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Simulations of policy responses and interventions to promote inclusive adaptation to and recovery from the COVID-19 crisis in Vietnam.

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Abstract

This paper investigates the impact of the COVID-19 pandemic on income, poverty and inequality in Vietnam. We use the Vietnam Household Living Standards Survey 2018 in combination with the Labor Force Surveys for 2018, 2019 and 2020 to simulate the impact of COVID-19 shocks in 2020. We use the difference-in-differences method, which is used little in the COVID-19 literature, to document that the income of workers in the production, construction, trade, transport, restaurant and hotel, real estate, support services, education and recreation sectors was heavily affected, especially in the fourth quarter of 2020. The simulation results show that per capita expenditures decrease in all eight regions, however the poverty rate or number of poor people increases only in the Southeast and Mekong River Delta regions. The poverty rate increases more in the urban area than in the rural area. In contrast, the number of poor households increases more in the rural area than in the urban area. Overall, the COVID-19 pandemic's effect on the poverty rate is very small and therefore does not affect inequality much.

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I. Introduction

The COVID-19 outbreak has had significant social and economic impacts. The IMF (2020a) estimates global GDP growth decreased 3 percentage points in 2020 alone due to COVID-19, while the World Bank (2020) estimates a 5-percentage-point decline. Meanwhile, between 71 and 100 million people have fallen into extreme poverty because of the pandemic (World Bank, 2020b). Vos, Martin and Laborde (2020a, 2020b) used 30 household surveys mainly from Sub-Saharan Africa and South Asia and a poverty line of USD 1.90 per day and found that the number of people in poverty globally would increase between 14 and 22 million in the event GDP growth slowed down by 1 percentage point. In the most extreme scenario of a 20 percent income or expenditure contraction, Sumner et al. (2020) show that the number of people living in poverty could increase by 420 to 580 million. This means that the pandemic has had significant impacts on poverty.

The first confirmed case of COVID-19 in Vietnam was reported on January 23, 2020. As at January 9, 2021, the country had recorded 1,513 confirmed cases, 1,361 recoveries, and 35 deaths.[1] Despite its large population of over 95 million people and proximity to China, Vietnam is one of the

[1] Vietnamese Ministry of Health. COVID-19 updates as at January 10, 2020 [Available from: https://ncov.moh.gov.vn/web/guest/trang-chu] (accessed January 10, 2020)

countries with the lowest number of confirmed cases of COVID-19. Vietnam's success in containing the COVID-19 outbreak has impressed international communities (Sen, 2020). In 2020, its economic growth rate was 2.91 percent, while most other countries around the world reported negative values.

To successfully contain the COVID-19 outbreak, the Vietnamese government took early and aggressive measures at the very beginning of the outbreak. A nationwide isolation period was imposed for 15 days, from April 1 to 15, and then extended 1 more week. The government restricted international travel and suspended visas for foreigners entering Vietnam. All schools were closed from February to April 23, 2020. All suspected cases of COVID-19 were traced, and affected individuals were moved to a hospital or military camp for a 14-day isolation period. The government also offered free testing and free treatment for those who tested positive, and enforced wearing face masks in public spaces.

All the above factors mean that Vietnam provides us with an excellent case to investigate the impact of COVID-19 on poverty and inequality and identify key channels of impact on household expenditures (e.g., job losses or wage/profit reductions due to lockdown, recession, and border closures, and decreases in international remittances). This investigation would help policymakers understand exactly how the COVID-19 pandemic are affecting poverty and inequality. Its findings would provide evidence on who would be most vulnerable to COVID-19 and benefit most from subsidies. Note that food and foodstuff prices did not increase dramatically in Vietnam in 2020 because there was no panic buying and therefore did not affect household welfare that year.

We use the Labor Force Survey (LFS) 2020 and the difference-in-differences method to compare workers' income in 2020 with their income in 2019, with income growth between 2019 and 2018 acting as a control group to estimate COVID-19's impact on income. We controlled for time and seasonal effects, otherwise our estimation results would be biased (Dang and Nguyen, 2020). Our findings show that workers' monthly income was heavily affected in the second quarter of 2020. More specifically, the COVID-19 pandemic decreased monthly income by 7.5 percent that quarter. This significant reduction is attributable to the Vietnamese government implementing a lockdown from April 1 to 23, 2020, to contain the COVID-19 outbreak. Since the COVID-19 outbreak started in the first quarter of 2020 and was controlled by the third quarter that year, we find it reduced income less in the first quarter and had no impact on it in the third quarter. Workers' monthly income decreased by 4.9 percent and 4.0 percent in the first and fourth quarters of 2020, respectively. Agriculture workers' income was least affected by COVID-19. Workers in the production, construction, trade, transport, restaurant and hotel, real estate, support services, education and recreation sectors saw their income heavily affected, especially in the second quarter of 2020. For instance, the COVID-19 pandemic decreased trade workers' income by 11.4 percent, 14.4 percent and 48.9 percent in the first, second and fourth quarters of 2020, respectively, while transport workers' income was very mildly affected. All the above results are

supported by zero effects from placebo tests. We also simulate the impact of the COVID-19 pandemic on household per capita expenditures and poverty. Our simulation estimates show that the poverty rate increased slightly from 10.53 percent to 11.11 percent in 2020 due to the COVID-19 pandemic. Poverty rate rises very slightly for both male and female household heads. Households working in the restaurant and hotel sector fell into poverty in the largest number. In addition, more households with male household heads fell into poverty due to the COVID-19 pandemic than households with female household heads. The simulation Gini index estimates show a very slight increase (0.0014 points) in inequality. We use standard microeconomic data on income, expenditures and various other socio-economic characteristics at the household, individual or intra-household level (e.g., employment) to define our simulation scenario and then calibrate and validate it with data from the VHLSS 2020. Next, we link COVID-19 shocks to real household income to estimate their effects on poverty and inequality. Also, we identify key channels of impact on household expenditures (e.g., job losses or wage/profit reductions due to lockdown, recession, and border closures, and decreases in international remittances). In addition, we analyze three phases of the crisis:

1) initial impact

2) partial reopening, and

3) full reopening / recovery.

Finally, we disaggregate average effects by gender, economic sector and other socio-economic characteristics to understand the key (heterogeneous) pathways and coping mechanisms at play.

The rest of the paper is structured as follows. Section 2 contains a literature review. Section 3 sets out the channels through which the COVID-19 pandemic affects household poverty and inequality. Section 4 presents our dataset. Section 5 describes the difference-in-differences method used to estimate the pandemic's impact on workers' income, presents the estimation results and reports the simulation results for household poverty and inequality. Section 6 concludes the paper.

II. Literature review

The International Labour Organization (ILO, 2020: 5) provides estimates focused on the working population and argues that there would be between 9 and 35 million new working poor (who fall below the World Bank poverty line of USD 3.20 per day) in developing countries in 2020. Havrlant et al. (2020) use the input-output framework to calibrate demand shocks to individual sectors in Saudi Arabia and

show that the GDP in 2020 is estimated to differ from the baseline level by -4.8 percent to -9.8 percent. The World Bank (2020a) reports that the COVID-19 pandemic has led to the deepest recessions in eight decades despite the governments of many countries having implemented unprecedented policy support. The pandemic is likely to cause long-term damage to growth prospects, with living standards contracted in the coming years. There will be no economic growth in Asia for the first time in 60 years, and the GDP of the US and Europe is expected to decrease between 8 percent and 13 percent (IMF, 2020b). Beland et al. (2020) investigate the short-term impacts of COVID-19 on employment and wages in the United States. They find that the COVID-19 pandemic caused an increase in the unemployment rate and decreased the number of hours worked and labor force participation but did not have significant effects on wages. Furthermore, they report it had heterogeneous impacts, with a more negative effect on the labor market outcomes of men, younger workers, Hispanics and less-educated workers. However, Pouliakas and Branka (2020) find female workers were more vulnerable to COVID-19 in European countries. They also show that older workers, non-natives, less-educated workers, those working longer hours and those working in micro-sized workplaces are at a very high risk of COVID-19 disruption. In a similar vein, Fana et al. (2020) analyze the lockdown measures implemented in three European countries – Germany, Spain and Italy – and demonstrate that restrictions on economic activity have significant impacts on those workers with lower wages and worse working conditions. They also find there were negative consequences for women and young workers. Those findings suggest that the COVID-19 pandemic has had asymmetric effects on the labor market, which has led to an increase in poverty and inequality. In fact, Palomino et al. (2020) evaluate the effects of social distancing and lockdown measures in Europe. They find that poverty and wage inequality increase in all European countries in all their simulations and that poverty and inequality are higher in the countries in Eastern and Southern Europe than those in Central and Northern Europe. Obviously, the COVID-19 pandemic has impacted employment differently in different sectors, with some sectors being severely affected and others, only mildly. Barrot et al. (2020) use data from France to show that social distancing measures affected employment in the hotel and restaurant, arts and leisure, services, food, agriculture, wholesale and retail, and construction sectors the most and employment in the computer services, telecommunications, consulting, scientific and technical sectors the least.

Although Vietnam shares a border with China – the epicenter of the COVID-19 pandemic – it has successfully fought the pandemic. Vietnam's successful measures such as extensive monitoring, contact tracing, strict quarantine enforcement and aggressive testing have been widely analyzed and evaluated (Huynh, 2020; Trevisan et al., 2020). Dang and Giang (2020) use a web-based rapid assessment survey conducted immediately after lockdown measures were lifted in Vietnam to show that having a job increases financial position, income and savings, and that having a permanent job contract is strongly correlated to fewer job worries. They also indicate that those who have a

permanent job contract, are in good health and are well-educated assess their current and future financial position more positively. In addition, the lockdown in Vietnam caused income and job losses, and financial uncertainty, especially for unskilled, informal and blue-collar workers (Tran et al., 2020). Dang and Nguyen (2020) use the difference-in-differences method and multiple editions of the LFS to estimate the causal effects of the lockdown. They find that the lockdown increased the unemployment rate and decreased the number of hours worked, and workers' income and wages. They also demonstrate that workers in the transport and tourism sectors were most heavily affected by the lockdown. Yang et al. (2020) used the World Bank's COVID-19 High-Frequency Phone Surveys of Households in Vietnam to investigate the impact of COVID-19. They conducted the first round of surveys between June 5 and July 8, 2020. Their results show that 90 percent of those who were working in February 2020 returned to the same job in May/June, 95 percent of family businesses remained open, and 90 percent of family farms were not affected by COVID-19. Income of respondents in this survey was not affected by COVID-19. However, women had a higher probability of working reduced hours or stopping working entirely during school closures to care for their children.

Our paper is similar to that of Dang and Nguyen (2020); however, it differs from the existing literature in several ways. Unlike Dang and Nguyen (2020), we do not consider the first quarter of 2020 as a control group because Vietnam was affected by COVID-19 at the end of January of that year due to its common border with China. Instead, we use the corresponding months of 2019 as a control group. In addition, we use the estimation results of COVID-19's impact on income in different industries to simulate the change in household poverty status and inequality.

III. Conceptual framework

In this section, we explain the identification strategy used to estimate COVID-19's impact on poverty and inequality. First, the change in income due to COVID-19 was estimated by industry using difference-in-differences estimation and various editions of the LFS. Then, COVID-19's impact on poverty and inequality was simulated based on those results, remittance scenarios and the Vietnam Household Living Standards Survey 2018.

3.1 Difference-in-differences estimation

We use the difference-in-differences method to estimate COVID-19's short-term impact on individuals' income by economic sector in Vietnam. The COVID-19 pandemic, which broke out in 2020, can be considered a shock. Basically, the model assumes that income growth is constant over time,

especially in the short term, therefore, income in the COVID-19 period can be estimated in the case without the COVID-19 pandemic. In this paper, we focus on quarterly income growth to show how COVID-19 significantly impacted income during the most heavily hit quarters. We assume that, in a natural (non-COVID-19) situation, the income growth observed between two successive quarters is composed of two effects: natural (yearly) growth + a quarterly seasonality effect.

$$\Delta Y(T0,T1|COVID) = E\left(Y_{Covid}^{2020,T1}\right) - E\left(Y_{No\ Covid}^{2020,T0}\right)_{\text{Average Growth + Quarterly Seasonality Effect + Quarterly Covid Effect}} - E\left(Y_{No\ Covid}^{2020,T1}\right) - E\left(Y_{No\ Covid}^{2020,T0}\right)_{\text{Average Growth + Quarterly Seasonality Effect}} \quad (1)$$

Since the average income in $2020, T1$ without the effect of COVID-19 is not known, and the assumption of constancy of growth over the years is checked, the component $E\left(Y_{No\ Covid}^{2020,T1}\right) - E\left(Y_{No\ Covid}^{2020,T0}\right)$ is replaced by $E\left(Y_{No\ Covid}^{2019,T1}\right) - E\left(Y_{No\ Covid}^{2019,T0}\right)$.

In the econometric model, we use the log of income, and then the expected difference represents expected growth. By using the difference-in-differences model, our model of interest to be estimated can be rearranged into the following econometric model:

$$Y_{ip} = \alpha + \sum_{t=1}^{4} \beta_t D_t + \gamma T + \sum_{t=1}^{4} \delta_t (D_t * T) + \theta X_{ip} + \vartheta p + \varepsilon_{ip} \quad (2)$$

The values of D_t and T are assigned in Table 1. X_{ip} represents individual characteristics including age, age squared, gender (males vs. females – the reference group), education level (i.e., primary education incomplete – the reference group, primary education completed, lower secondary education completed, upper secondary education completed, vocational education completed and college or above completed). The coefficient ϑ captures province fixed effects. All standard errors are clustered at the provincial level.

To run regressions for Equation (2), we first append LFS 2020 and LFS 2019, and then append LFS 2019 and LFS 2018. LFS 2019 appears two times in our dataset. Note that data was not available for the fourth quarter of 2020, so we examine the change in income only in the first three quarters of 2020. And we use the data for the first three quarters of 2018 and 2019 to be consistent with the data in LFS 2020.

Table 1. Treatment and control group assignment

Year		D_1	D_2	D_3	D_4	T
2020	First quarter	1	0	0	0	1
	Second quarter	0	1	0	0	1
	Third quarter	0	0	1	0	1
	Fourth quarter	0	0	0	1	1
2019	First quarter	0	0	0	0	1
	Second quarter	0	0	0	0	1
	Third quarter	0	0	0	0	1
	Fourth quarter	0	0	0	0	1
2019	First quarter	1	0	0	0	0
	Second quarter	0	1	0	0	0
	Third quarter	0	0	1	0	0
	Fourth quarter	0	0	0	1	0
2018	First quarter	0	0	0	0	0
	Second quarter	0	0	0	0	0
	Third quarter	0	0	0	0	0
	Fourth quarter	0	0	0	0	0

Now, the easiest model, in which we compare only income growth from one year to the next, can be reduced to:

$$\Delta Y(\boldsymbol{Year_{2020}}, \boldsymbol{Year_{2019}}|\boldsymbol{COVID}) = \boldsymbol{E}(\boldsymbol{Y^{2020}_{Covid}}) - \underbrace{\boldsymbol{E}(\boldsymbol{Y^{2020}_{No\ Covid}})}_{\boldsymbol{Average\ Yearly\ Growth\ +\ Yearly\ Covid\ Effect}} - \boldsymbol{E}(\boldsymbol{Y^{2019}_{No\ Covid}}) - \underbrace{\boldsymbol{E}(\boldsymbol{Y^{2019}_{No\ Covid}})}_{\boldsymbol{Average\ Yearly\ Growth}} \quad (3)$$

Then, from Equation (3), the econometric model can be simplified to what follows (see also Table 2).

$$Y_{ip} = \alpha + \beta D + \gamma T + \delta(D * T) + \theta X_{ip} + \vartheta p + \varepsilon_{ip} \quad (4)$$

Table 2. Dataset organization

Year	D	T
2020	1	1
2019	0	1
2019	1	0
2018	0	0

3.2. Simulation model

As for household welfare, COVID-19 can generate multiple shocks, such as a reduction in labor supply, an increase in prices, and a decrease in remittances. Also, the starting time, duration and extensiveness of these shocks can vary and affect individual households differently. Given the complexity of COVID-19 shocks, the proposed micro-simulation tries to synthesize COVID-19's overall impact and to quantify the effect attributable to the different channels. Formally, we assume that the impact COVID-19 shocks have on welfare can be approximated by aggregating the effect of the main channels of impact. If we denote the welfare of household h at time t_0 by w_{h,t_0}, the change in welfare due to COVID-19 shocks is:

$$\Delta w_{h,t_1} = \sum_{i=1}^{I} \quad f_i\left(\Delta F_{h,i,t_1}\right) \tag{5}$$

where $\Delta F_{h,i,t_1}$ denotes the variation in factor i between t_0 and t_1 for household h, and f_i is the approximation function linking the money metric welfare and factor i. The two most commonly used proxies of household welfare are per capita expenditures and per capita income, depending on the country. The factors that are expected to affect welfare are remittances, labor income (distinguished by economic sector, source, etc.), public transfers, and consumer prices (where relevant in such a short time as the period in question).

Period of analysis and period of interest: Since the intensity of changes in the different factors considered can vary over time, it may be helpful to assess impact in the shorter term, the longer term, and even periodically. We therefore need to determine the time unit of welfare (e.g., monthly revenue) as well as the time period of interest (e.g., March to September).

Note that (monetary) welfare depends on two main factors: consumer prices and (nominal) disposable income. Consumer prices are closely related to producer prices. In addition, consumer prices are related to the fluidity of the distribution and commercialization of goods. For producers, an increase in the cost of inputs increases their prices. In distribution and commercialization chains, any turbulence that causes a partial stock shortage reduces supply and increases prices. Note that some prices may even decrease with COVID-19, like those of energy products and, potentially, durable goods.

Household disposable income depends on certain factors. Let's assume, for instance, that it includes:

The net income earned by each active member of a household, by economic sector

Household internal and external remittances

Public transfers (including those existing before COVID-19 and those introduced after COVID-19 broke out)

To assess COVID-19's impact on welfare, we need to estimate the amount of income earned in each sector and by each active member of a household. Household surveys usually contain information on whether a household member is active (in the labor market) and which economic sector they work in. Note that in some cases, we find a large number of respondents did not report their income in the survey.

Labor income variation: The assumption is that the labor/salary variation affects only households with active members and non-zero labor income. If we denote average household labor income of household h operating in sector s at time t as $r_{h,s,t}$, and the number of active members working in sector s as $n_{h,s,t}$, then the total household labor income is:

$$R_{h,t} = \sum_{s} n_{h,s,t} r_{h,s,t}$$

and its change with respect to time t_0 is:

$$\Delta R_{h,t_{0,1}} = \sum_{s} n_{h,s,t} \Delta r_{h,s,t_{0,1}}$$

Note that $n_{h,s,t}$ can change over time as well if, for example, workers move from one economic sector to another or become unemployed between the two periods. To estimate such a change, we calibrate the total number of workers in sector s at time t according to the official employment statistics (or estimates) and based on an individual's probability of working in sector s (the "job queuing" approach). In other words, if the total number of workers in sector s decreased by 10 percent due to COVID-19, then the status of the 10 percent of workers in sector s with the lowest probability of being in that sector is changed to "unemployed."

IV. Dataset

In this study, we use the 2018 edition of the nationally representative Vietnam Household Living Standards Survey (VHLSS) conducted by the General Statistics Office of Vietnam to simulate poverty and inequality levels in 2020 in the context of COVID-19. It provides a lot of information about households and individuals, such as age, gender, education level, remittances, expenditures, employment status and income. The VHLSS 2018 includes 9,396 households. We rely on per capita household expenditures to calculate the poverty rate. The poverty line was VND 11.97 million in 2018.

We also consider the 2020 edition of the provincially representative LFS in this study. This survey provides a lot of labor market information on individuals, such as income, employment status and monthly hours worked, and is conducted quarterly.

Furthermore, we rely on the World Bank's COVID-19 High-Frequency Phone Surveys of

Households in Vietnam, which uses the 2018 edition of a nationally representative household survey as its sampling frame. These household surveys are conducted by the Mekong Development Research Institute under the supervision of the World Bank. The first round of the survey was carried out among 6,300 households between June 5 and July 8, 2020. The second round of the survey was conducted between July 27 and August 12, 2020. The third round was to be conducted between September 9 and October 1, 2020, and the fourth and fifth rounds, in January and March 2021, respectively.

Table 3 provides some details about the average proportion and average income of male and female workers by sector. One can expect that COVID-19 will have a larger negative impact on the welfare of female workers in service sectors, such as the trade, restaurant and hotel, communication, science and recreation sectors. This is because the average proportion of female workers and the average wage for female workers are high in these sectors.

Table 3. Distribution of the average proportion and average income of workers by gender across 17 sectors

Sector	Impact on income (T1)	Male		Female	
		Average proportion of workers	*Average income*	*Average proportion of workers*	*Average income*
Agriculture	0.000	0.9888	3,727.4	0.5137	3,297.8
Mining	0.000	0.0096	809.6	0.0026	95.3
Production	-0.150	0.3909	22,122.7	0.3349	19,801.6
Utility	-0.148	0.0117	985.6	0.0044	325.9
Construction	-0.180	0.1962	11,577.1	0.1074	6,825.9
Trade	-0.148	0.2794	6,782.3	0.3071	8,684.9
Transport	0.038	0.0665	3,791.1	0.0601	3,594.4
Restaurant and hotel	-0.153	0.0835	1,609.7	0.1229	2,390.9
Communication	-0.156	0.0103	1,260.8	0.0163	1,735.8
Finance	-0.090	0.0189	2,390.4	0.0291	3,124.5
Real estate	-0.196	0.0124	689.3	0.0132	763.7
Science	-0.210	0.0135	1,272.8	0.0162	2,283.8
Support services	-0.161	0.0117	841.1	0.0168	1,571.5
Government	-0.044	0.0609	4,374.0	0.0674	6,047.2
Education	-0.077	0.0780	5,992.3	0.0812	6,621.5
Health	-0.073	0.0231	1,988.3	0.0277	2,510.0
Recreation	-0.138	0.0099	379.9	0.0110	**427.0**

V. Empirical results

On January 23, 2020, the first confirmed case of COVID-19 was reported in Vietnam. On January 31, the government ordered the cancellation of all flights between Vietnam and infectious regions in China. All schools were closed from February to the end of April that year. On March 31, 2020, the government ordered a nationwide 15-day isolation period, from April 1 to 15. It then extended that

period to April 23, 2020.

V.1 Difference-in-differences results

Columns 1 and 2 of Table 4 provide estimation results for Equations (4) and (2), respectively. The estimates show that workers' monthly income decreased by 4.1 percent in 2020 due to the COVID-19 pandemic. When the pandemic's impact is broken down by quarter, we find that workers' monthly income was heavily affected in the second quarter. This is because the government implemented a nationwide lockdown in April 2020. COVID-19 decreased monthly income by 4.9 percent in the first quarter, 7.5 percent in the second quarter and 4 percent in the fourth quarter of that year. Although it was successfully contained in Vietnam, the economy was still affected due to restrictions on international and domestic flights, and a decrease in exports and imports.

Table 4. Difference-in-differences estimates of monthly income

	Log of monthly income	
	(1)	(2)
D_T	-0.041**	
	(0.016)	
D1_T		-0.049***
		(0.014)
D2_T		-0.075***
		(0.015)
D3_T		0.010
		(0.018)
D4_T		-0.040*
		(0.023)
T	0.058***	0.058***
	(0.009)	(0.009)
D	0.058***	
	(0.009)	
D1		0.046***
		(0.011)
D2		0.042***
		(0.009)
D3		0.059***
		(0.010)
D4		0.087***
		(0.011)
N	1,492,376	1,492,376
adj. R^2	0.313	0.314

Notes: Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions control for individual characteristics, including age, age squared, gender (males vs. females – the reference group), education level (i.e., primary education incomplete – the reference group, primary education completed, lower secondary education completed, upper secondary education completed, vocational education completed and college or above completed) and province fixed effects. All standard errors are clustered at the provincial level.

The literature on gender gap decomposition has consistently shown large unexplained gaps exist in Vietnam (Liu, 2004; Pham and Reilly, 2007). Examining COVID-19's impact on income by gender is therefore also of interest. During the COVID-19 period in question, women's income may have decreased more than men's. We use a three-way interaction between D, T and a dummy variable for gender to test this hypothesis. Table 5 reports the three-way interaction results for the sample as a whole and by sector. We find that COVID-19's impact on females' income is similar to its impact on males' income. In the trade sector, COVID-19 had a 5.8 percent greater negative impact on females' income than on males' income. And females' income was hit 15.5 percent, 11.9 percent and 12.7 percent harder than males' income in the transport, science and support services sectors, respectively. We find no evidence of a statistical difference between COVID-19's impact on females' income and males' income in other sectors, including the agriculture, mining, production, utility, construction, restaurant and hotel, communication, finance, real estate, government, education, health, and recreation sectors.

Table 5. Heterogeneity analysis by gender

#	Sector	D*T*Gender	N	adj. R^2
	Whole sample	**0.011**	**1,492,376**	**0.313**
1	Agriculture	-0.035	468,448	0.360
2	Mining	-0.013	6,250	0.323
3	Production	0.006	271,410	0.278
4	Utility	-0.055	12,213	0.348
5	Construction	0.012	133,358	0.255
6	Trade	0.058***	205,727	0.189
7	Transport	0.155***	58,062	0.232
8	Restaurant and hotel	-0.033	78,296	0.175
9	Communication	-0.037	10,703	0.350
10	Finance	0.007	15,617	0.277
11	Real estate	0.026	7,003	0.222
12	Science	0.119**	8,957	0.294
13	Support services	0.127**	9,839	0.248
14	Government	0.043	62,988	0.380
15	Education	0.031	75,087	0.389
16	Health	-0.023	22,060	0.326
17	Recreation	0	8,953	0.263

Notes: Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions control for the interaction between D and gender, the interaction between T and gender, the interaction between D and T, T, D, and individual characteristics, including age, age squared, gender (males vs. females – the reference group), education level (i.e., primary education incomplete – the reference group, primary education completed, lower secondary education completed, upper secondary education completed, vocational education completed and college or above completed) and province fixed effects. All standard errors are clustered at the provincial level.

Now we examine the COVID-19 pandemic's impact on monthly income by economic sector and

quarter. Table 6 reports the regressions of Equation (2), which indicate that mining workers' monthly income was not affected by the pandemic in the first three quarters of 2020, however, they increased by 15.2 percent in the fourth quarter of 2020. Also, agriculture workers' income was the least affected by COVID-19 pandemic. We find evidence of the COVID-19 pandemic having a positive effect on agriculture workers' income in the third and fourth quarters of 2020. The income of workers in the production, construction, trade, transport, restaurant and hotel, real estate, support services, education and recreation sectors was heavily affected, especially in the fourth quarter of 2020. For instance, the pandemic decreased trade workers' income by 11.4 percent, 14.4 percent, 3.3 percent and 48.9 percent in the first, second, third and fourth quarters of 2020, respectively. Likewise, restaurant and hotel workers' income decreased by 11.6 percent, 16.6 percent and 30.1 percent in the first, second and fourth quarters of 2020, respectively. While the income of transport workers was very mildly affected, that of utility workers was also relatively affected, with income in this latter sector falling by 11 percent, 8.5 percent and 10.2 percent in the first, second and third quarters of 2020, respectively.

Table 6. Difference-in-differences estimates of monthly income by economic sector

#	Sector	D1_T	D2_T	D3_T	D4_T	*N*	adj. R^2
1	Agriculture	-0.018	-0.023	0.090***	0.266***	468,448	0.363
2	Mining	-0.015	0.011	-0.007	0.152***	6,250	0.326
3	Production	-0.114***	-0.143***	-0.119***	0.003	271,410	0.281
4	Utility	-0.110***	-0.085**	-0.102***	-0.024	12,213	0.348
5	Construction	-0.141***	-0.155***	-0.160***	-0.095***	133,358	0.256
6	Trade	-0.114***	-0.144***	0.033*	-0.480***	205,727	0.204
7	Transport	0.039**	-0.008	0.112***	-0.219***	58,062	0.239
8	Restaurant and hotel	-0.116***	-0.166***	0.011	-0.301***	78,296	0.182
9	Communication	-0.117***	-0.192***	-0.05	0.003	10,703	0.353
10	Finance	-0.051*	-0.087*	-0.064**	-0.185***	15,617	0.28
11	Real estate	-0.151**	-0.175***	-0.111**	-0.116***	7,003	0.222
12	Science	-0.164***	-0.126***	-0.061	-0.075**	8,957	0.294
13	Support services	-0.128***	-0.156***	-0.083*	-0.264***	9,839	0.249
14	Government	-0.012	-0.008	-0.006	-0.171***	62,988	0.382
15	Education	-0.045***	-0.072***	-0.072***	-0.304***	75,087	0.398
16	Health	-0.04	-0.073***	-0.029	-0.056	22,060	0.327
17	Recreation	-0.129***	-0.190***	-0.027	-0.214***	8,953	0.267

Notes: Standard errors are in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01. All regressions control for T, D1, D2, D3, D4 and individual characteristics, including age, age squared, gender (males vs. females – the reference group), education level (i.e., primary education incomplete – the reference group, primary education completed, lower secondary education completed, upper secondary education completed, vocational education completed and college or above completed) and province fixed effects. All standard errors are clustered at the provincial level.

As for the rest of the sectors, the estimation results show workers in most of them saw their income affected in the fourth quarter of 2020. For instance, education workers' monthly income fell by 4.5 percent, 7.2 percent, 7.2 percent and 30.4 percent in the first, second, third and fourth quarters of

2020, respectively. Likewise, in the recreation sector, we find workers' monthly income decreased by 12.9 percent, 19 percent and 21.4 percent in the first, second and fourth quarters of 2020, respectively. The income of workers in the finance, government and health sectors seems to have been less affected. Finance workers' income declined by 9 percent, 16.8 percent and 14.7 percent in the first, second and third quarters of 2020 (Column 1). Government workers' income decreased only in the fourth quarter of 2020, by 17.1 percent.

Our estimation results would be biased if the usual growth from one quarter to another were not the same due to the seasonality effect. If this were the case, it would also mean that the seasonality effect on income between the first and second quarters of 2019 was the same as that between the first and second quarters of 2018. We use the 2017, 2018 and 2019 editions of the LFS to test this hypothesis. Organization of the new dataset is the same as the old dataset containing the 2018, 2019 and 2020 editions of the LFS. However, LFS 2019 in the new dataset is considered as LFS 2020 in the old dataset. Similarly, LFS 2018 and LFS 2017 in the new dataset are considered as LFS 2019 and LFS 2018 in the old dataset, respectively. We expect the interaction between D and T in Equation (4) to be either not statistically significant or statistically significant but the magnitude of the coefficients of the interaction is small. Also, we expect the interactions between D1, D2, D3, D4 and T in Equation (2) to be either not statistically significant or statistically significant but the magnitude of the coefficients of the interactions is small.

Table 7 reports the estimation results for Equations (4) and (2) for the new dataset containing the 2017, 2018 and 2019 editions of the LFS. The estimate is not statistically significant for the D_T interaction (Column 1). This suggests that monthly income growth between 2019 and 2018 is similar to that between 2018 and 2017. If we examine monthly income growth by quarter of 2019 (Column 2), we can see that growth in the first, second and third quarters of 2019 and 2018 is not statistically different from that in the first, second and third quarters of 2018 and 2017. The result is positive and statistically significant at around 10 percent; however, the magnitude of the coefficient is small. These findings suggest that our estimates of the pandemic's impact on income are unbiased.

Table 7. Robustness checks

	Log of monthly income	
	(1)	(2)
D_T	0.009	
	(0.011)	
D1_T		0.012
		(0.014)
D2_T		-0.001
		(0.012)
D3_T		0.010
		(0.013)
D4_T		0.021*
		(0.012)
T	0.049***	0.049***

	(0.007)	(0.007)
D	0.049***	
	(0.007)	
D1		0.035***
		(0.007)
D2		0.042***
		(0.007)
D3		0.049***
		(0.008)
D4		0.065***
		(0.008)
N	1542229	1542229
adj. R^2	0.315	0.315

Notes: Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions control for individual characteristics, including age, age squared, gender (males vs. females – the reference group), education level (i.e., primary education incomplete – the reference group, primary education completed, lower secondary education completed, upper secondary education completed, vocational education completed and college or above completed) and province fixed effects. All standard errors are clustered at the provincial level.

Now we perform robustness checks for individual economic sectors. Table 8 reports the estimation results of falsification tests for the four quarters of 2019. We find that in nearly all economic sectors, either workers' income in the first, second, third and fourth quarters of 2019 is not statistically different than in the first, second, third and fourth quarters of 2018, respectively, or the result has an unexpected sign. The difference in income is statistically significant in some sectors; however, the magnitude of the coefficient of the interactions D1_T, D2_T, D3_T and D4_T is small and positive.

Table 8. Robustness checks by economic sector

#	Sector	D1_T	D2_T	D3_T	D4_T	*N*	adj. R^2
1	Agriculture	0.012	0.008	0.011	0.045*	336,844	0.382
2	Mining	-0.033	-0.006	-0.03	-0.014	4,627	0.369
3	Production	0.044***	0.013	0.020*	0.018*	176,031	0.292
4	Utility	0.063	0.035	0.05	0.03	8,173	0.358
5	Construction	0.064***	0.048***	0.063***	0.033***	86,620	0.274
6	Trade	0.036**	0.022	0.022*	0.024**	139,748	0.205
7	Transport	-0.022	-0.048***	-0.033*	0.016	38,631	0.238
8	Restaurant and hotel	0.02	-0.019	-0.015	-0.023	52,777	0.194
9	Communication	0.057**	0.078***	0.093***	0.055**	7,392	0.377
10	Finance	0.023	-0.01	0.007	-0.003	10,092	0.309
11	Real estate	0.109*	0.087**	0.074	0.075*	4,341	0.209
12	Science	0.131***	0.051	0.087*	0.058	5,579	0.287
13	Support services	0.06	0.001	0.041	0.038	6,491	0.259
14	Government	0.054***	0.006	0.004	0.031*	47,160	0.414
15	Education	0.037***	0.016	0.009	0.028***	53,949	0.457
16	Health	0.005	0.041*	0.032	0.009	14,932	0.343
17	Recreation	0.035	-0.012	0.025	0.052	6,266	0.274

Notes: Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions control for individual characteristics,

including age, age squared, gender (males vs. females – the reference group), education level (i.e., primary education incomplete – the reference group, primary education completed, lower secondary education completed, upper secondary education completed, vocational education completed and college or above completed) and province fixed effects. All standard errors are clustered at the provincial level.

VI. Simulation results

We simulate the COVID-19 pandemic's impact on household per capita expenditures and poverty based on the above difference-in-differences estimation results. We rely on the VHLSS 2018 to calculate household per capita expenditures and poverty in the different sectors.

Table 9 provides the simulation results for poverty headcount, which show that the poverty rate increases slightly from 10.53 percent to 11.11 percent during the COVID-19 pandemic period. If we examine households by sector, we find that poverty rate increases only slightly in some sectors. For example, the poverty rate of households working in the agriculture and trade sectors increases by 0.15 percent and 1.51 percent, respectively. When it comes to the gender of the household head, the results show a very small increase in the poverty rate for both male- and female-headed households. The poverty rate increases more in the urban area than in the rural area. It changed very little in the rural area—just 0.47 percent. Although workers' income declines significantly across all sectors, the poverty rate increases only very slightly. This could be because the poverty rate was very low in 2018. Furthermore, the government successfully controlled the COVID-19 pandemic, which mitigated the economic losses related to it. The poverty rate increases 0.26 percent in the Southeast and 1.28 percent in the Mekong River Delta.

Table 9. Poverty headcount and simulated scenario

Groups	Initial Level	Scenario Level	Scenario Change
Sector of employment			
Non-active	5.18%	5.96%	0.78%**
Agriculture	22.04%	22.19%	0.15%**
Mining	8.52%	8.52%	0.00%
Production	2.43%	2.49%	0.06%
Utility	8.67%	8.67%	0.00%
Construction	5.75%	6.04%	0.29%
Trade	3.07%	4.58%	1.51%***
Transport	0.84%	1.96%	1.12%
Restaurant and hotel	0.61%	6.35%	5.74%
Communication	0.00%	0.00%	0.00%
Finance	0.00%	0.00%	0.00%
Real estate	0.00%	0.00%	0.00%
Science	0.00%	0.00%	0.00%
Support services	0.00%	1.08%	1.08%
Government	1.41%	1.41%	0.00%
Education	2.30%	2.30%	0.00%
Health	2.28%	2.28%	0.00%
Recreation	0.00%	0.00%	0.00%
Gender of household head			
Male	11.48%	11.98%	0.51%***
Female	6.89%	7.74%	0.85%**
Area			
Urban	1.42%	2.23%	0.81%*
Rural	14.88%	15.35%	0.47%***
Region			
Red River Delta	1.12%	1.45%	0.32%
Northern Uplands	18.32%	19.39%	1.07%
Northwest	44.72%	45.44%	0.72%
North Central Coast	16.07%	16.30%	0.23%

South Central Coast	11.22%	11.42%	0.21%
Central Highlands	23.27%	23.81%	0.54%
Southeast	1.21%	1.47%	0.26%*
Mekong River Delta	6.39%	7.67%	1.28%***
Population	**10.53%**	**11.11%**	**0.58%*** **

Notes: The poverty measurement is the headcount. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Significance levels are reported only for the change statistic.

When it comes to the absolute value of poverty, Table 10 indicates that agriculture is the sector in which the largest number of households (78,556) fall into poverty. The construction sector ranks second, with 71,189 households falling into poverty due to the COVID-19 pandemic. Also, 56,177 households working in production fall into poverty. In terms of the gender of the household head, three times more male-headed households fall into poverty due to the pandemic than female-headed households. Similarly, nearly six times more rural households fall into poverty than urban households. Although the COVID-19 pandemic affects all people, the number of poor households increases only in the Southeast and the Mekong River Delta, with 45,900 households falling into poverty in the former region and 218,954 households doing so in the latter region.

Table 10. Number of poor households and simulated scenario

Groups	Initial Level	Scenario Level	Scenario Change
Sector of employment			
Non-active	898,467	923,225	24,758
Agriculture	8,514,292	8,592,847	78,556**
Mining	36,919	36,919	0
Production	241,969	298,146	56,177**
Utility	42,381	42,381	0
Construction	635,159	706,348	71,189**
Trade	319,780	319,780	0
Transport	28,636	28,636	0
Restaurant and hotel	17,496	27,960	10,464
Communication	0	0	0
Finance	0	0	0
Real estate	0	0	0
Science	0	0	0
Support services	0	5,536	5,536
Government	36,673	36,673	0
Education	46,783	46,783	0
Health	19,953	19,953	0
Recreation	0	0	0
Gender of household head			
Male	9,384,777	9,569,844	185,067***
Female	1,453,728	1,515,341	61,613**
Area			
Urban	471,661	506,908	35,246*
Rural	10,366,843	10,578,277	211,434***
Region			
Red River Delta	234,242	301,421	67,180
Northern Uplands	2,407,191	2,548,348	141,157
Northwest	2,096,013	2,129,653	33,640

North Central Coast	1,954,950	1,983,182	28,232
South Central Coast	1,062,414	1,081,934	19,520
Central Highlands	1,771,507	1,812,626	41,119
Southeast	215,173	261,073	45,900*
Population	**10,838,505**	**11,085,185**	**246,680*** **

Notes: The poverty measurement is the total number of poor households. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Significance levels are reported only for the change statistic.

Table 11 presents the simulated estimates of average per capita expenditures. The COVID-19 pandemic decreases households' per capita expenditures in all sectors, with expenditures falling by 3.55 percent on average. Households working in the trade sector see the largest decrease in per capita expenditures due to COVID-19, at 9.33 percent. Households working in the restaurant and hotel sector rank second, at 6.76 percent. The per capita expenditures of households working in the support services, education and recreation sectors decline by 4.87 percent, 5.3 percent and 5.6 percent, respectively. Female-headed households see their per capita expenditures affected by the COVID-19 pandemic more than male-headed households do, and urban households are harder hit than rural households. We find that households' per capita expenditures decrease in all regions, but do so the most (4 percent) in the North Central Coast region and the least (2.26 percent) in the Northwest region.

Table 11. Average per capita expenditures and simulated scenario

Groups	Initial Level	Scenario Level	Scenario % Change
Sector of employment			
Non-active	11,228.93	10,901.26	-2.92%***
Agriculture	5,836.65	5,750.25	-1.48%***
Mining	7,571.75	7,468.77	-1.36%***
Production	9,485.34	9,359.98	-1.32%***
Utility	9,304.85	9,129.87	-1.88%***
Construction	7,182.28	6,978.72	-2.83%***
Trade	11,758.89	10,662.07	-9.33%***
Transport	11,344.54	10,801.89	-4.78%***
Restaurant and hotel	10,685.18	9,962.65	-6.76%***
Communication	16,089.86	15,623.82	-2.90%***
Finance	20,807.32	20,125.44	-3.28%***
Real estate	13,372.91	13,021.84	-2.63%***
Science	17,551.06	17,170.12	-2.17%***
Support services	14,854.00	14,130.16	-4.87%***
Government	12,609.03	12,118.62	-3.89%***
Education	12,376.03	11,719.75	-5.30%***
Health	14,558.14	14,383.62	-1.20%***
Recreation	8,802.64	8,309.29	-5.60%***
Gender of household head			
Male	8,373.02	8,093.90	-3.33%***
Female	10,581.27	10,135.82	-4.21%***

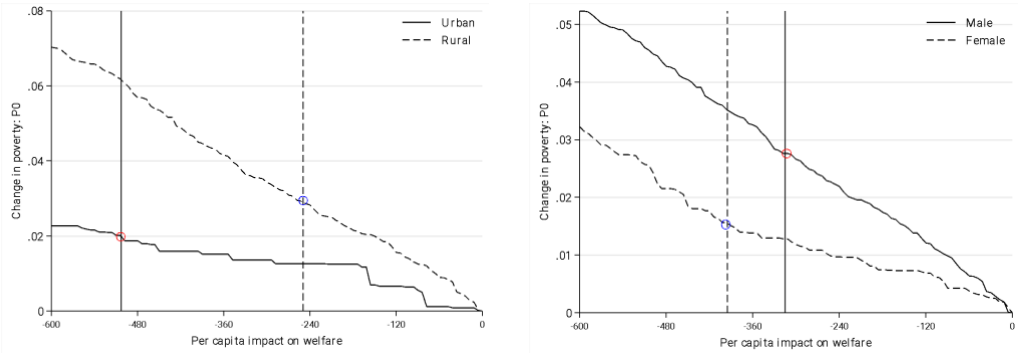
Area			
Urban	13,512.38	12,925.01	-4.35%***
Rural	6,592.90	6,410.28	-2.77%***
Region			
Red River Delta	11,138.55	10,760.49	-3.39%***
Northern Uplands	6,941.19	6,746.73	-2.80%***
Northwest	4,331.76	4,233.95	-2.26%***
North Central Coast	6,579.12	6,315.97	-4.00%***
South Central Coast	8,468.20	8,149.59	-3.76%***
Central Highlands	7,246.95	7,012.48	-3.24%***
Southeast	12,595.38	12,103.86	-3.90%***
Mekong River Delta	7,266.21	6,999.42	-3.67%***
Population	**8,826.16**	**8,512.91**	**-3.55%***

Notes: The statistic is the average. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Significance levels are reported only for the change statistic.

The change in poverty headcount depends on several factors, including the extent of COVID's negative impact on welfare, in what extent the government has mitigated its impact, and the non-poor population's vulnerability to poverty. The further non-poor households are from the poverty line, the less vulnerable they fall into poverty. To better illustrate this case, we draw the poverty vulnerability curves, which indicate change in poverty according to the negative impact on or decrease in welfare that every individual in a given population experiences. As we can observe in Figure 1-A, rural households are more vulnerable than urban ones. However, in absolute terms, the impact is larger for urban households. Similarly, male-headed households are more vulnerable than female-headed ones, but on average, the extent of the impact on welfare is larger for female-headed households.

Figure 1. Household change in poverty and poverty measurement (P0)

Panel A **Panel B**



Notes: P0 is initial poverty rate.

As for the Gini index, which measures inequality, our simulation estimates of it are reported in Table 12 and indicate a very slight increase (0.0018 points) in inequality. Inequality decreases slightly, by 0.0014 points, for households working in agriculture. Rural households also experience a slight decrease in inequality, while urban households see a small increase, of 0.0052 points. Households working in support services see the largest increase in inequality, of 0.0088 points, and those working

in trade see the second-largest increase, of 0.0087 points. Also, the inequality experienced by households working in the restaurant and hotel, and health sectors increases by 0.0080 points and 0.0032 points, respectively. Male-headed households experience a decrease in inequality, while female-headed households do not. Although households' per capita expenditures decrease in all regions in Vietnam, inequality tends to decrease in the Northern Uplands, Northwest, North Central Coast and Central Highlands regions, and remains unchanged in the Red River Delta, South Central Coast, Southeast and Mekong River Delta regions.

Table 12. Gini index and simulated scenario

Groups	Initial Level	Scenario Level	Scenario Change
Sector of employment			
Non-active	0.3916	0.3945	0.0029***
Agriculture	0.3293	0.3279	-0.0014***
Mining	0.3138	0.3138	0.0000
Production	0.2929	0.2936	0.0007
Utility	0.3529	0.3521	-0.0009
Construction	0.2829	0.2809	-0.0020***
Trade	0.3377	0.3464	0.0087***
Transport	0.3393	0.3415	0.0021
Restaurant and hotel	0.3096	0.3176	0.0080***
Communication	0.3362	0.3342	-0.0020
Finance	0.2550	0.2565	0.0015
Real estate	0.3504	0.3507	0.0003
Science	0.3243	0.3265	0.0022
Support services	0.2803	0.2891	0.0088***
Government	0.3214	0.3267	0.0053
Education	0.2822	0.2834	0.0012
Health	0.3243	0.3276	0.0032*
Recreation	0.2419	0.2417	-0.0002
Gender of household head			
Male	0.3705	0.3685	-0.0020***
Female	0.3670	0.3671	0.0001
Area			
Urban	0.3329	0.3381	0.0052***
Rural	0.3170	0.3147	-0.0023***
Region			
Red River Delta	0.3298	0.3301	0.0003
Northern Uplands	0.3832	0.3797	-0.0035***
Northwest	0.3980	0.3907	-0.0073***

North Central Coast	0.3331	0.3267	-0.0064***
South Central Coast	0.3459	0.3464	0.0004
Central Highlands	0.4230	0.4166	-0.0065***
Southeast	0.3373	0.3390	0.0017
Mekong River Delta	0.2992	0.2975	-0.0017
Population	**0.3734**	**0.3717**	**-0.0018*** **

Notes: The statistic is the average. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Significance levels are reported only for the change statistic.

When it comes to gender-related issues, impacts are usually computed for female-headed households or male-headed households. However, these computations do not cover the male and female populations strictly speaking. Furthermore, it is also necessary to evaluate COVID-19's impact on children. We therefore estimate the main statistics of interest for three population groups: adult males (who are male and aged over 15), adult females (who are female and aged over 15) and children (who are aged 15 and under 15).

The simulation results for those three populations are provided in Table 13. We find that the change in per capita expenditures is similar among all three populations due to COVID-19's impact by sector, gender of the household head, area and region.

In terms of the number of poor people, we find that the number of poor males and females increases the most in the agriculture sector and second-most in the construction sector. However, the number of poor children increases more in the construction sector than the agriculture sector, by 58,521 and 30,466, respectively. The COVID-19 pandemic causes the number of poor females to increase more than the number of poor males in the agriculture sector, by 70,742 and 62,213, respectively. The pandemic also results in an increase in the number of poor males, females and children in the production and trade sectors. The number of poor females grows more than the number of poor males in the production sector, while this result is reversed in the trade sector. In the production sector, COVID-19 causes the number of poor males, females and children to increase by 18,609, 31,051, and 18,507, respectively. Similarly, in the trade sector, COVID-19 causes the number of poor males, females and children to increase by 27,626, 24,786 and 19,702, respectively. When it comes to the gender of the household head, the results show that the number of poor males, females and children in female-headed households grows more than the number of poor males, females and children in male-headed households. Likewise, the number of poor males, females and children grows more in the rural area than in the urban area. However, we find no change in the number of poor males, females and children by region, except in the Mekong River Delta.

The change in poverty headcount of the male, female and child populations is reported in Columns 7 to 9 of Table 13, which show that the poverty rate of males, females and children increases

very little by sector, gender of the household head, area and region. These findings are corroborated by the Gini index simulation results, in which we find that COVID-19 has no or very little effect on the Gini index by sector, gender of the household head, area or region.

Table 13. Impact of COVID-19 on male, female and child populations

Population	Change in per capita expenditures			Change in number of poor people			Change in poverty headcount			Change in Gini index		
	Male (1)	Female (2)	Child (3)	Male (4)	Female (5)	Child (6)	Male (7)	Female (8)	Child (9)	Male (10)	Female (11)	Child (12)
Sector of employment												
Non-active	-2.92%***	-2.92%***	-2.92%***	38,636**	55,047**	42,473*	0.63%**	0.75%**	1.10%*	0.00***	0.00***	0.00**
Agriculture	-1.54%***	-1.50%***	-1.37%***	18,313*	21,620*	16,170*	0.13%*	0.15%*	0.15%*	-0.00***	-0.00***	-0.00***
Mining	-1.21%***	-1.35%***	-1.52%***	0	0	0	0.00%	0.00%	0.00%	0.00	0.00	-0.00
Production	-1.38%***	-1.42%***	-1.10%***	0	3,044	3,044	0.00%	0.08%	0.11%	0.00**	0.00	-0.00
Utility	-1.82%***	-2.05%***	-1.77%***	0	0	0	0.00%	0.00%	0.00%	0.00	-0.00	-0.00
Construction	-3.04%***	-2.90%***	-2.44%***	12,463	9,809	9,809	0.32%	0.25%	0.30%	-0.00	-0.00**	-0.00***
Trade	-9.59%***	-9.17%***	-9.21%***	50,219***	61,297**	45,694***	1.42%***	1.51%**	1.62%***	0.01***	0.01***	0.01***
Transport	-4.78%***	-4.89%***	-4.63%***	13,569	9,070	15,370	1.19%	0.69%	1.60%	0.00	0.00	0.00
Restaurant and hotel	-6.56%***	-6.77%***	-7.11%***	47,608	44,957	71,955	4.87%	3.82%	10.16%	0.01***	0.01***	0.01**
Communication	-4.20%**	-3.00%***	-1.85%***	0	0	0	0.00%	0.00%	0.00%	-0.00	-0.00	-0.00
Finance	-3.22%***	-3.31%***	-3.32%***	0	0	0	0.00%	0.00%	0.00%	0.00	0.00**	-0.00
Real estate	-3.03%***	-2.76%***	-1.65%***	0	0	0	0.00%	0.00%	0.00%	0.00	0.00	-0.00
Science	-2.00%***	-2.17%***	-2.34%***	0	0	0	0.00%	0.00%	0.00%	0.00	0.00	0.00
Support services	-4.92%***	-4.92%***	-4.71%***	1,384	1,384	2,768	0.65%	0.74%	2.52%	0.01***	0.01**	0.00
Government	-3.92%***	-3.75%***	-4.06%***	0	0	0	0.00%	0.00%	0.00%	0.01	0.00	0.01*
Education	-5.51%***	-5.29%***	-5.00%***	0	0	0	0.00%	0.00%	0.00%	0.00	0.00	0.00
Health	-1.40%***	-1.02%***	-1.23%***	0	0	0	0.00%	0.00%	0.00%	0.00	0.00**	0.00
Recreation	-5.44%***	-5.25%***	-7.10%***	0	0	0	0.00%	0.00%	0.00%	0.00	-0.00	-0.00
Gender of household head												
Male	-3.39%***	-3.35%***	-3.22%***	133,598***	129,256***	152,872**	0.45%***	0.44%***	0.68%**	-0.00***	-0.00***	-0.00***
Female	-4.35%***	-4.13%***	-4.17%***	48,593***	76,973**	54,411**	0.77%***	0.81%**	1.03%**	0.00	0.00	-0.00
Area												

Urban	-4.38%***	-4.32%***	-4.35%***	79,732**	86,913**	100,940	0.68%**	0.65%**	1.25%	0.01***	0.00***	0.00***
Rural	-2.82%***	-2.80%***	-2.64%***	102,459***	119,316***	106,342***	0.42%***	0.46%***	0.54%***	-0.00***	-0.00***	-0.00***
Region												
Red River Delta	-3.43%***	-3.33%***	-3.46%***	11,309	31,420	24,451	0.16%	0.38%	0.45%	0.00	0.00	-0.00
Northern Uplands	-2.87%***	-2.83%***	-2.66%***	37,484	37,484	66,189	0.82%	0.79%	1.73%	-0.00***	-0.00***	-0.00**
Northwest	-2.23%***	-2.37%***	-2.16%***	9,630	10,400*	13,610	0.64%	0.68%*	0.82%	-0.01***	-0.01***	-0.01***
North Central Coast	-4.07%***	-3.97%***	-3.96%***	7,751	12,731	7,751	0.19%	0.28%	0.21%	-0.01***	-0.01***	-0.01***
South Central Coast	-3.86%***	-3.68%***	-3.75%***	7,959	4,880	6,681	0.23%	0.14%	0.27%	0.00	0.00	0.00
Central Highlands	-3.06%***	-3.52%***	-3.05%***	19,830	11,196	10,094	0.75%	0.41%	0.45%	-0.00***	-0.01***	-0.01***
Southeast	-3.89%***	-4.03%***	-3.68%***	15,333*	16,985	13,583	0.24%*	0.24%	0.31%	0.00***	0.00	0.00
Mekong River Delta	-3.86%***	-3.62%***	-3.44%***	72,895***	81,134***	64,925***	1.16%***	1.21%***	1.57%***	-0.00	-0.00	-0.00
Population	**-3.59%*** **	**-3.58%*** **	**-3.43%*** **	**182,191****	**206,229****	**207,283*****	**0.51%*** **	**0.53%*** **	**0.75%*** **	**-0.00*** **	**-0.00*** **	**-0.00*** **

Notes: The statistic is the average. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

VII. Conclusion

In this paper, we used the Labor Force Survey 2020 and the difference-in-differences method to estimate the COVID-19 pandemic's impact on the income of workers in different sectors and quarters of 2020. Workers' monthly income was most heavily affected in the second quarter. Agriculture workers' income was least affected by the pandemic. Workers in the production, construction, trade, transport, restaurant and hotel, real estate, support services, education and recreation sectors saw their income heavily affected, especially in the second quarter of 2020.

We also simulated the COVID-19 pandemic's impact on household per capita expenditures and poverty based on the VHLSS 2018. Our simulation estimates show that the poverty rate increases slightly from 10.53 percent to 11.11 percent during the COVID-19 pandemic period, although workers' income decreases significantly across all sectors. The Gini index simulation results show a very slight increase (0.0014 points) in inequality. This could be because the poverty rate was very low in 2018. Although per capita expenditures decrease in all eight regions studied, the poverty rate and the number of poor people increase only in the Southeast and Mekong River Delta regions. Furthermore, the government successfully controlled the COVID-19 pandemic, which mitigated the economic losses related to it. Food prices did not increase in 2020, even during the lockdown period.

Our simulation results also show that poverty rate of female-headed households increased more than that of male-headed households. Likewise, the per capita expenditures of female-headed households decrease more than those of male-headed households. The households that receive remittances typically either have a female household head or have a greater number of female members. This can be because female-headed households receive more remittances than that male-headed households. Furthermore, migrants are generally male. Females generally stay behind to be responsible for the household and would then receive more remittances. This suggests that female-headed households would be more affected by the COVID-19 pandemic than male-headed households due to the reduction in remittances.

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