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The Impact of COVID-19 on Formal Firms

Micro Tax Data Simulations across Countries

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Abstract

How is the COVID-19 pandemic affecting firm profits and tax payments in developing countries? This paper uses administrative corporate tax records from 10 low- and middle-income countries around the world to provide plausible estimates. Modeling the lockdown-triggered revenue shock with simple and transparent assumptions, the analysis predicts that less than half of all firms will remain profitable by the end of 2020, about 5–10 percent of the formal aggregate annual payroll will be lost, and firm exit rates will double. As a result, it is expected that tax revenue remitted by the corporate sector will fall by at least 1.5 percent of baseline gross domestic product. Differences in sectoral composition and firms' cost structures generate heterogeneity in the results across countries: wage subsidies are less effective in low-income countries and government revenue losses are smaller.

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The Impact of COVID-19 on Formal Firms: Micro Tax Data Simulations across Countries

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1 Introduction

The COVID-19 (Coronavirus) pandemic and the associated containment measures are causing far-reaching damage to firms around the world. Firms are suffering from reduced demand due to lockdowns and movement restrictions. Yet, the limited availability of firm censuses and survey data in many developing countries hampers policymakers' ability to quantify the economic impact of the pandemic and the effect of policy measures to support firms. In this paper, we use a novel dataset of administrative corporate tax returns from 10 low- and middle-income countries to provide plausible estimates of the direct effects of the lockdown on firms' profits, payrolls, and exit rates. We then derive the implications for tax revenues and government support policies. On average across countries, our lower-bound predictions (optimistic scenario) suggest that only half of all firms remain profitable, tax revenue remitted by corporations falls by 1.5% of GDP, and aggregate corporate losses increase by 2.9% of GDP.

Our analysis relies on a few simple and transparent assumptions about the shock firms face and the adjustments they make. We simulate scenarios in which a demand shock induces a drop in firms' sales over either three or five months – which can be thought of as the length of the lockdown with perfect compliance to governments' instructions, or of reduced activity for a longer period with imperfect compliance. The severity of the shock — the percentage drop in monthly sales — differs across economic sectors. We assume that firms produce a unit of output with a Leontieff production function which requires capital, labor and material inputs in fixed proportions, with the proportions estimated from each firm's tax declaration. In our very stylized world, firms can reduce their material costs proportionally to the drop in demand; they reduce labor costs only when making losses because re-contracting workers is costly; and they cannot adjust their fixed costs. Implicitly, we assume that firms aim to weather the shock in a way that allows them to scale their production back up quickly at the end of the lockdown. In practice, some of the loss in demand might be permanent, and the losses are likely to occur over a longer span than three or five months, albeit at a lower rate once movement restrictions are eased.[1] While simplistic, these transparent assumptions provide plausible lower bounds of the pandemic's effect on formal firms and on tax revenue, which can later be complemented with general equilibrium analyses and realized data.

This paper uses for the first time a novel dataset of corporate income tax records across countries assembled by the authors as part of a project to promote the use of administrative tax data from developing countries for research and policy evaluation.[2] Administrative tax data often represent the most recent source of firms' balance sheets in developing countries, they include the largest firms which are often missing in survey data, and they typically constitute the only panel data of firms. Our dataset contains the entire formal corporate sector of 10 countries at different levels of development, in Sub-Saharan Africa, Eastern Europe and Latin America. While the structure of corporate tax returns differs across countries, we harmonize the

[1] Balla-Elliott et al. (2020) shows that firms expect demand to be a third lower than pre-COVID levels upon re-opening.
[2] See Pomeranz and Vila-Belda (2019) and Slemrod (2018) for a summary of recent studies using administrative tax data.

data to obtain comparable measures of revenues, costs and profits, and the breakdown of costs into material inputs, labor costs and fixed costs. We also use the information on firms' economic sector to assign firms to one of three groups—high, medium and low impact—which we assume face a 100%, 50% and 20% drop in demand respectively during the lockdown or period of reduced activity. The categorization of sectors into impact groups follows the taxonomy by Vavra (2020). We present the effects of the shock as percentage deviations in outcomes (e.g. profits) compared to the baseline year (the latest available data), typically 2018 or 2019. All replication codes are available here.[3]

The first part of our analysis simulates the impact of the COVID-19-triggered revenue shock on firms. We start by examining firms' profitability. The average formal firm reports an annual profit margin of 10% and therefore can only absorb shocks to its revenue of a similar magnitude over the year. In a scenario in which firms do not adjust their costs, only 27% remain profitable following a three-month lockdown. Once we allow for firms to adjust material inputs, 44% remain profitable. The largest firms tend to fare a bit better, which slightly mitigates the aggregate profit loss.

In a second step, we estimate the impact of the lockdown on formal employment, as measured by payroll losses. As re-contracting formal labor is costly (and wages are rigid), we assume that firms cut their payroll only when it is necessary to avoid making losses. Thus, firms which can absorb the demand shock without becoming unprofitable do not lay off workers. Under these assumptions, we find that the average firm cuts its annual payroll by 6.7% (26.8% of quarterly payroll). In aggregate, 5.8% of the annual payroll (23.2% of the lockdown quarter payroll) is lost.

Third, we use the panel dimension of the data to predict plausible exit rates. We measure the pre-COVID exit rates among loss-making and profit making firms as an average across years, and find these rates to be remarkably stable across countries and over time. We then apply these rates to the post-COVID profit distribution, allowing for the revenue shock and for firms' material and payroll adjustments. The results suggest that the share of firms exiting would on average double, with large variation across countries. Aside from the exit rates, the firm-level results are relatively homogeneous across the countries we study. However, firms in poorer countries might fare better than we predict, as they could join the informal sector instead of shutting down completely, and because their true profitability might be higher than observed in the data due to more misreporting.

The second part of our analysis focuses on the implications of our firm-level results for governments' policies and public finances. First, we estimate to what extent wage subsidies—a widely discussed policy tool, common in many European countries (Giupponi and Landais, 2020)—can mitigate formal employment losses. We find that, on average, even a 90% wage subsidy can only prevent 30% of the predicted payroll cuts. To understand this result, note that in our simulations, wage subsidies affect formal employment only

[3]Replication codes remain live and will continue to be updated with extensions based on feedback from governments and researchers. World Bank Policy Notes that summarize the results for each of the 10 countries will be published on the authors' websites in August.

in marginal firms; i.e. firms that lay off workers in the absence of the wage subsidy but retain them when receiving the subsidy. Firms are marginal if their losses can be compensated by a reduction in their labor costs. But labor costs only represent 21% of all costs on average, and an even smaller share in poorer countries, presumably due to the high level of informal employment within formal firms. For many firms, fixed costs are so high that the revenue shock pushes firms into loss-making territory even if wages are subsidized. As a result, wage subsidies are largely inefficient for countries in Sub-Saharan Africa, and are useful to protect employment only in moderately impacted sectors in middle-income countries.

Finally, we estimate the budgetary impact of the shock, which reduces the tax revenue collected from the corporate sector and increases the private sector's financing needs. Summing up the reduction in tax revenue for the three main taxes remitted by firms (the Corporate Income Tax (CIT), payroll tax and Value-Added Tax (VAT)) we predict that tax revenue from corporations will drop by 1.5% (2.5%) of GDP in 2020 under the three-month revenue shock (five-month shock). Our estimates constitute a lower bound as we do not account for large expected losses in other taxes such as import tariffs. We also predict that firms accumulate excess losses equal to 2.9% (5.8%) of GDP. Thus, to avoid massive bankruptcies, governments need to provide additional loans and credit guarantees to firms. A government with a balanced budget at baseline would need to borrow 4.4% (8.3%) of its baseline GDP, on average, to fully cushion the formal corporate sector and its workers from this unexpected shock.

Overall, our estimates imply very large increases in borrowing needs to cover tax revenue shortfalls and to guarantee loans to the corporate sector – a challenge for developing countries with limited fiscal space (Loayza and Pennings 2020, Benmelech and Tzur-Ilan 2020, and Abraham et al. 2020). Countries with limited access to international capital markets will require a substantial increase in budget support from donors. A silver lining is that poorer countries seem relatively less impacted on the dimensions we examine: the average loss in tax revenue from corporations in our five Sub-Saharan African countries is 1.0% (1.7%) of baseline GDP in the three-month (five-month) shock scenario, while it is 1.9% (3.0%) in the middle-income countries. This is because middle-income countries have larger formal sectors, higher effective tax rates and sectoral compositions which produce a slightly stronger revenue shock.

Our analysis faces several limitations. First, it only considers a demand shock— arguably the key direct impact of COVID-19 (Coibion et al. 2020)— and assumes that firms have no problems sourcing inputs; in practice the pandemic also induces a supply shock which can amplify the demand shock (Guerrieri et al. 2020). Second, we do not account for the indirect impacts of the shock through firms' trade linkages which are potentially important (Baqaee and Farhi 2020, Bonadio et al. 2020). Third, in our framework firms do not adapt to the crisis (for example by changing products, selling online etc.). Fourth, profits in administrative tax data could be under-reported for tax minimization purposes, so that firms in our data might exhibit artificially low profitability in the pre-Covid baseline. Taking into account caveats (i)-(iii), the numbers in this paper could be considered as plausible lower bounds arising from direct effects, in partial equilibrium, without taking into account the full set of government support policies. Dynamic general

equilibrium models of the economy, with linkages across sectors and firms, are needed to gauge more complex medium-term effects.

Despite these shortcomings, our simple framework proved useful to inform policymakers in our partner countries in real time, at the onset of the lockdowns. Researchers in high-income countries have recently used a wealth of digitally-generated high-frequency information on economic activity to study the impact of COVID-19 (e.g. Chetty et al. 2020). Many developing countries nowadays generate similarly detailed digital information (e.g. transaction-level records from e-billing systems and credit/debit card reporting), but still need to build the infrastructure to use these data for timely economic analysis. This project illustrates the benefits of using harmonized administrative tax data for just-in-time policy analysis, and aims to create a bridge for researchers and policy makers to work with such data. Administrative tax data remain selected, since they only cover the formal sector, and should thus be complemented with survey-based studies of the informal sector (Alfaro et al. 2020). Yet, formal firms are the relevant group to study from a public finance perspective, as they remit the lion's share of taxes and because they can be reached directly with tax policy measures and liquidity provision.

This paper is organized as follows. In section 2 we present the data and the modeling assumptions. In section 3 we estimate the direct impact of the pandemic on firms' profitability, payroll and exit rates. In section 4, we examine the implications for public finances and potential policy responses through wage subsidies. Section 5 concludes.

2 Data and Modeling Assumptions

2.1 Data

Our study uses firm-level corporate tax records from 10 countries – a diverse group of countries spanning three continents.[4] Table 1 shows the descriptive statistics by country, ranked in increasing order of GDP per capita. Countries' GDP ranges from 643 USD per capita in Uganda to 12,027 USD in Costa Rica. Population size also varies substantially, from 1.5 million inhabitants in Eswatini to 110 million in Ethiopia. Similarly, the number of firms in the data ranges from 3,791 in Eswatini to over 80,000 in Costa Rica. The number of firms by inhabitants is generally higher in richer countries.

Our analysis relies on a few key variables: a firm's sector of activity, its revenue, profits and total costs, and the breakdown of costs into fixed costs (machinery, buildings, etc.), material costs (inventory, inputs into production) and labor costs (the wage bill). The profit rate is defined as profits (the tax base) divided by turnover. We use a firm's sector to determine its revenue loss from the lockdown[5]: we assign firms to the

[4] These data are not publicly available, except the data for Ecuador which are published here. The Ecuadorian data contains the tax declarations of firms required to file balance sheets (hence excluding very small firms).

[5] As mentioned above, we use the term lockdown here and thereafter to refer to the reduced form of the shock. The 100, 50 and 20% shocks can correspond to a period of total or partial inactivity for 3 or 5 months or more, with imperfect compliance of firms to lockdown restrictions, or an extended period of reduced activity.

high, medium or low impact group following the classification in Vavra (2020), which is detailed in Table A.1. In our simulations, we assume that firms in high impact sectors (e.g. restaurants, accommodation) experience a 100% revenue loss during the lockdown, firms in medium impact sectors (e.g. manufacturing) experience a 50% revenue loss, and firms in low impact sectors (e.g. education, essential retail) experience a 20% loss.[6] Based on the sectoral composition of the economy and our impact category classification, countries experience an average loss in sales during the lockdown between 38% (Ethiopia) and 59% (Costa Rica). When weighted by firms' sales, the average output loss varies less and is slightly lower, as larger firms tend to be in lower-impact sectors.

At baseline, at least 70% of firms are profitable in all but one country. The average profit margin (counting loss-making firms as having zero profits) ranges from 4% to 16%, and does not exhibit a clear correlation with a country's GDP per capita. This is relevant, as the profit margin indicates the relative drop in profits that firms can sustain without incurring losses.

In terms of the composition of costs, material costs are the largest component and represent 41% of total costs on average. Labor costs account for 21% and fixed costs for 37% of all costs on average.[7] Cost shares vary across countries, which will be relevant for interpreting our results. In particular, reported labor cost shares are lower in poorer countries – presumably due to labor informality – and material cost shares are correspondingly higher. Figure A.1 shows that the cost shares also vary by firm size (turnover) and profit margin. Profitability is increasing in firm size. The labor cost share and the fixed cost share are decreasing across firm-size deciles, while the share of material inputs is increasing.[8] This means that larger firms can better adjust to the demand shock, somewhat mitigating the shock's aggregate impact.

To confirm the accuracy of the cost share information, we compare our data to the cost shares observed in the World Bank Enterprise Survey, which contains the breakdown of costs into material, labor and fixed costs for the manufacturing sector. As Figure A.3 shows, the cost shares for the manufacturing sector in the two datasets are similar in levels and in slopes across firm-size deciles.

[6] We implicitly assume that the sectors gaining from the pandemic, e.g. retailers of cleaning products, refrigerators and teleconferencing equipment are sufficiently small and specific so that there is no sector group that experiences an overall revenue increase.

[7] The Albania data do not have the breakdown of costs into the different components, and the Ethiopia data do not feature a distinction between labor costs and material costs. We hence impute the cost shares in these cases with the average from the other countries at the sector and firm-decile level.

[8] Within the top decile, the profit margin continues to increase, but the cost shares are fairly stable (Figure A.2).

Table 1: Firm Profits and Cost Composition Across Countries

	Uganda (UGA)	Ethiopia (ETH)	Rwanda (RWA)	Senegal (SEN)	Eswatini (ESW)	Guatemala (GTM)	Albania (ALB)	Ecuador (ECU)	Montenegro (MNE)	Costa Rica (CRI)	Average
GDP Per Capita (Current USD)	643	772	773	1522	4146	4549	5269	6345	8846	12027	4489
N Firms	20194	11221	8321	5849	3791	25056	18785	56131	17655	80173	24718
Avg. Simulated Output Loss (%)	51	38	50	49	50	52	39	51	56	59	50
Avg. Simulated Output Loss (%, Weighted by Turnover)	48	47	42	42	41	51	34	46	49	56	46
Firms Profitable at Baseline (%)	75	69	72	99	75	69	87	80	59	100*	79
Avg. Profit Margin (%)	10	12	4	5	16	7	12	8	8	14	10
Avg. Material Cost (% Total Costs)	52	41	65	26	54	38	53	29	38	19	41
Avg. Labor Cost (% Total Costs)	11	29	6	11	15	29	24	28	32	26	21
Avg. Fixed Cost (% Total Costs)	34	31	28	63	31	32	22	42	30	55	37

Note: This table presents summary statistics on firms in ten countries. All statistics are from administrative corporate tax records, except the first row which is from the World Development Indicators. The allocation of firms to the high, low and medium impact group is based on the sector of economic activity and follows the classification in Vavra (2020), as displayed in Table A.1. We assume that the high impact sector experiences a 100% output loss during lockdown, and the medium and low impact sectors experience a 50% and 20% output loss, respectively. This, together with the sectoral composition of the economy, generate the average output shock. The average across countries (last column) is a simple average, unweighted by population or the number of firms. Shares are rounded to the nearest integer. The share of firms in the high/medium/low impact category in each country is displayed in Table A.2. * Costa Rica does not allow loss carry forward, so only 100-200 firms per year report losses.

2.2 Modeling Assumptions

We simulate the effect of the COVID-19-triggered lockdown as a revenue shock that lasts for either three or five months, i.e. roughly the duration of the lockdown. The size of the revenue loss during this period varies across sectors, as discussed above. In practice, the length and severity of lockdowns varies across countries. All countries in our sample had several months of lockdown or movement restrictions, and multiple countries have reimposed or strengthened restrictions over time. There is substantial uncertainty over the evolution of lockdown policies for the rest of 2020. Since our data are annual and do not reveal seasonality in sales across the year, our simulation of a three-month lockdown in the high (medium) impact sector simply corresponds to a 25% (17.5%) drop in firms' annual sales. This way of modeling affords a lot of flexibility and does not have to correspond to the exact length of the lockdown. For instance, taking the high impact sector, the three-month lockdown scenario would be equivalent to a two-month full lockdown followed by a two-month partial (50%) lockdown. It also allows for imperfect compliance of firms to governmental restrictions and longer period of reduced but sustained activity.

We further assume that firms produce a unit of output with fixed proportions of capital, material and labor inputs. In our simulations, each of the cost components reacts differently to the revenue shock. Firms can adjust their material costs in proportion to the shock. Labor costs are adjusted only to the extent that it is necessary to avoid making losses. This means that firms which can absorb the demand shock without becoming unprofitable do not lay off workers, even if profits decrease compared to the baseline. Finally, we assume that fixed costs are non-adjustable in the medium term.

These assumptions are a simplification, but they provide a transparent framework which we think approximates firms' immediate responses. Our reasoning is as follows. First, material costs essentially constitute inventory and raw materials. Firms should thus be able to adjust material inputs relatively easily to match expected demand, unless they have pre-committed contracts. Second, re-contracting formal labor is costly, and hence preferably avoided, especially if firms expect the demand shock to be temporary. Labor costs are thus the second variable of adjustment. Third, the non-adjustability of fixed costs captures the idea that firms need to continue paying rent for buildings and facilities, find it difficult to sell customized machines, and have to honor their debt payments. Our assumptions imply that the largest wage-bill adjustments would be observed among firms with high fixed costs relative to material costs, and firms that make little or no profits at baseline.

3 Impact on Firms

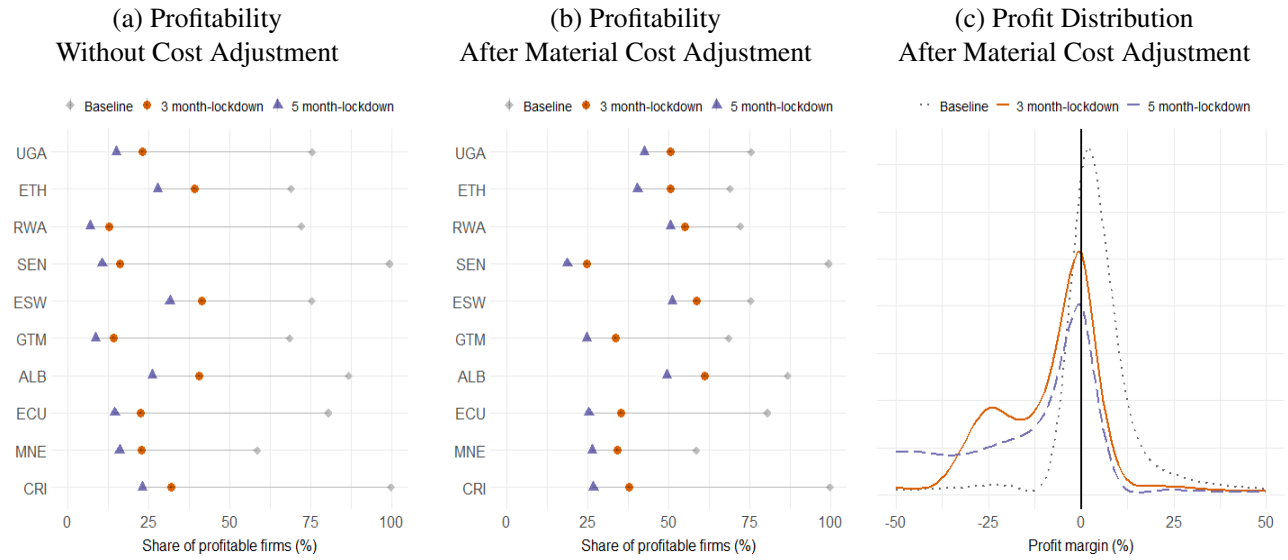
We first estimate how the lockdown-triggered revenue shock might impact firms' profitability, then measure the adjustment firms would make to weather the shock, and finally simulate the increases in firm exit rates.

3.1 Profitability

At baseline, 79% of firms are profitable on average across countries. If firms absorb the COVID-triggered revenue shock without making any adjustment on the cost side, the majority of firms are pushed into loss-making territory, as illustrated in Figure 1a. After the shock, the share of profit-making firms drops below 50% in all countries, and is below 25% in most countries. The shift is unsurprisingly strongest in the high-impact sectors, where almost all firms become unprofitable.[9]

[9]See the country-specific policy notes for graphs for each impact sector.

Figure 1: Impact on Firms' Profitability



Note: These figures show firms' profitability across countries assuming that firms face a lockdown-triggered loss in revenue (of about 50% on average) for three or five months. The first two panels show the share of weakly profitable firms (including firms with zero profits). In Panel (a), firms make no adjustment to weather the shock. In Panel (b) we allow firms to adjust their material costs in proportion to the shock. Panel (c) shows the cross-country average distribution of the profit margin after the material cost adjustment. Table A.3 provides precise numbers for the share of firms remaining profitable under different adjustment scenarios.

This shows that firms need to make adjustments to remain viable. We first allow firms to adjust material costs in proportion to the size of the revenue shock. For instance, if annual revenues fall by 12.5%, as for the medium-impact sector three-month lockdown scenario, then firms also reduce material costs by 12.5%. As shown in Figure 1b, this adjustment increases the share of firms that are still profitable after the shock, especially in low and lower-middle income countries (Senegal being the exception). This is because the share of material costs is relatively higher in these countries, with labor representing a smaller share of costs.

Yet, between one-third and two-thirds of firms in each country are still incurring losses despite the adjustment. Figure 1c illustrates that these losses are substantial in the average country. The profitability distribution has a thick left tail, even in the less pessimistic three-month lockdown scenario. The impact of the shock is largest for firms with a low share of material costs and, mechanically, in the most affected sectors. This also means that countries with a lower average share of material costs and a larger share of firms in the most affected sectors are relatively more affected.

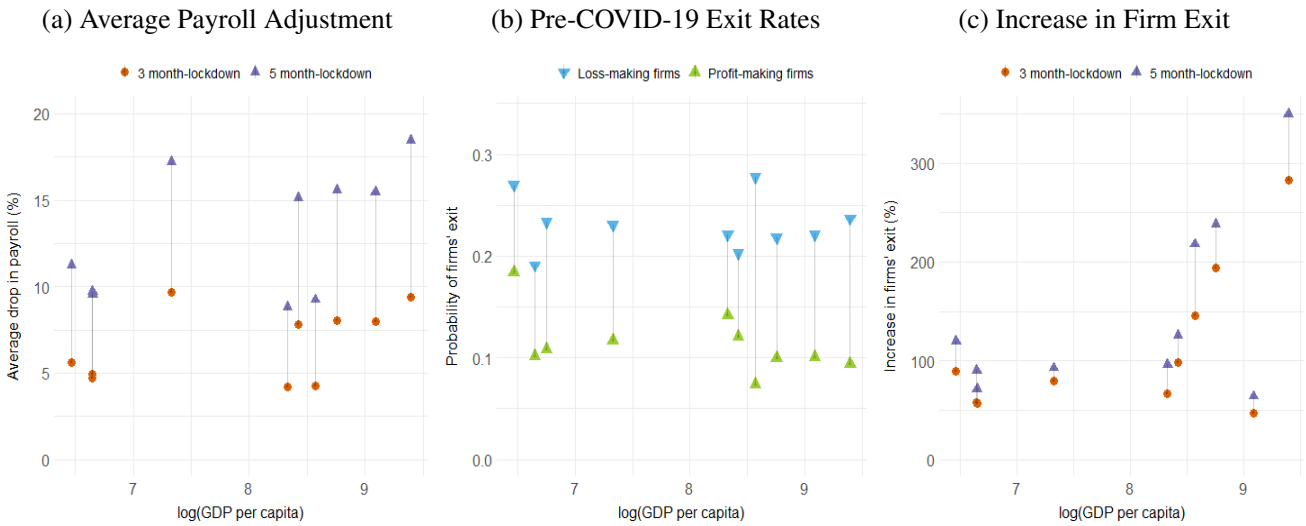
3.2 Payroll Adjustment

Firms that still make losses after adjusting their material costs need to adjust their payroll by laying off formal employees or decreasing their wages. The mechanics of the payroll adjustment are similar to those

of the material cost adjustment, but with a twist: we assume that firms reduce their payroll at most in proportion to the revenue shock, and adjust until they obtain either zero profits (for previously profit-making firms) or the baseline level of losses (for previously loss-making firms). Hence, we assume that firms reduce their payroll by as much as necessary to keep the business afloat, thus minimizing re-contracting costs and facilitating the restart of production after the lockdown.[10] We simulate an adjustment of firms' payroll (total formal wage bill) rather than the number of employees, as we do not consistently observe the latter in all countries' tax data. Our estimates may represent a lower bound for the percentage loss in the number of jobs if lower-paid employees are more likely to be laid off (e.g. as they are relatively more represented in functions such as customer service and day-to-day operations which would be cut first).

In the three-month lockdown scenario, we find that the average firm cuts its annual payroll by 6.7% (26.8% of the quarterly payroll). Overall, this means that 5.8% of the aggregate annual payroll is lost (23.2% of the payroll during the lockdown period). Figure 2a shows that the size of the payroll loss, as a percentage of the baseline payroll, is relatively stable across countries at different income levels. While lower-income countries have a smaller formal work force and their firms have a lower labor cost share on average, the absolute level of the labor adjustment is also smaller in these countries (as discussed further below), resulting in similar percentage adjustments.

Figure 2: Predicted Payroll Adjustment and Increase in Exit Rate



Note: Panel (a) displays the average adjustment in the payroll, as percentage of baseline payroll, for the two lockdown scenarios. Panel (b) displays the average exit rate over the pre-COVID-19 period, for loss-making and profit-making firms. The length of the panel on which these average rates are estimated is on average five years. Using these average exit rates and the share of firms which are profit/loss-making before/after the lockdown, Panel (c) displays the percentage increase in the exit rate predicted for 2020. Tables A.4, A.5 and A.6 provide precise numbers on the aggregate and average payroll losses and the increase in firm exit rates under different scenarios.

[10] We implicitly assume that previously loss-making firms have loans to cover their losses absent the revenue shock, but find it difficult to obtain additional financing to compensate for the COVID-19-triggered shock.

3.3 Exit Rates

Although firms can adjust their material costs and their payroll, some firms remains unprofitable following the lockdown, or more unprofitable than prior to the crisis. This applies to firms with high fixed costs and those receiving a large revenue shock, especially if their baseline profitability is also low. The profit loss would trigger an increase in firm exit rates. Exits are primarily thought of as firms closing their operations and filing for bankruptcy but could also refer to firms' leaving the formal sector and thus disappearing from the corporate tax data.

We estimate the potential increase in exit rates by exploiting the panel structure of our data. We calculate the average exit rate among loss-making and profit-making firms prior to 2020, as well as the overall average (benchmark) exit rate, for each of the three impact sectors. At baseline, profit-making firms display a 10-15% chance of exiting in a given year and loss-making firms a 20-30% exit rate. These patterns are stable across countries, as shown in Figure 2b, and across sectors and over time. We then apply the exit rates for loss-making and profit-making firms respectively, after shifting the profitability distribution for 2020 through the revenue shock and the material and labor cost adjustments, and hence obtain the overall share of firms exiting. Figure 2c shows that exit rates increase by 112% (147%) on average compared to the baseline for the three-month (five-month) lockdown. The increase in exit rates varies across countries, as the share of profitable firms also varies substantially and because the increases are calculated over a small (albeit stable) baseline exit rate. The increase in exit rates varies from 47% to 283% for the three-month lockdown and from 64% to 350% for the five-month lockdown scenario.

4 Implications for Government Policy and Public Finances

We now study the implications of our simulations for government policy and public finances. First, we estimate to what extent wage subsidies—a widely discussed policy tool, common in many European countries (Giupponi and Landais, 2020)—can mitigate the loss in formal employment generated by the lockdown. Second, we estimate the overall budgetary impact of the lockdown, which reduces the tax revenue collected from the corporate sector and simultaneously increases private sector financing needs.

4.1 Can Wage Subsidies Mitigate Payroll Losses?

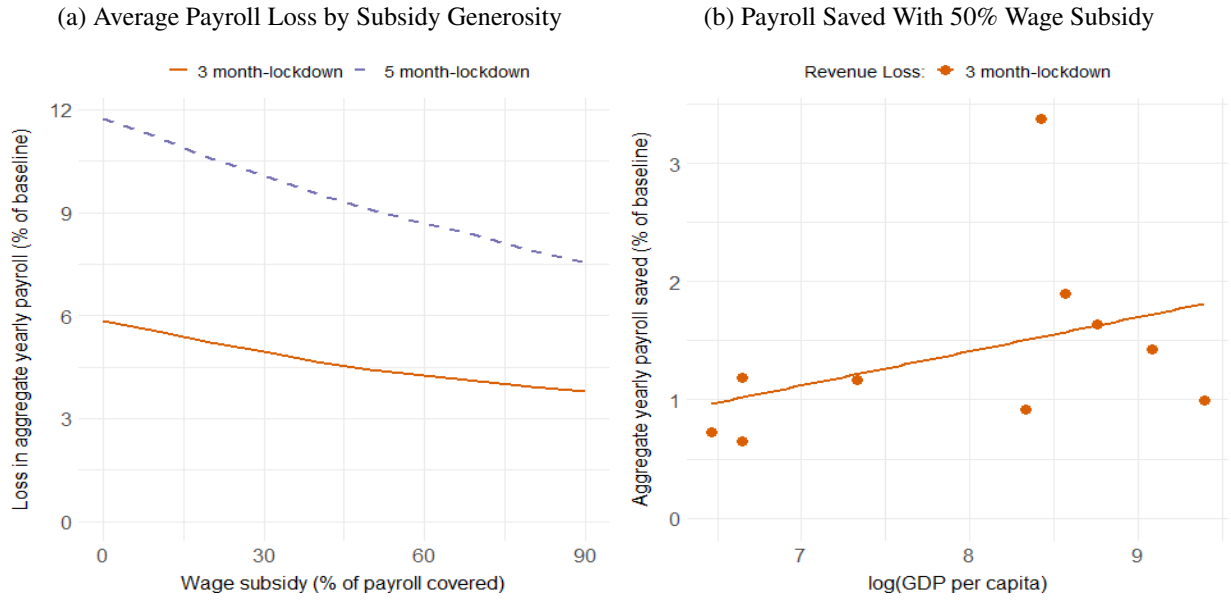
To minimize the loss of employment, some governments offer wage subsidies to firms during economic downturns (also called "short-work" schemes in Western Europe). We use our simulations to examine how much of the economy's formal aggregate payroll can be protected with wage subsidies and how this varies across countries.

Figure 3a shows the predicted loss in the aggregate annual payroll as a function of the generosity of the wage subsidy, on average across countries. The simulated subsidy ranges from 0% (no subsidy) to

90% of salaries paid for by the government during the lockdown period. Without any subsidy, the loss in payroll corresponds to the numbers presented in section 3.2: on average 5.8% (11.7%) of the aggregate annual payroll is lost in the three-month (five-month) lockdown scenario. As the simulated wage subsidy increases, firms' labor costs decrease and some firms become profitable again. Based on our assumption of costly re-contracting of labor, these firms stop laying off workers. As a result, a 50% wage subsidy reduces the aggregate payroll loss by 20%, and a 90% subsidy reduces it by 30%.

Thus, even large wage subsidies can only partially protect formal employment. To understand this, note that the impact of a wage subsidy depends on the share (and size) of 'marginal' firms. For marginal firms, a wage subsidy counteracts the loss in revenue from the demand shock and allows firms to become profitable again. However, two groups of firms are infra-marginal to wage subsidies. First, some firms remain profitable, especially in the low impact sectors, and we assume that these firms do not cut their labor costs in response to the temporary shock. Second, some firms incur large losses already at baseline, or have large fixed costs which cannot be adjusted. These firms make losses even after receiving a subsidy to their labor costs. The importance of this infra-marginal group of firms explains why even with a 90% wage subsidy aggregate annual payroll losses still amount to 5% (10%) for the three-month (five-month) shock scenario.

Figure 3: Impact of Wage Subsidies on Payroll Loss



Note: Panel (a) plots the aggregate annual payroll loss, as a share of the baseline payroll, for wage subsidies ranging from 0% (no subsidy) to 90% of the payroll covered. We display a simple average across countries (weighting all countries equally). Panel (b) displays the share of the annual payroll saved by a 50% wage subsidy (the difference between the predicted payroll loss with and without the subsidy, as a share of the baseline payroll), for the three-month lockdown scenario, for countries at different income levels.

Is there variation in the effectiveness of wage subsidies across countries? Figure 3b plots the aggregate

annual payroll saved with a 50% wage subsidy by countries' per capita GDP. We observe that the impact of wage subsidies on payroll saved is heterogeneous across countries: it is twice as large in upper-middle income countries compared to the poorest countries of our sample. This is because formal labor costs represent a larger share of total reported costs in richer countries (Table 1). Thus, wage subsidies have a broader reach and a higher impact in richer countries.

4.2 Tax Revenue Losses and Financing Needs

The reduction in firms' profitability and employment increases the pressure on governments' public finances. Based on our simulations, we now provide an estimate for tax revenue losses and for the increase in private sector debt. This provides benchmarks for the size of budget support packages needed for lower-income countries, and for the financing needs of the private sector.

Table 2 summarizes the key numbers for the three and five-month lockdown scenarios, ranking countries in increasing order of GDP per capita. The first three rows in each panel estimate the drop in tax revenue for the main taxes remitted by firms: the CIT, the payroll tax and the VAT. The fourth row measures the increase in losses accumulated by firms. Panel A reports the estimates as a percentage change from the baseline (last year available in the micro data), while Panel B reports them as a share of baseline GDP.

The first row shows that the CIT is predicted to collect only 65% (52%) of its baseline revenue on average under a three-month shock (five-month shock). For the countries we study, this is equivalent to a drop of 0.6% (0.9%) of revenue as a percentage of GDP. The drop in revenue is due to firms' reduced profitability, even after they adjust their material costs as discussed in Section 3. The revenue loss is largest in countries where firms have higher fixed costs and where firms are disproportionately in the high impact sectors (for example in Costa Rica, which has a large tourism sector).

The second row measures the drop in payroll tax revenue. In section 3.2 we estimated that firms would have to cut their aggregate annual payroll by 5.8% (11.7%) in the three-month (five-month) lockdown scenario to remain (weakly) profitable. To transform the payroll loss into a share of baseline GDP, we multiply the value of the lost payroll by the payroll tax rate (summing employer and employee contributions).[11] We find that on average governments lose 0.2% (0.4%) of GDP in tax revenue from payroll taxes. This loss is larger in richer countries which have substantially higher payroll tax rates.

[11]The tax rates for the CIT, VAT and payroll tax are displayed in Table A.7.

Table 2: Aggregate Impact for All Sectors, After Three [Five] Months

	Uganda (UGA)	Ethiopia (ETH)	Rwanda (RWA)	Senegal (SEN)	Eswatini (ESW)	Guatemala (GTM)	Albania (ALB)	Ecuador (ECU)	Montenegro (MNE)	Costa Rica (CRI)	Average
Panel A: As Percentage of Baseline, After a Three[Five]-Month Lockdown											
CIT Revenue Loss	22.2	29.4	24.7	37.4	15.8	51.2	34.4	35.1	38.4	60.2	34.9
	[35.0]	[44.1]	[35.8]	[51.8]	[24.6]	[65.8]	[48.5]	[49.7]	[54.7]	[71.0]	[48.1]
Payroll Tax Revenue Loss	3.2	4.9	5.2	6.3	NA	8.9	3.9	5.4	7.4	11.1	5.8
	[6.9]	[10.5]	[9.6]	[12.0]	NA	[18.1]	[8.5]	[11.3]	[14.8]	[20.6]	[11.7]
VAT Revenue Loss	11.0	12.0	11.9	10.2	10.3	13.6	9.0	11.2	12.5	13.6	11.5
	[18.4]	[20.0]	[19.8]	[17.1]	[17.2]	[22.6]	[15.1]	[18.7]	[20.8]	[22.6]	[19.2]
Increase in Firms' Losses	77.4	1.3	21.3	8966.5	48.3	117.8	100.8	172.0	86.1	1629.0	1122.0
	[164.2]	[2.7]	[38.9]	[16444.3]	[112.0]	[251.5]	[241.8]	[356.0]	[176.5]	[3127.4]	[2091.5]
Panel B: As Percentage of GDP, After a Three[Five]-Month Lockdown											
CIT Revenue Loss	0.9	0.4	0.1	0.7	0.5	0.8	0.6	0.8	0.5	1.0	0.6
	[1.5]	[0.6]	[0.1]	[1.0]	[0.8]	[1.0]	[0.8]	[1.1]	[0.8]	[1.2]	[0.9]
Payroll Tax Revenue Loss	0.0	0.0	0.0	0.1	NA*	0.3	0.2	0.1	0.4	0.6	0.2
	[0.1]	[0.1]	[0.0]	[0.2]	[NA]	[0.6]	[0.5]	[0.2]	[0.9]	[1.2]	[0.4]
VAT Revenue Loss	0.4	0.6	0.4	0.5	0.4	0.6	0.7	0.7	1.5	0.6	0.7
	[0.7]	[1.0]	[0.7]	[0.9]	[0.7]	[1.1]	[1.2]	[1.2]	[2.4]	[1.0]	[1.1]
Increase in Firms' Losses	0.8	0.8	0.7	3.9	0.4	5.3	1.6	2.1	3.8	9.4	2.9
	[1.7]	[1.7]	[1.3]	[7.2]	[1.0]	[11.3]	[3.8]	[4.4]	[7.9]	[18.1]	[5.8]
Total Tax Loss = CIT+Payroll+VAT	1.3	1.0	0.5	1.3	0.9	1.7	1.5	1.6	2.4	2.2	1.5
	[2.3]	[1.7]	[0.8]	[2.1]	[1.5]	[2.7]	[2.5]	[2.4]	[4.2]	[3.4]	[2.5]
Tax Losses + Firms' Losses	2.2	1.8	1.2	5.2	1.3	7.0	3.1	3.7	6.2	11.7	4.4
	[3.9]	[3.4]	[2.1]	[9.1]	[2.5]	[13.9]	[6.3]	[6.9]	[12.0]	[21.5]	[8.2]

Note: This table displays predicted tax revenue losses and the increase in firms' losses, as a percentage deviation from the baseline (last year available in the micro data) in Panel A, and as a percentage change of GDP in the baseline year in Panel B. *Eswatini does not levy payroll taxes.

The third row provides an estimate of lost revenue from the VAT. While we do not work with VAT data directly, we simulate taxable value-added as sales minus material inputs.[12] Since firms adjust their material costs proportionally to the shock, our estimated drop in value-added is exactly proportional to the size and duration of the revenue shock. Annual VAT revenue drops on average by 12% (19%) of its baseline value. This leads to a 0.7% (1.1%) drop in tax revenue as a percentage of GDP on average across countries.[13]

The fourth row of table 2 shows the increase in losses accumulated by firms over the year. The absolute

[12] In some countries, a share of the fixed costs—for example machinery—can be deducted from the VAT. Therefore our simulated value added might be too large. To account for this, we obtain the effective VAT rate as the tax rate which, when multiplied by our simulated value-added, equals the official VAT collection at baseline. The average effective VAT rate in our sample is 19%.

[13] The VAT loss calculation assumes that, when sales minus materials costs < 0 in a particular month, the firm pays no VAT that month, but does not "carry forward" the difference between sales and material costs in month t as a deduction in month $t+1$. As firms are normally allowed to carry forward negative value-added for some time, this is a simplification which may lead us to under-estimate the true VAT loss.

increase in losses as a percentage of GDP is 2.9% (5.8%) on average with the three-month shock (five-month shock).[14] This suggests that firms need to substantially increase borrowing to survive. Our numbers provide an estimate for the size of additional loans and credit lines required to support firms. The large increase in losses also implies large drops in CIT revenue in future years, as most countries allow firms to deduct losses from previous years from their CIT base.

We sum up the reductions in tax revenue to estimate the size of the hole in the government budget and hence the additional financing required. This is obviously a lower bound, as we consider only three main taxes remitted by firms, and do not account for large expected losses in trade taxes and personal income taxes. The drop in taxes remitted by corporations is predicted to reach 1.5% (2.5%) of GDP in 2020, under the three-month revenue shock (five-month shock). This is substantially larger than the size of typical IMF or World Bank budget support loans. In addition, if the government aims to cover all corporate sector losses by offering credit to firms, it would need to borrow an additional 2.9% (5.8%) of its GDP. Thus, a government with a balanced budget at baseline would need to borrow 4.4% (8.3%) of its baseline GDP to fully cushion the formal corporate sector and its workers from this unexpected shock. Overall, our estimates imply very large increases in borrowing, and suggest that lower-income countries with limited access to international capital markets require substantially increased budget support from donors to compensate for the massive loss in tax revenue.

Finally, our results are heterogeneous across countries: the poorest countries in our sample are on average less impacted. The average loss in tax revenue in the five Sub-Saharan African countries in our sample is 1.0% (1.7%) of their baseline GDPs, while it is 1.9% (3.0%) for the five middle income countries. What explains the differences across development levels? First, the formal sector is substantially larger, as a share of GDP, in richer countries, which therefore have more to loose. Second, effective tax rates are on average higher. This is evident for payroll taxes, which are very low in poor countries, and to some extent for the VAT. Third, the industrial composition of middle-income countries implies on average a slightly larger shock, as services (e.g. tourism) are more impacted than agriculture and manufacturing. The positive correlation between budget support needs and a country's income level is good news in difficult times, as richer countries have more fiscal space to manage the crisis. However, some increase in either budget support or borrowing from financial markets will be needed in almost all low- and middle-income countries.[15]

[14] While we report the increase in absolute losses as a percentage of baseline losses, this number is not always well defined. This is especially the case in countries where loss carry-forwards are limited such as Costa Rica and Senegal, and where initial losses reported were small.

[15] The question of whether financing options are sufficient, and whether they would allow countries to balance their budgets while keeping debt levels and interest payments sustainable, is beyond the scope of this paper.

5 Conclusion

We use administrative corporate tax records from 10 low- and middle-income countries to simulate how the COVID-19 pandemic impacts firm profits and tax payments. Modeling the lockdown-triggered revenue shock with simple and transparent assumptions, we predict that less than half of all firms will remain profitable by the end of 2020, about 5-10% of the aggregate annual payroll is lost, and exit rates double. We then show that payroll subsidies are unlikely to protect formal employment, especially in lower-income countries. Overall, we expect that governments' tax revenue shortfalls from the corporate sector will reach at least 1.5% of baseline GDP, and that tax revenue losses as a share of GDP are larger in richer countries.

Our study illustrates the benefits of using harmonized administrative tax data across countries for just-in-time policy advice. This work is part of an effort to make such data more widely used in comparative policy analysis. Our simulations will be improved in the coming months with the release of monthly and quarterly data (notably on VAT payments). This will allow us to refine the calibration of sector-specific demand shocks based on realized shocks. After corporate income tax declarations for 2020 are filed, we will also be able to compare our predictions to realizations, and to analyze the shortcomings of the simple assumptions we imposed.

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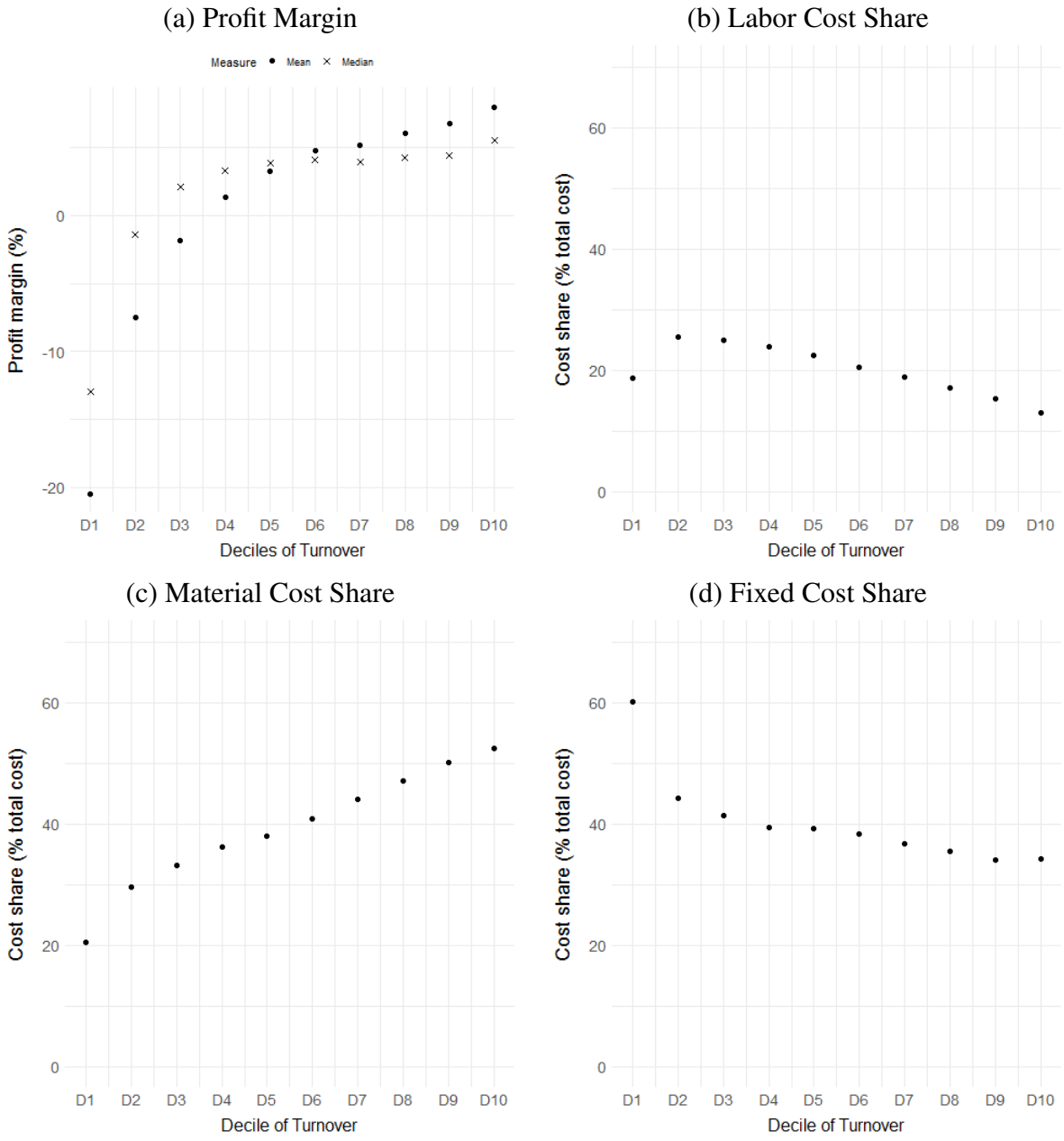
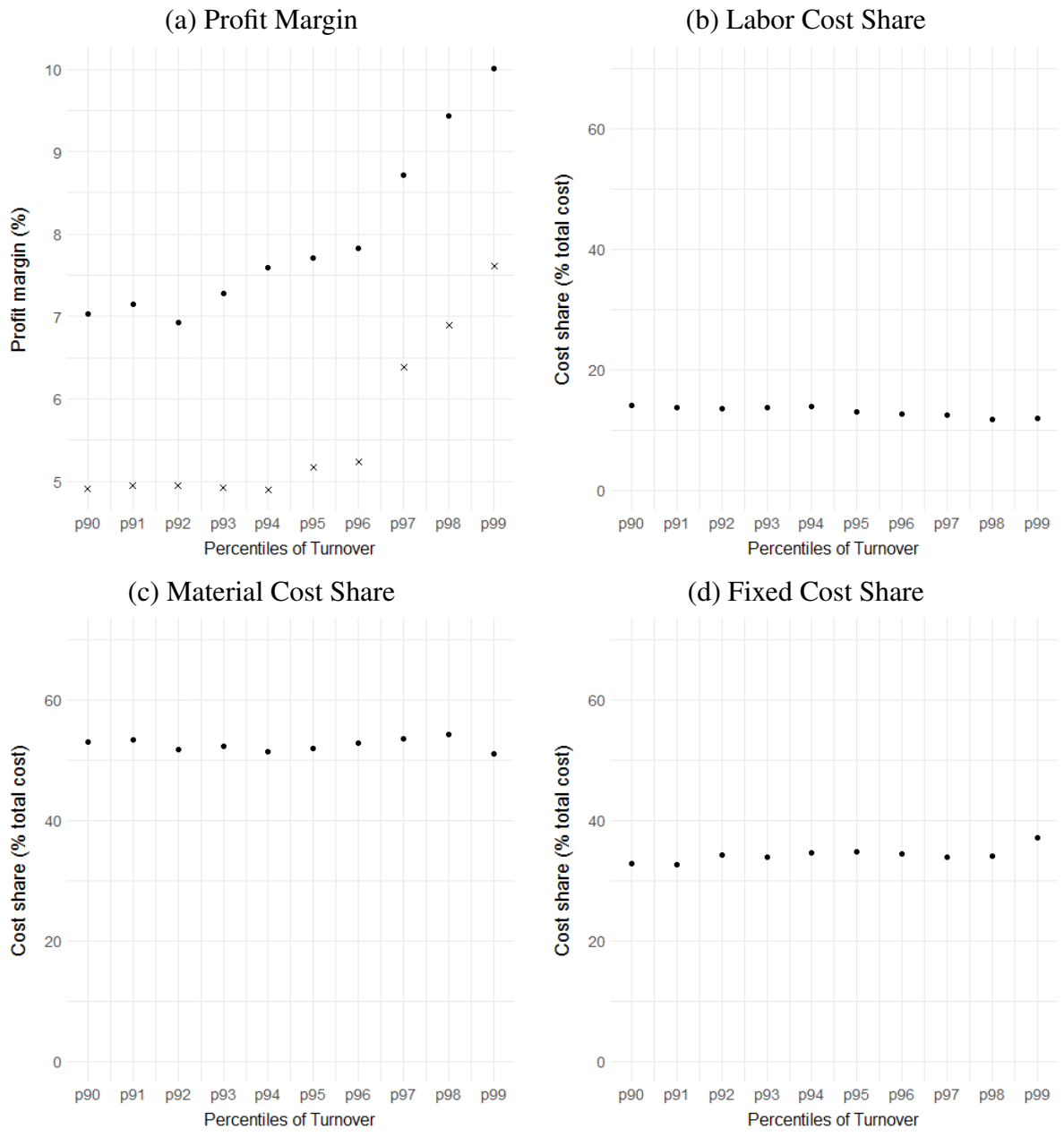
Appendix

Figure A.1: Firm Size, Profit Margin, and Cost Shares (Average Across Countries)



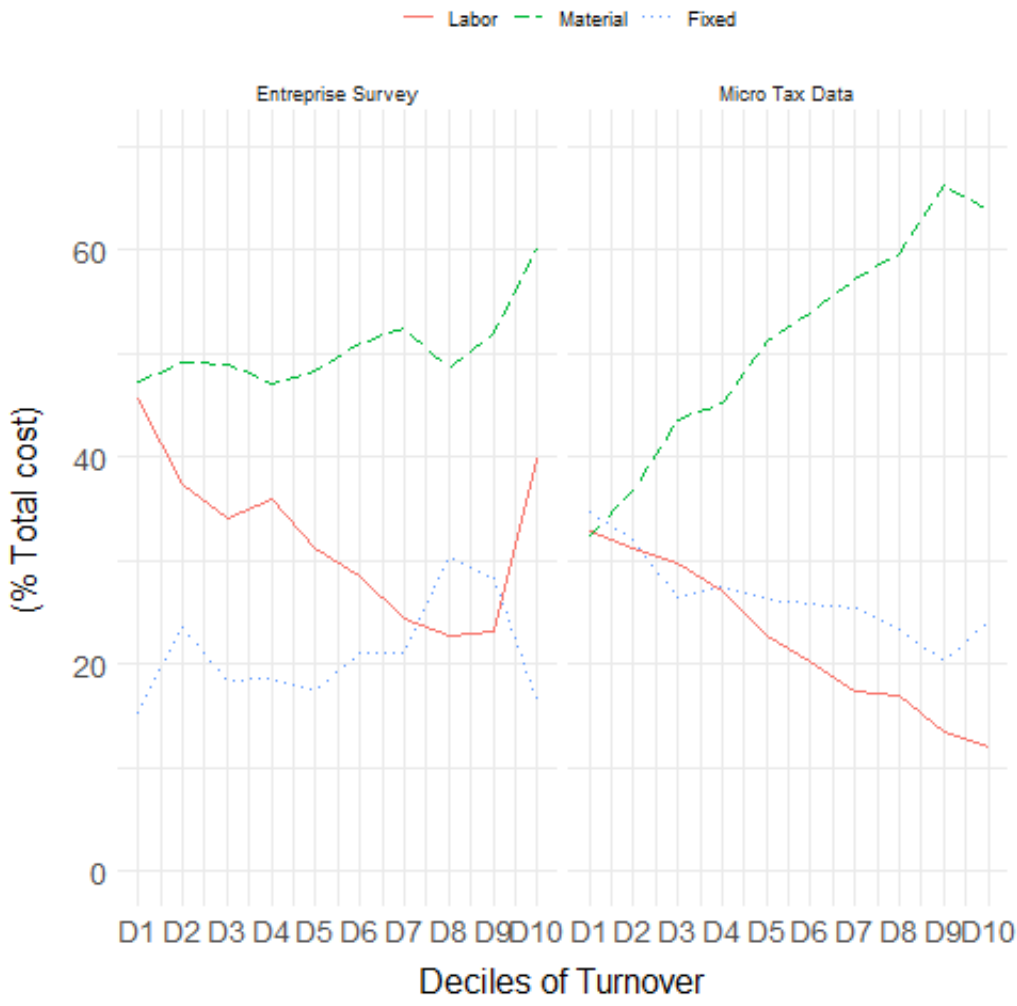
Note: This figure displays firms' profit margin, labor cost share, material cost share and fixed cost share by turnover deciles, as discussed in Section 2.1. The profit margin and cost shares are a simple average across countries (giving each country equal weight). This is based on administrative tax data from the ten countries listed in Table 1.

Figure A.2: Firm Size, Profit Margin, and Cost Shares (Average Across Countries), Top Decile Only



Note: This figure is identical to Figure A.1, but zooms in on turnover percentiles within the top decile of firms.

Figure A.3: Comparison of Cost Shares in Survey Data and Administrative Tax Data



Note: This figure shows the labor, material and fixed costs shares as percentage of total costs for firms in the manufacturing sector, for the World Bank Enterprise Survey (left) and our administrative tax data (right), as discussed in Section 2.1. The countries included are Costa Rica, Ecuador, Guatemala, Montenegro and Senegal, which are represented in both datasets. In the World Bank Enterprise Survey Data, cost details are available only for firms answering the Manufacturing Module (ISIC Rev.3.1: 15-37).

Table A.1: Impact Sector Categories

SECTORS (ISIC Rev 3 code)	Impact Category	
A AGRICULTURE, FORESTRY AND FISHING	Low Impact	
B MINING AND QUARRYING	Low Impact	
C MANUFACTURE*	Low Impact (Food, beverages, tobacco; basic pharmaceutical products)	Medium Impact (Non-essential products)
D ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY	Medium Impact	
E WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES	Medium Impact	
F CONSTRUCTION	Medium Impact	
G WHOLESALE AND RETAIL TRADE**	High Impact (Non-essential retail)	Low Impact (Essential retail)
H TRANSPORTATION AND STORAGE	High Impact	
I ACCOMMODATION AND FOOD SERVICE ACTIVITIES	High Impact	
J INFORMATION AND COMMUNICATION	Low Impact	
K FINANCIAL AND INSURANCE ACTIVITIES	Medium Impact	
L REAL ESTATE ACTIVITIES	Medium Impact	
M PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES	Low Impact	
N ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES	Low Impact	
O PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY	Low Impact	
P EDUCATION	Medium Impact	
Q HUMAN HEALTH AND SOCIAL WORK ACTIVITIES	Low Impact	
R ARTS, ENTERTAINMENT AND RECREATION	High Impact	
S OTHER SERVICE ACTIVITIES	High Impact	

Note: Impact sectors categories are defined at the ISIC rev 3 4-digits level, based on Vavra (2020). For some countries (Guatemala, Ethiopia and Uganda), we only have the ISIC rev 3 codes with 2 digits. In this case, we cannot separate manufacturing* of essential products (not affected by lockdown) from manufacturing of non-essential ones (highly impacted), and similarly for wholesale and retail trade** of essential and non-essential products. Those sectors are then categorized as medium impact sectors.

Table A.2: Distribution of Firms Across Impact Groups

	Uganda (UGA)	Ethiopia (ETH)	Rwanda (RWA)	Senegal (SEN)	Eswatini (ESW)	Guatemala (GTM)	Albania (ALB)	Ecuador (ECU)	Montenegro (MNE)	Costa Rica (CRI)	Average
High Impact (%)	17	9	31	30	27	13	13	29	35	30	23
Medium Impact (%)	60	38	18	17	30	73	28	27	28	50	37
Low Impact (%)	23	54	50	53	44	14	59	44	37	20	40
Avg. Simulated Output Loss (%)	51	38	50	49	50	52	39	51	56	59	50
Avg. Simulated Output Loss (%, Weighted by Turnover)	48	47	42	42	41	51	34	46	49	56	46
Avg. [Med] Turnover	1292	1982	509	3880	374	2710	1101	2118	523	673	1516
(Thous. USD)	[51]	[73]	[78]	[213]	[34]	[184]	[178]	[136]	[41]	[69]	[106]

Note: This table displays the share of firms in the high, medium and low impact sectors (rows 1-3) in the ten countries we study. The details of how we allocate sectors to impact groups are displayed in Table A.1. Rows 4 and 5 repeat the average simulated output shock from Table 1, which is determined by the sectoral composition of the economy, by our assumption that firms in the high/medium/low impact group experience a 100%/50%/20% revenue loss during the lockdown, and (for the weighted average in row 5) by the average firm size (turnover) in each impact group. Firms' average [median] turnover is shown in the bottom row.

Table A.3: Share of Firms Remaining Profitable Under Different Adjustment Scenarios

	UGA	ETH	RWA	SEN	ESW	GTM	ALB	ECU	MNE	CRI	Average
	Three-Month Lockdown										
No Adjustment	23.0	39.2	12.7	16.3	41.3	14.2	40.6	22.6	22.7	31.9	26.5
Material Adjustment	50.5	50.6	54.9	24.8	58.6	33.7	61.2	35.3	34.3	37.7	44.2
Material+Labor Adj.	54.9	58.7	57.3	29.7	64.2	47.6	70.7	48.3	42.0	49.1	52.3
	Five-Month Lockdown										
No Adjustment	15.0	27.8	7.0	10.7	31.6	8.7	26.1	14.6	16.1	23.1	18.1
Material Adjustment	42.6	40.4	50.6	18.7	51.1	24.8	49.5	25.4	26.5	26.8	35.7
Material+Labor Adj.	47.7	50.6	53.7	23.0	59.5	39.5	60.1	39.3	35.0	38.2	44.7

Note: This table displays the share of firms that remain profitable under different adjustment scenarios, as per the row titles. The material and labor cost adjustment mechanisms are discussed in Section 3.

Table A.4: Aggregate Annual Payroll Loss Under Different Wage Subsidy Scenarios

	UGA	ETH	RWA	SEN	ESW	GTM	ALB	ECU	MNE	CRI	Average
	Three-Month Lockdown										
No subsidy	3.2	4.9	5.2	6.3	2.0	8.9	3.9	5.4	7.4	11.1	5.8
50% Subsidy	2.5	4.2	4.0	5.1	1.1	5.6	2.0	3.8	5.9	10.1	4.4
90% Subsidy	2.2	3.9	3.3	4.8	0.8	4.2	1.5	3.0	5.0	9.2	3.8
	Five-Month Lockdown										
No Subsidy	6.9	10.5	9.6	12.0	5.0	18.1	8.5	11.3	14.8	20.6	11.7
50% Subsidy	5.4	8.8	7.5	10.1	2.6	11.0	6.3	7.8	12.2	19.1	9.1
90% Subsidy	4.7	7.6	6.2	9.3	2.0	8.2	3.5	6.2	10.6	17.2	7.6

Note: This table displays the aggregate payroll loss, as a share of the annual wage bill, under different wage subsidies, as discussed in Sections 3.2 and 4.1.

Table A.5: Average Annual Payroll Loss, No Wage Subsidy

	UGA	ETH	RWA	SEN	ESW	GTM	ALB	ECU	MNE	CRI	Average
Three-Month Lockdown	5.6	4.7	5.0	9.7	4.2	7.8	4.3	8.0	8.0	9.4	6.7
Five-Month Lockdown	11.2	9.7	9.5	17.2	8.8	15.1	9.2	15.6	15.5	18.5	13.0

Note: This table displays the average annual payroll loss, when there is no wage subsidy, as discussed in Sections 3.2 and 4.1. We calculate the average annual payroll loss for each firm as a percentage change from the baseline payroll, and then take a simple average across firms.

Table A.6: Increase in Firms' Exit

	UGA	ETH	RWA	SEN	ESW	GTM	ALB	ECU	MNE	CRI	Average
Three-Month Lockdown	89.7	57.9	56.8	79.5	66.3	98.7	145.3	194.1	47.0	283.2	111.8
Five-Month Lockdown	119.8	90.2	71.2	92.5	96.3	125.5	218.0	238.0	64.1	350.0	146.6

Note: This table displays the increase in firms' exit rates, as percentage of the pre-2020 average exit rate, as discussed in Section 3.3.

Table A.7: Tax Rates

	UGA	ETH	RWA	SEN	SWZ	GTM	ALB	ECU	MNE	CRI	Average
CIT (%)	30.0	30.0	30.0	30.0	27.5	25.0	15.0	22.0/25.0	9.0	10.0/20.0/ 30.0	21.0
VAT (%) Statutory rate	18.0	15.0	18.0	18.0	15.0	12.0	20.0	12.0	21.0	13.0	16.2
VAT (%) Effective rate	11.7	31.2	55.1	8.5	20.2	11.7	14.3	13.6	14.7	6.2	18.7
Payroll (%)	15.0	18.0	8.0	21.0	NA	17.5	27.9	11.2	25.5	37.2	18.1

Note: This table displays the statutory CIT rate, the statutory VAT rate, the effective VAT rate [aggregate VAT revenue/(turnover-material costs)], and the statutory payroll tax rate (the sum of social security contributions paid by the employer and the employee). The effective VAT rate and the statutory payroll tax rate are used in the calculation of tax revenue losses, as described in Section 4.2, with results displayed in Table 2.