DISCUSSION PAPER

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The Incidence of VAT Evasion

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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: D11, H22, H26

Keywords: Value added tax, Incidence, Evasion, Enforcement, Distributional Effects.

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 A2 and Figure A1 of the Appendix), rarely has pre-

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[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.

vious 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.

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). With the aim to prevent high inflation, the government allowed large formal retailers who operate under VAT (but who cannot have VAT input invoices on local agricultural products that they sell because of the exemption) to register thousands of postbox firms falling just below the VAT exemption threshold (for evidence

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[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.

of such bunching behavior, see Figure 1) and book the sales of local agricultural products happening in these large retail stores on the accounts of the non-VAT firms that only existed on paper.[6] A new government policy started to enforce VAT on these large retailers, which increased their statutory tax rate from a sales tax of 5% to a VAT (but due to no deduction possibilities effectively a sales tax) of 20%. As we detail below, 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, but we believe that our evidence is relevant for a much wider class of reforms which start to enforce the VAT.[7]

We use data on product and store level prices at 10-day frequencies, and a triple-difference design in order to estimate the incidence of enforcing VAT on prices. The design compares prices of agricultural goods produced by local farmers (treatment products) to that of other agricultural goods (control products) between affected and unaffected stores before and after the reform, and controls 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. This estimate is much smaller than previous empirical estimates of VAT incidence (which we summarize in Table A2). We provide suggestive evidence that firm owners did not fully bear the remaining two-thirds of the tax burden, but were able to shift some of the burden to employees as well as to farmers.

We then 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 high passthrough. We present suggestive evidence that is in line with these predictions. First, 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

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[6]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.

[7]For example, because of previous non-compliance of a firm due to the failure to register, or because of the extension of VAT to new firms due to the inclusion of new sectors into the VAT system and due to other tightenings of VAT exemption rules.

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), thus lowering their costs and the respective rate of passthrough. Additionally, we study how the well known result of Chetty, Looney, and Kroft (2009), Finkelstein (2009), Taubinsky and Rees-Jones (2018) that incidence depends on salience 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 other two mechanisms, results in lower equilibrium passthrough.

In the final part of the paper, we use diary reports from household expenditure surveys to show that while the demand of affected goods by average households was relatively inelastic to changes in price, 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, but the distributional consequences are 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.[8] Slemrod (2008) reviews this literature qualitatively, while in Table A2 and Figure A1 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.

2 Setting

2.1 The enforcement episode

We use a sudden enforcement of the VAT regime on previously non-compliant retailers as a "natural experiment". At the end of May 2018 the government said it discovered 461 "postbox" firms falling just below the VAT registration threshold. Figure 1 shows strong

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[8]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.

evidence of this type of bunching of firms below the threshold.[9] These postbox firms had a total turnover of around $83 million, and although they were legally independent, in practice they were being operated by the largest retailer in Armenia. This retailer used to channel its sales of local agricultural products 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 turnover-based taxes of 5% on the gross sales of these small firms rather than a VAT of 20%.[10] The government closed the small firms and started to fully enforce the VAT on the largest retailer. It also became apparent that the scheme was being used by ten other large retailers in Armenia.

This episode affected locally produced meat and vegetable products. In our analysis we focus on meat products. The reason is that the price and quality of vegetable are subject to large fluctuations due to seasonal factors that are especially significant in the end of spring and the beginning of summer, which is the period when the policy change we study happened.[11] In contrast, seasonal fluctuations are much more modest for meat products and the market structure is more clear, allowing us to distinguish between products that are supplied by small farmers (non-VAT) from the ones supplied by large, legally registered entities (VAT firms).[12] To make it clear, in the data, we do not directly observe the VAT status of a particular good
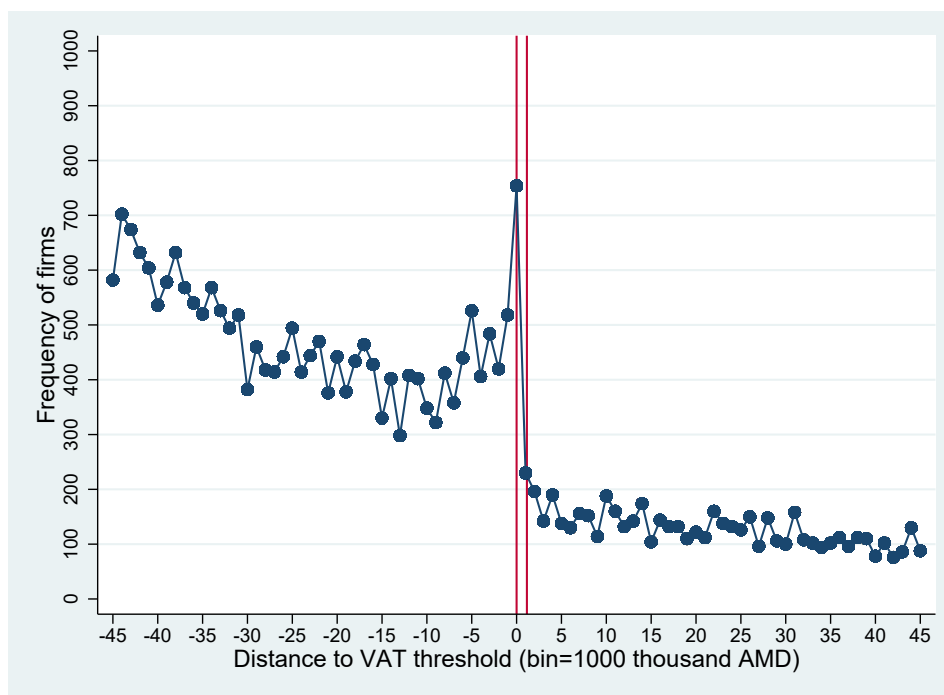
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[9]The VAT registration threshold is unusually large in Armenia, summing to around $125 thousand of annual turnover in 2018 and increasing to about $250 thousand of annual turnover in 2019 (Asatryan and Peichl 2017).

[10]More specifically, sales of some agricultural goods were booked as if there is a virtual small firm which operates independently inside a large store. Consumers could not detect this arrangement. After the enforcement episode the physical organization of stores and goods inside them did not change.

[11]During this period, many vegetable products which grow in fields yield and replace the ones that were grown in greenhouses or imported. Clearly, costs and prices for the same product are different depending on the growing method and origin. In the case of imported vegetables, input VAT can be also rebated. Unfortunately, our data does not allow us to clearly identify the origins and growing methods for all vegetable products in all stores.

[12]According to the World Development Indicators, a substantial share of population of Armenia, about 34% of total employment, is employed in agricultural sector and the vast majority of those are small farmers. The fact that small agricultural holdings are exempt from VAT and other taxes indicates that living conditions for people in this sector are rather low and the state maintains the policy to improve the livelihoods of farmers and alleviate poverty. There is significant heterogeneity in the types of agricultural activities and their organization because of agro-climatic conditions, which vary significantly across regions. In some activities there is a substantial presence of large farms that employ modern agricultural techniques, while large farms are essentially absent in others.

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).

sold in a particular store; however, the way markets operate in Armenia and their structure allow us to make this distinction. We present the description of the market structure below.

2.2 Market structure

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 only a negligible share of cattle and pork stocks is owned by holdings which have legal status. We thus conclude that nearly all of cattle and pork production in Armenia escapes the VAT. The picture is different for poultry and farmed fish. In these categories, holdings with legal status own a significant share of poultry or basins where fish grows. The productivity in the fish farming sector is especially high, which is also reflected in the fact that farmed fish is one of the main agricultural exports from Armenia.

The situation in beef and pork markets is the opposite, where exports are essentially absent and the country imports rather large quantities of meat. Table 2 presents total annual

Table 1: Stocks of Animal Husbandry by the Legal Status of Holdings

	Treated		Control	
	Cattle	Pig	Poultry	Fish
Holdings w/o legal status	757,612	160,923	2,730,686	1,039,423
Holdings w/ legal status	6,605	9,723	2,518,680	324,481

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

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.

imports of different categories of meat at the 4-digit Harmonized System (HS) of product classification for 2017 and 2018. An important observation that can be documented from this table is that at the HS 4 level, it is possible to distinguish fresh bovine animal meat from frozen. In 2017, before the policy change, the quantities of imported meat are very small compared with frozen type. 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. 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.[13] In the case of poultry, Armenia imports both fresh and frozen products. At the same time, significant numbers of local poultry are owned by firms with legal status.

Although holdings with legal status own almost half of the stock of poultry, one may still have concerns regarding the share of poultry produced by small farmers and sold to

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[13]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.

consumers. 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. This is a household-level survey which provides information on earnings, wealth, consumption, production and other activities of rural and urban households. Using this survey, we construct information on the total number of animal husbandry owned in different categories and total number/units of slaughtered and sold in respective categories within a year (2018). From Table 3 we can see that sales of pigs account for the third of the stock. In the case of cattle, the number is smaller at around 12% of the stock. This difference is not surprising because cows are also used for purposes of milk production and the number of slaughtered animals should be much lower compared with the stock. The same applies to poultry, which can be used to produce eggs. However, that cannot justify the negligible share of sales presented in Table 3. From this Table, it is evident that farmers do not sell poultry but rather hold them for the production of eggs, and possibly for family consumption. Unfortunately, the Integrated Living Conditions Survey does not provide data on fish but in addition to the argument provided above, it is quite intuitive that in the presence of large stocks of poultry and fish in holdings with legal status, VAT-paying retailers do not have incentive to buy from small farmers. Furthermore, we conduct estimations by excluding fish from our sample to ensure the robustness of our results.

Taking into account these observations, it is straightforward to classify products according to whether they are supplied by small farmers or by large firms. Fresh beef and pork are supplied by small farmers which do not pay VAT. Fish and poultry products are supplied by large firms whether they are produced locally or imported. Finally, processed meat products are also

supplied by large food processing firms. For the latter category we also observe the brands of the producers. Additionally, we have interviewed managers of retailers and our interviews confirmed our product classification approach regarding the VAT status of suppliers.

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.[14] 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 A2 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.[15] 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 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 reported by the Statistical Committee of the Republic of Armenia. The data are available at the level of detailed retail products (e.g., 25 distinct meat products) from around 40 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 treated group. Stores

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

[15] 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 ratem, 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).

in the treatment group are larger than others and are typically represented by a number of outlets in various districts of Yerevan and apply uniform pricing in all locations.

As discussed in Section 2 we restrict our sample to meat products. Fresh beef and pork products are in our treatment group because they are nearly always supplied by small farmers and are almost never imported. Based on these two features, we can confidently assume that fresh beef and pork used to be sourced from non-VAT suppliers before the reform. We observe prices for two categories of fresh beef and one category of pork. Within each category there are three or four sub-categories of products. However the availability of these sub-products varies from store to store. Remaining meat-related products in our sample, such as poultry, fish, and all varieties of sausages are in the control group.[16]

Some products have sub-categories and others are available only at this more general product level. For example, fish is available at the product level because there is only one widespread variety. On the other hand, sausages are available at detailed level of sub-categories where the information includes a brand name and a specific type of a sausage. In the case of products supplied directly by farmers, obviously the brand name is not present, but there is information on a particular part of the body. For example, for beef, it can be chuck, rib, etc.

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 (havings 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:

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

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[16]Sausages are made from pork and beef but 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 directly affect these producers and the prices of their products.

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.[17]

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.[18] For this reason, in the following we introduce an additional term into Equation 1 to capture price spillovers in the capital city:

$$
\begin{aligned}
log(p_{i,s,t}/p_{i,s,t_0}) = &\sum_{\tau=-k}^{\tau=k} \alpha_\tau 1[t=\tau] * VAT_i * Large_s + \\
&\sum_{\tau=-k}^{\tau=k} \beta_\tau 1[t=\tau] * VAT_i * Capital_s + \gamma_{i,t} + \lambda_{i,s} + \eta_{s,t} + \epsilon_{i,s,t}.
\end{aligned}
\tag{2}
$$

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

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[17]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.

[18]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. 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.

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:

$$log(p_{i,s,t}/p_{i,s,t_0}) = \alpha*Post_t*VAT_i*Large_s + \beta*Post_t*VAT_i*Capital_s + \gamma_{i,t} + \lambda_{i,s} + \eta_{s,t} + \epsilon_{i,s,t},$$
(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. 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.[19] 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

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[19]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.

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.

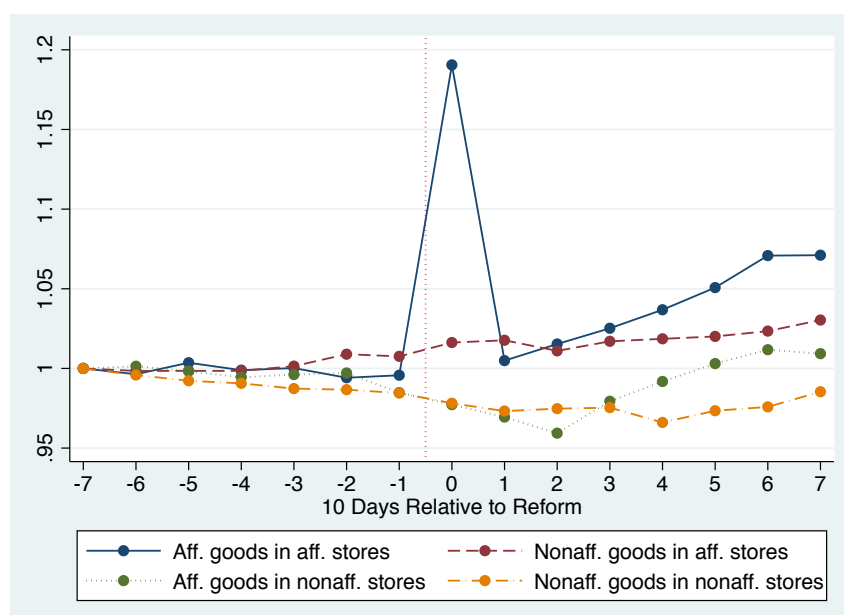# 4 Main results

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 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 A1 of the Appendix. First, as we have seen in the raw data, these estimations show no evidence for trends in affected
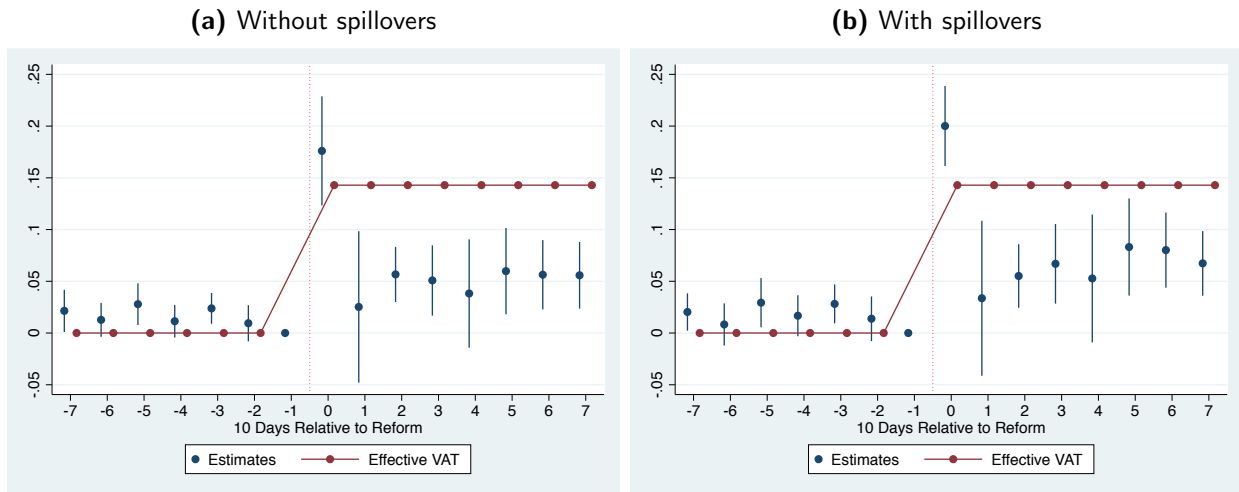
Figure 2: Development of Raw Price Levels

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

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 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.

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.

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 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 Average effects

To obtain the average effect of the policy beyond its short-term effects we estimate Equation 3. As mentioned in Section 3 our data runs until early December which implies that our estimations include 18 periods after the policy change. The results of the estimations are presented in Table 4. 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

Table 4: Baseline Passthrough Estimates

	(1)	(2)	(3)
α	0.034	0.052*	0.046*
	(0.030)	(0.027)	(0.024)
β		0.038	0.032
		(0.028)	(0.028)
Adj. R-squared	0.749	0.750	0.758
N	12682	12682	12201

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. All specifications include good-by-time, good-by-store and store-by-time fixed effects. The specification in column 3 drops the observations below the 1st percentile and above the 99th percentile and the first period after the reform. Standard errors are clustered at time and store level. * (**) (***) indicates significance at the 10 (5) (1) percent level.

in the second column of Table 4, the average increase in prices is about 5.2%. This estimate corresponds to a passthrough rate of about 36% which 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 , as well as winsorize the sample. The estimated coefficient is only slightly smaller and implies a passthrough of 32%.

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 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:

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

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

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

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:

$$\frac{\partial \pi}{\partial z_1}\bigg|_{F<\bar{x}} = 0 \Rightarrow F_1 = \frac{P_1}{p(1-\tau)}$$

$$\frac{\partial \pi}{\partial z_1}\bigg|_{F>\bar{x}} = 0 \Rightarrow F_1 = \frac{P_1(1-t)}{p(\beta, t)}$$

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:

$$F_1|_{F > \bar{x} \ \& \ \beta = 0} = \frac{P_1}{p}$$

$$1 - \tau < 1$$

$$\iff p(1 - \tau) < p$$

$$\iff \frac{P_1}{p(1 - \tau)} > \frac{P_1}{p}$$

$$\iff F_1|_{F < \bar{x}} > F_1|_{F > \bar{x} \ \& \ \beta = 0}$$

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 $F_1|_{F < \bar{x}} < F_1|_{F > \bar{x}}$.

$$\frac{1}{1 - \tau} \frac{(1 - t)(1 - \beta) + \beta}{1 - t} < 1$$

$$\iff (1 - t)(1 - \beta) + \beta < (1 - \tau)(1 - t)$$

$$\iff \beta < \frac{-\tau(1 - t)}{t}$$

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 $h'' > 0$:

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

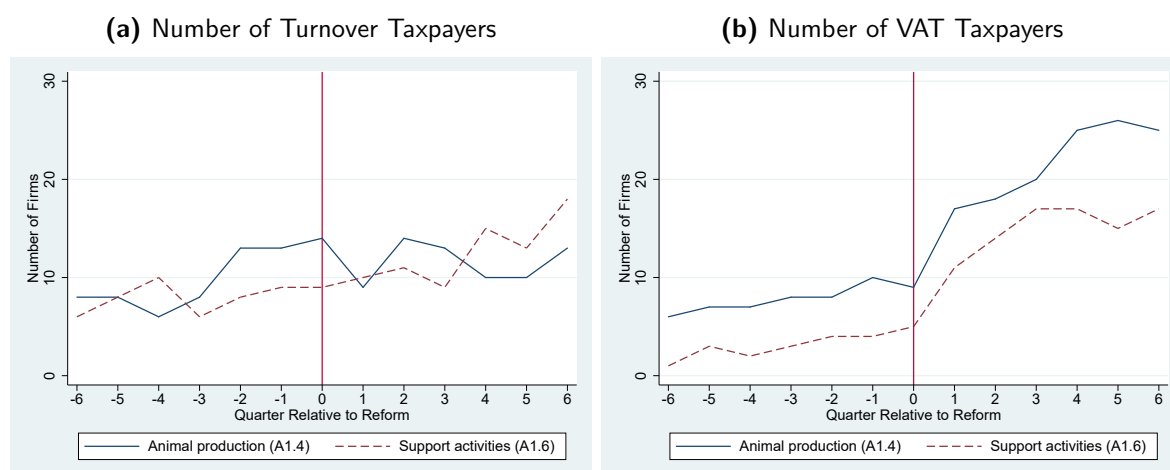$$\beta|_{F > \overline{x}} > \beta|_{F < \overline{x}}$$

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.
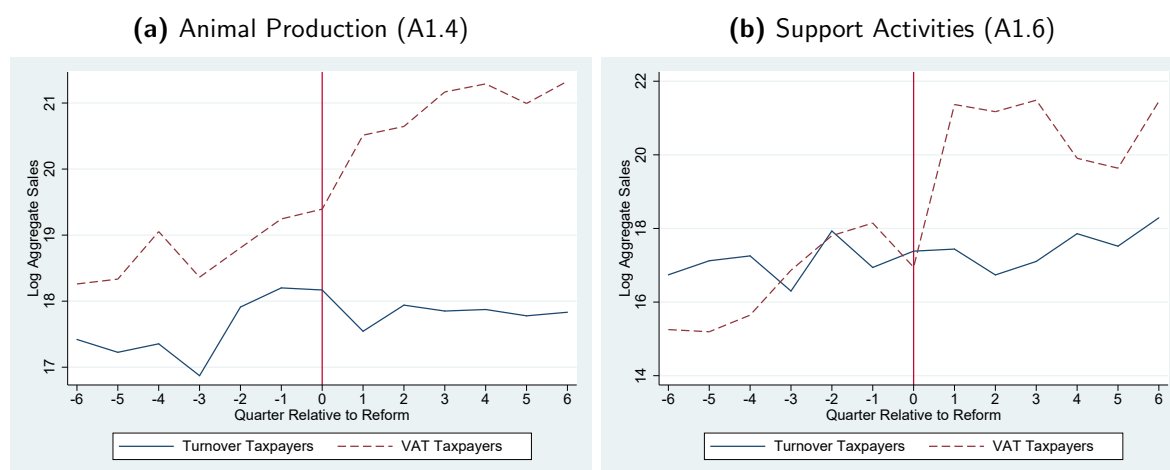
6.1 Supply chain effects

As predicted by our model, the VAT induces supply chain effects incentivizing retailers to buy more from VAT rather than non-VAT firms. Gadenne, Nandi, and Rathelot (2018) and Gerard, Naritomi, and Seibold (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[20] increase for VAT but not for turnover taxpayers.

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[20]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.

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 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.[21]

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

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

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.

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.[22] 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.[23] 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 5 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 amount to an average

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

[23]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 5: 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.

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 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.

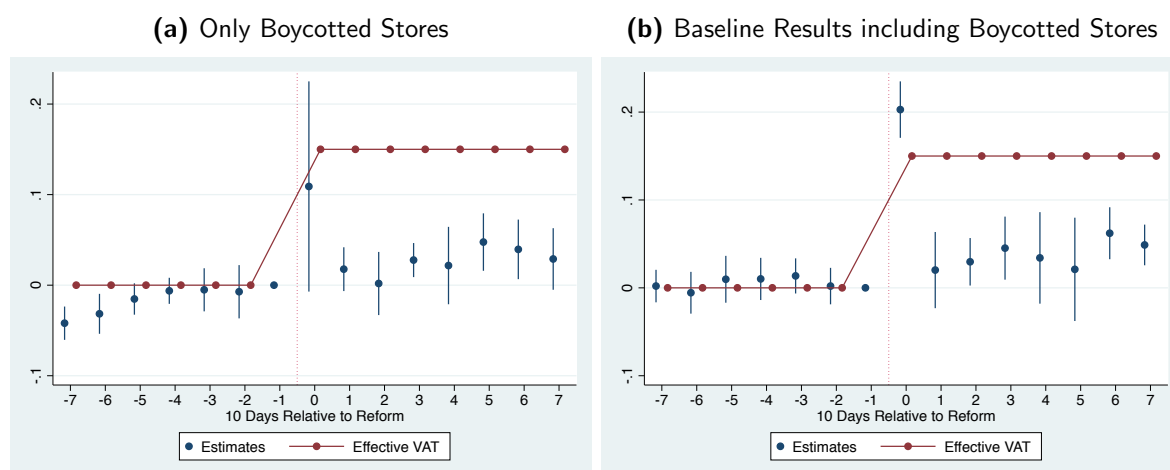**Table 6:** Food Security Audits in VAT and non-VAT Firms

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.

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.[24] Table 6 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

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[24]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.

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.

sample is much smaller since we are studying the sub-sample of switchers where audits were conducted in both tax regimes, but these regression 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.

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. [25]

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.[26] 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. Average estimates that include further periods, similar to the ones presented in Table 4, yield very small and insignificant effects. 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

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

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

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.
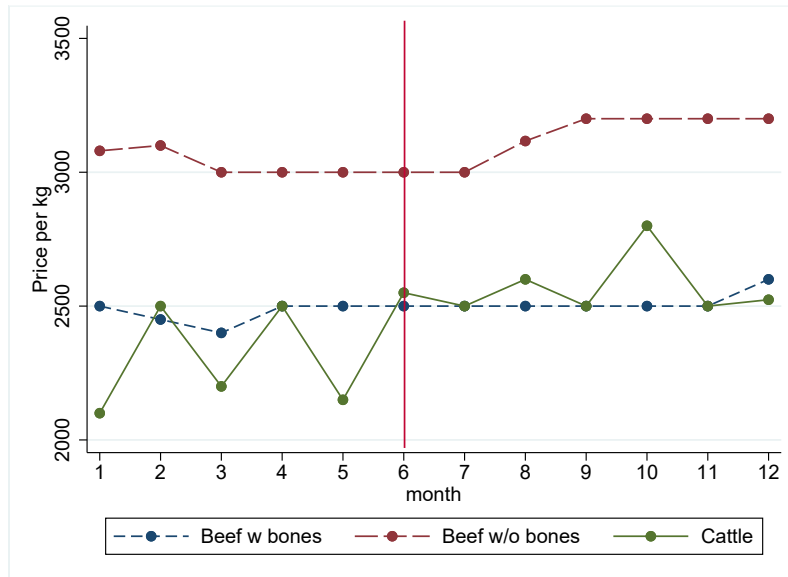
6.4 Incidence on other sides of the market

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

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.

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 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.[27] 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

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

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.[28] In the absence of large producers, firm fixed costs and time of travel 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.[29]

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 7 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 7) had a negative impact on the average prices of regions catering to Yerevan as opposed to the control region of Synuik.
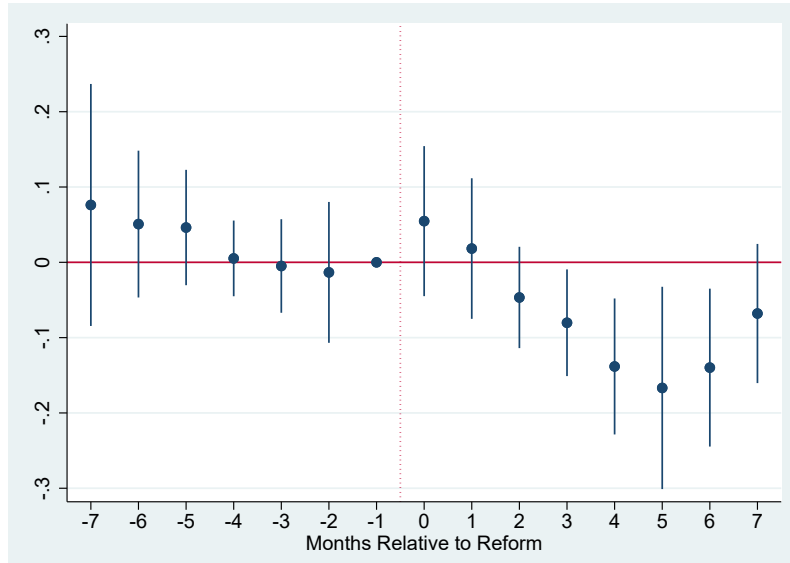
6.4.2   Employees

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.[30] We merge this data with further publicly available registry data on basic characteritics of

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[28]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.

[29]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.

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

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.

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).[31]

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

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

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.

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

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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 7. 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 4).[32] 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.

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[32]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 7: Consumer Responses in Price and Quantity

	(1)	(2)	(3)	(4)	(5)
		Pan	el 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)	(0.000)	(0.001)	(0.010)
Expenditures	0.033***	0.042***	0.019***	0.015***	0.025***
	(0.005)	(0.008)	(0.001)	(0.001)	(0.004)
Adj. R-squared	0.897	0.860	0.346	0.305	0.902
N	59517	41872	398377	286542	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.

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 7. As expected, we observe a drop in expenditures, 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 7, 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 7 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.[33] 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.[34]

7.2 Distributional effects

It is possible that the average treatment effects we have estimatesd 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,[35] and in Table 8 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 8 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,

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

[34]We also estimated specifications where our treatment group includes all meat related products (the control group in columns 2 and 4 of Table 7) and the control group is all remaining food categories. Our estimated coefficient turns out to be very small, indicating that the control group in our regressions is stable. Furthermore, our result change very little if we reestimate all regression in table Table 7 and make all other purchased food as our control group.

[35]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).

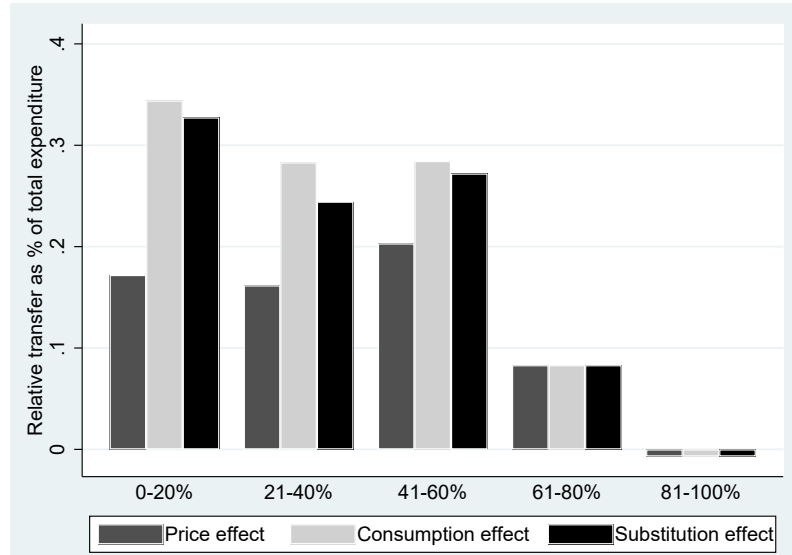**Table 8:** Distributional Responses in Price and Quantity

	(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***	0.012***
	(0.011)	(0.021)	(0.001)	(0.001)
Q2 Treatment (α)	0.039***	0.037*	-0.025***	0.025***
	(0.007)	(0.019)	(0.001)	(0.001)
Q3 Treatment (α)	0.048***	0.028	-0.017***	0.012***
	(0.008)	(0.017)	(0.001)	(0.001)
Q4 Treatment (α)	0.021***	0.026	-0.003	0.035***
	(0.006)	(0.017)	(0.002)	(0.002)
Q5 Treatment (α)	-0.003	-0.006	-0.007***	0.024***
	(0.006)	(0.019)	(0.002)	(0.001)
Expenditures	0.034***	0.042***	0.019***	0.016***
	(0.006)	(0.008)	(0.002)	(0.001)
Adj. R-squared	0.897	0.861	0.347	0.307
N	59517	41872	398377	286553

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.

Fally, and Gonzalez-Navarro (2020), Faber and Fally (2020) where prices are heterogenous across the household income distribution.

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 studying 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

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 8 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 7.

(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 enforcment do not flow back to consumers.

Using the passthrough estimates of column 1 of Table 8 and data on income and expenditure shares of quitiles, the first bars of Figure 9, labeled "Price effect", present mechanical 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 8 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 decimal 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 8 are similar 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.[36] 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. 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

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

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

Table A1: Passthrough Estimates

	without spillovers		with spillovers	
	+	-	+	-
α_0	0.176***		0.200***	
	(0.026)		(0.019)	
α_{+1}	0.025		0.033	
	(0.036)		(0.036)	
$\alpha_{+2/-2}$	0.057***	0.009	0.055***	0.014
	(0.013)	(0.009)	(0.015)	(0.011)
$\alpha_{+3/-3}$	0.051***	0.024***	0.067***	0.028***
	(0.017)	(0.007)	(0.019)	(0.009)
$\alpha_{+4/-4}$	0.038	0.011	0.053*	0.017*
	(0.026)	(0.008)	(0.030)	(0.010)
$\alpha_{+5/-5}$	0.059***	0.027	0.083***	0.029**
	(0.021)	(0.010)	(0.023)	(0.012)
$\alpha_{+6/-6}$	0.056***	0.013	0.080***	0.008
	(0.017)	(0.008)	(0.018)	(0.010)
$\alpha_{+7/-7}$	0.056***	0.021**	0.067***	0.020**
	(0.016)	(0.010)	(0.015)	(0.009)
Adj. R-squared	0.750		0.751	
N	12682		12682	

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.
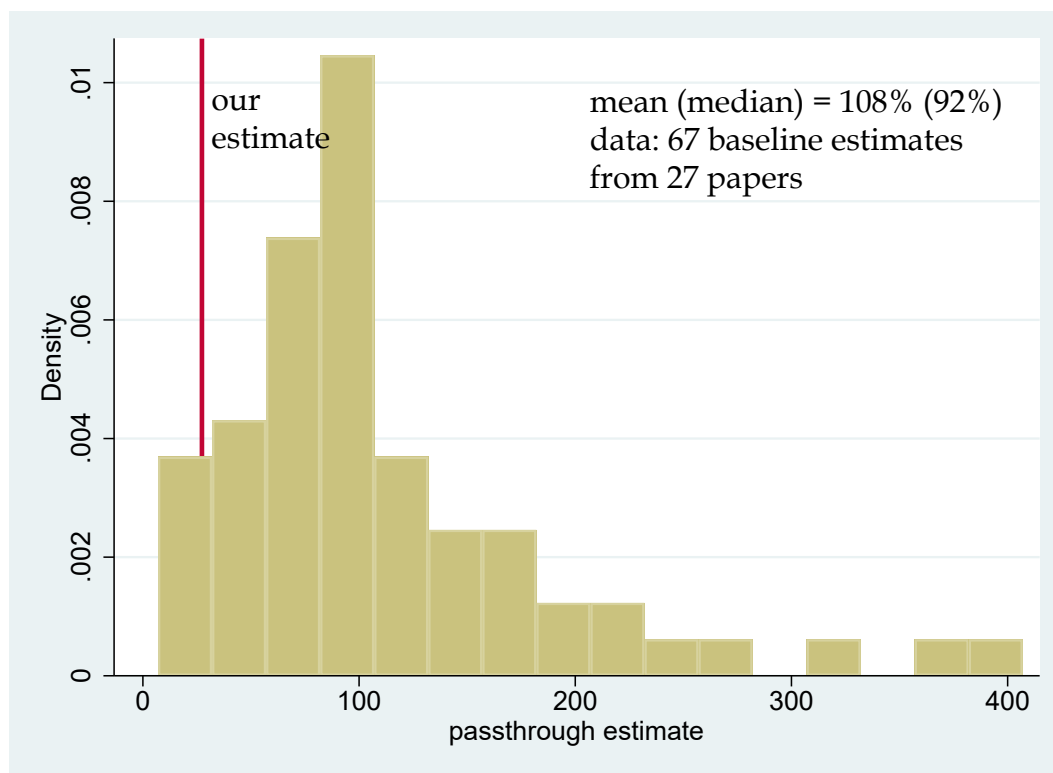
Table A2: Summary of Literature on Consumption Tax Incidence

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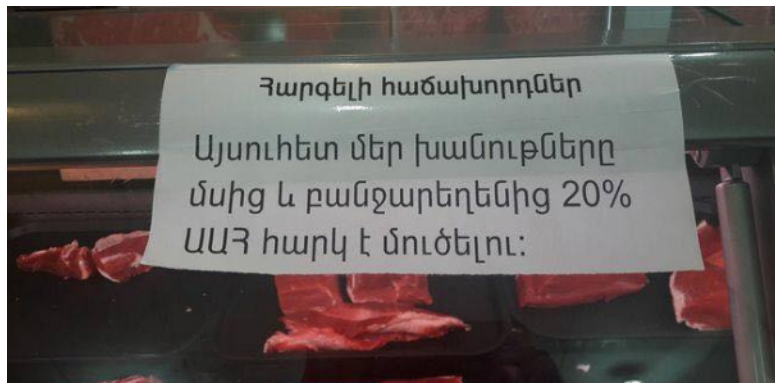
Notes: Passthrough estimates represent the baseline result(s) of each paper according to our judgement.

Figure A1: 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 A2. The vertical line denotes the baseline incidence estimate of this paper obtained from Table 4.

Figure A2: 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

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