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BACK TO TREND: COVID EFFECTS ON E-COMMERCE IN 47 COUNTRIES

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ABSTRACT

We study E-commerce across 47 economies and 26 industries during the COVID-19 pandemic using online transaction data from Mastercard. The online share of total credit card transactions surged during the pandemic, especially as governments made transfers to households in lockdown. As the fiscal support and mobility restrictions waned, online shares went back to pre-pandemic trends in almost all countries. We find little evidence of long-lasting structural changes in E-commerce spending patterns.

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1. Introduction

E-commerce surged when the COVID-19 pandemic hit in early 2020.[1] In a matter of a few weeks, as lockdowns were introduced, and in-person purchases were severely limited, online transactions increased to unprecedented levels in most economies. The sudden surge in online retail transactions attracted a lot of attention in the media, but there is little academic research documenting the facts. How big and widespread was the digitalization of consumption during this period? Were there significant differences across countries and sectors? Perhaps more importantly, were the effects persistent? Did the COVID-19 pandemic fundamentally alter the trajectory of E-commerce, or did it merely represent a transient deviation in the ongoing evolution toward a more digitized retail landscape?

This paper investigates these questions by leveraging a unique database provided by Mastercard ©. The data cover all transactions within the Mastercard network. Our sample comprises of 47 economies and 26 sectors, where Mastercard is more representative of total card transactions, for the period between January 2018 and April 2023.[2] The time span allows the analysis of both online and in-person patterns of spending for three years before and three years after the COVID-19 pandemic started.

We find that while online spending shares surged during the pandemic, after three years, they dissipated in almost all countries, and across most sectors, with the exception of a few industries within the retail and healthcare sectors. The findings are consistent with higher government transfers supporting online spending in the presence of pandemic restrictions, with the effects dissipating as both fiscal support and mobility restrictions have waned.

[1] For the pre-pandemic period, the U.S. Census Bureau estimates that e-commerce rose from 5 percent in 2007 to 11 percent in 2019 (https://www.census.gov/retail/index.html).

[2] The list of 47 economies is in Table 1.

The rest of the paper is organized as follows. Section 2 reviews the related literature; Section 3 describes the data; Section 4 documents stylized facts; Section 5 explores explanations for the observed patterns. Section 6 presents additional findings. Section 7 concludes.

2. Related literature

This paper is related to and makes contributions to three strands of literature.

First, a growing body of literature seeks to quantify the benefits to consumers from the internet, including Goolsbee and Klenow, 2006; Brynjolfsson and Oh, 2012; and Varian, 2013. Related to our paper in the use of credit card information, Dolfen et. al. (2020) use transaction-level data from the United States obtained from Visa, Inc. between 2007 and 2017, and estimate that E-commerce spending reached 8% of consumption by 2017 in the US, yielding consumers the equivalent of a 1% permanent boost to their consumption. These papers consider consumer benefits during *normal* times; but the internet can also bring benefits in terms of resilience to exceptional shocks such as the COVID-19 pandemic. For instance, Alipour et. al. (2022) uses data on credit and debit card transactions from Mastercard for German cities to evaluate geographical relocations of offline consumption after the COVID-19 shock. Auer, Cornelli, and Frost (2023) assemble a cross-country database on broad retail payment behavior using a variety of public and proprietary sources; their core dataset spans 18 countries over the period from December 2019 to December 2020.[3] They document that cash in circulation, use of card-not-present transactions, and downloads of payment apps all spiked during the early phase of the pandemic, with less pronounced changes for countries with greater pre-pandemic mobile adoption; they also note that recent data show that some of the effects have not lasted beyond the acute phase of the pandemic. For example, "card not present" transactions, or payments executed remotely without the presence of a physical card, fell again as lockdowns ended, even below pre-pandemic levels in some jurisdictions. Our paper contributes to this literature by extending the coverage of the credit and debit card data to 47 economies to look at the more recent COVID-19 period. We do not consider welfare questions and focus exclusively on the dynamics of online spending, using the COVID-19 pandemic as a natural experiment. Our

[3] Auer, Cornelli, and Frost (2023) note that the "proprietary series were obtained by the authors from the networks, subject to data agreements".

findings on the lack of persistence in online shares are consistent with Auer, Cornelli, and Frost (2023), though the latter use completely different data sources.

Second, our paper is related to the large literature on the economic effects of COVID-19 (e.g., Bloom, Fletcher and Ye, 2021, Chetty et. al., 2020). Soon after COVID-19 hit, some scholars predicted significant consequences for the retail industry (Roggeveen and Sethuraman, 2020). Wang et al. (2022) provide an extensive literature review on the effect of COVID-19 on a variety of consumer behaviors, ranging from purchases of (un)healthy food, panic buying, impulsive buying and stockpiling, among others. Historically, consumer behavior has frequently evolved, transitioning from itinerant merchants to mail-order catalogs, and subsequently from convenience stores to department stores (Moon et al. 2021). Various channels have frequently coexisted, with multiple theories attempting to elucidate preferences for different retail avenues. Protection Motivation Theory, for example, posits that perceived risk levels influence shopping preferences, whereas the Theory of Planned Behavior underscores the role of planning and intentions. Moon et al. (2021) contends that, in the context of COVID-19 in Korea, the evidence favors the relevance of Protection Motivation Theory. Sheth (2020) argues that changes in consumer habits would persist after the pandemic. Keane and Neal (2021) document consumer panic or hoarding during the pandemic; and although this does not necessarily lead to more online expenditure but, in period of lockdown, few alternatives were available. In sum, there are several reasons why the surge in E-commerce could have been contingent to COVID-19 pandemic with a transient effect (consistent with, for example, theories of panic or impulsive buying), or alternative theories suggestive of more permanent changes in consumer behavior. Whether the surge was a permanent shift or simply a large (but temporary) spike is ultimately an empirical question.

Finally, our paper is part of the growing literature that uses private data to improve and complement survey-based methods of economic measurement. Examples include the use of online price data for inflation measurement in Cavallo (2013) and the recent work by Chetty et al. (2020) and Carvalho et al (2020) to track economic activity in real-time during COVID-19.[4] Closer to our paper, Alandangady et al. (2019) uses credit and debit card transactions to create

[4] Other important examples are Choi and Varian (2012), Einav and Levin (2014), Glaeser at al (2017), and Abraham et al (2020).

daily estimates of retail spending that can approximate the official Census retail surveys in the United States. Our work contributes to this literature by showing how real-time credit card data can be used to measure E-commerce sales and improve the understanding of consumption patterns during times of crisis in many economies.

3. Data & Methodology

The digitalization of retail transactions (e-commerce) can be evaluated through various metrics. While the total volume of online spending saw an uptick during the COVID-19 pandemic, the overall consumer expenditure in the U.S. recovered too by early 2021 (Chetty et al., 2023). Our analysis, therefore, focuses on the share of online spending, defined as the ratio of online transactions to the total number of observable transactions. This share is indicative of both the preferences and constraints of consumers and sellers with respect to online transactions.

Credit and Debit Card Data

Our primary dataset is the universe of all credit and debit card transactions that were cleared through the Mastercard network between January 2018 and April 2023 in more than 200 economies and territories.[5] We limit our sample to 47 economies where Mastercard has a significant market share of total card transactions, accounting for over 20 percent of the card market.[6] Online Appendix A provides a more detailed description of the data.

The data contain the total dollar amount of the transaction, and a sectoral classification for the merchant associated with the transaction, spanning 26 sectors. Importantly, although the credit card data capture the aggregate transaction amounts, they do not include information on the specific items bought, along with their prices and quantities. We define "online" spending as any transaction wherein the card—be it physical or virtual—was not present at the point of sale. This broad categorization encompasses a variety of payment methods, including internet-based transactions via web browsers or mobile devices, as well as telephone or mail-order purchases.

[5] Nilson Report issue 1199 (June 2021) noted the global share of purchase transactions for Visa at 40%, UnionPay at 32%, Mastercard at 24%, and Rest at 4%.

[6] Appendix B shows that the online share patterns are similar when we use data from economies that are below that market share threshold.

All other transactions are classified as "offline." The transaction data are aggregated on a monthly basis for each country.

For each economy in the sample, the "online spending share" of total card consumption in economy *c* at time *t*, given by

(1)

$$s_{c,t} = \frac{Online\ Mastercard\ spending_{c,t}}{Total\ Mastercard\ spending_{c,t}}$$

$s_{c,t}$ is calculated using monthly transaction level data from Mastercard.

We normalize all series to 100 before the pandemic and report the normalized shares.[7] Importantly, we can compare the behavior of these shares over time across countries, and in particular the degree of reversion to pre-pandemic trends. We also report the deviations from pre-pandemic trends.

4. E-commerce during COVID: Heterogeneity and transience

In this section we, present stylized facts on online shares across economies and sectors. Although the levels and dynamics differ, we find surprising similarity in the transitory nature of the e-commerce surge across countries.

Online and total expenditures

Before looking at the share of transactions that take place online, it is helpful to understand the behavior of online and total expenditure separately. During the first few months of the pandemic, two forces were at work. On one hand, consumers did not spend, so total expenditure fell. On the

[7] For confidentiality reasons, we are not able to publish the online shares at the country-level. We can, however, report the online shares (without normalization) at the sector level (Tables 4 and 5), and also use these at country-time levels in the empirical analysis (Tables 2 and 3).

other hand, the lockdowns were forcing those who wanted to spend to go online. In some countries this led to an immediate increase in online spending. In others, online expenditure fell, but by less than total expenditure.

These two cases are illustrated in Figure 1, which shows the amount of total and online spending for the US and Brazil. Consumers' spending is seasonal, so we present seasonally adjusted indices using X13-ARIMA. In both countries, online spending was much higher three years after the pandemic started. But the short-term dynamics were different. The US illustrates the case where online expenditure rose despite the contraction of total spending. Online expenditure in Brazil, on the other hand, fell but by less than total expenditure. As a result, the share of online expenditure rose in both countries.

We further note that the increase in online spending was not caused by a contraction in the availability of cash (which can only be used offline). Indeed, Figure 2 shows some indicators for cash in both the US and Brazil. The top charts (Figure 2a) show a measure of *stock* of cash in circulation from the IMF's World Economic Outlook database. In both countries, the availability of cash increased at the onset of the pandemic, reflecting the effects of expansionary monetary policies. It continued to grow in the US while partially retracted in Brazil. The bottom charts (Figure 2b) show ATM withdrawals from Mastercard, a *flow* measure which can reflect the preference for holding cash on the part of consumers. In the US, cash withdrawals increased in mid-2020 and early 2021, peaking between 40% and 55% higher than before the pandemic started. In Brazil, ATM withdrawals fell by about 40% in 2020 in line with the movements in total expenditure, but increased thereafter, and reached pre-pandemic levels by end of 2022.

Online shares in 47 countries

Next, we document stylized facts on the evolution of online shares in 47 countries. We report the shares at two points in time (peak relative to 2019 average, and latest available, i.e. April 2023), and focus on the deviations during the COVID-19 pandemic with respect to economy-specific trends. In all cases, the pre-COVID trend is estimated in each economy using a regression of online shares on a monthly time trend between 2018 and 2019.

Figure 3 provides two examples of the dynamic behavior of the online share $s_{c,t}$ in the retail sector (solid line) compared to the pre-COVID-19 trend in each economy (dashed line). In the United States, the online share of spending in retail peaked shortly after the pandemic started, rising nearly by 30%. This share rose again when the economy faced waves of COVID-19 cases, and eventually reverted to the level predicted by the pre-COVID trend by early 2023. In Brazil the online share initially had a similar pattern but has fallen in 2022 and is now at a level below the one predicted by the pre-pandemic trends.

Table 1 summarizes the dynamic behavior of the online share for our sample of 47 economies. Results are ordered by the latest deviation relative to the pre-COVID trends. The shares reported in Column 1 are normalized to the average level for 2019, so these numbers need to be interpreted as indices relative to the pre-pandemic levels. Column 2 reports the online shares in April 2023 (latest available), while 3 Column reports differences relative to pre-pandemic trends. As shown at the bottom of the table, on average the online share rose by 57 percent at the peak, and then fell to 16 percent in 2023. Although current levels are 16 percent higher than before the pandemic started, they are, in fact, only 1 percentage point above the average level predicted by pre-pandemic trends. Median values tell a similar story of a surge and then a return back to trend over time.

The transitory nature of surge can be further illustrated by computing the global (weighted) average difference between the online shares and the predicted pre-crisis trends, both at the peak and with the latest data.[8] We find that the share of total transactions was 3.1 percentage points higher at the peak, but this number fell to just 0.6 percentage points by April 2023. At a global level, therefore, on average, only one-fifth of the deviation during the peak persists in the latest data.

Although on average countries are back to the levels predicted by pre-pandemic trends, there are still significant differences across countries in the numbers shown in the last column. In 30

[8] The average global deviation is calculated using the following 4 steps: i) calculate the deviations of the online shares from trend in each economy (as reported in Table 1), then ii) calculate the weight of each "economy-wide deviation" as the share of Mastercard spending of that economy over the total spending in the world, and iii) multiply each economy-wide deviation by the weight, using the Q3 2021 weight and (iv) compute the weighted sum which is defined as the average global deviation.

percent of the economies, these deviations are still numerically positive, though small and close to zero in all of these. For some smaller economies such as Bahrain, Croatia, and Slovenia, the shares are significantly higher.[9] But in all the other economies, including the United States and many developed economies, the online shares are now almost close to or significantly below the predicted pre-COVID trend levels.

5. What explains transience and heterogeneity in online shares?

The previous section has shown that E-commerce jumped at the onset of the pandemic, but the share of E-commerce quickly receded to pre-COVID-19 trend, with some heterogeneity across countries.

What can explain the heterogeneity across economies in the level and persistence of online shares? Figure 4 illustrates the strong correlation between global online shares and the strictness of the COVID-19 pandemic movement restrictions, as measured by Google's index of residential mobility, especially at the beginning of the crisis in the second quarter of 2020, when the lockdowns severely restricted mobility in most economies. However, the correlation declined as the pandemic continued. This is consistent with the impact of COVID-19 lockdowns and other restrictions on economic activity declining over time as economic agents learned how to cope with restrictions (see e.g. ECB, 2021).

To explore the issue in a more systematic way, we present a panel regression of the deviation in online shares from the predicted pre-COVID-19 trends on mobility, fiscal support during COVID-19, and other covariates (Table 2).[10] Given that levels may be picking up cross-sectional differences in pre-existing capabilities, we estimate the regression in changes. The dependent variable is measured by the change in online shares over the previous month; time-varying explanatory variables are also measured in differences. Time fixed effects are included in all regressions, but we do not include country fixed effects as several controls are time-invariant.[11]

[9] Note that some cross-sectional variation was normal also before the pandemic. The cross-sectional variation after COVID-19 is smaller than before the pandemic.

[10] Summary statistics for all the variables used in the regressions are reported in Table A1.

[11] The main findings are robust to estimation in levels (Table 3). The only time varying variables are Google mobility and number of new cases. The results reported in Column (1) of Table 2 remain robust when we include country fixed effects.

Column [1] shows that residential mobility and intensity of the pandemic, as measured by the number of new cases, correlate positively with the deviation from trend in the latest numbers. In Column [2], we include a number of additional controls. Residential mobility and intensity of the pandemic continue to be important drivers of online shares. Richer economies also returned faster to trend once the pandemic receded, as suggested by the negative coefficient on per capita income, though the estimates are statistically indistinguishable from zero.

In Column [3], we include the interaction of fiscal support during COVID-19 with the severity of the restrictions. The interaction term is positive and statistically distinguishable from zero at conventional levels. The estimates indicate that greater fiscal support was associated with higher online shares when restrictions were more severe. Therefore, government transfers supported spending by increasing consumption, which, in the presence of pandemic restrictions, could mostly be done online.

Notably, the average effect of fiscal spending on online shares (when evaluated at the average change in mobility) is also positive in Column [3]. The average change in mobility in the sample is 36.6 percentage points, therefore, the average effect of fiscal spending on E-commerce shares can be computed based on the coefficients in Column (3) as -0.0012+36.6*0.0063=0.23. Notably, a one percentage point (pp) higher change in residential mobility is associated with a 0.4 pp higher increase in online share gap, almost double the average effect of a one pp higher fiscal support.

Firm and Consumer Online Capabilities

One potential explanation for the rise in online shares observed during the pandemic is the fact that consumers and firms learned to transact online. In fact, some commentators anticipated a ‘collateral benefit’ of the lockdown period; according to this, many buyers and sellers would have been ‘obliged’ to learn online shopping. However, the lack of persistence in the surge in online shares suggests that this online capability was likely not a binding constraint.

To explore this further, we develop two new monthly measures of online learning at the country level. The first is "Firm capability", defined as the proportion of active firms that ever sold online since the start of the sample in 2019. The idea underlying this measure is that sellers who learned how to do transactions online and set up the necessary infrastructure have paid the fixed cost and will be able to do online transactions also in the future. The second is "Consumer capability", defined as the proportion of active consumers that ever bought online, building on the same idea. Figure 5 plots the median consumer and firm capability measures over time. On average, the measures of online capability kept increasing over time, suggesting that the online capabilities are more widespread than ever before. The fact that the share of online transactions has fallen from its peak, may not, therefore, be consistent with the story that technological constraints were not binding on average.

At the same time, such constraints could still play some role in explaining some of the differences we observe across countries. We included these measures of online capabilities in the regressions in Table 2, column 4.[12] We find the estimated coefficient on firm capability to be positive and statistically significant, while consumer capability is statistically indistinguishable from zero.

Robustness checks

Table 3 reports additional checks to confirm the results presented in Table 2. Column [1] repeats the final column in Table 1 as the baseline. Columns [2]-[3] includes alternative measures of mobility (retail, and grocery and pharmacy, which are negatively correlated with pandemic restrictions) and Column [4] uses the Oxford stringency measure. Column [5] drops the internet penetration variable. Columns [6]-[7] employ alternative specifications – with changes measured over 12-month period, and estimation in levels rather than changes respectively. The findings remain broadly similar, and in particular, the result that government transfers increased online consumption – especially during times of high restrictions on mobility – continues to be strong and robust.

[12] The number of observations reduces in Column [4] due to insufficient information to compute consumer and firm capabilities. Appendix Table A2 repeats Table 2 with all specifications repeated on the smaller sample. The results remain robust.

Notably, the estimated coefficients on online capabilities are not robust to alternative specifications. Overall, we interpret the evidence as providing little evidence of learning effects.

6. Additional Findings

In this section we explore the role of specific sectors that were particularly affected. We also discuss if the Mastercard data comprise a representative sample.

Restaurants, bars, and some retail categories experienced the largest increases in online spending shares, though divergence across sectors does not appear to persist.

Table 4 presents a snapshot of the share of online spending by sector, which is perhaps most revealing.[13] It shows the online share by sector pre-COVID, at the peak, at the latest time, and differences between the latest observation and the pre-COVID trend. Among these broad categories, restaurants-bars had the largest increase in online spending shares, rising more than 25 percentage points from 7.3 percent in 2019 to 32.6 percent at the peak. At peak values, services and retail also had large percentage point increases, though lower than that for restaurants-bars. By April 2023, however, the deviation turned negative for all the restaurants-bars, retail, and services sub-sectors.

These broad categories mask substantial heterogeneity across subsectors. Table 5 shows the difference between the latest online shares and the pre-crisis trend for 26 disaggregated sectors in our dataset. In particular, auto-rental, clothing stores, drug stores, and electrical appliances still report high online shares. Some of these sectors, in particular, drug stores, also had relatively low

[13] Sectoral averages are created by computing a weighted average of the deviation in online share from the trend at the economy-sector level, where the weights are the shares of Mastercard spending in the economy-sector as a ratio of global spending in that sector. Notably, there are few sectors (e.g. airlines and travel agencies), with typically very high online penetration; for these we introduce an upper limit on the pre-pandemic time trend, constraining the value below 100% (as eCommerce shares cannot exceed 100%). The industries whose online penetration has achieved the upper limit are included in Table 5. These include, for example, “mail order”, “airline”, “travel agencies”, and “utilities”. As our methodology for estimating online share applies a scaling factor of (total card spending / total consumption), the scaled online shares for these industries will converge to an upper limit of card spend/total consumption when the 100% threshold is met.

pre-COVID-19 e-commerce shares. On the other hand, the share of online spending in services, specifically hotel-motel, recreation, mail order, and other transport have all fallen to significantly below their pre-pandemic trend.

Similar to economy-wide results, there is divergence across sectors in pre-Covid trends. On average, sectors that were leaders in e-commerce before COVID-19 reported mildly higher increases in online shares (Figure 6). Most of the increase during the peak occurred in sectors with a middle-range in online. Sectors such as health care, electrical appliances, and sporting goods-toys reported the largest increases compared to the pre-crisis trend.

We also find these effects to be (largely) transitory, similar to the evidence across economies (Figure 7), but with the exception of certain sectors such as those in retail, including drug stores, clothing stores, and electrical appliances. The temporary nature looks to be particularly pronounced in industries with higher pre-pandemic shares of e-commerce, as well as in industries such as travel and entertainment.

Overall, the sectoral evidence supports the main findings in this paper: i) there is a divergence across sectors in E-commerce shares, with ii) early E-commerce adopters reporting mildly higher peak increases during COVID-19; and (iii) despite the sharp acceleration, the effects appear to be transitory with some exceptions in sectors such as in retail and healthcare.

Are Mastercard share representative?

We now compare our Mastercard shares with broader estimates for a subset of economies with alternative results obtained from survey data that incorporates other cards and payment methods. We do this in Figure 8 for the United States and the United Kingdom, where official survey estimates of “online retail spending” are published on a monthly basis by the US Census Bureau and the UK Office of National Statistics.

Although there are differences in levels, the overall dynamic patterns are similar. In particular, the official data also suggests that the online spending share in the United States has returned to

the pre-COVID trend levels, while the United Kingdom remains slightly above the trend-predicted levels.

7. Conclusions

During the COVID-19 pandemic, online purchases surged in almost all economies. This paper documents the extent of this surge in a systematic and comparable way, using a unique, large dataset covering 47 economies and 26 sectors, for close to three years before and after the pandemic. There is heterogeneity across countries and sectors in pre-COVID trends of share of online spending. Online spending shares surged during the pandemic across all economies, but the increase has reversed as the pandemic receded, with the exception of few sectors in retail, and healthcare.

The lack of persistence is surprising and contrary to expectations. A common story often seen in the press is that the pandemic accelerated the trend towards digitalization, forcing people to learn new digital skills; and this learning was going to stay. Our results support the quick uptake of E-commerce, but there is little support for any lasting learning by locking effects.

What can explain these patterns? During the first phase (surge to the spike), demand for E-commerce relative to in-person commerce surged. More importantly, the interaction between mobility and government transfers played a crucial role in explaining the temporary nature of these dynamics; as these effects waned, online shares came back to pre-pandemic trends.

There is still some heterogeneity: for 30 percent the economies, online spending shares remain higher than pre-pandemic trends. Furthermore, the scale up in e-commerce appears more longer-lasting in few sectors, including categories of retail, and healthcare. These results could indicate some extensive margin effects (new and younger customers continue to shop online). With travel and gathering restrictions and government transfers now lifted around the world, the long-term effects are important questions for future research.

Overall, the results show consumer spending patterns display a great deal of inertia. COVID-19 brought about a surge in E-commerce, but as the crisis subsided, spending patterns went back to trend. In that sense, there is little evidence of a “long COVID” effect on e-commerce.

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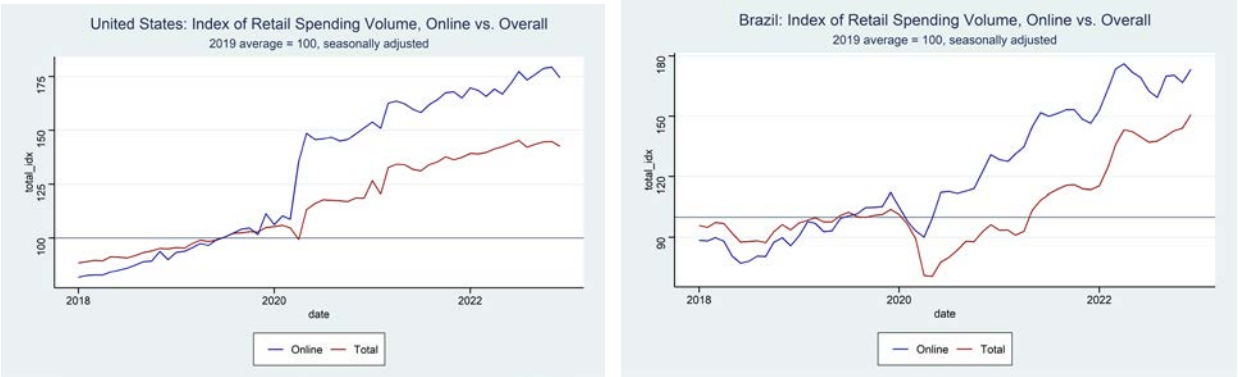
Figure 1. Retail spending during the pandemic



Notes. Figure 1 reports retail spending, seasonally adjusted using X13-ARIMA SEATS, adjusted with data starting in 2014.

Figure 2. Cash during the pandemic

Figure 2a Cash in circulation in the US and Brazil

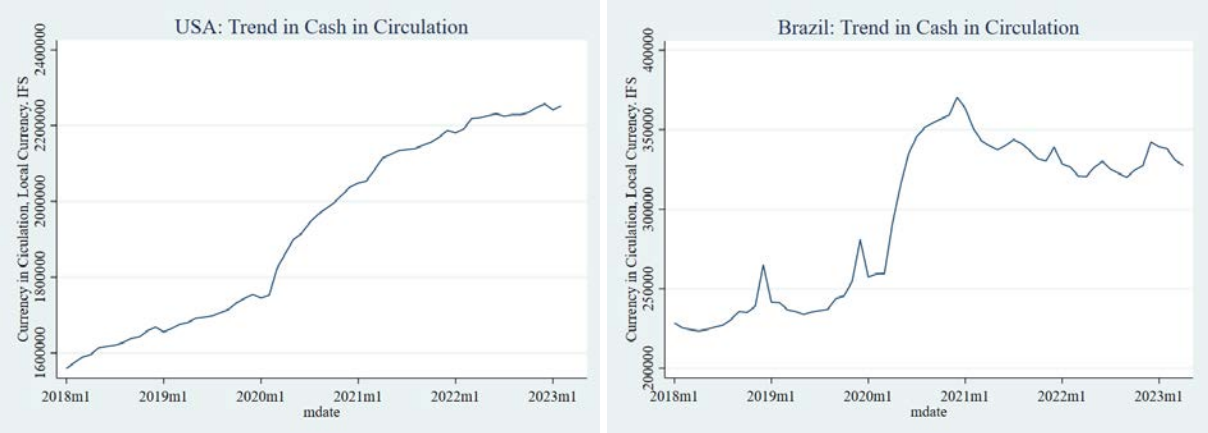
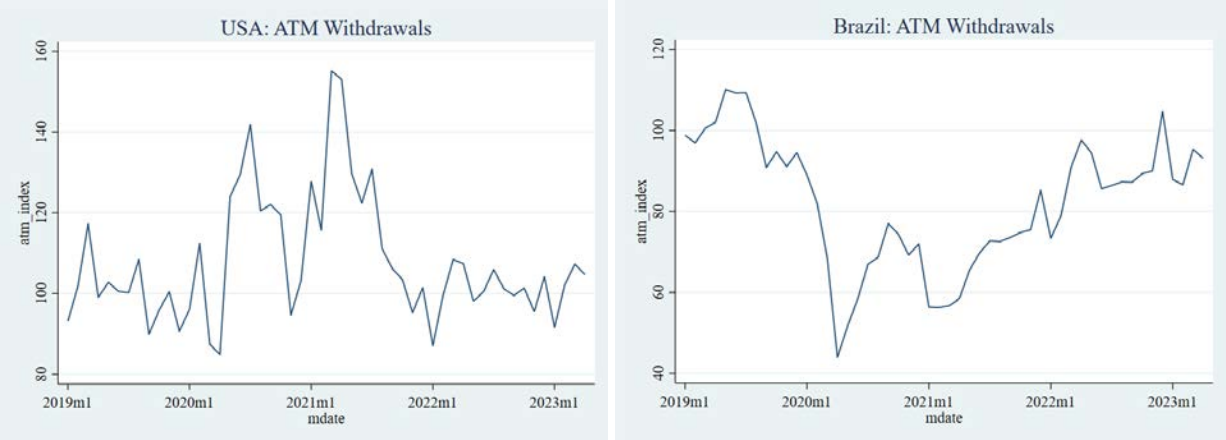
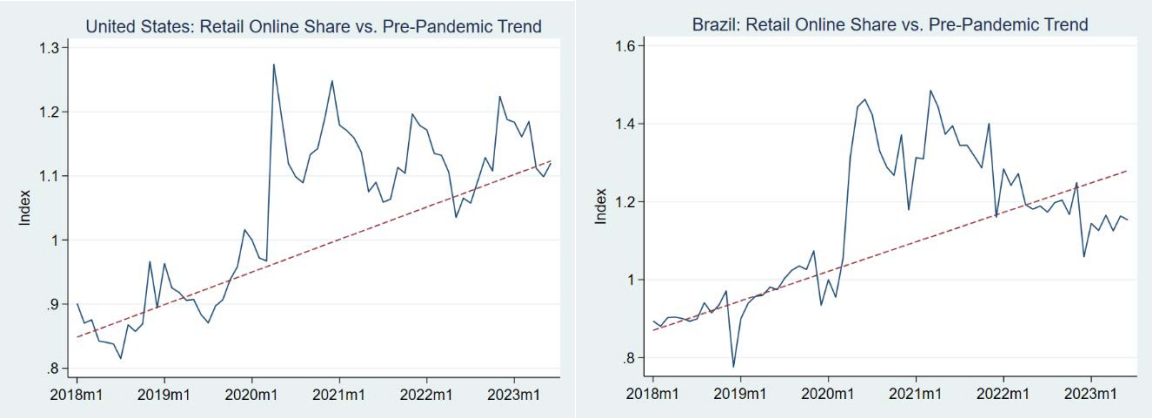


Figure 2b ATM Withdrawals in the US and Brazil



Notes. Figure 2a reports currency in circulation from the IMF's World Economic Outlook database; the Figure 2b reports ATM withdrawals from Mastercard.

Figure 3. Examples of Retail Online Spending Share During COVID



Notes: The "online spending share" of total card consumption in the retail sector in a given year is defined by Equation (1) in the text, as $s_{c,t} = \frac{Online\ Mastercard\ spending_{c,t}}{Total\ Mastercard\ spending_{c,t}}$. The online share indexed to January 2020=1.

Figure 4. Residential mobility (time spent at home) vs. e-commerce deviation from trend

Figure 4a

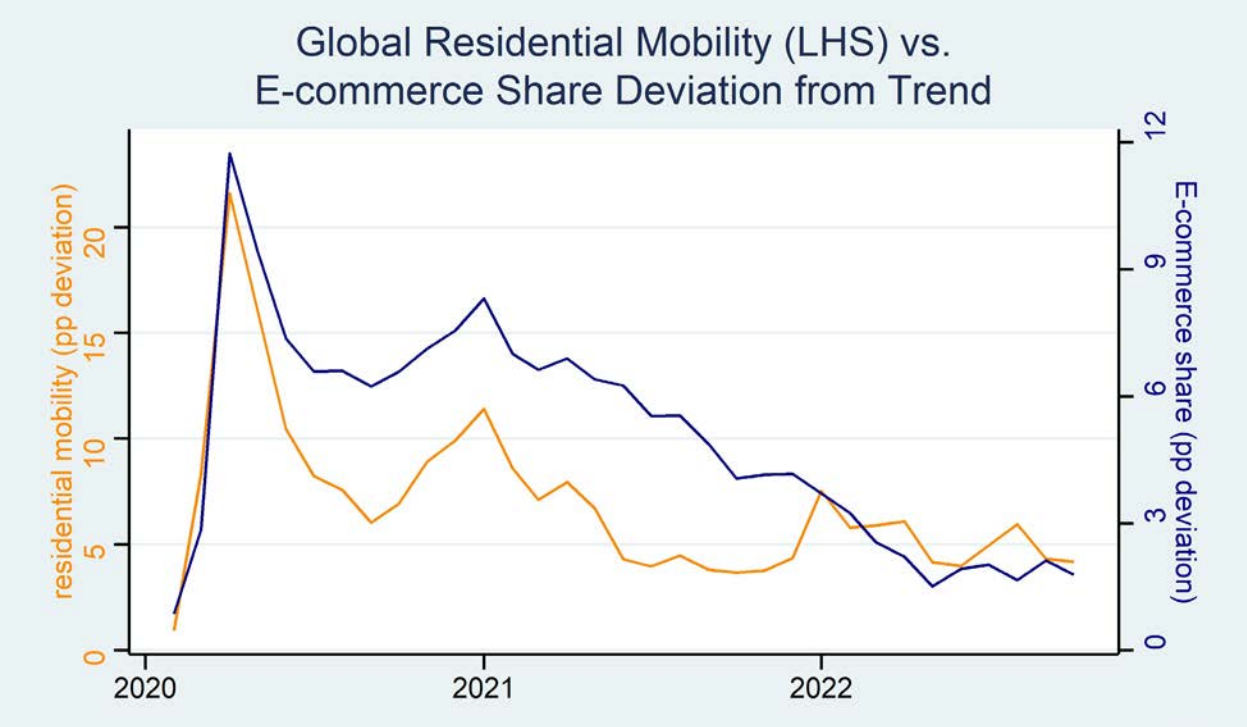
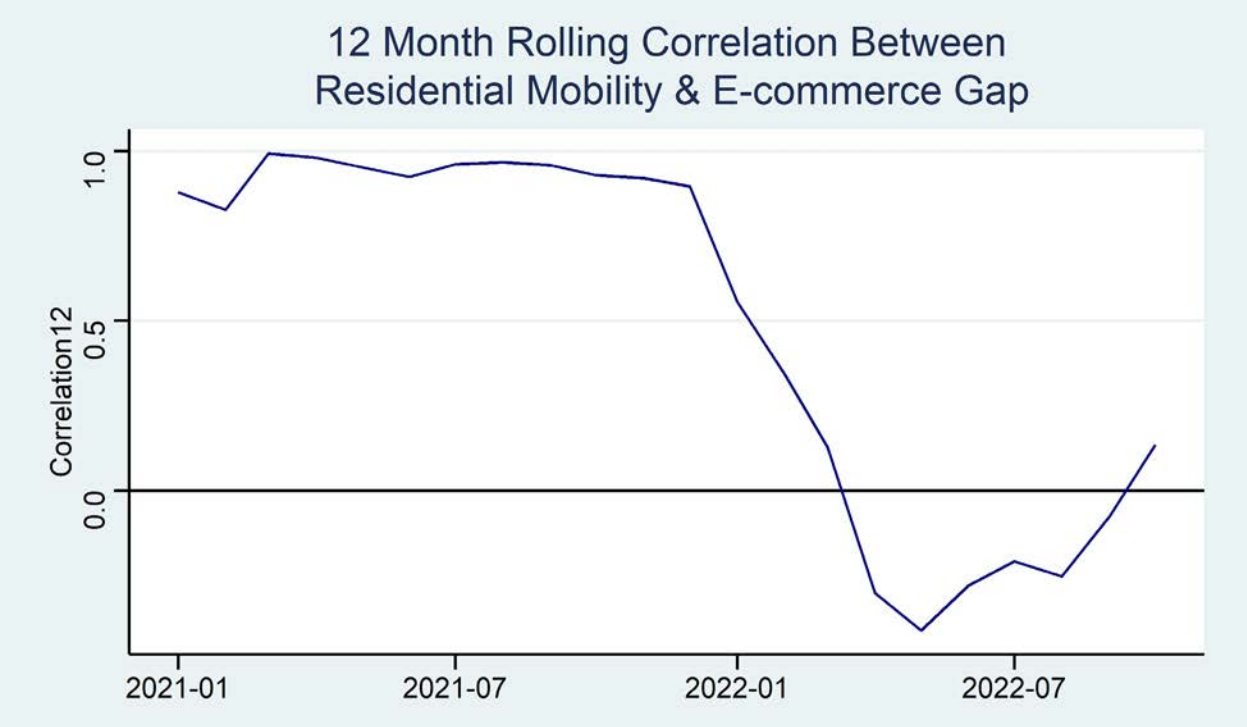
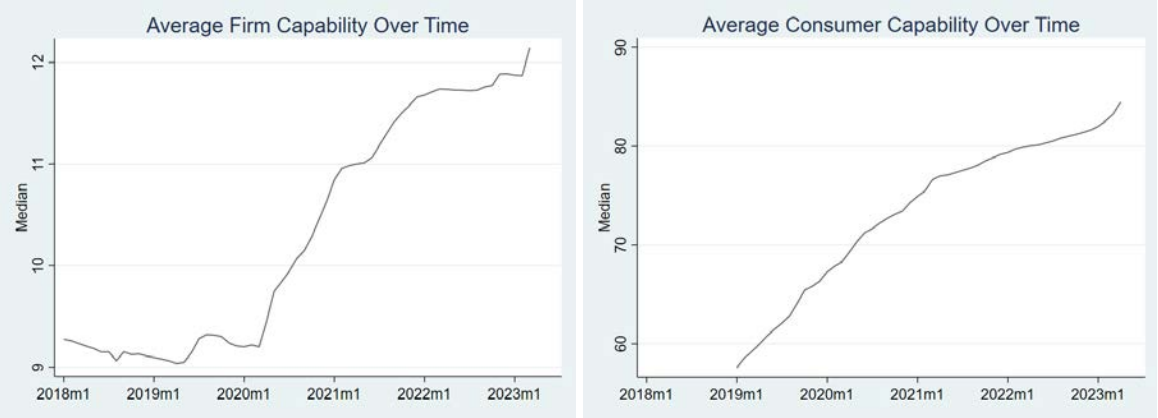


Figure 4b



Notes: E-commerce gaps are seasonally adjusted to account for spikes around the holidays. Both the global residential mobility and E-commerce gaps are computed by taking an equal weight average for the 47 economies in our sample. Google COVID-19 Mobility Reports Discontinued in October 2022.

Figure 5. Firm and Consumer Capability Over Time



Notes. “Firm capability” is defined at the country-time level, as the proportion of active firms that ever sold online since the start of the sample in 2018. “Consumer capability” is defined as the proportion of active consumers that ever bought online. Figure 5 plots the median consumer and firm capability measures over time.

Figure 6. Peak versus pre-COVID trend in online spending shares across sectors

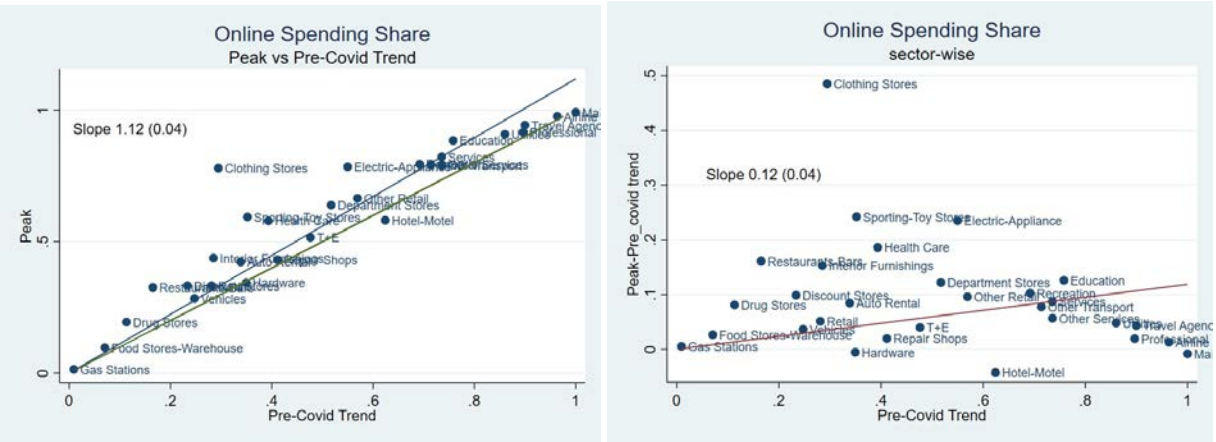
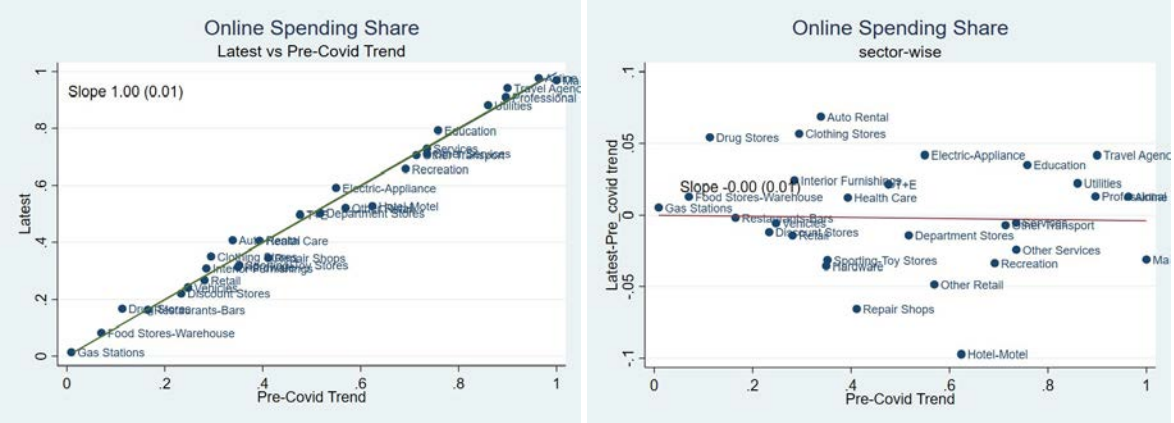
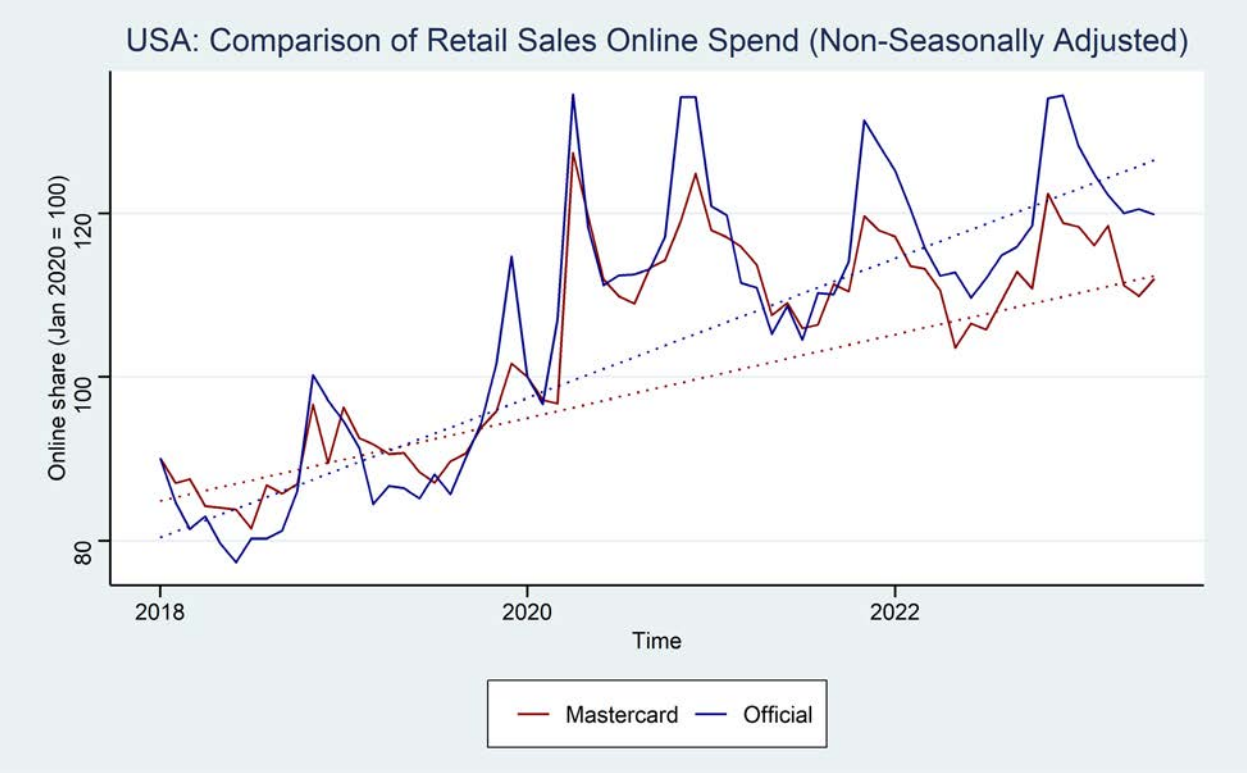


Figure 7. Latest versus pre-COVID trend in online spending shares across sectors



Notes: "Latest" refers to online spending share in April 2023. The pre-COVID trend is estimated in each sector using a regression of monthly online shares on a time trend between 2018-2019.

Figure 8*:* Online shares in retail sales in the United States and the United Kingdom
Comparison between modeled estimates and national statistics



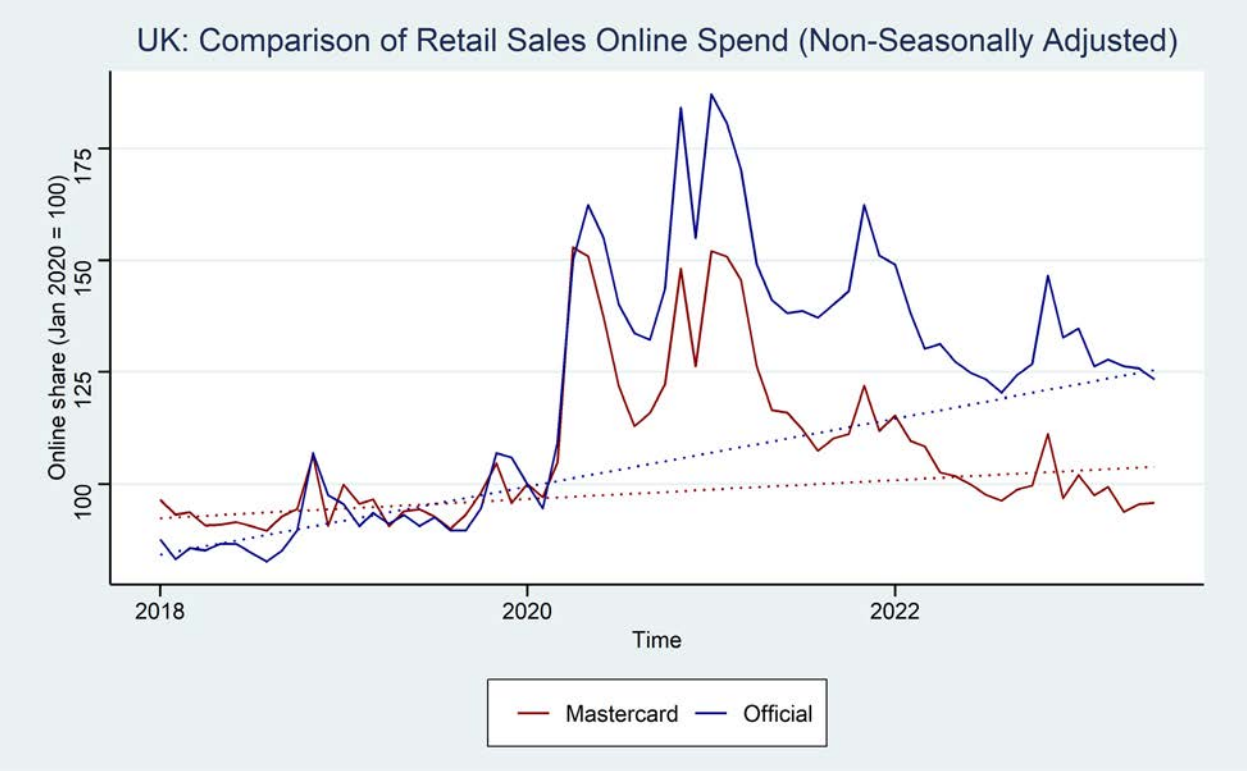


Table 1. Online Spending Share During COVID-19 in all Economies in the Sample

Economy	Crisis peak (relative to 2019)	Latest	Latest minus pre-COVID trend
Bahrain	1.77 (2022/02)	1.60	0.60
Croatia	2.47 (2022/01)	1.79	0.50
Slovenia	2.2 (2022/01)	1.42	0.49
Slovakia	1.89 (2022/02)	1.35	0.31
Ecuador	1.78 (2022/01)	1.18	0.30
Norway	1.33 (2022/02)	0.94	0.29
Serbia	1.68 (2022/01)	1.40	0.24
Italy	1.58 (2022/01)	1.16	0.24
Argentina	1.55 (2022/01)	1.16	0.17
Austria	2.01 (2022/03)	1.13	0.13
Jamaica	1.18 (2022/01)	1.10	0.10
United Kingdom	1.34 (2022/01)	0.97	0.06
United States	1.25 (2022/01)	1.11	0.06
Cambodia	1.54 (2021/07)	1.31	0.05
Sweden	1.31 (2022/01)	0.88	0.04
Hungary	1.82 (2022/01)	1.23	0.03
Australia	1.16 (2022/01)	1.04	0.01
Singapore	1.45 (2022/02)	1.19	0.00
Canada	1.38 (2022/01)	1.01	-0.01
Poland	1.71 (2022/02)	1.31	-0.01
Germany	1.52 (2022/03)	0.93	-0.02
Thailand	1.65 (2022/03)	1.26	-0.03
New Zealand	1.39 (2022/03)	0.96	-0.04
Philippines	1.66 (2022/01)	1.10	-0.04
Dominican Republic	1.36 (2022/01)	1.14	-0.05
Czech Republic	2.01 (2022/02)	1.27	-0.06
United Arab Emirates	1.22 (2021/02)	1.21	-0.07
Netherlands	1.39 (2022/02)	0.93	-0.07
Nicaragua	1.18 (2021/09)	0.90	-0.07
Bulgaria	1.31 (2022/01)	1.06	-0.09
Indonesia	1.55 (2022/02)	1.45	-0.09
Denmark	1.32 (2022/02)	0.90	-0.09
Brazil	1.37 (2022/02)	1.19	-0.11
Greece	1.58 (2022/01)	1.37	-0.11
Luxembourg	1.51 (2022/01)	0.93	-0.14
Lithuania	1.5 (2022/02)	1.01	-0.15
Barbados	1.75 (2022/01)	0.81	-0.16
Romania	1.59 (2022/02)	1.10	-0.17
Montenegro	1.9 (2022/01)	1.43	-0.18
Egypt	1.61 (2022/02)	1.47	-0.20
Malaysia	1.68 (2022/03)	1.19	-0.23
Zimbabwe	1.43 (2021/12)	1.10	-0.24
Costa Rica	1.33 (2022/02)	1.09	-0.28
Somalia	1.67 (2021/03)	0.82	-0.46
Mean	1.57	1.16	0.01
Median	1.55	1.14	-0.03
Standard Deviation	0.28	0.21	0.21

Notes. For each economy in the sample, the "online spending share" of total card consumption in any economy for a given year is defined by Equation (1) in the text, as $s_{c,t} = \frac{Online\ Mastercard\ spending_{c,t}}{Total\ Mastercard\ spending_{c,t}}$. "Latest" is the online share indexed to January 2020=1. Country-wise daily new covid cases data from ourworldindata.org. Monthly average of daily new cases are taken; month and year with the highest average is defined as peak. The peak is measured relative to the average online share in the economy for 2019.

Table 2. Correlates of deviation in online shares from the predicted pre-COVID trends

Dependent variable: Month-on-month change in online share gap (in pp)

	[1]	[2]	[3]	[4]
Residential Mobility, monthly avg %	0.5134***	0.5131***	0.4395***	0.3998***
	[0.04]	[0.04]	[0.05]	[0.05]
New Covid Cases per million, logs	0.0836**	0.0853**	0.0704*	0.0718*
	[0.04]	[0.04]	[0.04]	[0.04]
Pre-covid trend online share		-0.0014	-0.0019	0.0006
		[0.00]	[0.00]	[0.00]
COVID Fiscal spending as % 2019 GDP		-0.001	-0.0012	0.0027
		[0.01]	[0.01]	[0.01]
Internet penetration, 2019 (%)		-0.0012	-0.0008	-0.0013
		[0.01]	[0.01]	[0.01]
Residential mobility * Fiscal spending, 2019			0.0063***	0.0073***
			[0.00]	[0.00]
GDP per capita-2019, in '000'		-0.0002	-0.0001	-0.0023
		[0.00]	[0.00]	[0.01]
Firm capability (%)				1.1818**
				[0.56]
Consumer capability (%)				0.2081
				[0.22]
r2	0.5578	0.5579	0.5639	0.5471
N	1336	1336	1336	1082
Time FE	Yes	Yes	Yes	Yes
# countries	43	43	43	34
# months	33	33	33	33

Notes: Variables in differences are online share, Residential Mobility, Firm and Consumer Capabilities. The differences are computed by taking first difference month over month. Residential mobility on any given day of the week is measured as the percentage change from the baseline value, which is defined as the median value, for the corresponding day of the week, during the 5-week period Jan 3–Feb 6, 2020. GDP per capita is in $, constant prices, PPP 2017 international dollars, taken from the IMF WEO. “Firm capability”, defined at the (country, time) level, as the proportion of active firms that ever sold online since the start of the sample in 2018. “Consumer capability” is defined as the proportion of active consumers that ever bought online. Figure 5 plots the median consumer and firm capability measures over time. Robust standard errors in parentheses. ***, **, and * denote statistical significance at 1, 5, and 10 percent levels.

Table 3. Correlates of deviation in online shares from the predicted pre-COVID trends. Robustness

	[1]	[2]	[3]	[4]	[5]	[6]	[7]
	Baseline	Retail mob	Grocery and phar	Ox str	Ex internet	Yoy	Level
Residential Mobility, monthly avg %	0.3998***	-0.1547***	-0.1424***	0.0858***	0.3999***	0.3102***	0.2719***
	[0.05]	[0.02]	[0.02]	[0.02]	[0.05]	[0.04]	[0.04]
New Covid Cases per million, logs	0.0718*	0.0319	0.1127***	0.1033**	0.0699*	0.5091***	0.4163***
	[0.04]	[0.04]	[0.04]	[0.04]	[0.04]	[0.09]	[0.09]
Pre-covid trend online share	0.0006	0.0003	0.0046	0.0037	0.0007	-0.0590***	0.0027
	[0.00]	[0.00]	[0.00]	[0.01]	[0.00]	[0.01]	[0.01]
COVID Fiscal spending as % 2019 GDP	0.0027	-0.0026	0.0028	0.0031	0.003	-0.0056	0.0222
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.02]	[0.02]
Internet Penetration, 2019 (%)	-0.0013	-0.006	-0.0084	0.0006		0.0206	0.0255*
	[0.01]	[0.01]	[0.01]	[0.01]		[0.02]	[0.02]
Residential mobility * Fiscal spending, 2019	0.0073***	-0.0017***	-0.0038***	0.0025***	0.0073***	0.0155***	0.0098***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
GDP per capita-2019, in '000'	-0.0023	0.0002	-0.006	-0.006	-0.0031	0.0292**	-0.0064
	[0.01]	[0.01]	[0.01]	[0.01]	[0.00]	[0.01]	[0.02]
Firm capability (%)	1.1818**	0.7023	1.6310***	1.5475**	1.1815**	0.0008	-0.0707***
	[0.56]	[0.51]	[0.62]	[0.60]	[0.56]	[0.11]	[0.02]
Consumer capability (%)	0.2081	0.0253	0.2193	0.0969	0.2094	0.2585***	0.0657***
	[0.22]	[0.21]	[0.23]	[0.23]	[0.21]	[0.09]	[0.01]
r2	0.5471	0.5803	0.4932	0.4243	0.5471	0.5233	0.3198
N	1082	1082	1082	1171	1082	708	1105
Country FE	No	No	No	No	No	No	No
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# countries	34	34	34	34	34	34	34
# months	33	33	33	33	33	33	33

Notes: Column [1] repeats the baseline specification (column [4]) in Table 2. Columns [2]-[3] includes alternative measures of mobility (retail, and grocery and pharmacy, which are negatively correlated with pandemic restrictions) and Column [4] uses the Oxford stringency measure. Column [5] drops the internet penetration variable. Columns [6]-[7] employ alternative specifications – with changes measured over 12-month period, and estimation in levels rather than changes respectively. In all columns excluding Columns [6—[7], variables in differences are online share, Residential Mobility, Firm and Consumer Capabilities. The differences are computed by taking first difference month over month. In Column [6], online shares, and consumer and firm capabilities are in differences, computed as 12-month changes. In Column [7], all variables are in levels. Residential mobility on any given day of the week is measured as the percentage change from the baseline value, which is defined as the median value, for the corresponding day of the week, during the 5-week period Jan 3–Feb 6, 2020. GDP per capita is in $, constant prices, PPP 2017 international dollars, taken from the IMF WEO. “Firm capability”, defined at the (country, time) level, as the proportion of active firms that ever sold online since the start of the sample in 2018. “Consumer capability” is defined as the proportion of active consumers that ever bought online. Figure 5 plots the median consumer and firm capability measures over time. Robust standard errors in parentheses. ***, **, and * denote statistical significance at 1, 5, and 10 percent levels.

Table 4. Divergence Across Selected Sectors

sector	2019 average	Peak crisis	Latest	Latest vs pre-covid trend
All Categories	35.9	46.4	43.9	0.6
Restaurants-Bars	7.3	32.6	16.3	-0.2
Retail	21.8	33.2	26.7	-1.4
Services	67.5	82.2	73.0	-0.5

Table 5. Heterogeneity across sectors in persistence of online shares

sector	2019 average	Peak crisis	Latest	Latest vs pre-covid trend	Rank
Auto Rental	30.19	42.31	40.72	6.86	1
Clothing Stores	22.65	77.95	35.13	5.69	2
Drug Stores	10.31	19.43	16.75	5.43	3
Electric-Appliance	45.70	78.46	59.16	4.19	4
Travel Agencies	86.13	94.29	94.15	4.17	5
Education	73.45	88.41	79.29	3.49	6
Interior Furnishings	21.90	43.74	30.89	2.41	7
Utilities	84.77	90.82	88.23	2.21	8
Professional Services	85.48	91.58	90.94	1.29	9
Airline	93.02	97.64	97.64	1.28	10
Food Stores-Warehouse	4.92	9.69	8.32	1.28	11
Health Care	34.35	57.95	40.55	1.21	12
Gas Stations	0.48	1.44	1.42	0.50	13
Restaurants-Bars	7.30	32.63	16.34	-0.18	14
Vehicles	19.66	28.39	24.17	-0.57	15
Other Transport	66.74	79.13	70.66	-0.72	16
Discount Stores	15.83	33.23	22.15	-1.21	17
Department Stores	28.68	63.92	50.27	-1.44	18
Other Services	64.95	79.22	71.14	-2.42	19
Mail Order	97.95	99.16	96.88	-3.12	20
Sporting-Toy Stores	27.31	59.38	32.04	-3.16	21
Recreation	60.14	79.44	65.80	-3.38	22
Hardware	27.47	34.39	31.37	-3.58	23
Other Retail	46.15	66.50	52.05	-4.86	24
Repair Shops	32.22	43.10	34.58	-6.56	25
Hotel-Motel	38.65	58.14	52.66	-9.73	26
All Categories	35.89	46.35	43.89	0.64	

Appendix

Tables

Appendix Table A1. Summary Statistics (based on Table 2 Column 4)

Variable	Obs	Mean	Std. Dev.	Min	Max
Online share gap (online share-trend) (in pp), NSA	1082	0.0	3.4	-15.7	19.1
Residential Mobility, monthly avg %	1082	36.6	21.9	2.8	97.3
Pre-covid trend online share	1082	0.1	4.1	-15.5	34.1
COVID Fiscal spending as % 2019 GDP	1082	40.8	17.7	12.0	100.0
GDP per capita-2019, in '000'	1082	13.7	10.8	1.1	43.4
Residential mobility * Fiscal spending, 2019	1082	1.0	71.9	-567.3	844.8
Firm capability (%)	1082	7.1	2.4	-1.7	12.1
Consumer capability (%)	1082	78.5	18.0	26.6	99.7
Internet penetration (2019, %)	1082	0.0	3.4	-15.7	19.1

Notes: Variables in differences: online share gap (LHS), Residential Mobility, Firm and Consumer Capabilities (RHS). First difference month over month.

Appendix Table A2 Robustness Constant Sample

	[1]	[2]	[3]	[4]
Residential Mobility, monthly avg %	0.4974***	0.4969***	0.3956***	0.3998***
	[0.04]	[0.04]	[0.05]	[0.05]
New Covid Cases per million, logs	0.0876**	0.0926**	0.0706*	0.0718*
	[0.04]	[0.04]	[0.04]	[0.04]
Pre-covid trend online share		-0.0002	-0.0008	0.0006
		[0.00]	[0.00]	[0.00]
COVID Fiscal spending as % 2019 GDP		-0.0024	-0.0026	0.0027
		[0.01]	[0.01]	[0.01]
Internet penetration, 2019 (%)		-0.0022	-0.0015	-0.0013
		[0.01]	[0.01]	[0.01]
Residential mobility * Fiscal spending, 2019			0.0079***	0.0073***
			[0.00]	[0.00]
GDP per capita-2019, in '000'		0.0017	0.0017	-0.0023
		[0.01]	[0.01]	[0.01]
Firm capability (%)				1.1818**
				[0.56]
Consumer capability (%)				0.2081
				[0.22]
r2	0.5333	0.5334	0.5446	0.5471
N	1082	1082	1082	1082
Country FE	No	No	No	No
Time FE	Yes	Yes	Yes	Yes
# countries	43	43	43	34
# months	33	33	33	33

Notes: Variables in differences: online share (LHS), Residential Mobility, Firm and Consumer Capabilities (RHS). First difference month over month.

Appendix A: Detailed overview of database used in our study.

Payment Channels and the Scope of Study

Payments can occur through a variety of channels, including cash, card, check, and deposits. This study focuses on aggregated & anonymized card transactions within the Mastercard network. A related database from Mastercard was used by Mian et al (2013).

Although card transactions mainly serve the retail and services sector, specific segments like vehicle sales are underrepresented as deposits often take precedence over card payments.

Card payments are the predominant method for online transactions, translating to over-representativeness of e-commerce relative to household expenditures in aggregate. Although this translates to an inherent payment form bias, e-commerce shares in our database align well in markets whose official statistics agencies report e-commerce sales.

Our study adds value by providing a more granular look into the transience of e-commerce spend, across different industries and many more markets than is typically not readily available.

Data Structure & Dimensionality

- **Payment Channels:** A significant component of our study is defining online spending. For this purpose, we categorize E-Commerce as transactions where neither the cardholder nor the card are physically present. In transactions where tap to pay is initiated via a mobile wallet with a linked card, which represent a small portion of aggregate volumes, the card itself is not physically present.
- **Localization:** The data is relative to the card's issuing bank country. For instance, a transaction made using a Canadian card for an online purchase from a U.S. merchant will be attributed to Canada, regardless of the merchant's location.
- **Sectoral Definitions & Industry Representativeness:** Industries within our data set are identified using Merchant Category Codes (MCC) - a standard in the payments industry. While research often correlates MCCs with other industry classifications like NAICS or SIC, the core insights one could extrapolate from card payment transaction data remain consistent. Specifically, our figures exclude cash transactions and sectors not typically represented through card payments, such as rent or automotive sales. Hence, industry categorization should be contextualized within these parameters.

The database offers details on:

- Date & time: the date and time in which the transaction occurred
- Type of card: whether the card is a credit, debit, or pre-paid card
- Merchant location: what is the address on record for the merchant where the transaction took place?
- Industry classification: what industry is the merchant classified as
- Channel: whether the payment was an online or brick & mortar transaction
- Transaction amount: the value of the transaction made

Importantly, Mastercard does not have access to the following dimensions:

- Cardholder-specific details, like location, income, or account balances.
- Breakdown of individual items or SKUs in a purchase. Mastercard only observes the total payment amount.

Mastercard's Reach

The Mastercard network has a presence in 210 countries and territories, connected to 20,000 financial institutions and over 80 million merchant locations with more than 2.9 billion cards in force. In 2022, Mastercard processed approximately 125.7 billion transactions, amounting to a total value of nearly 8.2 trillion U.S. dollars from purchases and cash disbursements.

For this research, we thoroughly examine aggregated & anonymized transaction data. Our focus is on capturing industry and sector patterns by market monthly. Our figures represent aggregated and anonymized Mastercard transactions based on the card's issuing country.

The use of aggregated and anonymized data underscores our commitment to data privacy and ethical research practices. This database provides invaluable insights into transaction trends, allowing for a nuanced understanding of industry shifts and market dynamics. By focusing on Mastercard transactions, we study a significant portion of global transactional data, enabling us to deliver robust insights.

Appendix B: Mastercard's Market Share Cut-off

To increase the chances of having a representative sample in the paper we limited our data to economies where Mastercard has a significant market share. Changing this cutoff value has little impact on our results. To show this, we computed the online share for economies where Mastercard has a small share of the card market and compared it to the results we can obtain from the 47 economies included in our sample. Figure B1 shows that online shares are highly correlated between these two groups, with a correlation coefficient of 0.97.

Figure B1: Online shares in economies where Mastercard has >=20% and <20% market share.