sub-section we test the second prediction of our model that firms which switch from a turnover based tax regime into a VAT regime are more likely to become non-compliant with state regulations. In particular, we study non-compliance to tax regulations in the form of not printing receipts as well as non-compliance to product quality standards in the form of violating various food safety regulations.

To study tax compliance, we use data on thousands of mystery shopper audits. These audits in our sample were performed during 2017 and the first half of 2018, and the data is made publicly available by the State Revenue Committee of the Republic of Armenia.[30] These audits are non-random and it is likely that they are more often targeting the VAT firms, which typically face higher effective tax rates, than the small firms operating under a turnover tax regime.[31] Nevertheless, our analyis benefits from the fact that we include firm level fixed effects and study the non-compliance behavior of firms that switched between the two tax regimes during the period of six quarters of our sample. Of course, these switches of the tax regime are not entirely orthogonal to the non-compliance or the audit decision either. However, a legal change in 2018, which suggested that effective from January 2019, the VAT registration threshold is reduced two-fold compared to its pre-reform level of around $250 thousand of annual turnover, implies that at least some of the switching firms found themselves to be in the VAT regime in 2018 independent of their will.

The results of this exercise presented in Table 6 show that, conditional on performing a mystery shopper audit, VAT firms have about 15% higher likelihood of not printing a receipt than firms paying a turnover tax (column 1). In monetary terms, this amounts to an average fine of 60 thousand AMD (or about $150) in VAT compared to non-VAT firms (column 3). This finding that compliance is decreasing with the VAT rate is generally consistent with earlier empirical evidence (see, e.g., Artavanis 2018, Berger, Gerlinde Fellner-Rohling, and

[30] See https://www.petekamutner.am/Content.aspx?itn=tsTILists; retrieved in Armenian on 17.05.2019.

[31] Doerr and Necker (2018) implement a field experiment where hypothetical consumers randomly ask for receipts from small businesses. The paper finds evidence of collusive behavior where the willingness of consumers to tolerate evasion by business translates into significant savings in the price consumers face.

Table 6: Mystery Shopper Audits in VAT and non-VAT Firms

VARIABLES	(1)	(2)	(3)
	Penalty following an audit		
	Probability>0	Logarithm	Thousand AMD
Switch to VAT	0.147*	0.917**	60.533**
	(0.083)	(0.435)	(30.759)
Constant	0.879***	4.525***	212.260*
	(0.086)	(0.516)	(109.720)
Firm FE	Yes	Yes	Yes
Time (Y-M-D) FE	Yes	Yes	Yes
Observations	10,460	10,218	10,460
R-squared	0.098	0.095	0.039
F	6.412	6.008	4.062
Number of firms	7,757	7,748	7,757

Notes : The unit of observation are mystery shopper audits. Dependent variables in columns 1, 2 and 3 are, respectively, a dummy if a penalty follows an audit, the logarithm of one plus the monetary value of penalty, and the monetary value of the penalty in thousand AMD. The independent variable of interest "Switch to VAT" is a dummy for firms switching from a turnover tax regime into a VAT regime. All regressions include firm fixed effects. Even-numbered columns include fixed effects for the year, month and day of conducting an audit. Standard errors are clustered at the level of firms. * (**) (***) indicates significance at the 10 (5) (1) percent level.

Traxler 2016, De Paula and Scheinkman 2010) as well as the deterrence model of compliance with endogenous audits (Allingham and Sandmo 1972, Gordon 1989, Yitzhaki 1977). This finding is also similar to previous evidence where firms respond to enforcement by moving to other perhaps less verifiable margins of non-compliance (Carrillo, Pomeranz, and Singhal 2017, Slemrod, Collins, Hoopes, Reck, and Sebastian 2017), including such evidence from Armenia (Asatryan and Peichl 2017). Intuitively, higher non-compliance in the presence of a higher tax rate depresses the effective tax rate, so that the passthrough rate becomes smaller.

We then complement the main exercise with mystery shopper audits by studying the question of whether firms respond to the reform by additionally reducing product quality. We use data on about 2,000 food security audits conducted in the years 2012 to 2018. The data is made publicly available by the Food Safety Inspection Body of the Republic of Armenia.[32]

[32]See http://snund.am/en/inspection-plans/the-results-of-inspections/; retrieved in Armenian on 29.04.2020. Data for the year 2016 is not available.

Table 7: Food Security Audits in VAT and non-VAT Firms

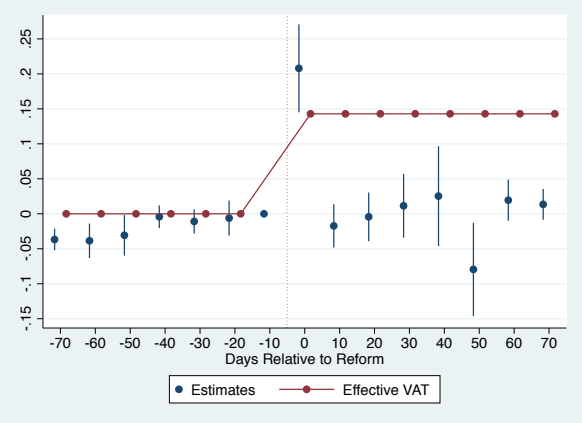
VARIABLES	(1)	(2)	(3)	(4)
	Probability (Penalty following an audit) >0			
	Cross-section		Panel	
VAT	0.0106***	0.0159***		
	(0.0004)	(0.0009)		
Switch to VAT			0.3617***	0.4505***
			(0.1333)	(0.1429)
Constant	0.0042***	0.0829	0.6690***	0.5242
	(0.0001)	(0.0983)	(0.0752)	(0.3231)
Firm FE			Yes	Yes
Time (Y-M-D) FE				Yes
Industry FE		Yes		
Observations	415,847	170,806	1,995	1,768
R-squared	0.0014	0.0354	0.0222	0.2154
Number of firms			1,669	1,533
F	590.7	272.9	7.365	1.192

Notes : The unit of observation are firms in columns 1-2 and audits in columns 3-4. The dependent variable is a dummy if a violation is found during an audit. The independent variable of interest "VAT" is a dummy equalling 1 for firms in a VAT regime and 0 for firms in a turnover tax regime, and "Switch to VAT" indicated the switchers from 0 to 1 . Column 2 includes industry fixed effects at the level of NACE letters. Columns 3-4 include firm fixed effects. Column 4 includes fixed effects for the year, month and day of conducting an audit. In panel regressions standard errors are clustered at the level of firms. * (**) (***) indicates significance at the 10 (5) (1) percent level.

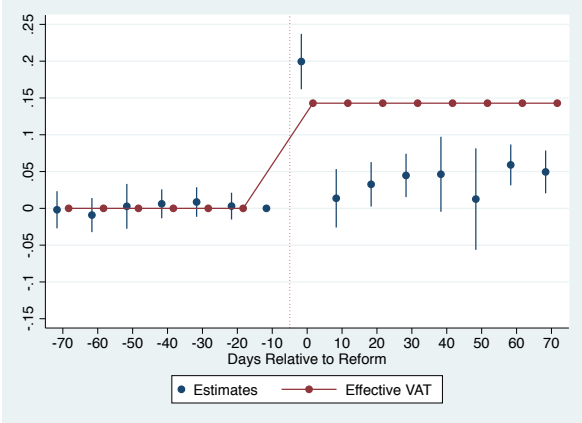
Table 7 studies the probability that a food security violation is found after an audit. Columns 1 and 2 compare VAT and non-VAT firms in a cross-section, while columns 3 and 4 focus on firms that switched between non-VAT and VAT regimes in a panel fashion. The latter sample is much smaller since we are studying the sub-sample of switchers where audits were conducted in both tax regimes, but these regressions control for firm fixed effects. The results from both samples are consistent with the interpretation that the reform induces firms to decrease product quality standards. Similar to non-compliance with taxes, this second form of non-compliance with state regulations more generally potentially depresses the costs that firms face, thereby implying a lower passthrough rate.

Figure 6: Passthrough in Stores Subject to Consumer Boycott

(a) Only Boycotted Stores



(b) Baseline Results including Boycotted Stores



Notes : Sub-figure (a) and (b) replicates the baseline analysis of Figure 3 by restricting the sample to, respectively, only the largest retail chain and the baseline sample including the largest retail chain.

6.3 Salience and consumer boycott

Chetty et al. (2009) predicts under-reaction of prices to taxes if the existence of the tax is made more salient to the consumer. Unlike the US, posted prices in our case are final and always include the tax. Nevertheless, the enforcement episode in Armenia may have made the VAT more salient to the consumers in two ways. First, discussions of the enforcement episode raised awareness that retail goods are in general taxable. Second, and more specifically, these discussions made the evasion aspect of taxes salient, that is they made it clear that taxes are being applied to the sub-set of stores which used to evade taxes.

Our identification approach is immune to the first mechanism given the triple-difference design. If salience of the VAT is increased for both treated and untreated products, we can net out the potential effects of salience on prices by differencing the prices of treated and untreated products within stores. To study the salience of the tax evasion aspect, we take advantage of the fact that the government's initial enforcement effort as well as the whole publicity of the episode was narrowly targeted on one retail chain which happens to be the largest retailer as well as a firm that is widely believed to be politically connected with the

previous government. Only after this initial publicity scandal it was revealed that other large retailers used similar strategies. [33]

To understand how the temporary surge in such sentiments affects the pricing behavior of the firm, we estimate a specification similar to Equation 2 but our treatment group includes only this specific large retailer.[34] In Figure 6 (a) we plot the estimated coefficients α_τ. The results show that this firm, similar to other large ones, increased its prices in the first period trying to trigger social unrest and then it decreased prices to its initial level. However, unlike the other stores its prices of affected goods remained at the initial levels during the following periods. It even decreased them in an effort to dump and attract consumers. Figure 6 (b) then replicates the baseline analysis in the baseline sample including the largest retailer and its smaller affiliate. As can be seen, the inclusion of these retailers drives the estimates down compared with the ones in Figure 3(b).

This evidence is specific to the firm and we can not rule out alternative explanations of the results. Nevertheless the evidence we present is suggestive of the salience mechanism. Information about the evasion behavior of firms generates consumer boycott towards the evading firm. This demand response forces the firm to revise its price-setting behavior trying to attract more demand and leads to lower equilibrium passthough. This mechanism is related to the findings of Antoniades, Clerides, and Xu (2019) who study an informational shock that induced a strong and religiously motivated boycott towards Danish products in the markets of Saudi Arabia. Although the setting is very different, the negative response of prices to boycott-driven demand shock that Antoniades et al. (2019) find is consistent with our results. Fisman, Hamao, and Wang (2014), Michaels and Zhi (2010), Pandya and Venkatesan (2016) present further evidence on the role of national sentiments in consumer demand and firm pricing decisions.

[33] "New discoveries of the National Security Service about Yerevan City retail chain" Banks.am, May 30th 2018.

[34] This organization also runs a separate smaller retail brand and our dataset contains information on prices in both.

6.4 Incidence on other sides of the market

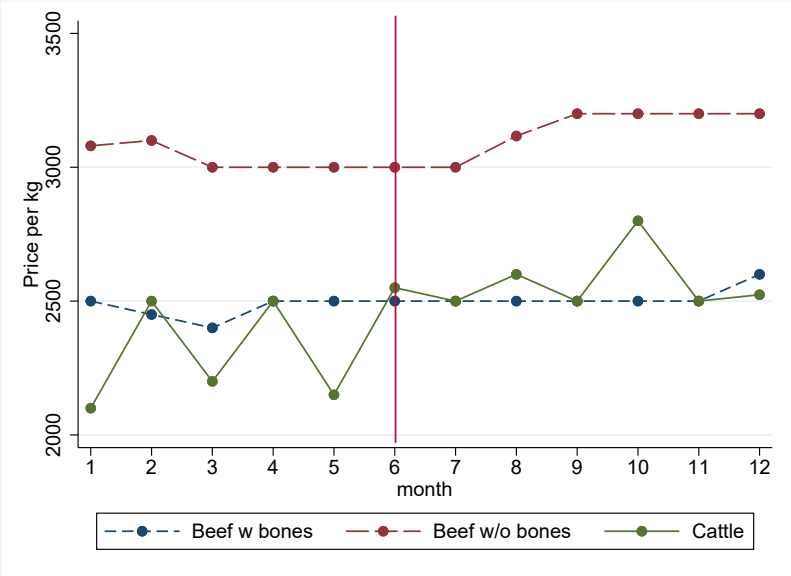
So far we have studied the incidence of VAT on consumers through prices. We have estimated the passthrough on prices to be about a third of the tax burden. The question we ask in this section is whether the remaining two-thirds of the tax remained with the firm-owners or whether it was shifted further onto producers or employees. In so doing we contibute to the literature that aims to quantify tax incidence on all immediate market participants (Benzarti and Carloni 2019). We find some suggestive evidence that both farmers and producers may have borne some of the tax burden. However, given data and identification limitations, we can not yet provide a sound conclusion nor quantify effects precisely. Indeed, as we discuss below, these findings rely on assumptions in addition to those made in the baseline analysis.

6.4.1 Farmers

As described in Section 3.4 we can measure consumer prices from the household expenditure survey. This survey also has a section surveying a small number of farmers and their production activities. From here we can calculate producer prices, i.e., unit prices of animals slaughtered by farmers and sold in the market, and compare these to the prices reported by consumers. We plot the monthly evolution of these consumer and producer prices in 2018 in Figure 7. In general, consumer prices are somehwat higher in the second half of 2018. Producer prices seem to also follow this trend, although the time series is also noisy due to the small number of transactions by farmers that we observe. This joint movement of producer and consumer prices would go opposite to the hypothesis that retailers were able to shift some of the remaining tax burden to farmers through lower prices. Of course, there are many aggregate shocks potentially affecting both demand and supply, which can drive this joint movement in prices. We therefore seek next to address the question of whether some of the tax incidence fell on the farmers by exploiting regional variation in Armenia.

Armenia is a small country and all regions supply agricultural products to the capital, which itself does not produce agricultural goods but is the largest consumer of such goods. In addition to the capital city there are 10 other provinces. Due to the peculiar geography

Figure 7: Consumer and Producer Prices



Notes : Beef w bones and and Beef w/o bones are the median unit prices for a kg of beef with and without bones paid by consumers by month. Cattle is the median unit price for a kg of of cattle received by the farmer.

of Armenia, one region, Syunik, is by far more isolated from the rest of the country and in particular from the big markets of the capital, Yerevan. In this exercise, we exploit this specific feature of Armenia's geography and study the regional spillovers originating from Yerevan by taking this isolated region as a control group.

According to Google Maps, it takes about two hours to drive from Yerevan to the capital city of any of the regions.[35] The only exception is the Syunik region, which is geographically isolated. From Yerevan it takes about six hours by car to reach Syunik's capital and largest city, Kapan, the car being the only mode of available transportation. Since most suppliers are small farmers and deliveries are small, the fixed cost of making the round trip from Syunik to Yerevan is very high.[36] In the absence of large producers, firm fixed costs and time of travel

[35] Capital cities are generally located in population weighted centers of each region.

[36] It is worthwhile to note that in order to improve phytosanitary conditions, from the start of 2020 the government introduced a requirement that all live animals should be slaughtered in slaughterhouses. This requirement met a significant opposition from farmers. Despite the determination of the prime minister, the government had to postpone the implementation of the regulation. This episode demonstrates that there are many small farmers who slaughter their animals at farm and not in special facilities.

make a major obstacle for producers of perishable goods such as fresh meat. These features make the region of Syunik a relatively clean control group.[37]

Ideally, we would like to compare how producer prices plotted in Figure 7 reported by farmers in Syunik behaved as compared with other provinces. However, due to the small number of transactions, we use consumer prices and re-estimate equation 4 by redefining the treatment variable to be zero for Syunik and one for all other regions except Yerevan (which we drop in this analysis). The results of the estimation presented in the last column of Table 8 show that the prices of affected goods decreased in regions close to Yerevan, relative to those in Syunik. This result provides suggestive support for the hypothesis that the VAT enforcement and the respective contraction of demand in Yerevan (as shown in column 3 of Table 8) had a negative impact on the average prices of regions catering to Yerevan as opposed to the control region of Synuik.

6.4.2 Employees

In this subsection we investigate the effect of the policy change on employment dynamics. Ideally, we would like to use tax-return data of firms to study wages and firm profits. Unfortunately, this is not possible since the confidentiality of such tax data does not allow us to identify the treated retailers. However, in Armenia data on the number of workers employed by each firm is made publicly available by the Insurance Foundation for Servicemen since 2017.[38] We merge this data with further publicly available registry data on basic characteritics of firms (such as industry and location) as well as quarterly firm-level data on amounts of tax payments for the one thousand largest taxpayers (which jointly pay almost 80% of taxes in Armenia).[39]

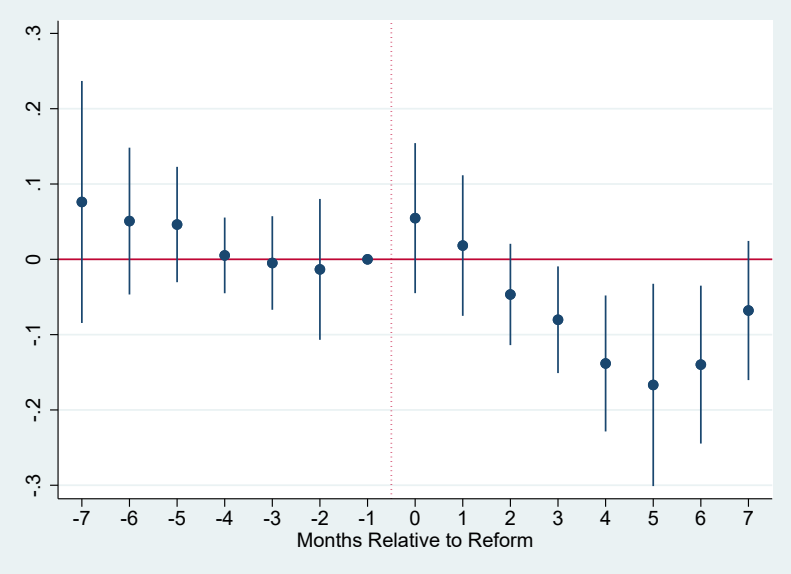
We estimate how the employment of affected firms evolved after the policy change. Our control group in this specification are other firms in the food retail sector. Thus we depart

[37] In terms of population, Syunik is ranked 7th out of 10 provinces, and in terms of cattle heads, 5th. Population data are from the most recent Census, conducted in 2011, and livestock data are from the 2018 Integrated Living Conditions Survey.

[38] See https://www.1000plus.am/en/search/mandatory/; retrieved in Armenian on 26.06.2019.

[39] Both of these datasets are made available by the State Revenue Committee of the Republic of Armenia; see https://www.petekamutner.am.

Figure 8: Employment Dynamics in Affected and Unaffected Stores



$Notes$: This figure plots the estimated coefficients α_τ for Equation 5 The coefficient α_τ captures the interaction of affected stores after the policy change. Estimations include time and store fixed effects. Standard errors are clustered at time level.

from the triple-difference method used above and rely a difference-in-difference estimation. More specifically, we estimate the following specification:

$$log(e_{s,t}/e_{s,t_0}) = \sum_{\tau=-k}^{\tau=k} \alpha_\tau 1[t=\tau] * Large_s + \lambda_s + \eta_t + \epsilon_{s,t}, \tag{5}$$

where $e_{s,t}$ is the number of employees at store s, at time t relative to the base. $1[.]$ is an indicator function, $Large_s$ is a dummy for large retailers affected by the reform. λ_s and η_t are store and time fixed effects, respectively. $\epsilon_{s,t}$ is the error term is clustered at the level of firms and time.

The results of estimations are presented in Figure 8 which plots the estimated coefficients α_τ. The pre-trends are flat. After the reform, affected firms experienced a decline in employment that peaks in month five at around a 15% decrease in the number of employees. This result would point to the possibility that some of the tax burden was passed on to employees. However, we also note that this evidence remains suggestive due to our inability to

use the baseline triple-difference model. The evidence here depends on the assumption that the treated set of large retailers were not affected differently in the post-reform period.

7 Consumer welfare

In this final section we use data from household expenditure surveys to study how the enforcement-driven price increase is reflected in consumer purchases of an average household. We then decompose these average price and quantity effects for separate parts of the income distribution, and calculate the relative transfers that the enforcement episode generated for households along the income distribution. The data and estimation strategy are described in Section 3.4.

7.1 The price elasticity of demand

We start by testing whether the price increase in affected goods that we have identified so far is reflected in consumer purchases as well. The results of estimating equation 4 on prices are presented in the first column of Table 8. The treatment effect estimate confirms the hypothesis that after the policy change there was a statistically significant differential increase in price of affected goods in the capital. The magnitude of this price effect is more than two times smaller than our baseline estimates of incidence obtained from store-level price data (see Table 5).[40] As we argued in Section 3.4, our estimates based on survey data, are likely to underestimate the passthrough because we cannot identify affected stores, so we proxy them based on their locations.

Then we study how expenditures on affected goods change given the tax-induced change in prices. To this end we re-estimate equation 4 but as a dependent variable taking the quantity of household purchases of a given good category measured in kilograms. To estimate this specification, we aggregate purchases over transactions (subscript j in equation 4). This estimation is presented in column 3 of Table 8. As expected, we observe a drop in expenditures,

[40] However, the confidence intervals of the two estimates intercept. Additionally, in section 7.2 below, we decompose the price incidence parameter into income quintile specific estimates and show that these estimates obtained from household survey data are similar to the baseline estimates of incidence if we only consider the incidence parameter of the affected households.

Table 8: Consumer Responses in Price and Quantity

	(1)	(2)	(3)	(4)	(5)
	Panel A				Panel B
	Log Price		Log Quantity in kg		Log Price
	Beef/Pork	Poultry	Beef/Pork	Poultry	Beef/Pork
Treatment (α)	0.019***	0.018	-0.014***	0.023***	-0.028**
	(0.006)	(0.017)	(0.001)	(0.001)	(0.010)
Expenditures	0.033***	0.042***	0.019***	0.014***	0.025***
	(0.005)	(0.008)	(0.002)	(0.001)	(0.004)
Adj. R-squared	0.897	0.860	0.347	0.306	0.902
N	59517	41872	398371	286549	36309

Notes: OLS regressions of equation 4. Treatment (α) captures the interaction of affected goods in the treatment region after the policy change. In Panel A the treatment region is the capital city (Yerevan). In columns 1-2 the dependent variable is the transaction price and in columns 3-4 the dependent variable is the the quantity of product consumed in kg. In columns 1 and 3 the treatment products are fresh beef and pork. In columns 2 and 4 the treatment products is fresh poultry. In Panel B the control area is the isolated region of Syunik, and the treatment area includes all other regions except for Yerevan (which is excluded from this sample). In column 5 the dependent variable is the transaction price and treatment category is fresh beef and pork. Estimations control for household head's age, gender, level of education, number of household members, a dummy for rural households and place of purchase. Estimations also include good-by-time, good-by-region and region-by-time fixed effects. Standard errors are clustered at time and region level. * (**) (***) indicates significance at the 10 (5) (1) percent level.

given the price increase. The change in the expenditures of affected goods amounts to a 1.4% drop in kg expenditures for the average household. Given the price change estimated in column 1 of Table 8, we arrive at an estimate of price elasticity of demand for meat of about 0.74. Being below unity, this estimate suggests that meat consumption in Armenia is relatively inelastic. This response is very similar to the standard findings of the literature and is in the range of an elasticity of 0.7-0.8 as found in the meta-analysis by Andreyeva, Long, and Brownell (2010).

We also investigate price and quantity responses of the closest substitute food item. We consider that the closest substitute product for fresh pork and beef is fresh poultry. Columns 2 and 5 of Table 8 reestimate our regressions for price and quantity, respectively, but our treatment product category includes different types of fresh chicken products. The set of

the control products is the same as in previous regressions.[41] We do not find evidence for significant price effects on fresh poultry products; however, the quantities of purchased poultry increase. This suggests that there was a substitution between the consumption of beef and pork into chicken, with a cross elasticity of demand of around 1.64.

7.2 Distributional effects

It is possible that the average treatment effects we have estimated for consumer prices and consumption quantities are different across the income distribution. To study this hypothesis, we interact the treatment effect of equation 4 with quintiles of aggregate annual household consumption as a measure of income,[42] and in Table 9 estimate the heterogenous treatment effects on prices and quantities of beef and poultry as well as the substitute product of chicken across the income distribution. This analysis shows that the passthrough of VAT enforcement onto the price of beef and pork products is distributionally not neutral. Column 1 of Table 9 indicates that prices increase by 4 to 5% for households at the bottom three quintiles, by 2% for households at the fourth quintiles, but they essentially do not change for households at the top quintile of the distribution. This result is consistent with the findings of Atkin, Faber, Fally, and Gonzalez-Navarro (2020), Faber and Fally (2020) where prices are heterogenous across the household income distribution. Following the same logic in column 3 we observe larger decreases in quantities among the bottom three quintiles. We also conducted *F test* for the joint equality of coefficients in columns 1 and 3. For both case we can confidently reject the hypothesis of equality.

We then approximate the orders of magnitude of the welfare implications of tax evasion for consumers situated along the income distribution. Our very simple approach to measuring welfare is to quantify the observed changes in consumption patterns resulting from the reform. We empirically estimate the parameters characterizing the demand function rather than study-

[41] Fresh beef and pork products are excluded from estimations.

[42] We follow Bachas et al. (2019) and the references therein by approximating the income distribution with aggregate household consumption rather than measures of income. One reason behind this approximation is the conjecture that surveys often measure income poorly due to various reasons such as income underreporting (Pissarides and Weber 1989).

Table 9: Distributional Responses in Price and Quantity

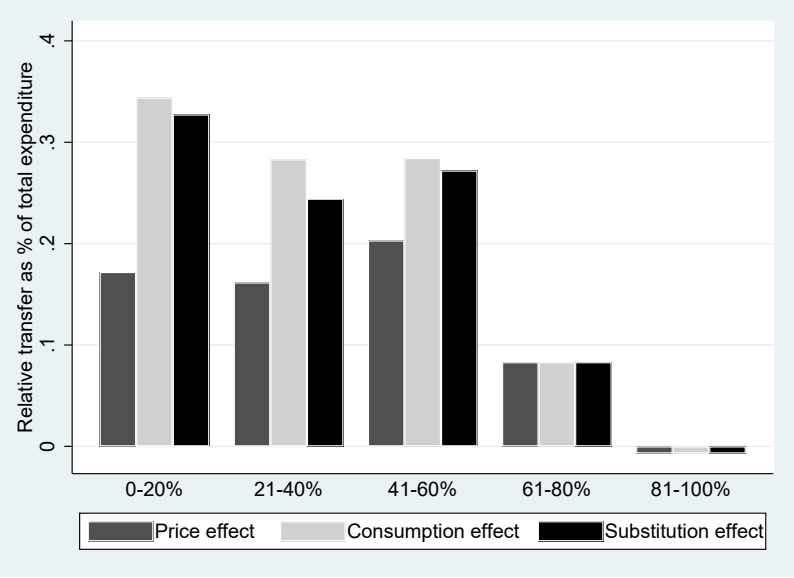
	(1)	(2)	(3)	(4)
	Log Price		Log Quantity in kg	
	Beef/Pork	Poultry	Beef/Pork	Poultry
Q1 Treatment (α)	0.044***	0.046*	-0.039***	0.008***
	(0.011)	(0.021)	(0.001)	(0.001)
Q2 Treatment (α)	0.039***	0.037*	-0.024***	0.027***
	(0.007)	(0.019)	(0.001)	(0.001)
Q3 Treatment (α)	0.048***	0.028	-0.015***	0.020***
	(0.008)	(0.017)	(0.001)	(0.001)
Q4 Treatment (α)	0.021***	0.026	-0.002	0.034***
	(0.006)	(0.017)	(0.004)	(0.001)
Q5 Treatment (α)	-0.003	-0.006	-0.007***	0.024***
	(0.006)	(0.019)	(0.002)	(0.002)
Expenditures	0.034***	0.042***	0.019***	0.015***
	(0.006)	(0.008)	(0.002)	(0.001)
Adj. R-squared	0.897	0.861	0.348	0.307
N	59517	41872	398365	286551

Notes: OLS regressions of equation 4. Treatment (α) captures the interaction of affected goods in the capital region after the policy change. Treatment is interacted with dummies for quintiles of household total expenditure level. In columns 1-2 and the dependent variable is the transaction price and in columns 3-4 the dependent variable is the the quantity of product consumed in kg. In columns 1 and 3 the treatment products are fresh beef and pork. In columns 2 and 4 the treatment products is fresh poultry. Estimations control for household head's age, gender, level of education, number of household members, a dummy for rural households and place of purchase. Estimations include good-by-time, good-by-region and region-by-time fixed effects. Standard errors are clustered at time and region level. * (**) (***) indicates significance at the 10 (5) (1) percent level.

ing optimized demand from utility maximization. In contrast, Gaarder (2018) and Mariscal and Werner (2018) estimate a full demand system as proposed by Deaton and Muellbauer (1980) and extended to a non-linear setting by Banks, Blundell, and Lewbel (1997). More generally, Atkin et al. (2020), Atkin, Faber, and Gonzalez-Navarro (2018) estimate price and welfare effects that vary by the income of households. Our analysis also assumes that the potential government revenues resulting from tax enforcement do not flow back to consumers.

Using the passthrough estimates of column 1 of Table 9 and data on income and expenditure shares of quintiles, the first bars of Figure 9, labeled "Price effect", present mechanical

Figure 9: Size of Relative Transfers over Household Income Quintiles



$Notes$: Bars labeled price effect use quantile-specific treatment effect estimates on the price of beef and pork as reported in column 1 of Table 9 to calculate the relative amount of transfers. The bars consumption effect and substitution effect correct for this first-order approximated transfer by taking into account, respectively, the quintile-specific parameters of price elasticity of demand for treated products and cross elasticity of demand for substitute products as derived from estimates of Table 8.

calculations of relative size of transfers in relation to household aggregate consumption across the quintiles of household income distribution. These transfers are only a first-order approximation of the distributional effects of tax evasion as they assume that the tax-induced change in prices did not lead to any behavioral responses by households. Taking into account the behavioral responses related to changes in consumption will mitigate or exacerbate the distributional effects of tax evasion depending on whether the underlying parameters of consumption responses are elastic or not. In particular, we study the behavioral change in the consumption of treated products as well as the potential responses in switching to the consumption of substitute products, which describes the cross elasticity of demand. Consistent with the result that prices have a higher incidence on households at the bottom half of the income distribution, column 3 of Table 9 shows that behavioral changes in the consumption of beef and pork are stronger among the poor compared to the richer households. To calculate quintile-specific elasticites, we round the changes in prices and quantities to the second deci-

mal and estimate decreasing elasticities of 1, 0.75, 0.4, 0 and 0 for the quintiles going from the poorest to the richest. The second bars of Figure 9 indicated with "Consumption effect" use these elasticities and correct the quintile-specific size of relative transfers with the behavioral change in the consumption of treated products. Regarding the potential substitution effects, we observe that the quintile-specific changes in the price of chicken shown in column 2 of Table 9 are similiar to those of beef and pork. Similiar to the elasticity of demand, we calculate the cross elasticity of demand for chicken with respect to beef and pork. The last bars of Figure 9 further correct transfers with this behavioral change in the consumption of substitue products.

The dark-shaded bars labeled "Substitution effect" of Figure 9 indicate quintile-specific transfers related to enforcing the VAT after taking into account these two types of behavioral responses. Owing to the small share of the value of treated products in total expenditure, that averages at around 3.4%, these transfers remain small. This simple calculation suggests that transfers gradually decrease in size along the quintiles. It takes 0.33% of total expenditure for households at the bottom quintile to pay for the tax, while the transfers from households at the top quintile nearly equal zero.

Our finding that the enforcement of VAT is likely regressive is interesting in that, despite the importance of this question, there are not many papers studying it empirically. Of course, there is a large debate on whether the VAT is progressive or regressive. In developed countries it is more often found that the VAT is regressive (Gaarder 2018). We contribute to this debate by showing that the VAT may be more progressive than often thought when considering the presence of evasion opportunities. This conclusion is similiar to the one by Bachas et al. (2019) who use household expenditure surveys from multiple developing countries and show that consumption taxes are de-facto more progressive when evasion opportunities are taken into account.[43] These findings arise from the conjecture that evasion is concentrated among small informal retailers where poorer households are likely to shop, while we show that the result can also hold in large formal supermarkets operating in relatively developed urban areas.

[43] Jenkins, Jenkins, and Kuo (2006), Muñoz and Cho (2003) use similiar techniques and study, respectively, the Dominican Republic and Ethiopia.

Nygård et al. (2019) is the only other paper on the distributional implications of VAT evasion that we are aware of. They study the question of how consumers and retailers benefit from collusive evasion, and show that, in contrast to our result, in Norway the extent of inequality becomes higher once adjusted for evasion. Estimates of retailers' rents of tax evasion along the income distribution are obtained using the expenditure method of Pissarides and Weber (1989). To calculate the benefits of evasion for consumers, Nygård et al. (2019) as well as Bachas et al. (2019) make assumptions about how prices in the hidden market deviate from prices in the regular market. In contrast, we estimate this passthough parameter directly from data.

This finding is also related to a more general, albeit still small, literature about the distributional effects of evasion and avoidance of income and wealth taxes, and not only of consumption taxes. Bishop, Formby, and Lambert (2000) and Johns and Slemrod (2010) use data from random audits conducted by the Internal Revenue Service of the US to study how the income distribution of individuals changes once correcting income for detected non-compliance, while Alstadsæter, Johannesen, and Zucman (2019) estimate the evasion behavior of the very wealthy in Scandinavian countries using data from random audits and offshore leaks.

8 Conclusions

A large literature in economics studies the question of how value added tax (VAT) burden is shared between the important groups of market participants as consumers, retailers, employees and producers. Despite the importance of tax evasion and avoidance as a quantitatively relevant phenomenon in many settings, rarely has previous research studied the incidence of VAT, or taxes more generally, in environements where evasion opportunities prevail. This has often led policy makers to assume that the rents of evasion from VAT typically remain with the party who is statutorily responsible for remitting the VAT, that is the retailer, and design policies in accordance to that belief.

Our study tries to understand the distributional consequences of VAT evasion both between and within groups of market participants applying a sharp identification approach. We exploit an enforcement episode in Armenia that brought non-compliant but otherwise large and formal retailers into the VAT system. We show that consumers bore only up to a third of this tax burden through changes in prices, which suggests that the rents of pre-reform evasion were broadly shared with the consumers.

We then ask whether these benefits of evasion were shared equally among consumers with different levels of income. We use data on diary reports of daily expenditures from household surveys and decompose the average incidence estimate into income quintile specific parameters. By estimating income-specific price elasticity of demand for products affected from the tax enforcement as well as the cross-elasticity of demand to substitute products, we calculate that household responses to the enforcement reform tend to be concentrated among the poor. This suggests that in practice VAT will likely be associated with less efficiency losses and also be less regressive if evasion possibilities are taken into account.

Turning to the sides of producers and retailers, we provide tentative evidence that retailers started to source more of their supplies from firms that were operating under VAT and less from small farmers. This suggests that VAT enforcement can be thought of as a case of industrial policy where enforcement of taxes has trickle down effects incentivizing suppliers to formalize and become larger. Regarding retailers, we show that, similar to previous findings from various settings, enforcement of taxes can hardly be perfect since it induces retailers to try and move to other less verifiable margins of non-compliance with various state regulations. These results on supply-chain effects and second-order evasion responses explain the low rate of a one-third passthrough estimate relative to what standard theory and empirics of tax incidence suggest. This discrepancy suggests that even partial equilibrium incidence analysis needs to take into account evasion opportunities.

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Appendix

A Meta-analysis of consumption tax incidence literature

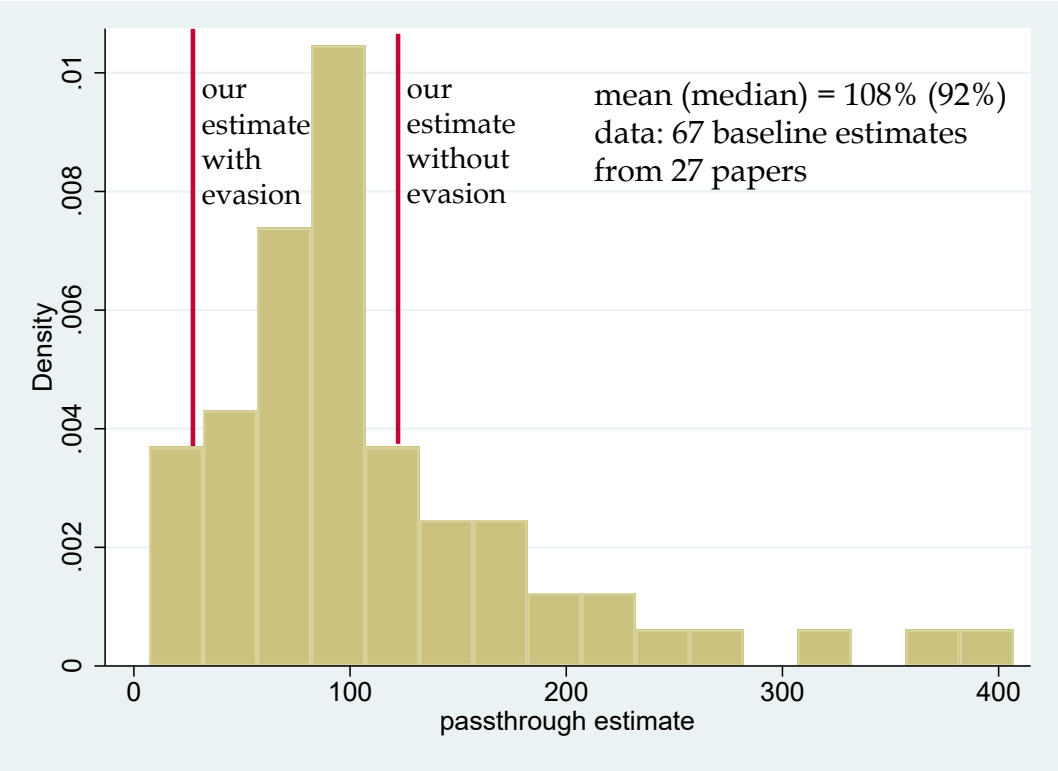
Table App.1: Summary of Literature on Consumption Tax Incidence

Paper	Type of tax	Direction	Goods/Services	Country	Year	Passthrough
Benedek et al. (2016)	VAT	Both	67 Consumption Goods	17 Eurozone Countries	1999 - 2013	139%
	VAT (reduced rate)	Both	67 Consumption Goods	17 Eurozone Countries	1999 - 2013	30%
	VAT (reclassification)	Both	67 Consumption Goods	17 Eurozone Countries	1999 - 2013	8%
Carbonnier (2007)	VAT	Decrease	Cars	France	1987	57%
	VAT	Decrease	Housing Repair Services	France	1999	77%
Kosonen (2015)	VAT	Decrease	Hairdressing	Finland	2007 - 2011	50%
Besley and Rosen (1999)	Sales Tax	Increase	Groceries	United States	1982 - 1990	121%
Poterba (1996)	Sales Tax	Increase	Clothing	United States	1925 - 1939	62%
	Sales Tax	Increase	Female clothing	United States	1947 - 1977	133%
	Sales Tax	Increase	Male clothing	United States	1947 - 1977	84%
	Sales Tax	Increase	Personal care items	United States	1947 - 1977	117%
Chouinard and Perloff (2004)	Excise Federal Tax	Increase	Gasoline	United States	1993	47%
	Excise State Tax	Increase	Gasoline	United States	1993	101%
Doyle and Samphantharak (2008)	Sales Tax	Decrease	Gasoline	Unites States	2000	68%
	Sales Tax	Increase	Gasoline	Unites States (Illinois)	2000	82%
	Sales Tax	Increase	Gasoline	Unites States (Indiana)	2000	100%
Stolper (2016)	Excise State Tax	Increase	Gasoline	Spain	2007 - 2013	95%
Bergman and Hansen (2016)	Excise	Both	Beer	Denmark	1997 - 2005	384%
	Excise	Both	Spirits	Denmark	1997 - 2005	72%
Carbonnier (2013)	Excise	Increase	Beer	France	1997	275%
	VAT	Increase	Beer	France	1995	66%
	Excise	Increase	Anise aperitif	France	1997	244%
	VAT	Increase	Anise aperitif	France	1995	43%
	Excise	Increase	Whisky	France	1997	183%
	VAT	Increase	Whisky	France	1995	43%
Ardalan and Kessing (2019)	Excise	Both	Beer	European Union	1996 - 2016	93%
	VAT	Both	Beer	European Union	1996 - 2016	70%
Young and Bielinska-Kwapisz (2002)	Excise	Increase	Beer	United States	1982 - 1997	171%
	Excise	Increase	Wine	United States	1982 - 1997	124%
	Excise	Increase	Liquor	United States	1982 - 1997	164%
Kenkel (2005)	Excise	Increase	On-premise beer	United States (Alaska)	2002	225%
	Excise	Increase	Off-premise beer	United States (Alaska)	2002	167%
	Excise	Increase	On-premise Wine	United States (Alaska)	2002	373%
	Excise	Increase	On-premise Liquor	United States (Alaska)	2002	328%
	Excise	Increase	Off-premise Liquor	United States (Alaska)	2002	189%
Harding et al. (2012)	Excise	Increase	Cigarettes	United States	2008	85%
Barnett et al. (1995)	Excise State Tax	Increase	Cigarettes	Unites States	1955 - 1990	89,70%
	Excise Federal Tax	Increase	Cigarettes	Unites States	1955 - 1990	101,60%
Delipalla and O'Donnell (2001)	Ad valorem	Increase	Cigarettes	6 Northern European Countries	1982 - 1997	72%
	Specific Tax	Increase	Cigarettes	6 Northern European Countries	1982 - 1997	92%
	Ad valorem	Increase	Cigarettes	6 Southern European Countries	1982 - 1997	147,72%
	Specific Tax	Increase	Cigarettes	6 Southern European Countries	1982 - 1997	216,54%
Bonnet and Requillart (2013)	Excise	Increase	Soft Drinks	France	2005	120%
	VAT (uniform)	Increase	Soft Drinks	France	2005	75%
	Sales Tax	Increase	Soft Drinks	France	2005	74%
Cawley and Frisvold (2017)	Excise	Increase	Soft Drinks	United States (Berkeley, CA)	2014	43,10%
Benzarti and Carloni (2019)	VAT	Decrease	Sit-down restaurants	France	2004 - 2012	9,70%
Benzarti et al. (2019)	VAT	Increase	Hairdressing	Finland	2012	34%
	VAT	Decrease	Hairdressing	Finland	2007	7%
Harju and Skans (2018)	VAT	Decrease	Restaurant Meals	Finland	2010	63,10%
	VAT	Decrease	Restaurant Meals	Sweden	2012	27,30%
	VAT	Decrease	Restaurant Meals	Finland	2010	40,40%
Buettner and Madzharova (2019)	VAT	Both	Many products	European Union	2004 - 2013	95,60%
Gaarder (2018)	VAT	Decrease	Food (Fresh)	Norway	2001	10,90%
	VAT	Decrease	Food (Storable)	Norway	2001	9,80%
Hindriks and Serse (2019)	Excise	Increase	Vodka	Belgium	2015 - 2016	116%
	Excise	Increase	Whisky	Belgium	2015 - 2016	99%
	Excise	Increase	Rum	Belgium	2015 - 2016	109%
Khan, Thompson, and Tremblay (2019)	Sales Tax	Increase	Marijuana	United States (Oregon)	2016	92%
Baker and Brechling (1992)	Excise	Both	Beer	United Kingdom	1973 - 1989	102%
	Excise	Both	Wine	United Kingdom	1975 - 1989	164%
	Excise	Both	Spirits	United Kingdom	1973 - 1989	91%
	Excise	Both	Tobacco	United Kingdom	1973 - 1989	71%
	Excise	Both	Petrol	United Kingdom	1973 - 1989	91%
Stehr (2007)	State beer tax	Both	Beer	United States	1990 - 2004	94%
	State liquor tax	Both	Spirits	United States	1990 - 2004	156%
	Markup on spirits	Both	Spirits	United States	1990 - 2004	19%

Source: Based on own compilation. We thank the research assistance of Alexander Nawrath for help in compiling this literature.

Notes: Passthrough estimates represent the baseline result(s) of each paper according to our judgement.

Figure App.1: Histogram of Estimates of Consumption Tax Incidence from Existing Literature



Notes: The histogram plots 67 baseline estimates of consumption tax incidence on consumer prices collected from from 27 papers. For further details on the sample of these papers and the underlying meta-data, see Table App.1. The first vertical line denotes the baseline incidence estimate of this paper obtained from Table 5. The second vertical line indicates the incidence estimate without evasion opportunities obtained from Table App.2.

B Tax incidence without evasion: A case study of gasoline market

Our baseline estimate of the incidence of VAT evasion is about one-third. This evidence is presented in Section 4. We summarize the literature that studies consumption tax incidence without evasion opportunities in Table App.1, and show that our estimate is very small compared to the findings of this standard literature. Section 6 discusses the mechanisms behind the finding of low passthrough in the presence of evasion possibilities. In this section, we additionally ask the empirical question of whether a low passthrough estimate is a generic feature of the Armenian economy.

Ideally, we would like to study a change in VAT rate in Armenia, and contrast that parameter with our baseline incidence parameter obtained from the enforcement reform. Unfortunately, the VAT rate has been stable for food products in Armenia. Instead, we are aware of a tax rate reform in the market for fuel that happened within our sample period. In particular, a tax reform that became effective on January 2018, increased the tax rates for gasoline and diesel products. For gasoline, excise tax increased from 25 thousand to 40 thousand Armenian drams per tonne of gasoline, which after netting in the VAT implies a tax increase of of 11,3 dram per litre. For diesel, a VAT with a standard rate of 20% was introduced from scratch instead reducing the the excise tax from 35 to 13 thousand dram per tonne. This implied an increase of 34,5 dram per litre of diesel.

Our data has information on fuel prices at nine different gas stations in Armenia. As before prices are observed 10-day frequencies from March 2017 to December 2018. As a control group, we use retail price data from Georgia. Georgia is a neighboring economy with similar level of development. During the study period there were no changes in fuel taxes in Georgia. We obtain the data from https://autotraveler.ru, and convert prices from Georgian laris to Armenian drams. We estimate the following equation:

$$log(p_{s,t}) = \alpha * Post_t * Armenia_s + \gamma_s + \eta_t + \epsilon_{s,t}, \tag{6}$$

Table App.2: Passthrough Estimates in the Gasoline Market

Product:	(1) Diesel	(2) Regular 92	(3) Premium 95	(4) Super 98
α	0.119***	0.059***	0.081***	0.090***
	(0.010)	(0.009)	(0.011)	(0.010)
Incidence, %	123.96	143.90	207.69	236.84
Adj. R-squared	0.969	0.936	0.955	0.915
Within R-squared	0.498	0.203	0.441	0.493
N	559	561	535	232

Notes: OLS regressions of equations 6. The coefficient α captures log price in Armenia relative to Georgia after the policy change. Incidence is the passthrough parameter expressed in percent of the tax burden, where 0% and 100% denominate null and full passthrough, respectively. All specifications include petrol station and time fixed effects. Standard errors are clustered at time level. * (**) (***) indicates significance at the 10 (5) (1) percent level.

where $Post_t$ is an indicator variable that takes a value of 1 in all periods after the tax change, and $Armenia_s$ is a dummy variable for petrol stations in Armenia. We estimate equation 6 for four different fuel categories as our dependent variable.

The results shown in Table App.2 suggest passthrough estimates of more than 100% in this market. The estimates are heterogenous across fuel types. In particular, fuel types that are typically consumed by lower income households, such as diesel and lowest quality gasoline (called regular 92), have lower passthrough rates than higher quality gasolines (premium 95 and super 98) which are typically used in more expensive cars. For these higher quality gasolines we find substantial over-shifting of 200% and more.

This finding that taxes have at least full passthrough on prices, and that they are even overshifted, is consistent with our literature review quantitatively summarized in Table App.1. They are also substantially larger than our passthrough estimate in the presence of evasion opportunities. Of course, the structure of the fuel market may be very different from that of the retail food market such that a direct comparison of the two incidence parameters is

not straightforward. This exercise, however, can reject the hypothesis that a low passthrough estimate is a generic feature of the Armenian economy.

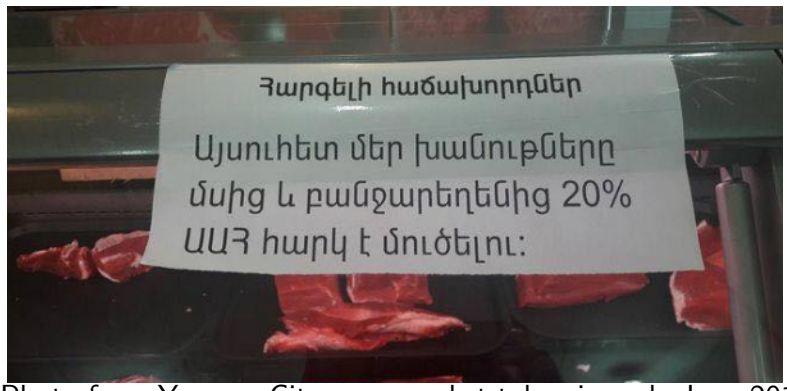
C Additional tables and figures

Table App.3: Passthrough Estimates

	without spillovers		with spillovers	
	+	-	+	-
α_0	0.176***		0.196***	
	(0.022)		(0.023)	
α_{+1}	0.033		0.034	
	(0.035)		(0.034)	
$\alpha_{+2/-2}$	0.068***	0.006	0.063***	0.001
	(0.014)	(0.006)	(0.014)	(0.007)
$\alpha_{+3/-3}$	0.066***	0.020***	0.073***	0.024***
	(0.007)	(0.007)	(0.009)	(0.009)
$\alpha_{+4/-4}$	0.068***	0.011**	0.071***	0.013*
	(0.016)	(0.005)	(0.025)	(0.007)
$\alpha_{+5/-5}$	0.076***	0.028**	0.087***	0.027*
	(0.009)	(0.013)	(0.013)	(0.014)
$\alpha_{+6/-6}$	0.077***	0.013	0.088***	0.007
	(0.008)	(0.008)	(0.009)	(0.009)
$\alpha_{+7/-7}$	0.072***	0.018	0.077***	0.019
	(0.009)	(0.013)	(0.010)	(0.013)
Adj. R-squared	0.997		0.997	
Within R-squared	0.004		0.006	
N	44861		44861	

Notes: OLS regressions of equations 1 which does not control for spillover effects and 2 which controls for spillover effects. Estimated coefficients of the interaction between affected goods and affected stores for periods after the policy change are displayed in columns with "+" sign and periods before the policy change are displayed in columns with "-" sign. All specifications include good-by-time, good-by-store and store-by-time fixed effects. Standard errors are clustered at time and store level. * (**) (***) indicates significance at the 10 (5) (1) percent level.

Figure App.2: Justifying Price Increases



Notes: Photo from Yerevan City supermarket taken in early June 2018. The Armenian text reads: "Dear customers, from now on our stores will pay a 20% VAT on meat and vegetables".
Source: panarmenian.net