VAT collection only at the retail stage: Evidence on tax compliance.

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Abstract

I explore the effects of institutional changes in tax collection on VAT remittances at the retail stage, using data on individual firms' tax files from the universe of German VAT returns. More specifically, I explore if tax evasion increases at the "last mile" due to the implementation of the so-called "reverse charge (RC)" mechanism in Germany. With the implementation of RC, Germany is increasingly removing VAT withholding along the value chain. To identify the effects of RC, I employ an instrumental variable (IV) approach. The IV approach exploits the institutional variation of RC based on the staggered introduction of RC in certain industries. The findings do not indicate that RC leads to greater evasion at the retail stage.

JEL-Classifications: H21; H26; D22

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1 Introduction

More than 160 countries around the world impose a value-added tax (VAT), which raises on average a third of the tax revenues (De Mooij and Swistak, 2022). The global trend towards VAT adoption includes not only developed countries, but also developing countries, which initially sought a substitute for customs revenue when entering trade agreements (Baunsgaard and Keen, 2010; Buettner and Madzharova, 2018). Developing countries are also among the more recent adopters of VAT, which have switched away from sales or turnover taxes (Agrawal and Zimmermann, 2022). Among the reasons for the popularity of VAT as an instrument to raise tax revenues, the literature has emphasized the "self-enforcing" properties of VAT: third party reporting, asymmetric incentives between the buyer and the seller, as well as tax withholding along the value chain, which protects VAT revenues upstream (see Pomeranz, 2015; Naritomi, 2019; Waseem, 2022). Moreover, unlike sales or turnover taxes, VAT does not distort production costs and selling prices because of tax cascading effects (Ring Jr, 1999; Hansen, K. Miller, and Weber, 2022).

Although there are advantages associated with the existence of tax liability along the entire value chain, it is precisely the collection of taxes along the value chain that is increasingly called into question in the European Union (EU). Specifically, the so-called "reverse charge" (RC) mechanism is increasingly removing the withholding of taxes along the value chain (e.g., De La Feria, 2019; Buettner and Tassi, 2023). Tax policymakers hope that this will make cross-border trade easier and make VAT less susceptible to fraud. However, in light of the economic literature, RC should be associated with an increase in VAT evasion.

To date, the application of reverse charge is already widespread. In the EU, all the 27 member states apply RC (Bussy, 2020). Some member states have also expressed interest in a reverse charge that generally applies to business-to-business transactions rather than selected items only (De La Feria, 2019). Moreover, whereas reverse charge was initially planned as a temporary measure, its scope has been extended to a longer period multiple times. Recently, the adoption of reverse charge has been extended until the end of December 2026 (Official Journal of the European Union, 2022). The economic value of transactions affected by the policy is also substantial. In Germany in 2018, for example, the sales falling under reverse charge accounted for around 330 billion euros, just below 10% of German GDP.

In a nutshell, RC involves a shift in VAT liability from the seller to the buyer in business-to-business transactions. With this shift in VAT liability, reverse charge affects the multi-stage collection of VAT as it moves the point of tax collection and tax remittance to the business-to-consumer (or retail) stage. Reverse charge, in other words, transforms VAT back into a retail sales tax (Keen and Smith, 2006; De La Feria, 2019). Hence, whereas the United States remain the only OECD country not applying a VAT (Keen and Lockwood, 2006), EU countries are now taking steps that make VAT more similar to retail sales taxes. As a consequence, the "'last-mile problem" of VAT is aggravated: sales at the retail stage are more difficult to track due to the lack of third-party reported information. It is therefore relatively easier to conceal sales at the retail stage in order to evade taxes (Slemrod, 2007; Naritomi, 2019; Waseem, 2022).

Against this background, this paper explores whether or not VAT evasion increases at the retail stage as a consequence of RC. I first discuss the implementation of RC and how it affects VAT liability and withholding. These aspects in turn relate to the effects on VAT compliance at the retail stage. As RC facilitates evasion by retailers, the main hypothesis is that if they engage more in tax evasion, their reported sales would decline. This hypothesis is tested empirically, by analysing the effects of RC on reported sales. I use data from the German VAT panel (2002-17), a data set that covers the universe of VAT tax files. The data set enables me to identify retailers buying and selling products that fall under the scope of reverse charge. To identify the effects of RC I employ a fixed-effects instrumental variable (IV) model. The IV approach exploits the institutional variation in the adoption of RC, based on the staggered introduction of RC in certain industries. The pre-treatment comparability between affected and non-affected firms in terms of observable characteristics is further improved in robustness checks applying the coarsened exact matching (CEM) algorithm (Blackwell et al., 2009).

The results alleviate concerns that reverse charge causes an increase in evasion at the retail stage. The discussion shows, however, that to date reverse charge applies to products that are predominantly sold in an environment where transactions are difficult to conceal, for example due to electronic payments or because of consumer warranty concerns.

The literature on the effects of reverse charge is still scant. Recent work has focused on the effectiveness of RC in preventing cross-border VAT fraud. Buettner and Tassi (2023) discuss how RC can stop VAT missing-trader fraud and estimate that the volume of VAT fraud was close to

5% of VAT revenues in Germany, before the introduction of the reform. Bussy (2020) shows that RC reduces reporting gaps between intra-community imports and exports, and estimates missing-trader fraud to be around 0.21% of VAT revenues in the EU. Stiller and Heinemann (2023) discuss fraud relocation across EU member states. In contrast to the previous literature, I shift the focus from VAT cross-border fraud to VAT evasion at the retail stage. The novel research question guiding this paper is whether RC aggravates VAT noncompliance at the retail stage or not. Some evidence from a cross-country analysis shows that RC is not related to an improvement of VAT collection efficiency (Madzharova, 2020). The current analysis contributes towards understanding if this aggregated result might be explained by an increase in VAT evasion occurring simultaneously to the declining cross-border fraud.

Beyond the effects of reverse charge, this paper also relates to the literature on the role of tax remittance liability. Slemrod (2008) points out that the standard (textbooks') "irrelevance proposition" might not hold in practice. That is, who remits the tax matters for the economic incidence of taxation and its efficiency. The different opportunities for evasion and avoidance, and the enforcement technology might affect market equilibria, tax incidence, and efficiency (Slemrod, 2008). Chetty, Looney, and Kroft (2009) also show that the economic incidence of a tax is not independent of its statutory incidence. A recent and growing strand of the literature explores (empirically) the effects of changes in tax remittance liability. Kopczuk et al. (2016) study evasion and pass-through of state diesel taxes. They find that moving the point of tax collection upstream is related to a greater volume of taxed gallons, which could be interpreted as decreased tax evasion by retailers. Garriga and Tortarolo (2022) study the effects of reforms to turnover tax withholding in Argentina, documenting that firms affected by more upstream withholding become more tax compliant. The evidence related to VAT is still scant. Pessina (2020) presents some evidence that firms are negatively affected by a reform that shifts VAT remittance liability to "trusted" buyers. The firms that are no longer collecting VAT on their sales are more likely to go out of business or to sell less. My contribution is to provide more evidence on the effects of changes in VAT remittance liability on tax compliance. Differently from Pessina (2020) and the rest of the literature, I investigate the effects of concentrating tax collection downstream, in a setting where multiple agents were liable for tax remittance before the introduction of the reform.

Finally, this paper complements the literature on VAT roll-out and evasion. Asatryan and Gomtsyan (2020) find that large retailers brought into the VAT net in Armenia are less likely to comply with the law and to print receipts. Waseem (2022) finds that an upstream extension of VAT in the supply chain in Pakistan causes a large increase in reported sales by firms downstream, providing some evidence for the importance of the withholding mechanism of VAT. More generally, Agrawal and Zimmermann (2022) investigate the effects of switching from a sales tax to a VAT, in India. First, while these papers focus on the roll-out of VAT, I shed some light on a reform that generates a radical change in the VAT system. These findings might be an important first step in understanding whether the effects of rolling-out or departing from VAT on evasion are symmetrical. Second, differently from these papers, I focus on a developed economy.[1] In contrast to developed economies, developing economies are settings of low enforcement and high informality (Waseem, 2023). They also lag behind with respect to the administrative and auditing infrastructures (Harrison and Krelove, 2005).

2 Conceptual framework

To understand how reverse charge works and why it can affect tax compliance at the retail stage, it is important to understand how it affects tax remittance liability and the reporting of sales and inputs. This section, therefore, first outlines reporting of sales and inputs before and after the introduction of reverse charge.

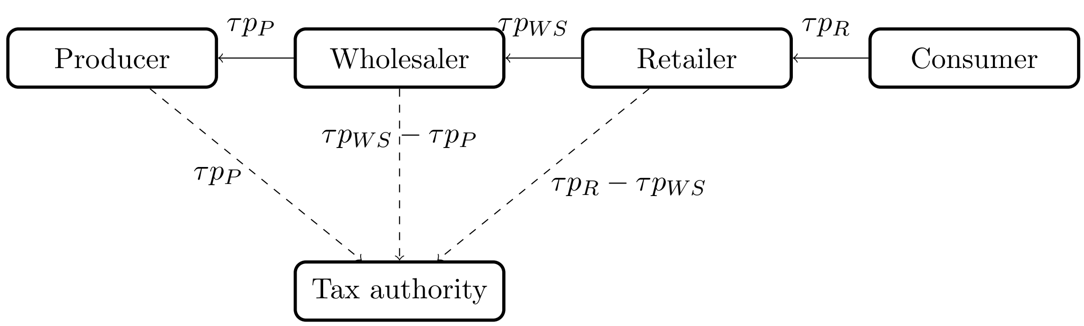
Let us consider a simple supply chain. The example is further illustrated in Figure 1.[2] Under the VAT regime, a producer sells their good and collects output VAT, which they remit to the tax authorities. The buyer, a wholesaler, further sells the good to a retailer. The wholesaler collects output VAT from the retailer, deducts their paid input VAT and remits their net VAT payment to the tax authorities. The retailer sells the good to a final consumer and collects output VAT, which they remit to the tax authorities, after deducting paid input VAT.

Reverse charge shifts the VAT remittance liability from the seller to the buyer in business-to-business (B2B) transactions and it applies at the product level. For example, if the legislator establishes that a good is to be sold under reverse charge, all agents involved in the sale of the

[1] Based on the UN classification (United Nations, 2020).

[2] Figure 1 shows the VAT payment to the upstream seller and the VAT remittance to the tax authority by each agent. Appendix Table C.1 describes the transactions, the VAT payments, remittances, and deductions in more detail.

Figure 1: VAT chain – a simple illustration

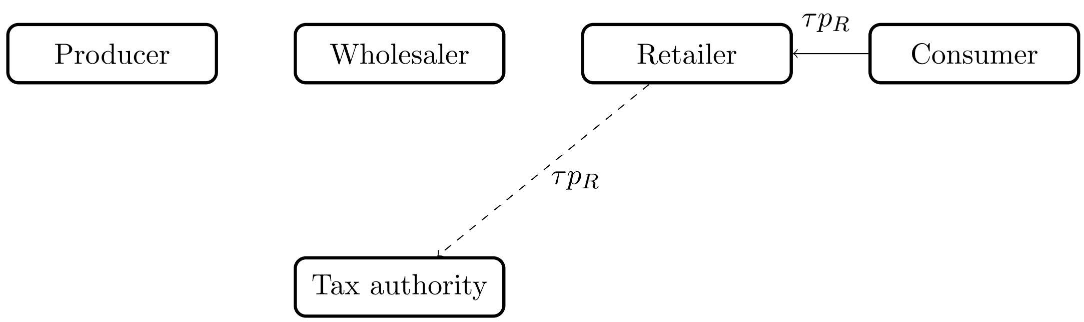


Notes: The trade flow starts from the producer, who sells the product to the wholesaler. The wholesaler sells the product to the retailer, who in turn sells the product to the final consumer. For simplicity we can assume that only one unit of the good x is sold or purchased. The continuous arrows represent the (input) VAT payments to the upstream seller. The dashed arrows represent the VAT remittances by each agent to the tax authority. The sales' values are omitted for simplicity. τ is the tax rate, p_P is the producer's price, p_{WS} is the wholesaler's price, and p_R is the retailer's price.

good are affected by reverse charge. As described next, reverse charge affects the multi-stage nature of VAT collection. In particular, reverse charge affects the withholding mechanism of VAT, since sellers are no longer collecting VAT from their buyers. So, under RC, the producer and the wholesaler no longer collect output VAT and remit it, but they are still expected to report to the tax authorities the sales that took place under reverse charge. The wholesaler and the retailer should also report the VAT liability incurred under reverse charge as buyers. However, the VAT liability on purchases can be netted out with deductible input VAT. The VAT remittance of the wholesaler is thus equal to zero. When selling goods to the final consumer, the retailer is *de facto* collecting VAT from these trades and they remit it to the tax authorities. This implies that the VAT collection is entirely concentrated at the B2C stage. For this reason, the literature describes reverse charge as a measure that transforms VAT into a retail sales tax (Keen and Smith, 2006; De La Feria, 2019). The VAT collection and remittance under reverse charge is illustrated in Figure 2, while Appendix Table C.2 shows reporting and transactions in more detail.

If all firms comply with the rules, the VAT revenues under both regimes are the same. However, the change in the VAT remittance liability following the introduction of RC implies that VAT evasion at the retail stage can become more profitable. In fact, the retailer can evade VAT in larger amounts as compared to the scenario without RC, based on the fact that they do not pay input VAT (to the wholesaler, in the previous example). The maximum amount a retailer can evade under VAT is

Figure 2: VAT chain with Reverse Charge – a simple illustration



Notes: The trade flow starts from the producer, who sells the product to the wholesaler. The wholesaler sells the product to the retailer, who in turn sells the product to the final consumer. For simplicity we can assume that only one unit of the good x is sold or purchased. The continuous arrow represents the VAT payment to the upstream seller. The dashed arrow represents the VAT remittances to the tax authority. The sales' values are omitted for simplicity. τ is the tax rate and p_R is the retailer's price.

$\tau \times (p_R - p_{WS})$, where τ is the tax rate, p_R is the retailer's price, and p_{WS} is the wholesaler's price. This implies that the maximum amount evaded is a function of the retailer's markup, $p_R - p_{WS}$. The maximum amount a retailer can evade under RC, instead, is $\tau \times p_R$ and is greater than possible evasion under a standard VAT regime, as it is a function of the total value added.[3]

This example also illustrates that reverse charge could exacerbate the "last-mile problem" of VAT, since the optimal level of evasion might increase if input VAT is no longer withheld by the supplier (Waseem, 2022). Pomeranz (2015, p. 2544) describes the problem as follows: "The key assumption behind the notion that "self-enforcement" breaks down at the retail stage is that, all else equal, the cost of evasion will be lower at that point than in the middle of the production chain because firm N is not faced by firm N+1 that would want a receipt." Reverse charge, therefore, may increase the optimal level of evasion, at a stage where the costs of tax evasion are relatively lower.

In theory, optimal evasion is also determined by the probability of detection and by the penalty attached to evasion (Sandmo, 2005; Slemrod and Gillitzer, 2014). In relation to these theoretical

[3]This implication hinges on the assumption of unilateral evasion (as compared to collaborative or collusive evasion, see Chang and Lai (2004); Pomeranz (2015)), in which the retailer does not report some transactions to the tax authorities. Collaborative evasion is mostly relevant for household services (Chang and Lai, 2004; Doerr and Necker, 2021) as compared to the case of (high-value) goods discussed in this empirical application, for which consumers might be interested in an invoice or warranty. Everything else equal, however, also allowing for a collaborative decline in prices should result in a reduction of total reported sales.

models, however, it does not seem that RC affects the probability that evasion is detected, nor the penalty attached to evasion.[4]

To reduce their VAT payments and evade VAT, retailers could simply underreport their taxable sales. This is the margin that is easier to manipulate as described by the last-mile problem. Keen and Smith (2006), instead, suggest the possibility that reverse charge might lead to greater VAT fraud as firms might illegitimately increase refund claims, since output tax liability is eliminated. This argument might be relevant for cases in which only outputs (and not inputs) are subject to RC, i.e., for manufacturers or service providers, but not so much for retailers. In B2B transactions it is also the case that a firm should report purchases under RC and the subsequent tax liability (as a buyer) in the VAT returns, but this liability can be netted out by claiming input VAT subject to RC (as shown in Appendix Table C.2). Therefore, firms are rather unlikely to inflate their inputs under RC, unless they assume that there will be no audits/controls for discrepancies within the same return. Any manipulations to inputs would also not coincide with third-party reporting.

The conclusion that retailers can evade VAT by underreporting their sales holds even though there is a paper trail of transactions.[5] It could be argued, however, that under reverse charge the quality of the paper trail itself might be lower. As no input VAT is withheld and can be claimed under reverse charge, there might be little reason to keep a paper trail for B2B transactions subject to reverse charge, except for compliance with the reporting rules. This argument could be generally valid, unless at least one trading party is concerned about third-party liability, which makes one trading party liable for VAT payments by the other party, if in bad faith.[6]

Beyond reverse charge, another factor that can affect reporting and evasion is the size of the firm. Large companies may have reputational concerns and decide not to engage in VAT evasion, as the

[4]For example, we know that efforts in the detection of noncompliance were rather increased for (B2B) cross-border fraud (German Federal Government, 2011), but no publicly available information suggests that particular measures were taken to prevent B2C evasion.

[5]The paper trail relates to third-party reporting and the presence of invoices and documentation along the value chain.

[6]The existence of the principle of third-party liability, in fact, might reduce the risk of evasion and collusion. Government regulation in recent years has attempted to make the buyer of a product liable for the tax payment of the seller (under the VAT regime). If it is proved that trading partners were in bad faith and might have prevented tax fraud or evasion, they may be held liable for the amounts evaded (De La Feria and Foy, 2016). The official birth of third-party liability at EU level is December 2014 (De La Feria and Foy, 2016). In Germany, for example, federal legislation introduced such provisions in 2001 (see Bundesministerium der Finanzen (2020, Section 25d).)

chance that someone might blow the whistle is higher. It is also more difficult to conceal tax evasion and fraud in larger firms. There is thus a greater probability that smaller firms evade or engage into fraudulent activities. Kleven, Kreiner, and Saez (2016) provide some theoretical foundations and some empirical stylized facts for this argument. The size of firms also matters for audit probability. Rhines, Bennett, and Bacht (2003) mention that in Germany general tax audits occur regularly for large firms, while it is not the case for smaller firms. Similarly, it could be argued that evasion might be more difficult to detect in the case of partnerships, as they are subject to less stringent reporting rules as compared to companies, and therefore they might be able to engage in evasion more easily.

In summary, if reverse charge leads to a reduction in compliance of a firm at the retail level, we would observe its reported sales to decline. These effects might be more relevant for smaller firms and partnerships. In the next section, I discuss the implementation of RC in Germany.

3 Institutional background

Reverse charge is a policy instrument that countries in the European Union (EU) and beyond have adopted in the fight against "missing-trader fraud" (Buettner and Tassi, 2023). Missing-trader fraud involves fraudulent traders who disappear without remitting VAT to the tax authorities. This type of fraud is especially a cause of concern in the EU, where missing traders can take advantage of zero-rated cross-border transactions to carry out their fraudulent schemes (Buettner and Tassi, 2023).

Germany has started applying reverse charge in 2002 (Bundesministerium der Finanzen, 2020).[7] This deviation from VAT has gained popularity among policymakers, demonstrated by Germany's request to the European Commission to adopt reverse charge on all transactions (the so-called General Reverse Charge Mechanism, see De La Feria (2019)), which has been refused. Nonetheless and upon the consent of EU institutions, Germany has expanded the list of goods and services subject to reverse charge over time.

[7] See Buettner and Tassi (2023) for an overview. The early applications mostly concerned services and goods provided as security.

For this analysis the identification of firms subject to reverse charge is based on the German VAT Act (*Umsatzsteuergesetz*), which lists goods and services affected by reverse charge; Table 1 shows the relevant amendments. I focus on products (not on services) affected by reverse charge:[8] gold, mobile phones, tablets, game consoles, laptops, and metals (Bundesministerium der Finanzen, 2020, Section 13b).[9] These products are taxed at the standard VAT rate of 19%.[10]

I am able to link the products affected by RC to retailing firms selling them, based on their industry classification. The four identified industries are "retail sale of computers," "retail sale of telecommunication equipment," "retail sales of hardware," and "retail sale of jewellery." For an overview of these industries and their classification, see Appendix Table C.3.[11]

Table 1: Introduction of Reverse Charge in Germany.

Date of implementation	**Reverse charge is applied to...**
1 January 2011	supply of gold.
1 July 2011	supply of mobile phones and integrated circuits.
1 October 2014	supply of tablets, games consoles, laptops, and metals.

Source: adapted from Buettner and Tassi (2023), based on Bundesministerium der Finanzen, 2020, and earlier years.
Notes: As integrated circuits are intermediate goods, they are shown in the table, but they are not relevant for the subsequent analysis.

4 Empirical Method

To estimate the effects of reverse charge at the last stage of the supply chain, I compare retailers that purchase inputs subject to RC –and thus do not pay VAT to their suppliers on these transactions–

[8]This choice is shaped by data availability, as it is not possible to know if service providers incur B2B or B2C sales. On the contrary we can expect retailers to mostly incur B2C sales.

[9]The list of metals includes silver, platinum, iron, steel, copper, nickel, aluminium, lead, zinc, tin, and cermets. See Bundesministerium der Finanzen (2020, Section 13b, Annex IV).

[10]Like other European countries, Germany also applies a reduced VAT rate (7%) to some basic or essential commodities.

[11]The data at industry level supports the view that the identified retailers are relatively more affected by RC, see Appendix Figure C-1.

to other retailers, which are not affected by reverse charge.[12] This enables me to investigate if the change in VAT remittance liability leads to more VAT evasion, measured by the decline in reported sales. This identification strategy has the advantage of comparing similar firms because, despite RC, all retailers are comparably affected by the last-mile problem of VAT.

I estimate the following two-way fixed-effects (FE) model

$$reported\ domestic\ sales_{it} = \alpha_i + \delta_t + \beta RC\ input_{it} + \gamma X_{it} + u_{it}, \tag{1}$$

where α_i is a firm fixed effect, δ_t captures period fixed effects, and u_{it} is an error term. Standard errors are two-way clustered at the industry and at the firm level to allow for correlation of the error term within industries and firms, as these are not necessarily nested due to firms changing industry (Cameron, Gelbach, and D. L. Miller, 2011). X_{it} is a vector of the included control variables: the federal state in which the firm has its legal seat and the legal form (partnership or limited company), which are mostly time-invariant, and two-digit-industry linear time trends. The dependent variable, $reported\ domestic\ sales_{it}$, are sales of firm i at time t.[13] (Reported) *domestic sales* captures the firm's domestic activity, and closely reflects the tax base of the firm.[14] The main regressor captures the extent to which a firm is affected by reverse charge, measured by two alternative regressors. The first is the value of input VAT subject to reverse charge, labelled *RC input*.[15] The alternative regressor is the *RC intensity*, as measured by the share of input VAT subject to reverse charge with respect to all input VAT ($\frac{\text{RC input}}{\text{Input VAT}}$).[16] The reason for exploiting both alternative regressors is that the first relates to the absolute volume of RC inputs, while the second considers the relative importance of RC inputs. Under certain assumptions, the estimated parameter β captures the average RC effects on firms affected by RC. If reverse charge is related to an increase in evasion at the retail stage, β will be negative for domestic sales.

[12]The selection of affected and not affected retailers is discussed in Section 5 in more detail.

[13]The dependent variables are in logs or transformed using the inverse hyperbolic sine. The transformation also depends on the main regressor. While the inverse hyperbolic sine transformation keeps 0 and negative values, the log transformation does not. But comparing the two transformations (see Panel B of Table C.5 and Table C.6) does not reveal major differences for the results.

[14]I construct this variable by subtracting exports from total sales, as exports are not subject to RC. Domestic sales include sales at different VAT rates, sales under reverse charge, as well as some tax-exempted sales. The details on variables' definition can be found in Appendix B.

[15]As *RC input* includes many zeroes, I apply the inverse hyperbolic sine transformation to this variable, and to the outcome variables when I use this regressor, to facilitate the interpretation.

[16]With this regressor, the outcome variables are in logs, except for $\widehat{RC\ sales}$, see footnote 18.

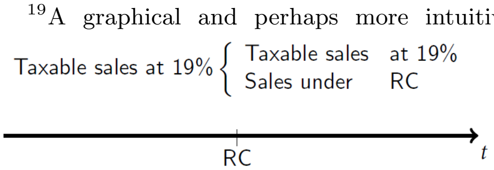
In addition to analysing the effects on *domestic sales*, I separately analyse the effects on two components of *domestic sales*: *Sales at 19%* (the standard VAT rate) and $\widehat{RC\ sales}$. These two components of *domestic sales* are mechanically affected by RC. *Sales at 19%* make up the majority of domestic sales, and exclude sales under reverse charge. The mechanical effect on this variable is due to the fact that, prior to the reform, the sales of goods that would later be affected by RC were reported as *sales at 19%.* After the reform, it is possible that retailers start selling the goods to other businesses under reverse charge.[17] If there is a mechanical decline of *sales at 19%*, β will be negative. The second component of *domestic sales* is $\widehat{RC\ sales}$, which closely captures the sales subject to reverse charge.[18] This category of sales is expected to be zero before the implementation of the reform and to become positive if firms have some B2B sales under reverse charge.[19] The mechanical effect of RC on $\widehat{RC\ sales}$, β, is thus expected to be positive.

The main analysis focuses on RC effects on reported sales, which are the product of the retailer price p_R and quantity x. In other settings, Asatryan and Gomtsyan (2020) and Doerrenberg and Duncan (2019) show that firms might lower their prices in the presence of increased evasion opportunities. At the same time the quantity sold increases.[20] In the context of RC, the baseline expectation is that sales would decline due to underreported transactions, i.e., reported x declines, while p_R remains constant. If, however, we believed that RC increases evasion opportunities, we could expect that RC also induces firms to pass-through lower prices to consumers in the short run. Profits would increase as a consequence in the industries affected by RC, thus we would expect

[17]Although I do not expect retailers to have a large share of business clients and thus of sales under RC, due to their industry classification, it is possible that they do, but retailing remains their main economic activity (Eurostat, 2008). It is also beyond the scope of this paper to establish whether B2B sales reported by retailers are rightful or if they are the consequence of a misclassification.

[18]This variable captures the residual sales, once subtracting sales at 19% and 7% from domestic sales. It also includes tax-free sales and sales at other VAT rates. It does therefore not exactly capture sales subject to reverse charge, but they are indeed an important component of these residual sales. For example, from the VAT data for Germany in 2017 (Destatis, 2019), we can estimate that 53% of the sales in this variable are subject to reverse charge. Due to the data processing and the fact that the agricultural sector is not included, I expect the coverage of RC sales to be even better as compared to economy-wide data. $\widehat{RC\ sales}$ is always transformed with inverse hyperbolic sine, due to the many zeroes for firms that only sell at the standard VAT rate.

[19]A graphical and perhaps more intuitive representation of changes in sales reporting is provided here.



[20]Neither study shows the overall effect on sales, $p_R \times x$.

firm entry over time, which would in turn relate to even lower long-run equilibrium prices in the presence of evasion.

A threat to identification in Equation 1 is represented by the fact that RC input (and, consequently, RC intensity) might be endogenous, i.e., subject to measurement error and simultaneity. First, RC input is reported by firms and can be manipulated. Second, for mobile phones, metals, and computers, reverse charge applies only if the transaction has a value greater than 5000 Euro (Bundesministerium der Finanzen, 2020), which means that RC can also affect the purchasing behaviour of firms to remain below or to exceed the threshold of 5000 Euro. Third, construction services are also subject to RC, implying that if a firm expands in terms of buildings, it is liable for VAT remittance and reports some RC input. This may well be correlated with firm's growth and turnover and may capture fixed costs rather than the extent to which intermediate inputs are subject to RC. Moreover, RC inputs and turnover might be simultaneously determined. These threats to identification also motivate the use of the two alternative regressors, RC input and RC intensity. While the value of input VAT subject to RC (RC input) would be the ideal regressor as it could be used to compute, i.e., revenue losses, it is also more problematic in terms of simultaneity bias.

Given these possible sources of bias, I instrument $RC\ input_{it}$ with a variable that captures the institutional variation in the adoption of RC. The instrumental variable (IV) is a time-varying binary variable, equal to 1 if firm i in industry j is subject to RC in year t, and equal to 0 otherwise. In other words, after policy implementation, the instrument is equal to 1 if a firm belongs to an industry trading products subject to reverse charge. I call this instrumental variable RC policy indicator ($RCPI$). The four industries affected by RC are identified with the help of the VAT Act (Bundesministerium der Finanzen, 2020) and the industry classification at the 5-digit level. The four identified industries are "retail sale of computers," "retail sale of telecommunication equipment," "retail sales of hardware," and "retail sale of jewellery." The first-stage regression thus looks as follows

$$RC\ input_{it} = \psi_i + \theta_t + \pi RCPI_{(i)jt} + \omega X_{it} + \epsilon_{it}, \tag{2}$$

where $RCPI$ only depends on industry j and varies over time depending on the date of implementation of RC.

This IV model estimates a local average treatment effect (LATE)-type parameter: the effect on compliers, that is on firms whose treatment status was changed by the instrument. Given the varied assortment of goods a retailer may offer, it seems plausible to allow for heterogeneous treatment effects, where each firm may respond uniquely to the RCPI-instrument. For this model to produce unbiased estimates, five assumptions need to hold (Cunningham, 2021):

i the stable unit treatment value assumption (SUTVA), which states that the potential outcomes of firm i are unrelated to the treatment status of other firms. In this setting, treatment status relates to the products that one firm sells. Since I am only analysing retailers, which supposedly are not each other's suppliers or trading partners, this assumption is likely to hold;

ii the independence assumption, which states that the instrument is as good as random. Given that reverse charge is implemented to tackle cross-border VAT fraud and B2B transactions, it seems plausible to assume that its application is exogenous to retailers and to their specialization or economic activity. In addition to that, Germany has introduced RC very promptly following the mechanisms available at the EU level;[21]

iii the relevance assumption, which states that the instrument is correlated with the endogenous variable. A priori, a firm affected by reverse charge will report more RC input, and this positive relationship can be explored in the first stage;

iv the monotonicity assumption, which states that all treated firms are affected in the same direction in the first stage;

v the exclusion restriction assumption, which states that any effect of the policy change on $reported\ domestic\ sales_{ijt}$ occurs via RC input (the endogenous variable). A retailer is affected by reverse charge and could perpetrate VAT evasion to a greater extent if and only if it does not pay input VAT to its supplier or, in other words, if it reports positive RC inputs. The exclusion restriction assumption could be violated if, for example, reverse charge also affects

[21] With its proposal in September 2009, the European Commission introduced a list of goods at risk of cross-border VAT fraud with the possibility of applying reverse charge on them (European Commission, 2009). Germany requested the introduction of reverse charge on some of these goods already after two months (European Commission, 2010). The EC's proposal was published in the official journal in January 2011 (Official Journal of the European Union, 2011). The list of goods included in the proposal, on which RC can be applied, has since then been expanded and introduced in the VAT directive (Council of the European Union, 2013).

compliance costs that relate to a decreased real activity or to bankruptcy and that are not captured by RC inputs. Increased compliance costs due to, i.e., keeping two invoicing systems or training the accounting department are most likely related to purchasing items subject to reverse charge in the first place, though. Moreover, compliance fixed costs are likely to be greater in the first period of RC implementation and are likely to be relatively smaller for retailers, which mostly have end customers, as compared to firms buying from and selling to other businesses under RC. As the main analysis mostly focuses on a balanced panel, i.e., firms that do not go out of business nor fall below the VAT threshold, I am less concerned about these issues at the extensive margin.

Before presenting the FE and IV results from Equation 1, it is worth investigating the reduced form of the model and check if there are anticipatory effects of the implementation of reverse charge ($RCPI$) on the outcome variables. Concretely, I estimate Equation 3

$$\textit{reported domestic sales}_{ijt} \;=\; \alpha_i + \delta_t + \sum_{\tau=-12}^{-2} \beta_\tau RCPI_{j\tau} + \sum_{\tau=0}^{6} \beta_\tau RCPI_{j\tau} + \gamma X_{ijt} + u_{ijt}, \quad (3)$$

where, I estimate 6 post-treatment effects (lags) and 11 anticipatory effects (leads) of the RC policy indicator ($RCPI$). The existence of anticipatory, or pre-treatment, effects can be excluded if the leads are not significantly different from zero (Angrist and Pischke, 2008). The excluded period is the first lead, i.e., the period before the implementation of reverse charge ($\tau = -1$).

As shown in Table 1, industries are affected by reverse charge in different years; one cohort since 2011 and one since 2014. Goodman-Bacon (2021) has shown that estimates from Equation 3 may be biased if there is (among others) treatment heterogeneity over time. Treatment homogeneity over time is a strong assumption as it would require the relative-period effects to be constant across cohorts (Sun and Abraham, 2021). This assumption can be violated if there are calendar time-varying effects (Sun and Abraham, 2021). In this analysis, the first cohort is affected by RC during the double-dip of the great recession, while the second is not and this could violate the treatment homogeneity assumption. Therefore, for robustness, I apply the Sun and Abraham (2021) estimator and present reduced-form results that are robust to treatment effect heterogeneity.

5 Data

To study the effects of reverse charge at the retail stage, I use administrative data from the universe of German tax files. Specifically, I use data from the German VAT panel (*Umsatzsteuerpanel*) from 2002 to 2017. This is data at firm level based on the VAT advance returns (*Umsatzsteuer-Voranmeldungen*), which are mandatory reports on taxable sales and VAT-deductible input payments. Firms have to fill in these tax returns on a yearly, quarterly or monthly basis, depending on their turnover. All the firms with a turnover greater than 17,500 Euro have to fill in the VAT advance returns; smaller firms are only required to submit the VAT returns.[22] Despite different reporting frequencies, the data is available on a yearly basis.

The raw data from the VAT advance returns is processed by the statistical offices to generate the VAT panel. A major difference between the VAT panel and the underlying reports is that some variables are combined, i.e., the individual items that firms report in the returns are not always identifiable in the data (see Destatis (2021)). For example, it is not possible to retrieve with precision the volume of sales subject to reverse charge.[23] An advantage of this data set, however, is the available information on firm's characteristics, including its legal form, the number of employees subject to social security contributions, the federal state where the firm has its seat, and whether the firm belongs to a VAT group. Each firm-year observation is assigned a five-digit industry code (NACE classification), which I use to identify the four retail sectors, listed above, selling products subject to reverse charge.

5.1 Data processing and treatment identification

The full data set (2002-17) contains about 50 million firm-year observations, of which I only keep firms in the retail sectors. I drop firms that are neither corporations nor partnerships, as they might face special tax treatments, which could confound my analysis (following Buettner, Madzharova, and Zaddach (2023)). I also drop firms belonging to a VAT group,[24] as joint reporting prevents

[22] The threshold was 16,620 Euro in 2002 and has been set to 17,500 Euro from 2003 onwards.

[23] The form is shown in Appendix Figures C-4 and C-5. The sales subject to reverse charge correspond to items 60 and 68 on page 1 of the advance returns.

[24] In German, *Organschaft*. A VAT group refers to independent businesses that come together to form a taxable unit.

the identification of sales by individual entities (Buettner, Madzharova, and Zaddach, 2023), and special tax rates may apply.

For the definition of the binary instrument in the first stage regression (Equation 2), I identify four industries affected by RC, based on the NACE industry classification (reported in more detail in Table C.3). One challenge to identification is that the industry classification codes have been modified in 2008; the code NACE Rev. 1.1 applied between 2002 and 2008 and NACE Rev. 2 applies since 2009. Three of the treated industries are clearly and uniquely identifiable through the NACE Rev. 1.1 classification or the NACE Rev. 2 classification, which means that these firms can be easily identified and followed over time. For the other industry, "retail sale of computers," I can identify treatment exclusively though the later NACE Rev. 2 classification, which means that I carry the industry code from 2009 backwards (more details in Table C.3). A firm is considered treated if it belongs to a treated industry in all years prior to treatment. A firm is assigned to the control group if it is in a retail sector, but in none of the treated industries, in all periods before the introduction of reverse charge.

I drop all firms that sort in or out of treated industries after the introduction of reverse charge, in order to reduce the self-selection bias due to firms manipulating treatment.[25] I also drop firms in the sectors "retail sale in non-specialized stores," "other retail sale of new goods in specialized stores," "retail sale of other second-hand goods in stores," "retail sale via stalls and markets of other goods," "retail sale via mail order houses or via Internet," and "other retail sale not in stores, stalls or markets," as their main specialization is unclear and I would need to make strong assumptions concerning their treatment status (i.e., concerning the products they sell). I work with a balanced panel containing 78,090 firms, in order to reduce confounding effects due to firms exceeding or falling below the VAT threshold only in some years, or due to firm entry or exit.

5.2 Descriptive statistics

Table 2 shows descriptive statistics for firms in sectors affected by reverse charge (Panel A), and separately for firms in industries not affected by reverse charge (Panel B). The first three rows of each panel refer to the main dependent variables, where we can observe that *sales at 19%* make

[25]I nevertheless present robustness results for a panel including firms that switch industry in Table C.5. Switching industry is not a widespread phenomenon, as less than 1% of firms in the balanced panel do so.

up most of domestic sales for both groups, while the sales subject to RC ($\widehat{RC\ sales}$) are clearly a more important component of sales for the affected firms (Panel A).

Table 2 also reports the VAT on inputs (*Input VAT*) that a firm can deduct to compute its VAT remittance, and the main regressors; deductible input VAT related to transactions subject to RC (*RC input*) and the share of RC input of all input VAT (*RC intensity*). RC intensity is on average more than twice as great for the firms affected by the reform, but it is overall small, i.e., < 1%.[26]

The last two items reported are *Affected by RC*, an indicator equal to 1 if a firm is subject to reverse charge and equal to 0 otherwise, and *Employees*, which measures the number of employees subject to social security contributions as of the 31 of December of each year and is taken from the Company Register (Destatis, 2021). From Table 2 we can derive that 8.7 % of all firms are affected by reverse charge and that firms affected by reverse charge are on average smaller than other retailers in terms of employees and turnover.

[26] At least partly, this can be explained by the threshold for RC transactions (see Section 4). Moreover, RC only affects part of a firm's inputs and it does not apply to all goods in all periods of the panel.

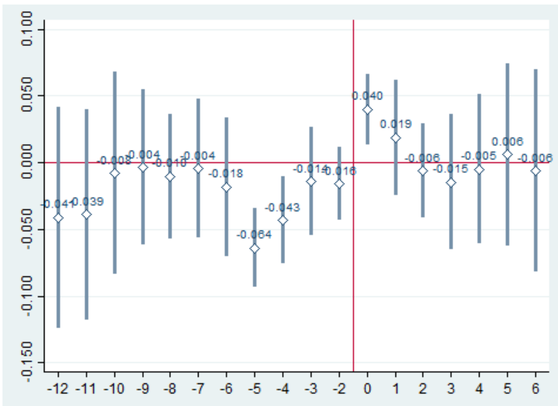
Table 2: Descriptive statistics.

	Mean	SD	N
Panel A - Retailers subject to RC			
Domestic sales (in €)	716,817.117	3,200,648.632	108,448
Sales at 19% (in €)	691,590.321	3,051,695.811	108,356
$\widehat{RC\ sales}$ (in €)	21,230.985	420,675.457	108,448
Input VAT (in €)	99,392.929	545,775.581	107,886
RC input (in €)	2,539.713	104,760.597	107,886
RC intensity	0.008	0.070	107,886
Employees	4.263	16.379	81,899
Affected by RC	1.000	0.000	108,448
Panel B - Other retailers			
Domestic sales (in €)	1,276,681.036	11,545,436.832	1,140,992
Sales at 19% (in €)	1,143,142.777	11,195,285.942	1,131,747
$\widehat{RC\ sales}$ (in €)	5,589.532	203,784.602	1,140,992
Input VAT (in €)	174,593.999	1,733,378.454	1,131,297
RC input (in €)	1,355.898	81,040.855	1,131,297
RC intensity	0.003	0.030	1,131,297
Employees	7.287	78.917	905,846
Affected by RC	0.000	0.000	1,140,992

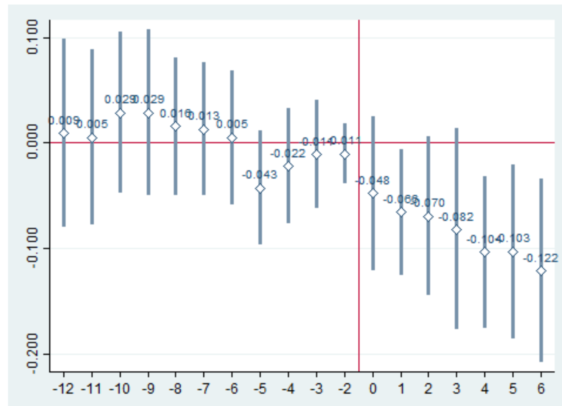
Notes: amounts in € in prices of 2017. Data refer to 78,090 firms. Annual observations for the years 2002-2017. SD stands for standard deviation and N stands for number of observations. *Panel A* shows the average values for the firms in 4 industries subject to reverse charge. *Panel B* shows the average values for all the retailers excluding these 4 industries. *Affected by RC* is an indicator equal to 1 if firm i is subject to reverse charge and equal to 0 otherwise.

6 Results

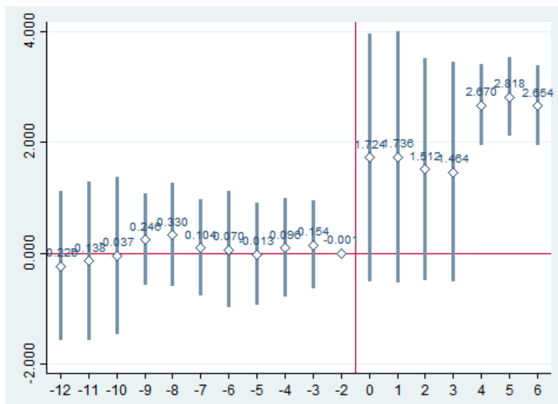
Figure 3: Anticipatory Effects of Reverse Charge.



(a) Domestic Sales



(b) Sales at 19%



(c) $\widehat{RC\ sales}$

Notes: The figure shows the estimated event-study coefficients of the reduced form (Equation 3). The dependent variable is reported in the subtitle and the main regressor is $RCPI$. The dependent variables are in logs, except for $\widehat{RC\ sales}$, which is transformed in inverse hyperbolic sine. The omitted period is the first lead. 95% confidence intervals (based on robust standard errors clustered at the industry level and at the firm level) are also reported.

This section reports the empirical results of the implementation of RC on VAT compliance. If firms evade more VAT after the introduction of RC, this should reflect in the decline of reported domestic sales.

The first piece of evidence relates to the test for anticipatory effects of RC. Figure 3 shows the reduced form estimates, i.e., the estimated coefficients of the instrument, $RCPI$, on the three dependent variables as in Equation 3. We can observe that, with very few exceptions and not close to the RC implementation, there are no significant anticipatory effects of reverse charge on domestic sales (Figure 3a). Moreover, there are no anticipation effects for sales at 19% (Figure 3b), which represent the main portion of sales. While the effects on domestic sales remain mostly not significantly different from zero after the introduction of reverse charge, we observe that sales at 19% decline latest after 4 years following the introduction of reverse charge. The sales subject to RC (Figure 3c), instead, increase during the post period. The Sun and Abraham (2021)'s estimates are shown in Figure C-2 and are largely consistent with the results shown here.

Table 3 shows the baseline results, without covariates, with RC input as main regressor in Panel A and RC intensity in Panel B. Columns 1, 3, and 5 report the FE results, whereas columns 2, 4, and 6 show the FE-IV results. The first-stage results are also reported in Table 3; they show that the policy instrument RCPI is relevant and is positively related to RC inputs, as expected.

In Panel A Column 1, we observe that RC input is positively related to domestic sales. We can observe that the effect of reverse charge on domestic sales remains positive, but not statistically different from zero, once we use the instrument (Column 2). Column 3 shows a positive relationship between RC input and sales at 19%, while the sign is negative for the IV estimates, which are also precisely estimated. These results indicate that increasing RC input by 1% is related to a decrease in sales at 19% by 0.16%.[27] As stated above, however, this decline is likely to be a mechanical effect of RC for retailers incurring B2B sales under RC. To confirm this, we can examine the effects on $\widehat{RC\ sales}$. Column 6 shows that $\widehat{RC\ sales}$ increase with the implementation of RC, and the effect is large. Despite the different magnitude of the estimated effects on sales at 19% and $\widehat{RC\ sales}$ (Columns 4 and 6), the two mechanical effects cancel out as shown by the null effect on domestic sales (Column 2). This can be explained by the fact that sales at 19% made up the vast majority of domestic sales, while $\widehat{RC\ sales}$ have increased substantially from being virtually equal to zero before the introduction of RC.

The results from Panel B show a similar picture: Column 1 and 2 show that RC intensity is positively related to domestic sales, but the IV coefficient is not significantly different from zero. Column 3 shows that RC intensity is positively related to sales at 19%, but this result is not statistically significant. The IV estimate, instead, is large, negative, and statistically significant. A 1 percentage-point (pp.) increase in RC intensity is related to a 13% decline in this category of domestic sales. Column 6 shows that $\widehat{RC\ sales}$ increase with RC intensity, supporting the presence of B2B trade for these retailers.

[27] See Bellemare and Wichman, 2020 for the interpretation of elasticities with hyperbolic sine transformations.

Taken together, these results do not indicate that B2C VAT evasion might occur as a consequence of RC, at least in the German retail sector. The findings rather point towards a different composition of domestic sales after the implementation of RC, as sales at 19% decline, while $\widehat{RC\ sales}$ increase.

Table 3: Effects on sales.

	Domestic sales		Sales at 19%		$\widehat{RC\ sales}$	
	FE	IV	FE	IV	FE	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A						
RC input	0.031***	0.027	0.026***	-0.160***	0.197***	4.388***
	(0.002)	(0.055)	(0.003)	(0.053)	(0.025)	(1.674)
N	1239110	1239110	1229835	1229835	1239110	1239110
First Stage						
RCPI		0.522***		0.519***		0.522***
		(0.080)		(0.081)		(0.080)
F-stat 1^{st}		42.116		41.197		42.116
AR F-test		0.254		7.108		5.806
AR p-value		0.614		0.008		0.016
Panel B						
RC intensity	0.616***	2.536	0.091	-13.085**	6.093***	360.623**
	(0.144)	(4.603)	(0.180)	(5.316)	(1.475)	(182.337)
N	1238883	1238883	1229528	1229528	1239110	1239110
First Stage						
RCPI		0.006***		0.006***		0.006***
		(0.001)		(0.001)		(0.001)
F-stat 1^{st}		33.286		35.080		33.251
AR F-test		0.324		7.059		5.806
AR p-value		0.569		0.008		0.016

Notes: The table shows the estimated coefficients of Equation 1. The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. The dependent variables in Panel A and $\widehat{RC\ sales}$ are in inverse hyperbolic sines, the other variables in Panel B are in logs. Robust standard errors clustered at the industry level and at the firm level in parentheses. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

6.1 Robustness checks

In this subsection, I present some robustness tests for the baseline results. Table 4 shows the results only for the IV regressions, when including covariates (federal state, 2-digit industry-specific time trends, and legal form). The inclusion of industry-specific time trends also helps control for heterogeneities in technological change. These results are consistent with the baseline results without covariates, showing a zero effect on domestic sales and a sharp decline of sales at 19%. Column 3 supports again the conclusion that, while sales at 19% decline, RC sales are increasing, thus explaining the zero effect on domestic sales. Table 4 also shows that firms changing legal status to being incorporated report on average greater sales.

Table 4: Effects on sales - with control variables.

	Domestic sales	Sales at 19%	$\widehat{RC\ sales}$
	(1)	(2)	(3)
Panel A			
RC input	0.007	-0.184***	4.541***
	(0.053)	(0.050)	(1.656)
Incorporated	0.181***	0.256***	-1.734*
	(0.048)	(0.056)	(0.893)
N	1238994	1229719	1238994
First Stage			
RCPI	0.515***	0.511***	0.515***
	(0.080)	(0.081)	(0.080)
F-stat 1^{st}	40.909	39.970	40.909
AR F-test	0.020	9.573	6.042
AR F-test p-value	0.888	0.002	0.014
Panel B			
RC intensity	0.907	-15.111***	374.378**
	(4.432)	(5.336)	(184.142)
Incorporated	0.188***	0.128**	1.446*
	(0.041)	(0.053)	(0.789)
N	1238767	1229412	1238994
First Stage			
RCPI	0.006***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)
F-stat 1^{st}	33.124	34.964	33.089
AR F-test	0.043	9.482	6.042
AR F-test p-value	0.836	0.002	0.014

Notes: The table shows the estimated coefficients of Equation 1. The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. The dependent variables in Panel A and $\widehat{RC\ sales}$ are in inverse hyperbolic sines, the other variables in Panel B are in logs. Robust standard errors clustered at the industry level and at the firm level in parentheses. The included controls are industry-year FE, legal status, and state of registration. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

Next, I apply a coarsened exact matching (CEM) algorithm to improve the pre-treatment comparability between affected and non-affected firms in terms of observable characteristics (Blackwell et al., 2009). The pre-treatment characteristics used in the matching algorithm are the number of employees, the legal form, and the state where the firm has its legal seat. The matching algorithm does indeed improve the comparability between the two groups, as it improves the overall imbalance measure from 0.182 to 0.127 (for details, see Iacus, King, and Porro (2012)). The results estimated with the inclusion of the CEM weights remain consistent with the baseline results, as shown in Table 5.

In the following robustness test, I consider alternative outcome variables that further corroborate

Table 5: Effects on sales - CEM.

	Domestic sales	Sales at 19%	$\widehat{RC\ sales}$
	(1)	(2)	(3)
Panel A			
RC input	0.029	-0.148***	4.257***
	(0.049)	(0.050)	(1.612)
N	1233066	1223806	1233066
First Stage			
RCPI	0.546***	0.542***	0.546***
	(0.083)	(0.080)	(0.083)
F-stat 1^{st}	43.612	45.522	43.612
AR F-test	0.370	7.069	6.009
AR F-test p-value	0.543	0.008	0.015
Panel B			
RC intensity	2.850	-12.785**	368.490**
	(4.358)	(5.220)	(182.304)
N	1232839	1223503	1233066
First Stage			
RCPI	0.006***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)
F-stat 1^{st}	33.164	35.178	33.133
AR F-test	0.459	7.045	6.009
AR F-test p-value	0.498	0.008	0.015

Notes: The table shows the estimated coefficients of Equation 1. The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. The dependent variables in Panel A and $\widehat{RC\ sales}$ are in inverse hyperbolic sines, the other variables in Panel B are in logs. Robust standard errors clustered at the industry level and at the firm level in parentheses. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

the baseline results. The regression results on the alternative outcome variables are shown in Table 6. Column 1 shows the results for VAT-exempted sales, which are a component of *domestic sales* and of $\widehat{RC\ sales}$.[28] The results show that these sales are not affected by RC, therefore supporting the conclusion that sales subject to reverse charge are the component of domestic sales which is positively affected. Column 2 shows the results for *Taxable sales*, another variable I construct, which includes sales at 19% and sales under reverse charge.[29] Like domestic sales, taxable sales should capture B2B sales under RC as well as B2C sales. The IV coefficient for taxable sales is small, negative, but not statistically significant supporting the null-effect on domestic sales.

Table 6: Effects on sales - alternative outcomes.

	VAT-exempted sales	Taxable sales
	(1)	(2)
Panel A		
RC input	-0.126	-0.079
	(0.130)	(0.053)
N	295286	1239110
First Stage		
RCPI	0.707***	0.522***
	(0.127)	(0.080)
F-stat 1^{st}	31.022	42.119
AR F-test	1.017	2.035
AR p-value	0.314	0.154
Panel B		
RC intensity	-6.593	-1.821
	(18.009)	(4.331)
N	64323	1229674
First Stage		
RCPI	0.010***	0.006***
	(0.003)	(0.001)
F-stat 1^{st}	8.514	33.168
AR F-test	0.151	0.170
AR p-value	0.697	0.681

Notes: The table shows the estimated coefficients of Equation 1. The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. The dependent variables in Panel A and $\widehat{RC\ sales}$ are in inverse hyperbolic sines, the other variables in Panel B are in logs. Robust standard errors clustered at the industry level and at the firm level in parentheses. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

Further robustness checks reported in the appendix show that the results are robust to the exclusion of outliers, i.e., firms with a RC intensity smaller than zero or larger than 1 (Table C.4). The results

[28] This is due to how the items in the VAT advance returns are combined in the data set. I refer the reader to Appendix B for details on variables' definition.

[29] Due to variables' aggregation, I cannot subtract "sales at different tax rates" from this variable. This variable excludes tax-free sales and sales at 7% VAT, because RC does not apply to goods taxed at 7% nor to tax-free goods.

are also robust to fewer restrictions on sample selection, allowing for firms that switch industry classification after the introduction of RC (Table C.5).[30] Since standard errors are clustered at the firm and at the industry level, and the industry classification changes in 2009 and may vary over time, I replicate the results by fixing the industry code to 2010 (pre-treatment). The results can be seen in Table C.7 and they are consistent with the baseline results.

Table 7: Effects on input VAT.

	(1)	(2)
RC input	-0.052	
	(0.068)	
RC intensity		-4.445
		(6.098)
Observations	1239110	1238927
First Stage		
RCPI	0.522***	0.006***
	(0.080)	(0.001)
F-stat 1^{st}	42.119	21.891
AR F-test	0.548	0.501
AR F-test p-value	0.459	0.479

Notes: The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. The dependent variable is in hyperbolic sines in Column 1 and in logs in Column 2. Robust standard errors clustered at the industry level and at the firm level in parentheses. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

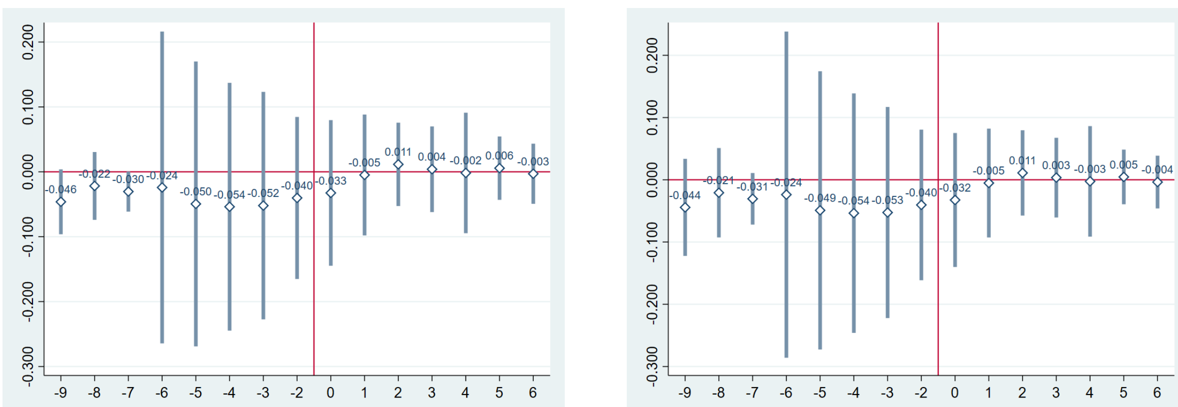
Table 7 shows IV results for deductible inputs as a dependent variable. Assuming that RC makes the paper trail less reliable or that it affects real economic activity, we should observe a decline in input VAT, on top of a decline in sales (which is so far not supported). If RC weakens the paper trail, however, firms could also try to overclaim inputs to evade VAT, causing an increase in input VAT. The coefficients for input VAT are small and negative, but imprecisely estimated. This shows at least that firms do not tend to overclaim input VAT after the introduction of RC, but further conclusions must be drawn carefully.

The last robustness check addresses the point, raised in Section 4, that the focus on reported sales might mask price and quantity effects that could still be consistent with evasion. In particular, we would expect that firms pass through lower prices to consumers if their evasion opportunities increase. The firm-level data does not allow for a separate investigation of prices or quantities. Therefore, I resort to industry-level data on retail prices p_R (2005 to 2017) from Destatis (2023),

[30] Table C.6 additionally shows that results are robust also when the outcome variables are in inverse hyperbolic sines also for the RC intensity, as compared to using log transformations.

that allow me to precisely identify the 4 retail sectors affected by RC, as in the previous analyses.[31] Using the natural logarithm of retail prices ($\ln(p_R)$) as an alternative outcome variable as well as heterogeneity-robust estimators (Sun and Abraham, 2021), I estimate (reduced-form) event-study regressions for the effects of RC introduction on prices. The results are shown in Figure 4. The overall findings support no effect on prices, especially no drop in the price level in the short run, i.e., the first 2 years after treatment. I additionally estimate the effects using the synthetic control approach with staggered adoption (Ben-Michael, Feller, and Rothstein, 2022),[32] following which the average treatment effect (standard error) is 0.009 (0.268). Given an overall null effect on prices, these results also imply no quantity effects, due to the null effect on sales. These tests provide another piece of evidence that RC has not led to greater evasion at the retail stage.

Figure 4: Effects of Reverse Charge on retail prices.



(a) Traditional estimator

(b) Sun and Abraham (2021) estimator

Notes: N = 676. The figure shows the estimated event-study coefficients of the introduction of RC on prices. The dependent variable is the natural logarithm of an industry's prices (2020 is provided as base year (Destatis, 2023)). The main regressor is RCPI. The other included controls on top of year and 5-digit industry fixed effects are the average price within the 3-digit industry sector and 3-digit industry fixed effects. The omitted period is the first lead. 95% confidence intervals (based on robust standard errors clustered at the industry level) are also reported. The change in standard errors between the periods −7 and −6 is consistent with the staggered introduction of the reform.

[31] To the best of my knowledge, data on quantities sold is not available.

[32] The advantage of this approach with respect to traditional synthetic control methods is that it is also robust to the staggered introduction of treatment. Moreover, the researcher is allowed to give more or less weight to improving pre-treatment fit for the average treated unit or across treated units, based on the case at hand. In this application, results are robust to both extreme choices.

6.2 Heterogeneity analysis

The following results explore the role of firm size and legal form for tax evasion. As discussed in Section 2, smaller firms and partnerships might conceal evasion more easily as compared to large firms and corporations. To explore the heterogeneous effects for firms of different size, I split the sample into two groups based on the skewed distribution of the number of employees:[33] small (up to the 90th percentile of the distribution, with approximately < 15 employees), and large (with ≥ 15 employees) firms. The size is assigned based on the number of employees in 2010, thus before the introduction of reverse charge. Table 8 shows the IV results, by firm size. We can see that for both categories there is no decline in domestic sales. These results are not consistent with the hypothesis that evasion in this context might be perpetrated by smaller firms, although the cutoff at the 90th percentile might not necessarily capture very large firms.[34]

Next, I look at the results by legal form. As explained in Section 3, the sample only consists of partnerships and companies and I can analyse the two categories separately, to explore differences in the outcomes related to reverse charge.[35] Here, we could expect evasion to be more prevalent in the case of partnerships, since they are subject to less stringent reporting rules as compared to companies. Table 9 shows the results by legal form, for partnerships (PAR) and companies (INC). We can see that, if anything, the decline of sales at 19% is greater and precisely estimated for partnerships, but in both cases domestic sales do not decline and the increase in residual sales $\widehat{RC\ sales}$ is substantial.

6.3 Unbalanced panel

In this subsection, I explore the effects on the unbalanced panel, which has the advantage including firms that were not present in the panel for the whole period of 16 years. We nonetheless have to acknowledge the fact that the unbalanced panel is more likely to violate the exclusion restriction

[33]Subject to social security contributions.

[34]Alternatively, I use the volume of sales in 2010 to classify firms. Here, I classify as small firms those with sales in the first quartile of the distribution. The rest is classified as large. The results are shown in Table C.8. The two types of classifications deliver different results, probably also related to the group size and to the statistical power. Nonetheless, I do not find a decline in domestic sales for any group.

[35]Classification is based on the legal form in 2010, i.e., prior to the introduction of RC.

Table 8: Effects on sales by size, based on number of employees.

	Domestic sales		Sales at 19%		$\widehat{RC\ sales}$	
	S	L	S	L	S	L
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A						
RC input	0.032	0.040	-0.125***	0.000	4.303***	1.154**
	(0.051)	(0.049)	(0.042)	(0.044)	(1.493)	(0.522)
N	801819	86775	797568	86710	801819	86775
First Stage						
RCPI	0.639***	1.376***	0.636***	1.375***	0.639***	1.376***
	(0.101)	(0.425)	(0.101)	(0.424)	(0.101)	(0.425)
F-stat 1^{st}	40.165	10.486	39.547	10.500	40.165	10.486
AR F-test	0.428	0.792	6.294	0.000	6.840	4.248
AR p-value	0.513	0.374	0.012	0.996	0.009	0.040
Panel B						
RC intensity	3.129	3.994	-11.725**	0.309	405.158**	114.641
	(4.847)	(4.365)	(4.921)	(4.369)	(192.798)	(80.929)
N	801770	86775	797375	86682	801819	86775
First Stage						
RCPI	0.007***	0.014**	0.007***	0.014**	0.007***	0.014**
	(0.001)	(0.006)	(0.001)	(0.006)	(0.001)	(0.006)
F-stat 1^{st}	37.891	5.916	38.496	6.060	37.920	5.916
AR F-test	0.457	0.792	6.255	0.005	6.840	4.248
AR p-value	0.499	0.374	0.013	0.944	0.009	0.040

Notes: The table shows the estimated coefficients of Equation 1. The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. The dependent variables in Panel A and $\widehat{RC\ sales}$ are in inverse hyperbolic sines, the other variables in Panel B are in logs. S represents small firms below the 90th percentile of the distribution of employees and L stands for large firms (with $> p(90)$ employees). Robust standard errors clustered at the industry level and at the firm level in parentheses. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

Table 9: Effects on sales by legal form.

	Domestic sales		Sales at 19%		$\widehat{RC\ sales}$	
	INC	PAR	INC	PAR	INC	PAR
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A						
RC input	0.056	0.021	-0.061	-0.215***	2.454*	5.564***
	(0.047)	(0.070)	(0.046)	(0.058)	(1.479)	(1.417)
N	169996	1069114	169573	1060262	169996	1069114
First Stage						
RCPI	0.556***	0.451***	0.555***	0.448***	0.556***	0.451***
	(0.140)	(0.076)	(0.141)	(0.077)	(0.140)	(0.076)
F-stat 1^{st}	15.771	35.028	15.386	34.173	15.771	35.028
AR F-test	1.862	0.087	1.629	9.263	2.401	7.431
AR p-value	0.173	0.768	0.203	0.002	0.122	0.007
Panel B						
RC intensity	3.902	2.052	-3.671	-18.347***	150.175	477.653**
	(2.722)	(6.101)	(2.997)	(6.362)	(104.793)	(207.878)
N	169928	1068955	169468	1060060	169996	1069114
First Stage						
RCPI	0.009***	0.005***	0.009***	0.005***	0.009***	0.005***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
F-stat 1^{st}	34.47	23.27	33.51	23.94	34.392	23.266
AR F-test	2.38	0.12	1.60	9.23	2.401	7.431
AR p-value	0.124	0.733	0.207	0.003	0.122	0.007

Notes: The table shows the estimated coefficients of Equation 1. The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. The dependent variables in Panel A and $\widehat{RC\ sales}$ are in inverse hyperbolic sines, the other variables in Panel B are in logs. "INC" stands for incorporated, while "PAR" stands for partnership. Robust standard errors clustered at the industry level and at the firm level in parentheses. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

assumption, in case RC-related compliance costs negatively affect firms, which ultimately go out of business. The results from Table 10 show that the probability of entering and exiting the panel are if anything negatively related to reverse charge, but this effect is small and not precisely estimated. This also supports the idea that businesses were not set up after the introduction of RC to evade VAT in the affected sectors.

The results for the unbalanced panel (see Table 11) are largely consistent with the results from the balanced panel, though less precisely estimated.

Table 10: Effects on firm entry/exit.

	P(exit) (1)	P(entry) (2)	P(exit) (3)	P(entry) (4)
RC input	-0.007	-0.033		
	(0.036)	(0.035)		
RC intensity			-0.455	-2.094
			(2.257)	(2.062)
Observations	3718377	3718377	3718372	3718372
First Stage				
RCPI	0.464***	0.464***	0.007***	0.007***
	(0.091)	(0.091)	(0.002)	(0.002)
F-stat 1^{st}	29.454	29.454	20.526	20.526
AR F-test	0.041	0.764	0.040	0.764
AR p-value	0.841	0.382	0.841	0.382

Notes: The table shows the estimated coefficients of the probability of firm entry or exit in the panel. The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. Robust standard errors clustered at the industry level and at the firm level in parentheses. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

6.4 Industry-level evidence for the retail sales of mobile phones

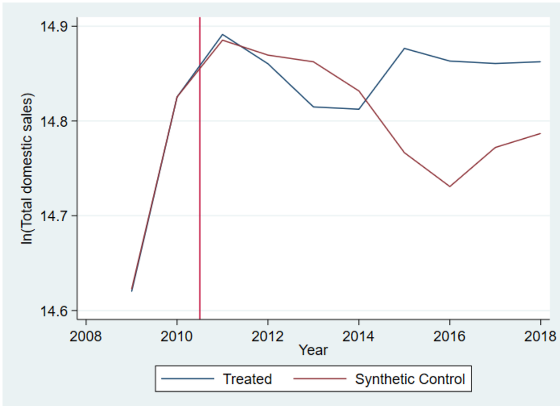
This subsection presents results at the industry level, where the only treated industry is the retail sales of telecommunication equipments, i.e., mobile phones, affected by RC in 2011. The focus on this industry is due to the fact that it shows the highest relative uptake of inputs under reverse charge (see Figure C-1) and is thus the most likely to show any unintended consequences of the policy. To estimate the results on retail sales of mobile phones, I use data at the industry level, also due to the small number of firms in this industry in the balanced panel. Since only one industry is treated, I rely on the synthetic control method to estimate treatment effects (Abadie and Gardeazabal, 2003; Abadie, Diamond, and Hainmueller, 2010). This approach weights potential control observations to create a counterfactual for the treated industry's outcome variables. Due

Table 11: Effects on sales - Unbalanced panel.

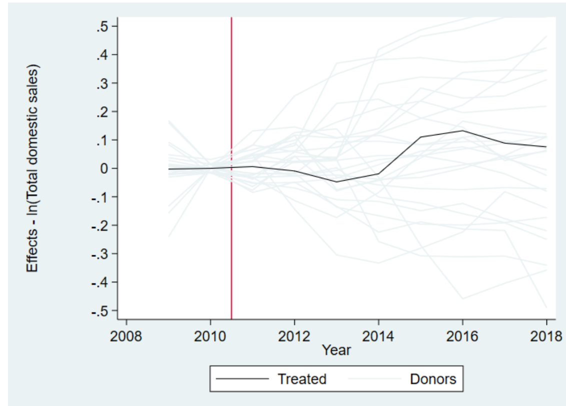
	Domestic sales (1)	Sales at 19% (2)	$\widehat{RC\ sales}$ (3)
Panel A			
RC input	0.113*	-0.107	3.407*
	(0.068)	(0.103)	(1.797)
N	3718377	3640960	3718377
First Stage			
RCPI	0.464***	0.461***	0.464***
	(0.091)	(0.091)	(0.091)
F-stat 1^{st}	25.978	25.770	25.978
AR F-test	2.343	1.158	3.185
AR F-test p-value	0.126	0.282	0.075
Panel B			
RC intensity	7.089*	-6.542	214.180*
	(4.174)	(6.917)	(128.003)
N	3713956	3639601	3718372
First Stage			
RCPI	0.007***	0.007***	0.007***
	(0.002)	(0.002)	(0.002)
F-stat 1^{st}	18.537	18.102	18.500
AR F-test	2.382	1.062	3.185
AR F-test p-value	0.123	0.303	0.075

Notes: The table shows the estimated coefficients of Equation 1. The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. The dependent variables in Panel A and $\widehat{RC\ sales}$ are in inverse hyperbolic sines, the other variables in Panel B are in logs. Robust standard errors clustered at the industry level and at the firm level in parentheses. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

Figure 5: Effects of Reverse Charge.



(a) Development of Domestic Sales



(b) Effects on Domestic sales for retailers of telecommunication equipment and placebo effects for other 26 industries

Notes: The figure uses industry-level data for retailers (2009-2018). These figures result from applications of the synthetic control method. The red vertical line represents the introduction of reverse charge for mobile phones. There are 26 donor industries. The dependent variable is (log) domestic sales. Figure 5a shows domestic sales for the treated industry and the synthetic control. Figure 5b shows the effects of RC on the treated industry (retailers of telecommunication equipment), darker line, and placebo treatments on the donor industries (lighter lines).

to data limitations with this data set,[36] I can use 26 industries in the retail sectors as controls (or donors, excluding the other 3 treated industries). The main outcome variable is *domestic sales*. The variables used to predict domestic sales are inputs and the number of firms in the industry.

Figure 5a shows the development of domestic sales for the treated industry and for the synthetic control. Figure 5b shows the effects of RC on the treated industry and placebo treatments on the donor industries. Even if, at first sight (see Figure 5a), it seems that RC has a positive effect on domestic sales of the treated industry, Figure 5b shows that this result is not significantly different from other placebo treatments.

In the Appendix, I also report results for sales at 19%, inputs and sales subject to reverse charge, which can be precisely measured in this data set (see Figure C-3). This analysis at the industry level comes with a caveat as the evidence can also be influenced by compositional effects. Nonetheless, the results presented here reflect the firm-level evidence that RC does not lead to a decrease in reported domestic sales, while they show that RC sales increase for the affected industry.

[36]In this section, I use industry-level data from the VAT advance returns, from 2009 to 2018.

7 Conclusion

In this paper, I explore the unintended consequences of reverse charge (RC), a policy that the European Union has introduced to stop cross-border VAT fraud. RC implies that the buyer, instead of the seller, is responsible for VAT remittance, thus affecting the withholding mechanism of VAT. In other words, RC transforms VAT back into a retail sales tax. While this policy can be effective in reducing cross-border VAT fraud, the literature has raised the concern that reverse charge might create opportunities for tax evasion at the last stage of the value chain, i.e., at the retail stage (Keen and Smith, 2006; De La Feria, 2019). First, I discuss that, if evasion occurs, we should expect retailers to underreport sales, and thus we would observe a decline in sales following the implementation of reverse charge. Second, I test this hypothesis empirically, by comparing retailers selling products subject to reverse charge to retailers that do not, using data from the universe of German tax files (German VAT panel). The results do not support the hypothesis that RC leads to more evasion at the retail stage, and they are consistent with retailers having some business-to-business trade.

This paper shows that reverse charge does not exacerbate the "last-mile problem" of VAT in the retail sector in Germany. While average effects might not capture one-shot evasion, the event-study results also do not support the concern of widespread VAT evasion after the introduction of RC. Discussing the external validity of these results is thus relevant for the policy implications of the paper, especially since RC will remain in place in the foreseeable future. First of all, in a cross-country analysis of 38 OECD countries, Germany ranks among the lowest quartile in terms of tax evasion (Buehn and Schneider, 2016), which sustains the idea that Germany might not be a low enforcement setting (Waseem, 2023). Moreover, within Germany, some official sources typically mention construction services, restaurants, hotels, etc., as more informal sectors. These are sectors with higher rates of illegal employment, thus evading income taxation and social security contributions (Bundesministerium der Justiz, 2021, Section 2a). In addition to that, for long-term retail purchases, consumers are more likely to use electronic payments, as compared to other industries (Deutsche Bundesbank, 2015, p. 63). This implies that in the industries affected by RC (typically long-term retail purchases) it might be more difficult to conceal sales (Immordino and Russo, 2018). The sectors affected by reverse charge might nonetheless be more formal than others, like hospitality and other services mentioned above. This in turn suggests that we may want to consider industry characteristics (and institutions) when generalising the possible consequences of reverse charge. For example, we cannot conclude from these results that a general reverse charge mechanism (De La Feria, 2019) would also not lead to more VAT evasion.

Another discussion concerns the interaction between retailers and missing-trader (MT) fraud, the type of cross-border VAT fraud that has been tackled with the introduction of reverse charge. If a retailer is involved in MT fraud, they might be consciously colluding or be inadvertently involved in the scheme. In either case, we would expect a (fully) compliant retailer as the gains from the fraud come from claiming the (input) VAT, which was not remitted by the MT. If reverse charge is introduced and MT fraud stops, we would expect an inadvertently-involved business to change supplier. This might have short-term effects on the retailer's performance until a new supplier is found. We do not observe a short-term drop in sales in the analysis, nonetheless. If instead the retailer was purely set up to participate in the fraud scheme, we would observe them to disappear once RC is introduced. Such retailers would not even show up in the analysis with the balanced panel, however, but at the same time firm exit is not significantly affected by RC in the unbalanced panel analysis.

For an overall evaluation of RC we would need to consider the overall revenue effects of RC, due to stopping cross-border fraud and perhaps facilitating VAT evasion at the retail stage. The findings from this study suggest that RC does not aggravate VAT evasion. If we consider them together with the evidence on cross-border fraud presented in Buettner and Tassi (2023), we could conclude that the implementation of RC as of today does not reduce VAT collection in Germany.

The limitations of the current analysis might also guide future research. In the paper, I have highlighted the existence of a threshold for the application of RC. The threshold was mainly introduced not to cause a disproportionate increase in compliance costs for small firms (European Commission, 2010). The role of the threshold as a policy instrument is an aspect that could be further investigated, with more suitable data at transaction level. Using transaction-level data could also be useful to distinguish between business-to-business and business-to-consumer transactions, which is a limitation of the current data set. Even though this analysis focuses on retailers, these firms may still sell some products to other firms rather than only to final consumers. While I present some suggestive evidence for this argument, I remain agnostic about firms misclassifying sales in order to commit a different type of VAT evasion.

Despite its limitations, this paper highlights that the global trend towards VAT adoption has taken a bit of a U-turn in the European Union, where the application of reverse charge on some goods and services affects the self-enforcing properties of VAT and concentrates VAT collection at the retail stage. The analyses and the discussion show that RC does not negatively affect VAT compliance of retailers in high enforcement settings or in settings where cashless payments are prevalent.

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Appendix

Does it matter who remits VAT?
The consequences of reverse charge in the retail sector.

Annalisa Tassi, FAU

Contents

A Additional tables and figures

Table C.1: VAT chain – a simple illustration.

Agent	Sales	Purchases	VAT paid	Input VAT	Remittance
Producer	p_P				τp_P
Wholesaler	p_{WS}	p_P	τp_P	τp_P	$\tau p_{WS} - \tau p_P$
Retailer	p_R	p_{WS}	τp_{WS}	τp_{WS}	$\tau p_R - \tau p_{WS}$

Notes: For simplicity we can assume that only one unit of the good x is sold or purchased. Therefore, "sales" indicates the price at which the firm sells the good. "Purchases" indicates the price at which the firm buys the good. "VAT paid" (on purchase) represents the VAT liability. "Input VAT" is the VAT rebate that the firm is entitled to. "Remittance" indicates the VAT remitted to the tax authorities. τ is the tax rate, p_P is the producer's price, p_{WS} is the wholesaler's price, and p_R is the retailer's price.

Table C.2: VAT chain with Reverse Charge – a simple illustration.

Agent	Sales	Purchases	VAT due	Input VAT	Remittance
Producer	p_P				
Wholesaler	p_{WS}	p_P	τp_P	τp_P	$\tau p_P - \tau p_P = 0$
Retailer	p_R	p_{WS}	τp_{WS}	τp_{WS}	$\tau p_R + \tau p_{WS} - \tau p_{WS} = \tau p_R$

Notes: For simplicity we can assume that only one unit of the good x is sold or purchased. Therefore, "sales" indicates the price at which the firm sells the good. "Purchases" indicates the price at which the firm buys the good. "VAT due" (on purchase) represents the VAT liability. "Input VAT" is the VAT rebate that the firm is entitled to. "Remittance" indicates the VAT remitted to the tax authorities. τ is the tax rate, p_P is the producer's price, p_{WS} is the wholesaler's price, and p_R is the retailer's price.

Table C.3: Industries affected by reverse charge.

Industry	**NACE Rev. 2**	**NACE Rev. 1.1**	**Identification through...**
Retail sale of computers, peripheral units and software in specialised stores	47.41.0	52.49.5	NACE Rev. 2
Retail sale of telecommunications equipment in specialised stores	47.42.0	52.49.6	NACE Rev. 2 or NACE Rev. 1.1
Retail sale of hardware, paints and glass in specialised stores	47.52.1	52.46.1	NACE Rev. 2 or NACE Rev. 1.1
Retail sale of watches and jewellery	47.77.0	52.48.5	NACE Rev. 2 or NACE Rev. 1.1

Notes: NACE Rev. 2 refers to the industry classification implemented from 2009. NACE Rev. 1.1 refers to the industry classification in place between 2002 and 2008. The column "Identification through..." specifies which industry classification I use to identify firms affected by reverse charge. I only use NACE Rev 2. when the corresponding NACE Rev. 1.1 code, though unique, contains multiple industries among which some are not affected by reverse charge. For example, (NACE Rev. 1.1) industry "Retail sale of computers, peripheral units and software in specialised stores" also includes "Assembling of computers for private clients (configuration according to client's wishes)," which corresponds to the NACE Rev. 2 code 26.20.0. I use NACE Rev. 2 or NACE Rev. 1.1 for identification, when both codes refer to exactly the same industry, without including any other industries.

Table C.4: Effects on sales: RC intensity between 0 and 1.

	Domestic sales (1)	Sales at 19% (2)	$\widehat{RC\ sales}$ (3)
Panel A			
RC input	0.025	-0.151***	4.145***
	(0.052)	(0.048)	(1.498)
N	1237711	1228436	1237711
First Stage			
RCPI	0.554***	0.551***	0.554***
	(0.086)	(0.086)	(0.086)
F-stat 1^{st}	41.950	41.017	41.950
AR F-test	0.251	7.130	5.788
AR F-test p-value	0.616	0.008	0.016
Panel B			
RC intensity	2.408	-12.496**	344.106**
	(4.371)	(5.983)	(166.882)
N	1237484	1228183	1237711
First Stage			
RCPI	0.007***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)
F-stat 1^{st}	42.874	36.418	42.832
AR F-test	0.321	5.475	5.788
AR F-test p-value	0.571	0.024	0.016

Notes: The table shows the estimated coefficients of Equation 1. The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. The dependent variables in Panel A and $\widehat{RC\ sales}$ are in inverse hyperbolic sines, the other variables in Panel B are in logs. Robust standard errors clustered at the industry level and at the firm level in parentheses. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

Table C.5: Effects on sales: Sample including industry switchers.

	Domestic sales (1)	Sales at 19% (2)	$\widehat{RC\ sales}$ (3)
Panel A			
RC input	0.027	-0.162***	4.300***
	(0.053)	(0.051)	(1.599)
N	1244868	1235588	1244868
First Stage			
RCPI	0.524***	0.521***	0.524***
	(0.083)	(0.083)	(0.083)
F-stat 1^{st}	39.915	39.114	39.915
AR F-test	0.278	7.698	5.971
AR p-value	0.598	0.006	0.015
Panel B			
RC intensity	2.444	-12.712***	338.985**
	(4.271)	(4.899)	(165.271)
N	1244641	1235281	1244868
First Stage			
RCPI	0.007***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)
F-stat 1^{st}	35.017	36.692	34.992
AR F-test	0.349	7.648	5.971
AR p-value	0.555	0.006	0.015

Notes: The table shows the estimated coefficients of Equation 1. The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. The dependent variables in Panel A and $\widehat{RC\ sales}$ are in inverse hyperbolic sines, the other variables in Panel B are in logs. Robust standard errors clustered at the industry level and at the firm level in parentheses. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

Table C.6: Effects on sales: Inverse hyperbolic sine transformation.

	Domestic sales (1)	Sales at 19% (2)	$\widehat{RC\ sales}$ (3)
RC intensity	2.167	-12.781***	338.985**
	(4.225)	(4.915)	(165.271)
N	1244868	1235588	1244868
First Stage			
RCPI	0.007***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)
F-stat 1^{st}	34.992	36.687	34.992
AR F-test	0.278	7.698	5.971
AR p-value	0.598	0.006	0.015

Notes: The table shows the estimated coefficients of Equation 1. The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. The dependent variables are in inverse hyperbolic sines. Robust standard errors clustered at the industry level and at the firm level in parentheses. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

Table C.7: Effects on sales: Invariant industry.

	Domestic sales (1)	Sales at 19% (2)	$\widehat{RC\ sales}$ (3)
Panel A			
RC input	0.027	-0.160**	4.388*
	(0.066)	(0.062)	(2.285)
N	1239110	1229835	1239110
First Stage			
RCPI	0.522***	0.519***	0.522***
	(0.076)	(0.078)	(0.076)
First-stage F-statistic	47.157	44.785	47.157
AR F-test	0.181	5.463	3.661
AR F-test p-value	0.672	0.024	0.062
Panel B			
RC intensity	2.536	-13.085*	360.623
	(5.527)	(6.509)	(246.388)
N	1238883	1229528	1239110
First Stage			
RCPI	0.006***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)
First-stage F-statistic	26.247	27.723	26.166
AR F-test	0.231	5.455	3.661
AR F-test p-value	0.633	0.024	0.062

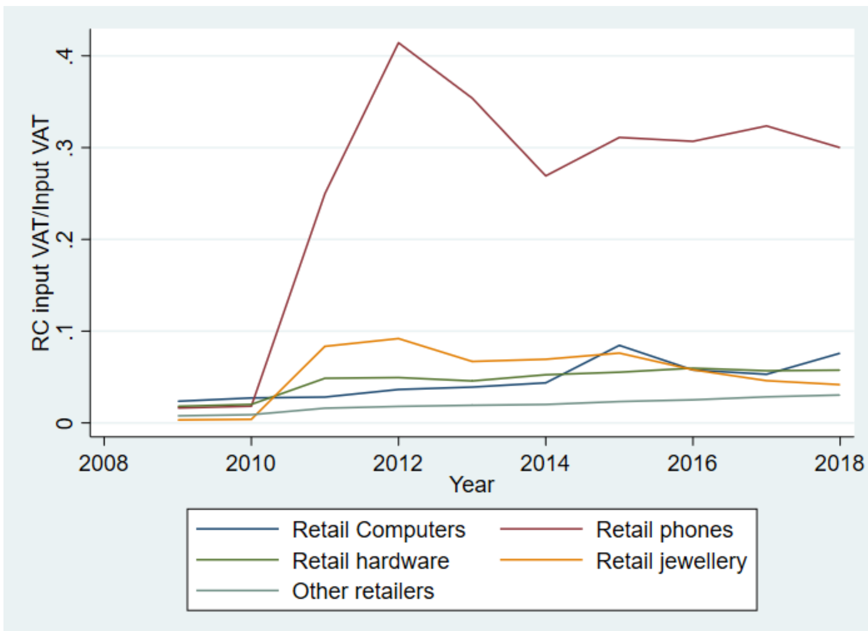
Notes: The table shows the estimated coefficients of Equation 1. The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. The dependent variables in Panel A and $\widehat{RC\ sales}$ are in inverse hyperbolic sines, the other variables in Panel B are in logs. Robust standard errors clustered at the industry level and at the firm level in parentheses. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

Table C.8: Effects on sales by size: Based on sales volume.

	Domestic sales		Sales at 19%		$\widehat{RC\ sales}$	
	S	L	S	L	S	L
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A						
RC input	0.141**	0.034	-0.110	-0.129***	6.542***	3.871**
	(0.063)	(0.051)	(0.078)	(0.043)	(1.477)	(1.519)
N	304209	934901	300585	929250	304209	934901
First Stage						
RCPI	0.236***	0.690***	0.233***	0.688***	0.236***	0.690***
	(0.054)	(0.118)	(0.056)	(0.118)	(0.054)	(0.118)
F-stat 1^{st}	18.853	34.495	17.530	33.971	18.853	34.495
AR F-test	4.481	0.480	1.819	6.617	6.205	5.469
AR p-value	0.035	0.489	0.178	0.010	0.013	0.020
Panel B						
RC intensity	14.694	2.907	-9.925	-10.839**	586.271	328.115**
	(9.019)	(4.339)	(8.021)	(4.346)	(367.539)	(160.957)
N	304096	934787	300542	928986	304209	934901
First Stage						
RCPI	0.003**	0.008***	0.003**	0.008***	0.003**	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
F-stat 1^{st}	5.887	42.183	6.254	42.980	5.874	42.210
AR F-test	5.214	0.487	1.885	6.539	6.205	5.469
AR p-value	0.023	0.486	0.170	0.011	0.013	0.020

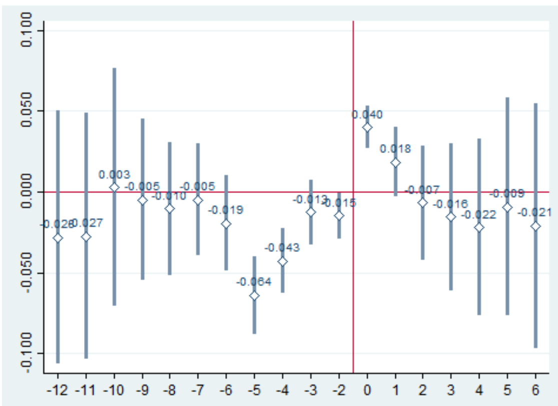
Notes: The table shows the estimated coefficients of Equation 1. The dependent variable is reported in the column header. The first stage regressor, $RCPI$, is a binary variable reflecting the institutional variation of RC. The dependent variables in Panel A and $\widehat{RC\ sales}$ are in inverse hyperbolic sines, the other variables in Panel B are in logs. S represents small firms below the 25th percentile of the distribution of sales in 2010 and L stands for large firms (with $> p(25)$ sales). Robust standard errors clustered at the industry level and at the firm level in parentheses. AR F-Test refers to the Anderson-Rubin (AR) F-test, robust to weak instruments (Baum, Schaffer, and Stillman, 2007). One (*), two (**), or three stars (***) indicate statistical significance at 10%, 5%, and 1% levels.

Figure C-1: RC intensity.

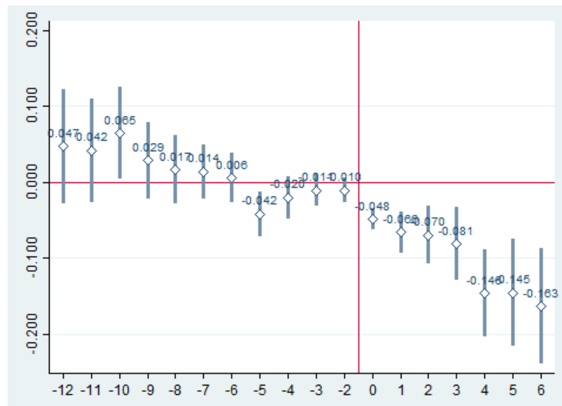


Notes: The figure shows the average RC intensity, as described on the y-axis, for retailers that are affected by RC (see Table C.3) and retailers who are not. This figure is based on the VAT advance returns data, at industry level.

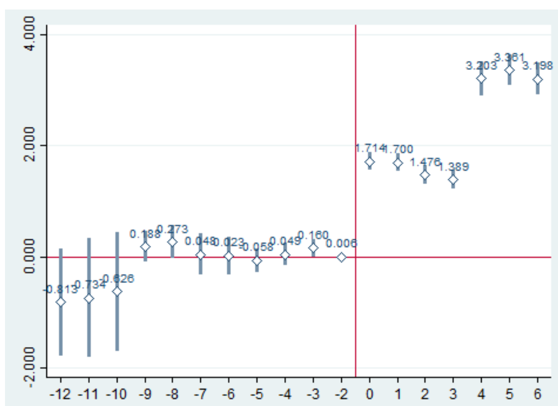
Figure C-2: Anticipatory Effects of Reverse Charge – Sun and Abraham (2021) estimator.



(a) Domestic Sales



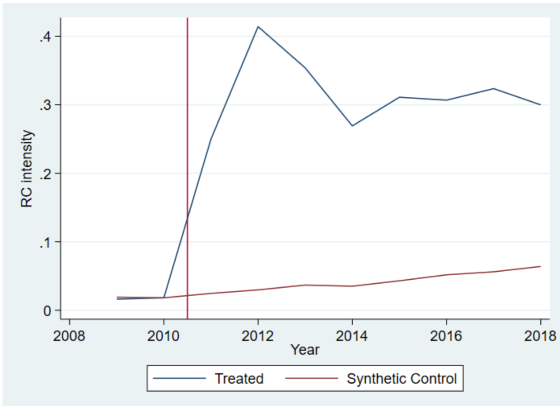
(b) Sales at 19%



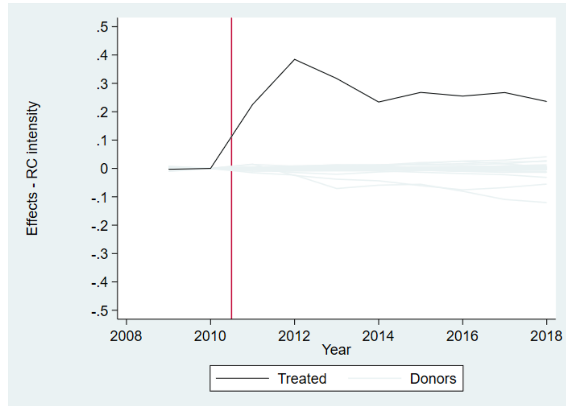
(c) $\widehat{RC\ sales}$

Notes: The figure shows the estimated event-study coefficients of the reduced form (Equation 3) using the Sun and Abraham (2021) estimator. The dependent variable is reported in the subtitle, whereas the main regressor is $RCPI$. The dependent variables are in logs. The omitted period is the first lead. 95% confidence intervals are also reported.

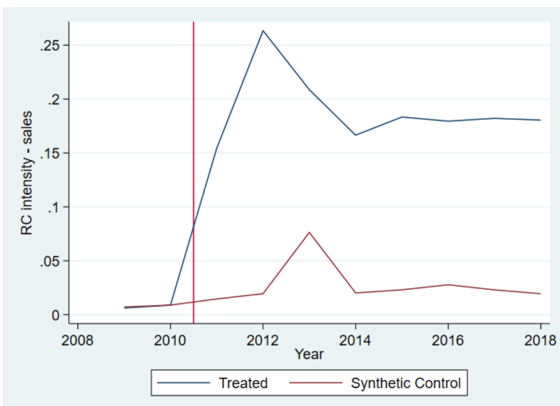
Figure C-3: Effects of Reverse Charge on the Mobile Phone retail sector.



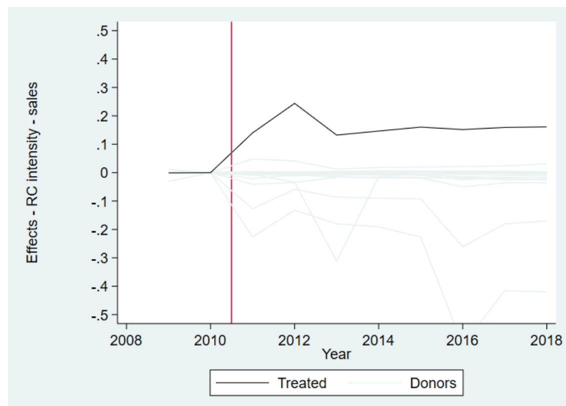
(a) Development of Share of RC Inputs



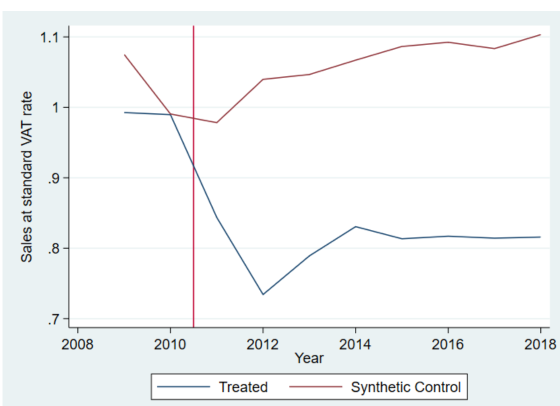
(b) Effects on Share of RC Inputs



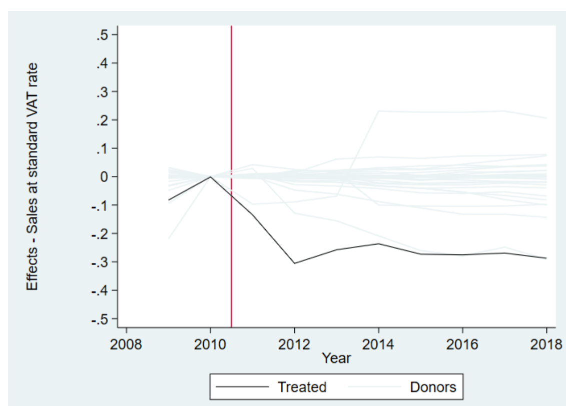
(c) Development of Share of RC Sales



(d) Effects on Share of RC Sales



(e) Development of Share of Sales at 19%



(f) Effects on Share of Sales at 19%

Notes: The figure uses industry-level data for retailers (2009-2018). These figures result from applications of the synthetic control method. There are 26 donor industries. The dependent variables are in logs and are reported under the respective figures. The red vertical line represents the introduction of reverse charge for mobile phones. Figures C-3a, C-3c, and C-3e respectively show the share of inputs and sales subject to reverse charge, and sales at 19% for the treated industry and the synthetic control. Figures C-3b, C-3d, and C-3f show the effects of RC on the treated industry (retailers of telecommunication equipment), dark line, and placebo treatments on the donor industries (lighter lines).

B Data

The data set used in this study is based on items reported by firms on the VAT advance returns (*Umsatzsteuer-Voranmeldungen*), shown in Figures C-4 and C-5. The single items are typically not available in the data set, as they are usually aggregated. The full details are available in Destatis (2021), while here I focus on the description of variables that I use.

- *Domestic Sales* is a variable that I construct starting from firm's *Total Sales* (the variable is called $ef7$ in Destatis (2021)). From *Total Sales*, I deduct exports to EU countries (items 41 and 44; the variable is called $ef13$ in Destatis (2021)) and other tax-free sales (including exports to third countries, item 43 of the tex returns. The variable is called $ef14$ in Destatis (2021)). *Domestic Sales* thus includes items 35, 42 (included only until 2006), 48, 81, 76, 77 (from 2011), 86, 60, and 68.

- *Sales at 19%* is used as given in the data set (the variable is called $ef9$ in Destatis (2021)). It correspond to item 81 from the VAT advance returns. Note that this variable corresponds to sales at 16% until 2006, since VAT was increased to 19% in 2007, but it applies to the same tax base.

- $\widehat{RC\ sales}$ is a variable I construct by subtracting *Sales at 19%* and *Sales at 7%* from *Domestic Sales*, it does not capture exclusively sales subject to reverse charge, but it is rather a residual part of sales not subject to the standard or reduced VAT rates; items 35, 42, 48, 60, 68, 76, and 77.

- *Input VAT* is used as given in the data set (the variable is called $ef19$ in Destatis (2021)). It includes items 61, 62, 63, 64, 66, and 67 from the VAT advance returns.

- *RC input* is constructed by subtracting deductible input VAT for deliveries and services (items 62, 63, 64, 66) and input VAT on EU imports (61) from *Input VAT*. Thus, it corresponds to item 67.

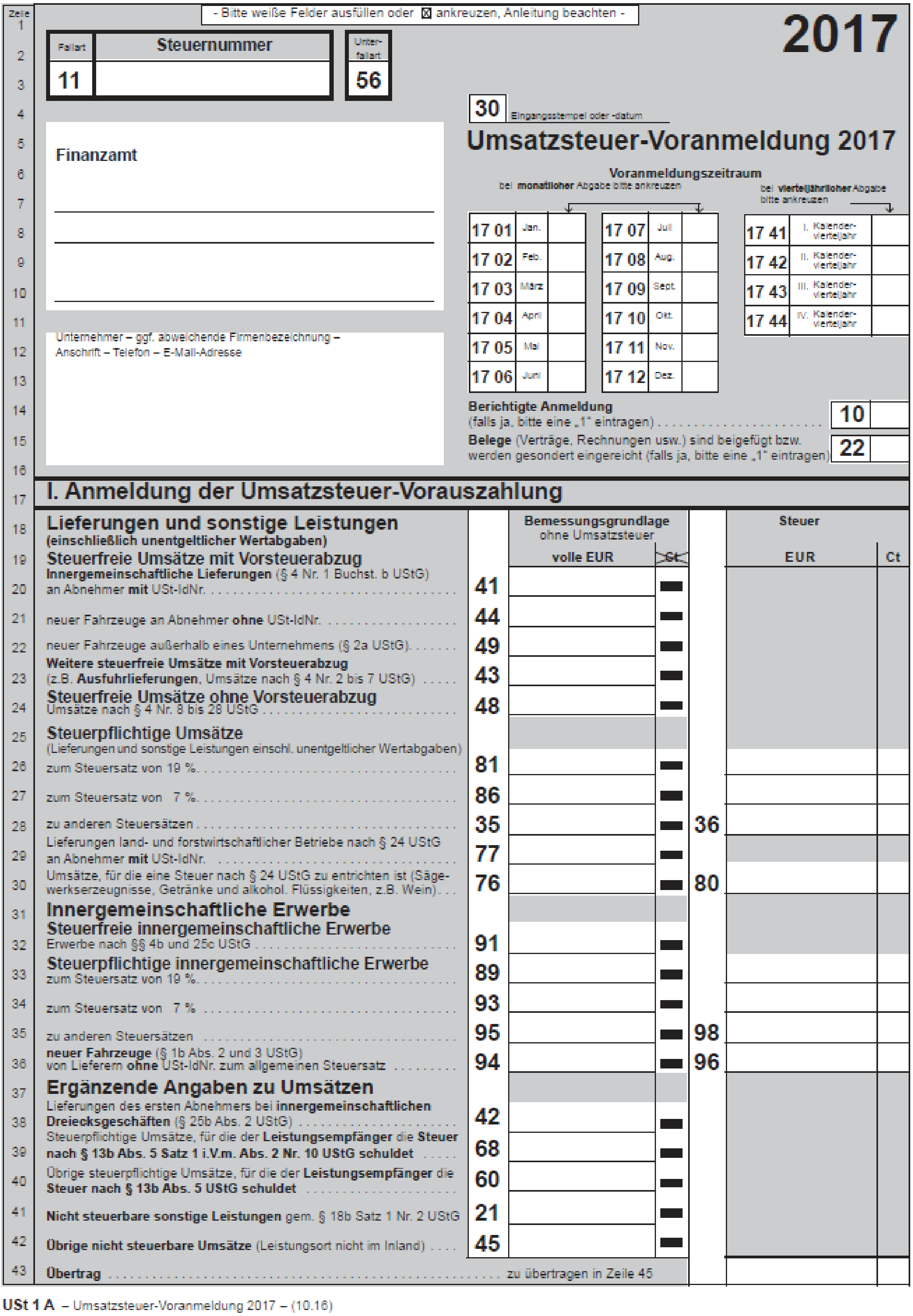
- *RC intensity* is constructed as the share of inputs subject to RC with respect to all inputs $(\frac{\text{RC input}}{\text{Input VAT}})$.

- *Taxable Sales* is another variable I construct from *Total Sales*. I subtract taxable sales at 7% VAT (item 86) and tax-free sales (variable $ef11$ or items 41, 42, 43, 44, and 48) from *Total*

Sales. This variable thus includes items 35, 76, 77 (from 2011), 81, 60, and 68. As reported in Destatis (2021), item 42 is not included in *Total Sales* since 2006, but is included in tax-free sales until 2011, which implies that between 2006 and 2010 item 42 is not included in *Total Sales*, but it gets subtracted nonetheless. Variable $ef8$ in the data set (Destatis, 2021) is also referred to as taxable sales, but it contains sales subject to reverse charge (items 60 and 68) only between 2011 and 2015.

- *Tax-free sales* is constructed starting from tax-free sales ($ef11$ in Destatis (2021)) and subtracting exports to EU countries ($ef13$ in Destatis (2021)) and other tax-free sales ($ef14$ in Destatis (2021)).

Figure C-4: VAT Return Form – Page 1.



- Bitte weiße Felder ausfüllen oder ☒ ankreuzen, Anleitung beachten -

2017

Fallart	Steuernummer	Unter-fallart
11		56

30 Eingangsstempel oder -datum

Finanzamt

Unternehmer – ggf. abweichende Firmenbezeichnung – Anschrift – Telefon – E-Mail-Adresse

Umsatzsteuer-Voranmeldung 2017

Voranmeldungszeitraum

bei **monatlicher** Abgabe bitte ankreuzen — bei **vierteljährlicher** Abgabe bitte ankreuzen

17 01 Jan.		17 07 Juli		17 41 I. Kalender-vierteljahr	
17 02 Feb.		17 08 Aug.		17 42 II. Kalender-vierteljahr	
17 03 März		17 09 Sept.		17 43 III. Kalender-vierteljahr	
17 04 April		17 10 Okt.		17 44 IV. Kalender-vierteljahr	
17 05 Mai		17 11 Nov.			
17 06 Juni		17 12 Dez.			

Berichtigte Anmeldung (falls ja, bitte eine „1" eintragen) 10

Belege (Verträge, Rechnungen usw.) sind beigefügt bzw. werden gesondert eingereicht (falls ja, bitte eine „1" eintragen) 22

I. Anmeldung der Umsatzsteuer-Vorauszahlung

		Bemessungsgrundlage ohne Umsatzsteuer volle EUR		Steuer EUR	Ct
Lieferungen und sonstige Leistungen (einschließlich unentgeltlicher Wertabgaben)					
Steuerfreie Umsätze mit Vorsteuerabzug					
Innergemeinschaftliche Lieferungen (§ 4 Nr. 1 Buchst. b UStG) an Abnehmer **mit** USt-IdNr.	41				
neuer Fahrzeuge an Abnehmer **ohne** USt-IdNr.	44				
neuer Fahrzeuge außerhalb eines Unternehmens (§ 2a UStG)	49				
Weitere steuerfreie Umsätze mit Vorsteuerabzug (z.B. **Ausfuhrlieferungen**, Umsätze nach § 4 Nr. 2 bis 7 UStG)	43				
Steuerfreie Umsätze ohne Vorsteuerabzug Umsätze nach § 4 Nr. 8 bis 28 UStG	48				
Steuerpflichtige Umsätze (Lieferungen und sonstige Leistungen einschl. unentgeltlicher Wertabgaben)					
zum Steuersatz von 19 %	81				
zum Steuersatz von 7 %	86				
zu anderen Steuersätzen	35		36		
Lieferungen land- und forstwirtschaftlicher Betriebe nach § 24 UStG an Abnehmer **mit** USt-IdNr.	77				
Umsätze, für die eine Steuer nach § 24 UStG zu entrichten ist (Sägewerkserzeugnisse, Getränke und alkohol. Flüssigkeiten, z.B. Wein) . . .	76		80		
Innergemeinschaftliche Erwerbe					
Steuerfreie innergemeinschaftliche Erwerbe Erwerbe nach §§ 4b und 25c UStG	91				
Steuerpflichtige innergemeinschaftliche Erwerbe zum Steuersatz von 19 %	89				
zum Steuersatz von 7 %	93				
zu anderen Steuersätzen	95		98		
neuer Fahrzeuge (§ 1b Abs. 2 und 3 UStG) von Lieferern **ohne** USt-IdNr. zum allgemeinen Steuersatz	94		96		
Ergänzende Angaben zu Umsätzen					
Lieferungen des ersten Abnehmers bei **innergemeinschaftlichen Dreiecksgeschäften** (§ 25b Abs. 2 UStG)	42				
Steuerpflichtige Umsätze, für die der **Leistungsempfänger** die **Steuer nach § 13b Abs. 5 Satz 1 i.V.m. Abs. 2 Nr. 10 UStG schuldet**	68				
Übrige steuerpflichtige Umsätze, für die der **Leistungsempfänger** die **Steuer nach § 13b Abs. 5 UStG schuldet**	60				
Nicht steuerbare sonstige Leistungen gem. § 18b Satz 1 Nr. 2 UStG	21				
Übrige nicht steuerbare Umsätze (Leistungsort nicht im Inland)	45				
Übertrag . . . . zu übertragen in Zeile 45					

USt 1 A – Umsatzsteuer-Voranmeldung 2017 – (10.16)

Figure C-5: VAT Return Form – Page 2.

– 2 –

Steuernummer:

					Steuer EUR	Ct
Übertrag						
Leistungsempfänger als Steuerschuldner (§ 13b UStG)		**Bemessungsgrundlage** ohne Umsatzsteuer **volle EUR**	Ct			
Steuerpflichtige sonstige Leistungen eines im übrigen Gemeinschaftsgebiet ansässigen Unternehmers (§ 13b Abs. 1 UStG)	46			47		
Andere Leistungen eines im Ausland ansässigen Unternehmers (§ 13b Abs. 2 Nr. 1 und 5 Buchst. a UStG)	52			53		
Lieferungen sicherungsübereigneter Gegenstände und Umsätze, die unter das GrEStG fallen (§ 13b Abs. 2 Nr. 2 und 3 UStG)	73			74		
Lieferungen von Mobilfunkgeräten, Tablet-Computern, Spielekonsolen und integrierten Schaltkreisen (§ 13b Abs. 2 Nr. 10 UStG)	78			79		
Andere Leistungen (§ 13b Abs. 2 Nr. 4, 5 Buchst. b, Nr. 6 bis 9 und 11 UStG)	84			85		
Steuer infolge Wechsels der Besteuerungsform sowie Nachsteuer auf versteuerte Anzahlungen u. ä. wegen Steuersatzänderung				65		
Umsatzsteuer						
Abziehbare Vorsteuerbeträge						
Vorsteuerbeträge aus Rechnungen von anderen Unternehmern (§ 15 Abs. 1 Satz 1 Nr. 1 UStG), aus Leistungen im Sinne des § 13a Abs. 1 Nr. 6 UStG (§ 15 Abs. 1 Satz 1 Nr. 5 UStG) und aus innergemeinschaftlichen Dreiecksgeschäften (§ 25b Abs. 5 UStG)				66		
Vorsteuerbeträge aus dem innergemeinschaftlichen Erwerb von Gegenständen (§ 15 Abs. 1 Satz 1 Nr. 3 UStG)				61		
Entstandene Einfuhrumsatzsteuer (§ 15 Abs. 1 Satz 1 Nr. 2 UStG)				62		
Vorsteuerbeträge aus Leistungen im Sinne des § 13b UStG (§ 15 Abs. 1 Satz 1 Nr. 4 UStG)				67		
Vorsteuerbeträge, die nach allgemeinen Durchschnittssätzen berechnet sind (§§ 23 und 23a UStG)				63		
Berichtigung des Vorsteuerabzugs (§ 15a UStG)				64		
Vorsteuerabzug für innergemeinschaftliche Lieferungen neuer Fahrzeuge außerhalb eines Unternehmens (§ 2a UStG) sowie von Kleinunternehmern im Sinne des § 19 Abs. 1 UStG (§ 15 Abs. 4a UStG)				59		
Verbleibender Betrag						
Andere Steuerbeträge						
In Rechnungen unrichtig oder unberechtigt ausgewiesene Steuerbeträge (§ 14c UStG) sowie Steuerbeträge, die nach § 6a Abs. 4 Satz 2, § 17 Abs. 1 Satz 6, § 25b Abs. 2 UStG oder von einem Auslagerer oder Lagerhalter nach § 13a Abs. 1 Nr. 6 UStG geschuldet werden				69		
Umsatzsteuer-Vorauszahlung/Überschuss						
Abzug der festgesetzten **Sondervorauszahlung** für Dauerfristverlängerung (nur auszufüllen in der letzten Voranmeldung des Besteuerungszeitraums, in der Regel Dezember)				39		
Verbleibende Umsatzsteuer-Vorauszahlung ...... **(bitte in jedem Fall ausfüllen)** **Verbleibender Überschuss** - bitte dem Betrag ein Minuszeichen voranstellen -				83		

II. Sonstige Angaben und Unterschrift

Ein Erstattungsbetrag wird auf das dem Finanzamt benannte Konto überwiesen, soweit der Betrag nicht mit Steuerschulden verrechnet wird.
Verrechnung des Erstattungsbetrags erwünscht / Erstattungsbetrag ist abgetreten (falls ja, bitte eine „1" eintragen) — 29
Geben Sie bitte die Verrechnungswünsche auf einem gesonderten Blatt an oder auf dem beim Finanzamt erhältlichen Vordruck „Verrechnungsantrag".

Das **SEPA-Lastschriftmandat** wird ausnahmsweise (z.B. wegen Verrechnungswünschen) für diesen Voranmeldungszeitraum **widerrufen** (falls ja, bitte eine „1" eintragen) — 26
Ein ggf. verbleibender Restbetrag ist gesondert zu entrichten.

Über die Angaben in der Steueranmeldung hinaus sind weitere oder abweichende Angaben oder Sachverhalte zu berücksichtigen (falls ja, bitte eine „1" eintragen) — 23
Geben Sie bitte diese auf einem gesonderten Blatt an, welches mit der Überschrift **„Ergänzende Angaben zur Steueranmeldung"** zu kennzeichnen ist.

Hinweis nach den Vorschriften der Datenschutzgesetze:
Die mit der Steueranmeldung angeforderten Daten werden auf Grund der §§ 149, 150 der Abgabenordnung und der §§ 18, 18b des Umsatzsteuergesetzes erhoben. Die Angabe der Telefonnummern und der E-Mail-Adressen ist freiwillig.

Bei der Anfertigung dieser Steueranmeldung hat mitgewirkt:
(Name, Anschrift, Telefon, E-Mail-Adresse)

Datum, Unterschrift

- nur vom Finanzamt auszufüllen -

11 | 19

12

Bearbeitungshinweis

1. Die aufgeführten Daten sind mit Hilfe des geprüften und genehmigten Programms sowie ggf. unter Berücksichtigung der gespeicherten Daten maschinell zu verarbeiten.
2. Die weitere Bearbeitung richtet sich nach den Ergebnissen der maschinellen Verarbeitung.

Datum, Namenszeichen

Kontrollzahl und/oder Datenerfassungsvermerk

C VAT remittance by retailers

In this section, I describe the transactions and VAT remittance by retailers before and after the introduction of reverse charge under different assumptions. Let us start from the simplest case, in which a perfectly competitive retailer buys inputs at value $p_{WS}z$, where p_{WS} is the price charged by the wholesaler (the supplier) and z is the volume of the goods. Under the VAT regime, the retailer pays $\tau p_{WS}z$ to the wholesaler, where τ is the tax rate. The retailer then sells z to final consumers for $(1+\tau)p_R z$, where p_R is the price charged by the retailer, remitting $\tau p_R z - \tau p_{WS} z = \tau z \underbrace{(p_R - p_{WS})}_{margin}$ to the tax authorities. Let us now assume that reverse charge applies to z. The retailer no longer pays VAT to the wholesaler; it sells z to the final consumer and remits $\tau p_R z - \underbrace{\tau p_{WS} z}_{deductible\ input\ VAT} + \underbrace{\tau p_{WS} z}_{retailer's\ VAT\ liability\ under\ RC} = \tau p_R z$ to the tax authorities.

The retailer's liability as a purchaser cancels out with the deductible input VAT. By taking the difference between the two remittances we get

$$\Delta = \tau p_R z - \tau p_R z + \tau p_{WS} z = \tau p_{WS} z > 0. \tag{C.4}$$

This implies, that under RC the net VAT payment by the retailer should increase.

Next, we allow the retailer to be vertically integrated and to sell x to consumers and y to businesses. Since the firm is classified as a retailer, we can assume that $x > y$, so that most of the firm's activity is at the B2C level. Under VAT, the retailer remits $\tau p_R(x+y) - \tau p_{WS}(x+y)$. Under RC, the same retailer would not be liable for the VAT on its B2B sales. The retailer would remit $\tau p_R x - \underbrace{\tau p_{WS}(x+y)}_{deductible\ input\ VAT} + \underbrace{\tau p_{WS}(x+y)}_{retailer's\ VAT\ liability\ under\ RC} = \tau p_R x$.

By taking the difference between the two remittances we get

$$\Delta = \tau p_R x - (\tau p_R x + \tau p_R y - \tau p_{WS} x - \tau p_{WS} y) = \tau p_{WS} x - \tau y \underbrace{(p_R - p_{WS})}_{margin} > 0, \tag{C.5}$$

since $y < x$ and assuming that the margin is small.

Finally, we allow for behavioral responses whereby the retailer underreports sales x at the value x' when RC applies ($x' < x$), whereas B2B sales remain unaffected. Under VAT, the retailer remits as before $\tau p_R(x+y) - \tau p_{WS}(x+y)$. Under RC, the retailer remits $\tau p_R x'$. Therefore, the difference between the two remittances is

$$\Delta = \tau p_R x' - (\tau p_R(x+y) - \tau p_{WS}(x+y)) = \underbrace{\tau p_R(x'-x)}_{<0 \text{ since } x'<x} + \underbrace{\tau p_{WS} x - \tau y(p_R - p_{WS})}_{\text{mechanical effect as in C.5}}. \tag{C.6}$$

The change in VAT net payment is negative if and only if the behavioral response is larger than the positive mechanical effect in Equation C.6.