Employment Opportunities and Income Sources in the Face of the COVID-19 Pandemic: Panel Data Evidence from Ethiopia

Mehari H. Abay
Independent Consultant
Addis Ababa, Ethiopia
Email: hilufabay@gmail.com; Phone: +251-914-303494

Abstract

We examine the implication of the COVID-19 pandemic on employment opportunities and income sources by combining the Ethiopia LSMS-ISA pre-COVID-19 face-to-face survey data with post-COVID-19 high-frequency phone surveys and applying a difference-in-differences approach. We show how the pandemic is associated with labor market participation and livelihood sources in Ethiopia. The results show that COVID-19-related mobility restrictions have reduced employment activities with disproportionate job losses among vulnerable groups such as women, youth, and informal workers. We also find that the number of confirmed COVID-19 cases is associated with significant reduction in employment. Our estimations show that doubling the number of COVID-19 cases is associated with a 5.4 percentage points decrease in employment rates, on average. Our results consistently show that the employment shocks due to the COVID-19 pandemic was sharp and more pronounced in April 2020, and most households reported job losses and income reductions more in that month. The results have important policy implications that underline the importance of social protection interventions to support the vulnerable groups during the pandemic, as well as labor market interventions to cover them through formal employment protection laws.

Keywords: Labor market, COVID-19, informal employment, Ethiopia

1. Introduction

The COVID-19 pandemic has triggered various mobility restrictions taken to control spread of the infections in many countries. These measures have disrupted economic activities and reduced employment and livelihood activities of individuals and households around the world (Abay et al., 2021; Amare et al., 2021; Arndt et al., 2020; Bene et al., 2021; Egger et al., 2021; Josephson et al., 2020; Liverpool Tasie, 2021; World Bank, 2020). As the COVID-19 pandemic spreads worldwide, the big challenge in addition to the health risk have been the disruptions on the economy, particularly the adverse impacts on employment and income of households. Looking at the context of Ethiopia, the first COVID-19 case in the country was confirmed on March 13, 2020 in Addis Ababa. It has since spread to all 11 regions of the country, and there has been an upsurge of cases and deaths afterwards. To slow the spread of the pandemic, the Ethiopian federal government put in place several measures including restrictions on movement of people, which apparently affected the livelihood activities of citizens.

We examine the implications of the spread of the COVID-19 pandemic on employment opportunities and income sources by applying a difference-in-differences approach using a nationally representative panel dataset from Ethiopia. The LSMS-ISA panel data combined pre-COVID-19 baseline data and post-COVID-19 high-frequency-phone-survey data. The pre-pandemic data was collected in August 2019 using in-person household survey, and the post-pandemic data was collected monthly during April 2020–October 2020 using phone survey. The LSMS-ISA panel data provide detail information on employment and income sources before and after the pandemic. In addition, we compiled region-level COVID-19 cases data for all regional states in Ethiopia during the study period, April 2020–October 2020 from the weekly reports by Ethiopia Public Health Institute (EPHI 2020).[1]

As COVID-19 survey data are becoming available, there is a growing literature on impacts of the pandemic, and several studies have analyzed the adverse effects of the COVID-19 pandemic on labor market and livelihood outcomes in different contexts and countries (See for example, Balde et al., 2020; Egger et al. 2021; Josephson et al., 2020; Klassen and Murphy, 2020; Bussolo et al., 2021). Growing studies have been also conducted in various African countries (See for example, Abay et al., 2021; Amare et al., 2021; Zidouemba et al., 2020;

[1] Our analysis mainly covers the period until October 2020 with six rounds of the post-COVID-19 follow-up phone survey data. After the October 2020, the COVID-19 cases data is not complete and available for Tigray region due to the ongoing war that broke out in November 2020.

Makoni and Tichaawa, 2021; Durizzo et al., 2021). There is an increasing concern that the COVID-19 pandemic more adversely impacts vulnerable groups such as women, youth and informal workers, and it may have particularly exacerbated pre-existing unemployment rates because these groups are more likely to work in the less protected sectors as temporarily and casual workers (Adams-Prassl, 2020; ILO 2020a and 2020b). The emerging new evidence from Africa suggests that informal workers are adversely affected by COVID-19 pandemic (Balde et al., 2020; Josephson et al., 2020). For instance, Josephson et al (2020) find that non-farm income sources are most affected by lockdown policies, and Balde et al. (2020) find that lockdown measures in Mali, Senegal, and Burkina Faso increased job loss rates for informal workers of between 33 percent and 48 percent.[2]

This paper contributes to the growing evidence on the impact of the COVID-19 crisis on employment in the context of developing economies, particularly in sub-Saharan Africa. We assess the implication of the pandemic on employment in Ethiopia, where the problem of unemployment is major policy challenge. Even prior to the pandemic there was a pre-existing pressure on employment creation due to the massive population growth and youth bulge which is challenging the absorption capacity of labor markets—youth are three times more likely to be unemployed than those of adult counterparts (Filmer and Fox, 2014; ILO, 2018). In addition, informality remains a major characteristic of employment in Ethiopia, especially in urban areas (JCC, 2020). The Jobs Creation Commission also notes that in addition to the informal wage job, informal non-wage job or informally self- employed is still dominant. For instance, in the service sector, where the COVID-19 is expected to hit hard, 1.9 million workers out of 2.8 million are informal workers (Cancedda et al., 2020, JCC, 2020).

In this paper we examine the implication of the spread of the pandemic on employment and income sources of household heads during post-COVID-19 period, April 2020–October 2020. We also show the dynamic associations looking at the recovery over time as the stringency of the pandemic-related restrictions gradually relaxed across regions in Ethiopia. The more strong restrictions were imposed in April 2020 and eased in the subsequent months between May and October 2020, particularly the State of Emergency was lifted in September 2020. Our descriptive results show that the COVID-19 pandemic has triggered employment losses among all groups of household heads irrespective of their location, gender, age, and employment type.

[2] We thank the reviewer for bringing to our attention some of the literature.

However, employment of the female, younger, and informally employed household heads have fared worse compared to their counter parts, especially during the onset of the pandemic in April 2020. The COVID-19-related employment and income losses are also higher among the urban households engaged in informal non-farm family business and informal wage employment. Our DID estimation results also show that the number of confirmed COVID-19 cases is negatively associated with employment rates. For example, doubling the number of COVID-19 cases is associated with a 5.4 percentage-points decrease in employment rates. We find that the spread of the COVID-19 infections was significantly and negatively associated with employment outcome in April 2020, but this association was quickly reversed in the subsequent months starting from May 2020. Our results consistently show that the employment shocks due to the COVID-19 pandemic was sharp and more pronounced in April 2020, and most households reported job losses and income reductions more in that month. Further, informal workers have suffered the largest and significant declines in employment in all rounds during April 2020–October 2021, compared to the reference employment group (formal wage workers). On average, informal workers have suffered highest job loss between 13-19 percentage points higher than that of formal workers during Apr–Oct 2020. The results show that the speed of recovery for informal workers was differentially slow, and most strikingly, their employment levels did not fully recovered until October 2021. This suggests that the employment impact of the COVID-19 pandemic on informal workers is less likely to span short compared to the formal workers.

Our findings have important policy implications. First, we show that COVID-19 reduced employment activities and upsurge job losses of vulnerable groups such as women, youth and informal workers. This underlines the importance of social protection interventions to support the vulnerable groups during the pandemic, as well as labor market interventions to cover them through formal employment protection laws. The job losses are also concentrated more in urban areas relative to those in rural areas. This also highlights the need for effective and timely social protection programs in urban areas to respond to the employment and income loss of the vulnerable informal workers during the pandemic. Finally, our research contributes to the emerging policy debates on informal sectors (ILO 2019; IMF 2021). We note the relevance of considering location, demographic characteristics and types of employment in developing labor market interventions to protect and promote vulnerable groups in the labor market.

The rest of the paper is organized as follows. Section 2 discusses the context and reviews the literature on the impact of the COVID-19 pandemic. Section 3 describes the data and presents the descriptive results. Section 4 outlines the empirical estimation strategy. Section 5 presents the estimation results and discussion. Section 6 concludes.

2. Context and Impact of the COVID-19 Pandemic in Ethiopia

Looking at the context of Ethiopia, the first COVID-19 case in the country was confirmed on March 13, 2020 in Addis Ababa. It has since spread to all 11 regions of the country, and there has been an upsurge of cases and deaths afterwards. To slow the spread of the pandemic, the Ethiopian federal government put in place several measures including restrictions on movement of people, which apparently affected employment and livelihood activities. On mid-April 2020, the parliament has declared a five-month state of emergency in an effort to limit the spread of the disease. The measures taken impose a number of restrictions on activities and movement although they do not constitute a full lockdown. In addition, no national generalized lockdown has been declared, only local ones. There have been bans on gatherings and public events and travel restrictions, closure of restaurants and cafés in some regions. As a result, the measures have been varied from one region to the other. So the stringency of the measures varied across regions and time. As it will be discussed in the method section below, we estimate the impact of the COVID-19 conditional on regional trends by controlling for region and round interactions. The lockdown measures restrict movement of people and vehicles except for health personnel, fire service, security personnel, power and water supply agencies, pharmaceutical and medical services. We note that, although lockdown policies involve similar mobility restrictions, their implementation and stringency are likely to vary across regions and time, which may introduce heterogeneity in the impact of these mobility restrictions.

Specifically, the Government had imposed relatively little restrictions compared to neighboring countries. At 76/100, the Government's COVID-19 Response Stringency Index is relatively average. However, Ethiopia, like other SSA countries, is expected to see increased unemployment and decreased income from employment for many workers, as a result of COVID-19 crisis. Early estimates for the country shows that a 10-15 percent loss of employment livelihoods, which could have major effects leading to a cumulative loss of perhaps 1.6 - 2.4 million jobs depending on the severity and duration of the crisis, mostly in urban areas (JCC

2020). The IMF also projected Ethiopia's real GDP growth will be 3.2% in 2020 and 4.3% in 2021.

There are reports that job losses will be higher in sectors employing a high level of informal sectors, and in contrast to urban areas, the employment impacts of the pandemic are likely to remain small in rural Ethiopia. The LSMS-ISA phone survey conducted in April showed that about 18 percent of urban respondents and 10 percent of rural respondents reported that they had lost their job since the onset of the pandemic (Wieser et al. 2020a). However, nearly 40 percent of those who lost their job during this period attributed the job loss to non-pandemic reasons, primarily the seasonal or temporary nature of the work (Wieser et al. 2020a). However, these reports did not identify the employment trends and the magnitude of the employment loss in casual identification. To address this caveat, we estimate the impacts of the pandemic using rigorous method and identify the causal impacts. These studies also show that job losses were highest in hospitality, construction, and wholesale/retail sectors and were most likely to be reported by casual workers, private sector employees, and self-employed people (Wieser et al. 2020a). Thus, we estimate the impacts conditional on employment occupation and industry. We measure the dynamic effects of the pandemic on individual household heads' employment status during the period April–October 2020. The onset month of the mobility restrictions in Ethiopia was April 2020 but the restrictions have been gradually eased in subsequent month, particularly the five month State of Emergency declared by the government in April 2020 was relaxed in September 2020. We then examine the role of the spread of the COVID-19 pandemic in each region in exacerbating job losses overall during April-October 2020 and as the stringency of the restrictions varies in each round.

Our paper focuses both on the overall and heterogeneous implications of the pandemic based on household head's gender, age, employment type, and geographic location (i.e., rural and urban). Our analysis is also based on the aggregate implications during the study period, particularly, April-October 2020 period as well as the dynamic implications across time, which also shows the changes in outcomes associated with the COVID-19 restrictions and stringency variations in each month. In relation to this, a recently growing COVID-19 literature show that the economic impact of the pandemic varies across demographic groups, employment type, occupation and sectors (Adams-Prassl et al., 2020; Amare et al., 2021; Bussolo et al. 2021).

Further, informal firms that have not been supported by banks or have not benefited from

government assistance may be particularly vulnerable to COVID-19-related business disruptions. In many cases these factors have been associated with job losses, reduced earnings and welfare, particularly for low-skill workers in informal sectors (Bussolo et al. 2021; Ranzani and Suet, 2020; Abebe and Wieser, 2021; Amankwah and Gourlay, 2021). However, rigorous empirical evidence on the impacts of the pandemic on labor market outcomes in the context of developing countries is still limited. Therefore, our paper contributes to this body of literature by assessing the overall and heterogeneous implications of the pandemic from developing countries context.

3. Data and Descriptive Results

3.1 Data

We use the World Bank's LSMS-ISA panel dataset collected in collaboration with Ethiopia Central Statistics Agency (CSA) before and after the outbreak of the COVID-19 pandemic. We combine pre-COVID-19 data collected in August 2019 via face-to-face survey with post-COVID-19 High-Frequency-Phone-Survey (HFPS) of households collected every 3-4 weeks between April 2020 and February 2021.[3] The pre-COVID-19 LSMS-ISA data is nationally representative and contained detailed information on employment, income and other socio-economic variables of panel households. After the outbreak of the pandemic, the LSMS-ISA program has initiated tracking of the baseline pre-COVID-19 samples interviewed in August 2019, and conducted ten-rounds of COVID-19 monitoring phone surveys during April 2020–February 2021 (see also Wieser et al. 2020a and 2020b). However, as of the start of the write up of this paper only six-round of the phone survey data was available. As a result, our analysis mainly uses the pre-COVID-19 data and these six-round phone survey datasets collected during April–October 2020. When the data for the latest rounds was available, we updated and combined the baseline data from August 2019 with all the ten rounds of post-COVID-19 panel data from the HFPS. This enables us to assess the implication of the COVID-19 pandemic in relatively long post-COVID-19 period, which is rare in the COVID-19 impact literature, especially from developing countries.

[3] World Bank. Ethiopia-COVID-19 High Frequency Phone Survey of Households 2020. Dataset downloaded from www.microdata.worldbank.org.

In the August 2019 survey, a total of 6,770 samples of households were interviewed. Out of these samples, 5,374 (79.3 percent) households provided at least one phone number. These households then established the sampling frame for the phone survey. To obtain representative sample, the target sample size for the phone survey was determined to be 3,300 households (Wieser *et al.*, 2020). These samples of households were selected for the phone survey to collect data that enable statistical monitoring of monthly changes in key outcomes of interest. Lastly, the panel households successfully contacted and interviewed in April 2020 constituted 3,247 households. Table A1 in the Appendix provides the number of panel households interviewed in each round (column 1), as well as the sample of panel household heads we use in our analysis (columns 2–4). In the follow up phone surveys the sample size has been declining, and by October 2020 the number of households interviewed reduced to 2,702 due to attrition. It is important to note that the LSMS-ISA panel dataset in our analysis contains sample households interviewed at least twice between August 2019 and October 2020. As we will discuss in detail below in the empirical strategy section, this enables us to conduct panel data analysis of the same households and their household heads. Particularly, we able to compare employment trajectory of household heads in post-COVID-19 periods, relative to the pre-COVID-19 period, and examine how the pandemic is associated with labor market participation outcome using variants of difference-in-differences estimation approach.

Further, to account for attrition and keep the representativeness of the sample, the LSMS-ISA team has created appropriate sampling weights that ensured sufficient comparability in the distribution of observable characteristics between the baseline and the follow-up phone surveys (Wieser et al. 2020a). We thus applied the sampling weights to recover appropriate and representative statistics in a way that account for the systematic non-responses in the phone surveys (Korinek et al., 2007; Wooldridge, 2007). We also use restricted balanced samples without weighting and crosscheck robustness of our results. For example, in some of our estimation we need to restrict the observations to the household heads who are employed at least once between August 2019 and October 2020 so that we control for time-specific occupation and industry fixed effects. As shown in Table A1, column 2, the number of household heads employed at least once between August 2019 and October 2020 are 3,023. Similarly, the number of household heads who were initially employed in August 2019 is 2,050. In the result section,

we show the robustness of our results to sample attrition and adjusting using the LSMS-ISA sampling weights.

Lastly, the number of confirmed COVID-19 cases is one of the explanatory variables in our analysis. We compiled region-level confirmed COVID-19 cases from the Ministry of Health (MOH) and Ethiopian Public Health Institute (EPHI) (EPHI 2020). We extract the number of confirmed COVID-19 cases up to the end of October 2020. As the post-COVID19 surveys are fielded in monthly frequency, we compiled the confirmed COVID-19 cases data for each month and regions in Ethiopia. Figure A1 in the Appendix presents the regional distribution of confirmed COVID-19 cases across rounds in Ethiopia. As expected, the confirmed COVID-19 cases vary across regions and round. We exploit these variations in our estimations and examine how the spread of the COVID-19 infections was associated with the labor market crisis in Ethiopia.

3.2 Descriptive Results

In this section we provide the definition of variables of interest and the descriptive results. The pre-COVID-19 survey in August 2019 collected information on participation in income-generating activities for household members. Each eligible member was asked to recall the participation in the income-generating activities in the 7 days preceding the survey. The major employment activities are agricultural work, non-farm family business, casual, part-time or temporary work, and work for wage, salary, or commission. In addition, the post-COVID-19 pandemic monitoring phone surveys from April 2020 to October 2020 collected similar information except that detailed individual-level employment questions such as the employment status, employer's information, employment industry and occupation are asked only about the household head.[4] So, our analysis is mainly based on the household heads panel data. In addition, the phone survey in April 2020 asked household heads to report their employment status in the month prior to the outbreak of the COVID-19 pandemic. Thus, the data in April 2020 also gives the employment status of the head in March 2020, which shows the employment status before

[4] The LSMS-ISA pre-COVID survey and post-COVID-19 phone surveys provide detailed individual employment data about household heads, while the post-COVID-19 phone surveys' employment data for other household members is aggregated at household level. That is, unlike to the LSMS-ISA survey in August 2019, which recorded individual-level employment information for all eligible household members, the phone surveys recorded only the employment arrangement of the household heads.

the onset of the pandemic. As a result, employment outcomes are observed in eight rounds from August 2019 to October 2020 in which the pre-COVID months include August 2019 and March 2020 and the post-COVID-19 months include April 2020, May 2020, June 2020, July/August 2020, September 2020, and October 2020. Hence, we combine these rounds and quantify the employment trends of household heads conditional on employment arrangement, industry, occupation and locations of employment.

Table 1 presents the weighted summary statistics of employment variables for the pooled sample overall and disaggregated by location, demographic characteristics (gender and age group), and employment categories. The variables location, gender, age group, and employment categories are based on the pre-COVID-19 status in August 2019. The overall proportion of employment for the household heads is shown to vary by location and gender, but not much by age group. That is, on average, the proportion of employed household heads is higher in rural areas than urban areas and among male household heads than female household heads, but not much difference between the younger and older household heads.

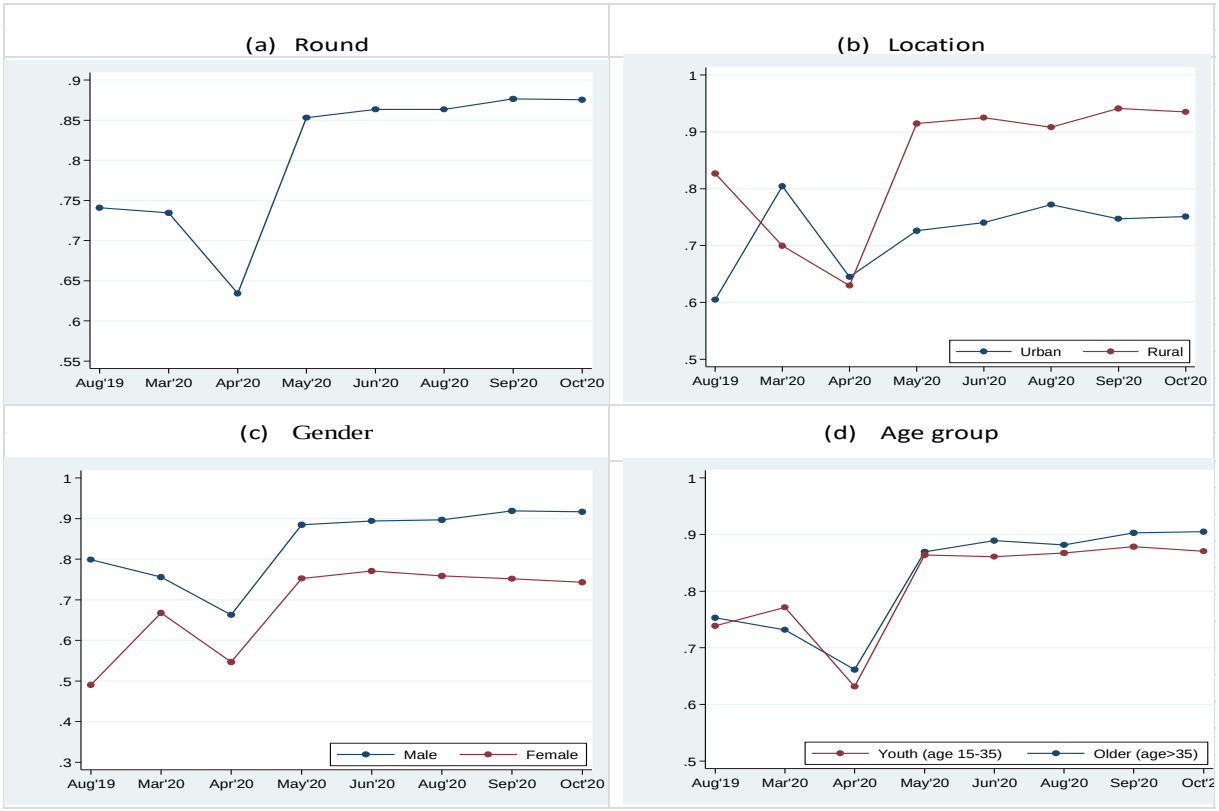
Table 1: Descriptive statistics, pooled sample

Variable	No. observations	Mean	S.D.	Definition
Overall	3,247	0.80	0.40	Proportion employed
Location				
Urban	2,270	0.72	0.45	Proportion employed in urban areas
Rural	997	0.84	0.37	Proportion employed in rural areas
Gender				
Male	2,251	0.84	0.37	Proportion of male employed
Female	996	0.68	0.47	Proportion of female employed
Age groups				
Youth	1,416	0.81	0.39	Proportion of youth (age 15–35) employed
Older	1,831	0.80	0.40	Proportion of older (age>35) employed
Employment categories				
Formal	408	0.88	0.33	Proportion employed in formal wage
Informal	416	0.85	0.36	Proportion employed in informal wage
Non-farm	456	0.83	0.38	Proportion employed in non-farm business
Farm	763	0.88	0.33	Proportion employed in farming

Source: Authors calculation based on Ethiopia LSMS-ISA August 2019 and HPPS 2020

Figure 1, Panel (a)–Panel (d), provides the employment trends overall and by location, gender, and age group, respectively. Both the overall and disaggregated employment trends in Panel (a)–Panel (d) clearly show sharp decline in employment rates of household heads in the onset of the pandemic (April 2020) compared to the period before, but quickly recovered in May 2020 and the following months. Therefore, after the pandemic-related restrictions were imposed in mid-March 2020, the employment trends showed a V-shaped recovery with quick fall in April 2020 and immediate recovery started in May 2020. Despite the recovery observed since May 2020, we note employment rates in urban areas remained below the employment rates before the outbreak of the pandemic (Figure 1, Panel (b)).

Figure 1: Employment rates by round, location, gender and age group

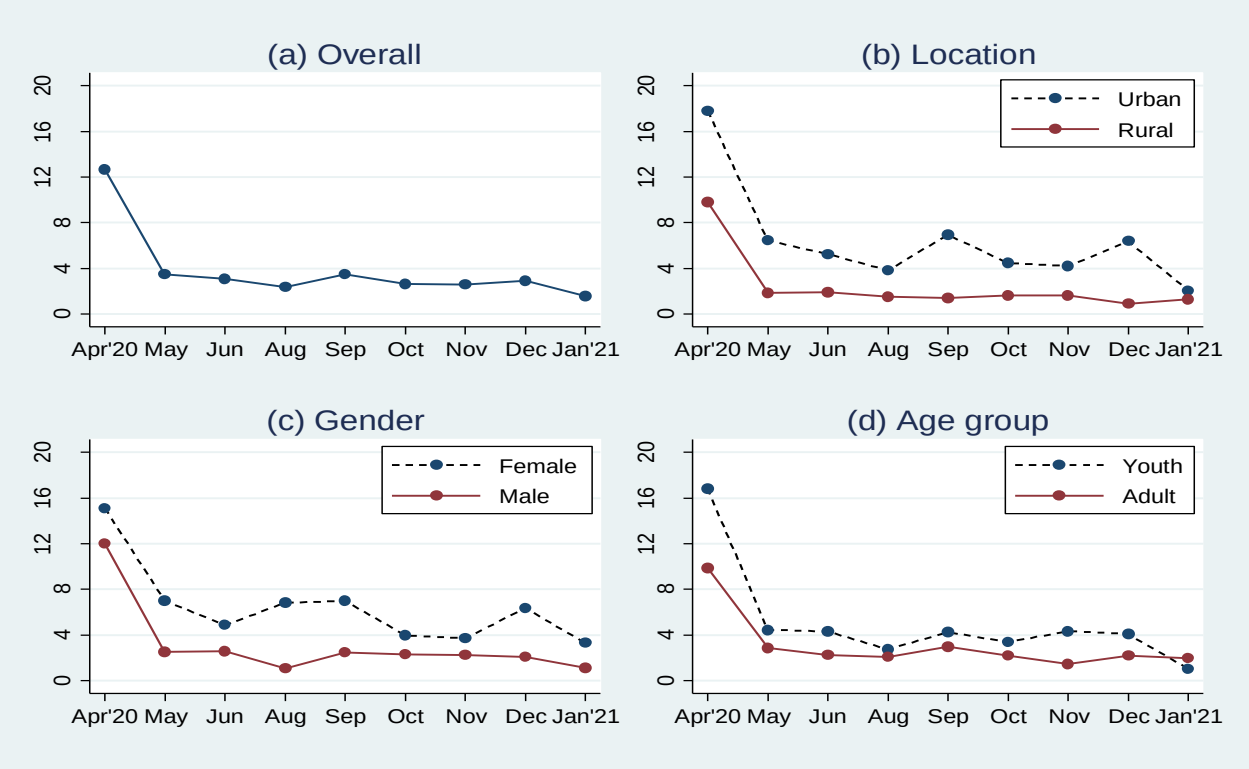


Source: Authors calculation based on Ethiopia LSMS-ISA August 2019 and HPPS 2020

Figure 2 shows the share of household heads with job loss during Apr 2020–Jan 2021, by location (Panel b), gender (Panel b), and age group (Panel c). The COVID-19 pandemic has triggered employment losses among all groups of household heads irrespective of their location, gender and age group. But employment of the urban, female and younger household heads have fared worse compared to their counter parts, particularly onset of the pandemic in April 2020

(Figure 2). While overall employment plunged by about 12 percent in April 2020, it fell sharply by about 18, 16, and 17 percent in the urban areas and among female and younger household heads, respectively.

Figure 2: Job loss by round, location, gender and age group

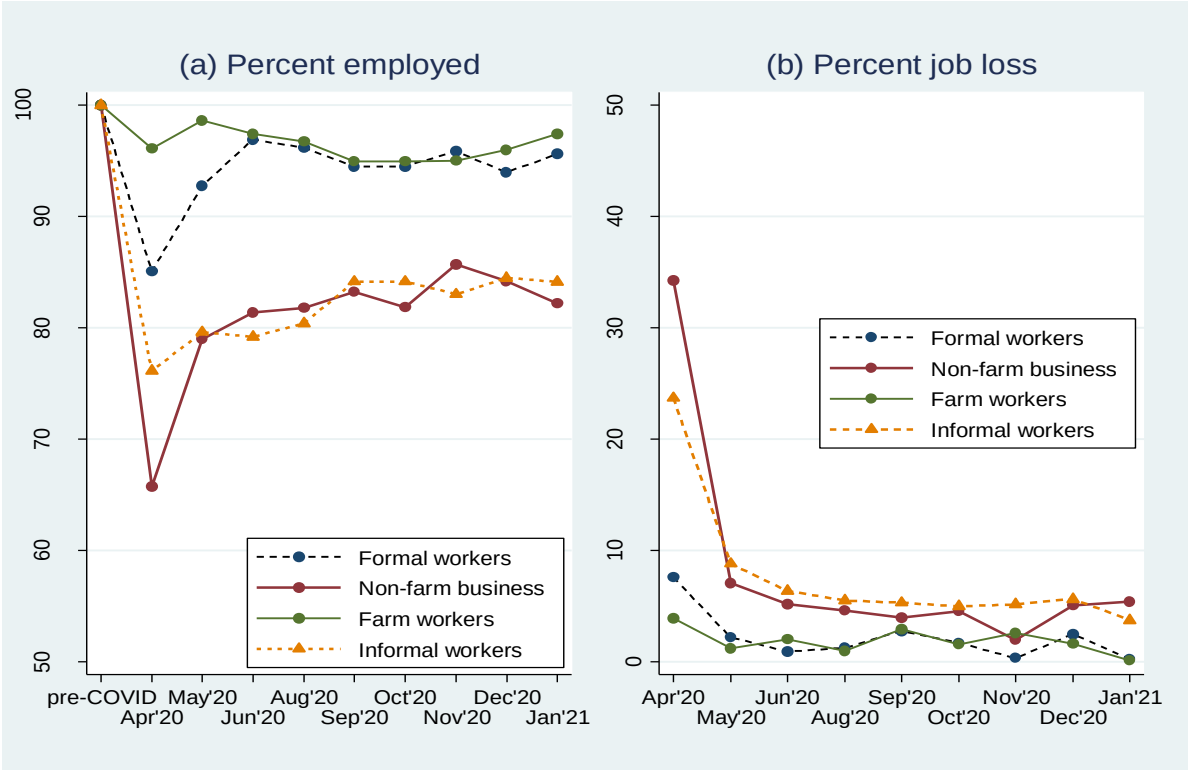


Source: Authors' calculation based on Ethiopia LSMS-ISA household phone survey data 2020-2021.

In relation to employment types and workers category, we define those who work as casual or temporary or private sector wage employees as informal workers. We have also alternatively defined informal work as working casual/temporary wage or working informally without written contract with employers (ILO 2013). Looking at the employment trends disaggregated by the initial employment categories of the household heads, Figure 3 below indicates that the job losses during the pandemic are much higher among the non-farm family business workers and informal workers than among farming and formal workers. In April 2020, when the Ethiopian parliament declared a State of Emergency (SOE) to slow spread of the COVID-19 cases, all types of employment activities have dropped sharply (Figure 3, Panel (a)). However, the job loss among the initially self-employed non-farm family business and informal wage workers was substantially higher, compared to the formal wage workers and self-employed

farm workers (Figure 3, Panel (b)). In April 2020, the number of household heads employed prior to the outbreak of the pandemic as non-farm family business and informal wage workers contracted by about one-third and one-fourth, respectively, which corresponds to the job loss of about 34 and 24 percent, respectively (Figure 3, Panel (b)). Moreover, up until January 2021, their employment level had not been fully recovered—it was, in fact, about 23 percent lower than the pre-COVID-19 period (Figure 3, Panel (a)). In contrast, the decline in formal wage and farm employment was relatively small with job loss of, on average, less than 10 and 5 percent, respectively, and rebounded quickly to the pre-COVID-19 levels. Overall, job loss had been substantially higher among initially self-employed non-farm family business and informal wage workers.

Figure 3: Job loss by round and initial (pre-COVID-19) employment category

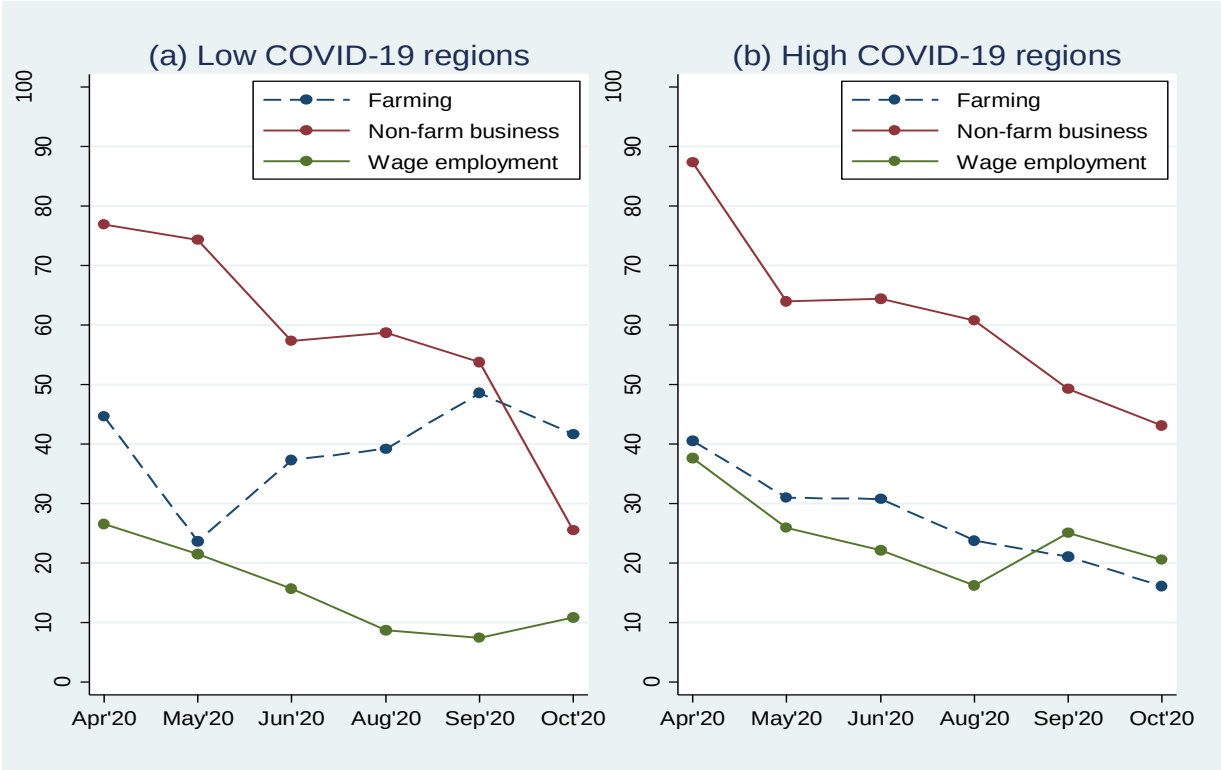


Source: Authors' calculation based on Ethiopia LSMS-ISA baseline survey 2019 and HFPS panel data 2020-2021.

Further, the post-COVID-19 phone surveys asked respondents about the impact of the pandemic on major income sources. Figure 4 presents the percentage of households reported income reduction in the high and low COVID-19 regions. We observe that the informal non-farm family business is highly affected by the COVID-19 pandemic, and higher percentage of

the households reported income reductions are in the high COVID-19 regions. We also note that the percentage of households reported that income reductions due to the COVID-19 pandemic have substantially declined over the rounds. In particular, households engaged in informal non-farm family business employment have suffered severely in terms of income reduction in April 2020. More than 80 percent of the households in informal non-farm family businesses have reported reduction in income in April 2020, compared to about 40 and 35 percent of the households engaged in farming and wage employment, respectively (Figure 4, Panel (a)-(b)). Although these figures reduced over time, the share of households reported income reduction remained higher (about 40 percent) among the non-farm business up until October 2020, while it reduced to about 20 percent for wage and farm workers. In addition, the reported income reductions from each employment sources were greater in regions that are more severely affected by the spread of the pandemic. A large share of the households reported income reductions from each of the employment sources are concentrated in the regions with high COVID-19 infections (Figure 4, Panel (b)).

Figure 4: Percentage of households reported income reduction in high and low COVID-19 regions



Source: Authors' calculation based on Ethiopia LSMS-ISA panel data 2019–2020 and region-level COVID-19 cases data from EPHI (2020).

The descriptive results above show the trends in employment and income sources during the pandemic period. In the next section, we explore whether the changes in employment can be attributed to the spread of the COVID-19 pandemic and associated mobility restrictions using difference-in-differences empirical estimation strategy.

4. Empirical Strategy

In this paper, we are interested to examine the implication of the COVID-19 pandemic on employment outcomes. We adopt a regression approach akin to Difference-in-Differences (DID) estimation strategy that compares changes in employment status of household heads pre-COVID-19 and post-COVID-19 periods. In our estimation we exploit the region-level confirmed COVID-19 cases during April–October 2020 as our main explanatory variable to assess the role of the pandemic on employment. Specifically, using the pre- and post-COVID-19 employment data along with the region-level COVID-19 cases data, we first estimate the overall aggregated change in employment due to the pandemic using the following DID specification with continuous treatment (i.e., log number of confirmed COVID-19 cases):

$$Emp_{it} = \alpha_i + \beta_0 Post(Apr-Oct)_t + \gamma_1(COVID19_{rt} * Post(Apr-Oct)_t) + \sum \rho_t X_j + \varepsilon_{it} \quad (1)$$

where the dependent variable Emp_{it} is a dummy variable equal to 1 if the household head is employed and zero otherwise; α_i represents individual and household fixed effects; $Post(Apr-Oct)_t$ is a dummy variable equal to 1 for the post-COVID-19 rounds April–October 2020 and 0 for the pre-COVID-19 round. The parameter associated with the time dummy captures aggregate trends in employment across rounds. $COVID19_{rt}$ is the region-level log number of confirmed COVID-19 cases during April–October 2020 in Ethiopia. $\sum \rho_t X_j$ are the vector of observable control variables and time interacted fixed effects including region x round, industry x round, and occupation x round fixed effects. By doing so, our estimation controls for region-round specific shocks such as variations in stringency of the COVID-19-related restriction measures across regions over time, and time varying shocks at the employment industry and occupation levels. ε_{it} is an error term that is assumed to be unrelated with COVID-

19 cases, at least conditional on the controlled variables including individual fixed effects, region-level policy responses and shocks, as well as industry and occupation level shocks.[5]

The interaction term between COVID-19 cases and post-COVID-19 dummy in equation (1) captures the overall changes in our outcome of interest (employment status) with varying exposure to the pandemic across regions during April–October 2020. Thus, the key parameter of interest in equation (1) is γ_1, and it identifies the effect for the entire period April–October. We expect that household heads exposed to high intensity of the COVID-19 infections are more likely to reduce employment activity as well as experience job losses due to the spread of the pandemic. One challenge to identify the impact of COVID-19 using the number of confirmed COVID-19 cases is that there could be differences between the actual confirmed COVID-19 cases and the true number of COVID-19 cases. This is mostly because the actual cases are likely to be underestimated due to low testing rates in most developing countries, and that may introduce some form of non-classical measurement error correlated with the outcome of interest (Amare et al 2020, Abay et al 2019). In this regard, similar to the previous study by Amare et al (2020), we expect that the actually confirmed cases are more important than the unknown cases to determine employment outcome. Moreover, we check robustness of our results using alternative methods.

In addition to the overall impact estimation in equation (1), which gives the aggregated impact for the entire post-COVID-19 period of April to October, we also examine the dynamic impact and assess the recovery phases by estimating equation (1) in a round by round approach. The formal approach we follow for this dynamic analysis relies on the multi-period nature of our data and the spatial variations in the spread of the COVID-19 pandemic. Formally, we measure the changes in employment status using the following dynamic difference-in-differences specification:

$$Emp_{it} = \alpha_i + \sum_t \beta_t \ round_t + \sum_t \gamma_t \ COVID19cases_{rt} * round_t + \sum_{t,j} \rho_{jt}(X_j * round_t) + \varepsilon_{ht} \qquad (2)$$

[5] In our setting, Ethiopia, the stringency of COVID-19 restrictions, as well as timing and length of those restrictions vary across regions. Thus, we include in our empirical estimations time-specific fixed effects for regions using interaction of round dummies with region to control the stringency of the restrictions across rounds and regions. In addition, we triangulate our analysis with the major timing of COVID-19-related mobility restrictions and other measures imposed by the regional and federal government of Ethiopia using secondary sources such as the COVID-19 related policy announcements reported by EPHI (EPHI 2020).

All variables are similar as described in equation (1) except that the post (Apr–Oct) variable is replaced by round to run a dynamic estimation, and the main parameter of interest now identifies the effect in each round. This dynamic DID estimation also control for individual and round fixed effects as well as the time interaction with region (region x round), employment industry (industry x round) and occupation (occupation x round) fixed effects. Equation (2) allows us to estimate the dynamic impact and assess the recovery in each round.

Lastly, we estimate the differential employment impact of the pandemic by initial employment/occupation type. That is, we examine how the COVID-19 pandemic affected formal and informal wage workers as well as workers in farm and non-farm family businesses. Therefore, in this analysis we focus on the impact based on the employment status of the household heads in the pre-pandemic round in August 2019. The employment types in the LSMS-ISA data are categorized into four groups: (1) permanent salaried, (2) temporary salaried, (3) self-employed, and (4) daily wage or casual. For our analysis, we categorize the household heads employment types as formal wage, informal wage, non-farm family business, and farming. We grouped the permanent wage employees as in the formal employment type (formal workers); and casual and temporary wage employment including wage workers with private individual are grouped as informal workers.[6] These employment groups are based on the employment arrangement of the household head in August 2019 (pre-COVID-19). We assess the heterogeneous employment impact of the pandemic on informal, non-farm and farm workers relative to the formal group using the following dynamic DID specification:

$$Emp_{it} = \alpha Empgroup_i + \sum_t \beta_t \; round_t + \sum_{t,g} \gamma_{t,g} \; Empgroup_j * round_t + \sum_{t,j} \rho_{jt}(X_j * round_t) + \varepsilon_{ht} \quad (3)$$

where $Empgroup_i$ is the employment group of the household head defined above as informal, non-farm and farm workers, and the formal group is the base-group. It is important to note that in this specification, the indicators for employment/worker group are interacted with round fixed effects. This allows us to assess the heterogeneous impact over the rounds and examine the recovery among the informal wage workers and the self-employed farm and non-farm workers. All the other terms are as discussed above.

[6] We also use alternative indicators for informal workers and included those working in formal sectors without a formal contract (ILO, 2013). The baseline LSMS-ISA data in August 2019 asked the employment arrangements and we exploited the data in such way to construct alternative measures and check robustness of our results.

Like the specifications in equation (2), we also run interaction of the indicators for worker group and round with the log COVID-19 cases variable. This allows us to see the differential impact of the spread of the pandemic by the type of employment overtime. Specifically, we estimate the following dynamic DID:

$$Emp_{it} = \alpha Empgroup_i + \sum_t \beta_t \ round_t + \sum_{t,g} \gamma_{t,g} \ Empgroup_j * COVID19cases_{rt} * round_t + \sum_{t,j} \rho_{jt}(X_j * round_t) + \varepsilon_{ht} \qquad (4)$$

All the variables are as defined in the previous specifications and $\gamma_{t,g}$ is the parameter of interest that capture the impact in this dynamic specification.

In all our estimations the dependent variable is a dummy variable that takes value 1 if the individual household-head is employed and zero otherwise. Our estimation results are also adjusted by sampling weights provided by the Ethiopia LSMS-ISA group to account for systematic non-response in each rounds during the phone surveys, and the standard errors are clustered at EA level. Further, our main estimations control the fixed effects for individual/household, round, and time interaction fixed effects of region-round, industry-round, and occupation-round. The employment industry and occupation information come from the August 2019 survey. Because of this if a given household head was unemployed or out of the labor force in the baseline August 2019, the observation for industry and occupation is missing. In such case, one solution is to impute the missing observation from previous labor market participation of the individual household head (for example Bussolo et al 2021). In our case, we have data only in August 2019 and afterward during March–October 2020. So, if the household head is unemployed in August 2019 survey, we impute the information from the next rounds that the household head becomes employed in the phone surveys. If the household head was never employed, then the household head is treated as never employed and dropped from estimation.[7] However, to probe our main results with and without these observations, we run our main estimations in the next section with the full sample, considering these observations as unemployed and including them in the type of employment regression, as well as by dropping and restricting the sample without these observations.

[7] From the total 3,247 sample household heads, 224 were unemployed or out of the labor force throughout the sample period. Thus, our analysis is based on the remaining 3,023 sample household heads (Table A1).

Lastly, it is important to note that our analysis is constrained by some weaknesses which need discussion. First, the numbers of regions in Ethiopia are few, and, thus, the sample of confirmed COVID-19 cases in our analysis is few to establish clean causal impact of the pandemic on the employment outcomes. Second, because regions with high level of interactions in the labor market may see higher rates of COVID-19 spread, the main dependent variables and regional COVID-19 rates are endogenous. We note that regional variations are not random in the context of COVID-19 and hence any left-over factors are likely to cause biases in our estimation. Although we believe that some of these biases are captured by the observable characteristics we control for, causality may not be still established by our difference-in-difference estimation. For these reasons, we are cautious in interpreting our results and refrain from claiming clean causality, and our results can only provide suggestive evidence of potential impacts of the COVID-19 pandemic on the employment outcomes.

5. Estimation Results and Discussion

We first discuss our results on the aggregated implication of the spread of the pandemic on employment during the entire April 2020–October 2020, and then we look at the dynamic implication that show the recovery over rounds as the stringency of the pandemic-related restrictions gradually relaxed across time and regions in Ethiopia. The more strong restrictions were imposed in April and eased in the subsequent months between May 2020 and October 2020, and particularly the State of Emergency was lifted in September 2020. Lastly, we present the heterogeneous implication of the pandemic by employment type, comparing the changes in employment among the informal workers and self-employed farm and non-farm business workers relative to the formal workers.

5.1 Confirmed COVID-19 cases and employment outcomes

Table 2 reports the overall and dynamic DID estimates, comparing the temporal evolution of outcome associated with the spread of the pandemic post period during Apr–Oct. As discussed above, the dependent variable in all columns is a dummy variable that takes value 1 if the individual household-head is employed and zero otherwise. In addition, the region-level confirmed number of COVID-19 cases is log-transformed. The estimates therefore show how employment outcome is associated with the region-level (log) confirmed COVID-19 cases

during post-pandemic period, Apr–Oct 2020. We present estimates using the balanced panel in Panel A and the unbalanced panel in panel B of Table 2. We prefer the estimates from the balanced panel but we still report the results from the unbalanced panel to check robustness of the results in relation to the relatively reduced sample sizes in our balanced panel data analysis. Columns 1-3 present the overall DID estimates of the specification in equation (1) and columns 4-6 present the dynamic DID estimates of the specification in equation (2). The estimations in columns 1-6 control fixed effects in stepwise: column 1 controls individual and round fixed effects, column 2 adds region-round interaction fixed effects, and column 3 adds the interactions industry-round and occupation-round fixed effects.

The main results in Table 2 can be summarized in four points. First, we find that the number of confirmed COVID-19 cases is negatively and significantly associated with employment overall during Apr–Oct 2020 (Panel A columns 1–3). For example, controlling for individual and round fixed effects only, column 1 shows that when the number of COVID-19 cases doubled the probability of being employed decreases by 3.3 percentage points during the post-period Apr–Oct 2020, relative to the pre-COVID-19 period. Second, the results show that the magnitude increases as we add round-specific fixed effects for region (column 2), industry and occupation (column 3). When we add these fixed effects, the magnitude almost doubled to 6.1 percentage-points in column 3.

Third, the dynamic DID estimates of equation (2) presented in Panel A, columns 4–6 of Table 2 show that employment was hit the hardest onset of pandemic April 2020. Specifically, without controlling the round-specific fixed effects, doubling the number of confirmed COVID-19 cases was associated with about 2.4 percentage-points decrease in the probability of being employed in April 2020, and it becomes insignificant but negative in the subsequent months May to October 2020 (Panel A column 4). When we still add the round-specific controls in column 6, we note that the significant negative effect increased in magnitude but concentrated only in April 2020. Table 2 (Panel A, column 6) shows that doubling the number of COVID-19 cases was associated with a 5.4 percentage-points decrease in probability of employment in April 2020. One reason for this is that onset of the COVID-19 pandemic in April 2020 was shaped by strong mobility and other pandemic-related restrictions in the country. Although there was no national lockdown in Ethiopia, after the first case of COVID-19 was detected in mid-March, the federal and regional governments have quickly imposed relatively strict measures in April 2020. In fact,

the government enacted with strict measures by declaring State of Emergency to contain the domestic spread of COVID-19.

Fourth, the above results are robust whether we use the balanced or unbalance panel observations (Panel A and Panel B of Table 2).[8] Overall, the estimates from our preferred specification (equation (2)) in column 6 show that even after we account for stringency of the containment measures across regional states in Ethiopia as well as accounting for time-varying industry- and occupation-specific factors, the spread of the COVID-19 infections was significantly and negatively associated with employment outcome in April 2020, but this association quickly reversed in the subsequent months starting from May 2020. This finding is generally consistent with our descriptive analysis in section 3.2 that the unprecedented employment shock due to the pandemic was more pronounced and sharp in April 2020, and most households reported job losses and income reductions more in that month.

[8] We also run estimations without applying sampling weight on both the balanced and unbalanced panel observations and the main results still hold but the magnitude of few coefficients is smaller without weight.

Table 2: Confirmed COVID-19 cases and employment outcome

	Overall			Dynamic		
	Panel A: Balanced panel					
	(1)	(2)	(3)	(4)	(5)	(6)
COVID-19 cases* Post Apr-Oct	-0.033***	-0.061***	-0.061***			
	(0.007)	(0.013)	(0.013)			
COVID-19 cases*Post Apr				-0.024*	-0.060***	-0.054***
				(0.014)	(0.013)	(0.012)
COVID-19 cases*Post May				-0.004	0.041**	0.043**
				(0.015)	(0.016)	(0.017)
COVID-19 cases*Post Jun				-0.011	0.016	0.033**
				(0.013)	(0.013)	(0.013)
COVID-19 cases*Post Jul/Aug				0.000	0.015*	0.025**
				(0.022)	(0.009)	(0.011)
COVID-19 cases*Post Sep				-0.004	0.014*	0.025***
				(0.026)	(0.008)	(0.010)
COVID-19 cases*Post Oct				0.002	0.012	0.021**
				(0.027)	(0.008)	(0.009)
R-squared	0.07	0.10	0.11	0.11	0.15	0.18
Observations	15715	15715	15715	15715	15715	15715
	Panel B: Unbalanced panel					
COVID-19 cases* Post Apr-Oct	-0.027***	-0.049***	-0.053***			
	(0.006)	(0.011)	(0.012)			
COVID-19 cases*Post Apr				-0.027**	-0.049***	-0.048***
				(0.012)	(0.011)	(0.010)
COVID-19 cases*Post May				-0.000	0.032**	0.033**
				(0.013)	(0.015)	(0.016)
COVID-19 cases*Post Jun				0.000	0.014	0.028**
				(0.012)	(0.011)	(0.013)
COVID-19 cases*Post Jul/Aug				0.000	0.013*	0.022**
				(0.020)	(0.008)	(0.010)
COVID-19 cases*Post Sep				0.005	0.013*	0.022**
				(0.023)	(0.007)	(0.009)
COVID-19 cases*Post Oct				0.009	0.011*	0.017*
				(0.024)	(0.007)	(0.009)
R-squared	0.06	0.09	0.11	0.10	0.14	0.17
Observations	21001	21001	19579	21001	21001	19579
Fixed effects						
Individual/household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Round fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Region x Round fixed effect	No	Yes	Yes	No	Yes	Yes
Industry x Round fixed effect	No	No	Yes	No	No	Yes
Occupation x Round fixed effect	No	No	Yes	No	Yes	Yes

Source: Authors' calculations based on Ethiopia LSMS-ISA 2019 and 2020 phone survey datasets.

Notes: In all estimations the dependent variable is a dummy variable that takes value 1 if the individual household-head is employed and zero otherwise. The estimates in Panel A and B provide the impact of the region-level log confirmed COVID-19 cases on employment using the balanced and unbalanced data, respectively. Columns 1-3 present the estimates from the aggregated DID regression in Equation (1) and columns 4-6 present the estimates from dynamic DID regression in Equation (2), respectively. All estimation results are adjusted by sampling weights accounting for systematic non-response in the phone surveys. Standard errors clustered at EA level are reported in parenthesis (*** p<0.01, ** p<0.05, * p<0.1)

5.2 COVID-19 pandemic and informal employment

The labor market impact of COVID-19 is expected to be enormously heterogeneous and more devastating for vulnerable workers in the informal sector. Informal workers typically lacks any social protection or coverage by formal employment protection laws as well as employment insurance (Amin and Okou 2020; ILO 2020). Understanding how and to what extent COVID-19 disruptions disproportionately affect employment outcomes of informal workers is important policy issue as informal employment is the source of livelihood for vast majority of the people in sub-Saharan Africa (SSA) countries like Ethiopia. The share of informal employment is 47 percent in Ethiopia, and on average about 77 percent of employment in SSA is informal (Bonnet et al. 2019; WB 2020 Nguimkeu and Okou 2019). In this section, we examine empirical questions related to employment vulnerability and disproportionate impact of the pandemic on informal workers in our setting, Ethiopia. Specifically, we examine the following three questions: first, we assess whether the COVID-19-related mobility restrictions and lockdown measures imposed by the government, as well as the spread of the pandemic, have had more severe impact on informal workers than formal workers. Second, we explore whether there is a differential recovery trajectory between the formal and informal workers during the study period April–October 2020. Lastly, we assess whether the employment vulnerability of informal workers varied across locations and industries. We specifically investigate whether the locations and industries in which informal workers would normally concentrate to earn their livelihood are the sources and drivers of the disproportionate risk of job loss for informal workers compared to the formal workers. As discussed above in section 4, to examine these questions we leverage the detailed employment related information about household heads collected in August 2019, and classify the sample heads into four employment groups: (1) formal wage and salaried workers, (2) informal wage workers, (3) self-employed non-farm family business workers, and (4) self-employed farm workers—based on their initial employment arrangements, occupations and industries.

Table 3, columns 1–3 below report the estimation results on the heterogeneous impact of mobility restrictions and lockdowns on employment of informal workers, self-employed farm and non-farm workers relative to formal workers. These estimates are based on the dynamic DID specification in equation (3). Similarly, columns 4–6 of Table 3 present the heterogeneous impact of the confirmed (log) number of COVID-19 cases on employment of informal and self-

employed farm and non-farm workers relative to formal workers, and the estimates are based on the dynamic DID specification in equation (4). To facilitate interpretation and analysis of the results, the estimations of both equations (3) and (4), add region-round and industry-round interaction fixed effects in stepwise, and we evaluate the sign and magnitude of the coefficients as we add these characteristics. Accordingly, columns 1 and 4 of Table 3 control for individual and round fixed effects only; then columns 2 and 5 add controls for region x round fixed effects; and columns 3 and 6 add controls for industry x round fixed effects.

In relation to the first empirical question, the results in Table 3 show that the COVID-19-related mobility restrictions and lockdown measures imposed by the government have had more severe impact on employment of informal and non-farm family business workers, relative to the formal workers (columns 1–3). For example, without controlling for the region-round and industry-round fixed effects, the results in column 1 show that the informal workers have suffered the largest and significant declines in employment in all rounds during April 2020–October 2020, compared to the reference employment group (formal wage workers). On average, informal workers have suffered highest job loss between 13–19 percentage points higher than that of formal workers during Apr–Oct 2020 (Table 3, column 1). Next to informal wage workers, the self-employed workers in non-farm family business have suffered job loss, on average, between 5–7 percentage points higher than the formal workers, but only during Apr–Jun 2020 and the magnitude is not significantly different from zero in the subsequent rounds Jul–Oct 2020. Contrary to the informal and non-farm business workers, farm workers was not significantly affected by the COVID-19 mobility restrictions, and the magnitude of the coefficient for farm workers was not significantly different from zero in April 2020, which suggests no difference compared to formal workers in April 2020. In addition, the farm workers have enjoyed 15–19 percentage points higher employment rate in the post-COVID-19 during May–Oct 2020, compared to the formal workers.

Further, in column 4 of Table 3, we find similar results about the heterogeneous impact of the confirmed number of COVID-19 cases on employment of the informal and non-farm workers. The results in column 4 of Table 3 show that the number of confirmed COVID-19 cases was negatively and significantly associated with employment of the informal wage workers and non-farm family business workers. For example, the rise in the number of COVID-19 cases, for example, doubling of the COVID-19 cases is associated with reduction in employment rate on

average between 1.3–3 percentage points for informal workers in all rounds during Apr–Oct 2020; and 1.6–2.3 percentage points reduction for non-farm business workers, but only during Apr–Jun 2020 and the difference is not statistically different from zero in the subsequent months after June 2020. Overall, the results in columns 1 and 4 of Table 3 strongly suggest that informal and non-farm family business workers have disproportionately suffered with higher job loss than formal wage workers, as well as higher than the farm workers, due to the pandemic-related mobility restrictions and spread of the COVID-19 infections during April–October 2020 in Ethiopia.

Table 3: Implication of COVID-19 pandemic on employment outcome, by type of employment

	Impact of mobility and lockdown restrictions			Impact of confirmed number of COVID-19 cases (log)		
	Estimates of equation (3)			Estimates of equation (4)		
	(1)	(2)	(3)	(4)	(5)	(6)
Informal X Apr	-0.141***	-0.138***	-0.134***	-0.028***	-0.027***	-0.020**
	(0.034)	(0.034)	(0.036)	(0.007)	(0.008)	(0.008)
Informal X May	-0.173***	-0.163***	-0.113***	-0.030***	-0.023***	-0.011
	(0.034)	(0.031)	(0.036)	(0.006)	(0.006)	(0.007)
Informal X Jun	-0.185***	-0.178***	-0.131***	-0.031***	-0.026***	-0.016**
	(0.037)	(0.034)	(0.038)	(0.006)	(0.006)	(0.007)
Informal X Jul/Aug	-0.145***	-0.145***	-0.079**	-0.017***	-0.014***	-0.006
	(0.037)	(0.036)	(0.038)	(0.005)	(0.005)	(0.005)
Informal X Sep	-0.149***	-0.154***	-0.088**	-0.015***	-0.014***	-0.006
	(0.034)	(0.033)	(0.034)	(0.004)	(0.004)	(0.004)
Informal X Oct	-0.130***	-0.133***	-0.077**	-0.013***	-0.011***	-0.004
	(0.038)	(0.037)	(0.038)	(0.004)	(0.004)	(0.004)
Non-farm X Apr	-0.068***	-0.074***	-0.083**	-0.023***	-0.019***	-0.014*
	(0.023)	(0.023)	(0.033)	(0.006)	(0.007)	(0.009)
Non-farm X May	-0.054*	-0.069**	-0.013	-0.017***	-0.013**	-0.001
	(0.031)	(0.028)	(0.041)	(0.006)	(0.006)	(0.007)
Non-farm X Jun	-0.070**	-0.081***	-0.041	-0.016***	-0.013**	-0.004
	(0.031)	(0.030)	(0.039)	(0.005)	(0.005)	(0.006)
Non-farm X Jul/Aug	-0.018	-0.032	0.021	-0.004	-0.003	0.004
	(0.031)	(0.029)	(0.037)	(0.004)	(0.004)	(0.005)
Non-farm X Sept	-0.014	-0.030	0.044	-0.003	-0.002	0.007*
	(0.030)	(0.029)	(0.033)	(0.003)	(0.003)	(0.004)
Non-farm X Oct	-0.012	-0.026	0.019	-0.003	-0.002	0.003
	(0.028)	(0.027)	(0.032)	(0.003)	(0.003)	(0.003)
Farm X Apr	0.035	0.012	0.007	-0.004	0.003	-0.002
	(0.021)	(0.023)	(0.034)	(0.008)	(0.009)	(0.013)
Farm X May	0.190***	0.139***	0.104***	0.037***	0.033***	0.018**
	(0.031)	(0.031)	(0.035)	(0.007)	(0.008)	(0.008)
Farm X Jun	0.154***	0.114***	0.086***	0.023***	0.021***	0.012*
	(0.030)	(0.030)	(0.032)	(0.006)	(0.006)	(0.007)
Farm X Jul/Aug	0.144***	0.107***	0.069**	0.016***	0.014***	0.007
	(0.032)	(0.031)	(0.032)	(0.004)	(0.004)	(0.004)
Farm X Sep	0.156***	0.125***	0.073**	0.016***	0.015***	0.007*
	(0.031)	(0.032)	(0.032)	(0.004)	(0.004)	(0.004)
Farm X Oct	0.163***	0.122***	0.100***	0.016***	0.013***	0.010***
	(0.031)	(0.031)	(0.031)	(0.004)	(0.003)	(0.003)
R-squared	0.097	0.137	0.143	0.095	0.134	0.141
Observations	13271	13271	13271	13271	13271	13271
Fixed effects						
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Round fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Region x round fixed effects	No	Yes	Yes	No	Yes	Yes
Industry x Round fixed effect	No	No	Yes	No	No	Yes

Source: Authors' calculations based on Ethiopia LSMS-ISA 19 and 2020 rounds

Note: The dynamic DiD estimations in columns 1-3 and 4-6 are based on the specifications in equation (3) and (4), respectively. Columns 1 and 4 control for individual and round fixed effects; the columns 2 and 5 control for individual, round, and region-round interaction fixed effects; and columns 3 and 6 control for individual, round, and region-round and industry-round interaction fixed effects. The employment categories: informal (employed by private individuals), non-farm family business, and farm are pre-COVID-19 employment status as of August 2019. In both Columns (1 and 2), formal employment (employed by GOs, NGOs or private companies) is the base employment category. Standard errors clustered at EA level reported in parenthesis (*** p<0.01, ** p<0.05, * p<0.1)

Furthermore, in columns 2–3 and 5–6 of Table 3 the results show that the above discussed differential impacts of the pandemic continue to hold as we add the round interacted

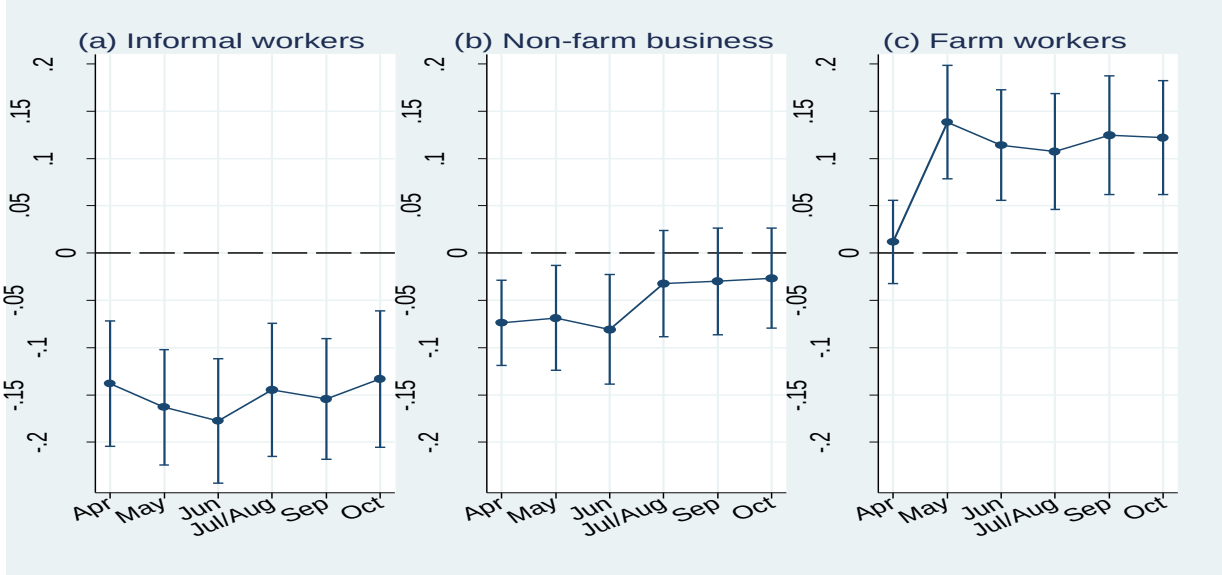
fixed effects region-round and industry-round to control the location and industry specific variations over time. However, when we control both fixed effects in columns 2–3 and 5–6 of Table 3, it is important to note that the magnitude of the heterogeneous impact declines. Particularly after April 2020, the decline in the coefficients is also economically significant. For example the range of differential impact of the mobility restrictions for informal workers declined to 7.7–13.4 percentage points but still significant in all rounds during April–October 2020 (column 3). For non-farm family business workers, the differential impact is now concentrated only in April 2020 and become insignificant in the subsequent rounds May–Oct 2020. The result that the magnitude of the negative differential impacts in columns 1 and 4 has declined when we control the time interacted region and industry fixed effects is an important finding and suggests that some of the differential impact of the pandemic on the informal and non-farm business employment is explained by the time-specific variations in the employment locations and industries of the informal workers (for example, see Bussolo et al. 2021). However, we note that significant portion of the differences in employment vulnerability and associated differential impact of the COVID-19 on informal workers relative to the formal workers is still not explained by the location and industry variations. Even after controlling for these time-varying characteristics, the significant differential impact on informal workers still holds means that irrespective of location and employment industries informal workers are highly vulnerable to job losses in the face of the COVID-19 pandemic. Thus, the labor market impact of the COVID-19 pandemic is not only heterogeneous but also devastating for informal employment and livelihood sources compared to formal employment.

Overall, the results presented above are consistent with recently growing evidences on employment risks of informal workers during the global COVID-19 crises. For instance, Bussolo et al. (2021) using similar approach but in different setting found that informal workers experienced a more severe employment and income shock than formal workers due to the pandemic-related lockdowns in India. In addition, Amare et al. (2021) found that wage-related employment activities are less affected by COVID-19 lockdown measures. One possible explanation that informal workers are more vulnerable to job loss due to COVID-19 pandemic compared to formal workers is related to the fact that while most formal works can be operated remotely during the lockdowns, informal workers cannot have such advantage as most informal activities are conducted in-person or they may be concentrated mostly in industries and

occupations that fundamentally didn't allow such remote work or not easy to move online, which typically makes their employment and livelihood sources more vulnerable in the face of COVID-19 pandemic (Dingle and Neiman, 2020; Bussolo et al. 2021; Abay et al. 2020a; Amare et al. 2021). Our paper contributes to this growing evidence and shows that the employment vulnerability of informal workers and the unequal impact of the pandemic on employment of informal workers inherently persisted during April-October 2020, and that informality during the pandemic by itself is the driver of job loss and explains most of the differential impact. The argument that informal employment is at risk during the COVID-19 crisis because informal workers concentrate in the vulnerable industries and locations as their source of livelihood only partly explains the labor market differential impact of both mobility restrictions and spread of the COVID-19 infections on informal workers.

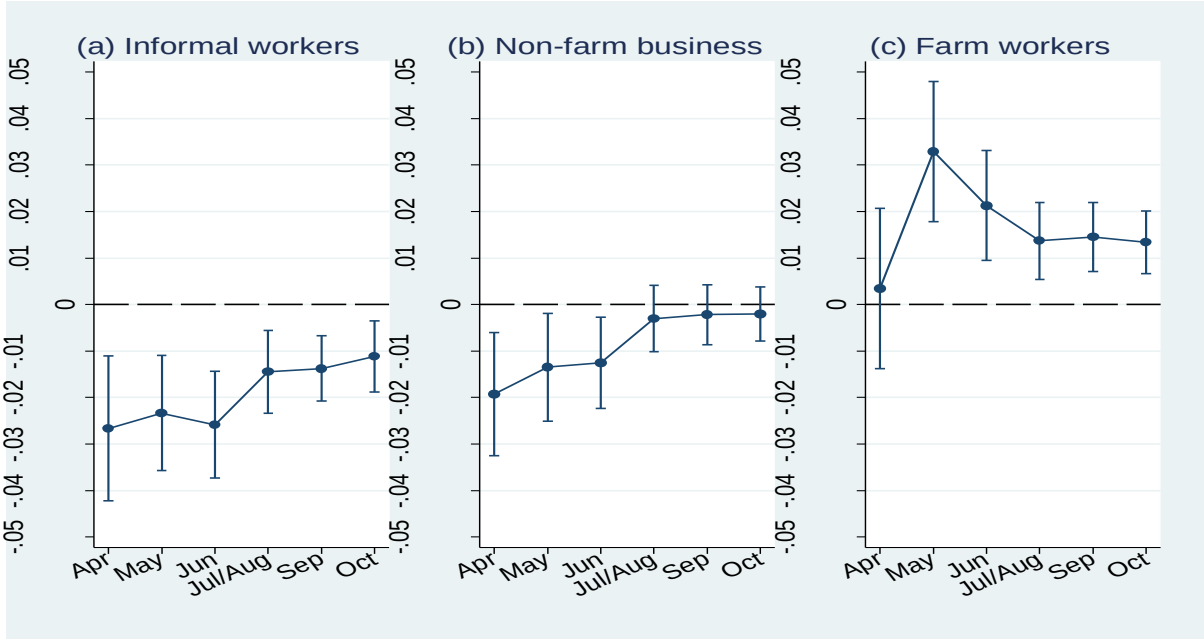
Next, we examine whether there is a differential recovery pace across the employment groups: formal, non-farm, and farm workers compared to the base group—formal wage workers. In the interest of simplicity and clear presentation of the post-COVID-19 recovery trajectories for the three employment groups, we plotted coefficients of the estimation results in columns 3 and 6 of Table 3 and presented in Figure 5 and Figure 6, respectively. Panels (a) and (b) in both Figure 5 and Figure 6, show that the speed of recovery for informal workers was differentially slow, and most strikingly, their employment levels did not fully recovered, until October 2020, to the pre-COVID-19 baseline level. This suggests that the employment impact of the COVID-19 pandemic on informal workers is less likely to span short compared to the formal workers. However, the non-farm family business workers, after their employment drop in April 2020, they quickly recovered in May 2020. We note that while the differential negative impact of mobility restrictions are persistently significant for informal workers during Apr–Oct 2020, it quickly appears insignificant for non-farm family business self-employed workers after one month in May 2020 (Figure 5, Panel (a) and (b).

Figure 5: Estimates of the COVID-19 mobility restrictions on the probability of being employed, by type of employment



Source: Authors' calculations based on Ethiopia LSMS-ISA 19 and 2020 rounds
Note: The coefficients and standard errors are from the dynamic DiD estimation of equation (3) presented in column 3 of Table 3. The estimation coefficients are plotted with 95% confidence intervals.

Figure 6: Estimates of the confirmed number of COVID-19 cases on probability of being employed, by type of employment



Source: Authors' calculations based on Ethiopia LSMS-ISA 19 and 2020 rounds
Note: The coefficients and standard errors are from the dynamic DiD estimation of equation (4) presented in column 6 of Table 3. The estimation coefficients are plotted with 95% confidence intervals.

Unlike the informal and non-farm business workers, Panel (c) in both Figures 5 and 6 depicts that farm employment was not significantly hit even onset of the pandemic in April 2020 when most employment activities were halted by the COVID-19 crises. In fact, employment level of farm workers was significantly and positively higher than the formal wage workers during post-COVID-19 May–Oct 2020. Despite the labor market crises wrought by COVID-19, the rise in employment rate of farm workers post-COVID-19 can be partly explained by seasonal fluctuation of agricultural activities in rural areas. In addition, the rural sector is not expected to experience much economic downturn due to COVID-19 disruptions, mainly because it is less developed and poorly connected to the global market. Further, farm employment might be absorbing the labor returnees from urban areas. However, in our case, because the unit of analysis is household head, we did not find much variation in migration of household heads during the pandemic, i.e., household heads' labor churning is small (below 1 percent) in our data.

6. Conclusion

We examine the implications of the COVID-19 pandemic on employment opportunities and income sources in Ethiopia. We combine the Ethiopia LSMS-ISA pre-COVID-19 data collected in August 2019 with post-COVID-19 high frequency phone surveys collected during April 2020–October 2020. In addition, we compiled region-level COVID-19 cases data for all regional states in Ethiopia. We assess the implications of the pandemic on employment and income sources using a difference-in-differences estimation approach, controlling for a number of confounding factors.

The results show that the COVID-19 pandemic has triggered disproportionately higher employment losses among the vulnerable groups such as female, younger, and informally employed household heads. These groups have fared worse compared to their counter parts, especially during the onset of the pandemic in April 2020. The COVID-19-related employment and income losses are higher among the urban households engaged in informal non-farm family business and informal wage employment. Our DID estimation results also show that the number of confirmed COVID-19 cases is negatively associated with employment rates. We find that the spread of the COVID-19 infections was significantly and negatively associated with employment outcome in April 2020, but this association was quickly reversed in the subsequent months

starting from May 2020. Our results consistently show that the employment shocks due to the COVID-19 pandemic was sharp and more pronounced in April 2020, and most households reported job losses and income reductions more in that month. Further, informal workers have suffered the largest and significant declines in employment in all rounds during April 2020–October 2021, compared to the reference employment group (formal wage workers). The results also show that the speed of recovery for informal workers was differentially slow and their employment levels did not fully recovered until January 2021. This suggests that the employment impact of the COVID-19 pandemic on informal workers is less likely to span short compared to the formal workers.

Our findings have important policy implications and underline the importance of social protection and labor market interventions to support the vulnerable groups in the labor market during the pandemic. Our study also contributes to the emerging policy debates on informal sectors. We note the relevance of considering location, demographic characteristics and types of employment in developing labor market interventions to protect and promote vulnerable groups such as the informal workers.

Lastly, we note that our analysis has important limitations. Although we control for a number of observable characteristics in our estimation, the few numbers of regions in which the analysis depends and the fact that we lack exogenous variation in confirmed COVID-19 cases restrains us from claiming clean causal impact of the pandemic on employment and income sources. As a result, our results only provide suggestive evidence on potential impacts of the COVID-19 pandemic in Ethiopia. We hope future studies will consider the limitations and complement the results using reasonably exogenous variation in COVID-19 pandemic.

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9. Appendix

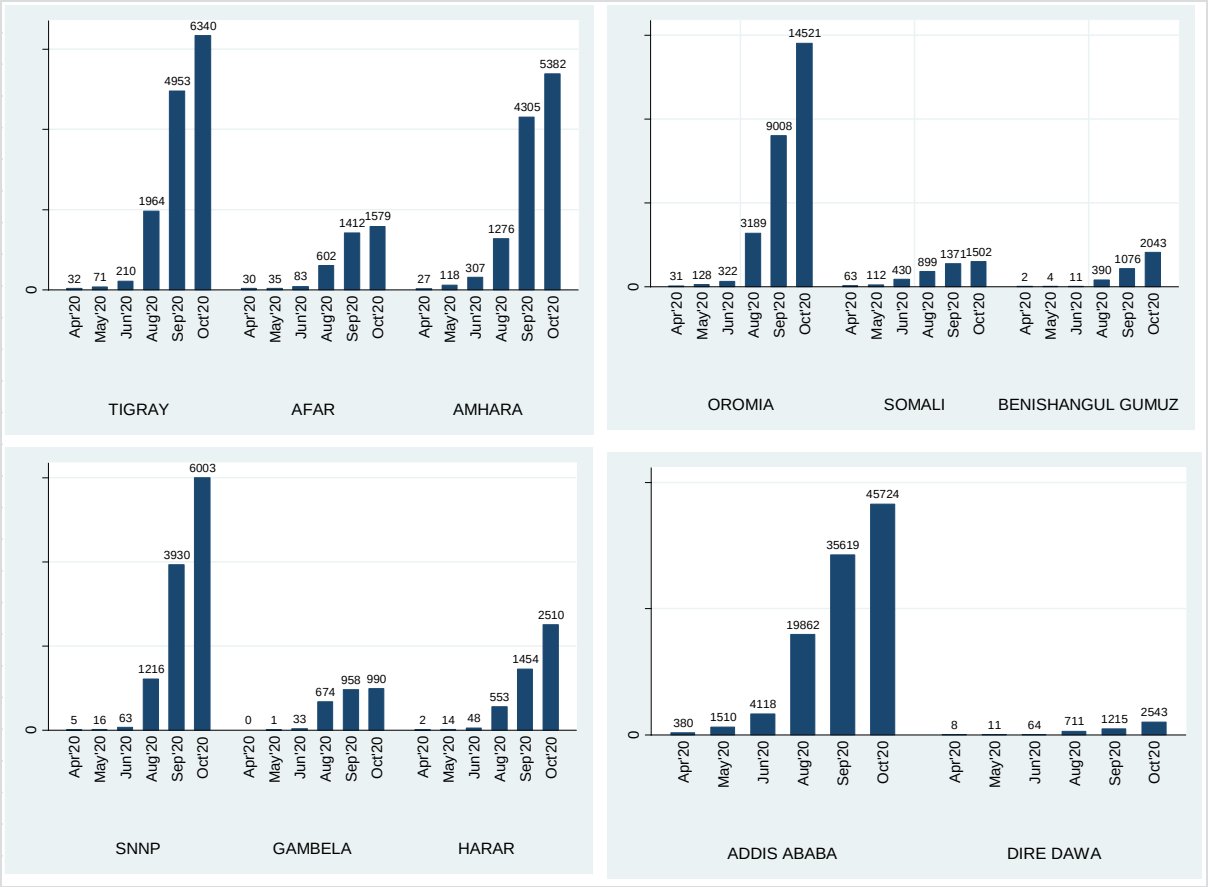
Figures and Tables

Table A1: Number of interviewed sample units by round

	All sample size	Sample size of those employed at least once during Aug 2019-Oct 2020	Balanced panel of those employed at least once during Aug 2019–Oct 2020	Sample size of those initially employed in Aug 2019
	(1)	(2)	(3)	(4)
Round 1 (Aug 2019)	3,247	3,023	2,245	2,050
Round 2 (Apr 2020)	3,247	3,023	2,245	2,050
Round 3 (May 2020)	3,105	2,892	2,245	1,955
Round 4 (Jun 2020)	3,056	2,855	2,245	1,935
Round 5 (Jul/Aug 2020)	2,876	2,689	2,245	1,819
Round 6 (Sep 2020)	2,768	2,583	2,245	1,757
Round 7 (Oct 2020)	2,702	2,514	2,245	1,705
Number of observations	21,001	19,579	15,715	13,271

Source: Authors' calculations based on Ethiopia LSMS-ISA 19 and 2020 rounds.

Figure A1. Regional variation in confirmed COVID-19 cases across rounds in Ethiopia



Source: Authors' calculation based on region-level COVID-19 data from EPHI (2020)

Note: Figure A1 provides regionally disaggregated number of COVID-19 cases across the study months to uncover how the regional differences in the spread of the pandemic is associated with labor market disruption in the country. We note there is substantial variation across regions in terms of the number of confirmed COVID-19 cases.