

Payroll Paradox: Using Labour Market Fluctuation in Dynamic Stochastic General Equilibrium (DSGE) Modeling in Nigeria

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Date of Submission: 01-08-2025

Date of Acceptance: 10-08-2025

ABSTRACT: The application of DSGE models in economic research within the labour market in Nigeria call for concern and further need exploration. This study therefore examined labour market fluctuations in Nigeria from 2008 to 2022 using a DSGE model to analyze the payroll paradox. It also assesses how different economic shocks affect labour market outcomes. The methodology of the study is focused on secondary time-series data from the Central Bank of Nigeria's statistical bulletin and the World Development Indicators were used covering 2008 to 2022. The analysis employs a Vector Autoregressive (VAR) model. The study conclude that economic shocks adversely affect labour market outcomes, worsening the economic outlook by prompting firms to cut jobs or reduce working hours. It is recommended that governments should implement labour market reforms that enhance wage flexibility.

KEYWORDS: Labour market, VAR, Employment, DSGE Model, Nigeria

I.INTRODUCTION

The Nigerian labour market, like those in industrializing and industrialized countries, has undergone significant structural changes over time. Industrializing countries are nations in the process of developing robust industrial sectors, while industrialized countries have already achieved this and possess well-established industrial and technological infrastructures. In Nigeria, there seems to be a shift from a traditionally conservative labour market to a more liberal and evolving one, reflecting broader economic transformation.

As Fowler, and Jensen (2020) defines, labor market are those physical places or abstract conceptions that brings potential or actual employers together with potential or actual employees. These markets operate through the interplay of supply and demand, which determine labour allocation and wages, assuming all else remain constant. Neo-classical economists liken the labour market to other markets, where supply and demand jointly determining the wages and employment levels. However, labor market differs fundamentally from markets for goods or money due to unique dynamics, such as wage rigidity and institutional frameworks.

Understanding these differences is particularly important for developing economies like Nigeria, where the labour market plays an essential role in fostering economic stability and growth. Acentral issue within this context is the payroll paradox-an economic phenomenon where payroll employment figures phenomen stable or response sluggishly despite significant economic changes. This paradox challenges traditional economic theories that predict immediate correlation between economic performance and employment levels (Dieste, Sauer, &Orzes, 2022).

The payroll paradox describes scenarios where wage adjustments fail to produce expected changes in employment levels or productivity (Brynjolfsson, Benzell, & Rock, 2020). This phenomenon arises due to factors such as labor market rigidities, institutional settings, and behavioral responses from workers and employers (Khan, Ul Hameed, Iqbal, Shah, Tariq, & Ahmed, 2022). For example, in a classical framework, a

wages reduction should theoretically encourage employers to hire more workers, reducing unemployment. Conversely, rising wages might decrease employment due to increased labor cost. However, the payroll paradox reveals that this relationship is not always linear or immediate, owing to complexities like wage stickiness and efficiency wage theories.

In Nigeria, the labor market exhibits high levels of informality, substantial under-employment, and significant sensitivity to both domestic and international economic conditions (Adekoya, 2023). By leveraging DSGE models, researchers and policymakers can delve into the complexities of labour market fluctuations and the payroll paradox within Nigeria's unique economic landscape. This model provides a robust framework for incorporating microeconomic foundations, analyzing stochastic shocks, and evaluating policy interventions. Applying DSGE analysis to the Nigerian context offers a pathway to better understanding and addressing labour market challenges while fostering economic stability and growth. Despite the extensive use of DSGE models in macroeconomic research, the nuanced behavior of labor markets within these models remains an area that requires further exploration. Traditional DSGE models often assume frictionless labor markets, which do not adequately capture the real-world complexities such as unemployment, job creation and destruction, wage rigidity, and search frictions. This gap in modeling labor market dynamics limits the effectiveness of DSGE models in informing policy decisions related to employment and labor regulations, especially in Nigeria some data did not capture wages, hours worked, and unemployment rate. The objective of this study is how different economic shocks affect labour market outcomes. Examining the payroll paradox through the perspective of labor market fluctuations using Dynamic Stochastic General Equilibrium (DSGE) modeling in Nigeria is highly significant for several reasons: understanding the payroll paradox and labor market fluctuations provides policymakers with insights into the intricate dynamics of employment, wages, and productivity. DSGE Models help in identifying specific areas within the labor market that may require targeted interventions, such as job creation programs, vocational training, or wage subsidies. The payroll paradox often involves situations where employment figures and wage data do not align with expected economic outcomes. This contributes to the development of economic models

that are tailored to the specific characteristics and challenges of Nigeria's economy. Previous researchers have discussed about monetary policy, business cycles using DSGE models. Few of them speaks about labour market fluctuation which is crucial for a developing economy like Nigeria. This study is unique compare to other researchers because it is estimated using VAR model, to check the impulse response of the variable and to forecast system of inter-related time series and analyse the dynamic impact of random disturbance on the system of variable. Some major question has been asked: how do different types of economic shocks affect labour market outcomes? The result is being tested via VAR techniques based on the variable employed in this study. The general objective of this study is to investigate Payroll Paradox: labor market fluctuations in DSGE modeling in Nigeria while the specific objectives are: to examine how different economic shocks affect labor market outcomes such as employment, unemployment rates, and wage dynamics; to measure how labor market frictions (e.g., search and matching frictions, wage rigidity, and hiring costs) influence the volatility of economic shocks in the labor market; and investigate the significant effects of different macroeconomic policies (e.g., monetary policy, fiscal policy, and labor market regulations) on labor market stability and employment levels.

II. LITERATURE REVIEW

Conceptual Framework

Payroll Paradox

The payroll paradox in Nigeria resulted from a blend of historical, political, and economic factors, particularly following the country's post-independence developments (Okoh, & Teidi, 2021). Following Nigeria's independence in 1960, the government prioritized developing a robust public sector to spur development and create jobs. This resulted in the swift expansion of ministries, agencies, and public institutions. While the rise in public sector employment was initially intended to absorb the growing labour force and reduce unemployment, it was often politically motivated rather than focused on productivity or efficiency, leading to overstaffing and inefficiencies. The payroll paradox in Nigeria describes the perplexing situation where the government allocates a significant portion of its budget to public sector wages, but still faces low productivity, inefficiency, and poor service delivery (Bandy, 2023).

Labour market

Nigeria, the most populous nation, had an estimated population of over 158 million in 2011, with more than 50% (approximately 87 million people) aged between 15 and 64 years. Among these working-age individuals, only 5% are classified as unemployed but actively seeking work. While Nigeria's unemployment rate appears low based on the ILO definition, this figure overlooks the reality that the labor market is largely concentrated in low-productivity sectors such as agriculture and services, particularly retail trade (Eruaga, Osiki, & Ubi-Abai, 2023).

Osadolor (2024) highlights that informality dominates the Nigerian labor market. Although two-thirds of the adult population participate in the workforce, self-employment in agriculture and non-farm activities constitutes 70% of total employment. These sectors are typically classified as part of the informal economy, where workers lack formal employers and generally have no access to social security. Labor market fluctuations, encompassing changes in employment, unemployment, wages, and labor force participation, are central topics in macroeconomics (Amin, Islam, Jelane, & Sumaia, 2024). Classical theories, such as those by Adam Smith and David Ricardo, emphasize the self-adjusting nature of labor markets, asserting that wages and employment adjust through market mechanisms to resolve any imbalances (da Silva, 2023). In contrast, Keynesian economics, pioneered by John Maynard Keynes, argues that labor markets can remain out of equilibrium for extended period due to wage stickiness and insufficient demand. Keynes (1936) contends that active government intervention is necessary to manage unemployment and stabilize labor markets. New Keynesian models integrate wage and price stickiness into the analysis of labor markets, illustrating how nominal rigidities can lead to fluctuation in unemployment and output.

DSGE Modeling

Dynamic Stochastic General Equilibrium (DSGE) models were initially not intended to incorporate essential elements of a functioning labor market, such as unemployment and segmentation. This limitation was acknowledged by scholars like Blanchard et al. (2010) and Gali et al. (2011). Blanchard (2009) notably described this omission as "a striking (and unpleasant) characteristic of the standard New Keynesian DSGE model." In response to criticisms, recent DSGE models have integrated labor market

imperfections, as shown in the works of Blanchard et al. (2010), Gali (2010), Castillo et al. (2008), Christiano et al. (2010), and Mattesini et al. (2009). By incorporating elements of search and matching theory, these models have enhanced their ability to align more accurately with real-world data (Christiano et al., 2011; Gertler et al., 2009).

Empirical Review

The payroll paradox refers to a discrepancy where, during economic downturns or upswings, firms do not adjust their payrolls (wages or employment) as predicted by DSGE models (Carlin, & Soskice 2024). This paradox creates challenges in understanding how shocks are transmitted through the labor market, particularly in developing economies like Nigeria. In DSGE models, labour market fluctuations are crucial for analyzing the impact of shocks on employment, wages, and overall economic output. However, labour market frictions such as wage rigidity, hiring costs, and institutional factors, tend to amplify the payroll paradox, especially in developing economies where labour market structures differ from those in advanced economies.

Several studies have explored labour market fluctuation in Nigeria, focusing on wage administration and labour supply in an organization (Aremu, 2006). Similarly, Arestis (2022), examined the effect of macroeconomic policies on labour market outcomes and highlighted the sluggish response of employment and wages to fiscal and monetary policy changes, supporting the presence of labour market frictions in the country. Oye, Alege, and Olomola (2018) further studied DSGE models tailored to the Nigerian economy, revealing that labour market frictions, including wages and employment adjustment costs, contributed to the slow transmission of shocks, offering a possible explanation for the payroll paradox during periods of significant economic fluctuations.

Theoretical Framework

Prior to the adoption of the DSGE model, the Real Business Cycle (RBC) model was used to predict economic fluctuations. Developed by Kydland and Prescott in 1982, this model is grounded in a structural microeconomic framework where economic agents make decisions and form expectations dynamically. The RBC model posits that fluctuations stem from the reactions of economic agents to random technology shocks and business cycles, focusing on two representative

agents: households and firms. Despite the significant contributions of RBC models, they were criticized for their assumption of flexible prices. This meant that any change in the nominal interest rate was always matched by a proportional change in inflation, leaving the real interest rate unchanged. Contrary to the Keynesian proposition that economic recessions are often associated with the inefficient resources utilization, the RBC model assumed that cyclical fluctuations were optimal responses to shocks, rendering stabilization policies not only unnecessary but also counterproductive. Additionally, the introduction of technology shocks in RBC models did not align with the traditional view of long-term growth. The models were also criticized for their inability to match empirical evidence with stylized facts about the economy.

The limitations of the RBC model led to the emergence of the New-Keynesian Macroeconomics (NKM) school of thought, which blends micro-foundation features of the RBC model with the DSGE platform as its core. The NKM assumes an imperfect and rigid economy, incorporating monopolistic competition, real and nominal rigidities, and various disturbances. These disturbances include sticky prices (Rebelo, Santana, & Teles 2024), demand shocks (Ruch, & Taskin, 2022), “nominal sticky wages (Schaefer, & Singleton 2022), consumption habits (ElmaslarÖzbaş, Akın, Güneysu, Özcan, & Öngen 2022), wage and price indexation and the inclusion of investment adjustment costs (Yuen, & Rozenbes 2022). Unlike the RBC perspective, these assumptions highlight the significant role of monetary and stabilization policies, thereby enhancing the models' relevance and popularity among academics and policymakers.

Keynes did not emphasize the stickiness of wages or prices as a primary factor behind the business cycles or persistent depressions with high unemployment. Nor did he consider wage and price flexibility necessarily beneficial. Aronica, Fazio, & Piacentino, (2022) provide a detailed micro-founded analysis of this issue. According to Hahn and Solow, Keynes's suggested “that excessive flexibility could cause drastic price fluctuations, potentially undermining the functions of money itself, deserve attention. They argue that some degree of nominal wage stickiness might be essential to avoid the detrimental effects of unlimited flexibility”.

The development of Dynamic Stochastic General Equilibrium (DSGE) models was prompted by neoclassical criticism of conventional

Keynesian models, which lacked supply-side factors in their framework (Feto, 2022). To address this limitation, neoclassical economists introduced DSGE models as an alternative for describing the aggregate economy, based on the assumptions that the economy is dynamic and that economy agents have rational preferences. DSGE models are utilized to identify sources of economic fluctuations, address questions about structural changes, forecast and predict the effects of policy changes, and conduct counterfactual experiments (Tovar, 2009). In DSGE models, agents include households, firms, the government, central banks, and other decision makers. These models are not only dynamic but also stochastic, meaning they account for random shocks such as changes in technology, oil prices, and macroeconomic policies.

III. METHODOLOGY

This study aim is to find solution to the research question on how different types of economic shocks affect labour market outcome in Nigeria. The targeted population consist of all citizen within the range of age 15 to 65. The data used in this study are secondary data obtained from Central Bank of Nigeria (CBN) and World Development Indicator (WDI) from 2008 to 2022.

Model Specification

RGDP =

Where:

RGDP is the Real Gross Domestic Product

INFR is the Inflation rate

GOVT-SPENDING is the Government Spending

EMP is the Employment rate.

Estimation Techniques:

In this investigation, a Vector Autoregressive (VAR) model is used as the statistical tool. Essential tests are conducted to estimate data, including unit root test, determining the optimal lag, variance decomposition and performing some diagnostics such as the Autocorrelation LM test, normality test, and heteroskedasticity test. In the VAR model analysis, the data will be transformed into logs before estimation and the VAR model is being specified in level.

VAR equation can be written as:

$$\begin{aligned}
 \ln rgdp_t &= \alpha_1 + \sum_{i=1}^k \alpha_{1i} \ln rgdp_{t-1} + \sum_{i=1}^k \phi_{1i} \ln emp_{t-1} + \sum_{i=1}^k \beta_{1i} \ln inf_{t-1} + \sum_{i=1}^k \delta_{1i} \text{govt-spending}_{t-1} + u_{1t} \\
 \ln emp_t &= \alpha_2 + \sum_{i=1}^k \alpha_{2i} \ln rgdp_{t-1} + \sum_{i=1}^k \phi_{2i} \ln emp_{t-1} + \sum_{i=1}^k \beta_{2i} \ln inf_{t-1} + \sum_{i=1}^k \delta_{2i} \text{govt-spending}_{t-1} + u_{2t} \\
 \ln inf_t &= \alpha_3 + \sum_{i=1}^k \alpha_{3i} \ln rgdp_{t-1} + \sum_{i=1}^k \phi_{3i} \ln emp_{t-1} + \sum_{i=1}^k \beta_{3i} \ln inf_{t-1} + \sum_{i=1}^k \delta_{3i} \text{govt-spending}_{t-1} + u_{3t} \\
 \ln \text{govt-spending}_t &= \alpha_4 + \sum_{i=1}^k \alpha_{4i} \ln rgdp_{t-1} + \sum_{i=1}^k \phi_{4i} \ln emp_{t-1} + \sum_{i=1}^k \beta_{4i} \ln inf_{t-1} + \sum_{i=1}^k \delta_{4i} \text{govt-spending}_{t-1} + u_{4t}
 \end{aligned}$$

Where:

$\alpha_{1j}, \phi_{1j}, \beta_{1j}, \delta_{1j}$ are parameters.
are the shocks.

IV. RESULTS AND DISCUSSION

Descriptive Statistics of the data

Table 1 presents descriptive statistics of the variables employed in this study. The emphasis is on mean and maximum. RGDP had an average of 11.0 and its maximum was 11.2. GOVT-SPENDING averaged 8.6 with 9.4. Employment and Inflation averaged and maximum at 3.9 approximately, 5.0 and 3.9, 5.4 respectively.

Unit root test

For empirical analysis, the order of integration for the variables is tested by using Augmented Dickey-Fuller (ADF) test. Outcomes portrayed in table 2 indicate RGDP is stationary at level, government spending and inflation are stationary at first difference while employment is not stationary at both.

Table 1. Descriptive statistics

	LNGOVT S...	LNRGDP	LNEMPLOY...	LNINFR
Mean	8.646748	11.07176	3.879684	5.076176
Median	8.469548	11.13681	3.881637	5.090186
Maximum	9.447391	11.23544	3.910697	5.453096
Minimum	7.939779	10.75370	3.840411	4.666924
Std. Dev.	0.451575	0.143595	0.024011	0.269442
Skewness	0.435965	-0.984192	-0.181971	-0.043256
Kurtosis	2.063687	2.813872	1.517802	1.645494
Jarque-Bera	1.023090	2.443237	1.455853	1.151357
Probability	0.599568	0.294753	0.482909	0.562323
Sum	129.7012	166.0764	58.19526	76.14265
Sum Sq. Dev.	2.854883	0.288673	0.008071	1.016384
Observations	15	15	15	15

Table 2: The Results of Unit Root Test

Variables	ADF	P-value (level)	ADF	P-value(first difference)
Lnrngdp	-4.573816	0.0037	-2.102701	0.2463
Lnemployment	-1.656975	0.4297	-2.219322	0.2090
Lngovt_spendin g	0.105256	0.9527	-3.914320	0.0128
Lninfr	-1.455031	0.5233	-3.471412	0.0293

Source: SPSS Output 2025

Variance Decomposition

The table presented in Table 4.3 forecasts payroll paradox using labor market fluctuation in Nigeria over a 5-years period, which can be divided into two phases: the short-run and the long-run.

Short-Run

In the short run, 100 percent of the forecast error variance in RGDP is explained by RGDP itself. The contributions from employment, government spending, and inflation are strongly

exogenous, meaning they have a very weak influence on predicting future RGDP. Employment significantly influences its own forecast, while government spending and inflation have a weak influence on predicting future employment. However, RGDP has a strong influence in forecasting employment in the short run.

Government spending is primarily influenced by itself, with 94 percent of its forecast variance explained internally. RGDP, employment, and inflation have a weak impact on predicting

future government spending in the short run. Similarly, inflation is strongly self-influenced, accounting for 79 percent of its forecast variance, while RGDP, employment, and government spending have a minimal effect on forecasting future inflation.

Long-Run

In the long run, the influence of RGDP on itself diminishes as we project further into the future, while the impact of employment, government spending, and inflation increases. This indicates that employment, government spending, and inflation exert a stronger endogenous influence on RGDP over time, while RGDP's influence on itself weakens.

Employment's influence on itself strengthens the further we move into the future, and its effect on government spending, and inflation also grows, while RGDP's influence weakens.

Government spending's influence on itself declines over time, while its relationship with RGDP and inflation fluctuates. However, its influence on employment increases as time progresses.

Finally, inflation's influence on itself weakens, and its relationship with government spending becomes more variable, but the influence of RGDP and employment on inflation grows as we move into the future.

Table 3 Variance decomposition

Variance Decomposition of LNRGDP:					
Period	S.E.	LNRGDP	LNEMPLO...	LNGOVT ...	LNINFR
1	0.021222	100.0000	0.000000	0.000000	0.000000
2	0.027127	98.20672	0.001069	0.594691	1.197522
3	0.029991	95.49335	0.662350	0.813282	3.031022
4	0.031631	93.04697	2.212001	0.851712	3.889320
5	0.032735	91.13954	3.932405	0.875585	4.052472

Variance Decomposition of LNEMPLOYMENT:					
Period	S.E.	LNRGDP	LNEMPLO...	LNGOVT ...	LNINFR
1	0.009373	35.84436	64.15564	0.000000	0.000000
2	0.011282	29.60982	67.25640	0.040817	3.092959
3	0.012038	26.13379	68.80935	0.460371	4.596494
4	0.012497	24.41093	70.03533	0.977540	4.576199
5	0.012891	23.41311	70.96836	1.310640	4.307888

Variance Decomposition of LNGOVT_SPENDING:					
Period	S.E.	LNRGDP	LNEMPLO...	LNGOVT ...	LNINFR
1	0.095035	4.719332	0.299844	94.98082	0.000000
2	0.138695	4.596898	30.10809	49.61937	15.67564
3	0.167686	4.119067	50.01515	34.02799	11.83780
4	0.183252	3.548897	57.69574	28.59432	10.16105
5	0.193516	4.421205	60.17323	26.01599	9.389576

Variance Decomposition of LNINFR:					
Period	S.E.	LNRGDP	LNEMPLO...	LNGOVT ...	LNINFR
1	0.154084	6.917788	8.339847	5.365501	79.37686
2	0.190105	11.78747	26.03503	4.167706	58.00979
3	0.200167	11.43664	31.56682	4.013576	52.98296
4	0.203656	11.14027	32.61157	3.918823	52.32934
5	0.205555	11.35131	33.08506	4.053759	51.50987

Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: LNRGDP LNEMPLOYMENT LNGOVT_SPENDING LNINFR

Impulse Response Analysis (IRFs)

Response to Cholesky One S.D. (d.f. adjusted) Innovations
± 2 analytic asymptotic S.E.s

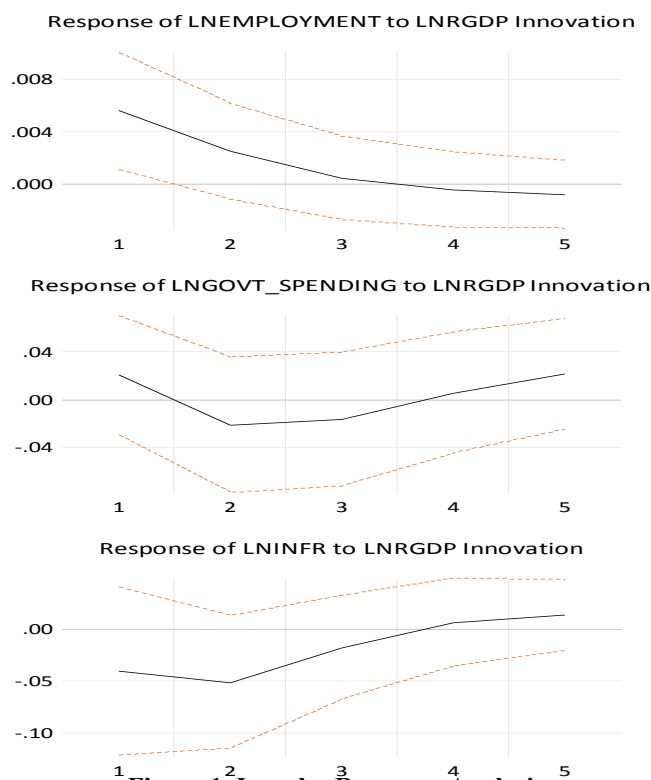


Figure 1. Impulse Response Analysis

In figure 1, the response of employment to RGDP shows a downward slope from periods 1 to 3, followed by a movement into negative territory from period 3, with fluctuations between periods 4 and 5, remaining negative.

The response of government spending to RGDP initially starts positively, then declines into negative territory before gradually rising back into positive territory.

The response of inflation to RGDP shows an initial negative decline from periods 1 to 2, followed by a gradual increase from negative values into a positive steady state.

V. CONCLUSION AND RECOMMENDATIONS

The study concluded that different types of economic shocks can negatively affect the labour market, as seen in the impulse response graphs showing the response of employment to shocks in RGDP. One reason for this negative effect is that if the rise in RGDP is driven by significant improvements in productivity-where firms produce more output with fewer workers-employment may decline even as RGDP increases. For instance, automation, technological advancements, or more efficient production methods can boost output without requiring additional labour. Additionally, the study also concluded that increase in RGDP may disproportionately benefit capital-intensive sectors like manufacturing or mining, while labor-intensive sectors such as services or agriculture may shrink or experience slower growth. This sectoral shift can result in an overall decline in employment, even as the economy expands.

The study also concluded that a negative response of employment to a shock in government spending in an impulse response graph which can be explained by several fiscal policy dynamics that impact labour market stability and employment levels. One key effect is that increased government spending, particularly when financed through borrowing, can lead to higher interest rates. This raises the cost of borrowing for businesses, potentially crowding out private investment. As a result, firms may reduce hiring or lay off workers, causing a negative effect on employment despite the rise in government spending. In Nigeria's economy, economic shocks adversely affect labor market outcomes, leading to job losses or reduced working hours, which worsen the economic outlook. These fluctuations in employment reflect

labor market instability caused by the lagged effects of economic variables.

In order to address the challenges identified and based on the conclusion, the study, recommended the followings:

- i. To address wage rigidity, government should implement labour market reforms that promote greater wage flexibility, particularly in the formal sector.
- ii. Given that macroeconomic shocks, particularly oil price volatility, disproportionately impact labour market outcomes, the Central Bank of Nigeria and the Ministry of Finance should implement counter-cyclical monetary and fiscal policies.
- iii. To tackle both the payroll paradox and broader labour market inefficiencies, the Nigerian government should prioritize policies that enhance labour market flexibility.

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