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Using Administrative Data to Assess the Impact of the Pandemic in Low-Income Countries: An Application with VAT Data in Rwanda

Giulia Mascagni & Adrienne Lees

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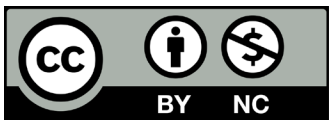

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Summary

This paper uses administrative data from Value Added Tax (VAT) returns to provide insights on the impact of the COVID-19 pandemic in Rwanda. We show that the lockdown in Rwanda had a severe impact on the domestic economy, despite relatively low case numbers. However, the economy quickly rebounded after restrictions were lifted, with overall sales losses amounting to 5 per cent of GDP. Although in absolute terms, these losses are concentrated amongst the largest firms, in proportional terms, small firms have been worse affected. We also show that firms providing accommodation, food and transport services, as well as those based in the capital, have been particularly affected by the crisis. Overall, the decline in economic activity translates to a 5.1 per cent loss in VAT revenue for the government. Our results offer policymakers evidence on the real impact of the crisis, both in aggregate terms and disaggregated by firm size, sector, and location. In a literature that has largely focused on higher-income countries, these results complement projections to inform appropriate policy responses in the specific context of low-income countries.

Keywords: Administrative data, COVID-19, economic shock, VAT sales

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Introduction

Within ten months of COVID-19 being declared a global pandemic in March 2020, a large and growing body of research started to shed light on its social and economic implications, and on the policy response to it. High-income countries are experiencing the highest death toll,[1] and face exceptionally large economic losses in terms of employment, incomes, and profits, which have been only partially offset by government relief (Chetty, Friedman, Hendren, Stepner, and The Opportunity Insights Team 2020; Deaton 2021). The picture in low-income countries is quite different. So far, these countries have seen far fewer cases of COVID-19, but some have nonetheless imposed severe restrictions in line with countries that have been more heavily affected (Von Carnap, Almås, Bold, Ghisolfi, and Sandefur 2020; Ray and Subramanian 2020). It is, however, unclear, whether lockdowns are an appropriate policy response in contexts characterised by high poverty rates, low state capacity, large informal sectors and less digitised economies (Hevia and Neumeyer 2020; Alon, Kim, Lagakos, and VanVuren 2020; Barnett-Howell and Mobarak 2020). Some studies have suggested that the highest impact of the pandemic in these countries might come from the restrictions themselves (Ray and Subramanian 2020; Goldberg and Reed 2020; Mahmud and Riley 2020; Teachout and Zipfel 2020). As such, the lower incidence of COVID-19 cases does not mean they have been spared dramatic losses in economic activity, both directly, due to restrictions and indirectly, because of a slowing global economy (Arndt, Davies, Gabriel, Harris, Makrelov, Modise, Robinson, Simbanegavi, van Seventer, and Anderson 2020). Exactly how severe these economic losses are is still unclear.

Against this background, this paper quantifies the economic impact of the pandemic in Rwanda, using high-frequency data for the population of formal firms, obtained from Value Added Tax (VAT) returns filed in 2017, 2018, 2019 and the first three quarters of 2020. In doing this, we provide three main insights on the implications of the crisis and the relative policy response in a low-income country context.

Firstly, our results show a sharp drop (32 per cent) in economic activity in April 2020, corresponding to the implementation of a nation-wide lockdown. Economic activity then quickly rebounded to pre-crisis levels right after restrictions were lifted (see Section 2.1). This result is consistent with the view that economic losses in low-income countries, where case numbers remained relatively low, are particularly related to lockdowns rather than citizens' health concerns (Goldberg and Reed 2020; Teachout and Zipfel 2020). It also raises valid questions about the appropriate policy responses in these contexts, which might differ from those adopted in higher-income countries. Are lockdowns advisable in countries where they are both harder to implement and less likely to be effective? Do they risk generating greater harm than the health crisis itself? While our paper does not fully answer these questions, it confirms a strong association between the lockdown and the economic impact of the crisis. A more comprehensive answer should be grounded in evidence from low-income countries, where households do not have the basic means to cope with restrictions (Egger, Jones, Justino, Manhique, and Santos 2020), and governments do not have the capacity to implement adequate relief measures alongside lockdowns (Ray and Subramanian 2020; Cirera, Cruz, Davies, Grover, Iacovone, Lopez, Medvedev, Maduko, Nayyar, Ortega, and Torres 2020). The need for informed policy responses is particularly urgent in low-income countries which are unlikely to vaccinate large proportions of their populations until late 2022.

[1] As of 26 January 2021, confirmed cumulative deaths from COVID-19 per million people have been particularly concentrated in Europe, the United States and Latin America (Our World in Data 2021).

Secondly, in Section 2.2, we investigate the distributional patterns of the crisis' impact, documenting two important facts. Since revenue in Rwanda is highly concentrated at the top of the income distribution, the economic losses in absolute terms are dependent on the performance of the largest firms. They are responsible for virtually all losses in economic activity and VAT revenue that we observe at the aggregate level. However, small firms experienced much greater losses than larger ones in proportional terms (see Section 2.2). Our results are consistent with similar evidence from Honduras (Bachas, Brockmeyer, and Semelet 2021) and with expectations that the poor in Sub-Saharan Africa are most-affected by the crisis (Djiofack, Dudu, and Zeufack 2020). This second fact points to the importance of providing appropriate relief and support particularly for the smallest businesses, which are especially vulnerable.

Thirdly, the aggregate drop in sales we document in Section 2.1 translates into a VAT revenue loss of approximately 30 per cent for April 2020 – with most of these losses being recouped in the subsequent months (see Section 2.5). The total drop in VAT revenue up to September 2020 amounts to 5 per cent compared to the same period in 2019. Other studies estimate that losses in other tax types may be even higher. For example, Lees, Mascagni, and Santoro (2020) estimate that CIT revenue might drop by 25 to 36 per cent in Rwanda in 2020, depending on different scenarios used to make projections. Estimates for South Africa project a similar (32 per cent) drop across all tax types and suggest that import taxes are the most-affected type (Arndt et al. 2020). While the literature on the economic effects of lockdowns is growing fast, there is still limited evidence on the tax revenue impact –- despite tax being key to funding both crisis response and recovery plans. Our results, therefore, represent novel insights on the crisis' actual impact on tax revenue.

Finally, in Sections 2.3 and 2.4, we also investigate disaggregated impacts by sector and geographical location. We find that the accommodation and food service, and the transportation and storage sectors, amongst others, suffer the greatest losses, as predicted by Lees et al. (2020). The geographical disaggregation reveals that the crisis has hit firms in the capital, Kigali, particularly hard.

Our results are both novel and highly policy-relevant, shedding more light particularly on the impact of the crisis and policy response in a low-income country context. They complement existing estimates and projections, by providing a measurement of actual impacts. More broadly, our analysis highlights the key role that administrative data can play in assessing economic performance in real time, during but also beyond the current pandemic. While the use of these data for research has become increasingly common, they are a particularly useful source of real-time information in low-income countries.[2]

The crisis has pushed researchers to look for new sources of high-frequency data to provide real-time insights into the economic shock and to inform policy responses. For instance, Chetty et al. (2020) build a dataset of high-frequency anonymised data from private companies in the US to analyse the impact of the crisis and policy responses on spending and employment, amongst others. Another example is Campos-Vazquez and Esquivel (2021), who use data on the universe of point-of-sale (POS) transactions to analyse how consumption responded to the crisis in Mexico. Other studies used data from stock exchanges, including financial statements and stock prices (Beck, Flynn, and Homanen 2020). These sources of data are, however, either not available or hardly relevant in low-income countries where stock exchanges are shallow, bank penetration is low and cash transactions dominate. Some studies on real crisis impacts in low-income countries rely instead on high-frequency survey data (Bishi, Grossman, and Startz 2020), in addition to those adopting forecast or simulation models (Younger, Musisi, Asiimwe, Ntungire, Rauschendorfer, and Manwaring 2020; Teachout and Zipfel 2020) or one-off surveys

[2]For a review of some papers using administrative data for tax analysis, see Slemrod (2019) and Mascagni (2018).

(Krishnan, Krkoska, Maaskant, Mengistu, and Meyer 2020). Although these surveys have become more common during the crisis and are indeed a valuable source of information, they are often expensive and seem likely to remain rather exceptional. The usual lag between surveys is years rather than months, or even weeks, and for good reasons: attrition rates are likely to increase dramatically when respondents are contacted several times to answer similar questions. Against this background, administrative data from tax returns represents a valuable alternative for firm-level analysis, particularly in lower income countries. Our analysis provides an application using these data to evaluate the impact of the pandemic in a low-income country, thus showing how it can be used as for real-time analysis on the economy during, but also beyond, the current crisis.[3] In Section 1.2 we describe its advantages, as well as some necessary caveats, in more detail.

1 Rwandan context and data

1.1 Rwandan context

Rwanda is a low-income African country, with a population of about 13 million people. It reported its first COVID-19 case on 14 March 2020. On the same day, it introduced restriction measures, such as school closures and a ban on public gatherings. A week later, on 21 March, the government announced a national lockdown that further restricted all movements outside the home and introduced a requirement for all but essential workers to work from home. These measures were strictly enforced and lasted until early May. In parallel, the government also started a program of support and relief for businesses, and for the most vulnerable, including food support and tax deferrals. As far as VAT is concerned, support measures adopted by the Rwanda Revenue Authority (RRA) included fast-tracking VAT refunds, especially for small businesses, a waiver of fines, penalties and interest related to late payments, and an short extension of the deadline to declare and pay VAT in March and April.[4] There is, as yet, no evidence on the reach of this relief programme and its effectiveness in alleviating the effects of the lockdown.

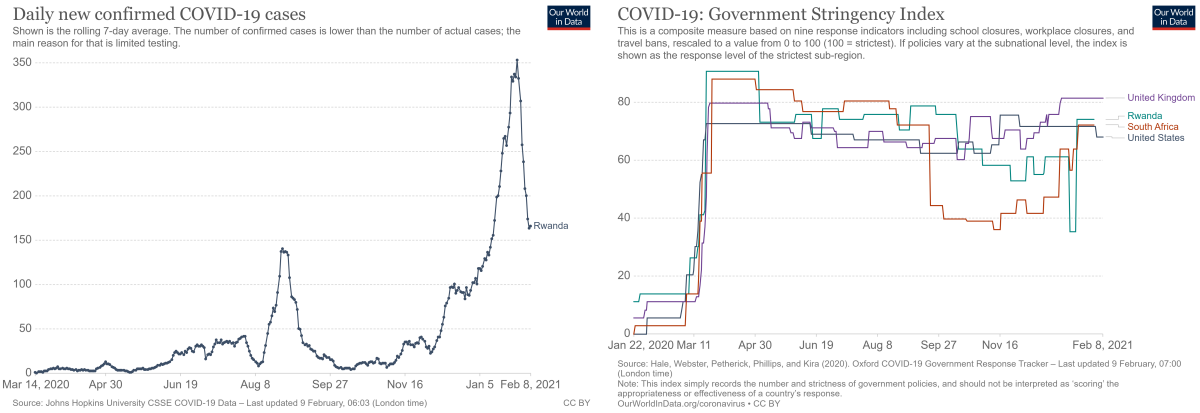
Panel (a) of Figure 1.1 shows that the number of cases in Rwanda has remained relatively low since the start of the pandemic. Although the spread of the virus remains much more limited than in other countries, the first weeks of 2021 have seen a dramatic increase in case numbers. This development pushed the government to introduce another lockdown in Kigali, the capital city, while other areas are subject to a curfew from dusk to dawn. This second lockdown started on 19 January and lasted for three weeks. Panel (b) of Figure 1.1 shows the Government Stringency Index for Rwanda, compared to other countries. It confirms that Rwanda has responded to the crisis with strict restrictions, which are fully comparable to other countries that have been affected much more severely.

Despite the relatively low incidence of cases, Rwanda is projected to experience severe losses in economic activity and tax revenue. A recent report based on administrative data from past

[3] Bachas et al. (2021) provide an application from a middle-income country using data from Honduras. Other studies, such as James (2020), use aggregate data to evaluate the impact of the crisis.

[4] The deadline for declaring and paying VAT is normally on the 15th of the month for monthly taxpayers, and on the 15th of the second month after the end of the quarter for quarterly taxpayers. It was extended to 18 March and 24 April, then returned to normal from May. Other tax measures include: the softening of tax arrears collection; extending the deadline for filing and paying income tax (PAYE and CIT); a temporary PIT waiver for school teachers, and tourism and hotel employees with incomes less than RWF 150,000 per month; a waiver of fines, penalties and interest accrued from late payment of PAYE and withholding tax (in addition to VAT); a temporary suspension of physical post-clearance and comprehensive tax audits; and taxpayers were permitted to adopt current-year basis in determining provisional taxes for the 2020 tax period.

Figure 1.1: Spread of COVID-19 and response in Rwanda



(a) COVID-19 spread **(b) Stringency of government response**

Note: Panel (a) shows the daily number of new confirmed cases, since March 2020. Panel (b) indicates how the governmental response has changed over time according to the Government Stringency Index, a composite measure of the strictness of policy responses. This includes school and workplace closures, restrictions on public gatherings, transport restrictions, and stay-at-home requirements. A higher score indicates a stricter response (i.e. 100 = strictest response). Source: Our World in Data (2021).

income tax returns estimates the economic effects of the crisis on Rwandan corporations, using two scenarios with lockdowns lasting for three or five months (Lees et al. 2020). The projections suggest that just 55 per cent of firms remain profitable after a three-month lockdown, compared to 72 per cent of firms in the baseline scenario pre-COVID. This corresponds to firms accumulating losses in sales of 0.7 to 1.3 per cent of GDP, respectively, for the three- or five-month long lockdown scenario. In turn, these projections imply large losses in payroll for employees (up to 9.6 per cent) and in tax revenue for the government (up to 36 per cent). The results we present in this paper complement these estimates by showing the actual impact of the crisis, based on sales reported in VAT declarations.

1.2 Data

Our analysis uses firm-level data from VAT declarations to evaluate the extent of the economic shock in Rwanda and its implications across the income distribution, sectors and geographical locations. This is the most suitable source of microeconomic data to answer these macroeconomic questions about the crisis. It has several advantages: it captures the entire population of formal firms; it is available at a higher frequency than the typical survey; and is already available in most countries.[5] It is also highly relevant for policy purposes, especially when estimating losses in tax revenue (Section 2.5), since it represents the tax base currently available to the government. As anticipated in the Introduction, other data options used to assess the impact of the crisis in other countries are either not available or not relevant (mostly due to very limited coverage) for low-income countries like Rwanda.

Our dataset encompasses all VAT declarations for 2017, 2018, 2019 and the first three quarters of 2020. VAT declarations in Rwanda are filed either monthly or quarterly, depending on business size.[6] Smaller firms are allowed to make quarterly declarations to decrease the com-

[5] Administrative data are, in principle, available in all countries, since they are collected in the process of administering and collecting taxes. However, quality and accessibility of data differs across countries, usually requiring several interactions with the local revenue authority.

[6] According to the Code of Value Added Tax (Law 37/2012), taxpayers with turnover below RWF 200 million (roughly US$200,000) can file quarterly, while others file monthly (Parliament of Rwanda 2012).

pliance and administrative costs related to record-keeping and reporting. If a firm files monthly, the deadline for submitting a return is the 15th of the following month, while if they file quarterly they are allowed to file within one and a half months after the relevant quarter has ended. So, for example, declarations for the fourth quarter of 2020 are due by 15 February 2021 – which is why we have only included the first three quarters of 2020 in our analysis.[7] Among the fiscal measures taken to support businesses during the COVID-19 crisis, discussed in Section 1.1, was a short deferral for VAT filing and payment. However, this deferral only affects the time of reporting, not the reference tax period for the information contained in the declaration. So, even if a firm is allowed to declare a few days later, the information it reports on sales and tax still refers to the same month or quarter. Therefore, this deferral does not affect our analysis.[8] Other tax relief measures, such as fast-tracking VAT refunds or waiving penalties, might affect the impact of the crisis on VAT revenue. In Section 2.5, we explore and discuss this possibility.

Table 1.1 shows that our dataset includes a total of over 21,228 firms in 2020, a number that as been growing progressively over the years from 16,497 in 2017. Despite the crisis, the total number of firms in 2020 is higher than 2019. However, this aggregate figure is still consistent with the possibility that some firms may have exited the market due to the crisis. We have not performed a detailed analysis of firm exits because our data does not allow us to observe it in any accurate way.[9] However, recognising that exits are likely to occur during our data period, we repeat our analysis both with a balanced and an unbalanced panel to make sure our results are not driven by a different composition of firms in the population.[10] Our results remain essentially unchanged regardless of the panel we use. About a third of our firms declare monthly, while the rest do so quarterly. As expected, annual average sales are much higher for taxpayers filing monthly, compared to quarterly ones.[11] As a result, over 90% of total VAT declared is generated by firms declaring monthly, as they are the largest ones. Almost half of all firms are in the wholesale and retail trade sector. Other major sectors are manufacturing, construction, knowledge-based services, and accommodation and food services.

For our analysis, we use both data on for all VAT firms, aggregated at the quarter level, and data on monthly declarations only. To obtain the former, we simply total monthly declarations for the relevant quarter for each firm, and merge the data with the quarterly declarations. The monthly dataset, while incomplete, is still highly relevant as it represents the vast majority of VAT sales and revenue. These data are then used to compute the basic statistics presented in Section 2, where we also provide some brief methodological notes on our calculations. It might only be worth mentioning here that we compute growth rates in two ways: at the aggregate level and at the firm level. The former is computed as the growth rate of total sales (Section 2.1)

[7] We are planning to obtain the data for the final quarter for 2020 and update the analysis at a later stage.

[8] The VAT dataset includes both the submission date and the tax period of reference. We use the latter to determine the relevant time when economic activity took place. The fact that the deferral was granted might have generated a compliance effect (e.g. firms complying more or less because of the presence of the crisis) but we are not able to measure this effect here. It is unclear what the direction of this effect would be or whether the effect would be sizeable at all given the deferral was only a few days long.

[9] The data on declarations tells us if firms declare or not, while it does not tell us if firms have actually closed. For example, it is quite likely that at the height of the crisis a firm might remain closed for several months, thus not filing declarations, but still resume operations at a later stage. Firms can also stop appearing in the declarations dataset when they change Taxpayer Identification Number (TIN). That can occur, for example, if they change organisational form (e.g. sole trader to corporation) or ownership. There is also anecdotal evidence of firms artificially closing and re-opening to reap tax or other benefits. Despite these challenges, we do see a slight increase in 'exits' in April 2020 in the declarations dataset, where 'exits' are defined as firms whose last declaration is in the previous month. However, it would be enough for these firms to miss one or two tax periods (which would be beyond our data period) for this not to be indicative of a true exit.

[10] The unbalanced panel includes any observation we have available in every period. The balanced panel requires firms to be present every quarter (fully balanced) or at least once in the year (partly balanced). The definition of fully or partly balanced panel does not affect our results.

[11] The average sales reported in Table 1.1 are calculated excluding nil-filers, which represent about a third of all declarations. This figure is consistent with evidence presented in Mascagni, Santoro, Mukama, Karangwa, and Hakizimana (2020) for Rwanda, Santoro and Mdluli (2019) for Eswatini, and Almunia, Gerard, Hjort, Knebelmann, Nakyambadde, Raisaro, and Tian (2017) for Uganda.

Table 1.1: Descriptive statistics for VAT-registered firms

	2017	2018	2019	2020[1]
Total number of firms	**16,497**	**18,751**	**20,954**	**21,228**
Monthly taxpayers	37.7%	36.0%	31.2%	30.1%
Nil-filers[2]	30.3%	31.9%	31.8%	32.5%
Firms in Kigali	72.1%	72.1%	72.1%	71.9%
Average annual sales[3] (RWF mil)				
Monthly taxpayers	1,029	1,112	1,242	920.3
Quarterly taxpayers	63.5	69.5	92.8	51.5
% of total VAT revenue from monthly taxpayers	92.1%	92.2%	92.2%	91.4%
Top five sectors (in 2019)				
Monthly taxpayers: Wholesale & retail trade (42.5%); Knowledge-based services[4] (8.8%); Manufacturing(8.3%); Other services[5] (7.6%); Accommodation & food services (7.4%)				
Quarterly taxpayers: Wholesale & retail trade (41.3%); Knowledge-based services (12.1%); Manufacturing (11.9%); Other services (9.3%); Construction (8.3%)				

Notes: [1]Data for 2020 runs from January to September. [2]A firm is defined as a nil-filer if their total annual sales are recorded as zero. [3]Excludes nil-filers. [4]Includes information and communication services, finance and insurance services, and professional, scientific and technical services (NACE Rev 2 codes J, K, and M). [5]Includes real estate, administrative and support services, education, human health and social work services, and arts, entertainment and recreation (NACE Rev 2 codes L, N, P, Q, R, and S).

or of total sales disaggregated by sector or location (Section 2.3 and Section 2.4) quarter-on quarter or year-on-year. The latter is the mean of growth rates calculated at the firm-level (more details in Section 2.2). Both are relevant for policy, from a more macro- or micro-perspective, respectively.

As anticipated above, we would argue that VAT data is the most suitable source of information with which to assess the impact of the crisis on real economic activity in Rwanda. These data allow us to observe the performance of the Rwandan economy in real-time – or at least with a relatively short delay compared to income tax declarations, which are typically filed only once a year, a few months after the fiscal year has ended.[12] However, these data come with a few caveats.

Firstly, VAT declarations naturally only include firms that are registered for this tax. The implication is that our analysis excludes both fully informal firms and micro firms that are below the threshold above which VAT registration is compulsory.[13] Our dataset therefore reflects the performance of the domestic economy and, more specifically, sales and consumption in the formal sector.[14] Secondly, our dataset is at the firm-level, not at the consumer-level. Therefore, in Section 2.2, we can only show distributional patterns across firms, not across consumers

[12]In Rwanda, income tax declarations are filed by 31 March, for the fiscal year ending 31 December. However, during the crisis these deadlines were postponed by a few weeks.

[13]The Rwandan VAT system includes a threshold of RWF 20 million (over US$20,000) below which firms are not legally required to register for VAT. These firms are only liable to pay income taxes, often under simplified regimes that minimise their compliance costs. The VAT threshold in Rwanda is relatively low (Mascagni, Dom, and Santoro 2021), which implies the exclusion of micro firms, while small ones are still part of our dataset.

[14]Our VAT data only refers to VAT-registered firms in Rwanda. It therefore excludes VAT paid on imports by non-registered firms, organisations and individuals. For reference, Rauschendorfer and Spray (2020) provide a detailed analysis of how the crisis affected imports in Uganda.

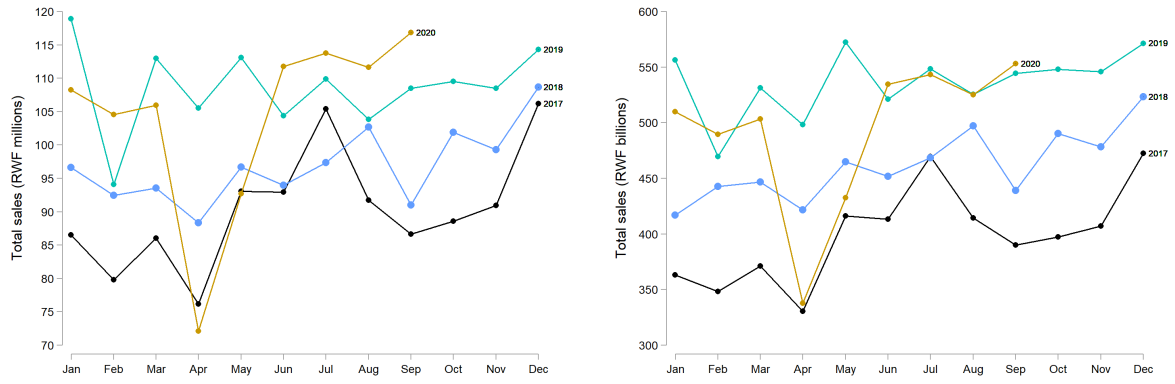
or households. We nevertheless attempt to provide some insights on the latter by looking at relatively richer or poorer geographical areas, along the lines of Chetty et al. (2020), which in Rwanda is very much related to location in the capital city or elsewhere (see Section 2.4). Thirdly, the data includes information on sales, but not on other variables, such as, most importantly employment, which are not relevant to the calculation of VAT payments. Employment has been highly affected by the crisis (Ranchhod and Daniels 2020) and it does not necessarily follow the same pattern of recovery as sales (Bishi et al. 2020).[15]

2 The impact of the crisis on economic activity and tax revenue

2.1 Aggregate impact on firm sales

We start by looking at the aggregate impact of the crisis on sales, as reported by Rwandan firms in their VAT declarations. Figure 2.1 uses the more disaggregated data from monthly declarations (the corresponding data using all declarations aggregated at the quarterly level is reported in Appendix Figure A2). Both panels of Figure 2.1 report four lines corresponding to the four years in our dataset (2017-2020) to allow for comparisons across years. Panel (a) of Figure 2.1 shows mean sales across firms by month. Panel (b) shows total sales, calculated as the sum of all sales reported by all monthly taxpaying firms in each month. Both panels show a clear drop in sales concentrated particularly in April 2020, the month most affected by the lockdown (see Section 1.1).

Figure 2.1: Aggregate impact on mean and total VAT sales



(a) Mean sales by month **(b) Total sales by month**

Notes: These graphs show seasonal trends in mean and total VAT sales for monthly taxpaying firms only in 2017, 2018, 2019 and 2020. Firms which report no sales across the relevant year (nil-filers) are excluded from the mean calculations. Here sales is taken as the total value of supplies, including VAT exempted and zero-rated sales.

Table 2.1 reports aggregate sales by quarter, calculated as total sales aggregated for all taxpayers (both quarterly and monthly) for each quarter. It also reports aggregate year-on-year growth rates in total sales, by quarter. In years prior to the crisis, Rwanda's economy performed well,

[15] Employment might or might not follow the same pattern as sales. For example, Bishi et al. (2020) show that employment was slower than sales to rebound amongst traders in Lagos. Ranchhod and Daniels (2020) document the crisis impact on employment in South Africa, showing that it had not fully recovered to pre-crisis levels after the lockdown was eased.

with VAT sales growing consistently at double digits. The year 2020 started with a slightly lower level of sales compared to the last quarter of 2019, which, at least partly, captures an early effect of the pandemic. The government of Rwanda moved promptly to contain the health risk at a very early stage. For example, it was one of the first countries to stop travel to and from China as early as February 2020, with likely implications for imports and exports. Although the lockdown started on 21 March (which is captured in the first quarter), Appendix Figure A1 shows that mobility had already started decreasing a week prior. While this partly explains the sluggish growth in the first quarter, the most dramatic decrease in sales (nearly 30 per cent) occurs in the second quarter, corresponding to the national lockdown which ended in early May. Sales then rebounded quickly in the third quarter of 2020, consistent with the mobility data in Appendix Figure A1. Overall, total sales across the first three quarters of 2020 are still nearly 10 per cent less than in the same period of 2019. In absolute terms, the total value across the first three quarters of 2020 is RWF 529.14 billion lower than for the same period in 2019, roughly equivalent to US$537 million at current exchange rates. To put this into context, GDP in Rwanda in 2019 was US$10.35 billion (World Bank 2021), so this loss amounts to approximately 5.2 per cent of GDP.

Table 2.1: Impact of COVID-19 on aggregate sales

	2017	2018		2019		2020	
	(1) Sales (RWF bn)	(2) Sales (RWF bn)	(3) YoY Growth	(4) Sales (RWF bn)	(5) YoY Growth	(6) Sales (RWF bn)	(7) YoY Growth
January–March	1,170.6	1,383.6	18.2%	1,664.2	20.3%	1,666.3	0.1%
April–June	1,263.2	1,564.7	23.9%	2,021.9	29.2%	1,422.5	-29.6%
July–September	1,386.5	1,515.6	9.3%	1,764.2	16.4%	1,832.2	3.9%
Total (Jan–Sep)	**3,820.3**	**4,463.9**	**16.8%**	**5,450.3**	**22.1%**	**4,921.1**	**-9.7%**

Notes: Total sales reported by all taxpayers, that is, both those who file quarterly and those who file monthly. Year-on-year (YoY) growth rates compare the relevant quarter to its counterpart in the previous year.

Appendix Table A1 reports figures corresponding to those of Table 2.1 but computed only using monthly declarations to obtain a more disaggregated view. While the picture emerging from monthly declarations is highly consistent with the overall population, it is worth noting that these larger taxpayers only suffered a total loss of 7 per cent in 2020 – compared to almost 10 per cent in Table 2.1. The total loss computed only based on quarterly declarations (referring to smaller taxpayers, as described in Section 1.1) is about 33 per cent. This provides a first indication that larger taxpayers suffered relatively less than smaller ones, as we show in more detail in Section 2.2.

To confirm our results, we consider two additional issues. Firstly, we take inflation into account by deflating all aggregate figures using consumer price index data reported by the National Bank of Rwanda (2021). Appendix Table A2 reports the aggregate sales figures by quarter after deflating. The pattern remains essentially the same, but the impact of the crisis is now more severe with an overall decline in sales of 16 per cent in 2020 compared to 2019. While sales still rebound quickly after restrictions are lifted, they remain slightly below the 2019 level in the third quarter. Secondly, we verify whether considering a balanced panel affects out results (see Section 1.2). We compute aggregate growth rates again but only including firms that appear at least once in a year (or the three quarters of 2020). Again, our results remain largely unchanged, with an overall decline in the balanced panel of 10.5 per cent, compared with just below 10 per cent in Table 2.1. This suggests that entry and exit do not play a key role in our analysis.

Comparing these results with the available literature, we can highlight two interesting observations. Firstly, the magnitudes we compute here are very much in line with those found in other studies. The most comparable analysis is by Bachas et al. (2021), who found a 40 per cent drop in sales during the lockdown in Honduras and an overall loss of 15 per cent by August 2020, compared to the same period in 2019. The projections for Rwandan firms based on historical income tax data forecast that firms' losses (referring to income less expenses, pre-tax) increased by 21% to almost 40%, respectively in the three and five months lockdown scenarios (Lees et al. 2020). In South Africa, Arndt et al. (2020) estimate that the full shock would result in a 34 per cent drop in GDP, which, however, improves to a decline of only 5 per cent in a 'quick' recovery scenario that seems consistent with what we observe in Rwanda. Campos-Vazquez and Esquivel (2021) calculate that movement restrictions in Mexico reduced consumption by 23 per cent, while Chetty et al. (2020) report that they led to a 30 per cent decrease in small business' revenue in less affluent areas of selected US cities. Secondly, the Rwandan data shows a very quick rebound to pre-crisis levels as soon as restrictions were lifted – or slightly below when we take inflation into account. This is in contrast to similar studies from both middle- and high-income countries, as reported respectively in Bachas et al. (2021) and Chetty et al. (2020). In those countries, spending remained low even after the lockdown was eased, probably because case numbers remained higher than in Rwanda. In this context, the economic slowdown was due more to health concerns than to the restrictions themselves. In contrast, our results confirm the view that, for low-income countries, where case numbers remained low, the main economic impact of the crisis seems to be from the lockdowns themselves (see Introduction).

2.2 Distributional impact

Having calculated the aggregate impact of the crisis, we now turn to distributional patterns. The main question we want to investigate is whether small firms are affected more than larger ones during the crisis. To do so, we divide the population of firms into ten deciles, based on total reported sales in 2019.[16] As in other low-income countries, sales in Rwanda are highly concentrated amongst the largest firms – those in the 10th decile.[17] As shown in Appendix Figure A3, these large firms account for about 88 per cent of total sales and 85 per cent of VAT revenue in 2019. On the other hand, the first seven deciles account cumulatively for less than 5 per cent of sales and VAT. Therefore, naturally, the largest firms also account for almost the entirety of the aggregate losses we discussed in Section 2.1, simply because these firms are larger in absolute terms.[18]

However, in proportional terms the picture is quite different. Table 2.2 reports growth rates calculated at the firm-level based on sales for 2019 and 2020, then averaged across firms by quarter (see Section 1.2). Growth rates are capped at 100 per cent to obtain meaningful mean figures across firms and are not directly comparable with the aggregate figures reported in Section 2.1.[19] These calculations include all firms, so sales from monthly declarations are

[16] Deciles are calculated excluding taxpayers reporting zero sales in 2019.

[17] For example, see Mascagni and Mengistu (2018).

[18] In aggregate terms, only the top decile saw losses in 2020 (both in the unbalanced and balanced panels), therefore the entirety of *aggregate* losses is due to the largest firms. However, as we will show in this section, in proportional terms smaller firms lose more than larger ones. The firm level versus aggregate growth rates are not fully comparable. One difference (in addition to the discussion in Section 1.2) is that the former is capped at 100 per cent to obtain more meaningful numbers. Uncapped firm-level growth rates would show some very large numbers in the bottom deciles, due to a minority of firms seeing large growth – but starting from a very low baseline. Taking the mean across firms is more meaningful when growth rates are capped at 100 per cent, since negative growth rates can be -100 per cent at most.

[19] Growth rates are calculated at the firm-level by taking the difference in sales in a quarter of 2019 compared to the same quarter in 2020, as a percentage of sales in the relevant quarter of 2019, excluding nil-filers in 2019 and capped at 100. The numbers reported in Table 2.2 are the mean of these firm-level growth rates, by decile. See the previous footnote on the (non-)comparability between firm-level and aggregate growth rates.

aggregated to the quarterly level before calculating the relevant statistics. The table includes both quarter-on-quarter growth rates (columns one to three) and the growth rates of cumulative sales for all the three quarters from January to September (column four) – all disaggregated by decile. These figures show a clear pattern: while, on average, all firms experienced dramatic losses, they have been much larger in the bottom deciles and consistently decrease as firm size increases. While the average smallest firms' (first decile) sales declined by over 62 per cent in 2020, the average largest firms (top decile) saw a decline of 'only' 13.4 per cent. This result is consistent with the finding that sales declined more in quarterly declarations (i.e. smaller firms) than monthly ones (i.e. larger ones), based on the aggregate data analysis of Section 2.1.

Table 2.2: Firm-level growth rates by decile

Decile	Mean Growth Rates				(5) Firms with negative growth
	(1) Q1	(2) Q2	(3) Q3	(4) Q1-Q3	
1	-71.5%	-68.7%	-59.9%	-62.6%	82.0%
2	-46.7%	-58.3%	-45.7%	-45.7%	78.9%
3	-39.2%	-56.1%	-44.3%	-38.2%	74.2%
4	-31.7%	-52.2%	-36.2%	-28.9%	68.9%
5	-26.7%	-47.3%	-35.1%	-28.1%	69.4%
6	-21.4%	-44.5%	-30.7%	-24.0%	69.0%
7	-18.1%	-43.3%	-28.4%	-23.5%	69.7%
8	-16.5%	-39.3%	-23.5%	-20.5%	67.8%
9	-14.9%	-34.7%	-19.0%	-18.3%	66.4%
10	-8.97%	-25.6%	-14.4%	-13.4%	62.4%
Total	**-25.7%**	**-44.4%**	**-30.7%**	**-28.1%**	**70.0%**

Notes: Deciles are calculated according to total annual sales in 2019, excluding nil-filers. Quarterly growth rates are calculated at the firm-level based on quarterly sales in 2019 and 2020. Sales are totalled across the first three quarters of the year to calculate the growth rate in column four. Growth rates are then capped at 100 per cent.

Although the mean of firm-level growth rates is negative for all deciles, not all firms experienced losses. Some still had positive growth rates. For example, although the mean of growth rates across firms is still negative in the third quarter, about 5,000 firms experienced positive growth, up from about 3,200 in the second quarter. Column five of Table 2.2 shows that the percentage of firms experiencing negative growth is correlated with firm size: it is larger in the first decile (82 per cent) compared to the top decile (62.4 per cent) or even the average of all firms (70 per cent). It might well be that larger firms, such as major supermarket chains, were more able to adopt the necessary measures to remain open during the crisis. That might have increased their chances of experiencing a positive level of growth – and indeed 34 per cent of firms in the top decile managed to do so. More detailed summary statistics on firm-level growth rates are available in Appendix Table A3, confirming that the incidence of negative growth is particularly high in the second quarter of 2020.

It is worth mentioning two additional robustness checks. Firstly, the distributional differences we document here are not due to a different sectoral composition amongst deciles. A very similar association between growth rates and firm size is observed within specific sectors, as shown in Appendix Figures A4 for manufacturing, A5 for wholesale and retail trade, and A6 for knowledge-based services. Secondly, they are not due to the balanced or unbalanced nature of

our data. While the calculation of growth rates requires that firms are observed in the relevant period of both in 2019 and 2020, adopting a stricter restriction that they should be observed in all quarters of both years hardly changes our results (see Appendix Table A7).

These results on the distributional impact of the crisis are consistent with those shown by Bachas et al. (2021) for Honduras, where the smallest firms also suffered the most from the crisis. Our results are also in line with simulations showing that in, Sub-Saharan Africa, the crisis is expected to affect mostly the poor (Djiofack et al. 2020). Our analysis shows that, while in absolute terms most of the losses come from the largest firms, in proportional terms the smallest firms bear the greatest burden. This is at odds with similar (but not fully comparable) results from the US showing that higher-income people reduced their spending more than lower-income ones, both in absolute and proportional terms (Chetty et al. 2020).

2.3 Impact by sector

The sectoral information available in the VAT declarations dataset is not fully complete and precise. For example, it does not allow us to split the retail sector into 'essential' and 'non-essential' retail. In addition, since the sectors are broadly defined, such as wholesale and retail trade, this information cannot be used to formulate concrete policy recommendations. However, it can still provide an initial indication of the worse-affected sectors in terms of aggregate sales, at least on a broad level.

The numbers presented in Table 2.3 are comparable to those reported in Section 2.1 in that they show total sales by quarter and growth rates in the aggregate values across years. During the lockdown quarter (column five), the most affected sectors were accommodation and food service, transportation and storage, mining and quarrying, and wholesale and retail trade. The sharp decline of the accommodation and food sector is fully expected especially during the lockdown, while sharp losses in the mining sector might be related to large capital outflows from low- and middle-income countries (Goldberg and Reed 2020). The firm-level growth rates, reported in Appendix Table A8, paint a similar picture, with the most-affected sectors being accommodation and food service, mining and quarrying, and construction. Table A8 also shows that the percentage of firms with negative growth is highest in the same three sectors. As in Section 2.1, restricting the analysis to the balanced panel does not affect our results. Consistently, the sectoral composition of the economy does not change in any appreciable way during the crisis (see Appendix Figure A4).

Table 2.3: Impact on aggregate sales by sector

Sector	(1) Sales[1] 2019 (bn)	(2) Sales 2020 (bn)	(3) Growth[2] Q1-Q3	(4) Growth Q1	(5) Growth Q2	(6) Growth Q3	(7) N[3]
Agriculture, forestry and fishing	35.8	43.8	22.2%	42.1%	7.73%	20.1%	265
Mining and quarrying	29.6	23.4	-20.9%	-11.9%	-45.8%	-1.33%	130
Manufacturing	525.7	580.3	10.4%	17.7%	-6.96%	21.6%	2,266
Utilities and energy	70.2	82.5	17.5%	10.0%	-6.57%	5-.0%	204
Construction	313.6	296.0	-5.64%	-13.3%	-13.6%	13.6%	1,636
Wholesale and retail trade	2,189.0	1,997.9	-8.73%	-4.50%	-28.7%	10.2%	8,733
Transportation and storage	282.4	190.2	-32.7%	-8.17%	-49.9%	-39.1%	718
Accommodation and food service	127.2	80.6	-36.6%	-7.42%	-56.9%	-44.1%	1,265
Knowledge-based services	806.5	781.6	-3.09%	0.04%	-11.1%	2.36%	2,322
Other services	204.4	170.2	-16.7%	-2.88%	-20.5%	-25.7%	1,840
Miscellaneous[4]	865.7	674.7	-22.1%	14.5%	-53.6%	4.71%	1,575
Total	**5,450.2**	**4,921.1**	**-9.7%**	**-0.13%**	**-29.6%**	**3.86%**	**20,954**

Notes: [1]Total sales from January to September for all taxpayers, quarterly and monthly. [2]Growth rates are calculated at the aggregate level, between total sales in the relevant period to the same period in the previous year (Q = quarter). [3]Number of firms in each sector in 2019. [4]The miscellaneous category captures firms without sector information.

2.4 Geographical differences

Similarly to Section 2.3, we will now consider the disaggregated impact of the crisis by geographical area. Being a small country, Rwanda has only five provinces, one of which captures the capital Kigali and its surroundings. Before examining the results, it is worth noting that the geographical location reported in the VAT data refers to the tax centre where the firm is registered, which does not necessarily correspond to the location of the actual business activity. For example, a large company (e.g. an hotel chain) with headquarters in Kigali and several branches throughout the country will appear as being based in Kigali. Therefore, the results presented here provide a useful indication of geographical differences, but they are not accurate enough to offer specific policy advice.

Table 2.4 shows the level of aggregate sales and their growth rates by province, along the same lines as Tables 2.3 and 2.1. Two interesting patterns emerge. Firstly, economic activity is highly concentrated in the capital city, which accounts for approximately 90 per cent of all sales in 2019 and 2020.[20] Secondly, the crisis affects firms in the capital to a much larger extent than anywhere else in the country. Aggregate sales decreased almost everywhere during the lockdown (see column five, comparing sales in the second quarter between 2019 and 2020), but the decline in Kigali was a lot more marked than anywhere else. Over the full period (column three), firms outside of the capital managed to recoup their losses and experienced positive aggregate sales growth. However, firms based in Kigali still saw a decline in aggregate sales

[20]This is a common observation in low-income countries, also documented in Mascagni and Mengistu (2018). It is due in part to the fact that larger firms, in particular, have headquarters in the capital.

of 11.5 per cent over the full period, compared to 2019. This is not related to differences in restrictions, as the lockdown implemented around April was applied nation-wide.

Table 2.4: Impact on aggregate sales by province

Province	(1) Sales[1] 2019 (bn)	(2) Sales 2020 (bn)	(3) Growth[2] Q1-Q3	(4) Growth Q1	(5) Growth Q2	(6) Growth Q3	(7) N[3]
City of Kigali	4,973.2	4,401.4	-11.5%	-1.07%	-31.6%	2.04%	15,115
Eastern province	95.7	105.1	9.81%	12.9%	-5.84%	22.2%	1,473
Southern province	126.9	136.1	7.22%	-1.85%	-0.10%	21.8%	1,588
Western province	156.1	174.9	12.1%	19.2%	-9.04%	26.9%	1,748
Northern province	98.2	103.5	5.38%	20.7%	-13.2%	10.4%	1,030
Total	**5,450.2**	**4,921.1**	**-9.71%**	**0.13%**	**-29.6%**	**3.86%**	**20,954**

Notes: [1]Total sales from January to September for all taxpayers, quarterly and monthly. [2]Growth rates are calculated at the aggregate level, between total sales in the relevant period to the same period in the previous year (Q = quarter). [3]Number of firms in each province in 2019.

The fact that Kigali was more affected by the crisis might provide some insight on the differential impact of the crisis between relatively higher-income and lower-income households. While we have no information at the household level, trends in aggregate sales might approximate trends in aggregate consumption – although there are important differences in these two measures.[21] As such, the larger drop in aggregate sales we observe in Kigali might be indicative of larger drops in consumption in the capital compared to other areas of the country. This would be consistent with similar findings from Uganda (Mahmud and Riley 2020) and the US (Chetty et al. 2020), showing a larger impact of the crisis amongst higher income households – possibly because they are more able and better prepared to comply with lockdowns.

However, it is important to note that, while formal consumption might have declined less in poorer areas in proportional terms, that does not necessarily mean these areas have been less severely affected in broader terms. In fact, there is evidence suggesting otherwise – that the poorest are expected to be hit the hardest by lockdowns (Djiofack et al. 2020; Barnett-Howell and Mobarak 2020; Younger et al. 2020; Teachout and Zipfel 2020). More research is needed to shed light on the full extent of the crisis' impact at the household-level. Relatedly, Appendix Table A9 reports large drops in firm-level growth rates across the whole of Rwanda. While firms in Kigali are confirmed to have suffered particularly during the lockdown, firm-level growth rates over the whole period have been similarly negative in other provinces.

2.5 Revenue Impact

We now turn to how these losses translate into lost tax revenue, a highly policy-relevant question. VAT is the main source of domestic revenue in Rwanda, as in other low-income countries.[22] Any losses in tax revenue should be particularly concerning for policymakers – especially so in countries that already struggled to raise enough to fund basic public services and ambitious development agendas before the crisis. In this section, we show how aggregate VAT revenue changed during the pandemic. The tables and figures presented here follow the same methods

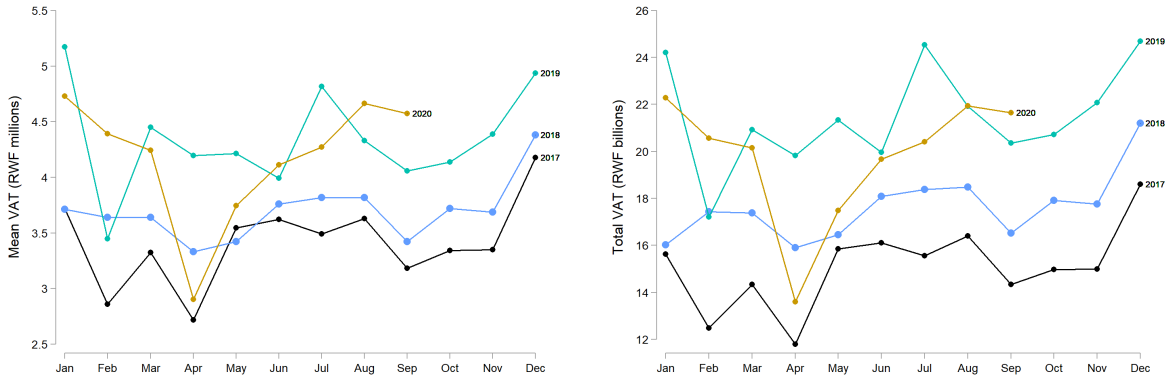
[21]Importantly, VAT sales includes business-to-business transactions that speak to production processes more than final consumption.

[22]Developing countries raise about 30 per cent of their revenue from VAT (Organisation for Economic Co-operation and Development 2018).

as those presented in Section 2.1, but use data on net VAT liabilities, as reported in the VAT declarations, instead of sales. Net VAT liability refers to the tax that firms are liable to pay, after having adjusted for tax paid on inputs, other credits and tax refunds.[23] This measure is the most immediately relevant one for policy, because it represents the revenue available to the government. However, we also discuss alternative measures that take into account some of the policy responses to the crisis (as anticipated in Section 1.1).

Figure 2.2 reports mean and total VAT revenue for monthly taxpayers, which is the most disaggregated data we have (see Section 1.2). Similar to the results in Section 2.1, losses in terms of net VAT are concentrated in April 2020, with a 31.4 per cent decline compared to in April 2019.[24] May 2020 saw a smaller but still fairly substantial decline, with net VAT rebounding relatively quickly after the lockdown was lifted. Appendix Figure A5 confirms this pattern based on quarterly data for all firms, with the second quarter being the most-affected.

Figure 2.2: Aggregate impact on mean and total VAT revenue



(a) Mean VAT revenue by month **(b) Total VAT revenue by month**

Note: These graphs show mean and total VAT reported for monthly taxpaying firms only in 2017, 2018, 2019 and 2020. Firms which report no sales across the relevant year are excluded from the mean calculations. This reflects net VAT due on sales, after adjusting for total VAT paid on inputs and other credits.

Table 2.5 reports total net VAT for each quarter, as well as the quarter-on-quarter growth rate in aggregate net VAT.[25] Similar to sales (see Section 2.1), growth in net VAT has been high and sustained in recent years, reflecting the strong performance of the Rwanda Revenue Authority. However, the crisis resulted in an aggregate decline of 5.1 per cent for the first three quarters of 2020, with a slight improvement in growth from the second to the third quarter. Total VAT across the first three quarters of 2020 was RWF 10.5 billion lower than for first three quarters of 2019 – roughly equivalent to US$10.7 million at current exchange rates, roughly 0.1 per cent of GDP or 1.5 per cent of total taxes on goods and services.[26]

The relief measures mentioned in Section 1.1, especially the acceleration of VAT refunds and waivers on penalties, may affect the impact of the crisis on VAT revenue. To account for this possibility, Appendix Table A11 repeats the analysis of Table 2.5 using on VAT payable *before* adjustments for refunds and credit carried forward. It shows a more modest decline of 3.8 per cent in 2020, compared to 5.1 per cent in Table 2.5, which is consistent with expedited refunds.

[23] For more details on the functioning of Rwanda's VAT system, see Mascagni et al. (2021)

[24] Based on VAT declarations for monthly taxpayers.

[25] The corresponding monthly figures, calculated only based on monthly declarations, are reported in Appendix Table A10.

[26] As reported in data available on the website of the Rwandan Ministry of Finance and Economic Planning, total taxes on goods and services were RWF 720.1 billion in 2019.

Table 2.5: Impact of COVID-19 on VAT revenue

	2017	2018		2019		2020	
	(1) VAT (RWF bn)	(2) VAT (RWF bn)	(3) YoY Growth	(4) VAT (RWF bn)	(5) YoY Growth	(6) VAT (RWF bn)	(7) YoY Growth
January–March	45.72	54.96	20.2%	66.79	21.5%	69.37	3.9%
April–June	47.32	54.76	15.7%	65.83	20.2%	55.11	-16.3%
July–September	50.21	56.95	13.4%	72.37	27.1%	69.96	-3.3%
Total (Jan–Sep)	**143.25**	**166.67**	**16.3%**	**205.00**	**23.0%**	**194.45**	**-5.1%**

Notes: Total VAT revenue reported by all taxpayers, quarterly and monthly. Year-on-year growth rates calculated between the same quarters of the two relevant years.

Studies on the impact of the crisis on tax revenue are scarcer than those looking at its broader economic impact. However, for comparison, Lees et al. (2020) forecast a loss in CIT revenue of approximately 25 per cent relative to the pre-COVID baseline after a three-month lockdown in Rwanda; while Arndt et al. (2020) estimate a 32 per cent drop across all tax types in South Africa, with import taxes being the most-affected type.

3 Conclusions

Our analysis provides new insight on the impact of the pandemic in a low-income country, Rwanda. We have shown that, despite case numbers remaining relatively low during our data period (see Section 1.1), the country has experienced a serious economic shock. Aggregate sales amongst VAT-registered firms dropped by about 30 per cent over the lockdown period, but rebounded quickly afterwards (see Section 2.1). Over the whole data period, losses in sales amount to 5.2 per cent of GDP. While almost all of the losses in absolute terms come from the largest firms, the smallest firms are the ones who have suffered the most in proportional terms (see Section 2.2).

We also show disaggregated results by sector and geographical location. While the caveats highlighted in Sections 2.3 and 2.4 prevent us from providing specific policy recommendations, these results still offer useful, though broad, indications for policymakers. They show that sectors like accommodation and food service, transport and storage, and mining and quarrying have been particularly affected by the crisis, as one might expect (see Section 2.3). Firms in Kigali have been hit particularly hard on aggregate, possibly indicating larger declines in consumption in the capital compared to other areas. However, impacts at the firm level have been severe throughout the country (see Section 2.4).

Overall, the decline in economic activity translates into a 5.1 per cent loss in VAT revenue for the government – at a time when tax revenue is needed more than ever, to fund the crisis response and recovery. A small part of this loss is associated with tax relief offered by the Rwanda Revenue Authority, most notably through expedited VAT refunds.

By providing evidence on the actual impact of the crisis, our results complement existing projections to inform policymakers about appropriate policy responses in the specific context of low-income countries. In Rwanda, restrictions on movement, and particularly the April lock-

down, seem to be responsible for the largest losses in economic activity – at least as far as the domestic, formal economy is concerned. While these impacts are mostly generated by large firms in the capital, policymakers should ensure smaller firms can access appropriate relief too, since they are the ones losing the most in proportional terms. They might also be the ones that employ more lower-income people, have a large share of informal workers and pay lower wages – all of which is highly relevant in responding to the crisis. These results are particularly relevant as the country is experiencing another surge in cases and another lockdown, although this time it is only applied to the capital.

By using real-time data from VAT declarations, we also show more broadly how these data can be used to assess the performance of the economy, during, but also beyond, the pandemic. In low-income countries, other sources of real-time data are either unavailable or hardly relevant due to shallow stock exchanges, low bank penetration and an economy that is still not fully digitised. In this context, administrative data from tax records provide a unique source of information on formal firms, subject to the caveats highlighted in Section 1.2.

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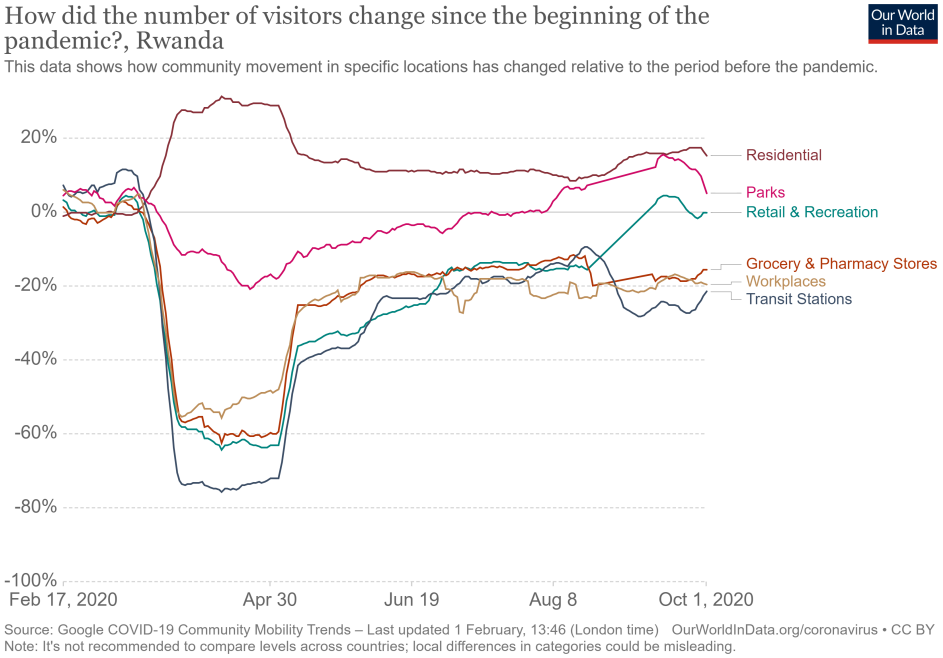
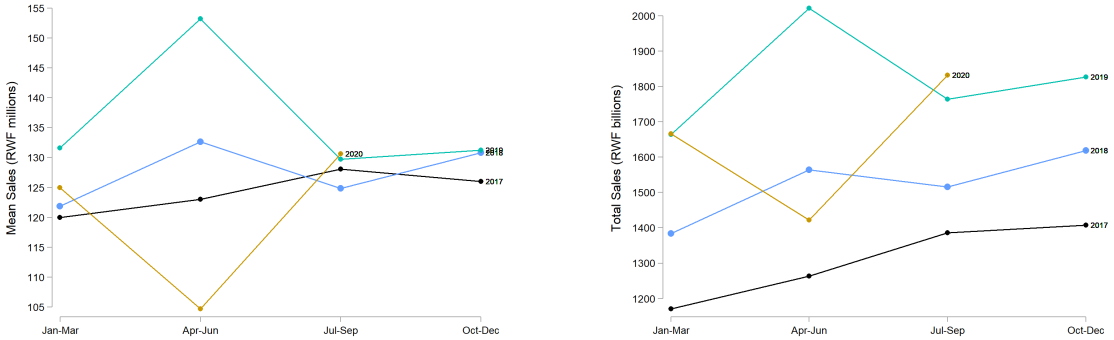
Appendix

Figure A1: Mobility in Rwanda during lockdown



Notes: This figure is based on mobility data from Google. The underlying data comes from Google's 'Community Mobility Reports', which are created with aggregated sets of data from users who have turned on location history settings on Google products. This is likely an unrepresentative sample of the wider population of Rwanda. Internet penetration is under 50 per cent in Rwanda, with smartphone usage even less common. So this mobility data might provide only a snapshot of the movements of a wealthier segment of society. The change in total visitors (or duration of time spent at home for the 'Residential' category) is measured relative to a baseline period between 3 January and 6 February 2020. Source: Our World in Data (2021)

Figure A2: Aggregate impact on VAT sales for all taxpayers



(a) Mean sales by quarter **(b) Total sales by quarter**

Note: These graphs show quarterly trends in mean and total sales for all firms filing VAT in 2017, 2018, 2019 and 2020 (monthly and quarterly taxpayers). Firms that report no sales across the relevant year (nil-filers) are excluded from the mean calculations. Here, sales is taken as the total value of supplies, including VAT-exempted and zero-rated sales.

Table A1: Impact of COVID-19 on aggregate sales by month

	2017	2018		2019		2020	
	Sales (RWF bn)	Sales (RWF bn)	Growth rate	Sales (RWF bn)	Growth rate	Sales (RWF bn)	Growth rate
January	363.2	417.1	14.8%	556.5	33.4%	510.0	-8.4%
February	348.5	442.8	27.1%	469.8	6.1%	489.7	4.2%
March	371.3	446.6	20.3%	531.3	19.0%	503.3	-5.3%
April	330.5	421.8	27.6%	498.4	18.2%	337.8	-32.2%
May	416.1	464.9	11.7%	572.4	23.1%	432.7	-24.4%
June	413.3	451.9	9.4%	521.2	15.3%	534.5	2.5%
July	469.8	468.5	-0.3%	548.3	17.0%	543.3	-0.9%
August	414.4	497.2	20.0%	525.5	5.7%	525.2	-0.1%
September	390.2	439.2	12.6%	544.4	24.0%	553.1	1.6%
Total (Jan-Sep)	**3,517.2**	**4,049.9**	**15.1%**	**4,767.9**	**17.7%**	**4,429.5**	**-7.1%**

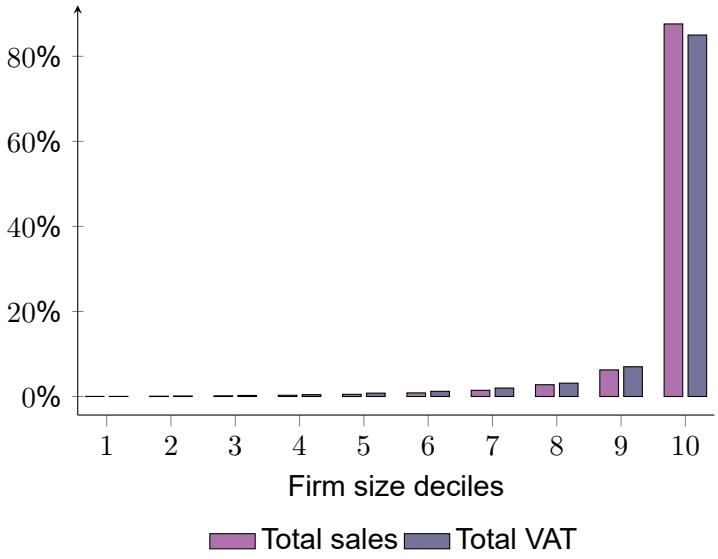
Notes: Total sales reported by monthly taxpayers only.

Table A2: Impact of COVID-19 on aggregate sales - deflated

	2017	2018		2019		2020	
	(1) Sales (RWF bn)	(2) Sales (RWF bn)	(3) YoY Growth	(4) Sales (RWF bn)	(5) YoY Growth	(6) Sales (RWF bn)	(7) YoY Growth
January–March	1,170.6	1,364.5	16.6%	1,602.5	17.4%	1,490.3	-7.0%
April–June	1,263.2	1,543.1	22.2%	1,945.0	26.2%	1,272.3	-34.7%
July–September	1,386.5	1,494.7	7.8%	1,698.8	13.7%	1,638.7	-3.5%
Total (Jan–Sep)	**3,820.3**	**4,402.3**	**15.2%**	**5,248.2**	**19.2%**	**4,401.3**	**-16.1%**

Notes: Nominal sales data is deflated using consumer price index (CPI) data provided by the National Bank of Rwanda. We take 2017 as the base year and deflate sales according to average annual CPI in each subsequent each year to obtain sales in real terms.

Figure A3: Proportion of annual sales and VAT revenue by decile



Note: Deciles are calculated for firms with non-zero total sales from January to December 2019.

Table A3: Detailed summary statistics of firm-level growth rates

	Mean	Std. Dev.	25%	50%	75%	95%	Max.	N
Q1 sales growth rate	-25.9	54.8	-76.2	-24.6	13.1	71.0	100	8,705
Q2 sales growth rate	-44.7	49.9	-91.0	-53.2	-12.0	54.9	100	9,833
Q3 sales growth rate	-30.9	55.5	-84.4	-33.5	8.81	69.9	100	9,007
Total (Q1-Q3)	**-34.2**	**53.9**	**-85.5**	**-38.9**	**3.89**	**66.2**	**100**	**27,545**

Table A4: Firm-level growth rates for the manufacturing sector

Decile	Q1	Q2	Q3	Q1-Q3	N
1	-73.9	-66.6	-52.4	-66.6	74
2	-56.4	-60.9	-44.6	-54.7	94
3	-45.5	-62.0	-53.2	-51.1	113
4	-41.2	-44.1	-42.9	-31.8	105
5	-32.3	-51.5	-37.1	-31.4	123
6	-22.1	-42.5	-31.2	-26.1	135
7	-12.2	-39.0	-30.1	-20.7	127
8	-19.3	-38.2	-28.7	-22.0	141
9	-11.2	-30.3	-19.5	-21.6	134
10	0.92	-18.1	-13.8	-10.5	152
Total	**-25.4**	**-41.8**	**-32.2**	**-30.7**	**1,198**

Notes: Deciles calculated according to total sales in 2019, excluding inactive firms, for the manufacturing sector only. Growth rates are capped at 100 per cent.

Table A5: Firm-level growth rates for the wholesale & retail trade sector

Decile	Q1	Q2	Q3	Q1-Q3	N
1	-67.5	-63.3	-57.9	-55.9	324
2	-40.8	-53.8	-37.7	-39.3	410
3	-34.7	-51.2	-34.4	-29.5	462
4	-23.7	-45.0	-27.0	-23.6	497
5	-23.2	-48.0	-30.7	-28.7	495
6	-13.5	-38.1	-22.0	-15.8	530
7	-12.3	-37.0	-18.9	-16.7	553
8	-12.7	-34.6	-13.6	-14.6	553
9	-11.0	-31.2	-14.4	-13.6	583
10	-4.90	-22.7	-6.84	-8.50	624
Total	**-20.9**	**-40.0**	**-22.9**	**-22.4**	**5,031**

Notes: Deciles calculated according to total sales in 2019, excluding inactive firms, for the wholesale and retail trade sector only. Growth rates are capped at 100 per cent.

Table A6: Firm-level growth rates for the knowledge-based services sector

Decile	Q1	Q2	Q3	Q1-Q3	N
1	-69.1	-61.3	-41.2	-45.3	86
2	-47.8	-53.8	-36.5	-38.0	97
3	-39.0	-45.4	-42.7	-28.4	96
4	-41.6	-56.8	-50.0	-46.6	106
5	-39.6	-47.8	-43.0	-30.3	110
6	-37.7	-41.5	-33.6	-27.9	136
7	-27.3	-47.0	-34.1	-23.0	135
8	-22.2	-47.0	-36.8	-28.9	138
9	-11.4	-39.6	-21.1	-15.5	151
10	-16.1	-20.3	-12.9	-14.1	156
Total	**-31.3**	**-43.8**	**-33.1**	**-28.1**	**1,211**

Notes: Deciles calculated according to total sales in 2019, excluding inactive firms, for the knowledge-based services sector only. Growth rates are capped at 100 per cent.

Table A7: Firm-level growth rates by decile for the fully balanced panel

Decile	Q1	Q2	Q3	Q1-Q3
1	-69.7	-68.4	-61.2	-59.7
2	-47.4	-58.6	-46.8	-46.4
3	-34.5	-53.8	-42.5	-35.9
4	-27.4	-51.6	-35.0	-27.9
5	-24.5	-45.8	-34.6	-27.4
6	-17.9	-42.2	-28.6	-23.4
7	-14.8	-41.8	-26.5	-24.0
8	-13.4	-38.2	-22.3	-22.3
9	-12.6	-34.3	-19.9	-27.6
10	-8.98	-26.1	-18.5	-17.7
Total	**-25.5**	**-45.5**	**-32.3**	**-28.9**

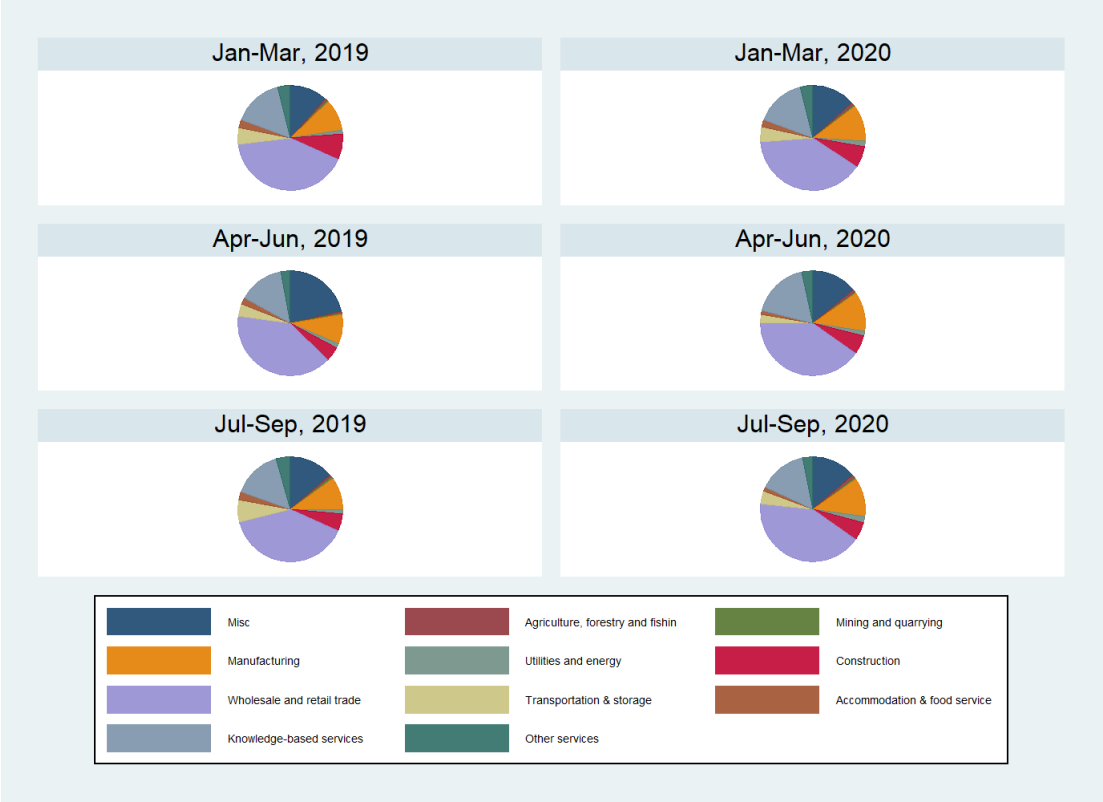
Notes: Growth rates are capped at 100 per cent. Only firms which are observed in every quarter between January 2017 and September 2020 are included in these calculations.

Table A8: Firm-level growth rates by sector

Sector	(1) Q1	(2) Q2	(3) Q3	(4) Q1-Q3	(5) Firms with negative growth	(6) N
Agriculture, forestry and fishing	-34.4	-54.8	-38.1	-36.7	72.0%	100
Mining and quarrying	-42.0	-62.0	-39.4	-49.3	79.7%	64
Manufacturing	-25.5	-42.6	-33.0	-31.6	71.4%	1,131
Utilities and energy	-41.1	-48.6	-30.0	-25.2	62.9%	97
Construction	-51.9	-54.2	-41.1	-41.6	77.5%	609
Wholesale and retail trade	-20.8	-40.2	-23.0	-22.5	66.3%	4,913
Transportation and storage	-28.4	-47.6	-30.9	-28.2	71.4%	416
Accommodation and food service	-26.6	-66.3	-53.4	-43.3	83.6%	782
Knowledge-based services	-32.1	-44.2	-34.3	-29.7	68.6%	1,139
Other services	-26.0	-44.1	-36.4	-29.3	72.6%	956
Miscellaneous	-25.1	-41.8	-30.3	-25.9	68.9%	772
Total	**-25.7**	**-44.4**	**-30.7**	**-28.1**	**70.0%**	**10,979**

Notes: Growth rates in the first three columns are calculated year-on-year for each quarter at the firm level. Growth rates in column four are calculated by comparing the total sales from January to September in 2019 against the same period in 2020. These rates are capped at 100 per cent. 'Knowledge-based services' include information and communication services, finance and insurance services, and professional, scientific and technical services (NACE Rev 2 codes J, K, and M). 'Other services' include real estate, administrative and support services, education, human health and social work, and arts, entertainment and recreation (NACE Rev 2 codes L, N, P, Q, R, and S). 'Utilities and energy' combines the electricity, gas, steam, and air conditioning sector with the water supply, sewage and waste management sector (NACE Rev 2 codes D and E). The 'miscellaneous' category covers firms for which no sector is observed in the VAT returns data.

Figure A4: Sectoral composition by quarter



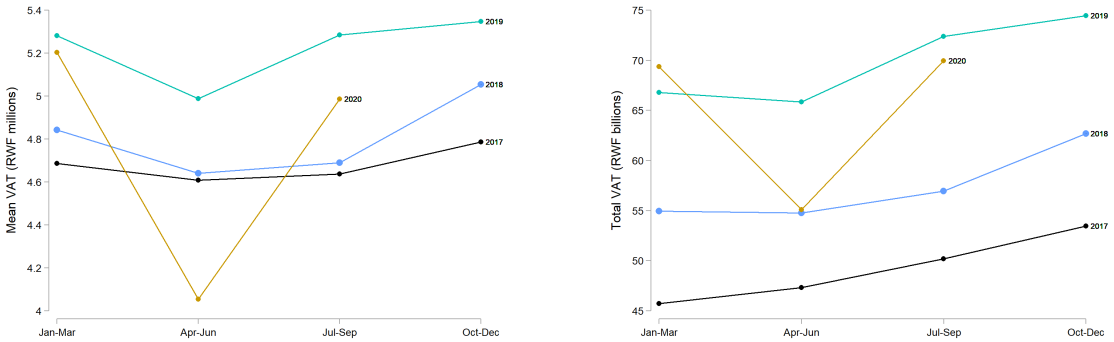
Notes: This figure shows the share of total sales coming from each sector, by quarter.

Table A9: Firm-level growth rates by province

Province	(1) Q1	(2) Q2	(3) Q3	(4) Q1–Q3	(5) N
City of Kigali	-26.6%	-45.6%	-32.2%	-29.4%	7,897
East	-19.6%	-38.6%	-23.6%	-18.4%	702
South	-30.7%	-41.8%	-29.6%	-29.5%	811
West	-23.3%	-44.6%	-27.8%	-26.9%	1,008
North	-18.6%	-40.1%	-24.3%	-22.1%	561
Total	**-25.7%**	**-44.4%**	**-30.7%**	**-28.1%**	**10,979**

Notes: Growth rates in the first three columns are calculated year-on-year for each quarter at the firm level. Growth rates in column four are calculated by comparing the total sales from January to September in 2019 against the same period in 2020. These rates are capped at 100 per cent.

Figure A5: Aggregate impact on VAT revenue for all taxpayers



(a) Mean VAT revenue by quarter **(b) Total VAT revenue by quarter**

Notes: These graphs show quarterly trends in mean and total VAT reported for all taxpaying firms in 2017, 2018, 2019 and 2020. Firms that report no sales across the relevant year (nil-filers) are excluded from the mean calculations. This reflects final VAT due on sales, after adjusting for total VAT paid on inputs, other credits and VAT refunds.

Table A10: Impact of COVID-19 on aggregate VAT revenue by month

	2017	2018		2019		2020	
	VAT (RWF bn)	VAT (RWF bn)	Growth rate	VAT (RWF bn)	Growth rate	VAT (RWF bn)	Growth rate
January	15.6	16.0	2.6%	24.2	51.1%	22.3	-8.0%
February	12.5	17.4	39.6%	17.2	-1.3%	20.6	19.5%
March	14.3	17.4	21.1%	20.9	20.4%	20.2	-3.7%
April	11.8	15.9	34.9%	19.8	24.6%	13.6	-31.4%
May	15.9	16.5	3.8%	21.3	29.6%	17.5	-18.0%
June	16.1	18.1	12.3%	20.0	10.3%	19.7	-1.5%
July	15.6	18.4	18.1%	24.5	33.5%	20.4	-16.8%
August	16.4	18.5	12.7%	21.9	18.6%	21.9	0.1%
September	14.3	16.5	15.2%	20.4	23.3%	21.7	6.4%
Total (Jan-Sep)	**132.5**	**154.7**	**16.7%**	**190.3**	**23.0%**	**177.8**	**-6.6%**

Notes: Total VAT revenue reported by monthly taxpayers only.

Table A11: Impact of COVID-19 on VAT payable

	VAT 2017	VAT 2018	YoY growth	VAT 2019	YoY growth	VAT 2020	YoY growth
Jan-Mar	20.04	22.07	10.1%	23.56	6.8%	26.47	12.3%
Apr-Jun	22.91	24.63	7.5%	28.62	16.2%	24.20	-15.4%
Jul-Sep	23.12	24.20	4.6%	29.80	23.2%	28.22	-5.3%
Total	**66.07**	**70.90**	**7.3%**	**81.98**	**15.6%**	**78.89**	**-3.8%**

Notes: VAT payable is calculated before refunds and credits (in contrast to VAT due, which takes these into account).