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ABSTRACT

The Effect of Unconventional Fiscal Policy on Consumption – New Evidence Based on Transactional Data*

We use novel transaction-level card expenditure data to estimate the effect of the temporary value-added tax (VAT) cut in Germany 2020. We find that the annualized growth rate of expenditures for durables increased by 6 percentage points (pp) during the tax cut, with a particularly strong increase of up to 11 pp for consumer electronics. The expenditure growth rate for semi-durables and non-durables did not change by and large. The estimates imply a consumption multiplier of 0.2 and an elasticity of fiscal revenues to a VAT rate reduction of two thirds.

JEL Classification: D12, E21, E62, E65, H31

Keywords: consumption expenditure, transactional data, temporary VAT cut, unconventional fiscal policy

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1 Introduction

Unconventional fiscal policy allows policy makers to stabilize an economy by engineering a path of consumption taxes. If fiscal policy makers decide to temporarily decrease the value added tax (VAT), this induces intertemporal substitution of consumption similar to a temporarily lower real interest rate engineered by monetary policy makers. As shown by Correia et al. (2013), a suitably chosen path of consumption taxes can be combined with paths of labor taxes and investment subsidies to implement (constrained) optimal allocations and relaxes constraints imposed on monetary policy.

Unconventional fiscal policy is thus particularly attractive in countries, in which conventional monetary policy is constrained by a nominal interest rate at the effective lower bound, or monetary policy cannot be country-specific because it is decided supranationally in a currency union. Indeed, both of these circumstances applied when Germany implemented a temporary VAT cut during the COVID-19 pandemic in the second half of 2020. The goal was to stimulate the economy by temporarily lowering the standard VAT rate by 3 percentage points (pp) from 19% to 16%, and the reduced VAT rate by 2 pp from 7% to 5%.[1]

We contribute to the literature by estimating the effect of the VAT cut on consumption expenditures in Germany, the largest euro area country in terms of GDP and population. We use novel transaction-level data from Fable Data. These data suffer less from measurement error than survey data and allow us to estimate the response for different consumption categories at a higher frequency and a regionally granular level. Our analysis uses information on actual transactions for durables, semi-durables and non-durables. We apply a difference-in-difference approach to identify the consumption response of German households to the VAT cut. As comparison, we use the expenditures of Austrian households which made their consumption decisions in a similar economic environment, generally had similar spending and card-

[1] The reduced rate applied to groceries, books and newspapers, hotel accommodation and short-term rentals (less than six months) of residential properties, and tickets for cultural events and services.

usage patterns, were exposed to the same unconventional monetary policy by the ECB as the German households but not to an analogous VAT cut.

Our goal is to estimate to which extent the VAT cut shifted consumption expenditures across time, across expenditure categories depending on their durability, whether the cut was successful in generating a macroeconomic stimulus and at which fiscal cost. We find that the temporary VAT cut increased the growth rate of durable expenditures the most, as predicted by consumption theory. The growth rate of durable expenditures increased by 6 pp, with a particularly strong increase of up to 11 pp for consumer electronics. For semi-durables and non-durables the consumption growth did not change significantly during the cut.[2] Back-of-the-envelope calculations show that these estimates imply a consumption multiplier of 0.2 and an elasticty of fiscal revenues to a VAT rate reduction of two thirds.[3] Our estimates further suggest that a VAT cut targeted towards durable goods would have provided a much more cost-efficient stimulus, increasing the multiplier by an order of magnitude to 2.5.

As a preview motivating our analysis, Figure 1 shows the difference between Germany and Austria in the share of cards used for durable purchases, at a weekly frequency in the time period of the VAT cut episode.[4] Figure 1 shows a significant increase in the share of cards used for durable purchases in Germany relative to Austria during the temporary VAT cut (shaded in grey in the figure), by up to 1.8 percentage points (pp) towards the end of the cut in December 2020. Subsequently, the difference in the share dropped by 1.4 pp during the first

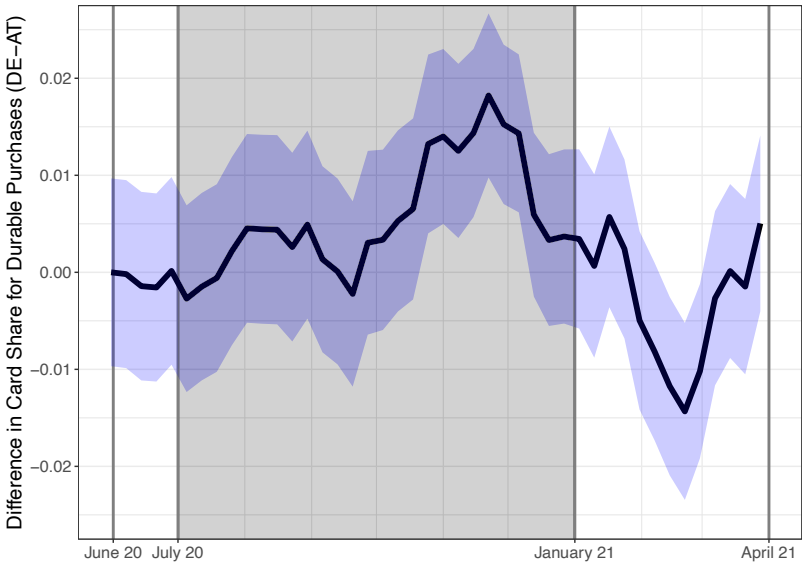
[2]The exception is the last month before the cut ended, in which we find a significant positive effect on expenditures for semi-durables and a marginally significant positive effect on non-durables. Remarkably, the size of the point estimates across goods during that month is largest for durables and smallest for non-durables, as predicted by theory. See Figure 2 in Section 6.

[3]The elasticity would equal 1 without any change of consumption behavior.

[4]We show the share of durable purchases larger than 50 euro. The threshold roughly corresponds to the 75th percentile of the distribution of durable purchases in Austria and Germany in 2019: at the 75th percentile, expenditures amount to 56 euro. The sign and significance (at conventional levels) of the effects in Figure 1 are robust to specifying different thresholds corresponding to the 90th or 99th percentile of that distribution, for example.

quarter of 2021. This first look at the data suggests that the VAT cut had a sizable effect on (durable) spending, which we will analyze in further detail in the rest of the paper.

Figure 1: Difference DE-AT in the share of cards used for durable purchases



Notes: 95% confidence interval shaded in blue. The grey shaded area in the figure corresponds to the period of the VAT cut from July 1 to December 31, 2020. The figure shows the share of cards used for durable purchases larger than 50 euro (see footnote 4). Differences are normalized to zero in June 2020 and smoothed using five-week, two-sided moving averages. The mean share of active cards with durable purchases larger than 50 euro is 31.8% (35.7%) in Germany (Austria). Source: own computations based on Fable Data.

Our analysis proceeds in the following steps. After a brief review of the related literature, we provide institutional background in Section 2 on the VAT cut and the economic environment in Germany and Austria during the sample period. We then illustrate key predictions of consumption theory in Section 3 that provide foundations for the estimated equations before we turn to the empirical analysis. We discuss the data in Section 4 and the estimated specification in Section 5. We present the estimation results in Section 6, discuss possible threats to identification and the macroeconomic implications.

1.1 Related literature

Correia et al. (2013) have emphasized the scope of unconventional fiscal policy for stabilizing the macroeconomy in an environment in which monetary policy is constrained or not available as policy instrument at the national level. Because the path of consumption taxes is a key component of unconventional fiscal policy, this has renewed the interest in the effect of changes in consumption taxes on consumption expenditures.

Compared to the large literature on the effect of monetary policy, empirical evidence on the effects of unconventional fiscal policy is scarce. Blundell (2009) and Crossley et al. (2009, 2014) find that the VAT rate cut in the UK in 2008 helped to mitigate the negative economic impact of the Great Financial Crisis and created a demand stimulus of GBP 2.1 bn (Centre for Economics and Business Research, 2009). Using survey data for European countries, D'Acunto et al. (2022) show that unconventional fiscal policy may be more effective than forward guidance to affect households' expectations and stimulate consumer expenditures. Agarwal et al. (2017) and Baker et al. (2019, 2021) analyze the response to changes in sales taxes in the U.S.[5]

Most closely related to our analysis is the paper by Bachmann et al. (2024) on the German VAT cut in 2020. There are two main differences. Firstly, we rely on novel transaction-level data for durables, semi-durables and non-durables, provided by Fable Data. Exploiting information on actual transactions across a broader set of expenditure items, we provide an alternative perspective on the macroeconomic implications of the VAT cut by complementing the research of Bachmann et al. (2021, 2024) whose estimates are based on survey data as well as scanner data, which are less affected by measurement error and cover non-durables and the subset of semi-durables sold in retail at the point of sale.

[5]See also their references for further literature. Because sales taxes are set at the local city, county or state level, a fiscal stimulus at the national level by changing the sales tax would be more difficult to implement than a change of the VAT set at the national level because it would require coordination of the tax change across states and municipalities.

Secondly, we rely on a different identification. We employ a difference-in-difference approach in the spirit of D'Acunto et al. (2022), exploiting differences in expenditures between Germany and Austria. The estimated effect of the VAT cut thus contains economy-wide expenditure changes in Germany resulting from the VAT cut, with the challenge to control for potential further aggregate shocks which may have affected Germany and Austria differently during the period of interest. In Section 6.2, we discuss potential threats to identification in our analysis. Bachmann et al. (2024) choose an alternative route to identify their effects, by comparing different household groups within Germany. They recover the so-called intercept (i.e., the economy-wide effect of the VAT cut) with structural modeling and the associated assumptions worthy of discussion.[6] Both routes have their merits.

The consumption multiplier of 0.2, implied by our estimates based on transactional data, has the same order of magnitude as the findings by Fuest et al. (2021) based on survey answers of households in 2020, or the findings by Funke and Terasa (2022) and Wollmershäuser et al. (2020) based on structural modeling. The estimates by Bachmann et al. (2024) or the calibrated model by Clemens and Röger (2022) imply a much larger consumption multiplier above 1 instead. A common conclusion is, however, that a VAT cut, which targets durable goods, would be much more effective in stimulating consumption than a general VAT cut covering all types of goods. Indeed, our estimates imply that the multiplier for durable spending would be well above 1 in this case.

A related literature has investigated the pass-through of the VAT cut to prices. Buettner and Madzharova (2021) discuss that the pass-through of VAT rate cuts, previous to the German VAT cut, differs

[6] Bachmann et al. (2024) calibrate a HANK model with durables. As mentioned by Ampudia et al. (2024, p.334), some components of the HANK model such as the New Keynesian Phillips curve and the policy rule may be considered as "weaker components." In their empirical analysis, Bachmann et al. (2024) estimate the effect of the VAT cut by comparing different households groups within Germany. They show that these groups do not differ in terms of observable characteristics but for the extent to which they are informed about the temporary nature of the VAT cut. This innovative identification strategy is threatened if other contemporaneous policy changes affect the compared groups differently. For example, consumers that were well-informed about the temporary nature of the VAT cut may also have been better informed about the ECB's unconventional monetary policy.

substantially across different types of consumption goods. Blundell (2009) finds that the overall pass-through after a VAT rate cut in the UK amounted to 75%. Harju et al. (2018) analyze a VAT rate cut in Finland and Sweden and show that the average pass-through may hide substantial heterogeneity. Kosonen (2015) finds a pass-through of 50% and unchanged quantities after a VAT rate cut in Finland. Jongen et al. (2018) find nearly a full pass-through after a VAT cut in the Netherlands whereas Benzarti and Carloni (2019) provide evidence for only a partial pass-through in the restaurant sector in France. Benzarti et al. (2020) provide evidence for stronger pass-through of VAT increases than decreases. Buettner and Madzharova (2021) instead find that price changes of household appliances after VAT rate cuts across 22 EU member states implied a 100% pass-through within four months after the respective cut. Bernardino et al. (2024) also find a strong pass-through for the VAT cut in Portugal in 2023.

In the context of the VAT cut in Germany in 2020, on which we focus, previous research has documented a large pass-through. Montag et al. (2021) estimate the pass-through to fuel prices in Germany in the first two months after the cut, using France as a comparison where no VAT cut took place. They find a pass-through of 83% for diesel and 61% for gasoline. Fuest et al. (2024) find a pass-through of 70% for groceries using Austria as comparison. Beck et al. (2021) use scanner data and find a pass-through of 76% for non-durable (fast-moving) consumption goods and 96% for durable (slow-moving) consumption goods using the Netherlands as comparison because of the similar market structure in the retail sector. We build on these results and take the pass-through into account when we analyze the effect of the German VAT cut on consumption expenditures.

Research on previous VAT cuts in Europe by Buettner and Madzharova (2021) finds that the decrease of expenditures after the expiration of the VAT cut tends to offset the increase of expenditures during the cut, indicating strong intertemporal substitution of expenditures. Baker et al. (2021) analyze the responsiveness of cross-border shopping to changes of sales tax differences across cities, counties and states in the U.S. They find evidence of intertemporal substitution in the short run but not in

the long run.

The estimate of the short-run elasticity by Baker et al. (2021) implies that retail spending increases by 2% if the VAT rate decreases by 1 pp. Buettner and Madzharova (2021) estimate similarly-sized effects. Our point estimates imply changes in consumption growth of a similar order of magnitude with intuitive heterogeneity across consumption goods. We find that the growth of expenditures on durables increases by 2 pp if the VAT rate decreases by 1 pp (6/3 = 2 if we linearly adjust our estimate based on the 3 pp decrease), whereas the expenditure growth of semi-durables and non-durables is by and large unaffected.

More generally, our paper relates to the literature on the effects of countercyclical fiscal stimulus (see the discussion in Feldstein, 2009) and the literature which exploits micro-level data to provide causal evidence on macroeconomic questions (Fuchs-Schuendeln and Hassan, 2016). In particular, we contribute to the recent strand of research that uses high-frequency transaction data to analyze consumption patterns of households. Gathergood et al. (2020), for example, use transaction data provided by Fable Data for the U.K. to study consumption responses to the COVID-19 pandemic policies, Chetty et al. (2020) use transaction data to analyze the consequences of the pandemic for the U.S. Buda et al. (2022) and Carvalho et al. (2021) exploit transaction data from cards and bank accounts to analyze consumption in Spain and its responses to monetary policy shocks (Buda et al., 2023). Beradini and Renzi (2022) analyze the effect of the COVID-19 pandemic on VAT revenue in Italy. Cabral et al. (2021) analyze the evolution of consumption expenditures during the pandemic in Portugal based on card transaction data. Eichenbaum et al. (2024) use data on VAT-relevant transactions in Portgual to learn about households expectation formation during the pandemic. Using data on debit and credit card transactions, Cevik (2023) finds that a VAT cut for expenditures on restaurant and catering services in Lithuania did not stimulate demand during the pandemic because of simultaneous other policies containing the pandemic.

2 Background on the VAT cut

On June 3, 2020, the German Federal Government announced a VAT cut between July 1 and December 31, 2020. The standard VAT rate was cut by 3 pp from 19% to 16%, and the reduced VAT rate was cut by 2 pp from 7% to 5%. The reduced rate applied to groceries, books and newspapers, hotel accommodation and short-term rentals (less than six months) of residential properties, and tickets for cultural events and services.[7] Exemptions apply to medical treatment of doctors, buying and selling of property, long-term rentals of residential property, intermediation of financial transactions, deliveries to other countries inside the EU or to other third-party non-EU states.

The goal of the VAT cut was to stimulate demand and mitigate the negative economic impact of the COVID-19 pandemic. The effectiveness of such a VAT rate cut is of major policy interest because it may come at a large fiscal cost: 49.6% of the German federal budget and 33% of the combined governmental budget originated from VAT revenue in 2019 (Bundesministerium der Finanzen, 2019).

Because we use consumption growth of Austrian households to control for common changes that have affected household behavior in both countries during the VAT cut episode, it is worth mentioning that no major VAT changes were implemented in Austria during the time period we analyze. Shortly after the German announcement, only a very minor VAT reduction was announced in Austria for the same time period between July 1 and December 31, 2020, as in Germany. The reduction was limited to very few specific expenditure items for which a reduced VAT rate applied: restaurants, hotels, cultural services, and books. The respective reduced rates were lowered from 13% or 10% to

[7] Since January 1, 2020, the reduced rather than the standard rate has been applied also to e-books, e-journals and long-distance train tickets. This change has no relevant effect on the expenditure categories we consider in our analysis. Some further changes in the implementation of the law, effective since January 1, 2020, had the goal to make evasion of VAT more difficult. The changes in expenditures at the beginning of 2020, as illustrated in Figure 3 in Appendix A.2, suggest that this change of the law may have induced a short-lived increase of card expenditures for durables in January 2020 but such an effect is not present for the other expenditure categories semi-durables and non-durables.

5%. The standard VAT rate remained constant at 20% in Austria. For the product categories on which we focus, i.e., durables, semi-durables and non-durables, the changes of the reduced VAT rates in Austria are negligible because either the concerned expenditure items are not included in these categories or, as in the case of books, they only account for a negligible share of expenditures in these categories.[8]

2.1 The pass-through of the tax cut to prices

An important element in the transmission of the VAT cut to consumption growth is the pass-through of the cut to prices. Previous research has shown that the pass-through has been large after the VAT cut in Germany, with a pass-through close to 100% for durable goods contained in the Nielsen scanner data and of about 70% for non-durable goods purchased in supermarkets or fuel (Beck et al., 2021, Fuest et al., 2024, Montag et al., 2021).

The sizable pass-through also shows in the data on price indexes for broader product categories in Germany provided by Eurostat.[9] We find a pass-through of 57% for durables, 49% for semi-durables and 85% for non-durables, accounting for the observed trend in German prices with a one-sided moving average with lags up to twelve months.[10] Table 5

[8] Although most of the expenditure items, to which the reduced VAT rates were applied in Austria, are not included in the product categories we analyze, one may worry about a possible income effect which affects expenditures in the categories we do analyze. In practice, the effect on income has been negligible because (i) expenditure items, to which the reduced rates have been applied, only accounted for 8% of total expenditures and (ii) the pass-through of the VAT cut for these expenditure categories has been minor. Indeed, the minor pass-through has been the political objective of the VAT cut for expenditure categories associated with hotels and restaurants, as illustrated by the following quote from the *Parlamentskorrespondenz Nr. 744* on July 2, 2020: "It's not about making the beer cheaper, it's about leaving more for the bar owners." (Original quote: "Es geht nicht darum, dass das Bier billiger wird, sondern dass den Wirten mehr bleibt.")

[9] HICP monthly data, accessed on November 18, 2022. To compute the pass-through, we use the "Non-energy industrial goods, durables only" index for durables, the "Non-energy industrial goods, semi-durables only" index for semi-durables and the "Processed food excluding alcohol and tobacco" index for non-durables. See Eurostat DataBrowser.

[10] Note that the pass-through is larger for *non*-durables for which we will estimate a *smaller* increase of the consumption growth after the VAT cut. This suggests that the relatively larger effects of the VAT cut on consumption-expenditure growth of

in Appendix A.6 shows that the pass-through is quite similar if we use the price trend in Austria as counterfactual or the price level prior to the announcement of the VAT cut in May 2020. The reason is that there have been no major changes in the evolution of prices in Austria during the VAT cut episode, as illustrated in Figure 6.

Figure 6 in Appendix A.6 illustrates the pass-through for durable, semi-durable and non-durable goods. The pass-through of VAT changes has been strong and symmetric for durables, i.e., strong both after the VAT decrease in July 2020 and after the subsequent increase back to the initial level in January 2021. Instead, the pass-through for semi-durables and non-durables has been strong after the VAT decrease in July 2020 but more sluggish after the increase in January 2021. The sluggish pass-through for semi-durables and non-durables in the first quarter of 2021 is further illustrated in Figure 7 in Appendix A.6, in which we focus on the difference between the respective price index between Germany and Austria, after accounting for trend and seasonality. Beck et al. (2021) and Fuest et al. (2024) also provide evidence for the sluggish pass-through of the VAT increase in January 2021 for non-durable and semi-durable goods, based on scanner data and retail price data.[11]

We check whether the observed differences in the price changes between Austria and Germany can be attributed to the tax cut rather than to unrelated changes in market power. We construct the Herfindahl index, which measures industry concentration, by using the volume of transacted amounts in euro for the respective suppliers per consumption category in the Fable data. Based on this measure, Table 6 in Appendix A.6 shows that there are no significantly different changes in the Herfindahl index between Austria and Germany during the sample period.

We use the series of the price indexes to deflate consumption expenditures, which are expressed in prices of the base month May 2020.[12]

durables, which we report below, would be even larger if the pass-through were homogeneous across consumption goods.

[11] Interestingly, the asymmetric pass-through differs from Benzarti et al. (2020) because the pass-through to the prices of these goods is smaller when the VAT *in*creases back to its initial level.

[12] We build on Buda et al. (2022) and complement their mapping of 835 MCC to

The changes in the consumption-expenditure growth rate, which we estimate, thus reflect changes in quantities rather than prices.

3 Theoretical background

Before we turn to the empirical analysis, we provide theoretical foundations for the estimated equations, which are derived from a simplified, standard consumption-saving model with non-durable and durable consumption goods. Building on Crossley et al. (2009) and, more recently, D'Acunto et al. (2022), the insights from the model allow for a structural interpretation of the estimation results. We refer to Appendix A.12 for the derivation of the key equations below.

3.1 Intertemporal substitution

Assuming a full pass-through of the VAT changes to prices for simplicity, a standard consumption-saving problem implies an intertemporal optimality condition that determines the path of non-durable consumption c_n. The condition can be written in logarithms as

$$\begin{aligned} \Delta \ln(c_{n,t+1}) &= \frac{1}{\sigma_n}\left[\ln\beta + \ln\left(1+r_{t+1}\right) + \ln\left(1+\tau_t^{c_n}\right) - \ln\left(1+\tau_{t+1}^{c_n}\right)\right] \\ &\approx \frac{1}{\sigma_n}\left[\ln\beta + r_{t+1} - \Delta\tau_{t+1}^{c_n}\right], \end{aligned} \tag{1}$$

where we use $\ln(1+x) \approx x$, Δ denotes the difference operator, $\tau_t^{c_n}$ is the time-varying VAT rate for non-durables, r_{t+1} is the real interest rate known in t and paid in $t+1$, β is the discount factor, and $1/\sigma_n$ is the intertemporal elasticity of substitution for non-durable goods.

Note that an anticipated increase in the VAT rate affects non-durable consumption growth in the same way as a decrease in the real interest rate. By affecting the relative price of consuming today versus tomor-

COICOP categories by extending the mapping for the additional 244 MCC present in our data. Details on how to map the price data on the 3-digit COICOP level to granular expenditure categories in our transaction data are provided here.

row, unconventional fiscal policy can stimulate expenditures similarly as conventional monetary policy that transmits to the real interest rate.

Suppose that the temporarily lower VAT rate is implemented at time t and then set to its initial level at time $t+1$, i.e., $\tau^{c_n}_{t-1} = \tau^{c_n}_{t+1} > \tau^{c_n}_{t}$. At the announcement in $t-1$ prior to the implementation in t, $\Delta\tau^{c_n}_{t} < 0$ in Germany. It follows from equation (1) that consumption growth between $t-1$ and t is lower in Germany than in Austria where the VAT is constant so that $\Delta\tau^{c_n}_{t} = 0$. Intuitively, German households shift consumption from $t-1$ to t, because consumption is relatively cheaper in t.

After the implementation in period t instead, $\Delta\tau^{c_n}_{t+1} > 0$ in Germany because of the commitment to increase the VAT rate back to its initial level in $t+1$. Thus, consumption growth between t and $t+1$ decreases in Germany relative to Austria where $\Delta\tau^{c_n}_{t+1} = 0$, again because of the intertemporal shift of consumption towards period t induced by the lower relative price of consumption in t. The higher the intertemporal elasticity of substitution $1/\sigma_n$, the larger the shift.[13]

3.2 Intratemporal substitution towards durables

The intratemporal optimality condition determining the optimal ratio of non-durable over durable consumption reveals two additional theoretical predictions. A temporary VAT cut should have a stronger effect on durable than non-durable consumption, and the effect on durables should be particularly strong towards the end of the temporary cut.

In the time period we analyze, inflation has been negligible for the consumption categories we consider but for the effects of the VAT cut. To focus on the key predictions, we thus assume that prices of consumption goods only change because of the VAT cut. We also assume the same intertemporal elasticity of substitution for durables and non-

[13] To be sure, the change of the consumption *levels* depends on the strength of the income and substitution effect triggered by the relative price change caused by the VAT cut, whereas the effect on the consumption growth rate is unambiguous. As discussed in Crossley et al. (2009), the income effect of temporary VAT cuts tends to be negligible for unconstrained households.

durables, $\sigma = \sigma_d = \sigma_n$.[14] The log-linearized intratemporal optimality condition is then

$$\tilde{c}_{n,t} - \tilde{c}_{d,t} = \frac{1}{\sigma}\left[\alpha + \frac{1+r}{r+\delta}\left(\tilde{\tau}_t^{c_d} - \tilde{\tau}_t^{c_n}\right) - \frac{1-\delta}{r+\delta}\left(\tilde{\tau}_{t+1}^{c_d} - \tilde{\tau}_t^{c_n}\right)\right], \tag{2}$$

where $\tilde{x}$ denotes a deviation in percent of variable x from the reference value prior to the VAT cut episode, δ is the depreciation rate of the durable good, $\tau_{t+1}^{c_d}$ is the VAT for the durable good at time $t+1$, and α is a constant defined in the derivation in Appendix A.12.

Equation (2) shows that a VAT cut may shift consumption towards durables for at least two reasons. Firstly, the cut may be larger for the VAT rate applied to durables than for non-durables. In this case, $\tau_t^{c_d}$ decreases more than $\tau_t^{c_n}$ lowering the price of durables relative to non-durables, as shown in the second term on the right-hand side of equation (2). It is plausible in our application that the cut of the VAT rate is larger for durables than for non-durables because more non-durable items qualify for the reduced VAT rate. This rate has been lowered by 2 pp whereas the standard VAT rate has been reduced by 3 pp, implying $\tilde{\tau}_t^{c_d} - \tilde{\tau}_t^{c_n} < 0$.

Secondly, durables have a resale value in the next period which is discounted to the present. As shown in the third term on the right-hand side of equation (2), a temporary VAT cut increases this value because the VAT rate increases back to its initial value after the cut ends (i.e., the deviation from the value prior to the cut $\tilde{\tau}_{t+1}^{c_d} = 0$) whereas the current VAT rate in period t applied to non-durables decreases ($\tilde{\tau}_t^{c_n} < 0$), so that $\tilde{\tau}_{t+1}^{c_d} - \tilde{\tau}_t^{c_n} > 0$. This second effect becomes stronger if the good is more durable so that the depreciation rate δ is smaller and if the end of the temporary VAT cut is closer so that the interest rate used to discount the effect becomes smaller. Thus, the intratemporal shift of the consumption basket towards durables is predicted to be stronger towards the end of the tax cut episode, and more so for more durable goods that have a lower depreciation rate.[15]

[14] The derivation without such assumptions is presented in Appendix A.12.

[15] Empirical evidence suggests that the intertemporal substitution elasticity of

In terms of the size of the intertemporal shifts of durable purchases, we expect the positive effect towards the end of the cut to be larger than the negative effect because of the postponement of consumption during the anticipation period (i.e., after announcement and before the implementation). During the anticipation period, which lasted for at most a month in our application, the consumption planned for that month may be postponed. During the period of the VAT cut instead, agents may bring forward durable purchases from the future, and thus from a much longer period.

If the depreciation rate $\delta = 0$, in principle, agents could take advantage of the temporary VAT cut to satiate all their durable consumption needs in the future. This is not the case in reality, of course, because most goods depreciate ($\delta > 0$), consumers face storage costs, liquidity constraints, and may expect possible other VAT cuts.[16] Generally, the expenditures of durables will respond more strongly than expenditures of non-durables after the VAT cut because expenditures of durables generate consumption flows in more than one period, i.e., during the lifetime of the durable good (e.g., Laibson et al., 2022).

4 Data

We use a novel data set on high frequency card transactions provided by Fable Data, and described further in Koeniger et al. (2024).[17] Fable Data is a data intermediary sourcing the data from financial organizations such as banks, card issuers, and open banking fintechs. Their goal is to provide representative information on expenditures for the covered expenditure items, which we validate in Koeniger et al. (2024) using other data sources that are available at lower frequency and at a more

durables is larger than for non-durables, i.e., $\sigma_d > \sigma_n$. Adding such realism would make the intratemporal shift towards durables more pronounced.

[16] We discuss further in Appendix A.12.1 how liquidity constraints modify the predictions.

[17] The paper contains further references to research based on the Fable data, and information about data access.

consolidated regional level.[18] The data covers well the expenditure for non-durables, semi-durables, and durables but for the expenditure on cars or housing which are usually not paid for using cards.

The vintage of the data set, which we have used, contains information on transactions since January 1, 2017. The unit of observation is a transaction with a specific card. For our sample period, we have access to data for Austria, Germany, and the U.K. As shown in Koeniger et al. (2024), the patterns of expenditures and card usage are very similar for Austria and Germany. Moreover, the ECB set a common monetary policy for Austria and Germany so that we use expenditures of Austrian cardholders as comparison group in our analysis.

The Fable data provide unique information about *actual* changes in consumption expenditures. Other available data are typically based on surveys that have a much lower frequency. The EVS survey in Germany, for example, is only conducted every five years where the last wave currently available is from 2018. Additional surveys analyzed in Bachmann et al. (2024) provide useful information on changes of expenditures for non-durables and durables during the pandemic. Scanner data provide more detailed information at the product level but focus on goods purchased in supermarkets. A contribution of our analysis is thus that we can analyze actual expenditures during the VAT cut episode in Germany for a much broader range of durables, semi-durables and non-durables.

The sample is based on about 308 million transactions with a ratio of 92:8 of German to Austrian transactions, which is similar to the population ratio of 83:9. Table 3 in Appendix A.3 shows summary statistics by year and country as well as the spatial distribution of cards. We focus on the expenditures per active card to account for sample growth, as more cards have been added to the data set over time by Fable Data while maintaining representative spending patterns in the sample, which are very similar in Austria and Germany (Koeniger et al., 2024). Table 3 shows that, in both countries, the expenditures per active card are ap-

[18]The Fable data are compared with official statistics over time, across regions, and across spending categories in both countries. The comparison shows that the card expenditures in the Fable data provide reliable information for consumption changes over time for the expenditure categories we focus on.

proximately 3,000 euro in each year with roughly one active card per one hundred population members.

For our analysis, we aggregate the transaction data across time and space so that each observation is based on at least 50 transactions per week.[19] We thus construct expenditure series for durables, semi-durables and non-durables at a monthly frequency for each NUTS3 region in Germany and Austria in the time period 2019–2021. For a given consumption category our sample consists of 11,772 observations. Figure 4 in Appendix A.3 illustrates the spatial distribution of sample observations.

We provide more detail in Appendix A.4 on how we construct the expenditure categories. In Appendix A.5, we describe how we construct the sample ensuring that each observation for expenditures in a NUTS3 region is based on sufficient number of transactions. We explain how we construct a measure for expenditures per active card that is robust to sample growth. Furthermore, we provide evidence in Appendix A.7 suggesting that possible measurement error is small which may arise from differences in the delivery date relevant for the VAT payment and the date of the transaction in the data.

5 Estimation

We identify the effects of the VAT cut on consumption-expenditure growth by applying a difference-in-difference approach. We compare the change in consumption growth in the tax cut episode in Germany and Austria. We focus on consumption growth because the theoretical predictions of the VAT cut on consumption growth result from the standard consumption Euler equation which requires less structural assumptions than predictions about consumption levels. We have elaborated on these predictions in Section 3. At the same time, the year-on-year consumption-expenditure growth rates for each month account for

[19] We experimented with an alternative threshold of at least 100 observations, which made the coverage of regions less representative however. See Appendix A.5 for further details on the construction of the sample and the coverage of regions by expenditure category.

seasonality in the expenditure patterns.

The difference-in-difference approach relies on the usual assumption that, conditional on the covariates, there is a common trend in consumption growth rates in Austria and Germany. Inspecting the card expenditure growth in Germany and Austria prior to the tax cut episode provides suggestive support for this assumption, as we will illustrate with the relevant coefficient estimates for the period prior to the VAT cut.

Possible threats to identification are cross-border shopping, and different incidences of the pandemic and the associated policy measures in Austria and Germany. We discuss these threats further in subsection 6.2.

For each consumption expenditure category i we estimate the specification

$$
\begin{aligned}
(3)\ \Delta \ln(c_{i,r,t}) \quad = \alpha_i \quad &+ \sum_{\tau \geq \text{June 2020}}^{T} \beta_{i,\tau} D_{r,\tau}^{(r \in \text{DE})} + \sum_{\tau > \text{Jan 2019}}^{T} \delta_{i,\tau} D_\tau + \phi_i D_r^{(r \in \text{DE})} \\
&+ \sum_{\tau > \text{Jan 2019}}^{\tau < \text{June 2020}} \psi_{i,\tau} D_{r,\tau}^{(r \in \text{DE})} + \boldsymbol{\gamma}' \mathbf{X}_{i,r,t} + \varepsilon_{i,r,t} \ ,
\end{aligned}
$$

where $c_{i,r,t}$ denotes consumption expenditure in category i in NUTS3 region r and month t, $r \in$ DE denotes the set of regions in Germany, $\mathbf{X}_{i,r,t}$ contains the set of covariates, and T is March 2021. The covariates may vary across region, month and expenditure category. We use measures for the containment policies during the pandemic as a control in our benchmark specification because the containment policies differed somewhat across Austrian and German regions and may have affected consumption expenditures.

The specification is a standard two-way fixed effect model. The time dummies for each month allow us to inspect the dynamics of the effects of interest in further detail. The dummies D_τ absorb time effects that are common across Austria and Germany. The dummy $D_r^{(r \in \text{DE})}$ absorbs common stable country differences in consumption growth rates that may result, for example, from differences in the institutional environ-

ment in Germany and Austria which shape consumption and saving decisions of households. The coefficients of interest $\beta_{i,\tau}$ then estimate the differences in consumption growth rates in Germany relative to Austria for each good category i during the VAT cut episode and beyond, which starts with the announcement of the cut in June 2020.

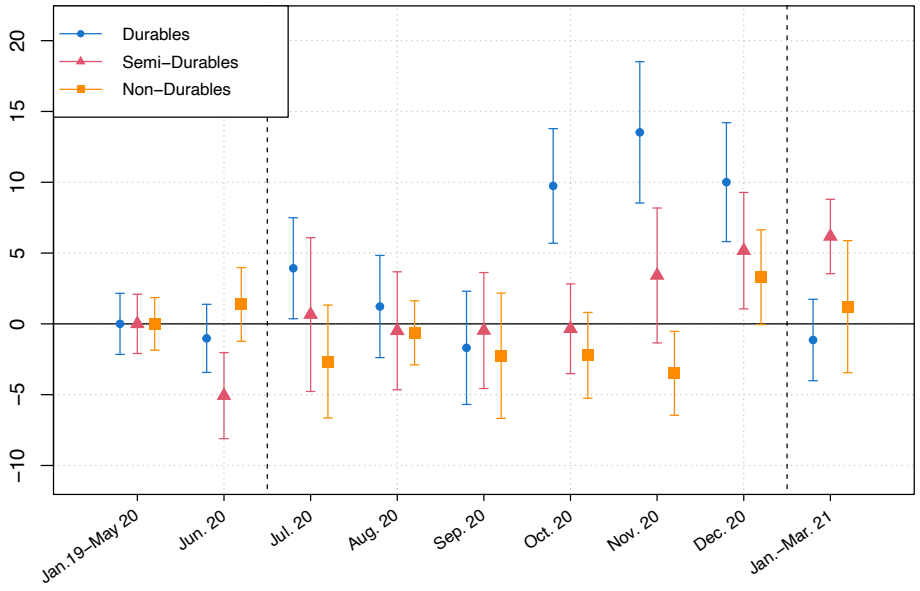
We inspect the coefficient estimates $\psi_{i,\tau}$ to check the validity of the common trend assumption prior to the VAT cut. Figure 3 in Appendix A.2 shows that the coefficient estimates of $\psi_{i,\tau}$ do not reveal a significantly different trend in consumption growth rates across Austrian and German regions prior to the VAT cut. In particular, the point estimate of $\psi_{i,\tau}$ for May 2020, the month before the VAT cut episode, is not significantly different from zero at conventional levels in any of the considered expenditure categories. During the second semester of 2019, i.e., the period one year before the VAT cut, there are no siginficant deviations from the trend prior to the VAT cut for semi-durables and non-durables. For durables, there is a significant negative deviation from trend in October 2019, which follows a marginally significant positive deviation in September 2019, suggesting that the deviations from trend observed in this semester in 2019 are rather random fluctuations around the trend than a systematic pattern. The average across all point estimates $\psi_{i,\tau}$ (of the dummies per month prior to the VAT cut) is zero per construction.

6 Results

Figure 2 plots the coefficient estimates for durables, semi-durables and non-durables. Table 1 summarizes the quantitative implications of the estimates before Table 2 displays possible differences of the effects in the third and fourth quarter of 2020.

Figure 2 shows the increase in year-on-year growth rates of consumption per month during the VAT cut episode in Germany, relative to the growth rate prior to the announcement in Germany and relative to the corresponding observed changes in the consumption growth rates in Austria. The period of the cut is indicated by the vertical dashed lines in the figure. Figure 2 plots the changes in percentage points for durables, semi-durables and non-durables, where the point estimates

Figure 2: Changes in consumption-expenditure growth rates by good type in the VAT cut episode



Notes: The changes of consumption-expenditure growth rates are relative to the stable difference in consumption trends in Germany and Austria prior to the VAT cut episode, normalized to zero and labeled as *Jan.19-May 20* in the figure. The estimates for the effect in each month of the first quarter of 2021 are consolidated in the figure. The Conley standard errors used for the 95% confidence intervals are robust to spatial correlation. Figure 8 in Appendix A.8 shows robustness of the results if the standard errors are computed differently. Source: own computations based on Fable Data.

and 95% confidence intervals for each good type in each month are plotted next to each other to facilitate comparison.

As predicted by theory, the estimates in Figure 2 reveal that the VAT cut increased the growth rate of consumption most for durable goods, particularly so towards the end of cut in the last quarter of 2020. During the anticipation period in June 2020 and in the first quarter in 2021 after the VAT cut instead, we do not find a significant effect on the consumption-expenditure growth of durables.

Figure 2 further shows a smaller, positive effect on the consumption growth of semi-durables, starting from November 2020 and extending into the first quarter of 2021. As Table 1 will reveal, this effect is quan-

titatively small when weighed by the volume of consumption expenditures in these months. The positive effect in the first quarter of 2021 is associated with the delayed pass-through of the VAT increase in January 2021 for semi-durables in Germany. As discussed in Section 2.1, this implied relatively lower prices for semi-durables in Germany than in Austria.

Concerning non-durable goods, Figure 2 reveals no significant effect on consumption growth rates during the VAT cut episode. In particular, the sluggish pass-through of the VAT increase in the first quarter of 2021 affected non-durables less than semi-durables, consistent with less intertemporal substitution of non-durable consumption expenditures. Figure 2 further shows that there has been no strong anticipation effect across good categories after the announcement of the VAT cut in June 2020. Only the consumption growth rate of semi-durables fell significantly.

Table 1 summarizes the quantitative effects. In the first three columns, we weigh the percentage-point change during each month of the cut with the relative size of the consumption in that month during the corresponding period in the previous year. Thus, a change of a growth rate obtains more weight if it results in a larger absolute change (because the growth rate is applied to a larger absolute amount). In the last column, the cumulative effect of the VAT cut is reported in percent of consumption in the second semester of the previous year 2019.[20]

Table 1 shows that the consumption-expenditure growth rate for durables increased by 6.3 pp during the VAT cut in the third and fourth quarter of 2020. The cumulative change during the period from June 2020 until March 2021 was 7.6%, in percent of consumption in the second semester of the previous year. Among durables, the effect was particularly strong for consumer electronics, for which consumption growth increased by 11.2 pp with a cumulative effect of 11.1%. For

[20]Specifically, we multiply the percentage-point change of consumption growth in each month with the consumption in that month. We then consolidate the resulting amounts per month for the period from June 2020 until the end of the first quarter of 2021, thus accounting for possible anticipation effects or delayed effects of the VAT cut. We express the cumulative change in percent, dividing by the consumption in the second semester of the previous year 2019.

Table 1: The quantitative effect of the VAT cut on consumption-expenditure growth

	Anticipation June 2020	VAT Cut Q3&4, 2020	Post Q1, 2021	Cumulative Change
Durables				
Real Cons. Growth	−1.02	6.32	2.86	7.57
p-value	0.60	0.02	0.27	0.08
Electronics				
Real Cons. Growth	−1.37	11.21	0.11	11.07
p-value	0.49	< 0.01	0.03	0.04
Semi-durables				
Real Cons. Growth	−5.07	1.36	13.72	7.30
p-value	0.01	0.44	< 0.01	0.01
Non-durables				
Real Cons. Growth	1.37	−1.20	6.05	2.21
p-value	0.21	0.32	0.01	0.39

Notes: Changes in the consumption-expenditure growth rate in the first three columns are reported in percentage points. The categories of consumption goods are defined in Appendix A.4. In the last column, we compute the cumulative change resulting from the VAT cut, in percent of consumption during the second semester of the previous year 2019. We thus multiply the percentage-point change of consumption growth in each month with the consumption in that month. We then consolidate the resulting amounts per month for the period from June 2020 until the end of the first quarter of 2021. Finally, we express the change in percent by dividing by the consumption in the second semester of the previous year 2019. P-values are obtained by testing the expenditure-weighted sum of coefficients for the monthly effects against the null of being equal to the stable pre-treatment difference of the respective consumption growth rate between Germany and Austria. Source: own computations based on Fable Data.

semi-durables, the consumption growth rate did not increase significantly with a point estimate of 1.4 pp. The cumulative effect of 7.3% was more significant because of the discussed stronger consumption growth extending into the first quarter of 2021, associated with the sluggish

pass-through of the VAT increase for semi-durables and non-durables discussed in Section 2.1.

As predicted by theory, the estimated effects were smaller for less durable goods.[21] Indeed, for non-durable goods, for which the consumption growth rate decreased by 1.2 pp during the cut, the cumulative effect is only 2.2% and not significant at conventional levels.

Table 2: The quantitative effect of the VAT cut on consumption-expenditure growth, by quarter

	Q3, 2020	Q4, 2020
Durables	1.08	11.13
p-value	0.68	< 0.01
Electronics	0.13	19.83
p-value	0.95	< 0.01
Semi-durables	–0.10	2.73
p-value	0.96	0.27
Non-durables	–1.84	–0.63
p-value	0.14	0.68

Notes: Changes in the consumption-expenditure growth rate are reported in percentage points. The categories of consumption goods are defined in Appendix A.4. P-values are obtained by testing the expenditure-weighted sum of coefficients for the monthly effects (within each quarter) against the null of being equal to the stable pre-treatment difference of the respective consumption growth rate between Germany and Austria. Source: own computations based on Fable Data.

The estimates in Figure 2 suggest that the increase of consumption-expenditure growth is stronger towards the end of the cut, as predicted by theory. Table 2 shows the expenditure-weighted increases of consumption growth by quarter, which can be compared to the corresponding average in the second semester in 2020 reported in the third column of Table 1. Accounting for the different size of expenditures across quar-

[21] Note that the effect on consumption growth is larger for more durable goods although the pass-through of the VAT cut to prices, as implied by the Eurostat data, has been relatively smaller for these goods as mentioned in Section 2.

ters, we find that consumption grew more in the fourth than in the third quarter, with a particularly large increase of 19.7 pp for electronics.

In Figure 8, Appendix A.8, we show that alternative assumptions about standard errors do not affect our main conclusions, using durable expenditures for illustration purposes in the figure. Moreover, we show in Figure 9 that the results are robust if we exclude NUTS3 regions at the German-Austrian border, or if we control for different average age or income in the NUTS3 regions. A further robustness check reveals that choosing the end of 2020 as the end of sample period does not significantly affect our results as reported in Figure 10 in Appendix A.8. Furthermore, Appendix A.9 shows that the effects are rather homogeneous across geographical areas in Germany and across regions with different age, income, and urban/rural characteristics.

6.1 Economic implications

We gauge the aggregate implications of our results by using the estimates for back-of-the-envelope calculations analogous to Bachmann et al. (2021). Details on these calculations are provided in Appendix A.1. Our estimates imply a fiscal revenue shortfall of 33 bn euro. The implied elasticity of fiscal revenues to VAT rate changes is 0.66, where the difference of the elasticity from 1 measures the extent to which the additional consumption growth generated by the VAT cut compensated partially the mechanical fiscal revenue loss resulting from the VAT rate cut.[22]

Our estimates further imply that, if the cut of the VAT rate were targeted to durables, the elasticity could be as low as 0.42. The elasticity thus would be 50% lower compared to the elasticity implied by VAT cut implemented in 2020. The elasticity would remain positive, however, indicating that the tax cut would be far from self-financing even if the implementation were more targeted.[23] The short-term multiplier

[22]The mechanical decrease in revenues without considering any behavioral response would imply an elasticity of 1. If instead the increase of expenditures had compensated fully the mechanical decrease in revenues, the elasticity would be zero.

[23]In other words, tax revenues depend positively on the tax rate. At the implemented VAT rates, the Laffer curve has a positive slope.

for durable spending would be 2.5 and thus much larger than the consumption multiplier of 0.2 which obtains if the VAT cut is applied to all consumption goods. This indicates scope for substantial cost reductions when providing a fiscal stimulus, by reducing the deadweight windfall accruing to consumers that do not change their consumption behavior after the VAT cut.[24]

What may explain the different size of the effects of the VAT cut compared with Bachmann et al. (2024) who obtain a much larger consumption response in their empirical estimates? Given that the estimated effect in Bachmann et al. (2024) is identified by exploiting within-country variation across households and thus does not include the aggregate effect of the VAT cut that is common across households, their larger empirical estimate suggests that there has not been a sizable positive common effect of the VAT cut on expenditures. Consumers may have been approximately Ricardian, anticipating that the temporary cut will be financed by future tax increases.

A possible explanation for the larger empirical estimate of the durable expenditure response in Bachmann et al. (2024) may be that survey respondents had expenditures for certain goods in mind when they answered the survey questions. If we assume that our estimated change of spending on electronics has been generated by the 65% of consumers that are informed about the cut according to Bachmann et al. (2024), we obtain that expenditures on electronics must have increased by $11/0.65 \approx 17\%$ for the informed consumers. This is still quite a bit lower than the 37% higher spending on durables reported in Bachmann et al. (2024) but within the range of our estimates if we also account for the possibility that the pass-through of 57% for durables implied by the Eurostat data may be low estimate relative to alternative findings in the literature for certain durable expenditure items (see Section 2.1). A stronger pass-through close to 100% would attribute more of the observed ex-

[24]These back-of-the-envelope calculations neglect possible further expenditure shifts towards durables resulting from the relative price change if only the VAT rate applied to durables were reduced. This may reduce revenues implying a smaller reduction of the elasticity and further modify the multiplier. Furthermore, the spending multiplier for durables is likely to be smaller over a longer time horizon as intertemporal substitution shifts spending of durables into the time window of the VAT cut and reduces it thereafter.

penditure changes to changes in quantities resulting in larger estimates for the effect of the VAT cut on durables.[25]

Compared with existing quantitative estimates on the effect of monetary policy on consumption, our estimates of the VAT cut in Germany may seem large instead. This is because the VAT rate has been changed by 3 pp which is more than ten times the usual change of nominal interest rates by 25 basis points (bp). Interestingly, if scaled by a factor of 1/10, the cumulative effect on consumption that we estimate has a similar order of magnitude as estimates of consumption responses in the euro area to a 25 bp change of the policy rate (e.g., Corsetti et al., 2022).

There are further similarities in the transmission of the VAT cut and monetary policy. Firstly, the stronger response of durables and semi-durables relative to non-durables, which we estimate after the VAT cut, is similar to results for the consumption responses after monetary policy shocks, estimated by Buda et al. (2023) using granular, high frequency Spanish transactional data. Secondly, the stronger response of durables towards the end of the VAT cut has a counterpart in analogous results reported by McKay and Wieland (2021) in the context of monetary policy.

Of course, there are also important differences in the transmission of the VAT cut as implemented in Germany and typical monetary policy shocks. For example, the transmission may differ because of differences in the expected persistence of the VAT cut and unanticipated changes of the policy rate; or because of differences in the salience of the changes in the policy rate and the VAT (e.g., D'Acunto et al., 2022). One would

[25] We further checked whether the different findings may be explained by spending on durables that are not covered well in the transactional data, such as cars. Inspecting the official statistics of newly registered cars from June 2020 to the end of the first quarter of 2021 (i.e., statistics on car registrations provided by Statistics Austria and press releases of the German Federal Motor Transport Authority (*Kraftfahrt-Bundesamt*) on car registrations (*Neuzulassungen von Personenkraftwagen (Pkw) im Jahresverlauf*), accessed in July 2024), we do not find a positive effect of the VAT cut on newly registered cars. Although the year-on-year growth rate of newly registered cars slightly increased in Germany relative to Austria during the third and fourth quarter of 2020, this effect was compensated by slower growth in June 2020 and the first quarter of 2021, indicating some intertemporal substitution of expenditures also in this spending category.

also need to take into account that firms are differently affected by both policies. The comparison of the effects of the two policies thus should be taken with a grain of salt.

6.2 Possible threats to identification

Possible threats to identification in our analysis are (i) cross-border shopping which would imply a violation of the SUTVA assumption, (ii) other macroeconomic policies that have been implemented at the same time as the VAT cut, but differently in Austria and Germany, and (iii) different shifts in payment patterns in Austria and Germany during the VAT cut episode. These threats may potentially bias our estimates. We first provide evidence which suggests that the volume of cross-border shopping was small during the sample period. We then discuss the robustness of our results given that we control for possible differences in the evolution of the pandemic in Austria and Germany and the related containment policies. Finally, we report results that reveal very similar payment patterns in Austria and Germany during the sample period.

6.2.1 Cross-border shopping

If the VAT cut in Germany had caused Austrians to increase their shopping in Germany or Germans to reduce their shopping in Austria, our estimation results based on the difference in consumption growth rates between Austria and Germany would be biased. We thus analyze the extent of cross-border shopping that we can observe in our data, i.e., expenditure with cards at Austrian merchants by residents from German NUTS3 regions, particularly those at the border with Austria, and vice versa. We find that cross-border transactions occurred mainly because of expenditures by Germans in Austria in the categories fuel, accommodation, and restaurants, which we do not include in our analysis.[26]

For the consumption categories we consider, we find that cross-border shopping at the point of sale in Austria accounts for only 0.10% of the total Fable-Data expenditure of Germans during the VAT cut

[26]Expenditures in the categories fuel, accommodation, and restaurants account for 60% of the transactions at the point of sale by Germans in Austria.

episode, and cross-border shopping of Austrians in Germany only accounts for 0.47%. In the respective NUTS3 border regions the percentages are a bit higher, as is intuitive, but still small at 0.98% and 1.29%.[27] We further find that the percentage of expenditures by residents in border regions, accounted for by cross-border shopping, even decreased slightly (by similar percentages in the respective border regions) during the VAT cut episode from June 2020 to December 2020.

Furthermore, Austrians could benefit from the VAT cut in Germany through e-commerce only to a very limited extent because German merchants who exceeded an annual volume of 35,000 euro in sales to Austria legally had to charge the Austrian VAT rate, as documented by the Austrian tax authorities.

Focusing on the expenditure category of durables for illustration purposes, Figure 9 in Appendix A.8 shows that the estimated effects are robust if we exclude NUTS3 regions at the Austrian-German border from the sample. We thus conclude that cross-border shopping seems of limited importance for the time period and product categories we analyze.

6.2.2 Other policy changes

Concerning other policy changes during the VAT cut episode, we check whether short-time work policies have been implemented differently in Austria and Germany and thus may confound our analysis. Austria and Germany both increased the access to, and generosity of, their short-time work programs to attenuate the effects of pandemic containment policies on household income. As shown in Figure 13 in Appendix A.10, the timing of these policies was similar in both countries, where the incidence of short-time work in Austria was higher at the beginning of the pandemic because a larger share of the labor force worked in tourism and hospitality. During the VAT cut episode, however, the incidence of

[27] In percent of the expenditures in the categories we consider in our analysis, we find that cross-border shopping accounts for 0.34% of these expenditures of Germans during the VAT cut episode and 1.17% for Austrians. In the respective NUTS3 border regions the percentages are 3.00% for Germans and 3.25% for Austrians.

short-time work was similar in Austria and Germany.[28] The replacement rate of income during short-time work (concerning employment subject to social security contributions) has been similar in both countries, varying between 80 – 90% in Austria and 70 – 87% in Germany.

In the months of September and October 2020, both countries also implemented similar further fiscal transfers to stabilize household income. They paid an extra bonus per child (*Kinderbonus*), which amounted to 300 euro in Germany and 360 euro in Austria, topped up by 100 euro for unemployed parents in Austria (Bachmann et al., 2022, Prammer, 2021). Furthermore, Austria implemented a permanent cut of the tax rate from 25% to 20% applied to the low income bracket between 11,000 and 18,000 euro, implying a maximum tax relief of 350 euro. We conclude that the income effect of these household income stabilization policies may have increased consumption for both non-durables and durables of non-Ricardian households during the period we analyze. To the extent that the income increase has been larger for Austrian households, this reduces the effect on consumption which we attribute to the VAT cut in our difference-in-difference set-up. As we explain in Appendix A.1, the differences in the income transfers between Austria and Germany are too small, however, to explain fully the quantitative differences between our findings and those of Bachmann et al. (2024).

The epidemiological incidence of the pandemic was similar in Austria and Germany (see Panel (a) of Figure 14 in Appendix A.10). Public health measures to counter the COVID-19 pandemic were similar over time and in scope at the national level in Germany and Austria (Fuest et al., 2024), so that they had similar effects on economic activity.

The weekly *Stringency Indices* of pandemic containment policies in Austria and Germany have a correlation of 92%.[29] Whereas the pandemic incidence and the related policies that are common in Austria and Germany are accounted for by the common time effects in our estimation, we use principal factor analysis to account for differences in the stringency of containment policies at the national level, mortality and

[28]The correlation of the share of short-time workers in Austria and Germany is 0.95 for the period from March 2020 to March 2021.

[29]See Panel (b) of Figure 14 in Appendix A.10. Further documentation is available at Covid-19 Government Response Tracker.

the incidence of Covid-19. We capture policies related to school and workplace closings, cancellation of public events, public transportation closure, stay at home restrictions as well as travel (internal, international) restrictions. The principal factor analysis allows us to control for this variation without running into issues of multicollinearity in our benchmark specification.[30]

6.2.3 The evolution of payment channels

In the descriptive companion paper (Koeniger et al., 2024), we document very similar payment patterns in Austria and Germany. For completeness, we reproduce Figure 15 in Appendix A.11. The figure illustrates that the use of payment channels has been very similar in Austria and Germany, also during the VAT cut episode. The correlation of the time series between the two countries for the shares of transacted volume at the point of sale, in ecommerce and at ATMs is very high at 0.90, 0.91, and 0.76, respectively. We thus conclude that different shifts in the use of payment channels across the two countries do not seem to pose a threat for our estimation.

7 Conclusion

We have estimated the effect of the VAT cut in Germany in 2020 on the (real) expenditure growth rate of durables, semi-durables and non-durables using transaction-level data. We have found that the VAT cut increased the expenditure growth rate most for durable goods, in line with theoretical predictions. The cut of the VAT rate by 3 pp increased the growth rate of durable expenditures by 6.3 pp. The growth rate of expenditures for semi-durables and non-durables instead did not change significantly during the period of the VAT cut.

Back-of-the-envelope calculations based on these estimates suggest that the VAT cut resulted in a fiscal shortfall of 33 bn euro resulting in a consumption multiplier of 0.2. Our calculations imply that a decrease of the VAT rate by 1% (*not* pp) reduces fiscal revenues by 0.66%. The

[30] We transform 45 dummies and two continuous variables into 5 factors.

stronger response of durables to the VAT cut suggests that cutting VAT only for these goods would generate a expenditure stimulus of the same size at a much lower fiscal cost. Indeed, our estimates suggest that the elasticity of fiscal revenues with respect to a change of the VAT rate targeted to durables would be 0.42 and thus 50% lower, and the short-term spending multiplier would be much larger at 2.5 in this case.

A Appendix

A.1 Details on the aggregate fiscal implications

We explain the back-of-the-envelope calculation based on Bachmann et al. (2021) to illustrate the quantitative implications of the intertemporal substitution of expenditures implied by our estimates. The calculations abstract from income or wealth effects about which our estimates are not informative because we estimate the effect of the VAT cut on consumption-expenditure growth and not on consumption levels. Income effects may be present if Ricardian equivalence fails. As discussed in Crossley et al. (2009), the income effect of a temporary VAT cut is likely to be small for the majority of consumers that are not constrained in their choices.

We use official statistics of the national accounts (Table 3.3.3, series 18, row 1.4, Federal Statistical Office of Germany) which reveal that spending on durables in 2020 was 203.549 bn euro. Spending on semi-durables amounted to 148.270 bn, and spending on non-durables to 473.700 bn in 2020.

Analogous to Bachmann et al. (2021), we calculate the counterfactual spending without a VAT cut assuming that, in the counterfactual scenario without a tax cut, households split their spending equally across the first and second semester in 2020. Using our annualized estimate of $1.0632^{0.5}$ based on Table 1, for the effect of the VAT cut on durables in the period from July to December 2020, we obtain $203.549/(1.0632^{0.5}) = 197.407$ bn as the counterfactual spending without the cut. Thus, the VAT cut generated an additional spending on durables of 6.142 bn.

The estimates for semi-durables and non-durables imply no additional spending. We further assume as Bachmann et al. (2021) that the spending on services has been similarly affected as spending on non-durables.

To gauge the effect on VAT revenue, we compute the difference between the actual VAT revenue and the counterfactual consumption spending multiplied by the VAT rate. The actual VAT revenue, taken from Table 3.4.3.16 of the national accounts (series 18, row 1.4), is 221.562 bn. The counterfactual consumption spending on durables, semi-durables, non-durables and services is, based on our calculations above,

$$197.407 + 148.27 + 473.7 + 818.949 = 1,638.326 \text{ bn.}$$

The counterfactual VAT revenue is then

$$0.19 \cdot (197.407 + 148.27 + 818.949) + 0.07 \cdot 473.7 = 254.438 \text{ bn,}$$

where we apply the reduced rate to expenditures of non-durable goods and the standard rate to expenditures of all other goods. The shortfall of the fiscal revenue is thus 254.438 – 221.562 = 32.876 bn. For durables only, the shortfall is 37.507 – 35.038 = 2.470 bn. The expenditure weighted reduction of the standard and reduced VAT rate of $0.71 \cdot 3/19 + 0.29 \cdot 2/7 = 19.5\%$ reduced the revenue by 12.9%. The implied elasticity of fiscal revenues to a VAT rate reduction is 12.9/19.5 = 0.66. It is smaller than 1 because expenditures positively respond to the rate cut. Overall, we find a larger shortfall than the 12 – 15 bn implied by the estimates in Bachmann et al. (2021) that is associated with a much smaller elasticity (0.25 – 0.31) of the fiscal revenues with respect to changes in the VAT rate. The consumption multiplier is $6.142/32.876 \approx 0.2$, and $6.142/2.470 \approx 2.5$ if we only consider durables.

A.1.1 Modified estimates accounting for differences in income transfers

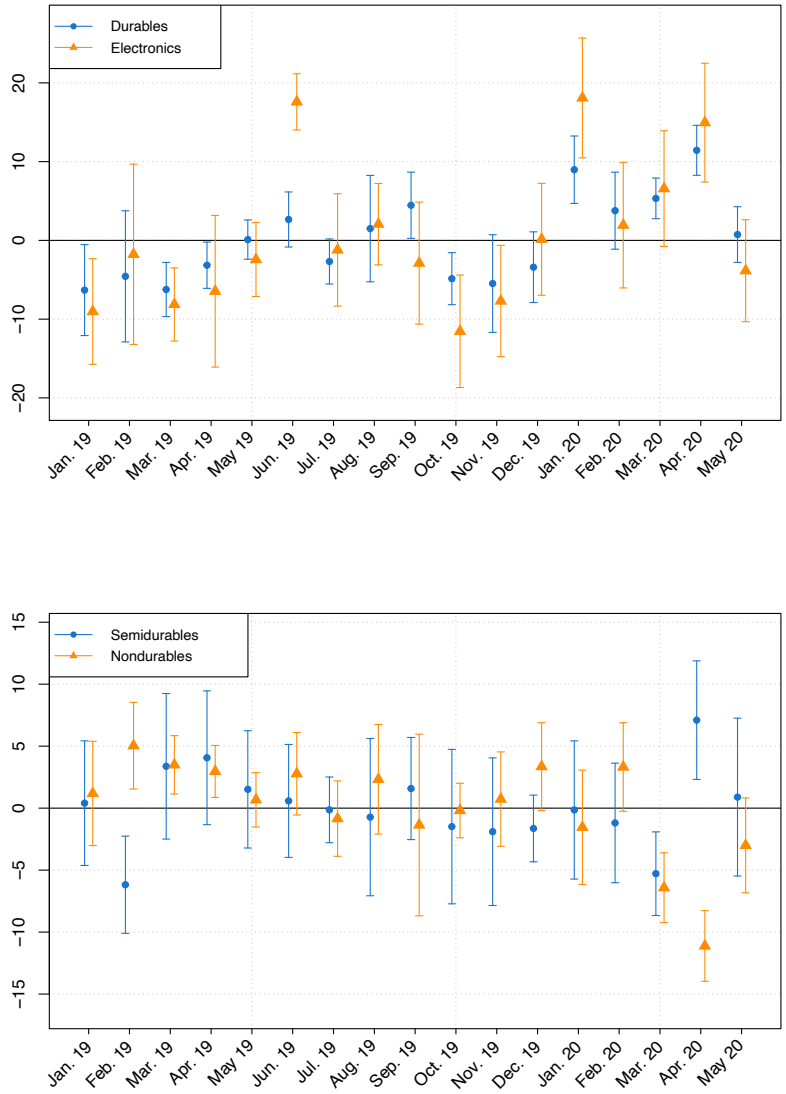
Let us consider differences in income transfers between Austria and Germany of 400 euro during the VAT cut episode because of the higher

child bonus and the income tax cut in Austria. Based on the estimates by Bachmann et al. (2022), we assume that Austrian households spend 32.5% of the additional transfers, amounting to 130 euro. If this amount were spend on durables, semi-durables and non-durables in line with the expenditure shares for these categories in the Fable data of 14.3%, 5.9% and 5.7%, this would increase spending by Austrian households on these categories by 18.6, 7.7, and 7.4 euro.

Our estimates for the effect of the VAT cut in Germany imply increases of 58.3, 13.3, and −7.9 euro for durables, semi-durables and non-durables. Considering that these estimates may be downward biased in our difference-in-difference setting by the amounts of additional spending in Austria because of the higher income transfers, the consumption increase due to the VAT cut in Germany would be larger at 76.9/925.2 = 8.3% for durables, 21.0/949.1 = 2.2% for semi-durables, and −0.5/657.9 ≈ 0% for non-durables. Comparing these numbers to our benchmark estimates of 6.3%, 1.4% and −1.2%, illustrates that the order of magnitude of the possible bias is too small to account for the different fiscal implications that we find relative to Bachmann et al. (2024).

A.2 Illustration of stable trends before the VAT cut episode

Figure 3: Percentage-point deviations from pre-trend



Notes: The Conley standard errors used for the 95% confidence intervals are robust to spatial correlation. Source: own computations based on Fable Data.

References

Agarwal, Sumit, Nathan Marwell, and Leslie McGranahan (2017) "Consumption Responses to Temporary Tax Incentives: Evidence from State Sales Tax Holidays," *American Economic Journal: Economic Policy*, 9 (4), 1–27.

Ampudia, Miguel, Russell Cooper, Julia Le Blanc, and Guozhong Zhu (2024) "MPC Heterogeneity and the Dynamic Response of Consumption to Monetary Policy," *American Economic Journal: Macroeconomics*, 16 (3), 343–88, 10.1257/mac.20210277.

Bachmann, Rüdiger, Christian Bayer, and Martin Kornejew (2022) "Kinderbonuskonsum," *Perspektiven der Wirtschaftspolitik*, 23 (4), 281–298.

Bachmann, Rüdiger, Benjamin Born, Olga Goldfayn-Frank, Georgi Kocharkov, Ralph Lütticke, and Michael Weber (2021) "A Temporary VAT Cut as Unconventional Fiscal Policy," *NBER Working Paper Series, No. 29442*.

——— (2024) "A Temporary VAT Cut as Unconventional Fiscal Policy," *Manuscript*.

Baker, Scott R., Stephanie Johnson, and Lorenz Kueng (2021) "Shopping for Lower Sales Tax Rates," *American Economic Journal: Macroeconomics*, 13 (3), 209–250.

Baker, Scott R., Lorenz Kueng, Leslie McGranahan, and Brian T. Melzer (2019) "Do Household Finances Constrain Unconventional Fiscal Policy?," *Tax Policy and the Economy*, 33, 1–32.

Beck, Günter, Alfred Dijs, Xavier Jaravel, Sebastian Kessing, and Sebastian Siegloch (2021) "Analyse der Verbraucherpreisentwicklung nach Senkung der Mehrwertsteuer," *Report commissioned by the German Federal Ministry of Justice and Consumer Protection*.

Benzarti, Youssef and Dorian Carloni (2019) "Who Really Benefits from Consumption Tax Cuts? Evidence from a Large VAT Reform in France," *American Economics Journal: Economic Policy*, 11 (1), 38–63.

Benzarti, Youssef, Dorian Carloni, Jarkko Harju, and Tuomas Kosonen (2020) "What Goes Up May Not Come Down: Asymmetric Incidence of Value-Added Taxes," *Journal of Political Economy*, 128 (12), 4438–4474.

Beradini, Francesco and Fabrizio Renzi (2022) "Mind the Gap! The (Unexpected) Impact of COVID-19 Pandemic on VAT Revenue in Italy," *Questioni di Economia e Finanza - Occasional Papers, No. 669*.

Bernardino, Tiago, Ricardo Duque Gabriel, João Quelhas, and Márcia Silva-Pereira (2024) "A Temporary VAT Cut in Three Acts: Announcement, Implementation, and Reversal," *Banco de Portugal Working Paper 04-2024*.

Blundell, Richard (2009) "Assessing the Temporary VAT Cut Policy in the UK," *Fiscal Studies*, 30 (1), 31–38.

Buda, G., V. M. Carvalho, G. Corsetti et al. (2023) "Short and Variable Lags," Cambridge Working Papers in Economics 2321, Faculty of Economics, University of Cambridge.

Buda, Gergely, Stephan Hansen, Tomasa Rodrigo, Vasco M. Carvalho, Álvaro Ortiz, and José V. Rodríguez Mora (2022) "National Accounts in a World of Naturally Occurring Data: A Proof of Concept for Consumption," *Cambridge Working Papers in Economics, No. 2244*.

Buettner, Thiess and Boryana Madzharova (2021) "Unit Sales and Price Effects of Preannounced Consumption Tax Reforms: Micro-level Evidence from European VAT," *American Economic Journal: Economic Policy*, 13 (3), 103–134.

Bundesministerium der Finanzen (2019) "Bund-Laender-Finanzbeziehungen auf der Grundlage der Finanzverfassung," *https://bit.ly/2YNlvcu, accessed on 07/11/2022*.

Cabral, Sónia, Cristina Manteu, Sara Serra, and Cátia Silva (2021) "Consumption Expenditure during the COVID-19 Pandemic: an Analysis based on Portguese Card Transaction Data," *Banco de Portugal Economic Studies*, 7 (4), 25–47.

Carvalho, Vasco M., Juan R. Garcia, Stephen Hansen, Alvaro Ortiz, Tomasa Rodrigo, José V. Rodrígez Mora, and Pep Ruiz (2021) "Tracking the COVID-19 Crisis with High-resolution Transaction Data," *Royal Society Open Science, No. 210218*.

Centre for Economics and Business Research (2009) "Credit Where Credit's Due - the VAT Cut Is Working," *Available at: https://bit.ly/3cHAChm*.

Cevik, Serhan (2023) "Dining and Wining During the Pandemic? A Quasi-Experiment on Tax Cuts and Consumer Spending in Lithuania," *IMF Working Paper 2023-188*.

Chetty, Raj, John N. Friedman, Nathaniel Hendren, Michael Stepner, and The Opportunity Insights Team (2020) "How did COVID-19 and Stabilization Policies Affect Spending and Employment? A New Real-time Economic Tracker based on Private Sector Data," *NBER Working Paper Series, No. 27431*.

Clemens, Michael and Werner Röger (2022) "Durable Consumption, Limited VAT Pass-Through and Stabilization Effects of Temporary VAT Changes," *DIW Discussion Paper Series, No. 2004*.

Correia, Isabel, Emmanuel Farhi, Juan P. Nicolini, and Pedro Teles (2013) "Unconventional Fiscal Policy at the Zero Bound," *American Economic Review*, 103 (4), 1172–1211.

Corsetti, Giancarlo, Joao B. Duarte, and Samuel Mann (2022) "One Money, Many Markets: Monetary Transmission and Housing Financing in the Euro Area," *Journal of the European Economic Association*, 20 (1), 513–548.

Crossley, Thomas F., Hamish W. Low, and Cath Sleeman (2014) "Using a Temporary Indirect Tax Cut as a Fiscal Stimulus: Evidence from the UK," *IFS Working Paper, No. 2014-16*.

Crossley, Thomas F., Hamish Low, and Matthew Wakefield (2009) "The Economics of a Temporary VAT Cut," *Fiscal Studies*, 30 (1), 3–16.

D'Acunto, Francesco, Daniel Hoang, and Michael Weber (2022) "Managing Households' Expectations with Unconventional Policies," *Review of Financial Studies*, 35 (4), 1597–1642.

Eichenbaum, Martin, Miguel Godinho de Matos, Francisco Lima, Sergio Rebelo, and Mathias Trabandt (2024) "Expectations, Infections, and Economic Activity," *Journal of Political Economy*, 132 (8), 2571–2611.

Feldstein, Martin (2009) "Rethinking the Role of Fiscal Policy," *American Economic Association: Papers and Proceedings*, 99 (2), 556–559.

Fuchs-Schuendeln, Nicola and Tarek Alexander Hassan (2016) "Natural Experiments in Macroeconomics," in Taylor, John B. ed. *Handbook of Macroeconomics*, 2, Chap. 12, 923–1012: Elsevier.

Fuest, Clemens, Florian Neumeier, and Andreas Peichl (2021) "Hat die Mehrwertsteuersenkung den Konsum belebt?," *ifo Schnelldienst Digital*, 2 (01), 01–06.

Fuest, Clemens, Florian Neumeier, and Daniel Stöhlker (2024) "The Pass-Through of Temporary VAT Rate Cuts: Evidence from German Supermarket Retail," *International Tax and Public Finance* (1).

Funke, Michael and Raphael Terasa (2022) "Has Germany's Temporary VAT Rates Cut as Part of the COVID-19 Fiscal Stimulus Boosted Growth?," *Journal of Policy Modeling*, 44 (2), 450–473.

Gathergood, John, Fabian Gunzinger, Benedict Guttman-Kenney, Edika Quispe-Torreblanca, and Neil Stewart (2020) "Levelling Down and the COVID-19 Lockdowns: Uneven Regional Recovery in UK Consumer Spending," *arXiv preprint arXiv:2012.09336*.

Harju, Jarkko, Tuomas Kosonen, and Oskar Nordström-Skans (2018) "Firm Types, Price-setting Strategies, and Consumption-tax Incidence," *Journal of Public Economics*, 165, 48–72.

ISO (2003) "Retail Financial Services - Merchant Category Codes."

Jongen, Egbert, Arjan Lejour, and Gabriella Massenz (2018) "Cheaper and More Haircuts After VAT Cut? Evidence from the Netherlands," *De Economist*, 166, 135–154.

Koeniger, Winfried, Peter Kress, and Jonas Lehmann (2024) "Consumption Expenditures in Austria & Germany: New Evidence based on Transactional Data," *IZA Discussion Paper No. 17361*.

Kosonen, Tuomas (2015) "More and Cheaper Haircuts after VAT Cut? On the Efficiency and Incidence of Service Sector Consumption Taxes," *Journal of Public Economics*, 131, 87–100.

Laibson, David, Peter Maxted, and Benjamin Moll (2022) "A Simple Mapping from MPCs to MPXs," *Mimeograph*.

McKay, Alisdair and Johannes F. Wieland (2021) "Lumpy Durable Consumption Demand and the Limited Ammunition of Monetary Policy," *Econometrica*, 89 (6), 2717–2749.

Montag, Felix, Alina Sagimuldina, and Monika Schnitzer (2021) "Does Tax Policy Work When Consumers Have Imperfect Price Information? Theory and Evidence," *CESifo Working Paper Series, No. 9138*.

Prammer, Doris (2021) "Unprecedented Fiscal (Re)actions to Ease the Impact of the Covid-19 Pandemic in Austria," *Monetary Policy & The Economy*, Q4/20-Q1/21, 153–173.

Wollmershäuser, Timo, Marcell Göttert, Christian Grimme et al. (2020) "ifo Konjunkturprognose Sommer 2020: Deutsche Wirtschaft – es geht wieder aufwärts," *ifo Schnelldienst*, 73 (Sonderausgabe), 3–58.

Supplemental Appendix

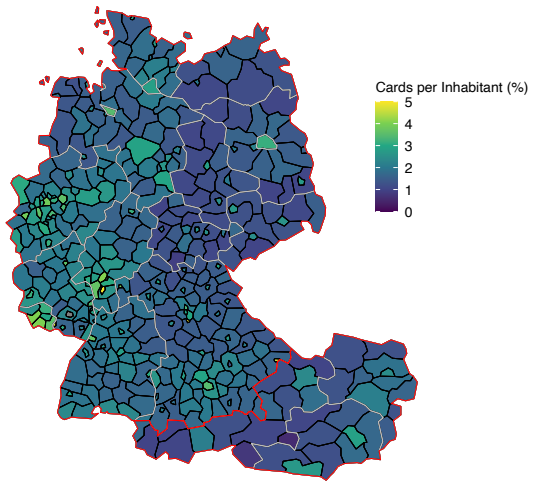
A.3 Data appendix

Table 3: Summary statistics by year and country

	Germany		Austria	
Year	Expenditure per Card (€)	Cards per Inhabitant (%)	Expenditure per Card (€)	Cards per Inhabitant (%)
2018	2,933	1.13	2,609	0.68
2019	2,988	1.29	2,834	0.86
2020	2,704	1.34	2,782	0.93
2021	2,961	1.36	3,072	0.98

Notes: Expenditure per card refers to the mean annual expenditure per card active at least once in that year. Cards per inhabitant refers to the number of cards active at least once in that year relative to the end-of-year population. Source: Fable Data and Eurostat.

Figure 4: Spatial distribution of cards across NUTS3 regions



Notes: *Cards per inhabitant* is obtained as the number of active cards per NUTS3 region over the entire sample period relative to population per NUTS3. Source: Fable Data.

A.4 The construction of expenditure categories

As is common in the literature, we classify expenditures into three categories: non-durables, semi-durables, and durables. We implement the classification based on the Merchant Category Code (ISO, 2003) assigned to each transaction where merchants are responsible for assigning the MCC that best fits the goods or services associated with the transaction. Table 4 shows how we map MCC codes into good categories.

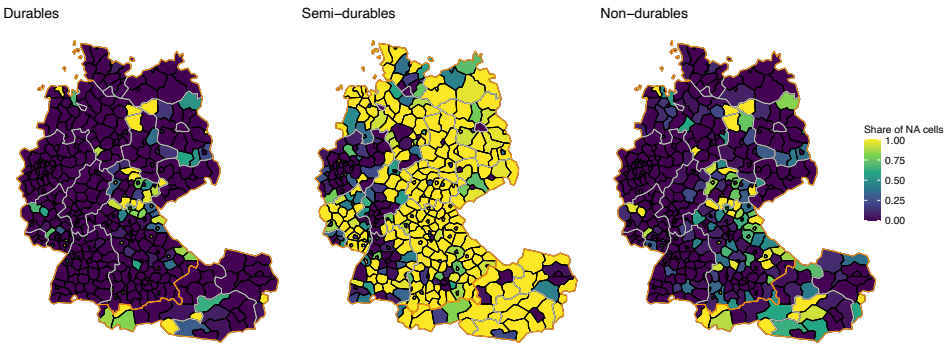
Table 4: Mapping of MCCs into good categories

Category		**MCCs**
Non-durable		5411, 5422, 5441, 5451, 5462, 5499
Semi-durable		5137, 5139, 5611, 5621, 5631, 5641, 5651, 5655, 5661, 5681, 5691, 5697, 5698, 5699, 5949, 7251, 7296
Durable	Electronics	5044, 5045, 5946, 5065, 5722, 5732, 5733, 5734, 7622, 7623, 7629
	Furniture	5021, 5712, 7641
	Home Improvement	1520, 1711, 1731, 1740, 1750, 1761, 1771, 1799, 5039, 5072, 5074, 5198, 5200, 5211, 5231, 5251, 5261, 5713, 5714, 5718, 5719, 5996
	Automotive	5013, 5271, 5511, 5521, 5532, 5533, 5561, 5571, 5592, 5598, 5599, 7531, 7534, 7535, 7538
	Other Durables	5094, 5099, 5932, 5940, 5941, 5942, 5944, 5945, 5948, 5950, 5971, 5972, 5998, 7631

A.5 The construction of the sample

We aggregate the transaction-level data to NUTS3 regions for each month. NUTS3 regions correspond to counties (*Landkreise* and *kreisfreie Städte*) in Germany, and groups of counties in Austria. A transaction is assigned to a NUTS3 region if the cardholder resides in that region. For each spending category (durables, semi-durables, non-durables), we consider expenditure amounts if they are based on at least 50 transactions per week. When we compute year-on-year growth rates, both the current observation and the corresponding observation in the previous year is based on at least 50 transactions. A month is not considered if one week in that month does not fulfill the criterion. This implies that we loose 12.7% (17.6%) of the observations for durables (non-durables), in percent of NUTS3-month cells in the sample. These are mostly rural areas such as the districts Außerfern, Lungau or Lienz in Austria and districts Hildburghausen or Lüchow-Dannenberg in Germany. For semi-durables instead, the spatial distribution of observations is more concentrated in urban areas so that we loose 66.6% of the observations. This is illustrated in Figure 5, which displays the share of cells that are not considered because of too few transactions per week.

Figure 5: Spatial distribution of sample observations



Notes: *Share of NA* refers to the share of months (of the 27 months per NUTS3 region in the sample) that are set to NA because there are less than 50 transactions per week. A month is not considered if one week in that month does not fulfill the criterion. Source: own computations based on Fable Data.

Choosing a higher threshold of 100 transactions per week would increase the share of not considered cells to 37.7% for durables, 86.3% for semi-durables, and 44.5% for non-durables, thus reducing the regional coverage substantially. We thus prefer the sample based on a threshold of 50 transactions.

To account for growth in the number of cards covered in the Fable data during the sample period, further documented in Koeniger et al. (2024), we normalize the expenditures in each NUTS3-region×month cell by the number of active cards in that cell. This allows us to capture also expenditure changes based on cards that are added to the Fable dataset during the sample period without spurious trends due to sample growth.

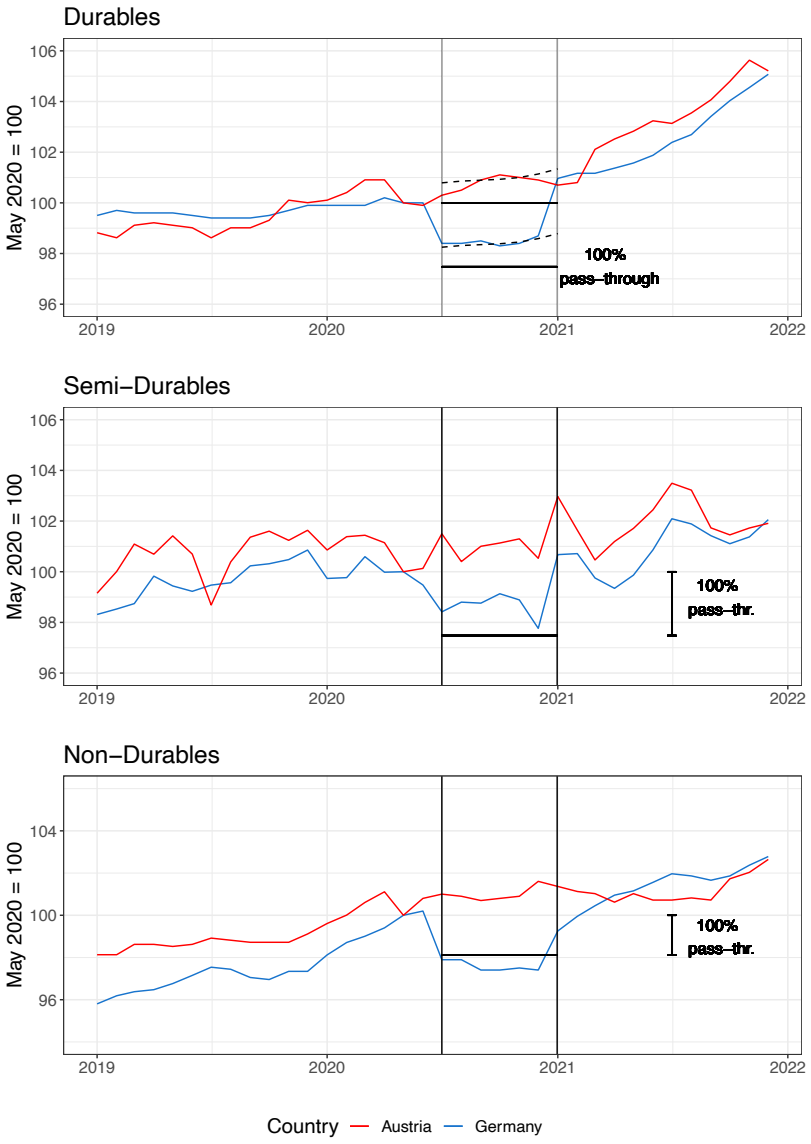
A.6 Pass-through of the VAT cut

Table 5: Average pass-through of the VAT cut

Category	*Relative to:* Price in May 2020	Price in May 2020 + price trend Germany	Price in May 2020 + price trend Austria
Durables	49.31%	57.21%	60.82%
Semi-Durables	54.48%	49.00%	57.92%
Non-Durables	70.29%	85.38%	83.32%

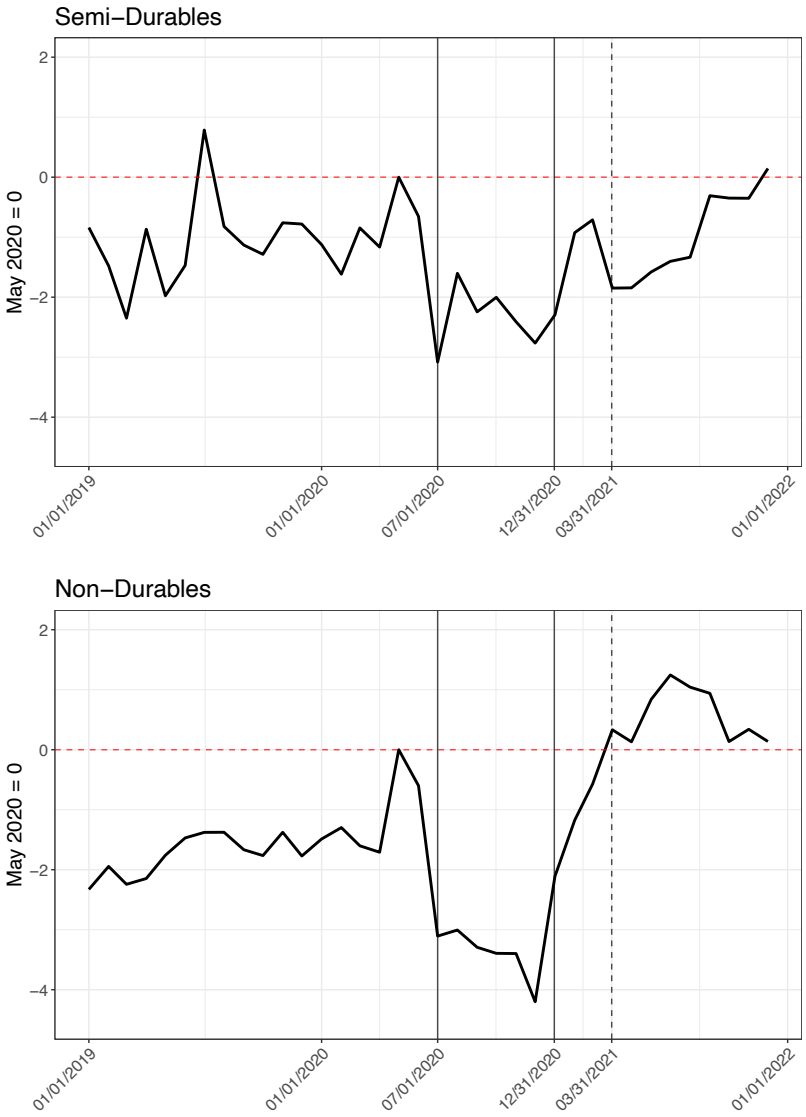
Notes: We compute the average pass-through between July and December 2020 for three alternative counterfactual scenarios assuming (i) prices that remain at their level in May 2020, (ii) prices starting from the price level in May 2020 with a trend based on German price data, (iii) prices starting from the price level in May 2020 with a trend based on Austrian price data. See Figure 6 for an illustration for the prices of durables. The trend is computed using a one-sided moving average with lags up to twelve months controlling for seasonality as month-specific average deviations from trend. Source: own calculations based on Eurostat price data.

Figure 6: Pass-through of the VAT cut



Notes: Price indices are normalized to 100 in May 2020. The vertical solid lines illustrate the VAT cut episode. The horizontal solid lines illustrate a full pass-through if we assume that prices had remained at their level in May 2020 during the VAT cut. In this scenario, a full pass-through would have implied a drop of prices to 116/1.19 = 97.48 for the entire period July to December 2020. The dashed lines in the top panel of the figure illustrate the counterfactual that includes a price trend, using Austrian price growth for the purpose of the illustration. Due to the strong seasonality in semi-durables, we present the time series of the trend including deviations from average monthly seasonality. For non-durables to which the lower VAT rate applies, a full pass-through would have implied a drop of prices to 105/1.07 = 98.13 for the entire period July to December 2020. We interpolate the value for January 2021 as the average between December 2020 and February 2021. The reason is that, because of the lockdown in January 2021, the price developments of food and drugstore products were determined using scanner data from the regular survey week only, and these implied an outlier drop in prices for the survey week. Source: own calculations based on Eurostat price data.

Figure 7: Difference of price indices (DE-AT)



Note: Difference of price indices of non-durables (semi-durables) for Germany and Austria from Figure 6, after accounting for trend and seasonality. A value of 0 indicates that the purged price indexes in Austria and Germany are the same. Due to the normalization the difference is zero in May 2020 by construction. Source: own calculations based on Eurostat price data.

Table 6 shows the results of a regression of the Herfindahl index, constructed by using the volume of transacted amounts in euro for the respective suppliers per consumption category in the Fable data, on the expenditure categories, dummies for periods in the sample period before, during and after the VAT cut, and a time trend. The estimates show that there are no significantly different changes in the Herfindahl index between Austria and Germany during the sample period, as indicated by the coefficient estimates and standard errors reported for the regressors in bold font of the table. This result is robust if we add further regressors to control for expenditure-item-specific changes of the Herfindahl index between Austria and Germany.

Table 6: Industry concentration in Germany and Austria during the sample period

Dependent Variable: Herfindahl-Hirschman Index		
	Coefficient	Std. error
Intercept	2959.5	222.1
Linear trend	6.1	25.3
DE	- 118.2	270.4
Pre-treatment period	- 97.7	283.7
Treatment period	- 2.9	415.2
Post-treatment period	- 15.7	539.2
DE × Linear trend	**8.5**	**35.7**
DE × Pre-treatment period	**52.1**	**401.1**
DE × Treatment period	**-167.4**	**587.2**
DE × Post-treatment period	**-268.1**	**762.5**
Expenditure category fixed effects	Yes	
Number of observations	756	
Adjusted R^2	0.31	

Notes: The regression includes fixed effects to control for the respective expenditure category *Food and beverage*, *Apparel*, *Electronics*, *Furniture*, *Home improvement*, *Automotive*, using *Other durables* as reference expenditure category. The regressors capturing country-specific changes in Germany are in bold font. Source: own calculations based on Fable Data.

A.7 Assessment of possible measurement error

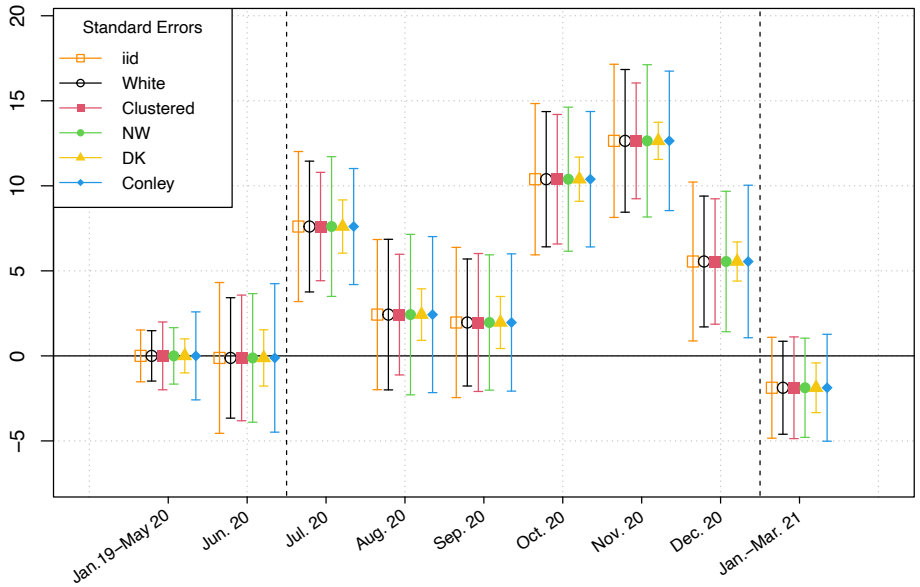
The VAT rate applied to the purchase price is determined by the delivery date and not by the transaction date, which we observe in the data. This may introduce systematic measurement error because households may pay for a good before or after the period of the VAT cut but benefit from the lower VAT rate by selecting a delivery date during the tax cut.

The systematic measurement error may bias our expenditures upward in the period between the announcement of the tax cut on June 3, 2020 and its implementation on July 1, 2020. Analogously, suppliers may agree to deliver goods on credit prior to the end of the cut on December 31, 2020 and to receive payment after the cut ended. Again this may bias expenditures upward during the months after the cut ended. It may, in turn, bias downward the expenditures observed during the VAT cut episode.

To get a sense of the size of the possible bias, we check the incidence of installment payments in the data because such payments allow consumers to decouple the delivery date from the payment dates. We find that 4 – 5% of the transaction expenditure are repeated monthly transactions in the Fable data for Austria and Germany, which could be installment payments, based on the criterion that there are at least two transactions with the same amount, the same MCC and merchant, and the transactions occur in consecutive months with the second transaction occurring within 27 to 31 days of the first. Only 0.6 – 1.2% of the transactions can be clearly identified as installment payments, however, based on the description in the Fable data attached to the transaction, accounting for 0.03 – 0.06% of the transaction expenditures. We thus conclude that the measurement error and bias resulting from the different timing of the payment and the delivery of goods is likely to be negligible.

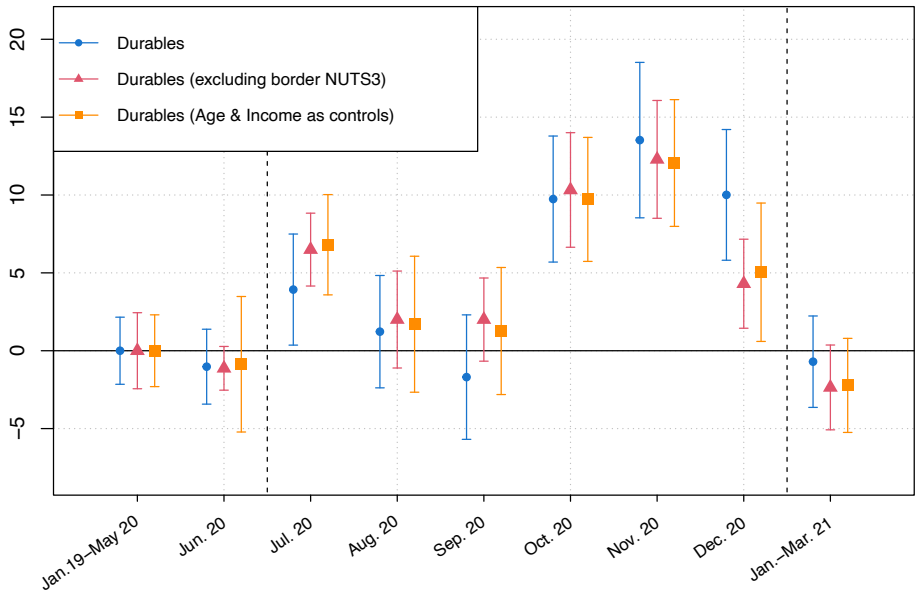
A.8 Robustness of the main results

Figure 8: Different standard errors for the effects on durable spending



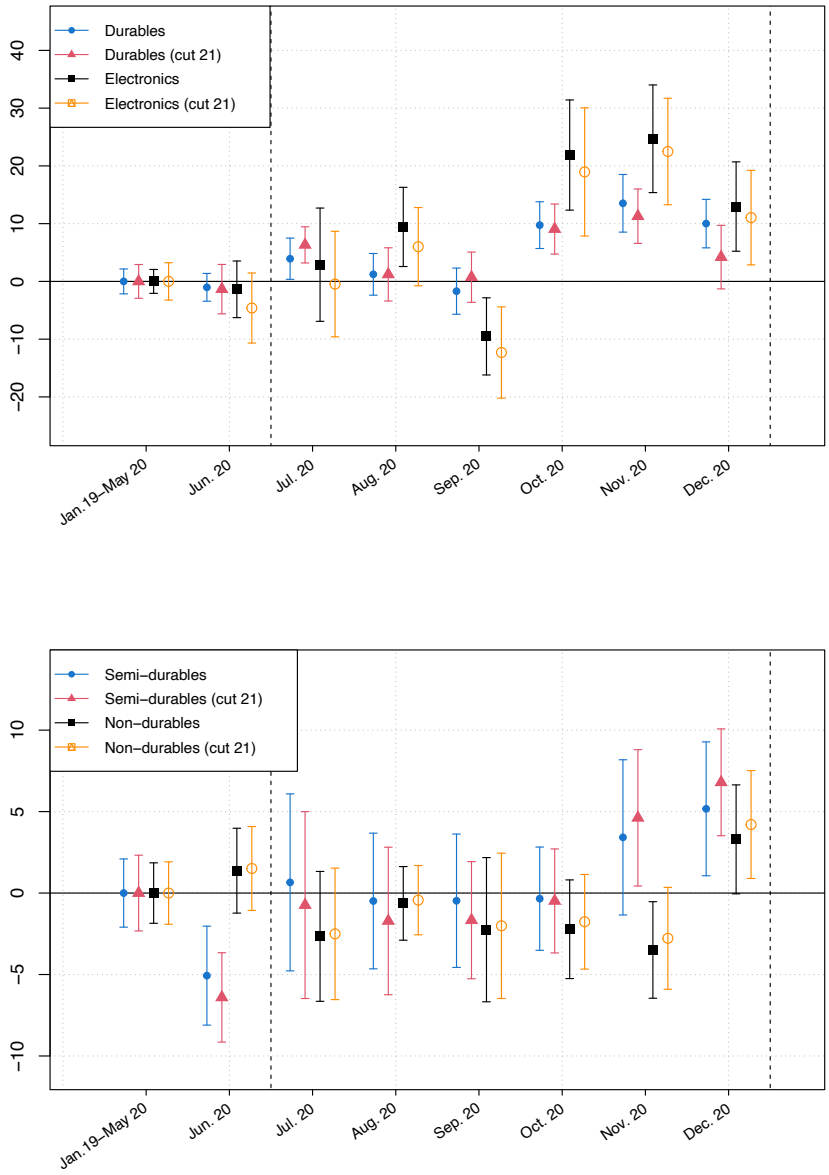
Notes: The changes of consumption-expenditure growth rates are relative to the stable difference in consumption trends in Germany and Austria prior to the VAT cut episode, normalized to zero and labeled as *Jan.19-May 20* in the figure. The estimates for the effect in each month of the first quarter of 2021 are consolidated in the figure. The figure displays 95% confidence intervals. As a benchmark, we report *iid* and heteroskedasticity-robust *White* standard errors. *Clustered* refers to standard errors clustered at the state level. *NW* refers to Newey-West (1987) HAC standard errors. *DK* refers to Discroll-Kraay (1998) HAC standard errors with a temporal correlation of up to 8 weeks. Conley standard errors are obtained using the longitude and latitude of the centroid of each NUTS3 region to calculate spherical distances between NUTS3 regions. We set the cutoff for spatial correlation to 200km corresponding to the first quartile of the distribution of dyadic distances between NUTS3 centroids. Source: own computations based on Fable Data.

Figure 9: Robustness of effects for durable consumption expenditure



Notes: The changes of consumption-expenditure growth rates are relative to the stable difference in consumption trends in Germany and Austria prior to the VAT cut episode, normalized to zero and labeled as *Jan.19-May 20* in the figure. The estimates for the effect in each month of the first quarter of 2021 are consolidated in the figure. The figure displays 95% confidence intervals. In the first robustness check, we re-estimate the main specification after dropping all NUTS3 regions at the German-Austrian border from the sample. In the second robustness check, we add average age and average income per NUTS3 region as controls to our baseline specification. The additional coefficient estimates in that specification imply that a one standard deviation increase of average age (sd = 2.8 years) is associated with a 0.12 pp increase of the consumption growth rate (p = 0.506). A one standard deviation increase in average annual income (sd = €2,789) is associated with a 0.49 pp decrease of the consumption growth rate (p = 0.026). Source: own computations based on Fable Data.

Figure 10: Robustness of effects with shorter sample period until the end of 2020



Notes: We check robustness if we do not consider the months in 2021 in the sample and then estimate the main specification. The results are reported next to our baseline estimates. Source: own computations based on Fable Data.

A.9 Heterogeneous effects

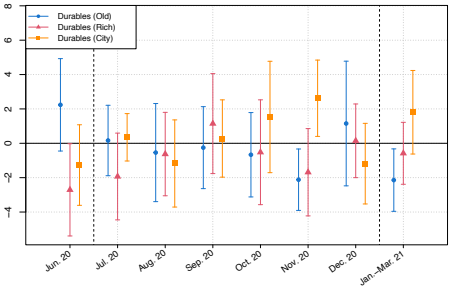
In this appendix, we explore the possible heterogeneity of the estimated effects of the VAT cut in Germany across age, income, urban or rural county, and region. We thus estimate whether relative to the same benchmark in Austria as before, the effects of the VAT cut have been different in across German regions with the characteristics mentioned above. Overall, we find that the estimated effects are rather homogeneous, with some exceptions mentioned below.

In the figures, we label as *Old* a NUTS3 region in which the average age of the card holder is above the sample mean of 45.3 years. We label a region as *Rich* if the average income lies above the sample mean of 34,659.52 euro. We label a region as *City* if it is a *kreisfreie Stadt* rather than a *Landkreis*. Furthermore, we group regions into the following four larger regions in Germany, as defined by the statistical office: Niedersachsen, Schleswig-Holstein, Hamburg, Bremen (NW); Nordrhein-Westfalen, Rheinland-Pfalz, Saarland (WW); MVP, Sachsen-Anhalt, Brandenburg, Berlin, Thüringen, Sachsen (OS); and Bayern, Baden-Württemberg, Hessen (SW), which is the benchmark region.

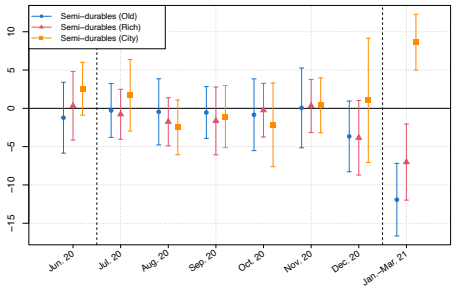
Figures 11 and 12 show that the estimated effects are rather homogeneous. The exceptions are (i) the positive increase of semi-durables in the first quarter of 2021, for which the figures illustrate that it has been stronger in cities or NUTS3 regions where age and income has been below average, as well as in Eastern German regions; and (ii) the somewhat stronger substitution away from non-durables in regions other than the Southwest of Germany.

Figure 11: Heterogeneity of the coefficient estimates across German regions with certain characteristics, by expenditure category

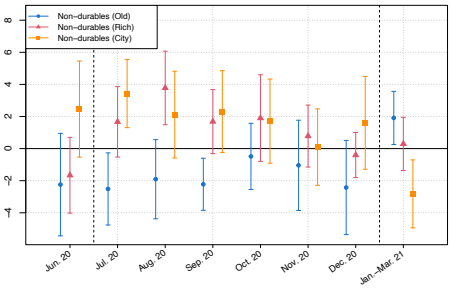
(a) Durables



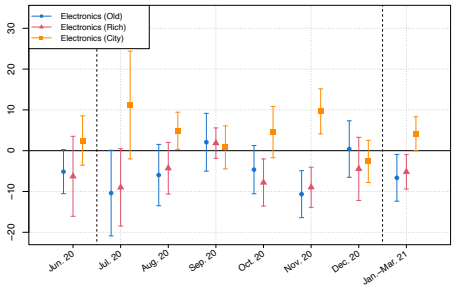
(b) Semi-durables



(c) Non-durables



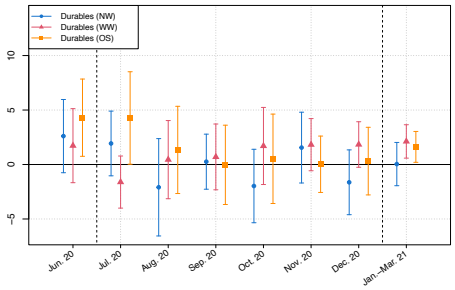
(d) Electronics



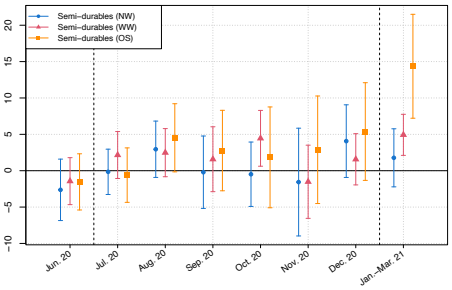
Notes: *Old* denotes a NUTS3 region in which the average age of the card holder is above the sample mean of 45.3 years. *Rich* denotes a region in which the average income lies above the sample mean of 34,659.52 euro. *City* denotes a region if it is a *kreisfreie Stadt* rather than a *Landkreis*. Source: own computations based on Fable Data.

Figure 12: Heterogeneity of the coefficient estimates across German regions, by expenditure category

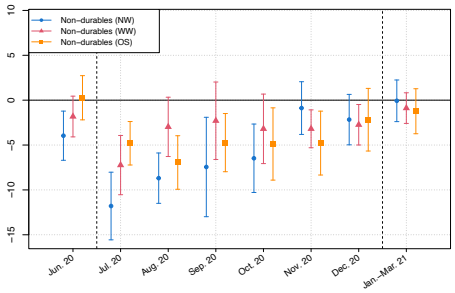
(a) Durables



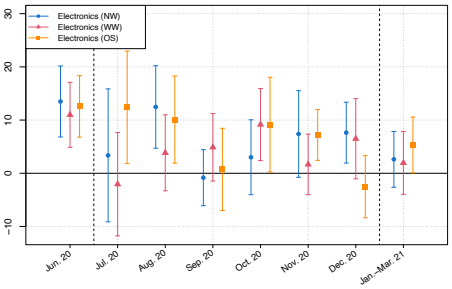
(b) Semi-durables



(c) Non-durables



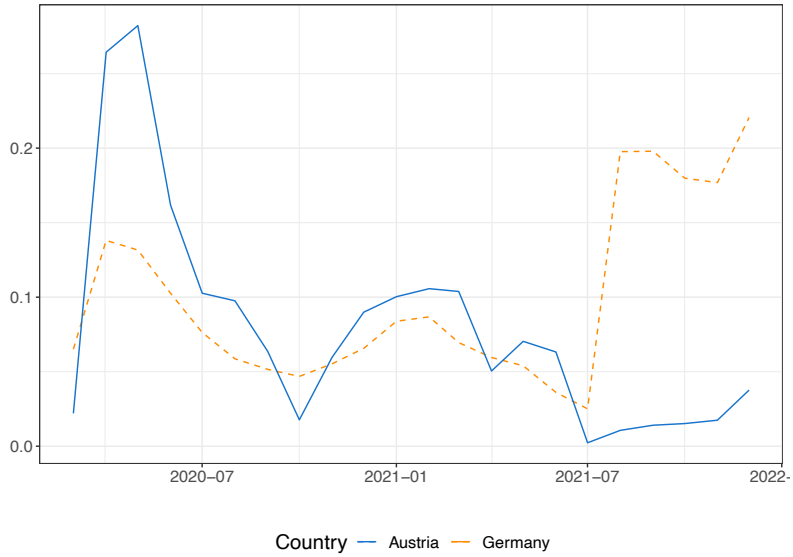
(d) Electronics



Notes: Four larger regions in Germany are defined, following the statistical office: Niedersachsen, Schleswig-Holstein, Hamburg, Bremen (NW); Nordrhein-Westfalen, Rheinland-Pfalz, Saarland (WW); MVP, Sachsen-Anhalt, Brandenburg, Berlin, Thüringen, Sachsen (OS); and Bayern, Baden-Württemberg, Hessen (SW), which is the benchmark region. Source: own computations based on Fable Data.

A.10 Controls for other policies

Figure 13: Share of the labor force share in short-time work

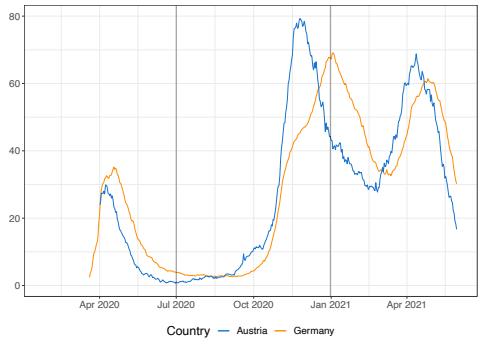


Notes: Monthly data for short-time workers as a share of the labor force. Sources: based on Destatis and Austrian Ministry of Labour and Economy

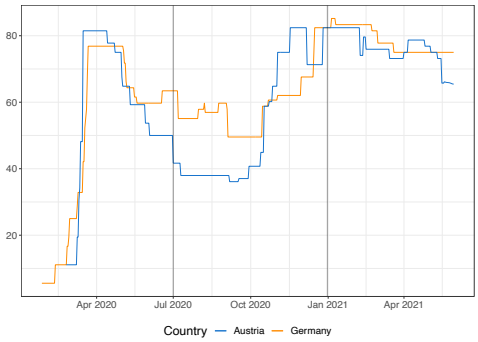
To account for regional variation of containment policies, we use the *Covid-19 Government Response Tracker* for Germany and Austria. We use five principal factors of the sub-indicators of the *Covid-19 Government Response Tracker* for NUTS3 regions in each month as control variables to capture policies related to school and workplace closings, cancellation of public events, public transportation closure, stay-at-home as well as travel restrictions (within the country and international) in Germany.

Figure 14: Measures of the COVID-19 pandemic

(a) New ICU cases per million



(b) Stringency Index

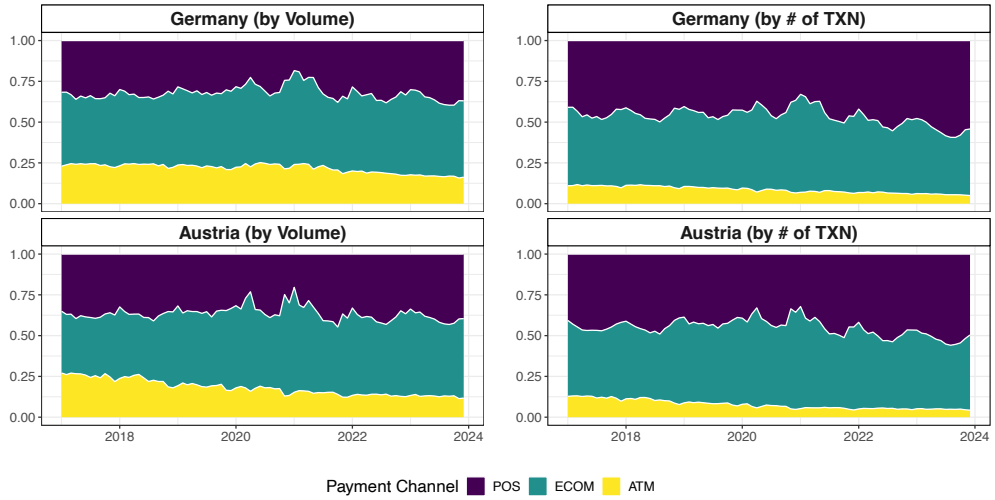


Notes: Panel (a) shows the daily number of new cases in intensive care unit per million inhabitants for Austria and Germany, one of the main decision metrics that determined the stringency of containment policies and thus the scope of relief measures. Panel (b) shows the daily level of the Covid-19 Government Response Tracker. Source: Our World In Data.

A.11 Evolution of the use of payment channels

We reproduce Figure 15 from our descriptive companion paper (Koeniger et al., 2024, Figure 13) for completeness. The figure shows the shares of cash withdrawals, point-of-sale transactions and ecommerce transactions over time in Austria and Germany, by the transacted volume in the left panels and by the number of transactions in the right panels. The figure shows that the shares have evolved very similarly in both countries, also during the VAT cut episode.

Figure 15: Payment channels



Notes: Shares by transacted volume and the number (#) of transactions. ATM: cash withdrawals, ECOM: ecommerce, POS: point of sale. Source: Fable Data.

A.12 Derivation of the theoretical predictions

We derive equations (1) and (2) displayed in the main text. Consider a simplified, standard consumption-saving problem with a non-durable consumption good c_n and a durable good c_d. The consumer maximizes

$$\max_{\{c_{n,t},c_{d,t}\}_{t=0}^{T}} \sum_{t=0}^{T} \beta^t U(c_{n,t}, c_{d,t}) \tag{4}$$

s.t.

$$(1+\tau_t^{c_n})c_{n,t} + a_{t+1} - (1+r_t)a_t + p_t(1+\tau_t^{c_d})(d_{t+1} - (1-\delta)d_t) = y_t, \ \forall t \tag{5}$$

$$c_{d,t} = \phi d_{t+1} \ , \tag{6}$$

where $U(\cdot,\cdot)$ is the utility function in each period, β is the discount factor, $\tau_t^{c_n}$ is the value added tax for non-durables in period t, $\tau_t^{c_d}$ is the value added tax for durables in period t, a_{t+1} is the position of financial assets in $t+1$ chosen in period t, r_t is the real interest rate paid in period t for financial assets a_t, p_t is the relative price of durables in units of the numeraire non-durable consumption good, δ is the depreciation rate, and y_t contains all other available resources or endowments.

The durable stock d_{t+1} chosen in period t generates a service consumption flow $c_{d,t} = \phi d_{t+1}$. Without loss of generality, we set $\phi = 1$. For concreteness, we assume a standard isoelastic utility function:

$$U(c_{n,t}, c_{d,t}) = \frac{c_{n,t}^{1-\sigma_n} - 1}{1-\sigma_n} + \psi \frac{c_{d,t}^{1-\sigma_d} - 1}{1-\sigma_d} , \tag{7}$$

with $\sigma_i > 0$ and $\sigma_i \neq 1$, $i = n, d$, and $\psi > 0$. Non-separable utility would yield qualitatively similar optimality conditions if we applied a logarithmic transformation to the Cobb-Douglas aggregator for the consumption basket, making the preference log-separable in the different consumption goods.

Substituting (5) and (6) into the objective function (4), taking derivatives with respect to a_{t+1} and d_{t+1}, and substituting the marginal utility of non-durable consumption in $t+1$ in the first-order condition for durable goods, we obtain

$$\frac{c_{n,t+1}}{c_{n,t}} = \left(\beta(1+r_{t+1}) \frac{1+\tau_t^{c_n}}{1+\tau_{t+1}^{c_n}} \right)^{\frac{1}{\sigma_n}} , \tag{8}$$

$$\psi \frac{c_{n,t}^{\sigma_n}}{c_{d,t}^{\sigma_d}} = p_t \frac{1+\tau_t^{c_d}}{1+\tau_t^{c_n}} - p_{t+1} \frac{1-\delta}{1+r_{t+1}} \frac{1+\tau_{t+1}^{c_d}}{1+\tau_t^{c_n}} . \tag{9}$$

Taking logarithms of equation (8), we obtain equation (1) in the main text. As (9) consists of non-linear terms that are added on the right-hand side, we log-linearize equation (9) to derive equation (2) in the main text. Denoting as $\tilde{x}$ percentage deviations from the equilibrium before the VAT cut, yields

$$\begin{aligned} \tilde{c}_{n,t} - \tilde{c}_{d,t} = & \left(\frac{\frac{1}{\sigma_n}}{\frac{1}{\sigma_d}} - 1 \right) \tilde{c}_{d,t} \\ & + \frac{1}{\sigma_n} \left[-\ln \psi - \frac{1+r}{r+\delta} \left(\tilde{p}_{t+1} - \tilde{p}_t \right) + \tilde{p}_{t+1} \right. \\ & \left. + \frac{1+r}{r+\delta} \left(\tilde{\tau}_t^{c_d} - \tilde{\tau}_t^{c_n} \right) - \frac{1-\delta}{r+\delta} \left(\tilde{\tau}_{t+1}^{c_d} - \tilde{\tau}_t^{c_n} \right) \right] , \end{aligned} \tag{10}$$

where we use in the derivation that

$$\frac{\frac{1+\bar{\tau}^{c_d}}{1+\bar{\tau}^{c_n}}\bar{p}}{\frac{1+\bar{\tau}^{c_d}}{1+\bar{\tau}^{c_n}}\bar{p}-\frac{1-\delta}{1+r}\frac{1+\bar{\tau}^{c_d}}{1+\bar{\tau}^{c_n}}\bar{p}}=\frac{1+r}{r+\delta}\,, \tag{11}$$

denoting values around which we approximate by $\bar{x}$, and $\tau_t^{c_i}-\bar{\tau}^{c_i}=1+\tau_t^{c_i}-(1+\bar{\tau}^{c_i})$, $i=n,d$.

Assuming that $\sigma=\sigma_n=\sigma_d$, (relative) prices of consumption goods only change because of the VAT cut (i.e., $\tilde{p}_t=\tilde{p}_{t+1}=0$) and defining $\alpha=-\ln\psi$, yields equation (2) in the main text.

A.12.1 Modified predictions with constrained households

As we cannot observe the incidence of borrowing constraints of consumers that make the transactions in our data, we briefly sketch how the theoretical predictions on the consumption response to the VAT cut would be modified for hand-to-mouth consumers.

Denoting with μ_t the multiplier of the borrowing constraint $a_{t+1}\geq\underline{a}$, the optimality conditions (8) and (9) would modify to

$$\frac{c_{n,t+1}}{c_{n,t}} = \left(\beta(1+r_{t+1})\frac{1+\tau_t^{c_n}}{1+\tau_{t+1}^{c_n}}+\frac{\mu_t}{c_{n,t+1}^{-\sigma_n}}\right)^{\frac{1}{\sigma_n}}\,, \tag{12}$$

$$\frac{c_{n,t}^{\sigma_n}}{\psi c_{d,t}^{\sigma_d}} = p_t\frac{1+\tau_t^{c_d}}{1+\tau_t^{c_n}}-p_{t+1}\frac{1-\delta}{1+r_{t+1}}\frac{1+\tau_{t+1}^{c_d}}{1+\tau_t^{c_n}}+p_{t+1}\frac{1-\delta}{1+r_{t+1}}(1+\tau_{t+1}^{c_d})\frac{\mu_t}{c_{n,t}^{-\sigma_n}}\,. \tag{13}$$

Equation (12) illustrates that a binding borrowing constraint today mechanically reduces current non-durable consumption and thus increases growth of non-durable consumption. The second term in brackets on the right-hand side is strictly positive if the constraint is binding so that $\mu_t>0$. In fact, changes of non-durable consumption over time do not depend on intertemporal substitution in response to relative price changes if consumers remain constrained, but rather on changes of their disposable income. A temporary VAT cut thus increases consumption of constrained consumers to the extent that their disposable income in-

creases. Such income effects on consumption tend to be small if VAT cuts are temporary, particularly if intertemporal arbitrage is limited by borrowing constraints.

Furthermore, the consumption basket of a constrained agent shifts more towards non-durable goods relative to an unconstrained consumer. Equation (13) shows that a binding borrowing constraint today adds the third term on the right-hand side, which is strictly positive if $\mu_t > 0$. The intuition is that the role of durables as an asset, providing resources for consumption tomorrow, is valued relatively less if the consumer is constrained today.

To sum up: if some consumers are borrowing constrained during the period of the VAT cut, this reduces the consumption increase through intertemporal substitution and mitigates the otherwise stronger consumption response of durables relative to non-durables.

The discussion above implies that the incidence of borrowing constraints, and possible changes of this incidence over time, make it more challenging to give a structural interpretation to our estimation results. Although the objective of the VAT cut has been to alleviate economic hardship and financial constraints, we have illustrated that the effects of VAT cuts may be dampened if a fraction of the population cannot intertemporally substitute consumption because of borrowing constraints.