2024, Volume 47, Issue 93, 18-56/ ISSN 2304-4306

E C O N O M Í A

revistas.pucp.edu.pe/economia

www.fondoeditorial.pucp.edu.pe

Peru 2020-2021: Household Income, Consumption, and Savings during the Pandemic

Pedro Francke [a,*], Josué Benites Garnique [b]

[a]Pontificia Universidad Católica del Perú

✉ pfranck@pucp.edu.pe * Corresponding author

[b]Pontificia Universidad Católica del Perú

✉ jbenitesg@pucp.edu.pe

Abstract

Peru is among the countries hardest hit by the COVID-19 pandemic, experiencing significant losses in terms of lives and well-being. This study examines the income, expenditure, and savings patterns of Peruvian households amidst the pandemic, with a focus on rural/urban and formal/informal differences. Additionally, we analyze shifts in consumption, particularly regarding food and health expenditures. Utilizing data from the National Household Survey (ENAHO), we conducted a multi-period analysis at the quarterly level spanning 2019-2021, with the pre-pandemic quarter as the reference point. Our findings reveal substantial disparities between rural and urban areas, as well as within these segments based on the formal or informal employment status of household heads, regarding income, expenses, savings, and shifts in consumption patterns. While all segments experienced income reductions, rural households recovered swiftly but maintained reduced food consumption. Formal workers experienced less income loss and did not dissave, whereas urban informal workers were most affected in terms of income and food deprivation. Finally, we discuss how these findings can inform public policy discussions in Peru, particularly related to social protection.

Article History: Received: 26 October 2023 / Revised: 30 November 2023 / Accepted: 30 January 2024

Keywords: COVID-19, household behavior, welfare

JEL Classification: I3, D1

https://doi.org/10.18800/economia.202401.002

1. Introduction

The COVID-19 pandemic struck Peru with exceptional severity. With more than 200,000 deaths, Peru's per capita mortality rate ranks among the highest in the world. The socioeconomic impacts were equally severe. National poverty rates escalated from 20.2% in 2019 to 25.9% by 2021, initially hitting rural areas harder but subsequently showing a more significant increase in urban regions during 2020 and 2021. According to Peru's National Statistics Institute (INEI, 2022), between 2019 and 2021, real monthly per capita income decreased by 10.5%, and real monthly per capita expenditure dropped by 10.7%, with urban areas experiencing the most significant declines.

The COVID-19 pandemic has been the most significant health and economic crisis the world has seen in a century, underscoring the importance of its analysis to improve public policy effectiveness and strengthen preparedness for future challenges. In Peru, the outbreak coincided with a period of political instability, including the dissolution of Congress, presidential vacancies, and economic slowdown.

This study examines changes in income, consumption, and savings during the pandemic, focusing on differences between urban and rural settings and household employment patterns. The analysis covers 2020 and 2021, years of peak COVID-19 mortality and concurrent economic shocks, including significant rises in commodity prices and global inflation. These years also saw widespread quarantine and social distancing measures, economic policies supporting employment and household finances (such as bonuses), and direct impacts on households, including caregiving and education shifts. Due to the simultaneous nature and complex interplay of these factors with household income and consumption, this paper opts for a temporal analysis without isolating specific causes. It aims to provide a comparative analysis of income, consumption, and savings across urban and rural households. Using data from the National Household Survey (ENAHO), the study conducts multi-period quarterly analyses from 2019 to 2021, controlling for sociodemographic variables and distinguishing between rural and urban settings, as well as between households led by individuals working in the formal and informal sectors.

2. The pandemic and the peruvian economy during 2020-2021

The first COVID-19 wave in Peru began in early March 2020 and ended on December 11, 2020, lasting 276 days (over nine months). The toll of the first wave was 990,202 positive cases and 92,639 deaths. The second wave started on December 12, 2020, and concluded on October 17, 2021 (approximately ten months), resulting in 1,223,934 positive cases and 107,805 deaths.[1] The third wave spanned from October 18, 2021, to April 27, 2022, resulting in 1,376,608 positive cases and 11,798 deaths. The third wave in Peru set new highs in case counts while resulting in far fewer hospitalizations, ICU admissions, and deaths than the earlier waves.

Analyzing the trends in positive cases and deaths per million inhabitants from March 2020 to January 2023 reveals a synchronous rise and fall of these metrics during the initial two COVID-19

[1]The criteria for the onset and end of a wave are based on the 14-day moving average of COVID-19 positive cases per million inhabitants. For further details, please refer to the "Supplement" section.

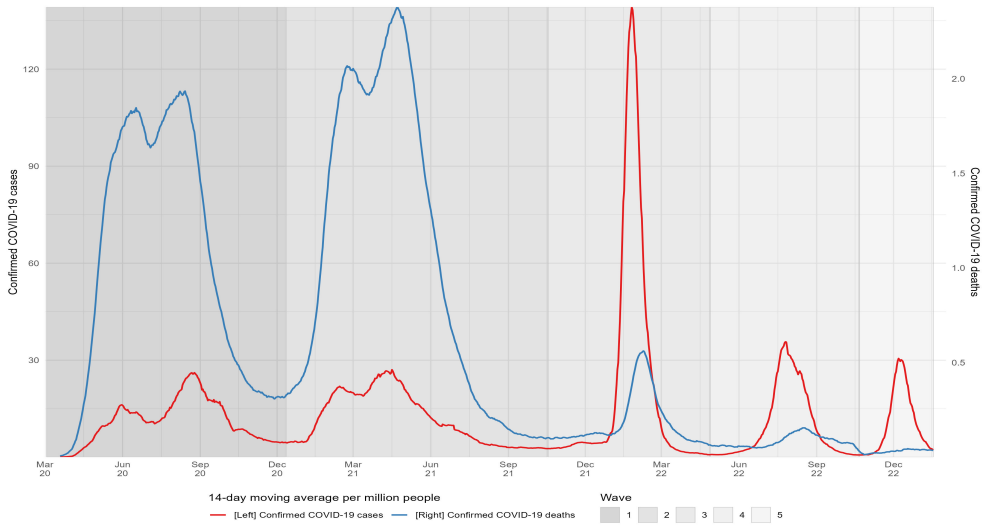
Table 1
Positive cases and deaths from COVID-19 by wave in Peru

Wave	Onset	End	Positive Cases	Deaths
1	2020-03-03	2020-12-11	990,202	92,639
2	2020-12-12	2021-10-17	1,223,934	107,805
3	2021-10-18	2022-04-27	1,376,608	11,798
4	2022-04-28	2022-10-21	570,020	4,774
5	2022-10-22	2023-01-17*	315,515	1,582

Source: National Open Data Platform (PNDA) - Open Data COVID-19.
Calculated by the authors as of January, 2023.

waves. The early stages saw simultaneous spikes in both metrics, with the first two waves marked by very high fatalities. In contrast, the third wave exhibited a surge in case numbers, attributed to enhanced testing accessibility, yet featured lower death rates. Subsequently, the fourth and fifth waves maintained high case counts but witnessed markedly fewer deaths, mirroring early pandemic levels. This pattern justifies focusing the analysis on 2020 and 2021, the years when the pandemic had its greatest impact.

Figure 1. Confirmed cases and deaths from COVID-19 by wave

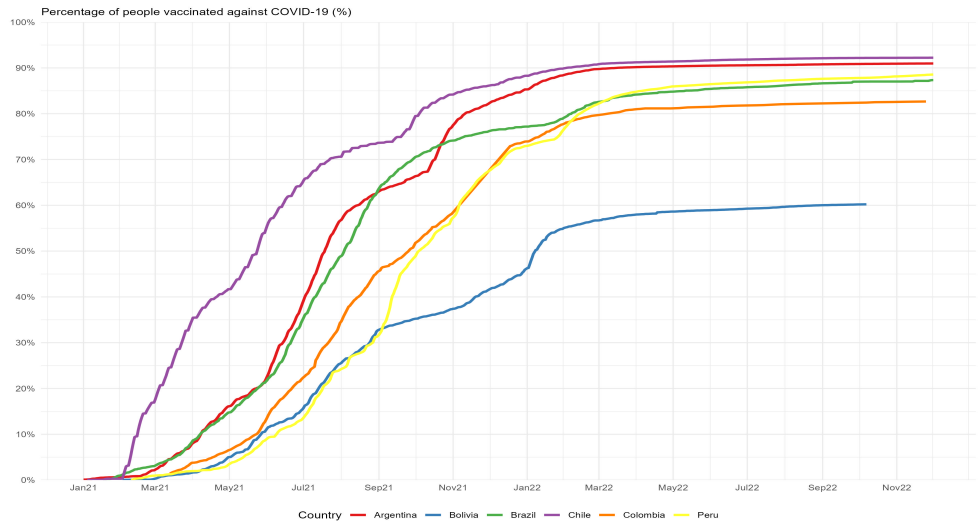


Source: National Open Data Platform (PNDA) — Open Data COVID-19.
Calculated by the authors as of January 17, 2023.

The decrease in mortality following the second wave can be primarily attributed to the advancement of the vaccination rollout. COVID-19 vaccination campaigns commenced in late December 2020 in Chile, Argentina, Mexico, and Costa Rica, while most countries in the region initiated their vaccination efforts during the first quarter of 2021 (Harrison et al., 2022). In Peru (see figure below), vaccination began later but accelerated significantly between September and

December 2021. By December 31, 2021, most selected countries had administered at least one vaccine dose to a significant portion of their population:[2] Bolivia (46%), Peru (73%), Colombia (74%), Brazil (77%), Argentina (85%), and Chile (88%).[3] Peru's progress was particularly noteworthy.

Figure 2. COVID-19 Vaccination rollout in Latin America, 2021-2022



Note: Includes initial vaccination protocol and partial vaccination.
Source: Calculated by the authors with official data collected by Harrison et al. (2022)

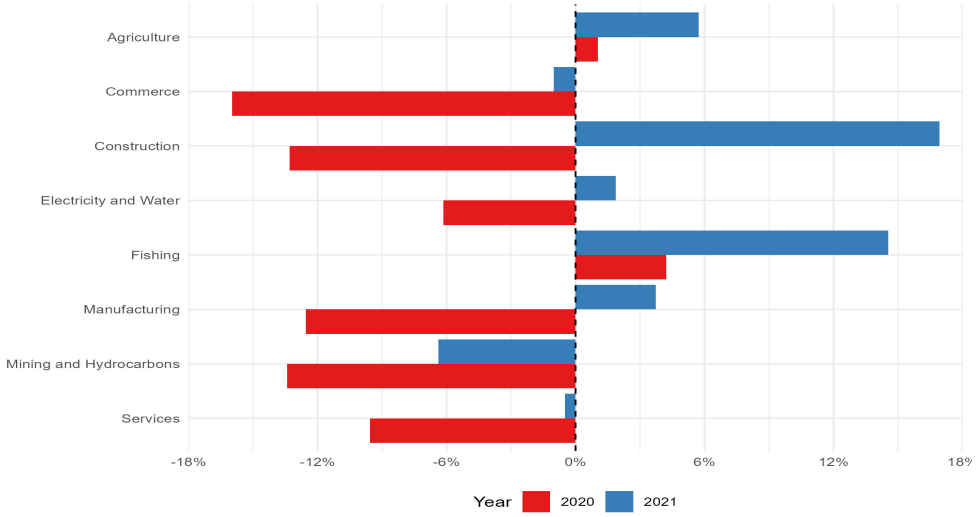
Regarding the economic situation, Peru's GDP contracted by 11.0% in the first year of the pandemic. However, impacts and recovery timelines differed across economic sectors. Notably, agriculture and fishing activities were able to maintain production above pre-pandemic levels throughout 2020. In contrast, sectors like trade, mining, hydrocarbons, and services continued to lag behind 2019 GDP levels throughout 2020 and 2021. Conversely, construction, electricity and water, and manufacturing sectors rebounded from GDP declines in 2020, surpassing pre-pandemic levels by the second half of 2021.

Analyzing the recovery timelines of various economic sectors, monthly GDP variations by activity in 2020-2021 provide insights into production reactivation. The construction sector initially declined from March to August 2020 but steadily exceeded pre-pandemic levels from September 2020 onwards, driven by eased restrictions and increased public investment. In contrast, trade and services only began recovering from mid-2021 due to lingering restrictive measures and reduced demand, especially in tourism. The agriculture, manufacturing, fishing, electricity, and water sectors saw modest early pandemic declines and later exhibited growth but could not sustain a higher growth trend despite fewer restrictions.

[2]The data is available as of the indicated date on the Our World in Data portal at https://ourworldindata.org/explorers/coronavirus-data-explorer under the "People vaccinated (by dose)" section. For further details, please refer to Mathieu et al. (2021).

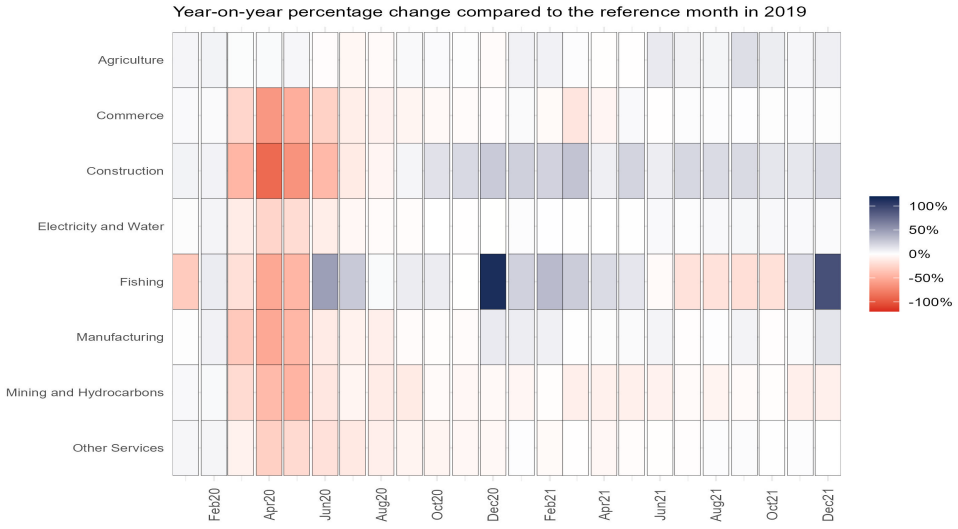
[3]For further details on the evolution and characterization of the vaccination process in Latin America, please refer to Harrison et al. (2022).

Figure 3. GDP by economic activity during the pandemic compared to 2019



Note: Change in Constant Terms (S/2007).
Source: Calculated by the authors with data from the Central Reserve Bank of Peru.

Figure 4. Monthly GDP by economic sector, 2020-2021



Source: Calculated by the authors with data from the Central Reserve Bank of Peru.

GDP changed by -11.0% in 2020 and +0.9% in 2021 compared to 2019. According to the IMF (2022), by the end of this period, the negative GDP gap still stood at 0.5%, with real GDP remaining 6.25% below its pre-pandemic trend. In contrast to its regional counterparts, Peru witnessed one of the most substantial GDP contractions in 2020 but achieved a swift recovery in 2021.

3. COVID-19 and households

The widespread shock of the pandemic had a significant economic impact at both the global and domestic level, leading to a substantial decline in households' real net income. The figure below shows that urban households were hardest hit in 2020Q2, the first full quarter of the pandemic (we use the notation year-Q-quarter number, e.g., 2021Q2 for the second quarter of 2021, to identify quarters.) Additionally, there is clear heterogeneity in the recovery process, with rural areas already slightly surpassing their 2019 income levels by the end of 2021.

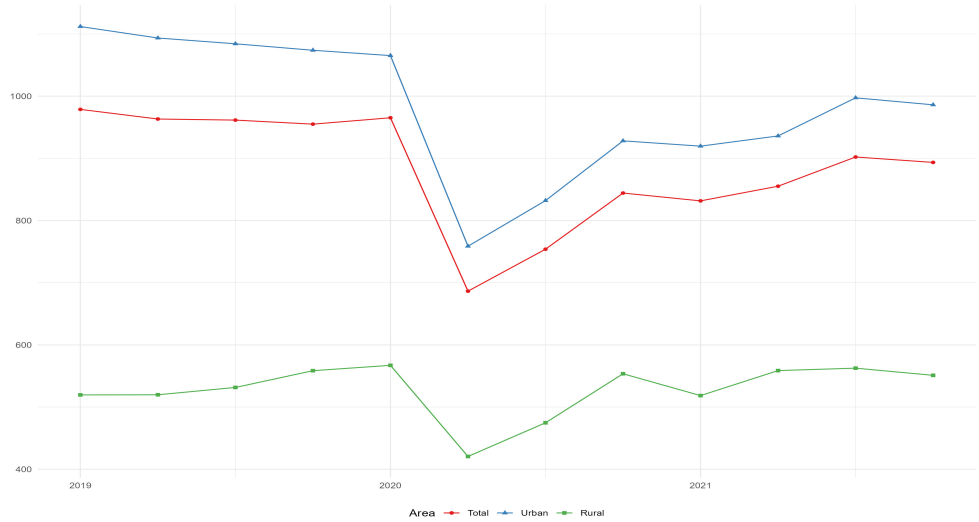
Figure 5. Household monthly net per capita income (Lima 2021 prices)

Source: Calculated by the authors with data from ENAHO 2019/2021.

Like the trend observed in net income, gross expenditure experienced a more pronounced decline in urban areas, persisting below pre-pandemic levels.

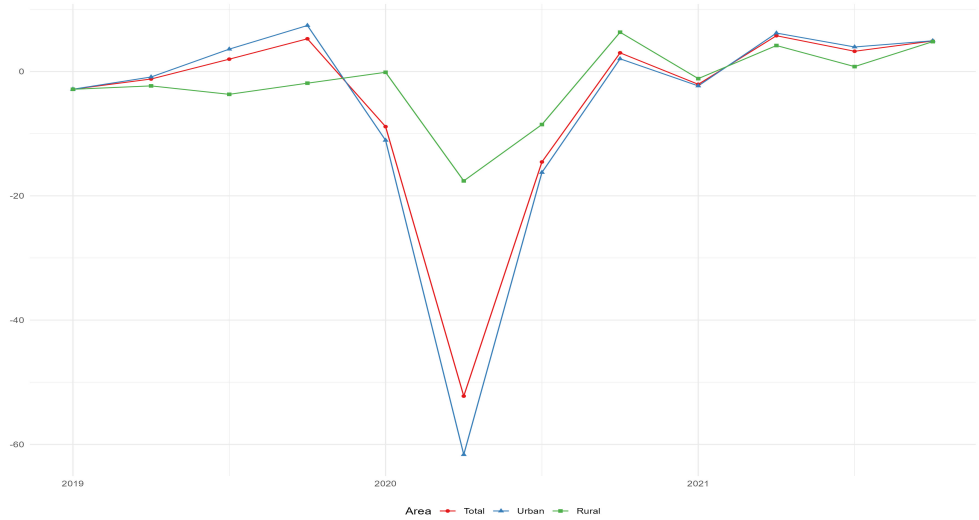
In urban areas, household savings saw the most significant decline during the early stages of the pandemic. However, by the end of 2020, positive savings margins had emerged, possibly driven by the need to rebuild a modest financial cushion in response to ongoing risks and uncertainty.

Figure 6. Household monthly per capita consumption expenditures (Lima 2021 prices)



Source: Calculated by the authors with data from ENAHO 2019/2021.

Figure 7. Savings margin (% relative to net income)



Source: Calculated by the authors with data from ENAHO 2019/2021.

4. Data and methodology

4.1 Data

We examine the pandemic's impact on households, considering both their geographical location and employment characteristics using data from ENAHO spanning from 2019 to 2021. Specifically, we utilize the "Employment and Income" module for socioeconomic variables and the "Summary" module for expenses, income, and other factors. ENAHO information is very thor-

ough and enables us to encompass a substantial proportion of Peruvian households. Notably, data for the top 1% of households and capital income may not be included, as indicated by Alarco et al. (2019) for Peru and De Rosa et al. (2022) for 12 Latin American countries (including Peru).

4.1.1 Dependent Variables

The following table describes the construction of the main variables used in the study:

Table 2
Main variables used in the study

Variable	Definition
Net Income	Continuous variable representing the logarithm of real monthly per capita income of households (at Metropolitan Lima 2021 prices).
Total Expenditure	Continuous variable representing the logarithm of real monthly per capita consumption expenditure of households (at Metropolitan Lima 2021 prices).
Savings Margin	Percentage of the savings margin (difference between household income and expenditure) relative to net household income.

Source: Prepared by the authors with data from Enaho.

Supplementary variables examined in the study include the following: components of total income, such as labor income, extraordinary income, and transfers, as well as food expenditure, the incidence of food deprivation, and healthcare expenditure.

Table 3
Specific response variables

Variable	Definition
Incidence of food deprivation	Dichotomous variable representing whether the nominal monthly per capita expenditure on household food is below the basic food basket (Benites and Francke, 2023).
Food expenditure	Continuous variable representing the logarithm of real monthly per capita household food expenditure (prices in Lima Metropolitan 2021).
Healthcare expenditure	Continuous variable representing the logarithm of real monthly per capita household healthcare expenditure (prices in Lima Metropolitan 2021).
Imputed rental income	Continuous variable representing the logarithm of real monthly per capita household imputed rental income (prices in Lima Metropolitan 2021). Refers to the monthly amount that households who own the dwelling or households with dwellings provided by third parties (other households/institutions) would pay as rent.
Private donation income	Continuous variable representing the logarithm of real monthly per capita household income from private donations for healthcare (prices in Lima Metropolitan 2021). Refers to the product donated/given by a private entity residing in another household. Includes donations/gifts from institutions such as NGOs, Churches, among others.
Public donation income	Continuous variable representing the logarithm of real monthly per capita household income from public donations (prices in Lima Metropolitan 2021). Refers to donations received from the state (social programs or public institutions).
Current transfer income	Continuous variable representing the logarithm of real monthly per capita household income from current transfers (prices in Lima Metropolitan 2021). Refers to donations received from the state (social programs or public institutions). Includes public and private monetary and non-monetary current transfers.
Labor income	Continuous variable representing the logarithm of real monthly per capita household income from work (prices in Lima Metropolitan 2021).
Rental income	Continuous variable representing the logarithm of real monthly per capita household income from rent (prices in Lima Metropolitan 2021).
Extraordinary income	Continuous variable representing the logarithm of real monthly per capita household extraordinary income for healthcare (prices in Lima Metropolitan 2021). Refers to income such as bonuses, profit-sharing, and other irregular incomes that do not have a counterpart by household members.

Source: Prepared by the authors with data from INEI (2022) and Benites and Francke (2023).

4.1.2 Control Variables

We employ various household socioeconomic conditions as control variables, approximated through the characteristics of the household head. The following table outlines the construction of the variables used in the study:

Table 4
Control Variables Used in the Study

Variable	Description	ENAHO Module
Household Head's Gender	Dichotomous variable that takes the value 1 if the household head is male and 0 otherwise.	Employment and Income
Age Group of Household Head	Categorical variable indicating the age group of the household head: 1: Under 25 years 2: 25 to 49 years 3: 50 to 64 years 4: 65 years or older	Employment and Income
Employment Status of Household Head	The variable indicates the size of the company where the household head works: 1: Not in the labor force 2: Unemployed 3: Formal job 4: Informal job	Employment and Income
Percentage of Dependent Members	Categorical variable indicating the proportion of dependent household members, defined as those who do not earn income: 0: 0% 1: Up to 25% 2: From 25% to 50% 3: From 50% to 75% 4: Over 75%	Summary

Prepared by the authors.

4.2 Empirical approach

To capture the impact of the pandemic's onset, we use a multiple-period econometric technique. As our focus is on the start of the pandemic, we take the last quarter of 2019 as reference. The equation below represents the key components of the initial pandemic shock:

$$y_{it} = \alpha_0 + \sum_{\tau=-1}^{T} \beta_\tau d_{\tau t} + \rho_d + X'_{it}\rho + \mu_{it}$$

In this equation, y represents the outcome of interest for household i during period t; and we estimate the variables outlined in Table 2. To account for geographic variations, we introduce fixed effects at the district level (ρ_d). Vector X' represents household characteristics, such as the percentage of dependent members, the gender of the household head, and the age group of the household head. Standard errors are clustered based on district-level data.

The variables $d\tau_t$ represent fixed effects for each period, with the last quarter of 2019 as base period (τ=-1), and the variables β_τ represent the coefficients of interest for capturing the period's impact. Although the nationwide mandatory quarantine began in the first quarter of 2020, there is substantial heterogeneity in the epidemiological progression. For example, Francke (2023) note that, on average, the first positive case of COVID-19 officially reported in a district occurred 84 days after the announcement of the quarantine. Therefore, we use the last pre-pandemic quarter as the baseline for comparison, which was followed by a series of shocks (quarantine measures, infection rates, and risk aversion, among others). However, we exclude from our analysis the first quarter of 2020, a period considered "partially affected" by the pandemic, to ensure a more accurate interpretation of the estimated parameters.

In addition to conducting a comparative analysis between urban and rural areas, we performed a heterogeneity analysis to understand the impact of the pandemic's onset on urban households. We categorized them based on the formal or informal employment status of the household head, simplifying the categories as "formal urban" and "informal urban." We excluded households where the head is not employed because there were too few such cases for meaningful analysis.

5. Results

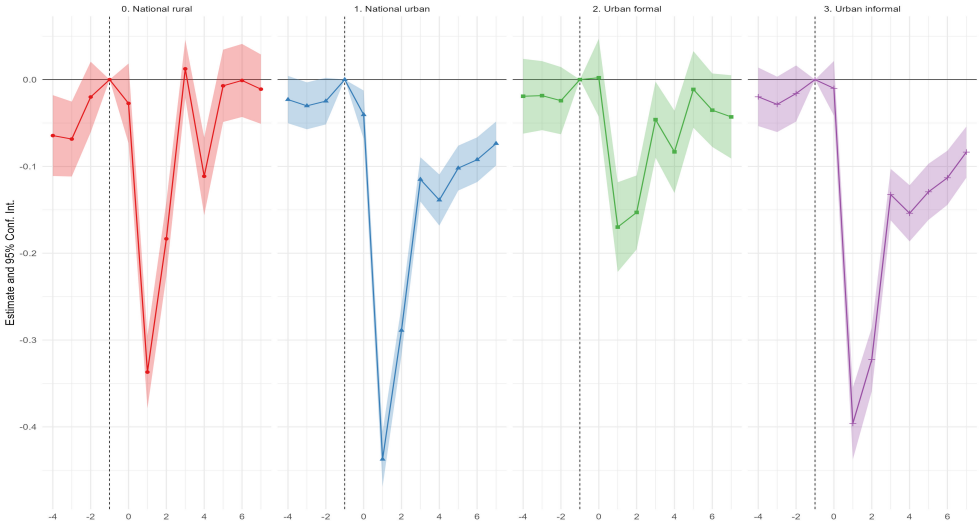
5.1 Main variables

5.1.1 Income

In the second quarter of 2020, with the onset of the pandemic and ensuing lockdown measures, real per capita household income declined across all regions and groups, although to a lesser extent for households led by formal workers (Figure 8 and econometric findings in Result 1). Although the pandemic disrupted many urban activities and measures such as the "perfect work suspension" allowed employers to temporarily halt salary payments, many formal workers managed to maintain their incomes throughout the lockdown. Viewing the pandemic as a temporary disruption, especially at its onset, may have encouraged many employers to focus on preserving the quality of their workforce by continuing to pay salaries. From 2020 to 2021, both rural and formal urban groups regained their real incomes after the initial shock. By 2021Q2 there was no significant difference in their income compared to the pre-pandemic levels. In contrast, households led by informal workers experienced persistent and substantial income reductions in the wake of the pandemic.

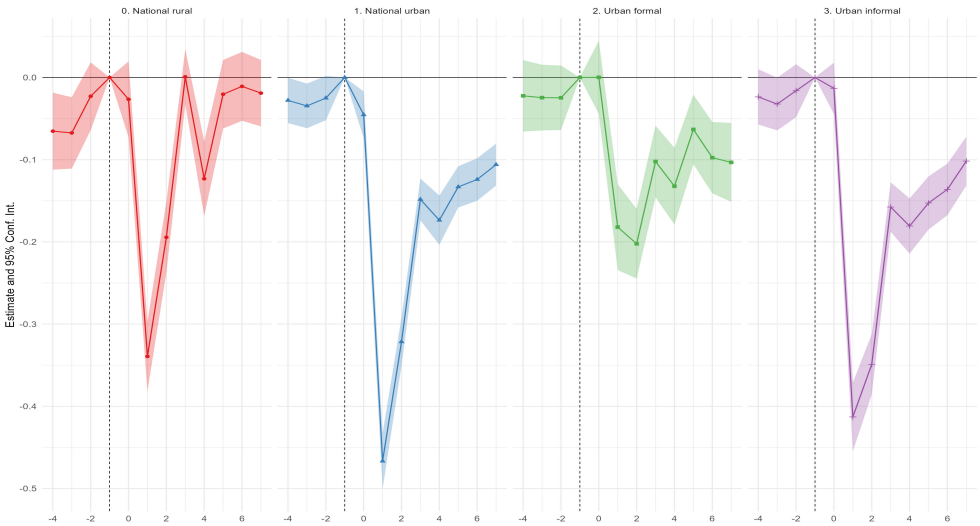
To gain a more detailed understanding of income dynamics, we analyzed income excluding the extraordinary income component, which includes withdrawals from CTS (Retirement Compensation) accounts and AFPs (Private Pension Fund Administrators). While survey participants may perceive these withdrawals as income and INEI records them as such, from an economic

Figure 8. Impact of COVID-19 on the Logarithm of Household Monthly Net Per Capita Income (Lima 2021 Prices)



standpoint, they represent a conversion of illiquid assets into liquid ones, thereby becoming available for consumption. This variable, which we call "non-extraordinary income," shows a more significant impact resulting from the onset of the pandemic. For instance, during 2020Q2 —the quarter of the pandemic's peak impact— urban income decreased by 47% compared to 2019Q4. These trends persisted in the results, generally increasing in magnitude (Result 2). Formal workers had not achieved a complete recovery by the end of 2021, in contrast to rural households.

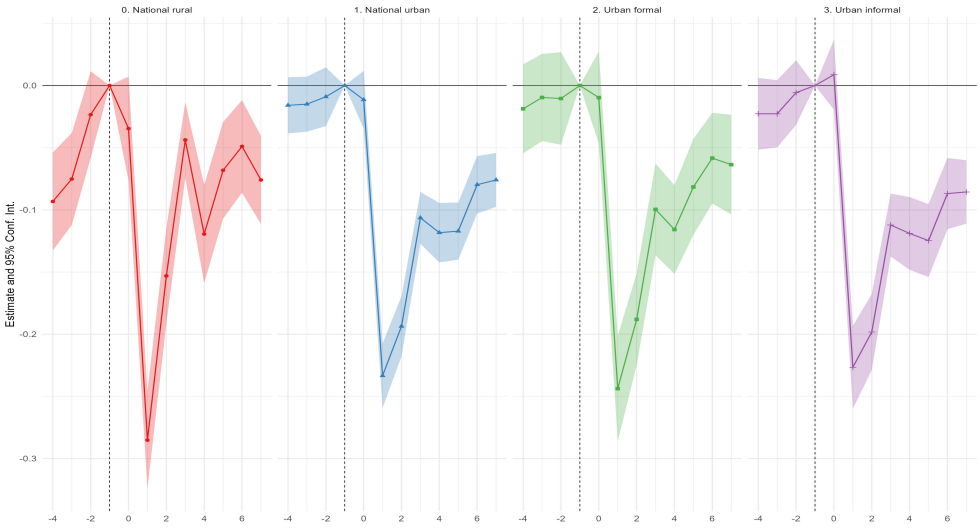
Figure 9. Impact of COVID-19 on the Logarithm of Household Monthly Non-extraordinary Per Capita Net Income (Lima 2021 Prices)



5.1.2 Total Expenditure

In 2020Q2, total real per capita household consumption expenditure sharply declined across all analyzed groups following the pandemic's onset, with rural areas and households led by informal urban leaders experiencing more pronounced decreases (Figure 10 and econometric findings in Result 3). While rural areas saw a relatively stronger rebound in 2020Q4, it was not until late 2021 that formal urban households caught up, albeit with no group fully recovering their pre-pandemic consumption throughout 2021 and up to 2021Q4.

Figure 10. Impact of COVID-19 on the Logarithm of Household Monthly Per Capita Consumption Expenditures (Lima 2021 Prices)

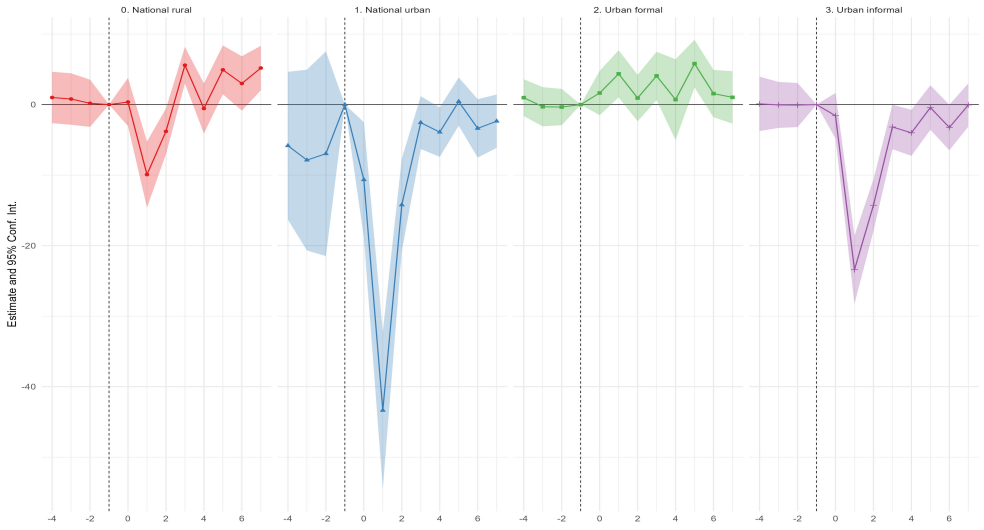


5.1.3 Savings Margin

Given the varying income and expenditure trends across different groups and throughout different stages of the pandemic, we examine the savings margin (Figure 11 and Result 4), which exhibits heterogeneous outcomes following the pandemic's onset. During 2020Q2 and 2020Q3, there were significant reductions in savings, particularly pronounced in urban areas compared to rural regions. Urban households responded to the pandemic by significantly cutting their savings from the outset. Interestingly, formal urban households initially responded to the pandemic shock by increasing their savings. The segment that most reduced its savings margin was informal urban households. Nevertheless, this decline in savings was not sustained, as both rural and urban informal households quickly adjusted their consumption-to-income margins.

We also conducted estimations for the savings margin concerning non-extraordinary income, excluding extraordinary income that may represent the consumption of assets such as CTS and AFP funds. When excluding the extraordinary income component, the savings results decrease in magnitude but not in direction. An exception is formal urban households, which, without extraordinary income, would have only been able to save at the beginning of the pandemic, followed by dissaving. Therefore, the savings outcomes for formal urban households were likely

Figure 11. Impact of COVID-19 on Household Savings Margin (% Relative to Net Income)



influenced by withdrawals from CTS and AFP accounts. For more detailed information, refer to Result 5.

Table 5

Summary of results on total income, total expenditure, and savings

Household Type	Real Income	Real Expenditure	Savings Margin	Hypotheses on Y, C, and S
Rural	Initial decline, subsequent increases until full recovery.	Strong initial decline, partial subsequent recovery.	Contemporaneous dissaving response until the third quarter of 2020, followed by savings generation.	Agriculture was less affected initially and later served as a refuge. The initial dissaving required subsequent expenditure adjustment, resulting in increased household savings.
Formal Urban	Initial decline less than other groups, subsequent significant but incomplete recovery.	Initial decline, subsequent significant but incomplete recovery.	No decline in savings, segments with higher savings and others with no significant effect.	Possible incomplete data due to CTS and AFP withdrawals; lower income decline indicates employers' protective measures to retain selected workforce; savings could be explained by uncertainty created by the pandemic.
Informal Urban	Very strong initial decline, subsequent significant but incomplete recovery.	Initial decline less than income, subsequent significant but incomplete recovery.	Short-term dissaving response.	Strong decline in income due to total absence of protection mechanisms; initial dissaving as the only way to maintain minimal consumption; subsequent adjustment due to the impossibility of maintaining dissaving.

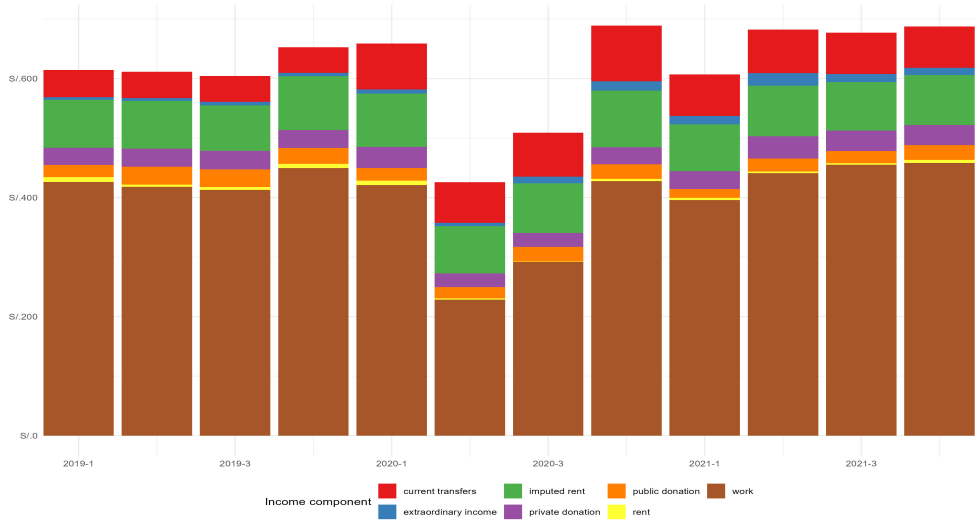
Note: Prepared by the authors based on results 1, 2, and 3 (illustrated in previous figures)

5.2 Income disaggregation

We divide income in two groups. The first group, household monetary income, includes income from work, rental income, current transfers (both domestic and foreign), and extraordinary income. The second group, non-monetary household income, comprises imputed rental income, private donations, and public donations. Income from work and imputed rental income are the most significant income categories. In 2019, they accounted for 68% and 14% of total income in rural areas, and 60% and 25% in urban areas, respectively. We describe the evolution of these components in 2020-2021 by component and area.

In rural areas, total real income contracted by approximately 34% in 2020Q2 compared to 2019Q4. During 2020Q2, some income components showed resilience and even increased. This was the case with extraordinary income and current transfers (both public and private), which remained above 2019 levels throughout the 2020-2021 period. While there were initial drops of 50% or more in income from work at the onset of the pandemic, rural areas had already surpassed 2019 levels by 2021Q2.

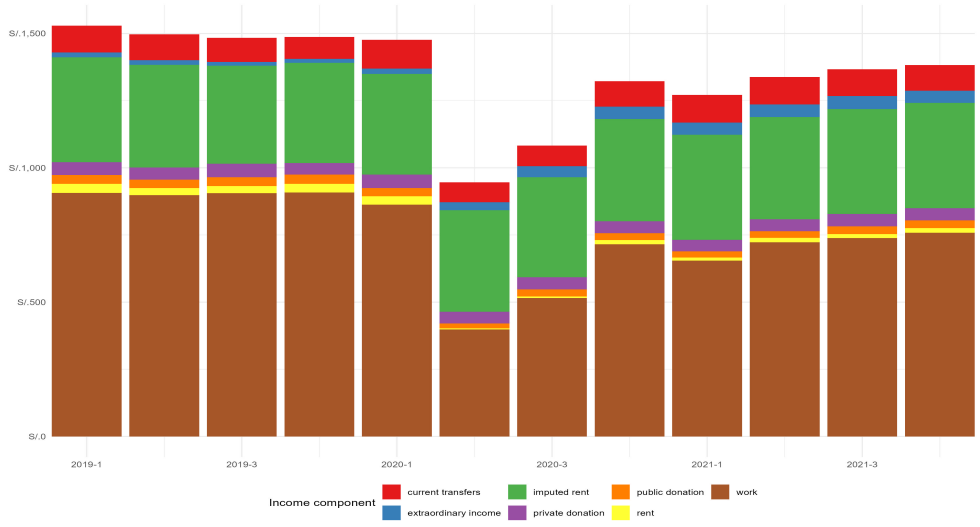
Figure 12. Components of Total Rural Household Income (Lima 2021 Prices)



In urban areas, during the peak of the pandemic in 2020Q2, total real income dropped by 36%. All income components decreased, except for public donations and extraordinary income compared to 2019Q4. Income from work experienced a decline of over 50% in 2020Q2 and did not recover to 2019 levels throughout 2020-2021. By the end of 2021Q4, only income from public donations, rent, and work remained below 2019Q4 levels. It is worth noting that the "imputed rent" component for housing remains quite stable, which tends to moderate the variations in total income figures. However, it is also an income component with a designated use (housing) and cannot be redirected to more pressing needs such as food or healthcare.

When applying the econometric model to the various income components, we found that, after controlling for the indicated sociodemographic variables, income from work significantly decreased in urban areas in 2020Q2. The decline was more pronounced among households led by informal workers, and income from work remained below pre-pandemic levels throughout

Figure 13. Components of Total Urban Household Income (Lima 2021 Prices)



the 2020-2021 period, with formal workers 13% and informal workers 16% below pre-pandemic levels as of 2021Q4. In contrast, the shock to income from work (including production for self-consumption) in rural areas was less severe than in urban areas in 2020Q2. Complete recovery was achieved only by 2021Q3 (Result 11). However, in 2021Q4, these incomes experienced a new decline, possibly due to increased prices of fertilizers, fuel, and transportation since July 2021.

Additionally, we observed that the monetary component of extraordinary income has been positive and significant since 2020Q2 among urban households and since 2020Q3 among rural households. Its intensity is higher among urban households compared to rural ones (Result 10). Furthermore, this effect is more pronounced among formal urban households, potentially due to the role of AFP or CTS withdrawals.

Contrary to the previous trends from the beginning of the pandemic (2020Q1), current transfers increased significantly and consistently in all groups (rural, formal urban, and informal urban), with less intensity among formal urban households, which can be attributed to the design of emergency aid "bonuses" (Result 12). Regarding the subcomponents of current transfers, private transfers decreased sharply in 2021Q2 and 2021Q3, then recovered, showing smaller reductions compared to pre-pandemic levels. On the other hand, public transfers experienced a considerable increase throughout the study period. When summing up both public and private transfers, the former are larger and grow more, making their impact dominant in this income group (Results 13 and 14).

5.3 Consumption adjustments in response to the pandemic shock

This subsection discusses how households in rural and urban areas, both formal and informal, adjusted significant components of consumption, such as food expenditure, the incidence of food deprivation, healthcare spending, and transportation and communication expenses, in response to the pandemic shock.

Our initial hypothesis was that household consumption underwent a significant restructuring in response to the widespread shock of the pandemic. Our econometric analysis reveals that food expenditure has consistently remained below pre-pandemic levels since the pandemic's onset. In 2020Q2, urban areas experienced a substantial 43% decline, exceeding the estimated coefficient for rural areas-a disparity that persisted in subsequent quarters (Result 6). These changes directly lead to shifts in food deprivation (Result 7), as measured by households whose food spending falls below the extreme poverty line. The latter represents the expenditures required for reaching a minimum dietary consumption to meet physiological needs Benites and Francke (2023).

Figure 14. Impact of COVID-19 on the Logarithm of Monthly Per Capita Household Food Expenditures (Metropolitan Lima 2021 Prices)

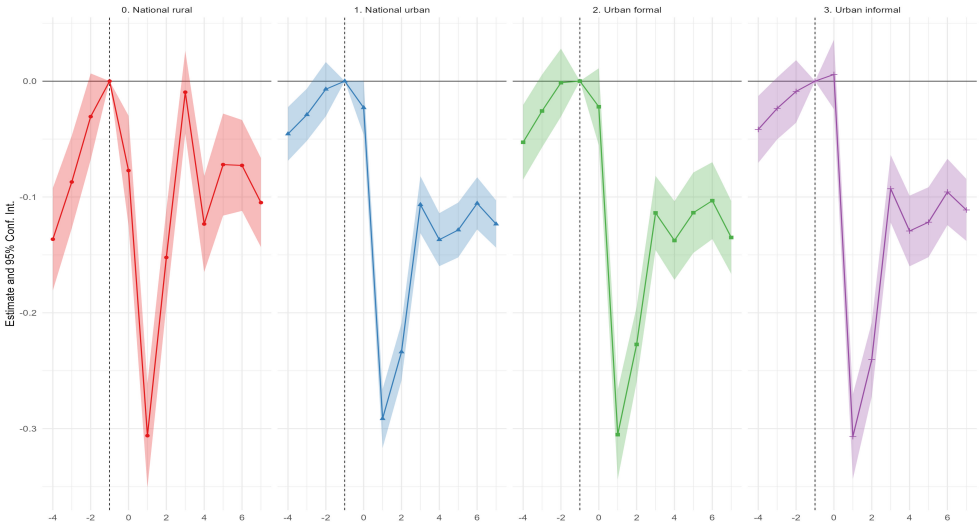


Table 6

Summary of results on total expenditure and food expenditure

Household Type	Total Expenditure	Food Expenditure	Effect on Food Deprivation and Hypothesis
Rural	Initial sharp decline; partial recovery later.	Initial decline smaller than in total expenditure; full recovery later.	Group that experiences a significant increase in food deprivation (FD) despite seeking to protect food expenditure; achieves full recovery in terms of FD, income, and food expenditure.
Formal Urban	Initial decline; subsequent significant but incomplete recovery.	Greater declines than in total expenditure throughout the period.	While relatively better protected, this group significantly adjusts food expenditure, resulting in food deprivation. This may be driven by the urgency to save as a safeguard against persistent pandemic risks.
Informal Urban	Initial decline smaller than in income; subsequent significant but incomplete recovery.	Initial decline similar to that in total expenditure; partial recovery later, even surpassing total expenditure.	Although poorer than formal urban households and hit harder in terms of income, this group adjusted food expenditure significantly, resulting in higher food deprivation. As income improved, it prioritized food expenditure, thereby reducing food deprivation.

Note: Prepared by the authors based on results 4, 5, 6, and 7.

How do other relevant expenses adjust in this context? We found that the profile of changes in food expenditure are not similar in the case of healthcare expenditure (Result 8). Healthcare spending initially (2020Q2) decreases significantly, which may seem surprising given the impact of the epidemic but can be the result of restrictions on healthcare services for other diseases during the quarantine and the early waves. Later on, healthcare spending recovered and even increased relative to pre-pandemic levels since the end of 2020, likely due to households giving higher priority to this category and delayed care due to access issues during the quarantines. One discussion point is how the pandemic leads to reduced expenses on essential needs like food and healthcare, with a recovery in healthcare spending but not in food, and how this behavior aligns with Figueroa's (1996) theory of lexicographic preferences.

6. Comparison of results with similar studies

This section compares our research with two studies on closely related topics. Higa et al. (2023) conducted an analysis of the effects of COVID-19 on individual employment and income for Lima, based on the Permanent Employment Survey, covering the period from April 2020 to June 2021, with January 2019 to March 2020 as the control or "baseline" period. They use a similar equation to ours, comparing variables such as income in quarters before and after the onset of the pandemic, while controlling for sociodemographic and employment variables, and incorporating geographic location fixed effects. Since their study focuses on individuals, they do not consider variables such as expenditure and savings. However, concerning individual income from work, they obtain results similar to ours, with a sharp decline in the second quarter and subsequent recovery, as well as a larger decline among informal workers. The parameters estimated by them are larger than ours, not surprisingly because at a household level the aggregation of the jobs of different members and other sources of income tends to reduce total income fluctuations. Additionally, since they perform estimations only until 2021Q2, and our study extends until 2021Q4, our results suggest that income recovery, particularly among informal workers, continued during that period.

Vásquez et al. (2021) conducted a study on income during the COVID-19 pandemic, with a specific focus on internal and external migrants, against the backdrop of significant Venezuelan immigration between 2017 and 2019. Their study employed a mix of qualitative and quantitative techniques. For our discussion, we concentrate on their econometric estimations of individual incomes using ENAHO data from 2018 to 2021. The estimation equation they used was similar to ours and that of Higa et al. (2023). The primary difference lies in their choice of the baseline period, i.e., from January 2018 to March 2020. They omitted the period from April 2021 to August 2021 due to a lack of data on migration status. Furthermore, they used three-month periods that do not align with calendar quarters. Additionally, they introduced interaction terms to analyze correlations with national or international migration status. However, their estimations for these variables were not significant, leading to the conclusion that "there is no evidence of a particular worsening in the examined labor indicators (total income, hours of work, income per hour) for international or internal migrant workers" (page 32). Like Higa et al. (2023)

and our study, they identify negative impacts on hourly incomes and an incomplete recovery.

An important finding in the data presented by Vásquez et al. (2021) is the apparent underrepresentation of international migrants in the ENAHO. According to their research, migrants, including those who have arrived from various foreign countries over many years, accounted for only 0.5% of the ENAHO sample during the period from 2018 to 2021. However, by the end of 2021, there were an estimated one million Venezuelan immigrants in Peru (R4V, 2023), making up 3% of the total population and a larger proportion of the working-age population, considering the ages of the immigrants. These disparities suggest the possibility of a non-sampling error in the ENAHO, leading to an underestimation of the migrant population. It is important to note that international mobility conditions virtually halted immigration during the 2020-2021 period. This issue underscores the need for cautious interpretation when analyzing statistics and findings derived from the ENAHO.

7. Conclusions

Following the COVID-19 pandemic, Peru experienced a series of significant shocks, including a surge in international inflation, a new presidential vacancy followed by widespread protests that resulted in numerous casualties, and a coastal El Niño phenomenon in 2023. With underlying factors pointing to an exacerbation of global warming and ongoing political instability, Peru will likely face additional economic and societal challenges in the years ahead. To prepare for these future shocks, it is crucial for Peru to conduct a comprehensive analysis of the pandemic's impact and extract valuable lessons from this period.

Our analysis of household income, consumption, and savings indicates that rural households initially experienced a sharp drop in income in 2020Q2. In response, they reduced their expenses and savings. However, in the subsequent quarters, their income recovered to pre-pandemic levels while maintaining lower total expenses and preserving savings levels. Urban households with formal working heads experienced a smaller income decline in 2020Q2 compared to other groups. They also reduced their expenses by a similar magnitude, resulting in a positive change in savings. A significant portion of this evolution can be attributed to extraordinary income. In the following quarters, their income and total expenses recovered considerably, and they did not reduce their savings at any point. It is important to note that withdrawals from CTS and AFP[4] accounts distort savings data, as the use of these funds is considered household income in ENAHO, rather than the disposal of their own assets. Urban households with informal heads showed the largest initial decline in 2020Q2, with significant adjustments to their total consumption and savings. In subsequent quarters, they restored a substantial portion of their income and expenses, but not entirely, and they stopped reducing their savings.

The study suggests that the components evolve heterogeneously according to the area of residence and economic activity. The econometric results show that extraordinary income increased from 2020Q2 in urban areas (2020Q3 in rural areas) and had a greater impact among formal urban households. This is likely linked to the approval of extraordinary withdrawals from CTS and

[4]IMF (2022) calculates 3.9% of GDP including CTS and AFPs for 2020.

AFP accounts in 2020. Additionally, income from work significantly decreased with the onset of the pandemic, especially in urban areas where it did not fully recover until the end of the study period (2021Q4). In rural areas, the decline in income from work was also significant but less pronounced than in urban areas, fully recovering in 2021. Moreover, current transfers increased significantly at the start of the pandemic, especially in rural areas. This can be attributed to public transfers, as private transfers decreased significantly at the beginning of the pandemic and remained low thereafter.

Furthermore, the increase in private healthcare expenditure since 2021, coupled with sustained low spending on food and increased food deprivation, also highlights a likely substitution between the two. Thus, strengthening the public healthcare system to provide universal free care could potentially enable households to increase food expenditure, thereby reducing food insecurity.

8. Results

Result 1

Impact of COVID-19 on the logarithm of monthly per capita net household income (Metropolitan Lima 2021 prices)

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	-0.064***	-0.023*	-0.019	-0.020
	(0.024)	(0.014)	(0.022)	(0.017)
P=-3	-0.068***	-0.030**	-0.018	-0.029*
	(0.022)	(0.014)	(0.020)	(0.016)
P=-2	-0.020	-0.025*	-0.024	-0.016
	(0.021)	(0.014)	(0.020)	(0.016)
P=0	-0.027	-0.040***	0.002	-0.010
	(0.023)	(0.014)	(0.023)	(0.016)
P=+1	-0.337***	-0.437***	-0.170***	-0.396***
	(0.021)	(0.016)	(0.026)	(0.021)
P=+2	-0.183***	-0.289***	-0.153***	-0.322***
	(0.022)	(0.015)	(0.022)	(0.019)
P=+3	0.012	-0.115***	-0.046**	-0.132***
	(0.017)	(0.013)	(0.022)	(0.015)
P=+4	-0.111***	-0.139***	-0.083***	-0.154***
	(0.023)	(0.015)	(0.024)	(0.016)
P=+5	-0.007	-0.102***	-0.011	-0.129***
	(0.021)	(0.013)	(0.022)	(0.016)
P=+6	-0.001	-0.092***	-0.035	-0.113***
	(0.021)	(0.013)	(0.022)	(0.016)
P=+7	-0.011	-0.074***	-0.043*	-0.084***
	(0.020)	(0.013)	(0.024)	(0.015)
Num.Obs.	37869	65431	17686	31571
R2 Adj.	0.398	0.445	0.376	0.353

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Result 2

Impact of COVID-19 on the logarithm of monthly per capita non-extraordinary household income (Metropolitan Lima 2021 prices)

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	-0.065***	-0.028**	-0.022	-0.024
	(0.024)	(0.014)	(0.022)	(0.017)
P=-3	-0.067***	-0.035**	-0.025	-0.032**
	(0.022)	(0.014)	(0.020)	(0.016)
P=-2	-0.023	-0.025*	-0.025	-0.016
	(0.021)	(0.014)	(0.020)	(0.016)
P=0	-0.027	-0.045***	0.000	-0.013
	(0.023)	(0.014)	(0.023)	(0.016)
P=+1	-0.339***	-0.467***	-0.182***	-0.413***
	(0.021)	(0.017)	(0.027)	(0.021)
P=+2	-0.194***	-0.322***	-0.202***	-0.349***
	(0.022)	(0.015)	(0.022)	(0.019)
P=+3	0.001	-0.148***	-0.102***	-0.158***
	(0.017)	(0.013)	(0.022)	(0.015)
P=+4	-0.123***	-0.174***	-0.132***	-0.181***
	(0.023)	(0.015)	(0.024)	(0.017)
P=+5	-0.020	-0.133***	-0.063***	-0.153***
	(0.021)	(0.013)	(0.021)	(0.016)
P=+6	-0.011	-0.124***	-0.098***	-0.136***
	(0.021)	(0.013)	(0.022)	(0.016)
P=+7	-0.019	-0.106***	-0.103***	-0.102***
	(0.021)	(0.013)	(0.024)	(0.015)
Num.Obs.	37869	65431	17686	31571
R2 Adj.	0.390	0.437	0.376	0.349

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Result 3

Impact of COVID-19 on the logarithm of monthly per capita gross household expenditure (Metropolitan Lima 2021 prices)

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	-0.093***	-0.016	-0.019	-0.023
	(0.020)	(0.011)	(0.018)	(0.015)
P=-3	-0.075***	-0.015	-0.010	-0.023*
	(0.019)	(0.011)	(0.018)	(0.014)
P=-2	-0.023	-0.009	-0.010	-0.006
	(0.018)	(0.012)	(0.019)	(0.013)
P=0	-0.035	-0.011	-0.010	0.009
	(0.021)	(0.012)	(0.019)	(0.014)
P=+1	-0.285***	-0.233***	-0.244***	-0.227***
	(0.020)	(0.013)	(0.022)	(0.017)
P=+2	-0.153***	-0.194***	-0.188***	-0.198***
	(0.020)	(0.012)	(0.019)	(0.016)
P=+3	-0.044***	-0.106***	-0.100***	-0.112***
	(0.015)	(0.011)	(0.019)	(0.013)
P=+4	-0.119***	-0.118***	-0.116***	-0.119***
	(0.020)	(0.012)	(0.018)	(0.015)
P=+5	-0.068***	-0.117***	-0.082***	-0.125***
	(0.020)	(0.012)	(0.020)	(0.015)
P=+6	-0.049***	-0.080***	-0.058***	-0.087***
	(0.019)	(0.012)	(0.019)	(0.015)
P=+7	-0.076***	-0.076***	-0.064***	-0.086***
	(0.018)	(0.011)	(0.020)	(0.013)
Num.Obs.	37869	65431	17686	31571
R2 Adj.	0.378	0.415	0.376	0.349

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Result 4

Impact of COVID-19 on the savings margin (% relative to income)

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	1.007	-5.827	0.987	0.103
	(1.858)	(5.338)	(1.327)	(1.961)
P=-3	0.794	-7.869	-0.307	-0.044
	(1.859)	(6.529)	(1.415)	(1.660)
P=-2	0.188	-6.964	-0.346	-0.064
	(1.706)	(7.388)	(1.307)	(1.593)
P=0	0.366	-10.652**	1.643	-1.576
	(1.738)	(4.162)	(1.598)	(1.640)
P=+1	-9.919***	-43.358***	4.362**	-23.413***
	(2.385)	(5.656)	(1.696)	(2.457)
P=+2	-3.798**	-14.221***	0.933	-14.271***
	(1.648)	(3.340)	(1.675)	(1.865)
P=+3	5.592***	-2.558	4.068**	-3.172**
	(1.318)	(1.903)	(1.741)	(1.604)
P=+4	-0.549	-3.904**	0.712	-4.003**
	(1.806)	(1.783)	(2.915)	(1.659)
P=+5	4.931***	0.429	5.812***	-0.418
	(1.762)	(1.734)	(1.715)	(1.602)
P=+6	2.996	-3.370	1.559	-3.247**
	(1.965)	(2.106)	(1.708)	(1.642)
P=+7	5.189***	-2.353	1.029	-0.055
	(1.605)	(1.921)	(1.890)	(1.558)
Num.Obs.	37869	65430	17685	31571
R2 Adj.	0.109	0.020	0.037	0.064

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Result 5

Impact of COVID-19 on the saving margin (% relative to non-extraordinary income)

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	0.834	-8.419	0.738	5.439
	(1.959)	(5.534)	(1.356)	(6.337)
P=-3	0.408	-8.614	-2.044	-3.095
	(2.065)	(6.636)	(1.902)	(3.768)
P=-2	-0.198	-5.916	-0.522	9.427
	(1.788)	(7.807)	(1.361)	(9.294)
P=0	0.707	-14.568***	1.456	-5.788
	(1.833)	(4.702)	(1.612)	(4.884)
P=+1	-9.902***	-53.422***	3.068*	-25.497***
	(2.465)	(7.165)	(1.753)	(3.546)
P=+2	-4.622***	-23.184***	-3.979**	-11.149*
	(1.744)	(5.814)	(1.827)	(6.552)
P=+3	4.282***	-10.225**	-0.753	-7.298***
	(1.397)	(4.074)	(1.819)	(2.589)
P=+4	-1.177	-139.118	-3.496	-278.277
	(1.948)	(129.922)	(2.899)	(268.151)
P=+5	3.765**	-3.039	1.515	-10.499
	(1.856)	(2.770)	(1.660)	(8.259)
P=+6	2.356	-3.969	-3.998**	2.723
	(2.018)	(2.651)	(1.817)	(8.126)
P=+7	4.055**	-6.455***	-4.074**	-4.315
	(1.751)	(2.413)	(1.958)	(3.334)
Num.Obs.	37869	65428	17685	31571
R2 Adj.	0.103	-0.009	0.028	-0.020

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* p < 0.1, ** p < 0.05, *** p < 0.01.

Result 6

Impact of COVID-19 on the logarithm of monthly per capita household food expenditure (Metropolitan Lima 2021 prices)

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	-0.136***	-0.046***	-0.053***	-0.042***
	(0.023)	(0.012)	(0.016)	(0.015)
P=-3	-0.087***	-0.029**	-0.026	-0.024*
	(0.020)	(0.011)	(0.016)	(0.014)
P=-2	-0.031	-0.007	-0.001	-0.009
	(0.019)	(0.012)	(0.015)	(0.014)
P=0	-0.077***	-0.023*	-0.022	0.006
	(0.024)	(0.012)	(0.017)	(0.015)
P=+1	-0.306***	-0.291***	-0.305***	-0.307***
	(0.023)	(0.013)	(0.020)	(0.019)
P=+2	-0.152***	-0.234***	-0.227***	-0.240***
	(0.021)	(0.013)	(0.017)	(0.016)
P=+3	-0.010	-0.107***	-0.114***	-0.093***
	(0.018)	(0.013)	(0.016)	(0.015)
P=+4	-0.123***	-0.137***	-0.138***	-0.129***
	(0.021)	(0.012)	(0.017)	(0.016)
P=+5	-0.072***	-0.128***	-0.114***	-0.122***
	(0.022)	(0.012)	(0.018)	(0.015)
P=+6	-0.073***	-0.106***	-0.103***	-0.096***
	(0.020)	(0.011)	(0.017)	(0.015)
P=+7	-0.105***	-0.123***	-0.135***	-0.111***
	(0.020)	(0.010)	(0.016)	(0.014)
Num.Obs.	37869	65431	17686	31571
R2 Adj.	0.258	0.242	0.281	0.244

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Result 7

Impact of COVID-19 on the incidence of household food deprivation

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	0.095***	0.034***	0.035***	0.029**
	(0.018)	(0.008)	(0.010)	(0.012)
P=-3	0.052***	0.014	0.012	0.011
	(0.017)	(0.008)	(0.011)	(0.011)
P=-2	0.019	0.006	0.013	0.007
	(0.016)	(0.008)	(0.010)	(0.011)
P=0	0.048***	0.026***	0.032***	0.008
	(0.018)	(0.009)	(0.011)	(0.012)
P=+1	0.212***	0.217***	0.193***	0.239***
	(0.018)	(0.010)	(0.017)	(0.015)
P=+2	0.106***	0.161***	0.138***	0.180***
	(0.018)	(0.010)	(0.014)	(0.013)
P=+3	-0.008	0.077***	0.064***	0.083***
	(0.015)	(0.010)	(0.012)	(0.014)
P=+4	0.088***	0.091***	0.066***	0.098***
	(0.017)	(0.010)	(0.013)	(0.015)
P=+5	0.031*	0.085***	0.072***	0.086***
	(0.017)	(0.010)	(0.013)	(0.013)
P=+6	0.043***	0.079***	0.072***	0.079***
	(0.017)	(0.010)	(0.012)	(0.013)
P=+7	0.079***	0.081***	0.086***	0.080***
	(0.016)	(0.009)	(0.012)	(0.013)
Num.Obs.	37869	65431	17686	31571
R2 Adj.	0.216	0.165	0.124	0.158

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Result 8

Impact of COVID-19 on the logarithm of monthly per capita household healthcare expenditure (Metropolitan Lima 2021 prices)

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	-0.248***	-0.174***	-0.220***	-0.152***
	(0.058)	(0.034)	(0.057)	(0.044)
P=-3	-0.142***	-0.087**	-0.076	-0.104**
	(0.055)	(0.036)	(0.057)	(0.042)
P=-2	0.058	0.011	0.015	0.001
	(0.053)	(0.031)	(0.045)	(0.039)
P=0	-0.070	-0.124***	-0.158***	-0.073
	(0.055)	(0.036)	(0.057)	(0.045)
P=+1	-0.237***	-0.291***	-0.387***	-0.160***
	(0.055)	(0.034)	(0.054)	(0.047)
P=+2	0.002	-0.044	-0.163***	0.050
	(0.057)	(0.034)	(0.056)	(0.045)
P=+3	0.091**	0.071**	0.099*	0.099**
	(0.044)	(0.033)	(0.051)	(0.040)
P=+4	-0.020	-0.038	-0.009	-0.016
	(0.056)	(0.035)	(0.049)	(0.043)
P=+5	0.141***	0.116***	0.186***	0.126***
	(0.053)	(0.031)	(0.048)	(0.039)
P=+6	0.250***	0.121***	0.118**	0.153***
	(0.053)	(0.031)	(0.052)	(0.037)
P=+7	0.158***	0.107***	0.118**	0.109***
	(0.050)	(0.029)	(0.051)	(0.036)
Num.Obs.	37869	65431	17686	31571
R2 Adj.	0.122	0.113	0.078	0.071

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Result 9

Impact of COVID-19 on the logarithm of monthly per capita household transportation and communications expenditure (Metropolitan Lima 2021 prices)

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	-0.187***	-0.046**	0.006	-0.090***
	(0.048)	(0.022)	(0.032)	(0.031)
P=-3	-0.090**	0.003	0.045	-0.027
	(0.044)	(0.022)	(0.033)	(0.031)
P=-2	-0.055	0.008	0.042	-0.018
	(0.044)	(0.025)	(0.031)	(0.031)
P=0	-0.028	-0.056**	-0.020	-0.062*
	(0.047)	(0.023)	(0.033)	(0.032)
P=+1	-0.655***	-0.638***	-0.548***	-0.655***
	(0.044)	(0.030)	(0.042)	(0.041)
P=+2	-0.418***	-0.471***	-0.384***	-0.465***
	(0.047)	(0.027)	(0.034)	(0.036)
P=+3	-0.254***	-0.324***	-0.212***	-0.330***
	(0.037)	(0.024)	(0.032)	(0.032)
P=+4	-0.288***	-0.350***	-0.277***	-0.339***
	(0.047)	(0.024)	(0.032)	(0.032)
P=+5	-0.126***	-0.275***	-0.214***	-0.258***
	(0.046)	(0.024)	(0.030)	(0.034)
P=+6	-0.041	-0.204***	-0.154***	-0.193***
	(0.044)	(0.024)	(0.031)	(0.032)
P=+7	-0.041	-0.155***	-0.164***	-0.138***
	(0.041)	(0.023)	(0.034)	(0.031)
Num.Obs.	37869	65431	17686	31571
R2 Adj.	0.250	0.284	0.259	0.204

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Result 10

Impact of COVID-19 on the logarithm of monthly per capita extraordinary household income (Metropolitan Lima 2021 prices)

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	-0.102*	-0.030	0.042	-0.036
	(0.053)	(0.041)	(0.068)	(0.047)
P=-3	-0.041	0.009	0.083	0.009
	(0.053)	(0.039)	(0.064)	(0.049)
P=-2	0.056	0.017	0.072	0.013
	(0.052)	(0.035)	(0.063)	(0.042)
P=0	0.047	0.004	0.095	-0.024
	(0.053)	(0.037)	(0.061)	(0.045)
P=+1	0.087	0.205***	0.277***	0.235***
	(0.057)	(0.046)	(0.075)	(0.061)
P=+2	0.214***	0.623***	1.280***	0.496***
	(0.056)	(0.046)	(0.083)	(0.055)
P=+3	0.191***	0.809***	1.615***	0.599***
	(0.053)	(0.045)	(0.083)	(0.052)
P=+4	0.239***	0.699***	1.350***	0.518***
	(0.059)	(0.049)	(0.089)	(0.052)
P=+5	0.373***	0.657***	1.362***	0.461***
	(0.058)	(0.048)	(0.107)	(0.050)
P=+6	0.181***	0.627***	1.467***	0.445***
	(0.059)	(0.048)	(0.098)	(0.048)
P=+7	0.095*	0.450***	1.101***	0.242***
	(0.050)	(0.055)	(0.104)	(0.055)
Num.Obs.	37869	65431	17686	31571
R2 Adj.	0.223	0.117	0.141	0.104

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Result 11

Impact of COVID-19 on the logarithm of monthly per capita household income from work (Metropolitan Lima 2021 prices)

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	-0.062	-0.077**	-0.016	-0.019
	(0.038)	(0.032)	(0.025)	(0.025)
P=-3	-0.086**	-0.104***	-0.024	-0.038
	(0.038)	(0.032)	(0.024)	(0.024)
P=-2	-0.025	-0.052*	-0.018	-0.037
	(0.036)	(0.032)	(0.022)	(0.024)
P=0	-0.136***	-0.186***	-0.015	-0.045*
	(0.039)	(0.034)	(0.026)	(0.024)
P=+1	-0.638***	-1.148***	-0.282***	-0.733***
	(0.040)	(0.038)	(0.037)	(0.035)
P=+2	-0.412***	-0.643***	-0.291***	-0.575***
	(0.037)	(0.037)	(0.027)	(0.029)
P=+3	-0.152***	-0.317***	-0.122***	-0.256***
	(0.029)	(0.033)	(0.026)	(0.023)
P=+4	-0.240***	-0.401***	-0.151***	-0.293***
	(0.039)	(0.037)	(0.028)	(0.026)
P=+5	-0.086**	-0.291***	-0.089***	-0.256***
	(0.035)	(0.033)	(0.026)	(0.025)
P=+6	-0.057	-0.240***	-0.129***	-0.236***
	(0.037)	(0.032)	(0.028)	(0.025)
P=+7	-0.076**	-0.225***	-0.130***	-0.158***
	(0.033)	(0.027)	(0.028)	(0.022)
Num.Obs.	37869	65431	17686	31571
R2 Adj.	0.439	0.477	0.286	0.225

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Result 12

Impact of COVID-19 on the logarithm of monthly per capita household monetary income from current transfers (Metropolitan Lima 2021 prices)

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	0.039	-0.070	0.006	-0.166***
	(0.057)	(0.046)	(0.076)	(0.063)
P=-3	0.040	0.055	0.177**	-0.078
	(0.058)	(0.047)	(0.072)	(0.061)
P=-2	0.012	0.013	0.174**	-0.066
	(0.060)	(0.046)	(0.075)	(0.059)
P=0	1.414***	0.865***	0.833***	1.080***
	(0.054)	(0.042)	(0.080)	(0.057)
P=+1	1.480***	0.689***	0.611***	1.111***
	(0.051)	(0.051)	(0.082)	(0.069)
P=+2	1.571***	0.936***	0.794***	1.312***
	(0.051)	(0.045)	(0.074)	(0.055)
P=+3	1.744***	1.273***	1.171***	1.680***
	(0.047)	(0.047)	(0.073)	(0.053)
P=+4	1.325***	1.216***	1.196***	1.520***
	(0.056)	(0.047)	(0.070)	(0.057)
P=+5	1.294***	1.244***	1.249***	1.552***
	(0.054)	(0.041)	(0.073)	(0.051)
P=+6	1.204***	1.200***	1.146***	1.541***
	(0.057)	(0.044)	(0.077)	(0.055)
P=+7	1.139***	1.175***	1.157***	1.477***
	(0.054)	(0.045)	(0.079)	(0.055)
Num.Obs.	37869	65431	17686	31571
R2 Adj.	0.396	0.327	0.162	0.247

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Result 13

Impact of COVID-19 on the logarithm of monthly per capita household income from private monetary transfers (Metropolitan Lima 2021 prices)

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	-0.173***	-0.162***	-0.133**	-0.148***
	(0.047)	(0.040)	(0.052)	(0.055)
P=-3	-0.063	-0.010	0.016	-0.025
	(0.051)	(0.046)	(0.063)	(0.057)
P=-2	-0.063	0.029	0.042	-0.008
	(0.047)	(0.046)	(0.064)	(0.059)
P=0	-0.122***	-0.138***	-0.049	-0.149***
	(0.047)	(0.039)	(0.055)	(0.052)
P=+1	-0.292***	-0.437***	-0.285***	-0.318***
	(0.046)	(0.042)	(0.057)	(0.057)
P=+2	-0.328***	-0.316***	-0.208***	-0.282***
	(0.044)	(0.044)	(0.053)	(0.052)
P=+3	-0.142***	-0.167***	-0.177***	-0.133***
	(0.044)	(0.040)	(0.056)	(0.051)
P=+4	-0.129**	-0.253***	-0.266***	-0.212***
	(0.052)	(0.044)	(0.056)	(0.052)
P=+5	-0.123**	-0.200***	-0.245***	-0.122**
	(0.050)	(0.039)	(0.058)	(0.054)
P=+6	-0.068	-0.114**	-0.172***	-0.077
	(0.049)	(0.046)	(0.063)	(0.051)
P=+7	-0.114**	-0.174***	-0.159***	-0.141***
	(0.047)	(0.038)	(0.058)	(0.050)
Num.Obs.	37869	65431	17686	31571
R2 Adj.	0.134	0.133	0.085	0.129

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Result 14

Impact of COVID-19 on the logarithm of monthly per capita household income from public monetary transfers (Metropolitan Lima 2021 prices)

Term	0. National Rural	1. National Urban	2. Formal Urban	3. Informal Urban
P=-4	0.140**	0.050	0.125*	-0.036
	(0.061)	(0.042)	(0.064)	(0.048)
P=-3	0.048	0.041	0.158***	-0.065
	(0.060)	(0.040)	(0.056)	(0.049)
P=-2	0.056	-0.012	0.154***	-0.081*
	(0.064)	(0.039)	(0.053)	(0.046)
P=0	1.701***	1.241***	1.012***	1.534***
	(0.057)	(0.048)	(0.075)	(0.053)
P=+1	1.793***	1.222***	1.003***	1.650***
	(0.055)	(0.048)	(0.074)	(0.057)
P=+2	1.908***	1.466***	1.132***	1.892***
	(0.056)	(0.045)	(0.067)	(0.048)
P=+3	2.039***	1.821***	1.514***	2.289***
	(0.051)	(0.048)	(0.065)	(0.045)
P=+4	1.594***	1.785***	1.617***	2.116***
	(0.059)	(0.044)	(0.067)	(0.053)
P=+5	1.552***	1.805***	1.675***	2.118***
	(0.057)	(0.042)	(0.063)	(0.054)
P=+6	1.450***	1.692***	1.500***	2.072***
	(0.060)	(0.041)	(0.066)	(0.053)
P=+7	1.398***	1.686***	1.498***	2.022***
	(0.060)	(0.043)	(0.064)	(0.052)
Num.Obs.	37869	65431	17686	31571
R2 Adj.	0.423	0.360	0.201	0.348

Note: All regressions include controls. Employment status is not used for the formal urban or informal urban subsample.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

9. Supplement

This section presents a proposal for the periodization of the pandemic into waves for the Peruvian case, based on consolidated data and the identification of different stages within each wave. The pandemic's onset is traced back to the early days of March. The first confirmed case of COVID-19 reported by the Ministry of Health (MINSA) occurred on March 6, 2020. Subsequently, another death due to coronavirus was retrospectively attributed to March 3, 2020. Since the pandemic's onset until February 2023, Peru has experienced five waves of COVID-19.

We establish criteria for the onset and conclusion of a wave based on the 14-day moving average of COVID-19 positive cases per million inhabitants. Although data on positive cases may lack full reliability, the curve's behavior closely mirrors that of deaths, albeit with a lead time of approximately 15 days due to the nature of the disease. We propose that a wave can consist of up to five stages: Onset, Peak, Deceleration, Trough, and Plateau. The first two stages are part of the stage where positive cases surge until reaching their peak ("Onset-Peak"), while the last three are part of the period after a wave reaches its peak. In the first two waves, there is a stage we term the "trough" with a high number of cases but with a short period of decline, followed by resurgence. However, starting from the third wave of COVID-19, this stage is not present, and waves only comprise the four stages of Onset-Peak-Deceleration-Plateau.

Supplement 1

Criteria for Identifying Stages Within COVID-19 Waves for the Peruvian Case

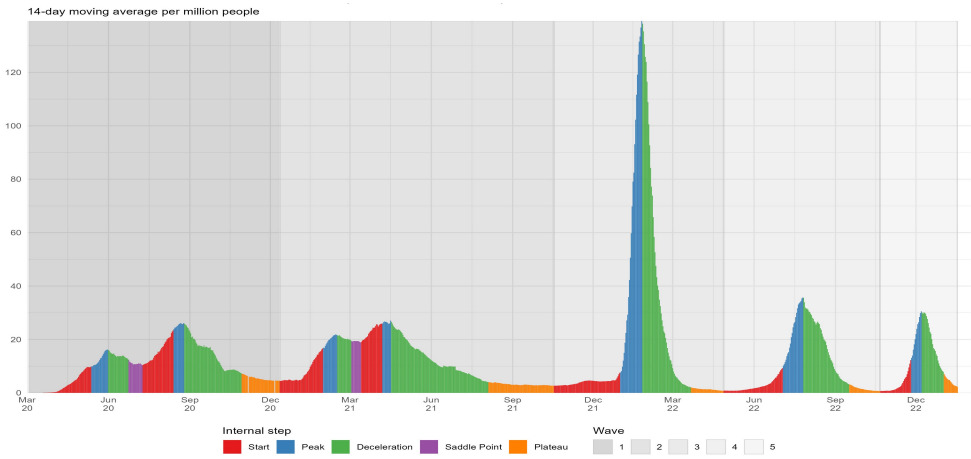
Stage	Description
Onset of Start	The "Onset" of a wave is defined as an increase in the moving average of positive cases for 7 consecutive days. It ends when the indicator levels exceed the third quartile of cases from the "Onset-Peak" block. It may be preceded by a "Plateau" or a "Trough." When preceded by a "Trough," it indicates a resurgence in cases within a wave (a new "Start"); if preceded by a "Plateau," it marks the beginning of a new wave ("Onset").
Peak	The "Peak" is above the third quartile and the maximum of the "Onset-Peak" block. It precedes the "Deceleration" stage.
Deceleration	It begins after the moving average of positive cases reaches the maximum Peak until it reaches the 40th percentile of the 'Deceleration-Plateau' block. There is a rapid decline in the moving average of positive cases. It may precede a "Trough" or a "Plateau".
Trough	The "Trough" is the stage where the moving average is below the 40th percentile of the "Deceleration-Plateau" block and between a "Deceleration" and a "Start" process (i.e., it is a "Start" where the moving average of positive cases increases). The presence of "Trough" stages was a feature of the first two waves.
Plateau	The "Plateau" is the stage where the moving average of positive cases falls below the 40th percentile of the "Deceleration-Plateau" block. It marks the end of a COVID-19 wave, with a sustained increase over the next 7 days.

Prepared by the authors.

The evolution of the moving average of positive cases per million inhabitants across different stages within each wave exhibits variability. For instance, during the initial two waves, there are

instances of upswings in the moving average of positive cases per million inhabitants. However, starting from the third wave, the trend of upswings diminishes, with the peak of positive cases occurring during this wave.

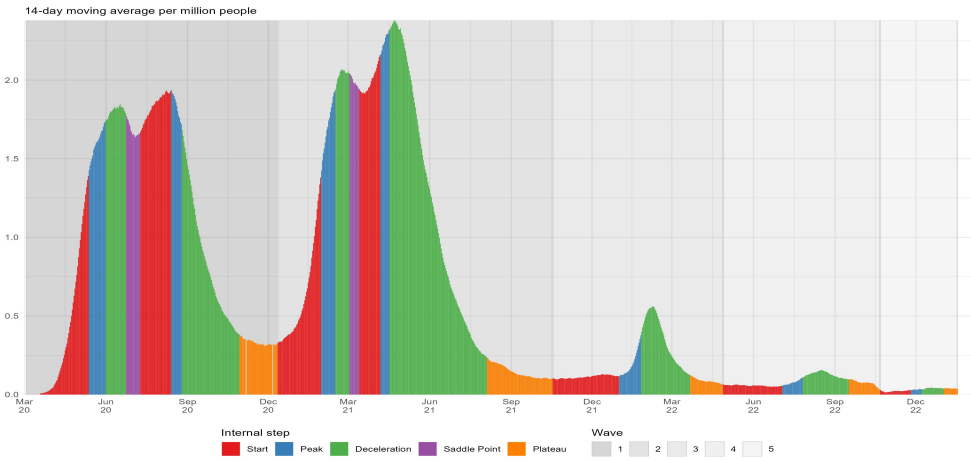
Supplement 2. Confirmed Cases by Wave and Internal Phase



Note: Calculations based on data up to 2023-01-17.
Source: Own elaboration with data from Plataforma Nacional de Datos Abiertos COVID-19 (MINSA) - COVID-19 confirmed cases and deaths.

Regarding the evolution of the moving average of deaths per million inhabitants across different stages within each wave, there are noticeable upswings during the initial two waves, reaching historical peaks. However, the trend of upswings diminishes starting from the third wave. Additionally, the moving average of deaths per million inhabitants from the third wave onwards is lower than for the first two waves.

Supplement 3. Confirmed Deaths by Wave and Internal Phase



Note: Calculations based on data up to 2023-01-17.
Source: Own elaboration with data from Plataforma Nacional de Datos Abiertos COVID-19 (MINSA) - COVID-19 confirmed cases and deaths.

References

Alarco, G., Castillo, C., and Leiva, F. (2019). Riqueza y desigualdad en el perú. *Visión Panorámica. Lima: OXFAM*.

Benites, J., and Francke, P. (2023). COVID-19 y el alza de la inseguridad alimentaria de los hogares rurales en Perú durante 2020-2021.

De Rosa, M., Flores, I., and Morgan, M. (2022). More unequal or not as rich? Revisiting the latin american exception.

Figueroa, A. (1996). *Teorías Económicas del Capitalismo*. Fondo Editorial de Pontificia Universidad Católica del Perú.

Francke, P. (2023). Impacto del COVID-19 sobre la pobreza y vulnerabilidad monetaria. Instituto Nacional de Estadística en Informaática [INEI].

Harrison, C., Horwitz, L., and Zissis, C. (2022). Timeline: Tracking Latin America's Road to Vaccination. *Americas Society/Council of the Americas*.

Higa, M., Ospino, C., and Aragon, F. (2023). The persistent effects of COVID-19 on labour outcomes: Evidence from Peru. *Applied Economics Letters 30(8)*, 1065–1076.

IMF (2022). Peru: 2022 Article IV Consultation-Press Release; Staff Report; and Statement by the Executive Eirector for Peru. International Monetary Fund, Lima, Perú.

INEI (2022). Evolución de la pobreza monetaria 2010-2021 [Informe técnico]. Instituto Nacional de Estadística e Informática, Washington, DC.

Mathieu, E., Ritchie, H., Ortiz-Ospina, E., Roser, M., Hasell, J., Appel, C., Giattino, C., and Rodés-Guirao, L. (2021). A global database of COVID-19 vaccinations. *Nature Human Behaviour 5(7)*, 947–953.

R4V (2023). América Latina y el Caribe, Refugiados y Migrantes Venezolanos en la Región.

Vásquez, T., Morel, J., and Mendoza, J. (2021). The impact of COVID-19 on work and employment among internal and international migrant workers in Peru.