Limitations of Unit Root Tests: A Mexican Case Study

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Why Rethink Unit Root Tests?

Field of Study

Intersection of time series econometrics and the Mexican labor market dynamics.

Crucial Importance

Unit root tests are the foundation for ARIMA modeling, cointegration analysis, and forecasting accuracy.

The Gap

Empirical evidence reveals significant interpretation conflicts within Mexican data series.

Objective & Hypothesis

Objective

To evaluate the limitations of **ADF, PP, and KPSS** tests when applied to Mexican labor market variables.

Hypothesis

Results reflect **statistical properties** rather than economic realities, leading to potential policy misinterpretations.

Research Question

"Are standard tests reliable for analyzing the Mexican labor market?"

Evolution of Unit Root Tests

1974
Granger & Newbold
Spurious Regressions

1981
Dickey & Fuller
ADF Test Introduced

1988
Phillips & Perron
PP Test (Non-parametric)

1992
Kwiatkowski et al.
KPSS (Stationarity Null)

2025
This work
Mexican Labor Analysis

Methodology Overview

Data Sources (2005 - 2025)

Variable	Frequency	Source
Unemployment Rate	Quarterly	INEGI-ENOE
Labor Informality	Quarterly	INEGI-ENOE
Participation Rate	Quarterly	INEGI-ENOE
Underemployment	Quarterly	INEGI-ENOE

Test Specifications

Tests Applied

ADF PP KPSS

Configurations

- Software: Stata 18
- With Intercept
- Without Trend

Methodology Overview

Optimised Computational Implementation (Stata)

1. Definition of Time Structuretsset quarters

2. Selection of Lags (Information Criteria)

```
varsoc part   // Example for Participation Rate
```

3. Execution of Level Tests (With auxiliary regression)
   * H0: Unit Root (Non-Stationary Series)

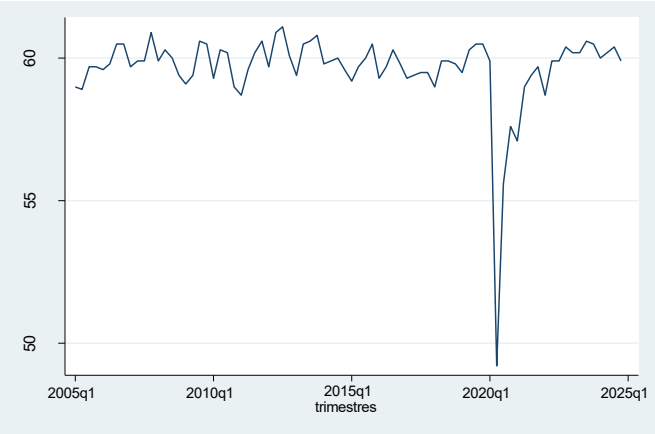
```
dfuller part, lags(4) regress
pperron part, lags(4) regress
kpss part
```

4. Tests on First Differences (D. Operator)
   * The “D.” operator calculates the difference automatically

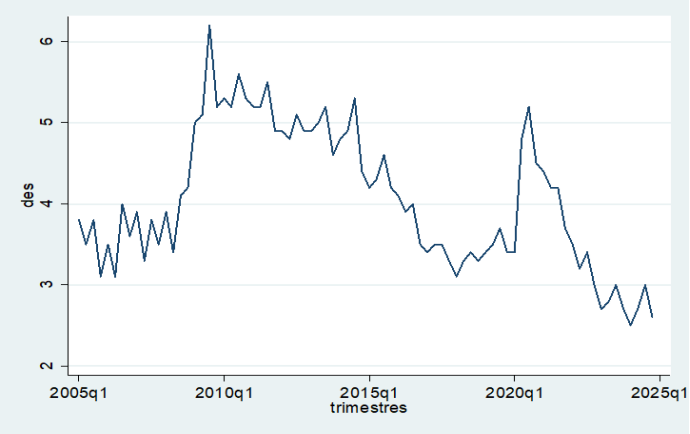
```
dfuller D.part, lags(4) regress
pperron D.part, lags(4) regress
```

Results

1- Labour participation rate (PART) in Mexico, 2005–2024



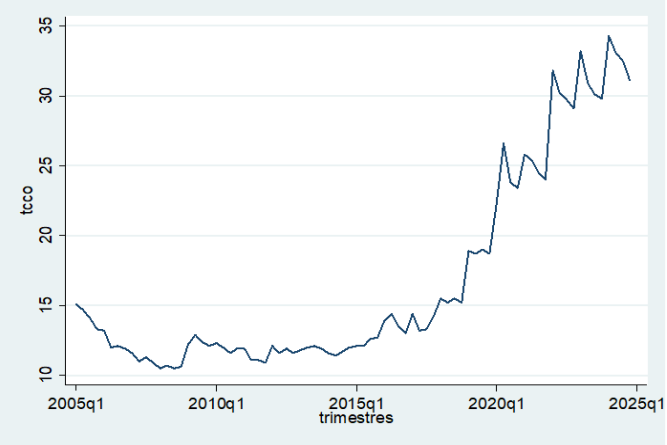
2- Unemployment rate (DES) in Mexico, 2005–2024



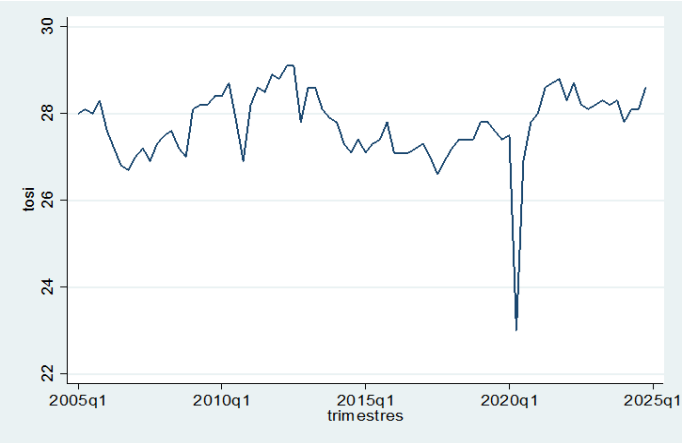
- **Graph 1:**
  - General Behaviour: The series shows relatively stable behaviour over time.
  - The Exception (Shock): There is a clear break in the second quarter of 2020, corresponding to the start of the COVID-19 pandemic. Outside this period, the variable tends to remain constant.
- **Graph 2:**
  - Range of Fluctuation: For most of the period (2005–2024), the rate fluctuated within a defined range between 3% and 6%.
  - Observed Deviations:
    - 2009: Exceeded 6% due to the effects of the 2008 financial crisis.
    - End of 2023: Fell below 3% in the last four months.
  - Although visually the variance may appear to be non-constant at first glance, the text argues that the reality is stable, as the total range of the series (2% to 7%) is narrow.

Results

4- Critical occupancy rate (CCR) in Mexico, 2005–2024.



5- Occupation rate in the informal sector (ORIS) in Mexico, 2005–2024



- **Graph 4:**
  - Differentiated Trend: Unlike the other variables, this series shows a clear upward trend, especially noticeable after 2020.
  - The health crisis accentuated this trend, but growth was already evident in previous periods. Visually, it is the variable that least resembles a stationary process (I(0)) due to this continuous positive slope.
- **Graph 5:**
  - Range: The variable shows stable behaviour, generally fluctuating between 26% and 30%.
  - Shock: Like the others, it shows a notable exception in the second quarter of 2020 due to the pandemic.

- We also have data on the underemployment rate (SUB), which behaves similarly to graph 01, with consistency, but between the first and second quarters of 2020, there was a jump from 9% to 25.4% and the labour informality rate (LIR) in Mexico, 2005-2024 with stable trajectories, varying between 26% and 30%, with the exception of 2020. Effects caused by the COVID-19 crisis.

Results

Pruebas de raíces unitarias en niveles
(Unit root tests at levels)

		Con deriva y sin tendencia *(Drifting and without direction)*		
		DFA	PP	KPSS
PART	Estadístico	-3.236	-46.914	0.0794
	Valor crítico	-3.545*	-19.422*	0.216*
DES	Estadístico	-1.906	-6.736	0.28
	Valor crítico	-3.545*	-19.422*	0.216*
SUB	Estadístico	-2.923	-29.184	0.0648
	Valor crítico	-3.545*	-19.422*	0.216*
CCR	Estadístico	0.736	0.948	0.493
	Valor crítico	-3.545*	-19.422*	0.216*
ORIS	Estadístico	-2.797	-37.345	0.14
	Valor crítico	-3.545*	-19.422*	0.119**
LIR	Estadístico	-0.81	-4.561	0.14
	Valor crítico	-3.545*	-19.422*	0.119**

Note: p<0.1*** p<0.05** p<0.01*
Fuente: elaboración propia en Stata

- This is the most critical part of the study, as it demonstrates the inconsistency between the different tests and economic intuition.Configuration: The tests were run with drift (intercept), but without deterministic trend.
- **Results by Test:**
  - **1. DFA (Augmented Dickey-Fuller):**
    - Result: The test indicated that all six variables are non-stationary (have a unit root). In all cases, the statistical value of the test (e.g., -3.236 for PART) was lower (in absolute value) than the critical value (-3.545), failing to reject the null hypothesis of non-stationarity.
  - **2. PP (Phillips-Perron):**
    - Mixed result: Unlike the DFA, the PP test indicated that three variables (PART, SUB, ORIS) are stationary I(0), as it rejected the null hypothesis.
    - Contradiction: The other three (DES, CCR, LIR) continued to be identified as non-stationary.
  - **3. KPSS:**
    - Inverse Logic: In this test, the null hypothesis is stationarity.
    - Result: It indicated that the unemployment rate (DES) and critical conditions (CCR) are stationary (I(0)), partially contradicting the previous results.
- There is a clear lack of agreement between the tests. The DFA is the most ‘pessimistic’ (suggesting that nothing is stable), while the PP and KPSS capture some stationarity, proving that the choice of test drastically alters the economic conclusion.

Results

Pruebas de raíces unitarias en primeras diferencias
(Unit root tests in first differences)

		Con deriva y sin tendencia *(With drift and no trend)*		
		DFA	PP	KPSS
PART	Estadístico	-5.396	-83.29	0.0288
	Valor crítico	-3.546*	-19.404*	0.216*
DES	Estadístico	-3.568	-103.969	0.0582
	Valor crítico	-3.546*	-19.404*	0.216*
SUB	Estadístico	-4.224	-89.713	0.036
	Valor crítico	-3.546*	-19.404*	0.216*
CCR	Estadístico	-3.109	-82.136	0.0895
	Valor crítico	-2.911**	-19.404*	0.216*
ORIS	Estadístico	-5.179	-90.174	0.0322
	Valor crítico	-3.546*	-19.404*	0.216*
LIR	Estadístico	-5.148	-88.729	0.0336
	Valor crítico	-3.546*	-19.404*	0.216*

Note: p<0.1*** p<0.05** p<0.01*
Fuente: elaboración propia en Stata

- **Unit Root Tests in First Differences**
  - This table serves to confirm the order of integration and ensure that the series are not 'explosive'.
  - **Procedure:** The first difference was applied to all variables.
  - **Unanimous Result:**
    - At this stage, all tests (DFA, PP, and KPSS) agreed.
    - All test statistics greatly exceeded the critical values (e.g., des in PP was -6.736 at level to -103.969 in difference).
  - This confirms that, statistically, the variables behave as I(1) (Integrated of Order 1). That is, they become stationary after differentiation.

Empirical Results Summary

Contradiction in Unemployment

PP test rejects unit root (stationary), while KPSS indicates non-stationarity. A direct conflict.

Overall Divergence

Conclusions diverge in **2 out of 4** variables analyzed, creating uncertainty.

High Sensitivity

Results are extremely sensitive to the inclusion of drift or trend parameters.

Contributions & Conclusions

- Tests often treat statistical symptoms, not economic causes.
- We established a critical framework for applying ADF, PP, and KPSS in Mexico.
- Extreme caution is recommended when interpreting stationarity in labor series.

Future Research Directions

Structural Breaks

Implement Zivot-Andrews tests to account for endogenous breaks.

Bayesian Approaches

Explore Bayesian VAR models that allow for partial non-stationarity.

Regional Expansion

Extend analysis to regional GDP and wage heterogeneity.

Theory Integration

Better integration of economic theory in the test selection process.

Thank you!

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