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ARTICLE

Remittances, Nonlabor Income as a Source of Hysteresis in Unemployment in Colombia, 2010–2020

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Abstract

This study seeks to determine the impact of remittances and nonlabor income on the duration of unemployment, and therefore on the hysteresis phenomenon in Colombia for the period between January 2010 and January 2021. The long-term unemployment rate in Colombia (LAPU) is calculated, and a vector autoregressive (VAR) model is subsequently estimated to evaluate the impact of remittances and nonlabor income on the LAPU. The results suggest that the increase in nonlabor income significantly affected LAPU in Colombia in the period analyzed. The growth of remittances instead turned out to positively and significantly impact LAPU only during the COVID-19 pandemic crisis. This suggests that remittances have become a fundamental income in times of crisis that allow for financing the search for work for a longer period of time, thus increasing the duration of unemployment and generating a hysteresis effect.

Keywords: unemployment duration; hysteresis; long-term unemployment; Covid-19

Resumen

Este estudio tiene como objetivo determinar el impacto de las remesas y los ingresos no laborales en la duración del desempleo y, por lo tanto, en el fenómeno de histeresis en Colombia durante el periodo comprendido entre enero de 2010 y enero de 2021. Con el fin de lograr el objetivo planteado, se calcula la tasa de desempleo a largo plazo en Colombia (LAPU) y posteriormente se estima un modelo de Vector Autoregresivo (VAR) para evaluar el impacto de las remesas y los ingresos no laborales en el LAPU. Los resultados sugieren que el aumento de los ingresos no laborales tuvo un impacto significativo en el LAPU en Colombia durante el periodo analizado. Por otro lado, el crecimiento de las remesas tuvo un impacto positivo y significativo en el LAPU solo durante el periodo de crisis de la pandemia de COVID-19. Esto sugiere que las remesas se han convertido en una fuente de ingresos fundamental en tiempos de crisis que permiten financiar la búsqueda de trabajo durante un período más prolongado, aumentando la duración del desempleo y generando un efecto de histeresis.

Palabras clave: duración del desempleo; histéresis; desempleo de largo plazo; Covid-19

The phenomenon of hysteresis in unemployment, characterized by persistent changes in the unemployment rate, has been widely discussed in the literature. Various studies, such as Layard and Nickell (1986), Blanchard and Summers (1986), Layard, Nickell, and Jackman

(1991), Blanchard and Portugal (2001), and Blanchard (2018), have shown that past temporary shocks can have lasting effects on the unemployment rate, leading to path-dependent behavior. This implies that unemployment is influenced by its own past values, which indicates a unit root process.

This study provides a detailed analysis of the factors influencing unemployment duration and persistence in Colombia. This context is interesting because of Colombia's higher average unemployment rate and nonaccelerating inflation rate of unemployment (NAIRU) compared to other countries in the Pacific Alliance (Cardona-Arenas and Sierra-Suárez 2020). A high NAIRU indicates labor-market rigidities and structural unemployment issues (Constantinescu and Nguyen 2018; Otoiu and Titan 2012).

Persistent unemployment in Colombia during economic expansion has been observed, reflecting inertial behavior of job seekers in the labor market, as pointed out by Knight (2018) and Lartey (2018). Furthermore, Colombia has experienced a significant increase in remittance inflows over the past decade, with an average growth rate of 5.8 percent from 2010 to 2020 (Banco de la República, Sección Sector Externo 2021). Certain departments, such as Risaralda, Quindío, and Valle del Cauca, have particularly high proportions of remittances, ranging from 5.17 percent to 9.44 percent of their respective GDPs.

The study explores the relationship between remittances and unemployment in Colombia, considering the influence of hysteresis and the impact of remittance inflows during both normal and crisis periods. By analyzing the dynamics of these variables, the study contributes to a deeper understanding of the factors shaping unemployment duration and persistence in the Colombian labor market.

This research investigates the impact of nonlabor income and remittances on the duration of unemployment in Colombia from January 2010 to January 2021, taking into account the existing literature on the hysteresis phenomenon. Previous studies in national and international contexts have primarily focused on examining the hysteresis hypothesis without providing causal explanations, largely given the lack of access to micro-founded longitudinal data. This study contributes to the research field by constructing a comprehensive database that includes variables such as household nonlabor income, duration of unemployment, and number of long-term unemployed individuals. Additionally, an indicator called the long-term unemployment rate (LAPU) is developed, which measures the persistence in the duration of unemployment over time.

This study addresses a key limitation of the existing literature by considering the determinants associated with long-term unemployment as a potential source of hysteresis. As suggested by Blanchard and Portugal (2001) and Blanchard (2018), past temporary shocks can have a lasting impact on the labor market, leading to an increase in unemployment duration and the emergence of hysteresis. However, no studies in Latin America have explored the role of nonlabor income and remittances as sources of hysteresis in unemployment. Similarly, limited empirical analyses have been conducted in North American and Asian contexts, and none of the identified studies specifically examines the hysteresis-generating effect of remittances and nonlabor income.

Therefore, this study innovates in the field by empirically analyzing the relationship of nonlabor income, remittances, unemployment duration, and hysteresis. It fills a gap in the literature by addressing the implicit dynamics of unemployment duration and hysteresis in the Colombian context. By investigating the impact of nonlabor income and remittances on the long-term unemployment rate, this study sheds light on the factors influencing unemployment persistence and provides valuable insights for policy makers and researchers interested in understanding the dynamics of the labor market in Colombia.

In the Colombian context, there is a lack of consensus regarding the existence of the hysteresis phenomenon in unemployment. Some studies support its presence, while others find no evidence of it. Betrán-Gonzales (2012) emphasizes that the success of reversing hysteresis depends on reintegrating the long-term unemployed into formal

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employment. Therefore, the duration of unemployment and hysteresis should be analyzed together. Considering the potential existence of hysteresis, it is important to consider the long-term effects of economic policy on unemployment behavior and its duration (Logeay and Tober 2006).

Omay, Ozcan, and Shahbaz (2020) emphasize that random and temporary labor market shocks tend to be linked to long-term unemployment dynamics in the presence of hysteresis. In light of this, the research question posed in this study is, What is the impact of remittances and nonlabor income on the duration of unemployment and the hysteresis phenomenon in Colombia from January 2010 to January 2021? To address this research question, a quantitative study using longitudinal data and vector autoregressive models (VAR) was conducted. This approach involved the estimation of a multi-equational dynamic model based on the systematization of anonymized microdata in longitudinal series. This research is the first of its kind in Colombia and Latin America; no similar studies have been identified in the international literature.

Extensive data systematization was then performed to construct the longitudinal series. The data was treated to account for factors such as deseasonalization and stationarity. Empirical estimation of VAR models was conducted, considering the impact of the pandemic as a random shock to control for its effects. Finally, the article follows a structured format, including sections on the state of the art, methodology, results, and general conclusions.

In conclusion, this research contributes to the understanding of hysteresis in unemployment by examining the impact of remittances and nonlabor income on the duration of unemployment in Colombia. The study utilizes longitudinal data and VAR models. The research article provides valuable insights, especially considering its novelty in Colombia, Latin America, and the international literature.

Literature review

Hysteresis and its measurement in different contexts

The term *hysteresis* comes from physics, according to Beltran (2012). Göcke (2002) explains how the term has been applied in the field of economics to the labor market to describe the dependence of unemployment over time. For Göcke (2002), strong and genuine hysteresis is characterized by observing unemployment dynamics with local equilibria very susceptible to degenerative or progressive changes (upward trend or downward trend of the series). These changes can be attributed to a specific kind of memory influenced by past economic shocks.

The concept of unemployment hysteresis goes back to analysis of unemployment persistence based on New Keynesian theories of wage determination, namely Layard and Nickell's (1986) theory of unions, as well as the insider-outsider theory developed by Lindbeck and Snower (1984, 1988).

Blanchard and Summers (1986) argued that in the presence of hysteresis, wages respond significantly to changes in the employment rate and to a lesser extent (or inelastically) to the unemployment rate. One of the first works intending to test the hysteresis hypothesis was that of Franz and Gordon (1993). In the context of Germany and the United States, between 1973 and 1990, both countries were characterized by a partial hysteresis; that is, the unemployment series seemed to exhibit a high memory but did not provide enough evidence to formally declare the existence hysteresis in unemployment.[1] Subsequently, research began to focus on the testing of unit roots and high recall tests. In

[1] *High memory in time series* refers to the ability of time series observations to retain information (such as the characteristic of high unemployment) over an extended period, which explains the trend over time.

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this sense, Koustas and Veloce (1996) found the existence of hysteresis for Canada and the United States using long-memory univariate time-series models.

Several studies have contributed to the understanding of hysteresis in unemployment. Røed (1996, 1997) and Song and Wu (1998) examined unemployment rates in fifteen Organisation for Economic Co-operation and Development (OECD) countries and found that unit root tests alone were insufficient to determine the presence of hysteresis. Kawaguchi and Murao (2014) analyzed cohorts of historical unemployment for twenty OECD countries and demonstrated that macroeconomic shocks have long-term effects on the labor market, leading to persistently high unemployment rates, indicative of hysteresis. Similarly, Ball and Onken (2022) found strong evidence of hysteresis in twenty-nine advanced economies by studying the relationship between unemployment and its natural rate, with varying degrees of hysteresis across countries. They also discovered asymmetry in hysteresis, where decreases in unemployment had a stronger impact on the natural rate than increases did. Bahmani-Oskooee, Chang, and Ranjbar (2017) focused on the United States and found partial evidence of hysteresis through stochastic dynamics of the unemployment rate. Ayala, Cuñado, and Gil-Alana (2012) examined eighteen Latin American countries, including Colombia, and concluded that sixteen of them exhibited evidence of hysteresis based on unit root tests and parametric models, considering endogenous structural changes.

These studies contribute to the understanding of hysteresis in unemployment, highlighting its presence and the influence of macroeconomic shocks and asymmetries across different countries and regions. Belke, Göcke, and Werner (2014) offer a comprehensive review of methodologies for modeling hysteresis, suggesting alternative approaches to time-series analysis. Deleidi and Levrero (2021) propose a structural vector autoregressive regression (SVAR) model, emphasizing the impact of monetary policy on prices, wages, and long-run unemployment persistence. Oliskevych (2015) found evidence of hysteresis in Ukraine by examining the effects of various shocks on unemployment. Trejos, Rivera, and Ríos (2017) investigated hysteresis in Mexico, confirming its presence through the strong inertia observed in the unemployment series and its macroeconomic determinants. These studies contribute valuable empirical evidence and propose alternative models, enhancing the understanding of hysteresis in unemployment dynamics in different contexts.

Empirical studies of hysteresis in unemployment often use unit root analysis to assess its presence. However, Amable, Henry, and Lordon (1992) argued that this approach mainly captures high persistence rather than hysteresis itself. Belke (2018) further emphasized that unit root analysis primarily indicates integration order rather than genuine local equilibria in unemployment dynamics. Thus, relying solely on this analysis may not provide conclusive evidence. To understand hysteresis, it becomes essential to explore causal factors and time-dependent paths. In the subsequent section, we examine the duration of unemployment as one such factor.

Duration of unemployment and hysteresis

Göcke (2002) suggests that inactivity time leads to a deterioration in labor quality, as individuals lack continuous training while unemployed. Employers are aware of this effect, causing the duration of unemployment to act as a negative selection mechanism for new hires. This hysteresis effect results in lower salaries for new hires than for dismissed workers, which creates temporary disturbances with lasting impacts on unemployment and the natural rate of unemployment. Factors that directly or indirectly affect reservation wages, such as nonlabor income (e.g., remittances, rents, transfers), can further prolong job searches and contribute to hysteresis. In contrast, Logeay and Tober (2006) argue that prolonged unemployment may be socially accepted because of political

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pressure to protect the unemployed through subsidies or aid. Overall, nonlabor income increases reservation wages over time, reducing employment opportunities and leading to persistent and high long-term unemployment characteristic of hysteresis.

The literature presents a wide range of determinants of hysteresis in unemployment. However, one of the consistent ones is that provided by Machin and Manning (1999), who focuses on analyzing the relationship between persistence and duration of unemployment. They concluded that the persistence in unemployment is due to a much slower rate of hiring for the long-term unemployed than the short-term unemployed, giving way to hysteresis in unemployment. That aligns with the conclusions of Clark, Knabe, and Rätzel (2009), who showed how economic easing can cause much higher regional unemployment, and as unemployment increases, hiring wages fall significantly in accordance with the increase of dismissal costs. This situation is a hysteresis generator.

Along those lines, Rusticelli (2014) concluded in the context of peripheral European countries that hysteresis in unemployment is caused by the duration of unemployment. A Kalman filter showed that the increase in the duration of unemployment produces a degenerative process in the labor market. Similarly, Marjanović and Mihajlović (2016), studying twelve OECD countries between 1990 and 2013, concluded that hysteresis existed from changes in long-term unemployment, which positively affect the unemployment rate and the natural rate of unemployment. Alternatively, investigating unobservable factors such as institutions, legislation, and technological innovations can reveal long-term effects on unemployment. Constructing a long-term unemployment indicator allows for the examination of the hysteresis phenomenon. Graafland (1991) confirmed that lagged long-term unemployment has an impact on unemployment levels in the medium and long term. Jones and Manning (1992) emphasized the disadvantage faced by the long-term unemployed as a result of skill deterioration. Apergis and Apergis (2020) explained how long-term unemployment reduces employability and perpetuates hysteresis. Jurajda and Münich (2003) find that higher unemployment rates lead to increased nonlabor income and persistently high levels of unemployment, indicating hysteresis. Webster (2005) emphasized the statistical misinterpretation of hysteresis. The LAPU indicator, introduced by the author, is used to analyze labor market failures and hysteresis, as discussed by Theodore (2007), Mitchell and Bill (2005), and Girardi, Meloni, and Stirati (2018).

As Blanchard and Portugal (2001) have indicated, the literature has managed to identify three determinants of the duration of unemployment: employment protection laws, unemployment insurance (see Lancaster 1979; Meyer 1990; Knight 2018), and nonlabor income (see Foley et al. 1997; Svejnar 1999; Lartey 2018). The mentioned studies highlight that nonlabor income can have a significant impact on the duration of unemployment.

In this sense, and as an example, Hajdu and colleagues (2020) studied the relationship between the Child Support Subsidy in South Africa and unemployment in rural areas, finding that beneficiary families did not intend to carry out productive activities because the subsidy allowed them to cover basic household expenses. Respectively, Rodriguez (2018) estimated a Vector Autoregressive model using the long-term unemployment variable to confirm the hysteresis effect in the United Kingdom and the Netherlands.

Remittance ratio, duration of unemployment and hysteresis

Banco de la República (2021) defines remittances as current transfers made by emigrants to their country of origin, in money or in kind. Such transfers are not conditioned by employment relationships, so it is expected that in a country that receives remittances, the labor supply of households may be affected by the increase in remittances. One of the first studies in Latin America to analyze this phenomenon is that of Funkhouser (1992), for Nicaragua, who found that the receipt of remittances reduces the probability of participating in the labor market. Accordingly, in the context of the Philippines, Rodriguez

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and Tiongson (2001) argued that an increase in remittances per nonmigrant family member reduces labor participation for men and women. The results are also consistent with the findings of Amuedo-Dorantes and Pozo (2006) in the Mexican context. They found that an increase in remittances is associated with a reduction in hours per month of work per capita in urban and rural areas, such that general labor participation is reduced in the face of changes in remittances.

According to Drinkwater, Levine, and Lotti (2003), the impact of remittances on unemployment can present two opposite effects in the labor-exporting country. First, unemployment may rise if recipients consider that remittances provide some form of social assistance, or they may reduce unemployment if such income spurs investment for the creation of new microenterprises. In line with that, Sharma and Cárdenas (2018) discuss whether remittances provide households with the funds necessary to start family businesses or prolong the duration of unemployment in Mexico.

For Mexico, Airola (2008) concluded that, in the face of increases in receiving remittances, the expected number of hours worked hours per week in urban areas reduced. Jackman (2017) emphasized the importance of remittances in spending in Latin American countries, indicating that a significant increase in remittances is more noticeable in eighteen Latin American countries, including Colombia. Coincidentally, these countries generally have high unemployment rates, in contrast to more developed economies.

The findings suggest a positive relationship between unemployment and remittances, particularly when the link between remittances and gross domestic product is weak, but the relationship grows over time. Bondarenko (2020); Withers, Henderson, and Shivakoti (2021); and Guha, Islam, and Hussain (2021) extensively explored the remittances-unemployment relationship in the context of the COVID-19 crisis. They found that the pandemic significantly affected unemployment, making recipient countries more reliant on nonlabor income such as remittances. This nonlabor income allows for longer job search periods, which results in increased unemployment rates as a result of prolonged waiting periods (Cuadros-Menaca, 2020). Similarly, Cuadros-Menaca and Gaduh (2020) found that remittances reduce child labor but do not affect schooling significantly. They also observe a smaller impact on the labor supply of adult females than children. In contrast, Arango, de la Mata, and Obando (2015), using data from the household survey in urban areas of Colombia from 2006 to 2011, found that higher unemployment rates negatively affect the likelihood of receiving remittances.

In general, the literature suggests that remittances, when considered as nonlabor income, tend to prolong the duration of unemployment. However, there is a possibility of endogeneity, as remittances may be sent to unemployed individuals. Despite this, some studies indicate that in developing countries, remittances have negative effects, particularly on labor supply, education, and economic growth. This conclusion is strongly supported by the work of Adams (2011), who analyzed fifty studies on the impact of remittances in developing countries. The detrimental effects are particularly evident in countries with high levels of corruption and institutional weaknesses, as emphasized by Borja (2020). Therefore, this article avoids imposing a priori relationships or restrictions and instead proposes the estimation of a multi-equation model like VAR to comprehensively interpret the results in a system of endogenous variables.

Methodology

This research follows an explanatory quantitative-longitudinal approach. It takes into account continuous and discrete quantitative variables that allow for the calculation of the LAPU variable and, subsequently, the estimation of VAR models to answer the research

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question. It should be noted that the VAR analysis was originally proposed by Sims (1986). Its utility consists of evaluating the effect of a shock on the endogenous variable system over time. This methodology proposes a simpler, more practical alternative to the traditional models of simultaneous equations. In the same way, we proceed to calculate the impulse-response functions that measure the cumulative reaction of each of the variables to an innovation in the others. The model is appropriate because it can be assumed that the endogenous variables in the system are functions of the lagged values of all variables in the system. For the purposes of this research, two alternative models are taken into account: the first incorporates the period with crisis (2010m1–2020m12), and the second takes into account the precrisis period (2010m1–2020m12).

A model is then specified where $Y_t = (x_1,\ x_2, x_3, \ldots, x_4)$ is a vector of $(n\ x\ 1)$, series of variables, where Y_t corresponds to the set of endogenous variables integrated I(0) and I(1) and seasonally adjusted in period (t). The model is represented in the following reduced form:

$$Y_t = \sum_{i=1}^{\rho} \Pi_i Y_{t-i} + \epsilon_{t,} \tag{1}$$

where i is the number of lags, and ϵ_t is a vector $(n\ x\ 1)$ of innovations or processes without serial autocorrelation, white noise and with zero expectation and matrix of variances $\sigma^2_{\varepsilon i}$ and covariances σ_{ij} constant over time. Thus, the residuals are distributed as white noise identically in time with zero mean and constant variance: $\varepsilon_t \sim N\left(0, \sigma^2\right),\ \ cov\left(\varepsilon_{ti},\ \varepsilon_{tj}\right) = 0,\ \forall t_i \neq\ t_j$. This representation of the model allows for overcoming bias problems in the estimation and reduces potential identification problems. It describes how the estimated shock in each endogenous variable is simulated in the impulse response function, considering that all variables of the system are endogenous (Beaton, Lalonde, and Luu 2009). Now, the contemporary reactions and the effect after the shock in the endogenous variables can be considered through the impulse-response functions represented generally as follows:

$$FIR_t = \sum_{j=1}^{n}\left[\sum_{i=1}^{m} r_{t,jt-i}\right], \tag{2}$$

where $r_{t,jt-i}$ measures the response of the variation in the long-term unemployment rate to each endogenous variable j of the system in the previous periods, that is, in its lags corresponding to the vector $Y_t = (x_1,\ x_2, x_3, \ldots, x_4)$, where each of the variables is expressed as a function of the accumulated random disturbances. Thus, for each shock, there are as many accumulated impulse-response functions as there are variables. In the present study, the generalized impulse-response functions by Pesaran and Shin (1998) are estimated, which produce impulse-response functions in which the order of the variables in the VAR has no implications on the results. Therefore, the identification problem in the present study follows the perspective of Sims (1986), in which no arbitrary restrictions are imposed on the model, considering that none of the variables in the system of equations of the estimated VAR model has sufficient theoretical or empirical support to be considered exogenous.

Variables and data

The data used in this article is derived from the National Administrative Department of Statistics' (DANE) Large Integrated Household Survey (GEIH by its Spanish initials), which focuses on measuring the labor-market structure and household income in Colombia. It has an annual sample of approximately 240,000 households, making it the most extensive national-level survey. Since 2010, the GEIH has provided methodological comparability with monthly data for the five major regions and detailed information for twenty-three

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departments, thirteen main cities, and eleven intermediate cities, collectively forming the urban labor market. This comprehensive data set, known as the "header module," serves as the primary information source for this article. It's important to note that the survey follows a probabilistic, stratified, unequal conglomerates, and multistage sampling methodology, ensuring robust and representative data collection.

The study examines the influence of nonlabor income and remittances on the long-term unemployment rate in Colombia. The analysis involves creating variables for the long-term unemployment rate (LAPU) and nonlabor income. The VAR model estimation includes additional variables, such as remittances, real wages, and the economy monitoring indicator (ISE). To construct the LAPU variable, the approach proposed by Webster (2005, 977) is followed. It involves calculating the ratio of individuals unemployed for at least fifty-two weeks to the total number of unemployed in the previous fifty-two weeks. This persistence indicator serves as a measure of long-term unemployment. The equation representing this indicator is as follows:

$$LAPU_t = \frac{Unemployed_{t \geq 52\ weeks}}{Total\ of\ Unemployed_{t-52}}. \tag{3}$$

The study includes two VAR models: VAR_1 and VAR_2. VAR_1 consists of four variables: real wage, remittances, nonlabor income, and long-term unemployment (LAPU). VAR_2 includes an additional variable, the economic monitoring index (ISE). The estimation periods are divided into precrisis and crisis. The LAPU variable is constructed from two variables: unemployed and long-term unemployed. The long-term unemployed variable is based on the question P7320 in the GEIH microdata.[2] In Colombia, long-term unemployment is defined as being unemployed for fifty-two weeks or more. This variable has undergone methodological changes over time to align with international standards set by the International Statistics Conference of Labour (CIET) and the International Labour Organization (ILO).

To avoid potential biases caused by methodological changes, the study focuses on the period from January 2010 to December 2020. By doing so, it ensures consistency in the data and eliminates the influence of changes reported by DANE.

In this study, the variable representing individuals unemployed for fifty-two weeks or more is referred to as long-term unemployed (P7320). Remittance data in dollars, obtained from Banco de la República, was adjusted for inflation using the consumer price index published by the US Bureau of Labor Statistics (2021). The total nonlabor income variable was constructed by aggregating responses related to nonsalary income, such as lease payments, pensions, and donations (variables 1–7 in Appendix 1).

Two models were estimated, one including the crisis period (2010M1–2020M12) and another excluding it (2010M1–2019M12). This accounts for the closure of establishments during the COVID-19 pandemic, which significantly affected unemployment. The number of lags in the models was determined using the Akaike information criterion (AIC), resulting in a lag order of five for both cases (see Appendix 3).

To address seasonality, the Tramo-Seats method was applied to deseasonalize the series. The Dickey-Fuller and Phillips-Perron tests, presented in Appendix 2, confirm the absence of seasonality. Additionally, serial autocorrelation tests (LM test) in Appendix 4 indicate no issues of serial autocorrelation in both models.

According to Banerjee and colleagues (1993, 7), a series that needs to be differentiated k times to achieve stationarity is denoted as I(k), whereas an I(0) series is already stationary. If a series requires one differentiation for stationarity, it is considered I(1), indicating the

[2] The data set used in the study had missing data for April and March 2020 due to limitations in data collection caused by the Covid-19 pandemic. To address this, the NNI Method (Nearest Neighbor Imputation) was applied to impute the missing values using the nearest available data.

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presence of a permanent component. In contrast, an I(0) variable has only a transitory component. However, the existence of different integration orders among the vector system's components does not challenge the idea that cointegration allows for stable relationships between variables as long as the processes are stationary. Appendix 2 provides unit root tests, confirming that the LAPU variable is integrated of order I(0), which implies that transitory disturbances only have transitory effects.

There is no consensus in the literature regarding a theoretical model that can establish exogeneity restrictions on the relationship between LAPU and remittances. Granger causality tests (Appendix 5) do not provide significant evidence of unidirectional causality, which supports the findings of the impulse response functions estimated in the VAR model. Figure 1 illustrates the variables, highlighting a decreasing trend in long-term unemployment and nonwork income. This trend potentially suggests an improvement in labor formality conditions. The LAPU variable remains stable over time, whereas real wages show a positive trend with a slight decline in 2016. The impact of the COVID-19 crisis on the variables becomes evident from March 2020.

Results and discussion

Table 1 presents descriptive statistics in relation to the variables analyzed in the article. Each variable has monthly observations for the analysis period. Table 1 shows how the mean values for the total unemployed GEIH, unemployment rate, long-term unemployed, and LAPU are higher than the results in Table 2 (sample precrisis period). Therefore, the data provide evidence of worsening labor-market conditions as a result of the COVID-19 crisis. Likewise, it is interesting to observe how the average of remittances and nonlabor income is higher in the time sample that incorporates the crisis period than in the precrisis period.

Table 3 presents the contemporary correlation matrix. By implication, the variables must be strongly correlated for their inclusion in the VAR system. This can be seen in the signs and estimated correlation coefficients: LAPU versus total unemployed GEIH, LAPU versus unemployment rate, and long-term unemployed versus unemployment rate. Thus, as long as the long-term unemployment component is high compared to the total number of unemployed or the unemployment rate, even when the economy goes through phases of economic expansion, the duration of unemployment can be persistently high, something that Blanchard (2018) called asymmetric hysteresis.

According to Blanchard (2018), the relationship between cyclical and long-term unemployment is crucial in understanding the negative effects of hysteresis. This sheds light on why unemployment in Colombia does not respond rapidly to economic growth. Tuman (2000) supported this idea, emphasizing the close connection between economic growth and employment. To achieve inclusive and sustainable growth, comprehensive policies are needed to promote quality job creation and to enhance job opportunities for all population segments. Vidal and colleagues (2017) emphasized the notable changes in Colombia's economic activity over time. Their development of a "monthly regional indicator of economic activity" holds practical value in predicting various indicators, including labor market trends, across Latin American economies.

Following Blanchard methodologically, an indicator is calculated, consistent with the ratio between the number of long-term unemployed and the total number of unemployed captured by the GEIH unemployed module question P7320. This ratio constitutes the LAPU and is plotted on a scatterplot against the unemployment rate (Figure 2). The result suggests that during periods of relatively low unemployment, the LAPU is relatively higher. Likewise, in periods of economic boom or accelerating aggregate demand, the long-term component will continue to be relatively high with respect to total

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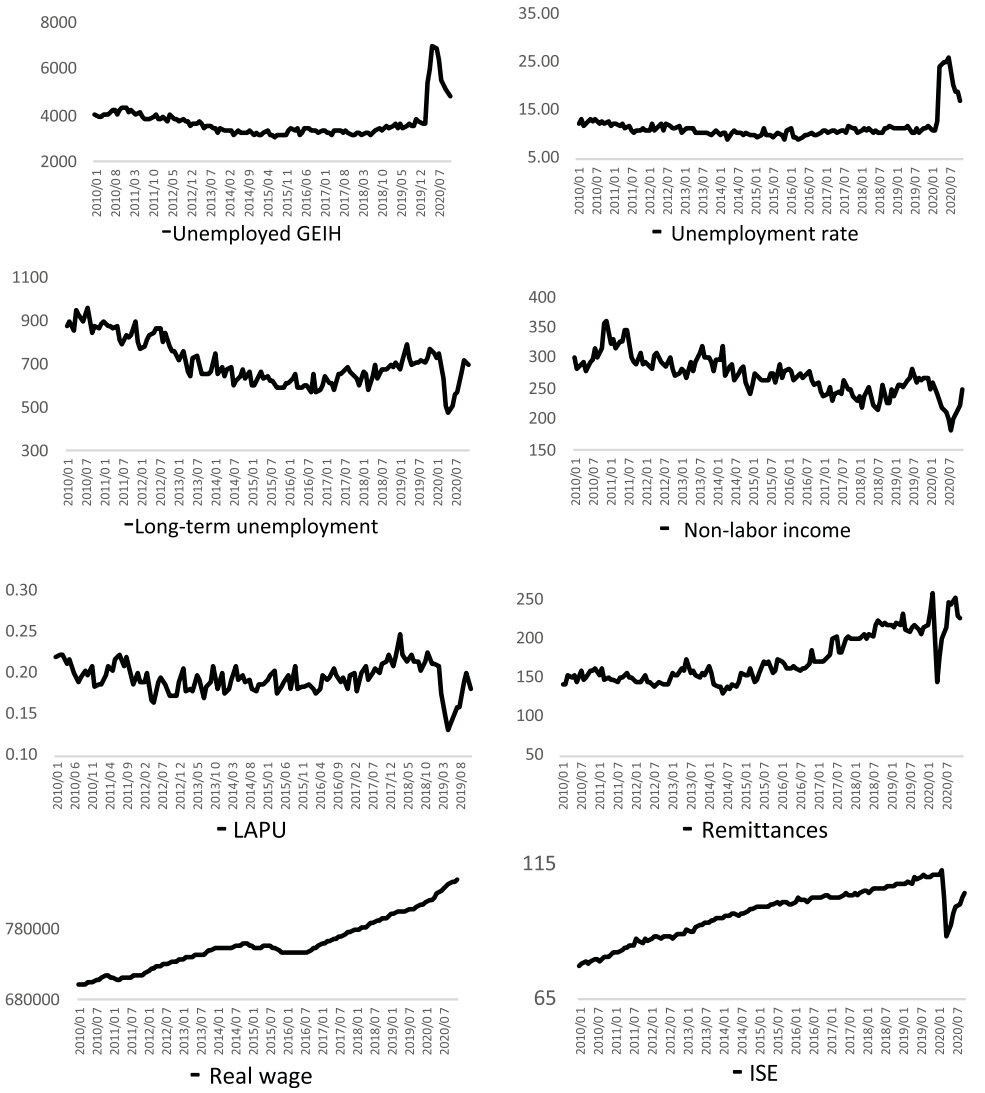

Figure 1. Level variables, Colombia, 2010M1–2020M12. Elaborated with data obtained from the GEIH for nonlabor income and unemployment, Banco de República for remittances, seasonally adjusted series using the Tramo-Seats method.

unemployment. That provides evidence of the presence of asymmetric hysteresis, as LAPU is related to the unemployment rate, which is consistent with characteristics of highly inertial unemployment. Note that Table 4 displays the regression equation corresponding to Figure 3.

Figure 3 illustrates the cumulative impulse response functions of the endogenous variable system in the VAR_1 model. The model was estimated for the period including the COVID-19 pandemic crisis (2010: M1–2020: M12). The impulse response functions measure the reaction of each variable to a shock of one standard deviation in the system's endogenous variables. The results show that the LAPU variable significantly responds to a positive shock in nonlabor income for up to ten periods after the shock. Conversely, nonlabor income also significantly responds to the LAPU variable for up to six periods

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Table 1. Statistical description 2010M1-2020M12

	Unemployed GEIH	Long-term unemployment	- LAPU	- Remittances	- Real wage	Unemployment rate	- Nonlabor income	- ISE
Media	3662.830	690.5831	0.194429	173.1568	763094.8	11.34584	2.68E+08	98.12209
Maximum	6939.604	896.8719	0.246602	257.3106	845859.5	25.93133	3.47E+08	111.9412
Minimum	3074.583	475.4166	0.131259	127.4012	709573.9	9.036013	1.81E+08	81.98435
Std. Dev.	699.9616	90.39776	0.017983	30.64867	33885.10	2.995085	30845365	7.882902
Observations	118	118	118	118	118	118	118	118

Table 2. Descriptive statistics 2010M1-2019M12

	Unemployed GEIH	Long-term unemployment	- LAPU	- Remittances	Real wage	Unemployment rate	- Nonlabor income	- ISE
Mean	3492.429	697.7515	0.196458	169.04458	756733.4	10.61997	2.72E+08	97.90053
Maximum	4201.487	896.8719	0.246602	229.6663	815677.9	12.20183	3.47E+08	110.6416
Minimum	3074.583	569.8832	0.163391	127.4012	709573.9	9.036013	2.16E+08	81.98435
Std. Dev.	276.4795	86.29538	0.015267	26.72821	27657.74	0.729169	27574050	7.914092
Observations	108	108	108	108	108	108	108	108

Table 3. Contemporary correlation matrix

Variables	Unemployed GEIH	Number of DLD	- LAPU	- Remittances	- Real wage	Unemployment rate	- Nonlabor income	- ISE
Unemployed GEIH	1	−0.025	−0.334***	0.222**	0.445***	0.932***	−0.238***	−0.263***
Long-term unemployed	−0.025	1	0.691***	−0.207**	−0.410***	−0.221**	0.607***	−0.512***
LAPU	−0.334***	0.691***	1	0.179*	−0.079	−0.409***	0.245***	0.142
Remittance	0.222**	−0.207**	0.179*	1	0.826***	0.289***	−0.667***	0.742***
Real wage	0.373***	−0.468***	−0.083	0.835***	1	0.515***	−0.777***	0.749***
Unemployment rate	0.932***	−0.221**	−0.409***	0.289***	0.564***	1	−0.425***	−0.099
Nonlabor income	−0.238***	0.607***	0.245***	−0.667***	−0.731***	−0.425***	1	−0.652***
ISE	−0.264***	−0.512***	0.142	0.742***	0.687***	−0.099	−0.652***	1

Source: Own elaboration

Table 4. Long-term unemployment rate (LAPU) vs. unemployment rate. Colombia. 2010M1-2020M12

Dependent variable LAPU	Coefficient	Std. Dev	t-Statistic	Prob.
Unemployment rate	−0.002450***	0.000499	−4.908957	0.0000
C	0.222238***	0.005882	37.78429	0.0000
F-statistic	24.09785			
Prob(F-statistic)	0.000003			

Source: OLS estimation with robust errors to heteroscelasticity, the figure is the authors' elaboration based on DANE-GEIH microdata. Note: Individual significance at 99 percent (***), 95 percent (**), 90 percent (*)

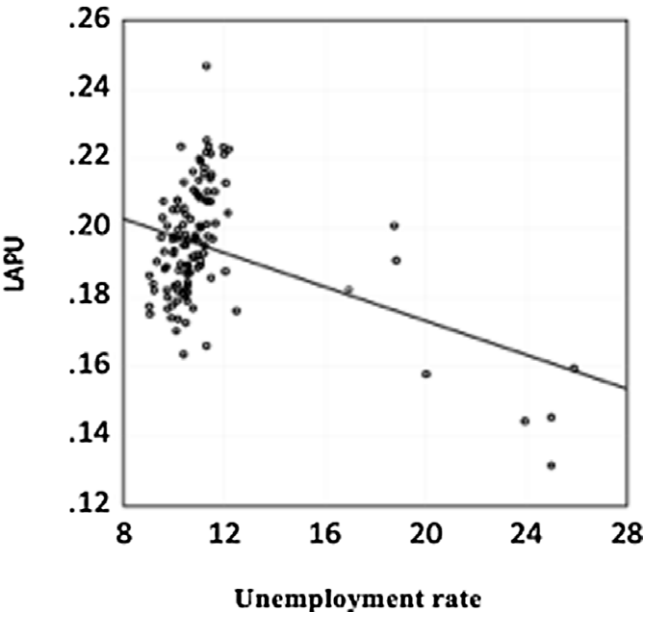

Figure 2. Long-term unemployment rate (LAPU) vs. unemployment rate, Colombia, 2010M1–2020M12. Elaborated with data obtained from the GEIH.

after the innovation shock, indicating a bidirectional relationship. Moreover, the findings provide evidence of the impact of remittances on long-term unemployment in Colombia. According to the LAPU measure, a positive shock to remittances leads to an increase in the number of people who have been unemployed for fifty-two weeks compared to the total number of people unemployed for a year.

The response of the nonlabor income variable to innovations in the remittances variable is significant and positive, showing that both variables can exhibit comovement. This impact occurs only between the fourth and fifth period after the shock in nonwork income. Therefore, the response obtained from the LAPU variable to a positive shock in the remittances variable is significant during a maximum of four periods after the innovation. Finally, it is very important to highlight that real wages turn out to be totally inelastic to LAPU behavior, evidence that reinforces the evidence of hysteresis following the assessments of Blanchard and Summers (1986) and Blanchard (2018).

The research findings support the existence of a relationship between remittances and duration of unemployment, indicating hysteresis effects on unemployment duration due to prolonged job search. However, there is a lack of empirical evidence regarding this relationship in the current economic crisis context.

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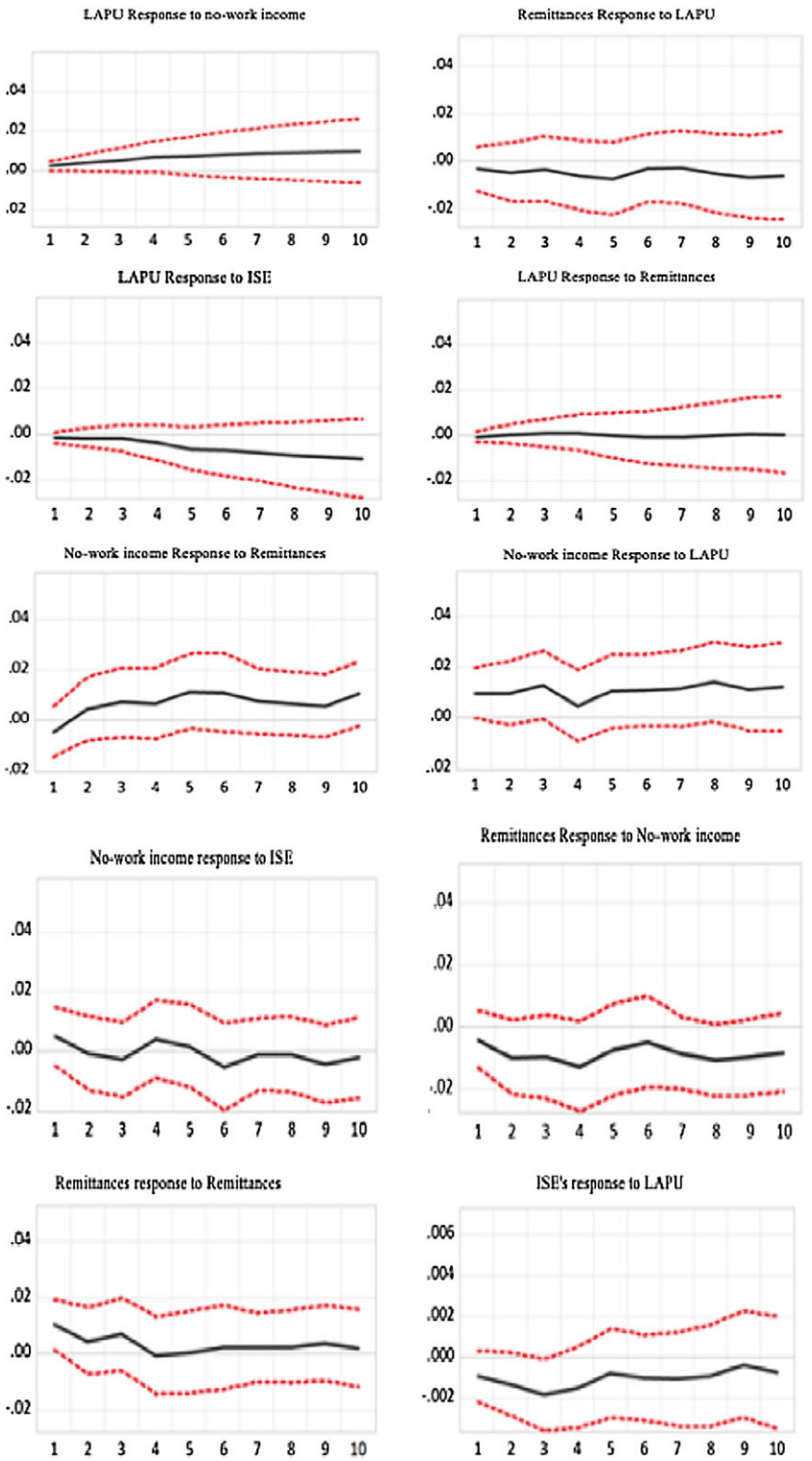

Figure 3. Generalized cumulative responses to innovations in endogenous variable system of the VAR_2 model [2010M1–2019M12]. Elaborated on the basis of the VAR_2 estimation.

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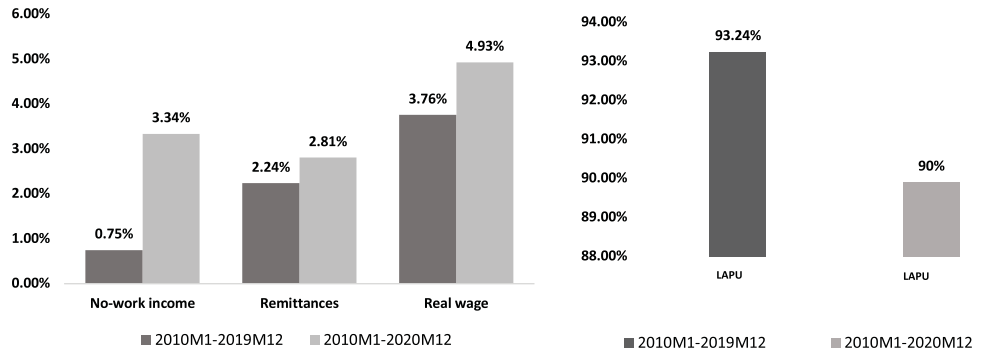

Figure 4. Variance decomposition of LAPU. Relative importance of precrisis period sample: 2010M01–2019M12 and with crisis period: 2010M01–2020M12. Elaborated on the basis of VAR estimations. The Cholesky order is LAPU, nonwork income, remittances, real wage. Akaike information criterion (AIC) is used to determine a number of lags for the VAR model (Appendix 3). Prediction horizon: 20 months.

Additionally, Finkelstein, Shapiro, and Mandelman (2016) demonstrate how remittances finance microenterprises in recipient households, especially during economic recessions. This suggests that remittances and nonwork income in Colombian households may move together as a result of increased microinvestments fueled by remittance resources.

Furthermore, the response of the remittances variable to changes in the long-term unemployed variable is significant in both periods analyzed. The impulse-response functions in Figure 4, based on the VAR_2 model, indicate that a positive shock in nonwork income leads to a significant and positive response in the duration of unemployment for four periods after the shock. This confirms that nonwork income increases the duration of unemployment in Colombia.

The study finds evidence of hysteresis in unemployment in Colombia during the analyzed period, as the long-term unemployment rate (LAPU) does not respond to changes in the Economic Tracking Index (ISE), which indicates a lack of impact from economic expansions or contractions. This finding aligns with Girardi, Meloni, and Stirati's (2018) notion that the absence of hysteresis implies an influence of economic fluctuations on the long-term unemployment rate.

Furthermore, in the VAR_2 model, which excludes the year 2020, LAPU does not significantly respond to a positive shock in the growth of remittances. This suggests that remittances have a limited effect on the LAPU during periods of relative economic normality. However, it is inferred that remittances become more influential during crises when they serve as the primary source of income for households unable to find employment.

Additionally, LAPU's response to a shock in the ISE remains null and insignificant, consistent with findings of the VAR_1 model. The robustness of the results is confirmed by using the number of people in long-term unemployment as a proxy for LAPU, indicating that a positive shock in remittances increases the number of long-term unemployed individuals for up to four periods after the shock.[3]

Analysis of variance decomposition

Analyzing the variance decomposition of both models, three important effects are noted regarding the variance of LAPU. The first is the percentage of variation of LAPU, which is

[3] Estimates are available upon request.

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self-explanatory. Noting that the first VAR 1 model includes the crisis period, the variance of LAPU is explained by itself at 100 percent for the first period after the shock. It subsequently descends and stabilizes the percentage of variance explained in periods 18 and 19 after the shock with 90 percent. This result must be contrasted with the VAR_2 model (which does not include the crisis). LAPU also explains itself by 100 percent in the first period after the shock. But when it stabilizes in periods 18 and 19, this effect increases over the first model (which does not include the crisis) and is explained at 93.24 percent. This indicates a higher level of exogeneity in the precrisis model than the crisis period.

Alternatively, in the VAR_1 model, the percentage of the variation of LAPU that is explained by remittances and no-work income reaches 3.34 percent and 2.81 percent, respectively, in periods 18 and 19 after the shock. In contrast to the VAR_2 model (precrisis), the variance of LAPU explained by remittances and nonwork income represents 0.75 percent and 2.24 percent of total variance of LAPU for periods 18 and 19 after the shock. This result is interesting for this research, as it reveals how the crisis of the current COVID-19 pandemic increased the relevance of remittances and nonwork income for the duration of unemployment in Colombia. This analysis is summarized in Figure 5.

Conclusion

According to the literature on the phenomenon of hysteresis, one cause and result of it is an increase in the duration of unemployment. Therefore, determining the variables that affect changes in the duration of unemployment is of interest and leads to understanding the causes of the phenomenon of hysteresis in unemployment. This research article differs significantly from the works identified in the literature in three ways. First is the achievement of the information systemization of the longitudinal series from the anonymized microdata for Colombia. Second, the construction of an unemployment duration persistence indicator captures the effect of hysteresis in unemployment. Third, this work is the first to show that unemployment duration persistence measured through LAPU responds positively to growth in remittances, achieved through rigorous estimation of VAR models.

This research has aimed to determine the impact of remittances and nonwork income on duration of unemployment and the phenomenon of hysteresis in Colombia for the period M1:2010–M1:2021. To achieve that objective, a methodology of estimating VAR autoregressive vector models is applied. According to the results of the estimations for VAR 1 (includes the crisis period year: 2020) and VAR 2 (not including 2020) models of the present study, by including the initial year of the COVID-19 crisis in the temporary sample, the variables of remittances and nonwork income have positively affected the long-term unemployment rate (LAPU). The indicator was constructed from the unemployed and duration of unemployment information from the GEIH microdata. This shows that the crisis fostered a change in the magnitude of impact that generates nonwork income and remittances in LAPU, and as a result, as a generator of hysteresis in long-term unemployment. In other words, the crisis had a significant impact on how non-labor-related income and remittances affect the long-term unemployment situation. This alteration in the relationship between these factors and unemployment may have contributed to the persistence of long-term unemployment or had a lasting effect after the crisis. This result is of special interest, as it demonstrates how an exogenous natural event such as the COVID-19 crisis can affect the conditions of duration of unemployment conjuncturally and structurally.

As expected, the COVID-19 crisis changed the composition of nonwork income in households and the dynamics of receiving remittances in Colombia. This effect has been identified in the research through the impact generated in LAPU. The evidence from this

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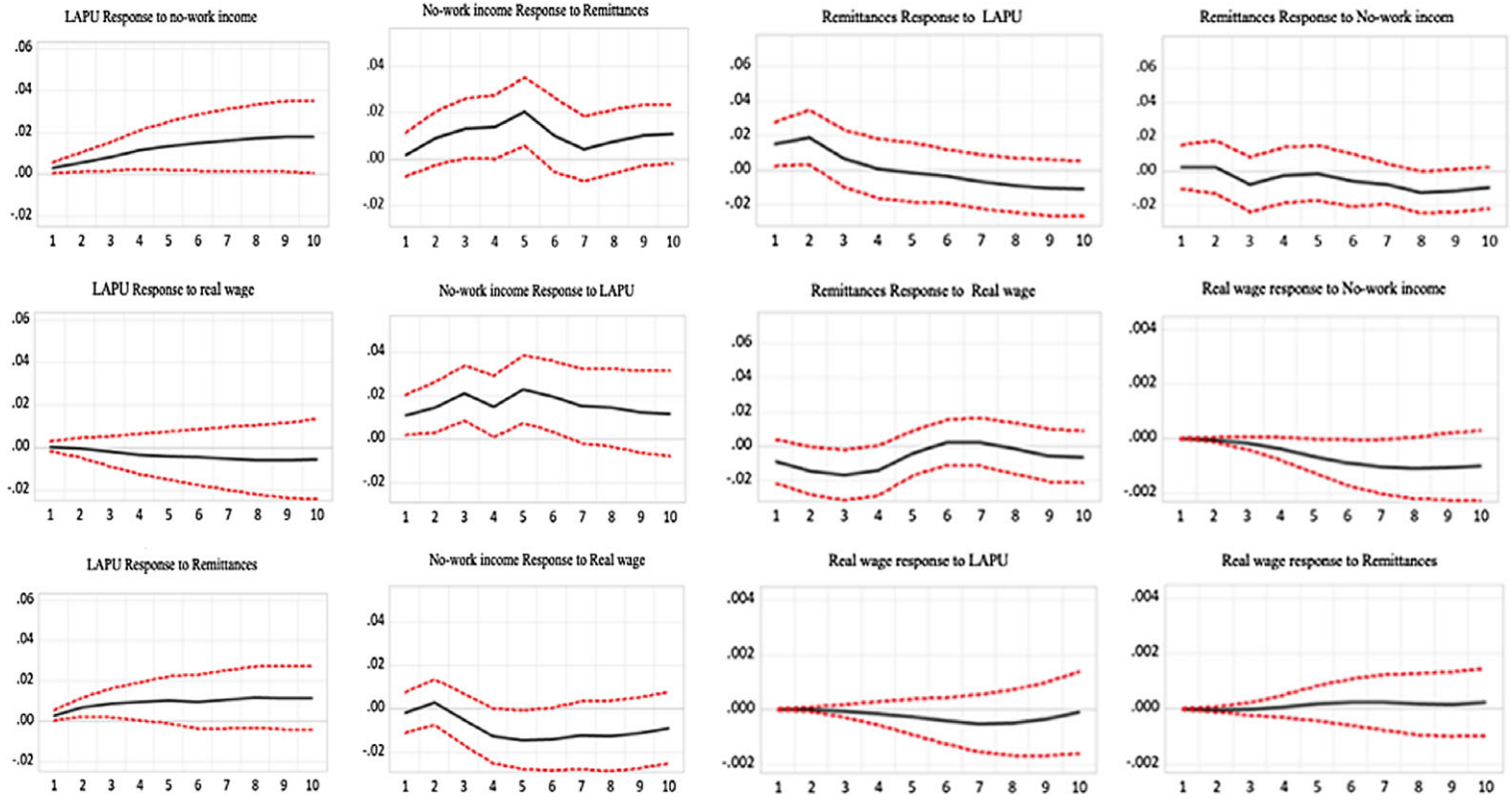

Figure 5. Generalized cumulative responses to the innovations of the endogenous variable system of the VAR_1 model [2010M1-2020M12]. Elaborated on the basis of the VAR_1 estimation.

study shows that LAPU is more sensitive to the variables of nonwork income and remittances during the crisis. Alternatively, the results from the VAR 2 model (not including 2020) show that LAPU responds significantly to a positive shock in the growth of remittances. In conditions of relative economic normality, these do not affect LAPU in Colombia. However, in periods of crisis it represents a relevant effect.

Thus, a positive shock in remittances in the model that incorporates the crisis period implies that the number of people who have been unemployed for more than fifty-two weeks will increase in relation to the total number of people who were unemployed twelve months previously, and that effect will be prolonged for up to a period of sixteen weeks—that is, for four months after the shock in remittances. It can be concluded that nonwork income, both in the model that includes the crisis period (VAR 1) and in the model that does not include the year 2020 or precrisis (VAR 2) is a variable that affects LAPU. However, it is an impact with less duration and intensity for the precrisis model. This allows us to infer that through the increase in nonwork income, it is possible to finance longer periods of job search, as through such income, there is an increase in the reserve wage of unemployed people. That is, the result according to estimations shows that long-term unemployment grows as a percentage of total unemployed in response to an increase in nonwork income.

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Appendix 1. List, description and source of variables

	Variable name	Length and periodicity	Source
1	Question: P7500S1A1 (Payments for Rentals of houses, apartments, farms, lots, vehicles, equipment)	Monthly (2010–2020)*	GEIH Revenue Module (DANE, 2021)
2	Question: P7500S2A1(Payments for Pensions or retirements for old age, invalidity or pension replacement)	Monthly (2010–2020)	GEIH Revenue Module
3	Question: P7500S3A1 (Maintenance payments for paternity, divorce or separation)	Monthly (2010–2020)	GEIH (DANE, 2021) Revenue Module
4	Question: P7510S1A1 (Receipt of money from other households to people residing in the country)	Monthly (2010–2020)	GEIH (DANE, 2021) Revenue Module
5	Question: P7510S3A1 (Receipt of donations grants from institutions in the country or outside the country)	Monthly (2010–2020)	GEIH (DANE, 2021) Revenue Module (DANE, 2021)
6	Question: P7510S5A1 (Receipt of money for interest on loans or for CDT's, savings deposits, profits or dividends for investments)	Monthly (2010–2020)	GEIH (DANE, 2021) Revenue Module
7	Question: P7510S6A1 (Receipt of pension or interest income on pension payments)	Monthly (2010–2020)	GEIH (DANE, 2021) Revenue Module
8	Total of real nonwork income (2018:100), IPC2018=100	Monthly (2010–2020)	GEIH (DANE, 2021) Nonwork income module, total of nonwork income
9	DLD (Long-term unemployment)	Monthly (2010–November 2020)	GEIH (DANE, 2021)
10	Unemployment rate	Monthly (2010–2020)	DANE, 2021
11	Remittances measured in US dollars at current prices	Monthly (2010–2020)	Banco de la República, 2021
12	Consumer Price Index (CPI) Urban	Monthly (2010–2020)	(US Bureau of Labor Statistics, 2021) variable required to deflate remittances
13	Indicator of monitoring the economy, ISE	Monthly (2010–2020)	DANE 2021
14	Real wage (minimum wage deflated CPI 2018)	Monthly (2010-2020)	DANE, 2021)

Note: Variables marked with an asterisk indicate that for March, April, May, June, and July 2020, there are no available data because the survey could not be carried out due to the COVID-19 crisis. The variable of total real nonwork income was elaborated by adding the values delivered as answers to the questions found as variables: P7500S1A1, P7500S2A1, P7500S3A1, P7510S1A1, P7510S3A1, P7510S3A1, P7510S3A1, P7510S5A1, P7510S6A1.
Source: Authors' elaboration based on DANE, Banco de República and Federal Reserve.

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Appendix 2. Unit root tests

	Augmented Dickey-Fuller test statistic				Phillip-Perron test statistic				
	ADF in levels		ADF in first difference		PP in levels		PP in first difference		Order of integration
	t-stat.	Prob.	*t*-stat.	Prob.	*t*-stat.	Prob.	*t*-stat.	Prob.	I(ρ)
Variables	Trend and intercept								
Unemployed GEIH	−2.994	0.138	−8.822	0.000	−2.181	0.496	−8.640	0.000	I(1)
Long-term unemployed	−3.194	0.090	−13.246	0.000	−3.078	0.116	−16.069	0.000	I(1)
LAPU	−4.686	0.001	−13.343	0.000	−4.594	0.0017	−15.664	0.000	I(0)
Remittances	−4.987	0.000	−9.518	0.000	−4.814	0.0007	−31.876	0.000	I(0)
Real wage	1.632	0.999	−1.256	0.648	2.718	1.000	−2.914	0.046	I(1)
Unemployment rate	−2.597	0.282	−7.734	0.000	−2.648	0.260	−12.509	0.000	I(1)
Nonwork income	−4.969	0.000	−14.004	0.000	−4.866	0.0006	−14.919	0.000	I(0)
ISE	−2.208	0.481	−9.651	0.000	−2.655	0.257	−8.796	0.000	I(1)

Appendix 3. Test of lag inclusion

VAR Lag Order Selection Criteria

Endogenous variables: LAPU3 DLOG(REAL NO-WORK_INCOME) DLOG(DEFLACTED REMITTENCE_CPI_U) DLOG(SR_TC)

Sample: 2010M01 2020M12
Included Observations 114

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1182.493	NA	1.23e-14	-20.67531	-20.57930	-20.63635
1	1347.208	314.9810	9.08e-16	-23.28434	-22.80431	-23.08952
2	1417.460	129.4124	3.51e-16	-24.23614	-23.37208	-23.88547
3	1515.956	174.5287	8.27e-17	-25.68345	-24.43536	-25.17692
4	1555.570	67.41236	5.49e-17	-26.09772	-24.46560*	-25.43533*
5	1579.881	39.66576*	4.79e-17*	-26.24353*	-24.22738	-25.42529

Note. Asterisk indicates lag order selected by the criterion. LR = sequential modified LR test statistic (each test at 5 percent level). FPE = final prediction error. AIC = Akaike information criterion. SC = Schwarz information criterion. HQ = Hannan-Quinn information criterion.

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Appendix 4. Serial autocorrelation test, LM test VAR 1, and 2 LM test VAR1

VAR1 Residual Serial Correlation LM Tests

Sample: 2010M01 2020M12

Included Observations 114

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	7.581969	16	0.9603	0.468138	(16, 263.4).	0.9604
2	20.60167	16	0.1943	1.303291	(16, 263.4).	0.1946
3	12.37232	16	0.7180	0.770750	(16, 263.4).	0.7182
4	12.00014	16	0.7440	0.747047	(16, 263.4).	0.7442
5	15.14003	16	0.5144	0.948049	(16, 263.4).	0.5147
6	12.66510	16	0.6971	0.789420	(16, 263.4).	0.6973

Note: Asterisk indicates Edgeworth expansion corrected likelihood ratio statistic.
Source: Authors' elaboration based on VAR1 estimation.

VAR2 Residual Serial Correlation LM Tests

Sample: 2010M01 2019M12

Included Observations 103

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	18.05410	16	0.3207	1.137852	(16, 229.8).	0.3211
2	9.008996	16	0.9130	0.556944	(16, 229.8).	0.9131
3	8.642014	16	0.9274	0.533840	(16, 229.8).	0.9275
4	11.97478	16	0.7457	0.744977	(16, 229.8).	0.7460
5	9.445770	16	0.8939	0.584488	(16, 229.8).	0.8941
6	14.39647	16	0.5692	0.900270	(16, 229.8).	0.5696

Note: Asterisk indicates Edgeworth expansion corrected likelihood ratio statistic.
Source: Authors' elaboration based on VAR1 estimation. Note:

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Appendix 5. Granger Causality/Block Exogeneity Wald tests

Sample : 2010M01 2020M12			
Included comments : 114			
Null hypothesis: the variable does not cause granger the dependent variable			
Dependent variable: LAPU			
excluded	Chi-sq	df	Prob.
DLOG(Nonwork income)	1.996206	5	0.8497
DLOG(Remittances)	6.483341	5	0.2620
DLOG(Real wage)	3.916845	5	0.5614
all	11.79466	fifteen	0.6945
Dependent variable: DLOG(Nonwork income)			
excluded	Chi-sq	df	Prob.
LAPU	7.617013	5	0.1786
DLOG(Remittances)	10.04870	5	0.0739
DLOG(Real wage)	6.572387	5	0.2544
all	32.59381	fifteen	0.0053
Dependent variable: DLOG(Remittances)			
excluded	Chi- sq	df	Prob.
LAPU	6.599767	5	0.2521
DLOG(Nonwork income)	3.485196	5	0.6256
DLOG(Real wage)	6.867122	5	0.2307
all	19.50310	fifteen	0.1918
Dependent variable: DLOG(Real wage)			
excluded	Chi- sq	df	Prob.
LAPU	11.86664	5	0.0367
DLOG(Nonwork income)	6.265748	5	0.2812
DLOG(Remittances)	22.87189	5	0.0004
all	37.96955	fifteen	0.0009

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