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Determine the impact of wages on the rate of economically active people in Sinaloa from 2012 to 2023 using an econometric model

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Abstract. The study examined the impact of the minimum wage on the participation of the economically active population (EAP) in Sinaloa between 2012 and 2023, using a linear regression model to analyse its relationship with variables such as GDP, inflation, interest rates and foreign direct investment. The findings revealed that the minimum wage has a positive and significant effect on labour participation, with a coefficient of 0.0147 (p=0.0023), while GDP also showed a positive influence, although other macroeconomic variables were not statistically significant. The model obtained an adjusted R^2 of 93.9%, highlighting its explanatory power, although factors such as inflation and foreign direct investment were not determinant, possibly due to the regional context and local economic structure. Limitations such as a 12-year observation period and the exclusion of variables such as educational level or gender were noted. In conclusion, the minimum wage is a key tool to encourage labour participation, but its effectiveness is conditional on the balance with economic growth, recommending sustainable wage policies, promotion of regional development and broader and longitudinal studies to better understand labour dynamics.

Keywords. Minimum wage, economically active population, GDP, labour participation and labour market

Introduction:

The relationship between wages and the participation of economically active people (EAP) is a crucial issue in labour economics studies, as it directly affects economic growth and social equity. In Sinaloa, a region characterised by its agricultural and industrial dependence, this relationship takes on a particular dimension, marked by fluctuations in the minimum wage, labour market conditions and the local productive structure. Recent studies have highlighted that wages are one of the main determinants of workers' decisions to enter or remain in the labour market (Fields, 2017; Card & Krueger, 2020).

Classical economic theory suggests that an increase in wages can stimulate labour supply by making work more attractive, especially in vulnerable sectors (Borjas, 2020). However, this effect may vary depending on market characteristics, such as labour flexibility

and the educational level of the working population (Hamermesh, 2019). In the case of Sinaloa, previous studies have analysed the impact of wages in agriculture, one of the main sectors of the local economy, finding that wage increases can influence labour migration to other sectors or even abroad (Gómez et al., 2021).

On the other hand, labour supply elasticity in response to wage changes is influenced by factors such as informality, the gender gap and government policies (Fernández & García, 2018). In Mexico, the dual structure of the labour market, where a formal and an informal sector coexist, presents unique challenges for understanding how wages affect labour participation (Levy, 2018). In this sense, Sinaloa is no exception, as a significant part of its labour force operates informally, which may alter the traditional relationship between wage and market participation (Cabrera et al., 2019).

In addition, fluctuations in the minimum wage have generated debate about its effectiveness in improving workers' quality of life and fostering labour market inclusion. According to Rivera and Sánchez (2020), recent increases in the minimum wage have had a positive impact on household disposable income, but their effect on labour participation is not always linear. This phenomenon could be explained by the interaction between the minimum wage and costs associated with employment, such as transport and training (Martínez et al., 2022).

In regional terms, Sinaloa has specific demographic and economic characteristics that shape the relationship between wages and EAP. The rural population, for example, may show greater sensitivity to wage changes due to its dependence on seasonal agricultural activities (Vargas & Pérez, 2021). In contrast, urban areas in Sinaloa, with greater economic diversification, may experience more moderate labour supply responses (Flores & Castillo, 2023).

The impact of wages is also mediated by education and gender. Women face additional barriers to labour market participation, such as lack of access to childcare and the persistence of cultural norms that restrict their participation (Pérez & González, 2021). According to studies by López et al. (2020), wage increase policies can incentivise greater inclusion of women in the labour force, but their effects are conditioned by other structural factors.

Another crucial element is the interaction between wage policies and corporate strategies. According to Jiménez and Rodríguez (2019), firms may respond to wage increases by optimising their production processes or by reducing their labour demand, which in turn may affect the composition of the EAP. In Sinaloa, sectors such as agriculture and manufacturing have shown dynamics in response to changes in the minimum wage, notably a reduction in informal employment in certain areas, but also a slowdown in the generation of new formal jobs (López & Hernández, 2020).

In addition, macroeconomic trends, such as inflation and economic growth, play a key role in the relationship between wages and labour participation. According to the National Minimum Wage Commission (2023), increases in the minimum wage must be carefully balanced to avoid negative effects on inflation and to maintain a favourable environment for job creation. In the case of Sinaloa, where the economy is linked to national and international dynamics, these factors have a significant impact on EAP participation (Gómez et al., 2021).

This study seeks to analyse how wage variations have influenced EAP participation in Sinaloa during the period 2012-2023, using an econometric approach to identify significant patterns and relationships. Through a comprehensive analysis, it aims to contribute to the debate on wage policies and their effectiveness in promoting labour welfare and economic inclusion, especially in regional contexts with heterogeneous characteristics.

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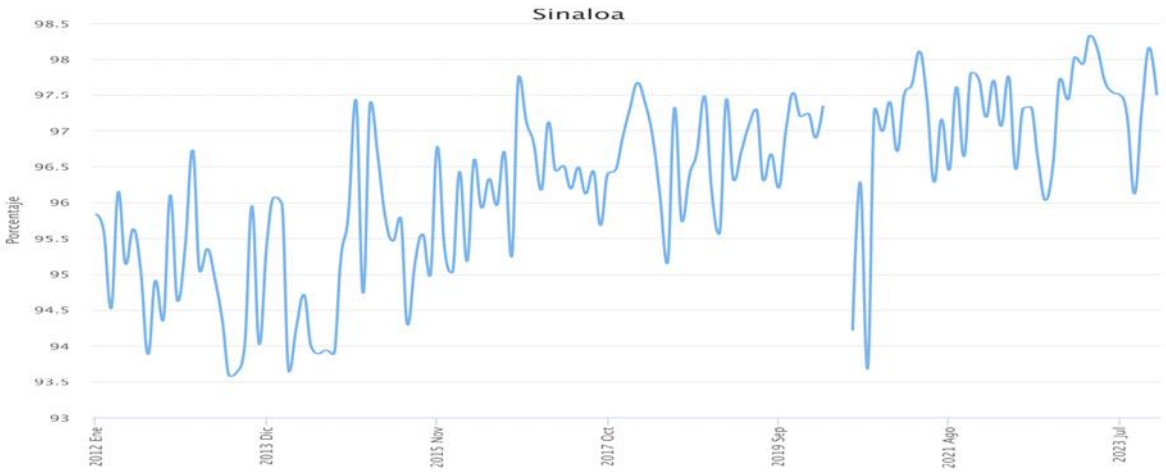
Materials and Methods:

The present study focuses on analysing the impact of the minimum wage on the participation of the economically active population (EAP) in Sinaloa during the period 2012-2023. To meet this objective, a methodological framework was designed using quantitative and econometric tools, based on a correlational and explanatory approach. The key features of the research process are described below.

In which we can visualise the behaviour of the following variables involved in this study in the state of Sinaloa during the period 2012 to 2023.

Economically Active Population (EAP)

The behaviour of the Economically Active Population (EAP) rate in Sinaloa between 2012 and 2023 shows a general upward trend, with minor variations in some years. In 2012, the rate was 95.15%, starting a slight decrease in 2013 and 2014, reaching a minimum of 94.90% in 2014. From 2015 onwards, a steady increase is observed, with some moderate fluctuations.



Source: INEGI

Minimum wage

The behaviour of the minimum wage between 2012 and 2023 shows a general upward trend, with gradual increases during the first years and steeper increases from 2018 onwards.

In 2012, the minimum wage was 105.3, with slight increases in the following years, reaching 111.1 in 2016 and 116.3 in 2017. This period reflects relative stability, with modest wage adjustments, possibly associated with inflation or conservative economic policies.

From 2018 onwards, a significant change in the dynamics of increases can be observed. The minimum wage rose from 121.6 in 2018 to 135.4 in 2019, marking a sharper increase. This growth continued to accelerate in the following years, reaching 157.4 in 2020, 174.9 in 2021 and reaching 199.3 in 2022. Finally, in 2023, the minimum wage reached its highest level in the period, at 207.44.

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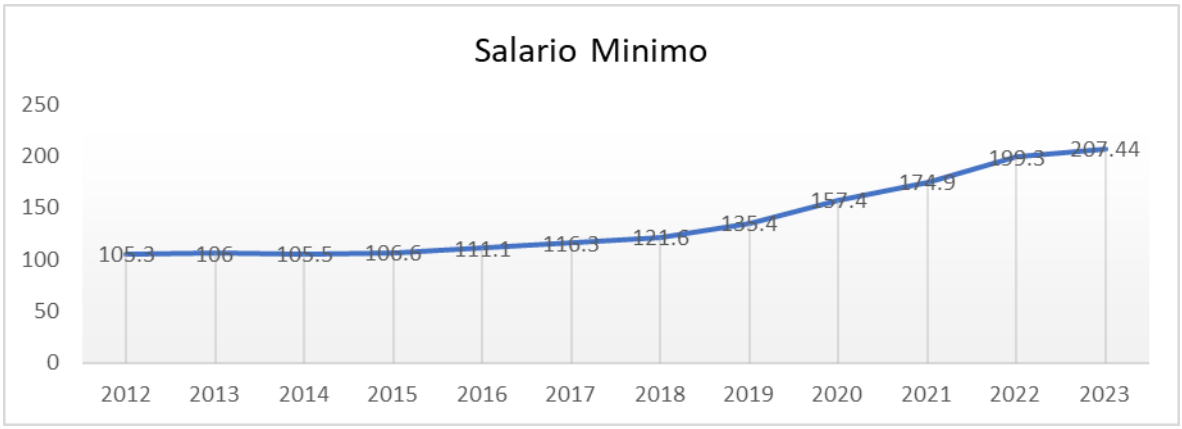
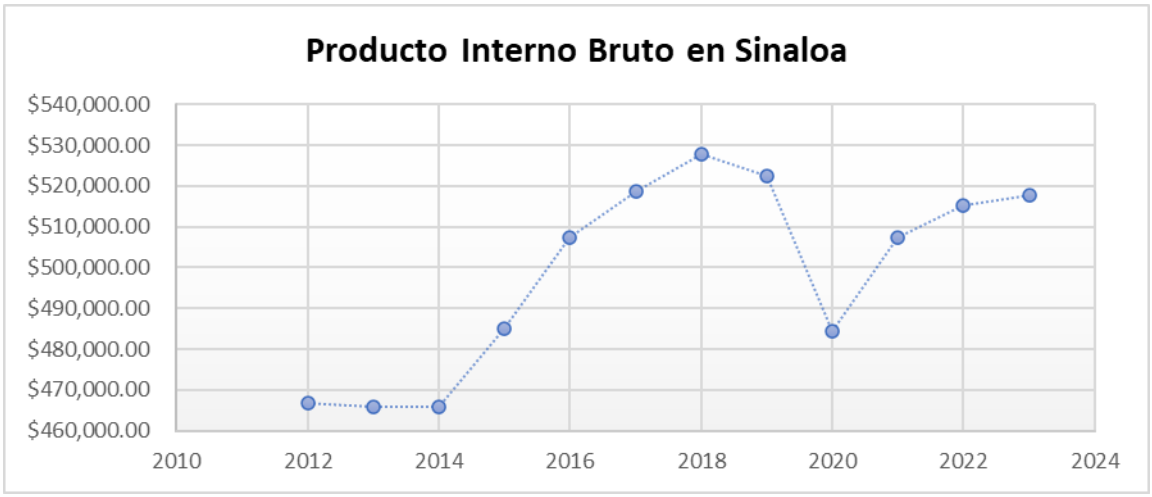


Source: CONASAMI
Own elaboration.

Gross Domestic Product

The behaviour of the Gross Domestic Product (GDP) of the state of Sinaloa between 2012 and 2023 shows a general trend of growth, although with some fluctuations throughout the period.

Between 2012 and 2014, GDP remained practically stable, with a slight decrease from $466,781.78 million in 2012 to $465,691.05 million in 2014. From 2015 onwards, GDP recorded significant growth, reaching $485,181.19 million. This increase continued in the following years, with a peak of $527,714.06 million in 2018, reflecting economic expansion in the state.



Source: INEGI
Own elaboration.

Cumulative Annual Inflation

The behaviour of annual inflation between 2012 and 2023 shows significant variations, reflecting periods of moderate stability and episodes of high inflation.

In the first years, from 2012 to 2016, inflation remained relatively subdued, fluctuating between a low of 2.13 in 2015 and a high of 4.08 in 2014.

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In 2017, inflation reached a significant peak of 6.77. Although in 2018 there was a slight moderation to 4.83, in 2019 it declined again to 2.26, indicating a period of inflationary control.

However, in 2020 and the following years, inflation began to pick up again. In 2021, a considerable increase to 7.36 was recorded, reaching its highest level in 2022 at 7.82. In 2023, inflation declined to 4.66, indicating an effort to stabilise prices.

Source: INEGI
Own Elaboration

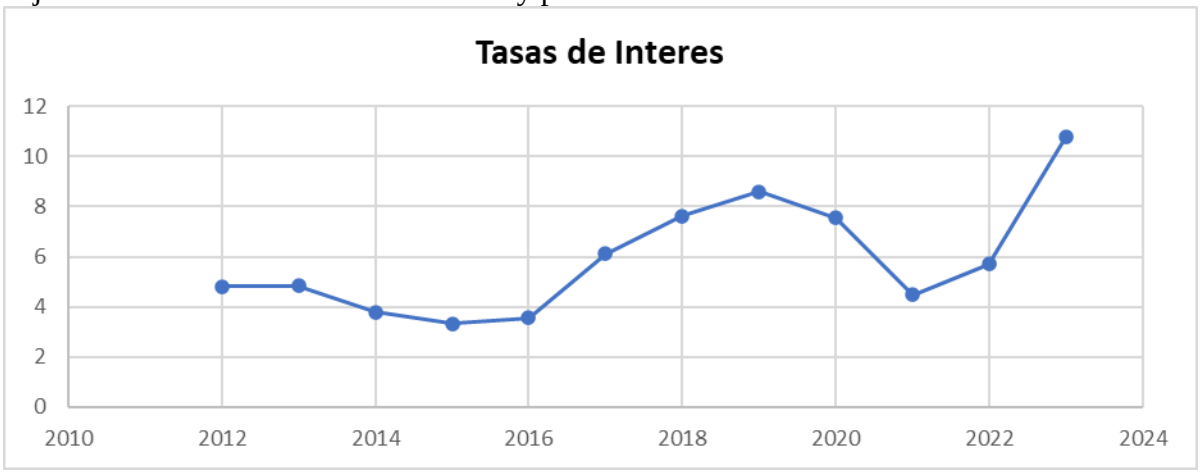
Interest rates

Interest rate behaviour in the period from 2012 to 2023 shows significant fluctuations, reflecting different economic cycles and monetary policy adjustments.

Between 2012 and 2016, interest rates remained relatively low and stable, ranging from a low of 3.32 in 2015 to a high of 4.85 in 2013.

From 2017 onwards, a shift towards a steady increase in rates can be observed. In 2017, the rate rose to 6.11, followed by a steep increase in 2018 and 2019, peaking at 8.59 in the latter year.

In 2020, rates decreased slightly to 7.55 to support economic activity. However, in 2021 they were reduced sharply to 4.48, marking a more accommodative monetary policy. Subsequently, in 2022 and 2023, rates rose again, reaching a peak of 10.77 in 2023, reflecting a tightening adjustment to combat overall inflationary pressures.



Source: Banco de Mexico
Own elaboration

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Foreign Direct Investment

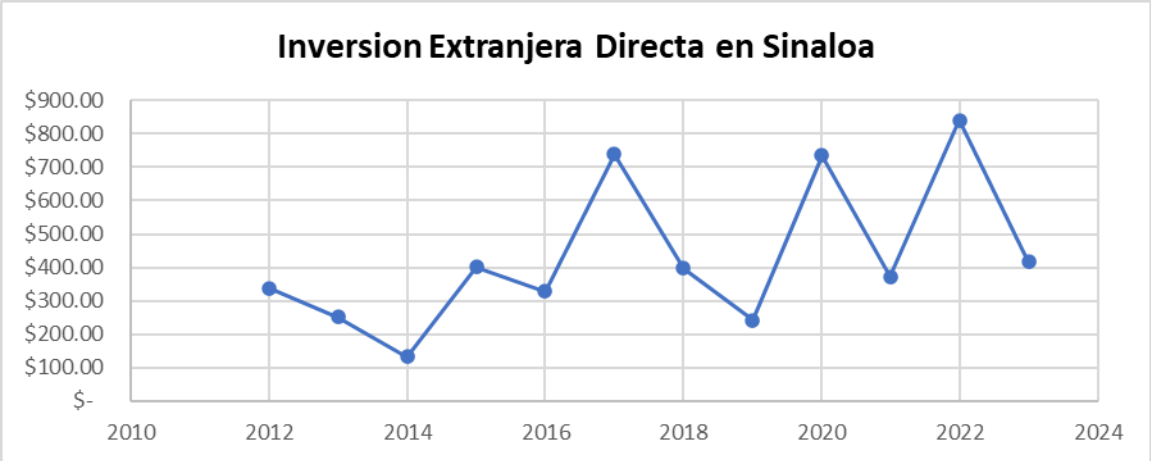
The behaviour of Foreign Direct Investment (FDI) in Sinaloa between 2012 and 2023 shows a high variability in the attraction of foreign capital.

In the first years of the period, FDI registered moderate fluctuations. In 2012, it reached $338.98 million, decreasing to $252.51 million in 2013 and falling significantly to $133.44 million in 2014. However, 2015 saw a recovery with $402.30 million, although in 2016 it dropped again to $328.98 million.

2017 marked a significant peak, reaching $739.13 million. This trend did not continue in the following years, as in 2018 and 2019 the investment fell to $397.12 million and $243.09 million, respectively.

In 2020, at the height of the pandemic, FDI was surprised by recovering significantly to $734.94 million. This was followed by an all-time high of $839.73 million in 2022, before declining to $416.55 million in 2023.

Overall, FDI in Sinaloa reflects an oscillating trend, influenced by external and local factors, showing boom and bust moments in different years.



Source: Banco de Mexico
Own elaboration

Type of study

The focus of this study is quantitative, due to the need to establish statistical relationships between the minimum wage and the EAP participation rate. It is a correlational study because it analyses the association between the variables, and explanatory because it aims to identify how the minimum wage influences people's decision to participate in the labour market.

Variables

1.- **Dependent Variable:**

- Participation rate of the economically active population (EAP).

2.- **Independent Variable:**

- Minimum wage.

3.- **Control Variables**:

- Gross Domestic Product (GDP).
- Annual cumulative inflation.
- Interest rates.

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- Foreign direct investment (FDI).

Data Sources

The analysis was based on secondary data collected from reliable and relevant sources, such as:

- Annual reports of the National Institute of Statistics and Geography (INEGI).
- Reports of the National Commission on Minimum Wages.
- Economic indicators from Banco de México and other national financial institutions.
- Macroeconomic studies are available in government and academic databases.

The selection of a 12-year period, from 2012 to 2023, allowed us to identify long-term trends in the variables considered.

Methodology

Data Collection:

Historical data on minimum wage, EAP participation rate and control variables were collected. Priority was given to uniformity in units of measurement and accuracy of data.

Econometric model:

An ordinary least squares (OLS) linear regression model, widely used in quantitative analysis, was developed. The general equation of the model was:

EAP=β0+β1(MinimumWage)+β2(GDP)+β3(Inflation)+β4(InterestRates)+β5(FDI)+ϵEAP=β0+β1(Minimum Wage)+β2(GDP)+β3(Inflation)+β4(Interest Rates)+β5(FDI)+ϵ

Where:

- β0β0 is the constant term.
- β1...β5β1...β5 are the coefficients associated with the independent and control variables.
- ϵϵ represents the error term.

1.- **Statistical Analysis:**

- Model coefficients were evaluated using t-tests and p-values to determine their statistical significance.
- Model adjustment was measured using R-squared and adjusted R-squared.
- Diagnostic tests such as Durbin-Watson were applied to check for autocorrelation problems.

2**.- Software:**

EViews 12 was employed to perform the econometric calculations and corresponding statistical tests.

Ethical Considerations

Only publicly available information was used, and ethical standards were respected in the analysis and presentation of results. No personal or confidential data was handled.

Limitations of the Study

- The analysis uses annual data, which may not capture seasonal variations in the behaviour of variables.

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- The results focus on the Sinaloa context and may not be applicable to other regions with different economic structures.

This methodological approach ensures the necessary rigour to understand the dynamics between minimum wage and EAP participation in a specific regional context.

Results

The econometric analysis conducted to measure the impact of the minimum wage on the economically active population (EAP) rate in Sinaloa, over the period 2012-2023, yielded the following key results:

Dependent Variable: TASA_DE_POBLACION_ECONOMICAMENTE_ACTIVA_EN_SINALOA
Method: Least Squares
Date: 11/24/24 Time: 23:40
Sample: 2012 2023
Included observations: 12

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	81.75015	1.766283	46.28373	0.0000
SALARIO_MINIMO	0.014736	0.002909	5.066318	0.0023
PRODUCTO_INTERNO_BRUTO	2.59E-05	3.92E-06	6.616697	0.0006
INFLACION_ANUAL	-0.052166	0.053536	-0.974404	0.3675
TASAS_DE_INTERES	-0.033973	0.046887	-0.724573	0.4960
INVESION_EXTRANJERA_DIRECTA_EN	-2.93E-05	0.000385	-0.076001	0.9419

R-squared	0.966512	Mean dependent var	96.25431
Adjusted R-squared	0.938605	S.D. dependent var	0.925915
S.E. of regression	0.229423	Akaike info criterion	0.200353
Sum squared resid	0.315809	Schwarz criterion	0.442806
Log likelihood	4.797884	Hannan-Quinn criter.	0.110588
F-statistic	34.63370	Durbin-Watson stat	2.360302
Prob(F-statistic)	0.000237		

1.- **Relationship between variables:**

- **Minimum wage** presented a positive (0.0147) and highly significant (p = 0.0023) coefficient, indicating that an increase in the minimum wage is associated with an increase in the EAP rate.
- **Gross Domestic Product (GDP)** also showed a positive and significant relationship (coefficient = 2.59E-05, p = 0.0006), suggesting that a growing economy encourages labour market participation.
- Control variables, such as **annual inflation**, **interest rate**, and **foreign direct investment**, did not show statistically significant relationships with EAP in this model.

2. **Quality of the model**:

- The adjusted coefficient of determination (R2R2) is 0.939, indicating that 93.9% of the variation in the EAP rate can be explained by the variables included in the model.
- The FF test (p = 0.0002) validates the joint significance of the independent variables.

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3. **Standard errors**:
   - The low standard deviation of the dependent variable (0.9259) reflects a controlled and accurate distribution of the data.

Discussion of Results

The results suggest that the minimum wage is a determining factor in the labour participation of the economically active population in Sinaloa. Its positive impact is in line with economic theories that indicate that a more attractive wage incentivizes people to enter or remain in the labour market.

Relationship with Control Variables:

GDP: Its positive influence reinforces the idea that a prosperous economy generates jobs and motivates people to participate in the labour market.

Annual inflation and interest rates: Although these variables are relevant in other research, they were not significant in this study, possibly due to the low volatility of the period analysed.

Foreign direct investment: Its lack of significance may be due to its low representativeness in sectors that absorb a large amount of local employment, such as agriculture or manufacturing.

Comparison with previous studies:

These results are consistent with research pointing to the ability of the minimum wage to reduce informality and increase labour participation, if it remains within economically sustainable limits. However, no significant influence of macroeconomic factors such as inflation or interest rates was observed, suggesting a particular context for Sinaloa.

Limitations:

- The observation period of 12 years may be insufficient to capture significant long-term variations.
- The exclusion of other relevant variables, such as education or social policies, may limit the scope of the conclusions.

Conclusions

1. The minimum wage has a positive and significant impact on the rate of economically active population in Sinaloa, which positions it as a key tool to encourage labour participation.
2. Economic growth, reflected in GDP, also plays a crucial role in the activation of the labour market.
3. Macroeconomic factors such as inflation, interest rates and foreign direct investment did not show a significant relationship with EAP in this analysis.

Recommendations

1. **Strengthen wage policies:**

Promote gradual and sustainable wage adjustments that incentivise labour participation without generating excessive inflationary pressures.

2. **Foster regional economic growth:**

Boost key sectors, such as agriculture and industry, to act as engines of employment and improve workers' quality of life.

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3. **Broaden the scope of the analysis:**
Incorporate additional variables, such as educational attainment, gender and social policies, to enrich the understanding of factors influencing labour participation.

4. **Design differential strategies:**
Consider the particularities of Sinaloa's labour market, such as high informality and agricultural dependence, when formulating labour policies.

5. **Encourage longitudinal research:**
Conduct analyses over longer periods to capture long-term dynamics and assess the effects of wage policies in different business cycles.

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