Economics Bulletin

Volume 44, Issue 4

The pandemic shock and the heterogenous responses for durable versus non-durable industries

Enlinson Mattos
Fundacao Getulio Vargas - Sao Paulo School of Economics

Leonardo Stelzer-Rossi
Tax Revenue Service - Sao Paulo

Abstract

We use administrative data from a representative state in Brazil to provide robust estimates of the heterogeneous impacts of the COVID-19 pandemic on durable versus non-durable sectors. Employing a dynamic differences-in-differences strategy, our results suggest a 62\% relative reduction in revenues for the automotive industry (durable) in the pandemic shock, accompanied by a nearly 70\% decline in tax collection within the durable relative to the non-durable sector for the three three-month crisis period. Furthermore, our analysis indicates a rebound within three months, reinforcing the fast response of the durable sector after a crisis.

We have benefited from comments from Fabiana Rocha, Marcelo Arbex and Marcos Nakaguma. Leonardo Stelzer Rossi thanks the support of the Sao Paulo Revenue Service (RESP). The views and opinions presented in this paper reflect those of the authors. They do not necessarily reflect the views or the official position of the Brazilian Revenue Service. Any errors are our own.
Citation: Enlinson Mattos and Leonardo Stelzer-Rossi, (2024) "The pandemic shock and the heterogenous responses for durable versus non-durable industries", *Economics Bulletin*, Volume 44, Issue 4, pages 1414-1433
Contact: Enlinson Mattos - enlinson.mattos@fgv.br, Leonardo Stelzer-Rossi - leostelzer@hotmail.com.
Submitted: August 15, 2024. **Published:** December 30, 2024.

1 Introduction

Health crises (e.g., the COVID-19 pandemic) can have important heterogeneous economic effects as they represent a sudden drop in the current households' budget constraint, which may affect an individual's consumption composition. Caballero (1990) shows that the economic outcomes of the durable (versus non-durable) sectors are rather dependent on these income fluctuations and not on the expected lifetime income (Modigliani and Brumberg (1954)) consistent with Levin and Erceg (2002) findings on durables sector responses to interest rate policy.

The most recent literature on pandemic shock has focused on estimating the negative effects on small firms (Bartik et al., 2020), across countries (Bachas et al. (2020)) or focusing on supply versus demand shocks countries ((Benguria and Taylor, 2020)).[1] Despite the magnitude of the crisis, there is limited evidence of its heterogeneous impacts across sectors in developing countries.

The main reason for this gap is the lack of data, which usually comes from administrative records in high-income countries focusing on either labor market outcomes or size-dependent firms' responses. For instance, Cui et al. (2022) investigates payroll tax cuts' impact on the labor market in China, while Humphries et al. (2020) investigates the CARES Act in the U.S.. Alternatively, Bennedsen et al. (2020) and Santos et al. (2020) investigate the COVID-19 impact on firms' revenues and labor outcomes for the Danish and Portuguese economies, exploring the heterogeneous impact of the COVID-19 depending on firms' size.[2]

This paper leverages unique Brazilian firm-level administrative data (8,219 firms; January/2017 - December/2021) from Sao Paulo, the wealthiest state in Brazil, regarding the universe of transactions in the most representative industries in the durable sector (automobile) and non-durable (livestock) to establish two empirical facts. First, although our estimates suggest that both durable and non-durable goods' time series evolved similarly before the shock of the health crisis, the health crisis had a real negative impact on durable goods for three months, stronger right after its beginning. Second, our average Treatment on the Treated (ATT) estimates suggests a non-significant difference in revenues or tax revenues when we compare before versus after the shock.

[1] See also Chetty et al. (2020); Cororaton and Rosen (2021); Busso et al. (2021); Granja et al. (2020).

[2] See Londono-Velez and Querubin (2022) for the impact of pandemic policies on household savings decisions and Guerrero-Amezaga et al. (2022) for a recent treatment of small firms' responses to the health crisis.

In particular, we consider a dynamic Difference-in-Difference (DiD) estimator to document a reduction of 72% (79%) in the revenues (VAT taxes) in the first month of the pandemic for durable compared to non-durable goods, a negative impact of 62% (70%) in average on revenues (tax collection) that lasted three months, and a slight positive effect on tax collection for durable (compared to non-durable) one year after the drop in the revenues. These results highlight the heterogeneous responses of different sectors and the fast economic recovery of the durable goods industry in a developing country to a pandemic crisis.

The next section briefly documents the fundamentals of observing changes in consumption patterns during a crisis. Section 3 documents the data and our empirical strategy. Sections 4 and 5 bring the results and conclusion, respectively.

2 Consumption Patterns During Crisis

The COVID-19 pandemic has heightened market volatility and consumer uncertainty far beyond typical levels seen during global crises. As consumption patterns shifted, consumer decision-making was further disrupted by government-imposed self-isolation, lockdowns, and social distancing. With everyday purchases restricted, behavior changed significantly.

Three key behavioral theories suggest that consumption during the pandemic leaned heavily towards non-durable goods (Loxton et al. (2020)), other than the traditional *permanent income hypothesis* explained below. This paper aims to quantify the extent and duration of these consumption shifts.

Consumer behavior during COVID-19 reveals trends in panic buying, herd mentality, and discretionary spending adjustments. Panic buying occurs when consumers purchase excessive quantities or various products in response to anticipated shortages or crises. Yuen et al. (2020)) identifies four factors driving this behavior during the pandemic: perception of risk, fear of the unknown, coping mechanisms, and social psychology. When consumers believe the threat is high, they panic buying as a form of self-protection. Although our data doesn't allow us to test for panic buying directly, this phenomenon likely contributes to increased demand for non-durable goods.

In crises with limited information and perceived threats, herd mentality often leads individuals

to follow collective behavior instead of making rational, independent decisions. This amplifies societal anxieties, with consumers mirroring the purchasing habits of others rather than following expert advice (Kameda and Hastie (2015)). The hoarding of essential items like food and cleaning supplies, driven by herd mentality, exemplifies the Tragedy of the Commons. Consumers act self-interested despite knowing it harms the collective, leading to widespread shortages. This behavior enabled manufacturers to adapt and meet shifting demands, profiting from the increased need for essential goods. Maslow's Hierarchy of Needs (Maslow (1954)) further explains consumer priorities during crises. According to Lester (2013), people prioritize basic needs like food, water, and safety products over higher-order desires in times of distress. This shift towards panic buying of non-durable essentials reflects consumer anxiety about future availability. Despite strict containment measures, many risked their health to secure essential goods, underscoring the prioritization of lower-order needs, even at the expense of potential economic or health risks.

Last, the *permanent income hypothesis*' (Friedman (1957)) provides a useful framework for understanding how consumers responded differently during the pandemic, particularly in their consumption of durable and non-durable goods. During economic shocks like the pandemic, consumers view income reductions as temporary and adjust their spending accordingly. As a result, they continue to spend on essential non-durable goods like food and hygiene products. However, purchases of durable goods, which require larger investments and can be postponed without impacting immediate well-being, are delayed until consumers expect a recovery or more stability in their future income. As consumers base their spending decisions not only on their current income but also on their expected long-term income (permanent income), this explains the sustained demand for non-durable goods during the pandemic despite economic uncertainty. Consumers prioritize essential items in the short term while delaying the purchase of durables, such as automobiles and household appliances, as they are optimistic about their financial prospects stabilizing over time. As the health crisis is under control and economic recovery expectations improve, consumers gradually shift their spending toward durable goods. Thus, despite the potential income declines during the pandemic, non-durable industries are less affected as consumer spending focuses on survival essentials.

3 Data and Empirical Strategy

Data. VAT taxes are under the state responsibility in Brazil. The state of São Paulo accounts for 30% of the total ICMS (VAT) revenue in the country, which amounted to R$ 214 billion in 2022.[3] Sao Paulo state tax authority is responsible for collecting and recording the state's associated value-added taxes using *Electronic Invoices* (EI) of the universe of transactions at the consumption good level, based on the National Classification of Goods (NCM). We explore this data covering the period from January 2017 to December 2021 with a focus on outbound operations at the industry level of the supply chain rather than the plant/firm level.[4]

We consider the first two digits of the NCM grouped into chapters (sectors) based on the common characteristics of the products. This chapter-based analysis allows for precisely selecting firms producing durable and non-durable goods. To choose the control and treatment chapters affected by the COVID-19 crisis, we start computing the revenue share per NCM chapter. Next, we identify the most representative chapters of non-durable goods (ND - control group) and durable goods (DR - treatment) using the corresponding percentage in the sum of monthly revenues (January 2017 - December 2021).[5]

Chapter 2 of the NCM, livestock industry, corresponds to the largest share of total revenue for the ND sector in the period, around 28% of the category, and therefore is our control group. As representatives of durable goods, we choose products from Chapter 87, the automotive industry. They represent approximately 20% of the revenue in our period for the eligible durable sector revenues, which is the largest share in the eligible DR sectors.[6] Last, we restrict our analysis to firms negotiating goods that belong to these chapters between January 2017 and December 2021.

[3]ICMS - is the Portuguese acronym for this state's VAT, tax on the circulation of goods and services.

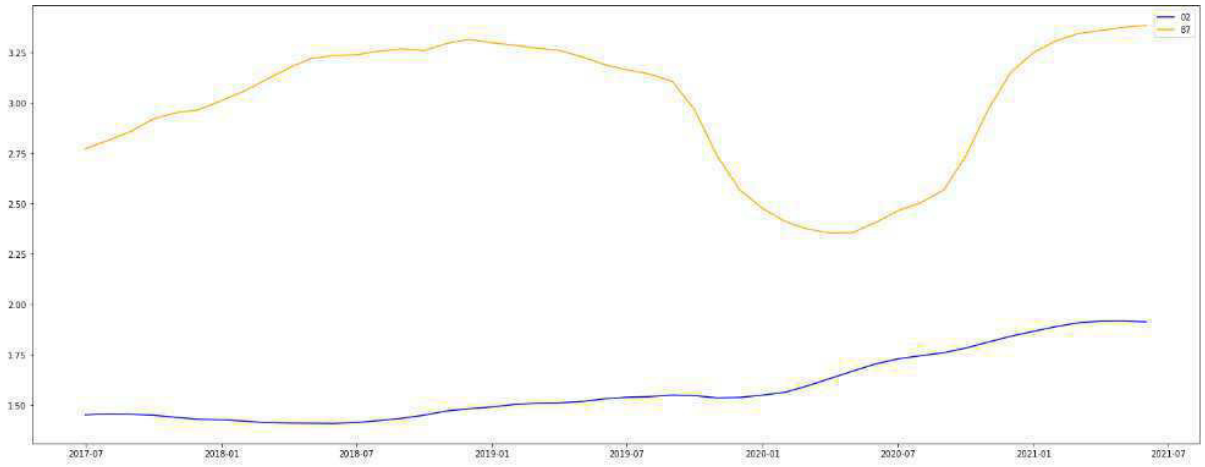
[4]This decision aims to avoid double counting of billing amounts in subsequent stages of the chain, contributing to greater accuracy of the analysis by avoiding incorrect repetition of financial information.

[5]We restrict our analysis to chapters that represented more than 0.25% of total revenue in the period, as illustrated in FigureA1. All data was deflated by the Consumer Price Index (IPCA), January 2023.

[6]This corresponds to the third largest revenue share in the DR sector. The other two largest sectors (Chapters 39, 10.39% - Plastic and derivatives- and 85, 8.95% - Nuclear reactor' and boiler producers) are very concentrated sectors with few firms participating. Moreover, the plastic sector is associated with packaging in both durable and non-durable sectors. Therefore, we choose products that belong to Chapter 87 of the NCM (motor vehicles and other land vehicles), which represent only durable goods and are associated with a much larger set of firms. On the other hand, products from Chapter 2 of the NCM (livestock) belong exclusively to the category of non-durable goods, are in the basic family consumption basket, and represent firms with the largest share in the *ND* sector.

Figure 1 summarizes the evolution of the de-seasonalized revenues of the two series (DR and ND goods). We observed a huge drop in the revenue of the auto industry in April 2020, which rapidly recovered within three months.[7]

Figure 1: Revenues - ND (livestock/meat industry, 02) x DR (Auto Industry, 52)



Source: SEFAZ-SP, elaborated by the authors using de-seasonality series. Graph displays control (ND) and treatment (D) groups. Deflated by inflation Jan-2023, in billion reais.

Table I shows data for control and treatment groups from January 2017 to December 2021. The treatment group has significantly more companies (7,318) than the control (901), with the treatment group's monthly revenue averaging R$ 2,997.54M, higher than the control's R$ 1,605.55M. VAT taxes for the treatment group average R$ 420.78M, markedly surpassing the control's R$ 116.10M.

Before the crisis (up to 03/2020), the control group (treatment) had an average turnover of 1.47 (3.02) billion reais, suggesting that companies in the treatment group were already in a prominent position in billing terms. However, during the crisis period (04/2020 to 06/2020), the control group maintained an average turnover of 1.49 billion reais, while the treatment group drastically reduced to an average of 1.06 billion reais. Finally, after the most critical period of the crisis, the control group (treatment) experienced a considerable increase in revenue, reaching an average of 1.92 (3.27) billion reais.

Empirical Strategy. We employ a dynamic diff-in-diff, having the durable sector as our

[7]The descriptive statistics and results for the variable "VAT (ICMS) Collection" starts in April 2017 after the tax exemption was granted to slaughterhouses, butchers and supermarkets. Using this period in our analysis does not change our qualitative findings and is available upon request.

Table I: Descriptive Statistics - Control Group (ND) and Treatment (DR)

	Control	**Treatment**
Number of firms	901	7318
Revenue	1.6	2.9
VAT taxes	0.11	0.42
	01/2017 a 03/2020*	
Revenue	1.47	3.02
VAT taxes	0.11	0.42
	04/2020 to 06/2020	
Revenue	1.49	1.06
VAT taxes	0.11	0.12
	07/2020 a 11/2021	
Revenue	1.92	3.27
VAT taxes	0.14%	0.47

Source: SEFAZ-SP, elaborated by the authors.
Notes: This table shows the descriptive statistics from treatment and control groups. The values are Monthly Average in R$ bi, jan/2023.[8]

treatment group, represented below:

$$Y_{ij} = \alpha_{\mathrm{T}} + \gamma_{\mathrm{t}} + \alpha_{\mathrm{T}} \cdot \sum_{j=1(4)}^{60} \beta_j \cdot \mathbf{D}_j + \varepsilon_{it} \tag{1}$$

where Yij is our dependent variable revenues (VAT taxes) for the firm i, in the month-year j; α_{T} represents our group fixed effect (dummy for DR). γ_{t} is our month-year fixed effect, where t captures a year/month effect, 2017-01 (2017-04) to 2021-12; β_j are our ATT (average of the treatment on treated) coefficients of interest; D_j are the dummy variable capturing all months in the analysis (forty before and 20 after the COVID crisis) and ε_{it} is our error.[9]

We also consider a *static* model to capture the heterogeneous impact (ATT-Average treatment on the treated) of the Pandemic crisis on the durable versus non-durable sectors, i.e., we run the

[9]For the models using tax collection, we consider the period from April 2017 due to the end of the tax exemption for slaughterhouses, supermarkets, and butchers decreed in December of the previous year, but that comes into effect from April 2017. Our ATT results are robust to this choice; see panels (e) and (f) in Figure C1 for the results using Revenues starting in April 2017 (panel e) and Tax revenues in January 2017, respectively. As expected, the first three months of the tax revenue do not satisfy the assumption of parallel trends.

following model:

$$Y_{ij} = \alpha_{\mathrm{T}} + \gamma_{\mathrm{t}} + \alpha_{\mathrm{T}} \cdot \beta \cdot \mathbf{D} + \varepsilon_{it} \tag{2}$$

where all variables are defined as before, but the variable D either assumes 1 for the three months of the crisis and zero otherwise (during crisis effect) or one after the crisis and zero otherwise (after-crisis effect).

4 Main Results

We start showing our ATT results in Table II. The results suggest that the non-durable sector experienced an average revenue decrease in these three months (April, May, and June/2020) of 62% (s.e. 0.10) with a decrease of 70% (s.e. 0.10) for taxes. While the estimated effect of the health crisis comparing the auto and livestock industries in the period before versus after the health crisis is not significant (0.0404; s.e.= 0.10) because of the fast recovery of the auto sector after three months, our estimates reveal (Table B1) that April 2020 stands out.[10]

Table II: Differences in Differences Sales/Revenues and Tax Revenues

Dep.	Ln (Sales/Rev.)	Ln (Sales/Rev.)	Ln (Tax Rev.)	Ln (Tax Rev.)
Treat. x during crisis	-0.6251***		-0.7053***	
	(0.1059)		(0.1063)	
Treat. x after crisis		0.0104		0.0851
		(0.1008)		(0.1026)
F.E.: Treat(Durable)	Yes	Yes	Yes	Yes
F.E.: Month-Year	Yes	Yes	Yes	Yes
S.E. clustered	Firm	Firm	Firm	Firm
Observations	157,862	157,862	87,406	87,406
R2	0.04097	0.04075	0.03294	0.03295

Notes: Panel with the universe of firms in the Sectors livestock (02) and auto (87) from 2017 - 2021 with fixed-effects: year/month (time) and group (dummy for treated) and cluster at the firm level. Results based on the regression represented by equation (2), with reference period March/2020. The estimated ATT coefficients for the three months after the hit of the COVID crisis suggest that that the *D* sector compared to the *ND* counterpart had their sales/revenues (taxes) dropped by 63% (70%) in average compared to March/2020. The estimated effect before versus after the health crisis is not statistically significant for sales/revenues (tax revenues) 0.014 (0.08).

In Figure 2, we present (a) revenues and (b) VAT collection as the dependent variables for

[10]The model that represents our finding of a non-significant effect of the crisis on revenues and taxes is similar to our ATT model described above. However, the variable D assumes 1 for all the months after March 2020 and zero otherwise.

equation (1) monthly.[11] The three months immediately following the onset of the pandemic crisis had a more pronounced effect on the durable goods series than the non-durable ones. The negative and highly significant coefficient of our dynamic diff-in-diff model suggests a reduction in revenues (taxes) of around 73% (79%) for the Auto industry revenues (tax collection) in São Paulo compared to the livestock sector. We also observe negative effects in the subsequent months of May, approximately 56% (54%), and June, with around 33% (28%). [12]

5 Discussion and Conclusion

Shifts in consumption during a crisis such as COVID-19 can be understood using both behavioral theories (Loxton et al. (2020)) and the permanent income hypothesis (Friedman (1957)) model. These adjustments prioritize essential, non-durable goods in the short term, as these items are critical to maintaining daily life. In contrast, expenditures on durable goods, which often represent long-term investments, are postponed until economic conditions stabilize and consumers feel more confident in their future financial prospects.

Our paper considers the recent COVID-19 crisis and administrative data from the Electronic Invoices of São Paulo State Finance Department (SEFAZ-SP) to test its impact on the durable sector (automotive industry), comprising around 8.21% (20%) of total (Durable) revenues in São Paulo, contrasted with the non-durable sector, the livestock sector (4.4% (28%) of total (ND) revenues). The durable goods sector faced a relative drop in revenue and taxes collected, which rapidly recovered after three months. After one year, we observed a positive impact on tax revenues for the durable sector, which shows that individuals instantly reduce expenses on capital (durable sector) right after an unexpected crisis.[13]

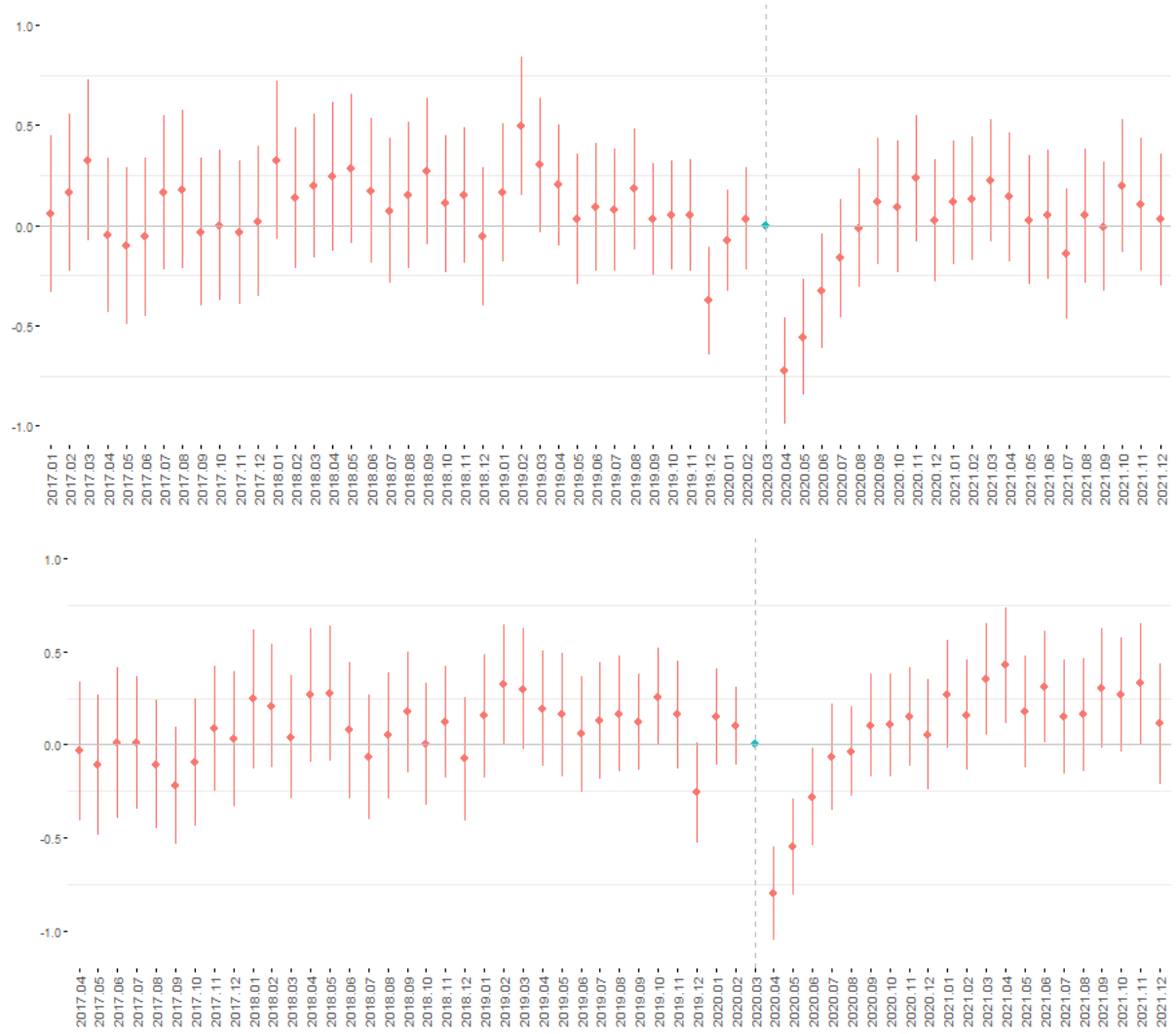
[11] Regressions using trimester are in the appendix, and with annual data is available upon request. We prefer to show this figure as it makes it clear that even in a monthly analysis that could be affected by different seasonality effects across sectors, our parallel pre-trend assumption holds. Only in December 2019 did there seem to be a slight reduction in sales revenues for the durable sectors, with a slight recovery in the next month, reinforcing our empirical strategy. Using a trimester or annual dataset makes this event go to zero.

[12] These two sectors present a larger seasonal component in their revenues and Figure B.2 shows the results using trimester data to reduce this component. We emphasize that (i) the coefficient for February 2019 (0.4960) suggests a 50% higher performance of the treated group (versus non-treated) concerning the counterfactual to March 2020. And (ii) in December 2019 (-0.3767), we had a drop of approximately 38% in the automotive sector concerning the livestock sector.

[13] The Brazilian government implemented an Emergency Aid Program for vulnerable families starting at the end of May. Although we cannot test the correspondent impact of this emergency aid with our data, Figure 1 suggests

Figure 2: Event Study Results

(a) Event Study - Sales/Revenues



Notes: Panel with the universe of firms in the sectors livestock (02) and auto (87) from 2017 - 2021 with fixed-effects: year/month (time) and group (dummy for treated) and cluster at the firm level. Results based on the regression represented by the equation 1, with reference period March/2020. The estimated ATT coefficients (represented in the y-axis) for the three months after the hit of the COVID crisis mean that the *D* sector compared to the *ND* counterpart had their revenues (taxes) dropped by 73% (79%) in April 2020, 56% (54%) in May/2020 and 33% (27%) in June compared to March/2020, see Tables B1 and B2 for the full set of estimates. The estimated effect before versus after the health crisis is not statistically significant for sales/revenues (tax revenues) -0.0199 (0.08). The estimated effects comparing the period during the crisis separately from before and after the Pandemic are -0.6201 (0.1047) and -0.7053 (0.1063) for revenues and tax collection, respectively, comparing durable versus non-durable sections.

This reinforces that consumer behavior during the COVID-19 period has demonstrated a shift in consumption of basic needs and non-durable items; right after the health-containment measures started to be eased, consumers have shifted spending again to pre-COVID-19 priorities, increasing spending on durable goods.

a rather stable livestock time series. Such a policy would have affected our control group (comparatively) less in the last month of the crisis.

References

Bachas, P., A. Brockmeyer, C. Semelet, and C. Ungerer (2020): "The Impact of COVID-19 on Formal Firms," World Bank Publications - Reports 34392, The World Bank Group.

Bartik, A. W., M. Bertrand, Z. B. Cullen, E. L. Glaeser, M. Luca, and C. T. Stanton (2020): "How Are Small Businesses Adjusting to COVID-19? Early Evidence from a Survey," NBER Working Papers 26989, National Bureau of Economic Research, Inc.

Benguria, F. and A. M. Taylor (2020): "After the Panic: Are Financial Crises Demand or Supply Shocks? Evidence from International Trade," *National Bureau of Economic Research*, 2, 509–526.

Bennedsen, M., B. Larsen, I. Schmutte, and D. Scur (2020): "Preserving job matches during the COVID-19 pandemic: firm-level evidence on the role of government aid," Tech. rep.

Busso, M., J. Camacho, J. Messina, and G. Montenegro (2021): "Social protection and informality in Latin America during the COVID-19 pandemic," *PLOS ONE*, 16, e0259050.

Caballero, R. J. (1990): "Expenditure on Durable Goods: A Case for Slow Adjustment*," *The Quarterly Journal of Economics*, 105, 727–743.

Chetty, R., J. Friedman, M. Stepner, and T. O. I. Team (2020): "The Economic Impacts of COVID-19: Evidence from a New Public Database Built Using Private Sector Data," NBER Working Papers 27431, National Bureau of Economic Research, Inc.

Cororaton, A. and S. Rosen (2021): "Public Firm Borrowers of the U.S. Paycheck Protection Program [The risk of being a fallen angel and the corporate dash for cash in the midst of COVID]," *Review of Corporate Finance Studies*, 10, 641–693.

Cui, W., J. Hicks, and M. Norton (2022): "How well-targeted are payroll tax cuts as a response to COVID-19? evidence from China," *International Tax and Public Finance*, 29, 1321–1347.

Friedman, M. (1957): *A Theory of the Consumption Function*, no. frie57-1 in NBER Books, National Bureau of Economic Research, Inc.

Granja, J., C. Makridis, C. Yannelis, and E. Zwick (2020): "Did the Paycheck Protection Program Hit the Target?" NBER Working Papers 27095, National Bureau of Economic Research, Inc.

Guerrero-Amezaga, M. E., J. E. Humphries, C. A. Neilson, N. Shimberg, and G. Ulyssea (2022): "Small firms and the pandemic: Evidence from Latin America," *Journal of Development Economics*, 155.

Humphries, J. E., C. A. Neilson, and G. Ulyssea (2020): "Information frictions and access to the Paycheck Protection Program," *Journal of Public Economics*, 190, 104244.

Kameda, T. and R. Hastie (2015): *Herd Behavior*, 1–14.

Lester, D. (2013): "Measuring Maslow's Hierarchy of Needs," *Psychological Reports*, 113, 15–17.

Levin, A. T. and C. J. Erceg (2002): "Optimal monetary policy with durable and non-durable goods," *Social Science Research Network*, 2002, 1–31.

Londono-Velez, J. and P. Querubin (2022): "The Impact of Emergency Cash Assistance in a Pandemic: Experimental Evidence from Colombia," *The Review of Economics and Statistics*, 104, 157–165.

Loxton, M., R. Truskett, B. Scarf, L. Sindone, G. Baldry, and Y. Zhao (2020): "Consumer Behaviour during Crises: Preliminary Research on How Coronavirus Has Manifested Consumer Panic Buying, Herd Mentality, Changing Discretionary Spending and the Role of the Media in Influencing Behaviour," *Journal of Risk and Financial Management*, 13.

Maslow, A. (1954): *Motivation and Personality*, New York: Harper.

Modigliani, F. and R. Brumberg (1954): "UTILITY ANALYSIS AND THE CONSUMPTION FUNCTION: AN INTERPRETATION OF CROSS-SECTION DATA," *Post-Keynesian Economics*, 1.

Santos, C., N. Kozeniauskas, and P. Moreira (2020): "Covid-19 and Firms: Productivity and Government Policies," CEPR Discussion Papers 15156, C.E.P.R. Discussion Papers.

Yuen, K. F., X. Wang, F. Ma, and K. X. Li (2020): "The Psychological Causes of Panic Buying Following a Health Crisis," *International Journal of Environmental Research and Public Health*, 17, 3513.

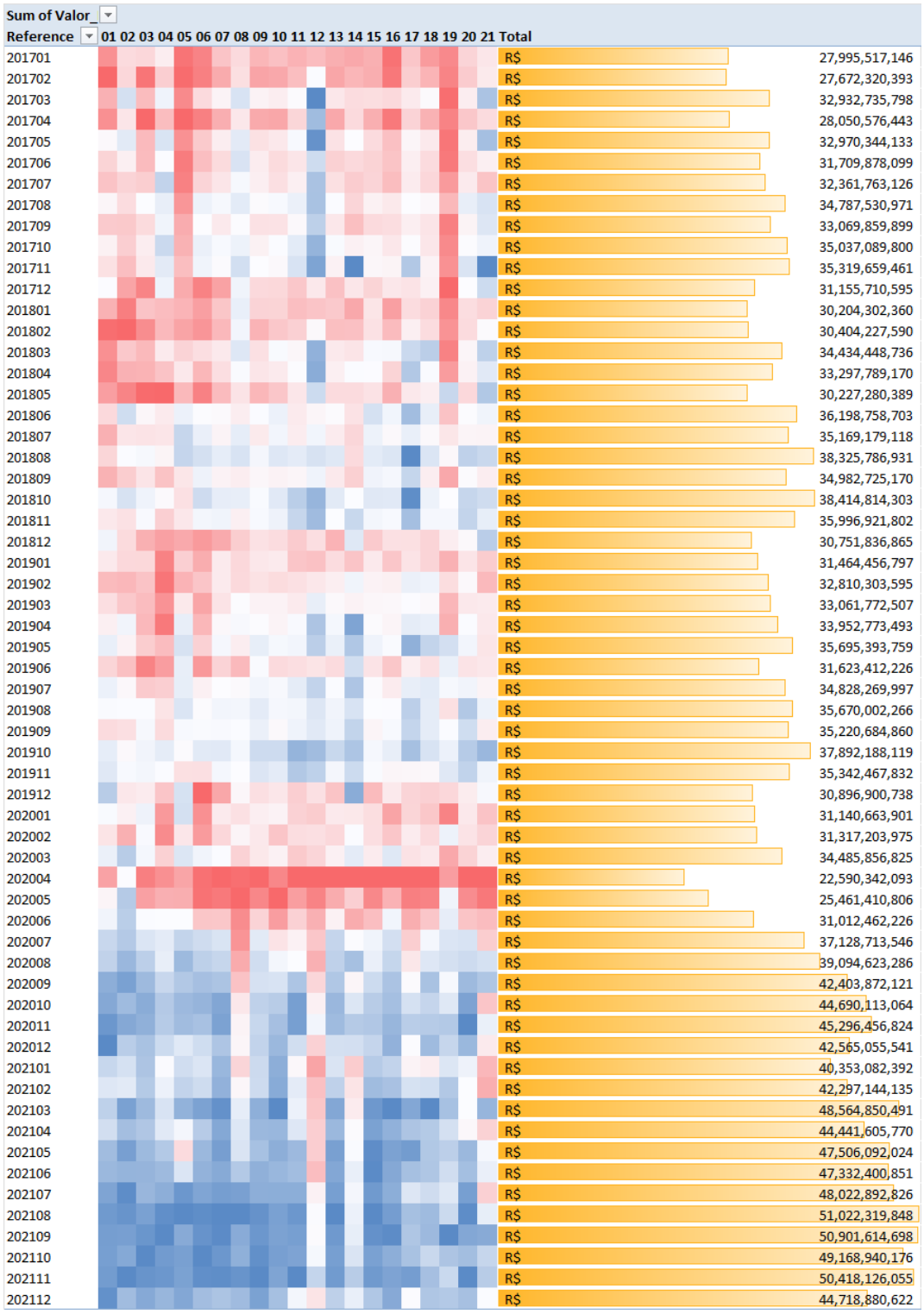
Appendix A - Treatment and Control Group

Figure A1: NCM - Chapters - Share larger than 0,25%

SECTION		Revenue	%
01	Chapter 2 - Meat and Edible Offal	R$ 96,333,072,484.48	4.40%
01	Chapter 4 - Dairy Produce; Bird's Eggs; Natural Honey; Edible Products of Animal Origin, Not Elsewhere Specified or Included	R$ 11,567,967,785.09	0.53%
02	Chapter 10 - Cereals	R$ 9,764,387,488.00	0.45%
02	Chapter 11 - Products of the Milling Industry; Malt; Starches; Inulin; Wheat Gluten	R$ 15,114,437,537.84	0.69%
03	Chapter 15 - Animal or Vegetable Fats and Oils and Their Cleavage Products; Prepared Edible Fats; Animal or Vegetable Waxes	R$ 19,822,268,898.54	0.90%
04	Chapter 17 - Sugars and Sugar Confectionery	R$ 28,390,694,453.38	1.30%
04	Chapter 19 - Preparations of Cereals, Flour, Starch or Milk; Pastrycooks' Products	R$ 30,535,605,723.46	1.39%
04	Chapter 20 - Preparations of Vegetables, Fruit, Nuts or Other Parts of Plants	R$ 6,406,087,497.83	0.29%
04	Chapter 21 - Miscellaneous Edible Preparations	R$ 17,470,621,234.40	0.80%
04	Chapter 22 - Beverages, Spirits and Vinegar	R$ 16,717,698,957.92	0.76%
04	Chapter 23 - Residues and Waste from the Food Industries; Prepared Animal Fodder	R$ 28,354,320,051.67	1.29%
05	Chapter 25 - Salt; Sulphur; Earths and Stone; Plastering Materials, Lime and Cement	R$ 9,057,311,013.50	0.41%
05	Chapter 27 - Mineral Fuels, Mineral Oils and Products of Their Distillation; Bituminous Substances; Mineral Waxes	R$ 48,315,847,352.12	2.20%
06	Chapter 28 - Inorganic Chemicals; Organic or Inorganic Compounds of Precious Metals, of Rare-Earth Metals, of Radioactive Ele	R$ 54,068,460,608.46	2.47%
06	Chapter 29 - Organic Chemicals	R$ 57,942,026,720.86	2.64%
06	Chapter 30 - Pharmaceutical Products	R$ 31,812,727,210.01	1.45%
06	Chapter 31 - Fertilisers	R$ 33,911,584,485.59	1.55%
06	Chapter 32 - Tanning or Dyeing Extracts; Tannins and Their Derivatives; Dyes, Pigments and Other Colouring Matter; Paints and	R$ 33,304,817,756.50	1.52%
06	Chapter 33 - Essential Oils and Resinoids; Perfumery, Cosmetic or Toilet Preparations	R$ 46,877,099,306.85	2.14%
06	Chapter 34 - Soap, Organic Surface-Active Agents, Washing Preparations, Lubricating Preparations, Artificial Waxes, Prepared	R$ 30,661,989,218.26	1.40%
06	Chapter 35 - Albuminoidal Substances; Modified Starches; Glues; Enzymes	R$ 8,392,305,756.84	0.38%
06	Chapter 38 - Miscellaneous Chemical Products	R$ 47,583,369,794.53	2.17%
07	Chapter 39 - Plastics and Articles Thereof	R$ 196,227,846,039.61	8.95%
07	Chapter 40 - Rubber and Articles Thereof	R$ 27,004,333,186.11	1.23%
09	Chapter 44 - Wood and Articles of Wood; Wood Charcoal	R$ 17,952,689,062.67	0.82%
10	Chapter 47 - Pulp of Wood or of Other Fibrous Cellulosic Material; Recovered (Waste and Scrap) Paper or Paperboard	R$ 7,759,420,367.33	0.35%
10	Chapter 48 - Paper and Paperboard; Articles of Paper Pulp, of Paper or of Paperboard	R$ 103,963,208,809.65	4.74%
10	Chapter 49 - Printed Books, Newspapers, Pictures and Other Products of the Printing Industry; Manuscripts, Typescripts and Pl	R$ 11,754,510,132.26	0.54%
11	Chapter 52 - Cotton	R$ 10,844,769,482.31	0.49%
11	Chapter 54 - Man-made Filaments; Strip and the Like of Man-made Textile Materials	R$ 9,526,276,705.71	0.43%
11	Chapter 56 - Wadding, Felt and Non-Wovens; Special Yarns; Twine, Cordage, Ropes and Cables and Articles Thereof	R$ 10,959,327,514.31	0.50%
11	Chapter 60 - Knitted or Crocheted Fabrics	R$ 9,994,938,940.47	0.46%
11	Chapter 61 - Articles of Apparel and Clothing Accessories, Knitted or Crocheted	R$ 23,073,400,176.44	1.05%
11	Chapter 62 - Articles of Apparel and Clothing Accessories, Not Knitted or Crocheted	R$ 23,499,168,442.22	1.07%
11	Chapter 63 - Other Made Up Textile Articles; Sets; Worn Clothing and Worn Textile Articles; Rags	R$ 12,068,104,084.40	0.55%
12	Chapter 64 - Footwear, Gaiters and the Like; Parts of Such Articles	R$ 9,836,151,865.38	0.45%
13	Chapter 68 - Articles of Stone, Plaster, Cement, Asbestos, Mica or Similar Materials	R$ 17,667,369,274.29	0.81%
13	Chapter 69 - Ceramic Products	R$ 5,592,858,575.22	0.26%
13	Chapter 70 - Glass and Glassware	R$ 26,791,222,803.63	1.22%
15	Chapter 72 - Iron and Steel	R$ 106,394,882,298.86	4.85%
15	Chapter 73 - Articles of Iron or Steel	R$ 73,561,654,727.72	3.36%
15	Chapter 74 - Copper and Articles Thereof	R$ 23,560,427,787.62	1.07%
15	Chapter 76 - Aluminium and Articles Thereof	R$ 80,088,680,954.42	3.65%
15	Chapter 82 - Tools, Implements, Cutlery, Spoons and Forks, of Base Metal; Parts Thereof of Base Metal	R$ 7,732,454,523.06	0.35%
15	Chapter 83 - Miscellaneous Articles of Base Metal	R$ 8,924,919,900.08	0.41%
16	Chapter 84 - Nuclear Reactors, Boilers, Machinery and Mechanical Appliances; Parts Thereof	R$ 227,838,279,900.36	10.39%
16	Chapter 85 - Electrical Machinery and Equipment and Parts Thereof; Sound Recorders and Reproducers, Television Image and S	R$ 118,058,908,306.51	5.39%
17	Chapter 86 - Railway or Tramway Locomotives, Rolling-Stock and Parts Thereof; Railway or Tramway Track Fixtures and Fittings	R$ 8,242,104,317.62	0.38%
17	Chapter 87 - Vehicles Other Than Railway or Tramway Rolling-Stock, and Parts and Accessories Thereof	R$ 179,852,384,237.21	8.21%
18	Chapter 90 - Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical or Surgical Instruments and Ap	R$ 28,395,711,923.79	1.30%
20	Chapter 94 - Furniture; Medical-Surgical Furniture; Bedding, Mattresses, Mattress Supports, Cushions and Similar Stuffed Furn	R$ 55,100,931,283.26	2.51%
20	Chapter 96 - Miscellaneous Manufactured Articles	R$ 6,494,934,450.78	0.30%

Notes: This figure shows the aggregated revenue by NCM (chapter 2 digits) and the correspondent share. We show only NCM with shares larger than 0.25% revenues. The gray (blue) ones are associated with the non-durable (durable) sector. We highlighted the largest shares of each sector.

Figure A2: NCM - Sections - Heat Map



Notes: This figure shows the activity level of each NCM per month. The right panel shows the aggregated revenue for that month. The red (blue) to the left panel indicates the below (above) median level of transactions. We note that the crisis period lies between April-June 2020, when all NCMs are in the red mode with the lowest levels of aggregated revenues.

Figure A3: NCM - Automobile Industry - Chapter 87

Time	Revenue chapter 87
201701	R$ 2.15 bi
201702	R$ 2.26 bi
201703	R$ 2.77 bi
201704	R$ 2.44 bi
201705	R$ 3.00 bi
201706	R$ 2.82 bi
201707	R$ 2.80 bi
201708	R$ 3.11 bi
201709	R$ 2.76 bi
201710	R$ 3.02 bi
201711	R$ 3.28 bi
201712	R$ 2.67 bi
201801	R$ 2.58 bi
201802	R$ 2.82 bi
201803	R$ 3.29 bi
201804	R$ 3.40 bi
201805	R$ 2.75 bi
201806	R$ 3.42 bi
201807	R$ 3.29 bi
201808	R$ 3.79 bi
201809	R$ 3.37 bi
201810	R$ 3.82 bi
201811	R$ 3.62 bi
201812	R$ 2.71 bi
201901	R$ 2.61 bi
201902	R$ 3.22 bi
201903	R$ 3.15 bi
201904	R$ 3.34 bi
201905	R$ 3.68 bi
201906	R$ 2.97 bi
201907	R$ 3.32 bi
201908	R$ 3.47 bi
201909	R$ 3.34 bi
201910	R$ 3.59 bi
201911	R$ 3.11 bi
201912	R$ 2.27 bi
202001	R$ 2.44 bi
202002	R$ 2.88 bi
202003	R$ 2.62 bi
202004	R$ 0.50 bi
202005	R$ 0.92 bi
202006	R$ 1.75 bi
202007	R$ 2.36 bi
202008	R$ 2.82 bi
202009	R$ 3.14 bi
202010	R$ 3.30 bi
202011	R$ 3.45 bi
202012	R$ 3.12 bi
202101	R$ 2.98 bi
202102	R$ 3.31 bi
202103	R$ 3.69 bi
202104	R$ 3.49 bi
202105	R$ 3.61 bi
202106	R$ 3.36 bi
202107	R$ 3.15 bi
202108	R$ 3.40 bi
202109	R$ 3.38 bi
202110	R$ 3.43 bi
202111	R$ 3.71 bi
202112	R$ 3.07 bi

Descriptive Statistics (CH.87)	
Mean (PRE)	R$ 3.02 bi
Mean (DURING)	R$ 1.06 bi
Mean (POST)	R$ 3.27 bi
Standard Deviation (PRE)	R$ 0.44 bi
Standard Deviation (DURING)	R$ 0.64 bi
Standard Deviation (POST)	R$ 0.33 bi

Crisis period	
MEAN PRE (2017/01 - 2020/03)	R$ 3.02 bi
MEAN PRE (-) 1 Standard Deviation	R$ 2.59 bi
MEAN PRE (-) 2 Standard Deviations	R$ 2.15 bi
MEAN PRE (-) 3 Standard Deviations	R$ 1.72 bi

Notes: This figure shows the revenue by NCM - 87 (Auto Industry) by month and the correspondent descriptive statistics considering pre-, during, and post-crisis period.

Figure A4: NCM - livestock Industry - Chapter 02

time	Revenue chapter 02
201701	R$ 1.31 bi
201702	R$ 1.21 bi
201703	R$ 1.38 bi
201704	R$ 1.30 bi
201705	R$ 1.56 bi
201706	R$ 1.48 bi
201707	R$ 1.43 bi
201708	R$ 1.56 bi
201709	R$ 1.45 bi
201710	R$ 1.55 bi
201711	R$ 1.51 bi
201712	R$ 1.61 bi
201801	R$ 1.41 bi
201802	R$ 1.23 bi
201803	R$ 1.30 bi
201804	R$ 1.27 bi
201805	R$ 1.35 bi
201806	R$ 1.48 bi
201807	R$ 1.37 bi
201808	R$ 1.46 bi
201809	R$ 1.38 bi
201810	R$ 1.58 bi
201811	R$ 1.48 bi
201812	R$ 1.62 bi
201901	R$ 1.50 bi
201902	R$ 1.37 bi
201903	R$ 1.44 bi
201904	R$ 1.50 bi
201905	R$ 1.63 bi
201906	R$ 1.45 bi
201907	R$ 1.61 bi
201908	R$ 1.53 bi
201909	R$ 1.43 bi
201910	R$ 1.58 bi
201911	R$ 1.62 bi
201912	R$ 1.80 bi
202001	R$ 1.51 bi
202002	R$ 1.44 bi
202003	R$ 1.55 bi
202004	R$ 1.32 bi
202005	R$ 1.54 bi
202006	R$ 1.60 bi
202007	R$ 1.74 bi
202008	R$ 1.76 bi
202009	R$ 1.93 bi
202010	R$ 1.97 bi
202011	R$ 2.10 bi
202012	R$ 2.19 bi
202101	R$ 1.72 bi
202102	R$ 1.61 bi
202103	R$ 1.73 bi
202104	R$ 1.70 bi
202105	R$ 1.90 bi
202106	R$ 1.91 bi
202107	R$ 2.01 bi
202108	R$ 2.07 bi
202109	R$ 2.05 bi
202110	R$ 2.05 bi
202111	R$ 2.04 bi
202112	R$ 2.14 bi

Descriptive Statistics (CH.02)	
Mean (PRE)	R$ 1.47 bi
Mean (DURING)	R$ 1.49 bi
Mean (POST)	R$ 1.92 bi
Standard Deviation (PRE)	R$ 0.12 bi
Standard Deviation (DURING)	R$ 0.15 bi
Standard Deviation (POST)	R$ 0.17 bi

Crisis period	
MEAN PRE (2017/01 - 2020/03)	R$ 1.47 bi
MEAN PRE (-) 1 Standard Deviation	R$ 1.34 bi
MEAN PRE (-) 2 Standard Deviations	R$ 1.22 bi
MEAN PRE (-) 3 Standard Deviations	R$ 1.09 bi

Notes: This figure shows the revenue by NCM - 2 (livestock Industry) by month and the correspondent descriptive statistics considering pre-, during, and post-crisis period.

Appendix B - Event Study - Revenues and VAT collection

Table B1: DiD (Firms' Sales/Revenues)

Dependent Var.:	LN_Value of Revenues	**Dependent:**	LN_Value of Revenues
treated x 201701	0.0596 (0.2000)	treated x 202001	-0.0736 (0.1280)
treated x 201702	0.1633 (0.2011)	treated x 202002	0.0336 (0.1313)
treated x 201703	0.3236 (0.2048)	treated x 202003	-
treated x 201704	-0.0475 (0.1967)	treated x 202004	-0.7278*** (0.1361)
treated x 201705	-0.1026 (0.1997)	treated x 202005	-0.5566*** (0.1462)
treated x 201706	-0.0566 (0.2018)	treated x 202006	-0.3265* (0.1463)
treated x 201707	0.1652 (0.1967)	treated x 202007	-0.1636 (0.1498)
treated x 201708	0.1801 (0.2002)	treated x 202008	-0.0135 (0.1499)
treated x 201709	-0.0332 (0.1891)	treated x 202009	0.1202 (0.1597)
treated x 201710	-0.0006 (0.1918)	treated x 202010	0.0934 (0.1672)
treated x 201711	-0.0354 (0.1838)	treated x 202011	0.2341 (0.1610)
treated x 201712	0.0201 (0.1923)	treated x 202012	0.0268 (0.1559)
treated x 201801	0.3254 (0.2004)	treated x 202101	0.1140 (0.1582)
treated x 201802	0.1367 (0.1794)	treated x 202102	0.1323 (0.1582)
treated x 201803	0.1957 (0.1818)	treated x 202103	0.2246 (0.1551)
treated x 201804	0.2428 (0.1887)	treated x 202104	0.1412 (0.1632)
treated x 201805	0.2858 (0.1895)	treated x 202105	0.0275 (0.1631)
treated x 201806	0.1725 (0.1848)	treated x 202106	0.0526 (0.1651)
treated x 201807	0.0721 (0.1851)	treated x 202107	-0.1407 (0.1663)
treated x 201808	0.1494 (0.1864)	treated x 202108	0.0484 (0.1721)
treated x 201809	0.2682 (0.1858)	treated x 202109	-0.0077 (0.1642)
treated x 201810	0.1077 (0.1740)	treated x 202110	0.1990 (0.1692)
treated x 201811	0.1505 (0.1722)	treated x 202111	0.1061 (0.1689)
treated x 201812	-0.0557 (0.1755)	treated x 202112	0.0280 (0.1662)
treated x 201901	0.1648 (0.1764)		
treated x 201902	0.4960** (0.1768)		
treated x 201903	0.3004. (0.1715)		
treated x 201904	0.2013 (0.1546)		
treated x 201905	0.0300 (0.1670)		
treated x 201906	0.0910 (0.1626)		
treated x 201907	0.0761 (0.1550)		
treated x 201908	0.1809 (0.1551)		
treated x 201909	0.0289 (0.1419)		
treated x 201910	0.0525 (0.1396)		
treated x 201911	0.0514 (0.1432)		
treated x 201912	-0.3767** (0.1377)		
Fixed-Effects:			
treated: Yes			
month-year: Yes			
S.E.: Clustered by: Firm			
Observations 157,862			
R^2 0.04122			
Within R^2 0.00049			

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Panel with monthly Revenues from all firms. April/2017 - DEz/2021(NCM's: livestock (ch.02) and Auto Industry (ch. 87). Fixed Effect: year/month (time) e group (dummy-treated). Cluster: firm-level. Notes: Regression represented by the equation 1, the table shows the coefficients and standard errors in parenthesis. In this way, the estimated ATTs for the three months when the crisis peaked are, respectively, -0.7278, -0.5566 and -0.3265. This means that the auto industry had its revenues reduced by 73% compared to the livestock industry In April/2020, 56% in May, and 33% in June compared to March/2020.

Table B2: DiD (Tax Revenues - ICMS)

Dependent Var.:	LN_ Tax Revenues	**Dependent:**	LN_ Tax Revenues
-	-	treated x 202001	0.1504 (0.1316)
-	-	treated x 202002	0.1017 (0.1080)
-	-	treated x 202003	-
treated x 201704	-0.0338 (0.1903)	treated x 202004	-0.7999*** (0.1286)
treated x 201705	-0.1057 (0.1920)	treated x 202005	-0.5474*** (0.1301)
treated x 201706	0.0112 (0.2060)	treated x 202006	-0.2796* (0.1333)
treated x 201707	0.0103 (0.1802)	treated x 202007	-0.0634 (0.1456)
treated x 201708	-0.1072 (0.1763)	treated x 202008	-0.0367 (0.1235)
treated x 201709	-0.2197 (0.1604)	treated x 202009	0.1044 (0.1413)
treated x 201710	-0.0942 (0.1731)	treated x 202010	0.1070 (0.1408)
treated x 201711	0.0864 (0.1715)	treated x 202011	0.1522 (0.1349)
treated x 201712	0.0324 (0.1859)	treated x 202012	0.0541 (0.1514)
treated x 201801	0.2443 (0.1895)	treated x 202101	0.2703. (0.1477)
treated x 201802	0.2077 (0.1697)	treated x 202102	0.1591 (0.1500)
treated x 201803	0.0388 (0.1689)	treated x 202103	0.3524* (0.1526)
treated x 201804	0.2657 (0.1826)	treated x 202104	0.4273** (0.1589)
treated x 201805	0.2765 (0.1841)	treated x 202105	0.1777 (0.1532)
treated x 201806	0.0767 (0.1869)	treated x 202106	0.3109* (0.1522)
treated x 201807	-0.0657 (0.1704)	treated x 202107	0.1485 (0.1569)
treated x 201808	0.0493 (0.1734)	treated x 202108	0.1614 (0.1546)
treated x 201809	0.1756 (0.1660)	treated x 202109	0.3030. (0.1639)
treated x 201810	0.0032 (0.1663)	treated x 202110	0.2691. (0.1569)
treated x 201811	0.1196 (0.1531)	treated x 202111	0.3289* (0.1654)
treated x 201812	-0.0742 (0.1685)	treated x 202112	0.1127 (0.1656)
treated x 201901	0.1535 (0.1700)		
treated x 201902	0.3227* (0.1643)		
treated x 201903	0.2989. (0.1655)		
treated x 201904	0.1936 (0.1592)		
treated x 201905	0.1625 (0.1683)		
treated x 201906	0.0565 (0.1581)		
treated x 201907	0.1272 (0.1593)		
treated x 201908	0.1668 (0.1575)		
treated x 201909	0.1216 (0.1326)		
treated x 201910	0.2575. (0.1333)		
treated x 201911	0.1604 (0.1468)		
treated x 201912	-0.2563. (0.1374)		
Fixed-Effects:			
treated: Yes			
year-month: Yes			
S.E.: Clustered by: Firm			
Observations 83,521			
R^2 0.03561			
Within R^2 0.00071			

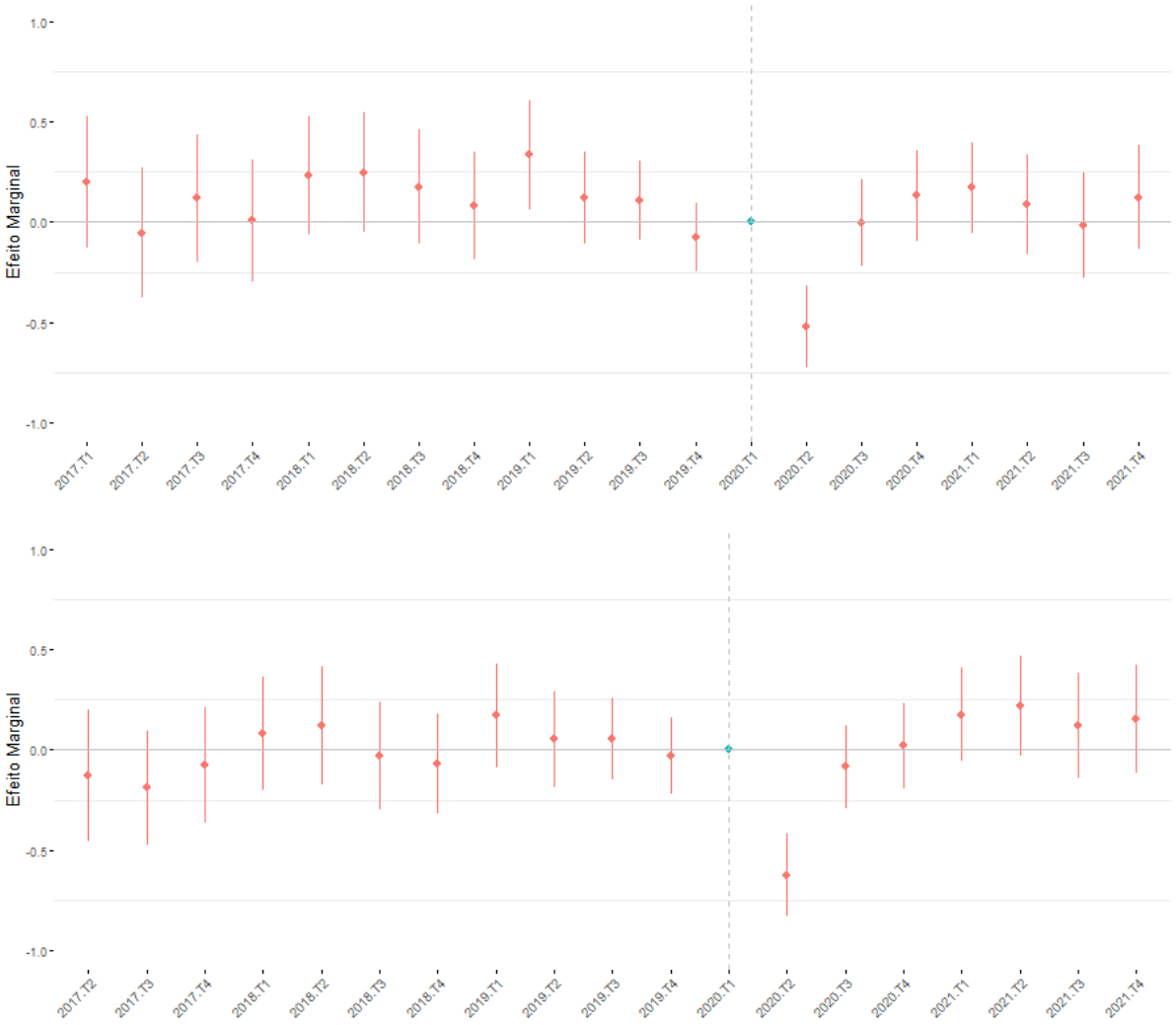
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Panel with monthly VAT tax collected (ICMS) from all firms. April/2017 - DEz/2021(NCM's: livestock (ch.02) and Auto Industry (ch. 87). Fixed Effect: year/month (time) e group (dummy-treated). Cluster: firm-level. Notes: Regression represented by the equation 1, the table shows the coefficients and standard errors in parenthesis. In this way, the estimated ATTs for the three months when the crisis peaked are, respectively, -0.7999, -0.5474, and -0.2796. This means that the automotive sector had its ICMS revenue reduced by approximately 80% compared to the livestock sector in April, 55% in May, and 28% in June compared to the reference month (March 2020).

Appendix C - Cluster and Periods Robustness.

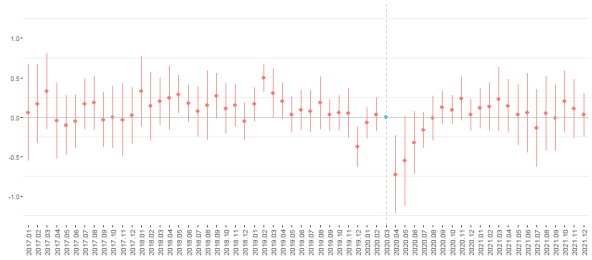
Figure C1:Event Study Results - Trimester Results

(a) Event Study - Sales/Revenues

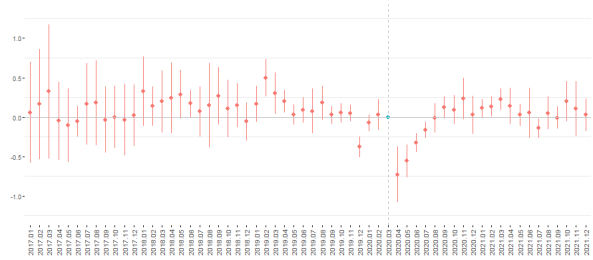


Notes: Panel with the universe of firms in the sectors livestock (02) and auto (87) from 2017 - 2021 with fixed-effects: year/month (time) and group (dummy for treated) and cluster at the firm level. Results based on the regression represented by the equation 1 aggregated at the trimester level, with reference period the trimester that includes March/2020. The estimated ATT coefficients (represented in the y-axis) for the three months after the hit of the COVID crisis mean that the *D* sector compared to the *ND* counterpart had their revenues (taxes) dropped by 62% (70%) in the first trimester after March/2020 compared to the last trimester before. The estimated effect before versus after the health crisis is not statistically significant for sales/revenues (tax revenues) -0.0199 (0.08), comparing durable versus non-durable sections.

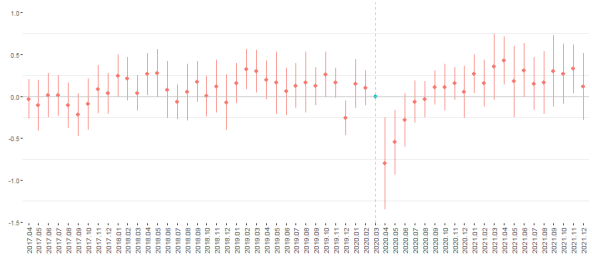
Figure C2: Sales/Revenues and Tax Collection: Cluster at Sector levels, 5 and 2 Digits and Changing the Beginning Period.



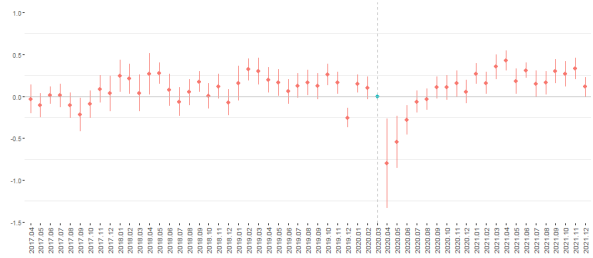
(a) Sales/Revenue - Cluster: Sector 5 Digits



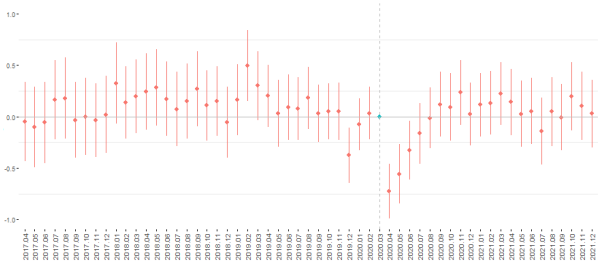
(b) Sales/Revenue - Cluster: Sector 2 Digits



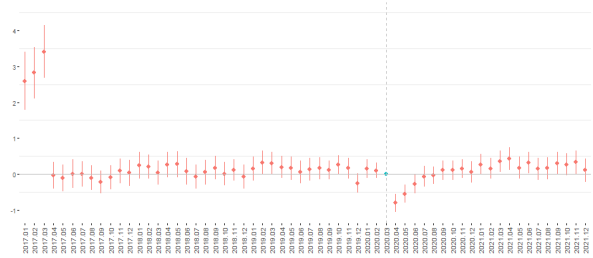
(c) Tax Revenues - Cluster: Sector 5 Digits



(d) Tax Revenues - Cluster: Sector 2 Digits



(e) Sales/Revenue - Beginning April 2017



(f) Tax Revenues - Beginning January 2017

Notes: Panel with all firms in the Sectors livestock (02) and auto (87) from 2017 - 2021 with fixed-effects: year/month (time) and group (dummy for treated) and cluster at the firm level. Results based on the regression represented by the equation 1, with reference period March/2020. The estimated ATT coefficients (represented in the y-axis) for the three months after the hit of the COVID crisis mean that the DS sector had their revenues (taxes) dropped by 73% (79%) compared to the ND in April 2020, 56% (54%) in May/2020 and 33% (27%) in June compared to March/2020. The estimated effect of the before versus after reform is 0.014 (0.08). For panels (e) and (f): The estimated ATT coefficients (represented in the y-axis) for the three months after the hit of the COVID crisis mean that the DS sector had their revenues (taxes) dropped by 83% (79%) compared to the ND in April 2020, 64% (54%) in May/2020 and 41% (27%) in June compared to March/2020. The positive effect at the beginning of the sample is because there was no taxes reported for the control group in these three months, the main reason for considering April-2017 as the starting period for taxes.