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Revealing the New Nexus in Urban Unemployment Dynamics: The Relationship between Institutional Variables and Long-Term Unemployment in Colombia

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Revealing the New Nexus in Urban Unemployment Dynamics: The Relationship between Institutional Variables and Long-Term Unemployment in Colombia

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ABSTRACT

The aim of this study is to assess the impact of various institutional variables on the Long-Term Unemployment Rate (LAPU) in the Colombian urban labor market. Vector Autoregressive (VAR) models are estimated using microdata from the Great Integrated Household Survey (GEIH), which has national coverage. Monthly data were analyzed for the 13 major capital cities and their metropolitan areas, as well as for the group of 11 intermediate capital cities, resulting in a total of 24 main urban labor markets in Colombia. The dataset includes unionized individuals, individuals with verbal and written contracts, non-labor income, unemployed individuals with subsidies, and individuals receiving severance payments. The results indicate that the growth in the number of unionized employees and non-labor income contributes to increasing the persistence in the duration of unemployment in Colombia. A key finding is that a positive growth in the ratio - gap between individuals with written contracts versus verbal contracts reduces LAPU. This provides evidence of how reducing information asymmetries in the Colombian labor market can improve labor market outcomes and contribute to medium- and long-term social welfare in Colombian urban centers.

JEL Classification: J01, J08, J41, J64, J65

Keywords: Institutions, Contracts, Non-labor income, Unemployment benefits, Unemployment duration, VAR.

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1. Introduction

Long-term unemployment is described in Colombia as a situation in which a person has been unemployed for 52 weeks or more (DANE, 2014), a definition consistent with the ILO (International Labor Organization). Long-term unemployment reveals important information about the profile of the unemployed, it tends to affect people of older age or lower educational levels ILO (2015). In this study, the aim is to provide a detailed analysis of the institutional factors influencing unemployment duration persistence in Colombia. This is significant because there have been no studies in Latin America that have investigated the role of certain institutional variables as sources of prolonged persistence in unemployment. Similarly, there has been limited empirical analysis conducted in North American and Asian contexts, with none of the identified studies specifically examining the persistence effect of unemployment duration due to contract type and unemployment benefits. Webster (2005) highlights the lack of understanding about long-term unemployment and criticizes government labor policies that focus on strategies to enhance employability without understanding the underlying causes of unemployment duration. He emphasizes that the effect of long-term unemployment is to leave the worker unemployed over time, which can have negative consequences both in industrial and human terms, making the individual less viable for future employment.

According to ILO data (2022) for Pacific Alliance countries, the proportion of long-term unemployed in relation to the total unemployed 2010-2021 for Colombia is 14%, followed by Chile with 12% and Mexico with 2%. In terms of weeks of unemployment, the average duration of unemployment in Colombia is very high: for the period 2010M1-2021M10 it was approximately 121 weeks - Great Integrated Household Survey - GIHS, (2021). This, together with the high rate of informality, close to 47.8% of the employed in the same period (DANE, 2021), is evidence of structural problems in

the labor market. In the Employment Mission report for Colombia, Meléndez, Alvarado and Pantoja (2021) explain that the high level of informality in the country is due to a deficient design of the contributory social security system and the regulation of the labor market. Additionally, the return to economic growth in terms of reduction of informality is very low. This may be due to the same factors just cited.

It is important to emphasize that Colombia has experienced persistent unemployment behavior during economic expansions, indicating inertia in the labor market, as noted by Knight (2018) and Lartey (2018). Concerns about the labor market can also be evidenced by comparing the average unemployment rate and the non-accelerating inflation rate of unemployment (NAIRU) for Colombia with other Latin American countries, for example, those belonging to the Pacific Alliance. The NAIRU for Colombia is close to 13.10%, for Chile it is 7.75%, and for Peru and Mexico it is 7.93% and 4.88%, respectively (Cardona and Sierra, 2020). Arango and Flórez (2020) point out that a high NAIRU may be associated with a higher level of structural unemployment and labor market rigidities, likewise a high NAIRU indicates labor market rigidities and structural unemployment issues (Constantinescu and Nguyen, 2018; Otoiu and Titan, 2012) aspects that make the country an interesting case of analysis to understand the dynamics of unemployment duration.

This article aims to analyze the impact of labor market regulations and institutions on the Long-term Unemployment Rate (LAPU) in Colombia for the period 2010M1-2021M10. For this purpose, the information on long-term unemployment from the GEIH (DANE, 2021) is systematized and an indicator of persistence in the duration of unemployment is constructed to measure the LAPU based on that proposed by Webster (2005 p.99). The response of this indicator to shocks in variables that reflect the effect of labor market institutions and regulations in Colombia is also measured using vector autoregressive models (VAR). The variables that are analyzed in this article are divided into i. Institutional variables: unionized people, ratio - gap between workers with written and verbal contracts, ii. Institutional variables: unionized workers, ratio - gap between workers with written and verbal contracts, iii. Variables of monetary transfers by labor regulation: unemployed people who receive unemployment benefits and people who receive severance payments.

Subsequently, this article analyzes the relative weight of each of these shocks on the variability of the LAPU with the intention of evaluating whether the institutional or regulatory channel from transfers has a major impact on the long-term unemployment rate. Colombian labor legislation provides for certain employee protection regulations: severance payments in the event of dismissal or termination

without just cause and severance pay for fixed-term and indefinite-term employment contracts. These measures have been the result of law reforms designed over the last 20 years, according to the Ministry of Labor (2021). Alternatively, Colombia has unemployment subsidies within the framework of the social protection system. They were established by Congreso de la República de Colombia. (2002) Law 789 of December 2002 together with the unemployment protection mechanism created by Congreso de la República de Colombia. (2013) Law 1636 of June 2013 under the administration of the family compensation fund (Londoño Upegui and Mejía Ortega, 2019).

Recently, Arango and Flórez (2020) evaluated the determinants of structural unemployment in Colombia, finding that it is affected by health and pension costs, fringe benefits, and layoffs, which constitute non-wage labor costs. The failures derived from public labor policy are of two types: distorting interventions that restrict job creation, and employment protection mechanisms that introduce cost overruns to payrolls. In both cases, formal hiring becomes costlier and worsens the situation of the labor market, which is already relatively rigid due to problems associated with structural unemployment (Arango and Flórez, 2020). Recently, some work in the international context has found that increases in unemployment benefits or monetary benefits translate into an increase in the duration of unemployment (Kyyrä, Parrotta, and Rosholm, 2013; Szydłowski, 2017 and Martins, 2021). Meanwhile, You and Wang (2018) find that contract law in China raises the duration of short-term unemployment. Therefore, long-term unemployment poses unique challenges to society. In general, models predict that unemployment insurance systems prolong unemployment spells for those who have already exhausted their savings or sources of income (Chodorow, Reich, and Coglianese, 2021).
The literature in Colombia shows few studies focused on the determinants of unemployment duration, so the analysis of the role of regulations in the labor market is novel. The study that most closely resembles the purposes of this paper is that of Clavijo-Cortes (2021); the author investigates the degree of persistent unemployment in Colombia, Chile, Peru, and Mexico. It concludes that the four countries in the sample show a high degree of persistent unemployment. However, Colombia and Mexico show periods of explosiveness associated with crises and institutional changes. The author follows a unit root analysis approach with Bayesian methods. The novelty of the present study compared to Clavijo-Cortes' work consists of different stages. First, constructing an objective indicator of persistence in unemployment duration to measure LAPU, an aspect not previously done for Colombia. This approach is more conclusive in showing direct impacts on an indicator of persistence in unemployment duration. It reveals a phenomenon that cannot be inferred from the characteristics of stochastic time series processes alone. Secondly, the information from the GEIH is systematized to

obtain the historical series of the number of unionized workers, workers with written and verbal contracts, the number of unemployed people with unemployment benefits and the number of people who have received severance payments, and has consulted information on the closure of work establishments.

In the estimation of the VAR models, variables are included that capture the effect of the institutions and regulations of the labor market in Colombia, among these: unionized people, and people with verbal and written contracts. These variables can have a positive impact on the duration of unemployment if one considers, for example, the explanation of Nickell (1997) who asserts that union benefits as well as greater rigidities in the labor market can increase the duration of unemployment, Recently, the literature has begun to question what the impact of unions is on unemployment and wages (Krussell and Rudanko, 2016), this aspect will be addressed in greater detail in the literature review section. Likewise, labor policy variables are included, such as the number of unemployed people with subsidy and people receiving severance payments. Finally, the non-labor income variable has been included due to its importance in the analysis of the duration of unemployment, which has been suggested by Blanchard, (2018).

This study addresses a significant limitation of the existing literature by examining the determinants associated with long-term unemployment, considering them as a possible explanation based on certain institutional agreements within the Colombian urban labor market, such as unemployment subsidies, severance pay, and the typology of employment contracts. It is the first work in the world to propose an empirical estimation of these relationships for an emerging country, considering microdata from a large integrated household survey and adopting a longitudinal perspective. This article begins with the literature review section, which allows identifying positions and research background on the determinants of the duration of unemployment. The second section describes the methodology in detail, and presents a complete analysis of the variables and data. In the third section, the research results are presented and in the fourth, the general conclusions of the study are presented, which are revealing to more clearly understanding the dynamics of the duration of unemployment in Colombia and what policy can best be undertaken to mitigate this phenomenon.

2. Literature Review

In general, countries with higher incomes tend to implement measures of monetary benefits when the problem of unemployment is high (OECD, 2020), a notable dynamic in OECD countries where benefits increase the duration of unemployment. The benefit policy seems to be the result of the increase in the duration of unemployment and not the opposite (Narendranathan, Nickel and Stern, 1985), which can be confirmed from the 1991 and 1993 OECD reports. According to the literature review, determinants of the duration of unemployment have been identified that converge toward spatial, macro-economic and institutional aspects. Regarding the former, the evidence does not have a solid theoretical framework. The seminal work of Rogers (1997) and Dawkins, Shen, and Sanchez (2005) stand out. They seek to explain the duration of unemployment in the United States from factors associated with the spatial relationship between labor demand and supply, displacement, and residential segregation. The macro-economic factors focus on the analysis of the economic cycle in periods of crisis and recessions. The institutional and regulatory determinants reveal a broad theoretical reflection with few empirical applications, given the difficulty of having representative longitudinal quantitative variables. Therefore, measuring the relationship between the duration of unemployment and its determinants requires a significant effort in collecting information related to the implementation of policies, regulations, and labor laws. This is the approach chosen for this study.

The literature review identifies two main categories of unemployment duration analysis: institutional determinants, which consider contract theory and unions, and determinants associated with regulations and labor policy, particularly focusing on labor protection and monetary transfers. However, there is a ratio - gap as no studies have empirically analyzed the effects of implicit and explicit hiring or the increase in unionization on unemployment duration. Existing works in Colombia suggest a significant relationship between non-labor income and unemployment duration (Núñez and Bernal, 1997; Castellar and Uribe, 2003). Conversely, other studies indicate that formal search channels are more effective in reducing unemployment duration, with younger people and informal workers experiencing shorter periods of unemployment (Viáfara López, Uribe García, 2008; Martínez, 2003). Additionally, Hernández and García (2017) find that years of education determine the duration of unemployment in Cali and its metropolitan area. Overall, studies on unemployment in Colombia are limited and do not cover the analysis categories outlined in this research, primarily focusing on population characterization.

It is important to note that from a labor market perspective, the so-called labor market institutions are agreements, collective rules of the game that affect market outcomes by changing the objectives of

decision makers. They are designed to increase worker rewards and can be expected to have effects on both labor demand and supply (Freeman, 2007). Also, labor policies respond to the institutional conditions of the markets and are designed to shape the characteristics of the labor force, affect companies' labor costs and affect the efficiency of job searches (Estevão, 2007). In its origins, the analysis of the duration of unemployment associated with regulatory interventions refers to the work of Topel and Welch (1980); here, how government aid can prompt a rapid transition from employment to unemployment. According to Rosenzweig (1998), problems concerning the impact of government interventions and their institutions on the labor market form an important part of the core of research in modern labor economics theory.

From a historical perspective, it was only in 1911 that the first compulsory national unemployment insurance system in the world was established in England, which constitutes a change in the position of the English State regarding support for the population living in poverty (Flora and Heidenheimer, 1981). Austria, Germany, Ireland, and Italy later introduced similar unemployment compensation schemes. In contrast, only until the end of the 20th century, has unemployment insurance been a common factor in structural reforms in Latin American countries, and little has been done to understand the impact of labor market regulations and institutions on the duration of unemployment. Zamanzadeh, Chan, Ehsani, and Ganjali (2019), state that the purpose of formulating labor policies and regulations is to overcome the limitations for job creation by strengthening the institutions of the rule of law. "(...) include the progressive effectiveness of the exercise of rights at work, in order to avoid a situation in which economic growth coexists with unacceptable forms of employment" (World Bank, 2012. p. 22).

Murtin and Robin (2018) observe the dynamics of unemployment for nine OECD countries, and for this they use regular contracts as a *proxy* of employment protection. As a conclusion, they determine that the reduction of unemployment insurance benefits could be useful to reduce unemployment. Recently, Chodorow-Reich and Coglianese (2021) analyze the US labor market using a factor model applied to the COVID-19 recession scenario, and find that state unemployment benefits increase in duration. According to Howell et al. (2007), protective legislation always destroys employment, understanding that labor market institutions such as rights to unemployment benefits, employment protection laws, and unions have little effectiveness as labor market policies, when it comes to reducing high unemployment.

It should be noted that some of the studies confirm an inverse relationship between monetary transfers to unemployment and institutional rigidities with respect to the duration of unemployment. This is

the case of Carling, Edin, Harkman, and Holmlund (1994), who examine the transitions out of unemployment in Sweden, showing that the rate of transition to employment increases at times close to the exhaustion of the subsidy or benefit, which reduces the duration of unemployment. Boeri (1999) supports that job security systems in OECD countries that apply strict regulations generally only postpone dismissals and generate many short-term contracts that affect the turnover of the unemployed group. Kupets (2006) finds in Ukraine that benefits tend to increase the probability of remaining unemployed for much longer.

In the context of more flexible labor markets, Kyyrä, Parrotta, and Rosholm, (2013) conclude that in the Danish labor market, prolonged periods of assistance in unemployment benefits increase the duration of the same significantly. Szydlowski (2017) exposes something similar for the United States when he analyzes the behavior of the duration of unemployment, showing that an increase of 10% in the weekly unemployment benefit corresponds to an increase in the average duration of unemployment between 0.6% and 7.9%. Martins (2021) uses regression discontinuity models that show that transitions to unemployment increase in response to access to benefits and subsidies in Portugal along the same lines. Meanwhile, You and Wang (2018) find that contract law in China raises the duration of short-term unemployment and indicates that migrants experience longer periods of unemployment.

The "institutional" category of the labor market encompasses government regulations and factors influencing union organization. Government mandates and labor regulations, such as employee protection measures and anti-discrimination policies, can impact employability and decrease workers' demand for unionism (Hirsch, 2008). Theoretical models of trade unions are crucial in the analysis of unemployment, particularly when contrasted and complemented with other approaches (Lindbeck, 1994). Union structures profoundly influence market dynamics, with many workers joining unions to collectively sell their labor and gain bargaining power (McConnell and Brue, 2017).

Union theories have also influenced the development of wage determination models, including the "insider-outsider" theory by Layard and Nickell (1986, 1988). This theory examines the impact of insider workers on wage negotiations and the externalities generated for outsiders or the unemployed. Under the assumption of a fully unionized economy, the aggregate unemployment rate can be significantly higher, as firms and unions jointly determine employment and wages (Layard and Nickell, 1990). Nickell and Layard (1999) demonstrate that union coverage affects unemployment.

Recent literature has questioned the impact of unions on unemployment and wages. For example, Açıkgöz and Kaymak (2014) show that a decrease in the productivity of less qualified unionized workers can discourage the hiring of potential unionized workers, leading to greater labor market rigidities affecting unemployment levels and duration. There is a consensus in the literature that unions generate externalities on labor demand and employment levels (Pencavel and Hartsog, 1984;

Bhattacharyya and Gupta, 2021). According to Devicienti, Manello, and Vannoni, (2017) the empirical literature agrees that the relationship between unions and the economic performance of companies is negative in terms of profits, while the effect of unions in productivity remains substantially uncertain.

Alternatively, there is a marked interest in understanding the role played by contracts and their typology in the flexibility or rigidity of labor markets. It is essential to clarify that a labor contract is a written or verbal agreement between two parties (an agent and a principal) who agree to a payment that is based on work activities and the amount of time dedicated to those activities. These contracts can be well-defined, that is, be explicit such as written contracts or be implicit, not well-defined contracts such as verbal contracts. It should be noted that Azariadis (1975) opens the theoretical field of implicit contracts, showing that in situations of uncertainty labor services are not auctioned under regulated conditions but under a set of implicit commitments. As a common practice, verbal contracts stand out, which must be established based on trust and transparency in information: if a firm or a worker is recognized for breaching contracts, the market will end up excluding them (Ehrenberg and Smith 2021). In this sense, MacLeod and Malcomson (1989) show that an implicit contract that provides job security for the worker induces labor market self-regulation, given that the design of labor market institutions may be guided by other objectives such as payroll taxation. A good part of the signed contracts are of an implicit nature. The main difference between explicit and implicit contracts is the completeness of the information: while in the first type there are no deeper information asymmetries, in the second there are. The reason is that the explicit contracts contain a greater amount of information known by the counterparties, including information on costs for breach of contract. On the other hand, in implicit contracts, one of the parties has a greater amount of relevant information related to the expectation of fulfillment of the contract, the trust related to the remuneration, or the incentives for deception and thus obtain higher prices.

The work carried out by Blanchard and Landier (2002) points out that allowing companies to fire workers under fixed-term contracts (explicit or implicit) can have perverse effects for the labor market. Analyzing data for young workers in France in the 1980 period, they find that the labor reform that allows term contracts has increased turnover and there is no significant reduction in the duration of unemployment. Güell (2003) conducts research to assess the implications of term contracts on the duration of unemployment in Spain for the period 1980-1994; their results show that the introduction of fixed-term contracts increased long-term unemployment. In summary, it is crucial to consider insights from Nickell (1997), who discusses how monetary benefits for the unemployed can impact the duration of unemployment, potentially leading to an increase over time. Analysis of market rigidities affecting unemployment suggests that factors such as high unemployment benefits, increased

unionization, high minimum wages, elevated taxes, and low education standards are associated with high unemployment rates and longer durations (Nickell, 1997).

A recent study by Cardona-Arenas and Sierra-Suarez (2023) highlights how non-labor income impacts the duration of unemployment in Colombia, demonstrating a hysteresis effect in this issue. However, the authors emphasize the importance of further exploring institutional hypotheses that influence the persistence of unemployment duration in the country (Cardona-Arenas and Sierra-Suarez, 2023). This new line of research directly motivates the focus, context, and analysis of results in the present work, contributing to the theoretical construct of labor market literature by opening up a more specific debate in the context of developing countries with high levels of unemployment duration.

3. Methodology

In this section, a clear and detailed description of the variables to be analyzed in this study and the data analysis methods to be used (econometric models, preliminary tests, robustness analysis) will be made. This research seeks to determine the impact that shocks have on non-labor income, the number of people with unemployment benefits, the number of people with verbal and written contracts, severance payments, unionized employees on the persistence of duration of unemployment measured by the LAPU in Colombia in recent periods. Similarly, the estimates include the variable of Economic Monitor Index/ Monitoring Indicator to Economy ISE economy to control the effect of the economic cycle and thus to isolate the short-term response of LAPU with respect to the structural one explained by the regulatory and institutional variables.

3.1 Specification and Estimation of Autoregressive Vector Models – VAR

For this type of analysis, the estimation of Autoregressive Vector models consistent with the original proposal of Sims (1986) is considered. 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 suitable as it assumes that the endogenous variables within the system are influenced by the lagged values of all variables in the system. These models offer a more practical and consistent alternative to traditional multi-equational models. To begin with, let's examine a version of a lower triangular reduce vector autoregressive form model in – Var (1):

$$Y_t = \sum_{i=1}^{\rho} \Pi_i Y_{t-i} + \epsilon_t \qquad [1]$$

Where i is the number of lags, and ϵ_t is a vector n $x1$ of innovations or processes without serial autocorrelation, white noise and with zero expectation and matrix of variances $\sigma_{\varepsilon i}^2$ and covariances σ_{ij} constant over time. Thus, the residuals are distributed as white noise identically in time with zero mean and constant variance: $\varepsilon_t \sim N(0, \sigma^2)$, $cov(\varepsilon_{ti}, \varepsilon_{tj}) = 0, \forall t_i \neq t_j$. This model representation helps address bias issues in estimation and mitigates potential identification problems. It explains how the estimated shock in each endogenous variable is incorporated into the impulse response function, assuming that all variables in the system are endogenous (Beaton, Lalonde, and Luu, 2009). Now, the immediate reactions and the subsequent effects following the shock in the endogenous variables can be examined through the impulse-response functions, typically represented as:

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

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 $Y_t = (x1, x2., x3, \dots, x4)$, each of the variables is expressed as a function of the accumulated random disturbances. Hence, for every shock, there exist as many accumulated impulse-response functions as there are variables. In this study, we estimate the generalized impulse-response functions developed by Pesaran and Shin (1998), which generate impulse-response functions wherein the ordering of variables in the VAR does not affect the outcomes. Consequently, the identification issue in this study adheres to Sims' (1986) perspective, wherein no arbitrary restrictions are imposed on the model. This approach considers that none of the variables in the system of equations within the estimated VAR model possess adequate theoretical or empirical support to be deemed exogenous

The analysis of decomposition of variance will be carried out considering its usefulness to get the proportion of the movements in the explained variables due to their "own" shocks, compared to the shocks of other endogenous variables. A crash in the i-th variable will directly affect that variable, by its auto-regressive component, but it will also be transmitted to all other variables of the system through the dynamic structure of VAR. Two models are estimated: VAR 1 and VAR 2. In the first model, the vector of endogenous variables of the system of equations is composed by: LAPU, the ratio - gap between people with written contracts versus people with verbal contracts, non-labor income, unemployed people with subsidies and unemployed people, people with severance payments, and unionized employed people, and one control variable: Control economic monitor CEM - as follows for VAR_1:

$$Y_t = \big(LAPU_1, \text{contracts}_2, non\ labor\ income_3, \text{severance payments}_4, unemployment\ \text{subsidies}_5, \text{unionized}_{6,} CEM_4\big) \text{ [3]}$$

An additional model (VAR 2) is estimated that will only include variables that capture cash transfers: unemployed people with subsidies and people who receive severance payments, to determine their impact on LAPU, and one control variable: Control economic monitor CEM- as follows:

$$Y_t = (LAPU_1, unemployment\ \text{subsidies}_2, severance\ payments_3\ CEM_4) \text{ [4]}$$

The series that showed signs of seasonality were seasonally adjusted with the TRAMO-SEATS method. Dickey-Fuller and Phillips-Perron unit tests have been implemented at the level and in the first difference with tendency and intercept for effects of greater rigor in the results. See Annex 1. Similarly, the order of lags for VAR 1, VAR 2 and 14 and 2 respectively has been determined considering the lag inclusion test based on AKAIKE information criterion. See Annex 2. Annex 3 presents the LM Test serial self-correlation test. None of the models have serial auto-correlation problems.

Hypothesis 1 for VAR Model 1. Shocks in the vector of endogenous variables $Y_t(x1, x2., x3, \dots, x6)$ corresponding to institutional variables impact the duration of unemployment in Colombia and the LAPU. In this hypothesis, it is anticipated that a positive shock in the number of unionized individuals, the gap ratio between individuals with written and verbal contracts, non-monetary income, and individuals receiving unemployment benefits will affect LAPU.

Hypothesis 2 for the VAR Model 2. Shocks in the vector of endogenous variables $Y_t = (x1, x2 \dots, x4)$ corresponding to cash transfers of employment protection impact the LAPU. The hypothesis predicts that positive shocks in monetary transfers related to labor market regulations, such as severance payments and unemployment benefits, will affect LAPU.

3.3 Variables and Data

For Machin and Manning (1999) there are two main sources of data regarding the duration of unemployment: 1) Labor force surveys and 2) Administrative measurements. Typically, the latter are affected by idiosyncratic factors, for this reason, population and labor force surveys remain the most reliable source. In this research, an important effort is made to systematize the information from the microdata reported by the DANE's Great Integrated Household Survey GEIH Households. As a unit

of analysis, the Colombian labor market between 2010 and 2021 is considered. To achieve the objective, the 13 major capital cities and their metropolitan areas, along with the group of the 11 intermediate capital cities, totaling 24 main urban labor markets in Colombia, have been considered. They are part of source information, the database of microdata of the module for the head of the Colombian labor market corresponding to the Great Continuous Household Survey. This database has undergone methodological changes over time, first in the increase of the sample of the National Household Survey NHS of DANE from 1984 to 2000, then in 2010 to conform to the international standards established in the International Conference of Labor Statistics (ICLS) and the International Labor Organization (ILO). Various questions evaluated by the GEIH remain to date,1 including the information regarding time of duration of employment situation. It is important to mention that the information systematization process has been carried out totaling the aggregate data for the header module (24 city and metropolitan areas), the data obtained takes into account by default the weight that corresponds to the sample in the universe investigated, in which This case is estimated and applied by DANE given the characteristics of the target population, so the subsampling weight is given the density of dwellings in the segment at the time of the survey.

The current research takes the period January 2010 to October 2021as a sample to perform the econometric analyses. It avoids potential biases due to the methodological changes reported by DANE. The variables that report the number of people is expressed in thousands. Table 1 lists the variables by category, source, and estimated model. In this same way it is a synthesis of data treatment and calculation of variables.

Table 1. Variables by Category and Model

Variable	Category	measurement	Source
LAPU	Persistence	Percentage of people unemployed for 52 weeks or more with respect to the total unemployed 52 weeks before for the sample – head of GEIH of the DANE	GEIH. DANE (DANE, 2022)
Other incomes	Other non-labor income[2]	Other "income" corresponds to the sum of different questions of the module of other income for the sample - head of the DANE's GEIH. Deflated 2018=100.	

1 The Integrated Household Survey (GEIH), conducted by DANE since 2010, replaced previous surveys like ENH and ECH. ENH provided quarterly data for Bogotá, Medellín, Cali, and Barranquilla until 1984, with annual national data. In 1984, Bucaramanga, Manizales, and Pasto were included, leaving quarterly data for seven cities and annual data for the national total. Arango, García, and Posada (2006) described methodological differences between ENH and ECH. GEIH has been conducted since 2010, providing quarterly data for 13 major cities and their metropolitan areas, and 11 intermediate cities, totaling 24 cities.

2 The other non-labor income variable comprises the sum of various sources, including alimony and child support, money received from other households within the country, income from leasing real estate properties, vehicles, and equipment, pension or retirement income, interest earned on loans or savings deposits, and income from severance pay.

Number of unionized employees	Institutional	Number of people who answered question Q7320 of the same module. "Are you a member or do you belong to a trade union or association?"	GEIH. DANE (DANE, 2022)
Ratio - gap between written and verbal contracts [3]	Institutional	The ratio-gap is derived from question Q6450, which asks whether the contract is verbal or written. It is calculated by subtracting the number of individuals with a verbal contract from those with a written contract.	GEIH. DANE (DANE, 2022)
Number of unemployed people with allowance	Money transfers due to labor regulations	The count of individuals receiving unemployment benefits is based on question Q9460 in the module for unemployed individuals.	GEIH. DANE (DANE, 2021)
Severance pay	Money transfer due to labor regulations	The count of individuals receiving grant income or interest from grants is based on question Q7510S6 in the other income module	GEIH. DANE (DANE, 2022)
Economic Monitor Index/ Control economic monitor	CEM	The time-stationarity adjusted series only requires a log-differencing transformation to achieve stationarity. It does not present atypicals.	System of National Accounts of DANE (DANE, 2022)

Source: Authors' Elaboration

The construction of the long-term unemployed variable, in the first place, the long term unemployed (LTU) variable that corresponds to question Q7320 from the unemployed people's module head of the Great Integrated Household Survey of DANE (GEIH) was considered[4]: "How long ago did you stop working?" In Colombia, people are considered to be long-term unemployed when they have been unemployed for more than 52 weeks. Therefore, a filter is applied to the monthly microdata provided by question Q7320 to identify all individuals with a total of 52 weeks or more of unemployment. Subsequently, the answer to the same question is used to create a variable that measures the average number of weeks in unemployment for the long-term unemployed. The Long-Term Unemployment Measured as A Percentage of Total Unemployment (LAPU) indicator is based on the data of long-term unemployment. The LAPU variable is then measured as the total number of people who have been unemployed for one year or more over the total number of people unemployed for six months

3 "Number of employees with a contract" variable, derived from question Q6440 in the GEIH of the DANE, indicates whether an individual has an employment contract, with a value of 1 for yes and 0 for no. Subsequently, the "total number of people working with a contract" variable is created, filtering data on verbal or written contracts based on question Q6450. This variable takes a value of 1 for verbal contracts and 0 for written contracts.

4 The long-term unemployment variable, derived from question Q7320 of the unemployed module in the GEIH microdata, had two missing values in April and March 2020. This was attributed to limitations in DANE's reports and databases during the COVID-19 contingency. To address this, imputation was performed using the Nearest Neighbor Imputation (NNI) method, taking the mean into account.

or one year. The indicator measures the percentage of people who were unemployed between six months and one year and are still unemployed one year later (Webster, 2005). The calculation of this indicator is as follows:

$$LAPU_t = \frac{LTU_t}{Unemployed\ people Q7320_{t-52}} \quad (1)$$

Table 2 provide a summary of the central tendency, dispersion, and range of values for each variable. Each variable has monthly observations for the analysis period. The average duration of long-term unemployment is approximately 120 weeks, with moderate variability indicated by a standard deviation of around 10.44 weeks. However, there is a considerable range between the minimum and maximum durations, spanning about 53 weeks, highlighting significant variation in long-term unemployment durations. Notably, the mean duration accounts for roughly 19.79% of total unemployed respondents who reported their last employment status, indicating a substantial proportion of long-term unemployed individuals among surveyed Colombian households

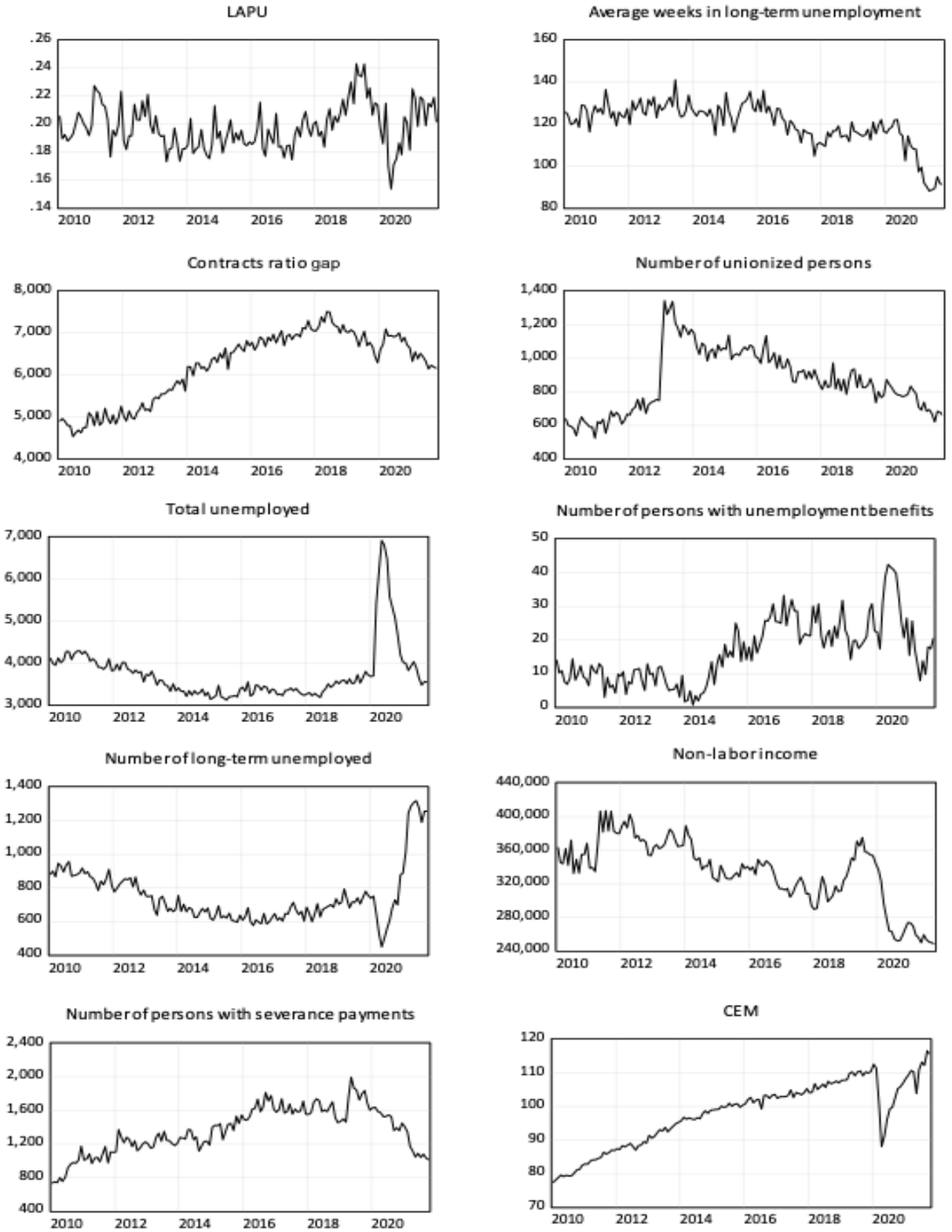
Table 2. Statistical description 2010M1-2020M12

Variable	Unit of measurement	Media	Max.	Min.	Std. Dev.	Obs.
LAPU	Proportion	0.197891	0.243180	0.153676	0.019611	118
Time in long-term unemployment	Weeks	120.0324	141.0992	88.09779	10.43889	118
Contracts ratio - gap	Number of people in thousands with contracts	6323.320	7507.960	4790.960	752.1479	118
Unionized	Number of people unionized in thousands	889.5157	1342.481	552.3716	175.0187	118
Total unemployment	Number of people unemployed in thousands	3700.186	6916.000	3115.000	678.4396	118
Umeployment benefist	Number of people in thousands receiving severance payments.	17.03239	42.45714	0.641345	9.632615	118
Long term uneployment	Number of people in thousands in long-term unemployment situation.	732.5507	1319.123	447.9684	160.1043	118
Non labor income	Thousands of pesos – Deflated 2018=100.	247.000.000	410.000.000	180.000.000	41.782.000	118
Severance payments	Number of people in thousands who have received severance payments.	1404.985	1994.170	966.6322	238.1155	118
CEM	Index	99.46279	116.6000	82.80000	8.235091	118

Source: Own elaboration, sample that includes the years 118 month and 2 degrees freedom.

Graph 1 shows an increase in the number of long-term unemployed and LAPU because of the recent pandemic crisis in contrast to a decrease in the average number of weeks in long-term unemployment. This decrease could be explained by the transition of the unemployed to inactivity resulting from the sharp contraction in economic activity that worsens the situation of the unemployed in Colombia.

Graph 1 Variables Used in the Model



Source: The data used in this study was obtained from the Great Integrated Household Survey (GEIH) conducted by DANE. However, data for certain variables such as rental payments, unemployment benefits, written and verbal contracts, and unionized

employees was not available for March, April, May, June, and July 2020 due to limitations in survey application caused by the COVID-19 pandemic. As a result, missing values were imputed using the Nearest Neighbor Imputation (NNI) method.

Graph 1 depicts a significant decline in the number of individuals with verbal contracts compared to those with written contracts during the recent COVID-19 crisis, underscoring the importance of analyzing the contract gap. The ratio between employees with written and verbal contracts has notably widened since 2014. Between 2012 and 2014, unionized workers steadily increased due to the growth of collective bargaining agreements (Urrea-Giraldo et al. 2020), aligning with a surge in the unionization rate starting from Juan Manuel Santos's presidential term in 2010. However, a subsequent negative trend suggests a decline in unionization, possibly reflecting corporate governance policies opposing collective bargaining processes.

The contract ratio-gap has shown positive and sustained growth throughout the period, slowing in 2018 and increasing in 2020, possibly due to lower hiring costs amid COVID-19 mitigation measures. Graph 1 also indicates a notable fluctuation and rise in the number of unemployed individuals receiving unemployment benefits from 2014 to 2021. Conversely, non-labor income exhibited a declining trend, briefly recovering between 2018 and January 2020, followed by a contraction likely due to COVID-19 containment measures.

In the empirical estimates, the challenge of not assuming transitive causal effects is confronted. Granger causality tests Granger (1969)[5] show insufficient evidence to reject the null hypothesis that growth in variables like CEM, unemployment benefits, and unionization does not cause Granger LAPU, and vice versa. This suggests a lack of evidence for unidirectional causality, consistent with the results found in the VAR model's impulse response functions. These variables are considered endogenous in the system, with test results included in annex 4.

As it is known, even when the VAR model is correctly specified, there may be the possibility of having omitted additional lags that should be present. However, this can be easily addressed if the normality in the disturbances is ensured, considering a confidence level of 99% and a significance level of 0.01, the null hypothesis "the Residuals are multivariate normal" is accepted. as verified in Annex 5. Furthermore, in Annex 6, the graph of the residuals is included, where it can be observed that they follow a process of random walk without discernible patterns

4. Results and Discussion

4.1 Impulse-response Functions and Variance Decomposition

The results of the VAR models estimated, considering the hypotheses formulated in the methodological section, are presented below (see graph 2). The impulse response functions measure the reaction of each of the variables to a shock in each of the endogenous variables of the system. In said system of interrelationships, all the variables react significantly or not to said shock; in which case there are as many impulse response functions as there are endogenous variables; These functions depend on the time elapsed since the shock occurs and to estimate the impulse response functions, the desired size of the shock must be determined, which by convention is one standard deviation, thus, in the event of a shock in one standard deviation, the size of the effect on the system of endogenous variables is given in the unit of measurement of the variable being considered, for example in terms of the LAPU in the axis of the ordinates, a significant and positive response is evidenced in (0.02) unit of measurement of LAPU) to a shock in one standard deviation in himself between period 1 and 5 after the shock. In this way it is clarified that the size of the effect in the response is given in the unit of measurement of the variable in question before a shock in one standard deviation. The blue line corresponds to the response while the red line corresponds to the 95% confidence intervals. It should be noted that our interest is to show the direction of the effect, given that in this type of VAR model, the differentiation of the variables makes the interpretation of the magnitude of the effect in terms of a unit of measure more complex, therefore in the end the analysis remains reduced to the direction of effect and its statistical significance.

First, the results reveal that LAPU exhibits relatively inertial behavior, responding positively and significantly to shocks to itself approximately between periods 1 and 6; this is not surprising as it is a measure of persistence in unemployment duration in which the variability of the ratio - gap of long-term unemployment to total unemployment is very limited (Webster, 2005). Second, LAPU responds negatively and significantly to a positive shock in the growth of the ratio - gap between the number of people working with written contracts versus people working with verbal contracts between periods 4 and 7 after the shock.

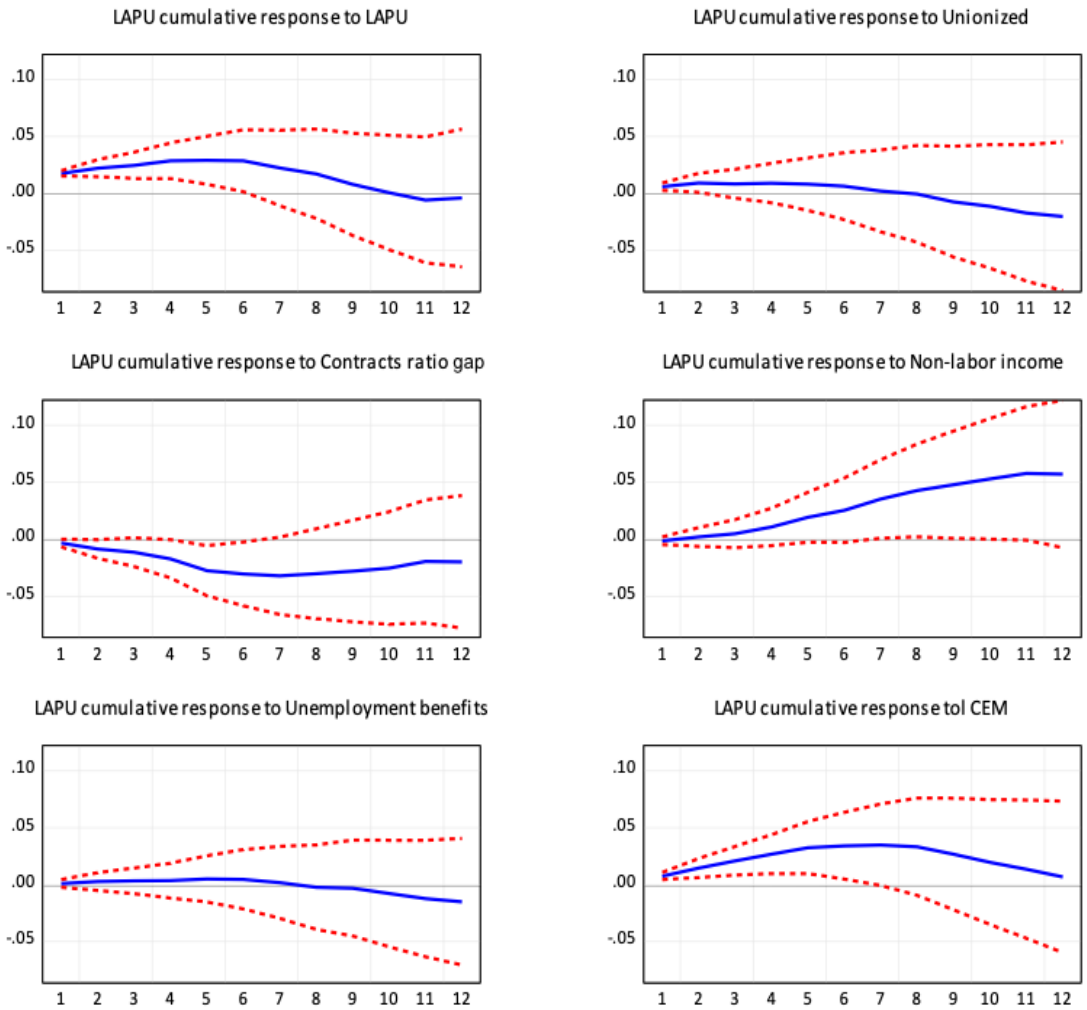
This finding suggests that explicit contracting mechanisms, such as written contracts, may be more effective in reducing unemployment duration in Colombia compared to implicit contracts, like verbal agreements. As noted by Clark, Knabe, and Rätzel (2009), labor market failures often stem from the security conditions of the labor market, which determine how easily an unemployed person can find

a new job. In conclusion, this study underscores the importance of labor formalization through written contracts as a means to reduce unemployment persistence in Colombia. The evidence indicates that addressing information asymmetries through transparent contracts can significantly enhance labor market outcomes by encouraging unemployed individuals to seek formal employment opportunities. This highlights the relevance of contract theories in understanding labor behaviors and emphasizes the need for policies that promote increased employment formalization. Ultimately, implementing measures to ensure regulatory compliance with written contracts can contribute to enhancing social welfare by facilitating workers' transition to more stable and secure employment.

Third, LAPU responds positively and significantly to a shock to non-labor income growth between periods 7 and 10 after the shock. These findings reveal that the Long-Term Unemployment Rate (LAPU) in Colombia responds positively and significantly to growth in non-labor income. This result, consistent with previous research such as Webster's (2005), suggests that income from activities other than the primary employment may contribute to prolonging the duration of unemployment. This finding underscores the importance of considering not only variables directly related to the labor market but also other socioeconomic aspects that may influence the dynamics of long-term unemployment.

According to Hirsch (2008), if high union labor compensation doesn't translate into higher productivity or product prices, union profits can act as a "tax" on company profits, limiting market competitiveness. This affects labor demand, as companies may thrive with higher union costs only if they can pass labor cost increases to consumers, which is often impractical, hindering companies with collective union bargaining. Thus, collective bargaining processes may create rigidity in Colombia, impacting unemployment duration persistence. VAR estimation results support this, showing LAPU positively responding to unionized personnel shocks in periods 1 and 3, and unionized personnel responding positively to LAPU in periods 2 and 11. Surprisingly, LAPU doesn't significantly respond to growth shocks among those receiving unemployment benefits, suggesting it's not a determinant of unemployment duration persistence. Graph 9 depicts the generalized impulse response functions from the VAR_1 model.

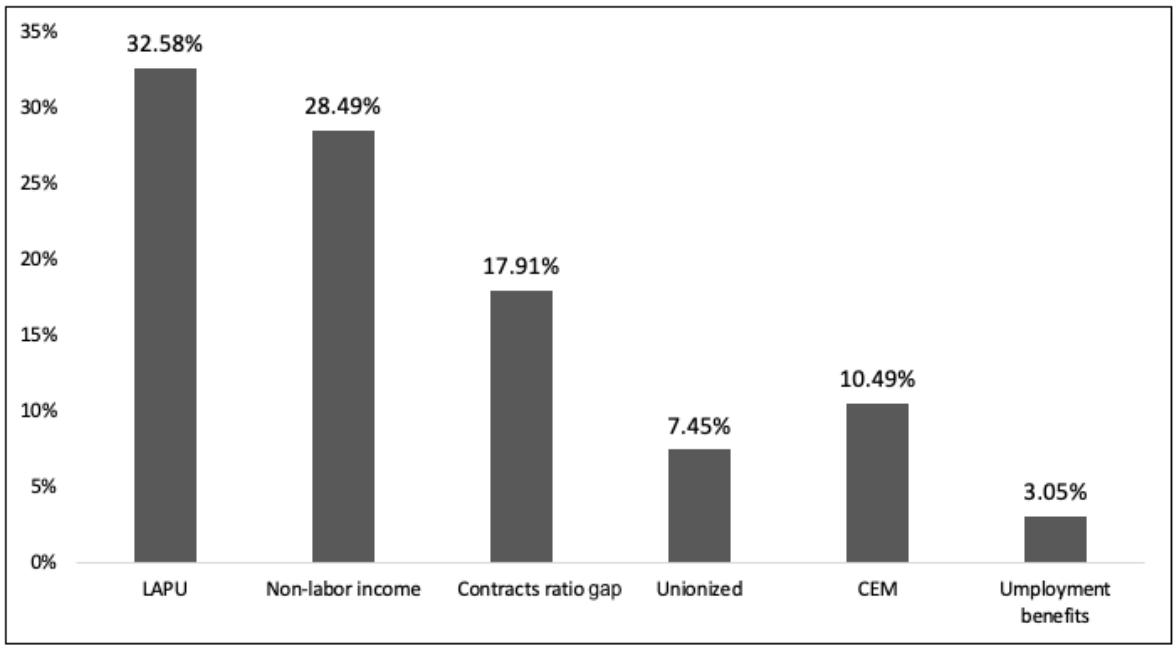
Graph 2. Generalized Impulse-response Functions Accumulated to a Standard Deviation



Source: Authors' own elaboration based on VAR 1 estimation.

When analyzing the variance decomposition, it is noteworthy to observe three important effects concerning the variance of LAPU. According to the results of the variance decomposition process of the LAPU, it can be found that non-labor income explains 28.49% of the variance, while the number of unionized explains 7.45% and the contract ratio - gap explains approximately 17.91%; this provides evidence of the important effect of institutional labor market variables on the persistence of unemployment duration for an emerging country such as Colombia. Finally, the ISE, a variable incorporated as a control for economic dynamics, explains 10.49% of the variability of the LAPU.

Graph 10. Variance Decomposition of LAPU at T=20

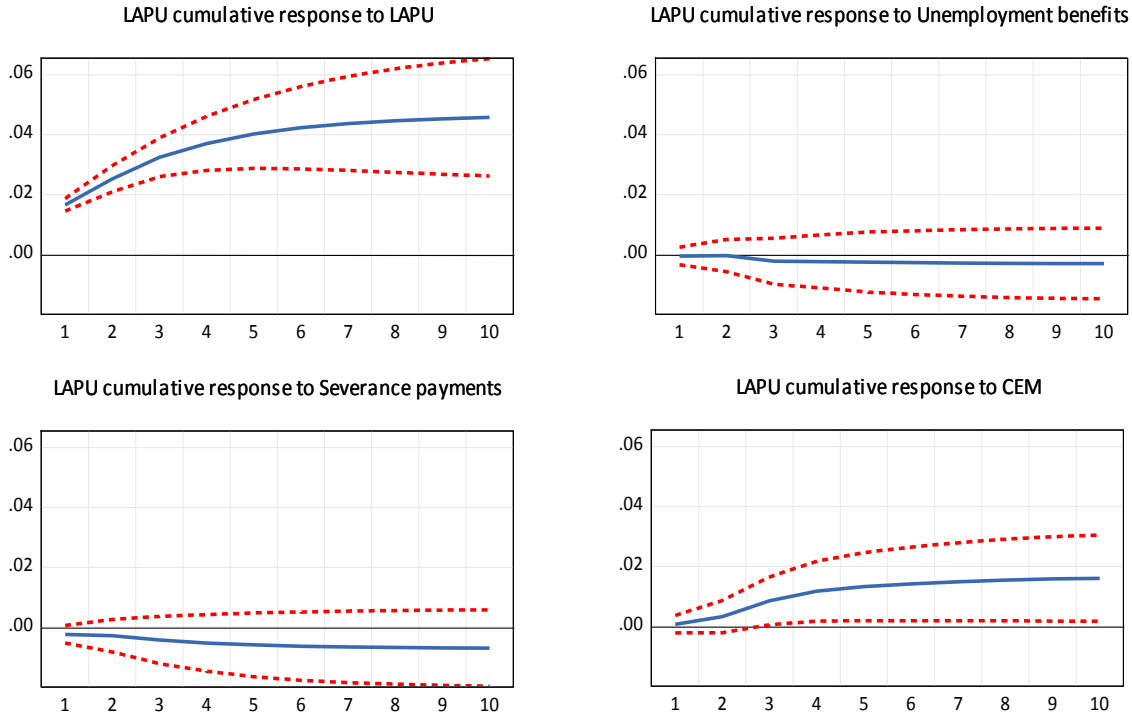


Source: Authors' own elaboration based on VAR1 estimation. T=20 period in which the variance stabilizes. Cholesky's order of the system: DLOG (CEM), DLOG (Non-labor income), DLOG (unionized), DLOG (Contract ratio - gap), DLOG (Unemployment benefits), LAPU

The results of the monetary transfer model are presented below (see graph 3); these results suggest that the unemployment subsidy and severance payments have no effect on the persistence of unemployment duration in Colombia as measured by the LAPU. It should be noted that the null effect of unemployment benefits in the LAPU may be due to the low coverage of this unemployment protection benefit over the total number of unemployed. In the present study, the calculation of the average percentage of unemployed people who have received unemployment benefits compared to the total

number of unemployed people reported by the GEIH has been carried out. The mean is 0.04%, the maximum value is 1% and the minimum value is 0.002%, for a total of 142 observations in the calculated time series.

Graph 3. Generalized Impulse-response Functions Accumulated to a Standard Deviation



Source: Authors' own elaboration based on the VAR 2 estimation.

Taking into account the results of the VAR 2 model, the variance decomposition process agrees robustly with the results of the impulse response functions, since the variables that correspond to monetary transfers such as severance payments and unemployment benefits do not show significant effects on the LAPU; it is correct to indicate that the percentage of the variance of the LAPU that is explained by the growth in people receiving unemployment benefits and growth of people receiving severance payments is very low, that is 4. 63% and 2.29%, respectively; while the growth of the ISE in this case explains about 21.09%, showing that cyclical economic activity has a greater impact on the LAPU than the variables corresponding to monetary transfers.

5. CONCLUSIONS

The aim of this study is to examine the impact of labor market regulations and institutions on the Long-Term Unemployment Rate (LTUR) in Colombia during the period 2010M1-2021M10. To achieve this, we collect and analyze data on long-term unemployment from the Integrated Household Survey, and develop an indicator of persistence in unemployment duration to assess the LTUR. Our findings reveal a significant sensitivity of this indicator to changes in variables reflecting the impact of labor market institutions and regulations in Colombia.

According to the results obtained through impulse-response functions and variance decomposition processes for the estimated models, it can be inferred that the path towards labor formalization is relevant. The increase in the gap between explicit (written) and implicit (verbal) contracts leads to a negative response of the LTUR, indicating a reduction in the persistence of unemployment duration in Colombia. Furthermore, the positive and significant response of the contract gap to an increase in total other non-labor income confirms previous findings suggesting an association between less formal employment and non-labor incomes, thereby supporting the hypothesis of a deepening process of labor informality in the country.

In conclusion, the results of this study underscore the importance of labor formalization through written contracts as an effective means to reduce the persistence of unemployment in the Colombian labor market. The evidence suggests that mitigating information asymmetries through more transparent and well-defined contracts can significantly enhance labor market outcomes by incentivizing the unemployed to seek formal employment opportunities. This finding reinforces the relevance of contract theories in understanding labor behaviors and emphasizes the need for policies that promote increased employment formalization. Ultimately, implementing measures to ensure regulatory compliance with written contracts can contribute to improving social welfare by facilitating the transition of workers to more stable and secure jobs.

Data on informality in Colombia reflect a combined effect of market failures and low productivity affecting the duration of unemployment. Additionally, it is evident that the COVID-19 crisis has exacerbated labor market conditions due to imposed restrictions, resulting in job losses and a negative impact on the tertiary and service sectors, which constitute a significant part of the Colombian economy. The evidence reveals a positive and significant relationship between non-labor incomes and the persistence of unemployment duration, suggesting that a significant portion of the economically active population seeks to generate additional non-labor incomes to subsist in the absence of formal employment.

The research results indicate that an increase in the number of unionized employees and non-labor incomes raises the LTUR. Primarily, it is concluded that the effect on this indicator of an increase in the number of unionized workers is related to collective bargaining processes that may create rigidities in the Colombian labor market and have an impact on the persistence of unemployment, an aspect requiring further investigation in future studies to determine the cause of such effect. As an alternative conclusion, it is highlighted that the limited effect of unemployment benefits on the LTUR is due to its low coverage, which is close to 0.04% for the period 2010M1-2021M10. This reveals the limited impact of this labor market regulation on the dynamics and duration of unemployment.

This study stands out for its innovative approach in analyzing the impact of labor market regulations and institutions on the Long-Term Unemployment Rate (LTUR) in Colombia. It provides a detailed and precise insight into how labor institutions affect the dynamics of the labor market in the country, offering valuable inferences on the relevance of labor formalization and the relationship between less formal employment and non-labor incomes. This adds significant value to existing literature by highlighting the importance of mitigating information asymmetries through transparent and well-defined contracts to improve labor market outcomes and promote greater employment formalization. Additionally, this study opens up new avenues for understanding the determinants of long-term unemployment in Colombia with potential applications for the context of developing countries.

Regarding future research directions, this study suggests the need to expand research on how labor reforms and training programs impact the dynamics of unemployment duration, which could provide crucial information for designing and implementing more effective policies. Furthermore, exploring the interaction between the formal and informal labor markets, as well as the impact of macroeconomic factors such as economic growth and inflation on the LTUR, could shed light on additional aspects contributing to a more comprehensive understanding of the determinants of long-term unemployment in Colombia.

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ANNEXES

Annex 1. Unit Root Tests and Order of Integration of the Series

Augmented Dickey-Fuller test statistic				**Phillip-Perron test statistic**				**Order Integration**
ADF in levels		**ADF in first differences**		**PP in levels**		**PP in first differences**		
T-stat.	Prob.	T-stat.	Prob.	T-stat.	Prob.	T-stat.	Prob.	I(ρ)
Trend and intercept.								
Number of people with labor contracts								
-3.2	0.088*	-14.823	0.000***	-3.626	0.031**	-14.849	0.000***	I(1)
Number of people working without contracts								
-3.007	0.134	-14.127	0.000***	-2.817	0.193	-14.315	0.000***	I(1)
Number of people working with a written contract								
-0.234	0.991	-13.322	0.000***	-0.818	0.96	-24.843	0.000***	I(1)
Number of people working with a verbal contract								
-4.705	0.001***	-11.971	0.000***	-4.993	0.000***	-11.971	0.000***	I(0)
LAPU								
-3.956	0.012**	-16.592	0.000***	-5.397	0.000***	-23.333	0.000***	I(0)
Average weeks of DLDs								
-2.629	0.268	-9.27	0.000***	-3.984	0.011**	-67.639	0.000***	I(1)
Number of people not receiving unemployment benefits								
-1.874	0.662	-11.673	0.000***	-2.206	0.481	-11.789	0.000***	I(1)
Number of persons in Long-term unemployment (DLD)								
-0.569	0.979	-12.244	0.000***	-0.635	0.975	-12.247	0.000***	I(1)
Unemployed								
-3.202	0.088*	-14.17	0.000***	-3.244	0.08*	-14.137	0.000***	I(1)
Number of people receiving unemployment benefits								
-3.601	0.033**	-16.453	0.000***	-3.444	0.010***	-16.453	0.000***	I(1)
Number of people with labor contracts								
-3.124	0.104	-9.523	0.000***	-2.929	0.156	-9.476	0.000***	I(1)
Total other non-labor income								

-2.069	0.557	-8.899	0.000***	-3.521	0.040**	-20.807	0.000***	I(1)
Number of people receiving severance and/or interest payments.								
-1.923	0.637	-14.77	0.000***	-1.372	0.864	-17.432	0.000***	I(1)
Number of persons who belong to a labor union or guild								
-2.044	0.571	-14.142	0.000	-1.881	0.658	-14.286	0.000	I(1)
Economic Monitor Index/ Control economic monitor- CEM								
-3.661	0.028	-9.499	0.000	-3.229	0.083	-10.934	0.000	I(1)

Source: Authors' own elaboration. **Note:** (P-value)-Prob based on MacKinnon (1996), one-sided P-values. Null Hypothesis: Has a unit root, Lag Length: Automatic Schwartz Info Criterion, (Automatic based on SIC, maxlag=13). Individual significance at 99% (***), 95% (**) and 90% (*).

ANNEX 2.

Akaike's Information Test for Inclusion of VAR 1 and VAR 2 Lags

Akaike's Information Test for Inclusion of VAR 1

VAR Lag Order Selection Criteria
Endogenous variables: LAPU, DLOG (unionized), DLOG (Contract ratio - gap), DLOG(Unemployment benefits), DLOG(Non-labor income), DLOG(CEM)
Exogenous variables: C

Sample: 2010M01 2020M12
Included Observations: 114

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1118.229	NA	1.35e-16	-19.51279	-19.36878	-19.45435
1	1208.718	169.8655	5.20e-17*	-20.46874	-19.46067*	-20.05962*
2	1238.905	53.48818*	5.79e-17	-20.36675	-18.49461	-19.60695
3	1263.007	40.17099	7.22e-17	-20.15802	-17.42182	-19.04755
4	1290.120	42.33349	8.65e-17	-20.00210	-16.40184	-18.54096
5	1306.523	23.88581	1.27e-16	-19.65830	-15.19398	-17.84648
6	1325.047	25.02363	1.84e-16	-19.35171	-14.02332	-17.18921
7	1359.680	43.13931	2.06e-16	-19.32772	-13.13527	-16.81455
8	1379.230	22.29403	3.11e-16	-19.03913	-11.98262	-16.17529
9	1402.639	24.23021	4.57e-16	-18.81823	-10.89766	-15.60371
10	1443.046	37.57168	5.28e-16	-18.89555	-10.11092	-15.33036
11	1496.235	43.85700	5.23e-16	-19.19710	-9.548401	-15.28123
12	1557.572	44.11973	4.92e-16	-19.64161	-9.128851	-15.37507
13	1616.443	36.14879	5.47e-16	-20.04286	-8.666031	-15.42564
14	1710.721	47.96595	3.89e-16	-21.06528*	-8.824388	-16.09739

* Indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Akaike's Information Test for Inclusion of VAR 2

VAR Lag Order Selection Criteria

Endogenous variables: LAPU DLOG(severance payments) DLOG(Unemployment benefits)
Exogenous variables: C

Sample: 2010M01 2020M12

Included Observations: 118

Lag	LogL	LR	FPE	AIC	SC	HQ
0	378.1457	NA	3.48e-07	-6.358401	-6.287960	-6.329800
1	431.2776	102.6617	1.65e-07	-7.106400	-6.824635*	-6.991995*
2	440.9167	18.13460	1.63e-07*	-7.117232*	-6.624144	-6.917024
3	446.2939	9.843002	1.73e-07	-7.055829	-6.351418	-6.769817
4	450.8146	8.045303	1.87e-07	-6.979908	-6.064174	-6.608093
5	456,4736	9,783382	1.99e-07	-6.923282	-5.796223	-6.465663
6	464.0531	12.71814	2.04e-07	-6.899205	-5.560824	-6.355783
7	475.5139	18.64798*	1.97e-07	-6.940913	-5.391208	-6.311687
8	479.3808	6.095292	2.16e-07	-6.853911	-5.092883	-6.138882
9	485.2435	8.943107	2.30e-07	-6.800737	-4.828385	-5.999904
10	488.9343	5.442451	2.54e-07	-6.710751	-4.527076	-5.824115

Source: Authors' own elaboration. * Indicates lag order selected by the criterion, LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.

ANNEX 3.
Serial Autocorrelation Test LM Test VAR 1 and 2

LM TEST VAR 1

VAR Residual Serial Correlation LM Tests
Sample: 2010M01 2020M12

Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	44.20057	36	0.1638	1.271235	(36, 112.5)	0.1718
2	25.06065	36	0.9144	0.667236	(36, 112.5)	0.9175
3	28.11985	36	0.8229	0.757885	(36, 112.5)	0.8285
4	35.06997	36	0.5127	0.971962	(36, 112.5)	0.5230
5	33.93628	36	0.5671	0.936253	(36, 112.5)	0.5770
6	30.96082	36	0.7069	0.844007	(36, 112.5)	0.7150
7	30.26012	36	0.7377	0.822590	(36, 112.5)	0.7452
8	31.59956	36	0.6779	0.863631	(36, 112.5)	0.6865
9	35.17480	36	0.5077	0.975279	(36, 112.5)	0.5180
10	20.42300	36	0.9828	0.533833	(36, 112.5)	0.9835
11	33.08423	36	0.6080	0.909621	(36, 112.5)	0.6175
12	33.88436	36	0.5696	0.934626	(36, 112.5)	0.5795
13	46.18260	36	0.1191	1.339034	(36, 112.5)	0.1258
14	37.22344	36	0.4125	1.040657	(36, 112.5)	0.4232
15	24.84085	36	0.9195	0.660805	(36, 112.5)	0.9224

Source: Authors' own elaboration. No serial correlation at lags 1 to h

LM TEST VAR2

LM TEST VAR 2

VAR Residual Serial Correlation LM Tests

Sample: 2010M01 2020M12

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	8.020464	9	0.5321	0.892742	(9, 277.6)	0.5321
2	8.928748	9	0.4439	0.995457	(9, 277.6)	0.4439
3	4.666940	9	0.8623	0.516367	(9, 277.6)	0.8623
4	9.323466	9	0.4080	1.040197	(9, 277.6)	0.4080

Source: Authors' own elaboration. Null hypothesis: No serial correlation at lags 1 to h

ANNEX 4. Granger causality test VAR1

LAPU, DLOG (unionized), DLOG (Contract ratio - gap), DLOG (Unemployment benefits), DLOG (Non-labor income)

VAR Granger Causality/Block Exogeneity Wald Tests
Sample: 2010M01 2021M10
Included observations: 114

Dependent variable: LAPU

Excluded	Chi-sq	df	Prob.
DLOG (unionized)	6.886023	14	0.9390
DLOG (Contract ratio - gap)	7.831383	14	0.8979
DLOG (Non-labor income)	8.462621	14	0.8639
DLOG (Unemployment benefits)	4.474130	14	0.9919
DLOG(CEM)	9.273171	14	0.8132
All	50.42891	70	0.9626

Dependent variable: DLOG (unionized)

Excluded	Chi-sq	df	Prob.
LAPU	17.86509	14	0.2130
DLOG (Contract ratio - gap)	12.10193	14	0.5981
DLOG (Non-labor income)	16.76652	14	0.2688
DLOG (Unemployment benefits)	11.06945	14	0.6806
DLOG(CEM)	6.209833	14	0.9609

All	53.17248	70	0.9329

Dependent variable: DLOG (Contract ratio - gap)

Excluded	Chi-sq	df	Prob.
LAPU	13.14723	14	0.5150
DLOG (unionized)	10.41788	14	0.7310
DLOG (Non-labor income)	19.07897	14	0.1620
DLOG (Unemployment benefits)	16.62219	14	0.2769
DLOG(CEM)	5.690763	14	0.9737
All	58.34194	70	0.8386

Dependent variable: DLOG (Non-labor income)

Excluded	Chi-sq	df	Prob.
LAPU	23.87970	14	0.0474
DLOG (unionized)	16.58975	14	0.2787
LOG (Contract ratio - gap)	25.77228	14	0.0277
DLOG (Unemployment benefits)	24.04639	14	0.0452
DLOG (CEM)	22.77309	14	0.0641
All	107.8972	70	0.0025

Dependent variable: DLOG (Unemployment benefits)

Excluded	Chi-sq	df	Prob.
LAPU	8.878793	14	0.8387
DLOG (unionized)	24.03881	14	0.0453
DLOG (Contract ratio - gap)	16.36743	14	0.2915
DLOG (Non-labor income)	20.99652	14	0.1017
DLOG(CEM)	18.19552	14	0.1980
All	77.06467	70	0.2630

Dependent variable: DLOG(CEM)

Excluded	Chi-sq	df	Prob.
LAPU	31.19449	14	0.0052
DLOG (unionized)	18.20861	14	0.1974
DLOG (Contract ratio - gap)	42.47343	14	0.0001
DLOG (Non-labor income)	14.85140	14	0.3884
DLOG (Unemployment benefits)	16.02718	14	0.3117
All	135.6644	70	0.0000

Source: Authors' own elaboration.

ANNEX 5.

VAR Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)
Null Hypothesis: Residuals are multivariate normal
Sample: 2010M01 2021M10
Included observations: 114

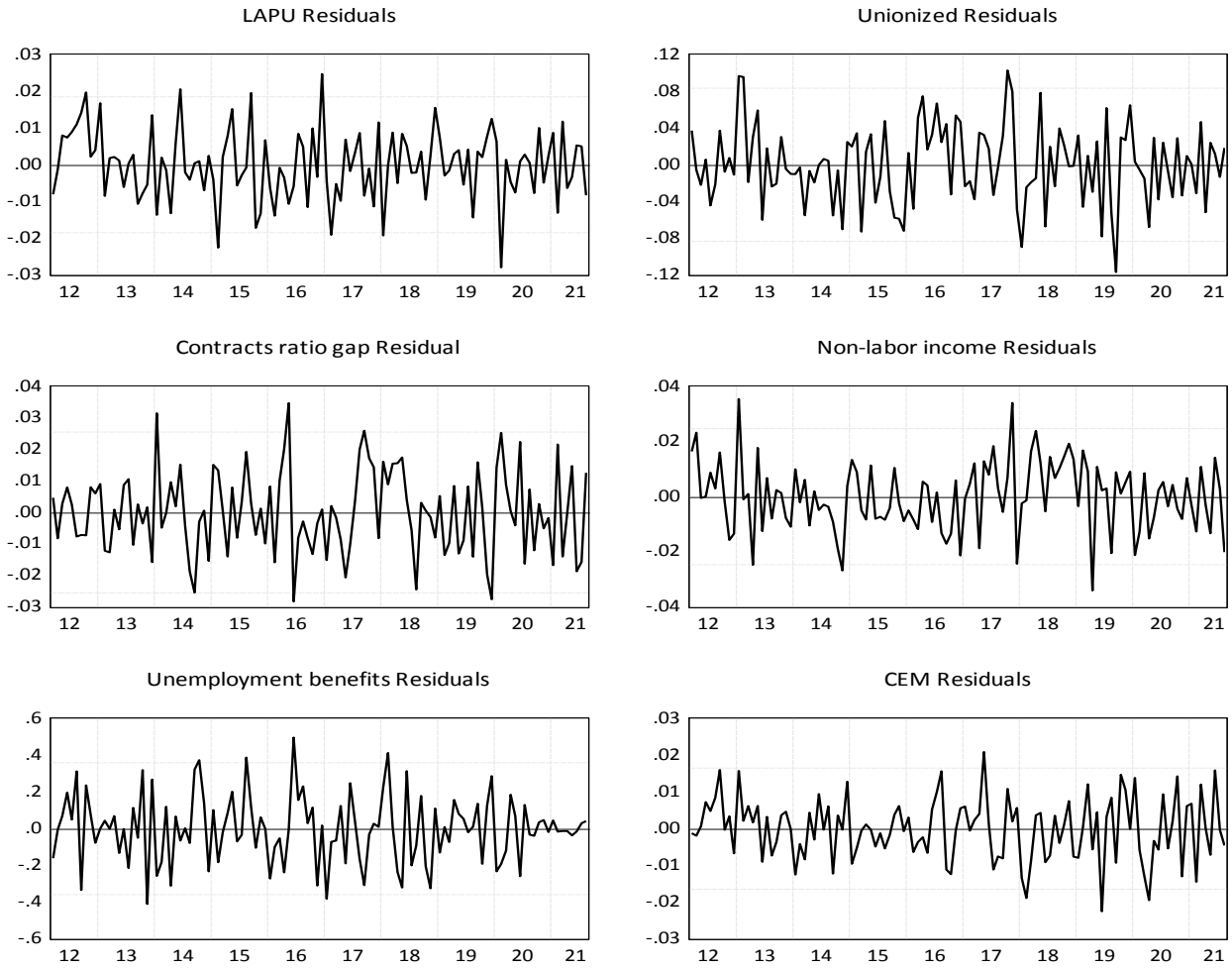
Component	Skewness	Chi-sq	df	Prob.*
1	-0.055420	0.065165	1	0.7985
2	-0.000821	1.43E-05	1	0.9970
3	0.070382	0.105021	1	0.7459
4	-0.053757	0.061318	1	0.8044
5	0.190258	0.757707	1	0.3840
6	-0.118059	0.294399	1	0.5874
Joint		1.283625	6	0.9726

Component	Kurtosis	Chi-sq	df	Prob.
1	3.270161	1.283132	1	0.2573
2	2.989784	0.237193	1	0.6262
3	2.449590	1.058083	1	0.3037
4	3.085544	0.493843	1	0.4822
5	3.164170	0.473357	1	0.4914
6	2.760837	0.037618	1	0.8462
Joint		3.583227	6	0.7329

Component	Jarque-Bera	df	Prob.
1	1.348297	2	0.5096
2	0.237207	2	0.8882
3	1.163104	2	0.5590
4	0.555162	2	0.7576
5	1.231064	2	0.5404
6	0.332017	2	0.8470
Joint	4.866852	12	0.9623

Source: Authors' own elaboration.

ANNEX 6. VAR Residuals



Source: Authors' own elaboration.