



# **NAIRU and Informality in the Mexican Labor Market**

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# Introduction: NAIRU

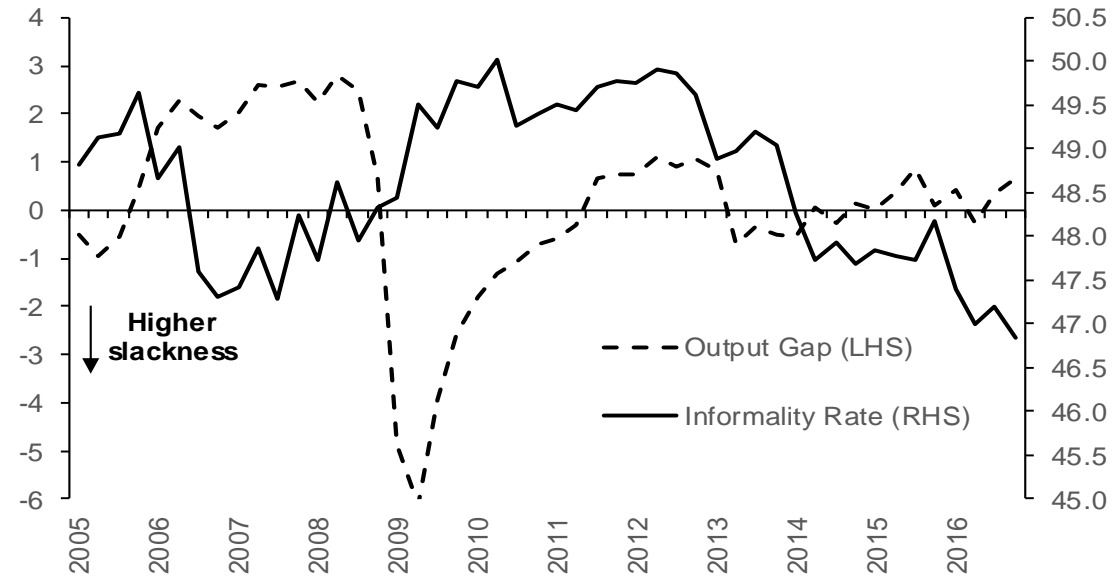
- The reading of the economic cycle is essential to the conduction of monetary policy.
- Economic indicators such as the gross domestic product and unemployment can help to assess the current stage of the economic cycle.
- One important topic in monetary policy focuses on whether unemployment is approaching its trend potential, i.e., the rate of unemployment at which inflation remains constant in the absence of supply shocks.
- This rate is called **non-accelerating inflation rate of unemployment (NAIRU)**.
- However, the estimation of the NAIRU is complicated because it is not directly observable and could vary over time.
  - *In general terms, the NAIRU may present variations due to structural changes in the fundamental factors affecting labor supply and demand.*
- In Mexico the presence of a sizeable number of informal workers imposes an additional challenge to estimation of the NAIRU.

# Introduction: Informality in the Mexican economy

- There is evidence that informal labor is more flexible in relative terms to the formal labor (Alcaraz, 2009)
- **This has implications for the cyclical adjustment of the labor markets.**
  - ✓ *For example, during recessions, the wage flexibility in the informal labor market allows to absorb more individuals who do not find formal employment.*
  - ✓ *Thus, informal sector absorbs workers who would potentially be unemployed (**informality rate is countercyclical**).*
- Given these particular characteristics of the Mexican labor market, **it is possible that unemployment rate in Mexico does not fully reflect the labor market slack.**
  - ***We propose a new indicator of labor market underutilization** that includes a measure of informality in the labor market by adding unemployed workers and informal wage earners.*

# Introduction: Informal labor and Economic cycle

Figure 1. Informality rate and Output Gap<sup>1/</sup>,<sup>2/</sup>  
%



1/ The output gap is shown as a percentage of potential GDP.

2/ We calculate informality in urban areas with a population larger than 15,000.

Source: Authors' calculations with ENOE, INEGI.

# Introduction: Econometric Methodology

- We estimate the NAIRU over time using both the **traditional unemployment rate ( $u_t$ )** and the augmented **unemployment rate that takes into account informality ( $u - extended_t$ )**.
- We estimate **NAIRU** and **NAIRU-inf** from equations that model inflation dynamics based on the Phillips curve.
  1. **Recursive estimations** in which the NAIRU is deterministic (estimated from a Phillips curve that is assumed to vary over time).
  2. **State-space specifications** that allow for more flexibility in the dynamic properties of the NAIRU.
    - i. *Phillips curve in which the NAIRU follows a random walk,*
    - ii. *Phillips curve in which the NAIRU follows a random walk and the unemployment gap follows an AR(2) process, and*
    - iii. *Phillips curve in which the NAIRU follows a random walk and the unemployment gap depends on the output gap (Okun's law).*

# Introduction: Results

- The labor market slack measured with both indicators of labor underutilization showed similar cyclical trends.
  - **However, in some particular periods we found subtle differences:**
    - ✓ *Slack in the labor market using the alternative indicator ( $u - extended_t$ ) anticipated better the inflationary pressures observed in 2007–2008.*
    - ✓ *During 2016,  $u - extended_t$  showed a greater degree of slack than the traditional  $u_t$ , which is consistent with the absence of considerable wage pressures observed during this period.*
- So, we conclude that taking into account informal employment when measuring labor market slack is relevant, and **can complement** the analysis of the economic cycle.
- In countries with a large informal labor, such as Mexico and other Latin American countries, **this new measure can be a useful tool for monetary policy analysis.**

# Presentation outline

- I. Modelling Inflation Dynamics and the NAIRU in Mexico
  - a. NAIRU and Econometric Methodology
  - b. Data
- II. Results
  - a. Time-Varying NAIRU
  - b. The Mexican Labor Market along the Economic Cycle
- III. Final Remarks

# Econometric Methodology

- The conceptual framework for estimating the NAIRU is based on the Phillips curve, which establishes a negative link between inflation and the unemployment-gap in the short run:

$$\pi_t = \pi_t^e + \beta(u_t - \bar{u}) + \delta X_t$$

- ✓  $\pi_t$  is the inflation rate and  $\pi_t^e$  is the expected inflation rate;
  - ✓  $(u_t - \bar{u})$  is the unemployment gap, defined as the difference between the observed unemployment rate ( $u_t$ ) and the NAIRU ( $\bar{u}$ ); and
  - ✓  $X_t$  represents a vector of variables controlling for the presence of supply shocks
- To estimate the model it is possible to generalize this relationship and, following Staiger, Stock and Watson (1997a and 1997b), we use the following empirical model to estimate inflation dynamics:

$$\Delta\pi_t = \beta(u_t - \bar{u}) + \gamma(L)\Delta\pi_{t-1} + \delta(L)X_t + \varepsilon_t \quad (1)$$

- ✓  $\Delta = 1-L$ ,  $L$  is the lag operator;
- ✓  $\beta(L)$ ,  $\gamma(L)$  y  $\delta(L)$  are lag polynomials; and
- ✓  $\varepsilon_t$  is an error term.

# Econometric Methodology

- In order to estimate the NAIRU we use two reduced-form approaches used widely in the literature.

## I. NAIRU Recursive Estimation

- Consider the version of equation (1) that models the NAIRU as a constant:

$$\begin{aligned} \beta(u_t - \bar{u}) &= \alpha + \beta(u_t), \text{ i.e. } \alpha = -\beta(\bar{u}) \\ \Delta\pi_t &= \alpha + \beta(u_t) + \gamma(L)\Delta\pi_{t-1} + \delta(L)X_t + \varepsilon_t \end{aligned} \quad (2)$$

if  $\hat{\alpha}$  and  $\hat{\beta}$  are the OLS estimators, the **NAIRU** estimate is:  $\hat{u} = -\hat{\alpha}/\hat{\beta}$

- To estimate a time varying NAIRU we computed the NAIRU's path through a recursive estimation of equation (2) as follows -leaving the sample's starting point fixed-

$$\hat{u}_t = -\hat{\alpha}_t/\hat{\beta}_t$$

# Econometric Methodology

- ii. **State-space specifications.** We modelled the NAIRU as an unobserved stochastic process, where we assumed that its determinants are unknown but persistent (i.e. they follow a random walk).
- 1. **NAIRU Random Walk.** As in Gordon (1997), the evolution of the NAIRU is obtained from the following system of equations:

$$\begin{aligned}\Delta\pi_t &= \beta(u_t - \bar{u}_t) + \gamma(L)\Delta\pi_{t-1} + \delta(L)X_t + \varepsilon_t \\ \bar{u}_t &= \bar{u}_{t-1} + e_t\end{aligned}\tag{3}$$

where errors are assumed to be i.i.d.  $N(0, \sigma_\varepsilon^2)$  and uncorrelated.

- 2. **NAIRU Random Walk and AR(2) Unemployment Gap:** In addition to assuming a random-walk NAIRU, this methodology models the dynamics of the unemployment gap  $(u_t - \bar{u}_t)$  following Laubach (2001).

$$\begin{aligned}\Delta\pi_t &= \beta(u_t - \bar{u}_t) + \gamma(L)\Delta\pi_{t-1} + \delta(L)X_t + \varepsilon_t \\ \bar{u}_t &= \bar{u}_{t-1} + e_t \\ (u_t - \bar{u}_t) &= \rho_1(u_{t-1} - \bar{u}_{t-1}) + \rho_2(u_{t-2} - \bar{u}_{t-2}) + \epsilon_t\end{aligned}\tag{4}$$

where  $\rho_1$  y  $\rho_2$  are parameters to be estimated, and the errors are assumed  $N(0, \sigma_i^2)$  and uncorrelated, with  $i = e, \epsilon$ .

# Econometric Methodology

3. **NAIRU Random Walk and Unemployment Gap (Okun's Law).** We include an equation relating the unemployment gap to the output gap (Okun's Law).

$$\Delta\pi_t = \beta(u_t - \bar{u}_t) + \gamma(L)\Delta\pi_{t-1} + \delta(L)X_t + \varepsilon_t$$

$$\bar{u}_t = \bar{u}_{t-1} + e_t$$

$$(u_t - \bar{u}_t) = \varphi_t y_t^{gap} + \epsilon_t \tag{5}$$

$$\varphi_t = \varphi_{t-1} + r_t$$

where  $\varphi_t$  is the time-varying Okun coefficient, modeled as a random walk, and errors are assumed to be  $N(0, \sigma_i^2)$  and uncorrelated, with  $i = \varepsilon, \epsilon, r$ .

- In this specification, we considered the output gap as an exogenous variable within the model, and estimated it using the Hodrick-Prescott (HP) filter with a tail correction method.
- All these are standard models for a stochastic parameters that changes over time and can be estimated by Maximum Likelihood (or Bayesian methods) and the Kalman Filter.

# Estimating NAIRU and NAIRU-inf: DATA

- Sample: January 2005 to December 2016
- Monthly seasonally-adjusted data
- $\pi_t$ : Core Inflation calculated as the annual change in the CPI
- Informal labor data is obtained from the Mexican Labor Survey (ENOE) (micro data)
- Urban workers
- $X_t$ : variables we consider to control for supply shocks
  - ✓ *Real effective exchange rate index for Mexico (BIS)*
  - ✓ *Import price index (Banco de México)*
  - ✓ *Oil price in U.S. dollars per barrel (West Texas Intermediate and Mexican mix)*
  - ✓ *U.S. CPI, and*
  - ✓ *Mexican CPI's telecommunications component*
- We subtract the mean from  $X_t$  in order to induce a zero-mean sample, avoiding bias from the constant component (**on average supply shocks are zero**) in the specifications for inflation dynamics.

# Estimating NAIRU and NAIRU-inf: DATA

- $u_t$ : Unemployed rate (traditional)

$$u_t = \frac{Unemp_t}{EAP_t} * 100$$

$Unemp_t$  is the number of people without a job and actively searching for one, and

$EAP_t$  is the Economically Active Population (unemployed plus employed) within total population aged 15 or older.

- $u - extended_t$ : unemployment and informal wage earners

$$u - extended_t = \frac{Unemp_t + Inf_t}{EAP_t} * 100$$

$Inf_t$  is the number of informal wage earners within the  $EAP_t$

- We assume that workers are informal if they are **wage earners without any of the following mandatory benefits**: *social security (IMSS or ISSSTE), retirement benefits (Afore), home loan (INFONAVIT), or private health insurance.* [ILO, 2003]

**Figure 2 Labor Market Composition, ENOE (Q4-2016)**

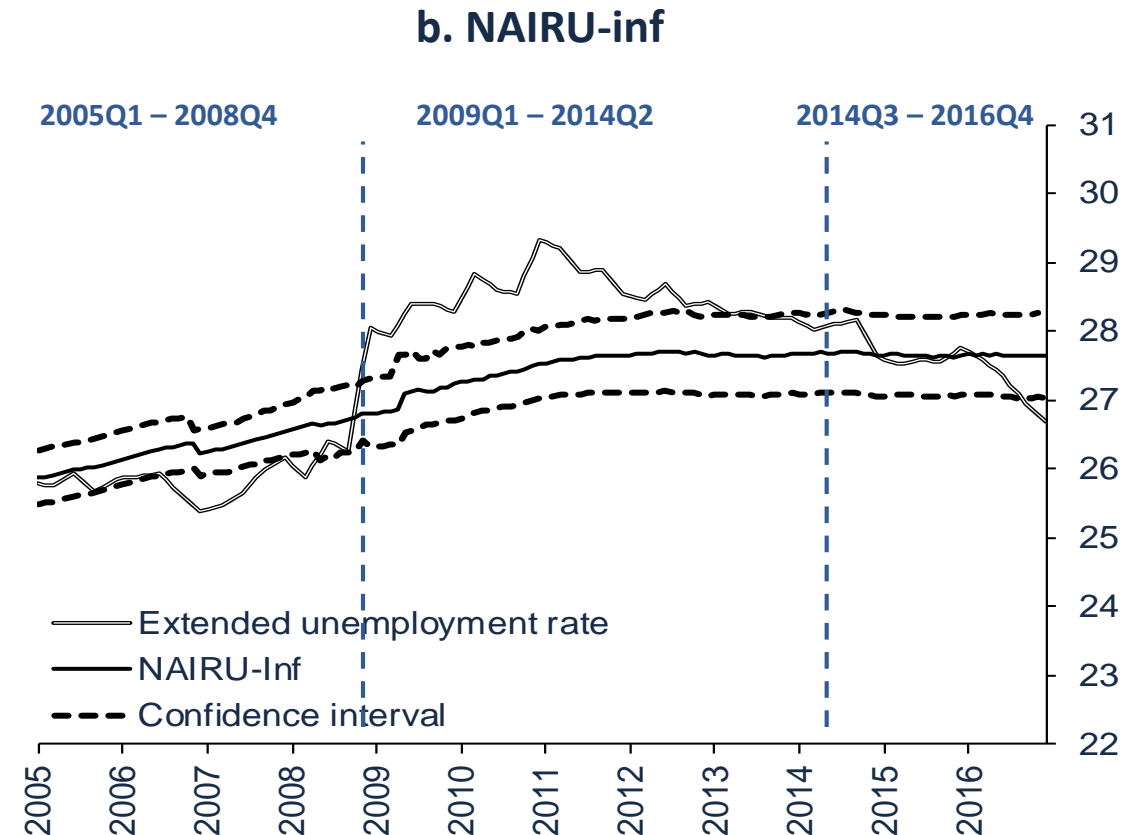
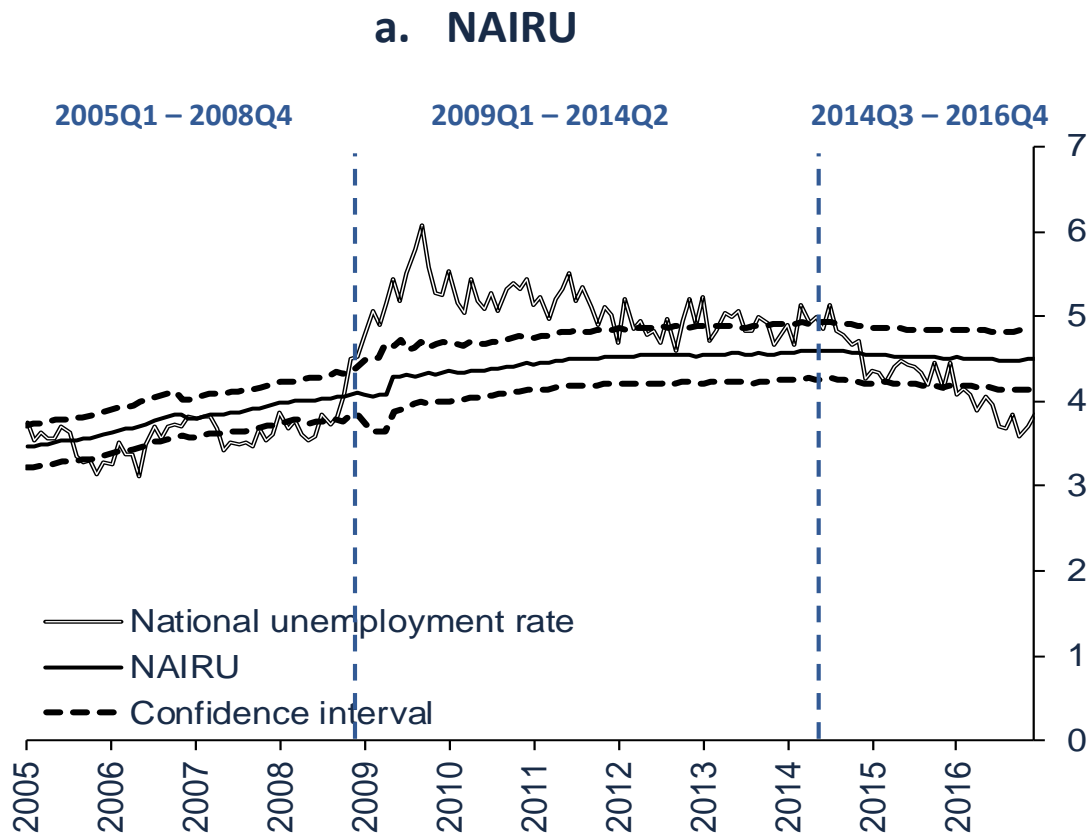
Percentage respect total Economically Active Population (EAP), 15 years and above. ¶



Note: Encuesta Nacional de Empleo y Ocupación (ENOE), INEGI. Survey's weights were used to obtain the population-representative figures.

# Results: Average Estimations of NAIRU and NAIURU-inf

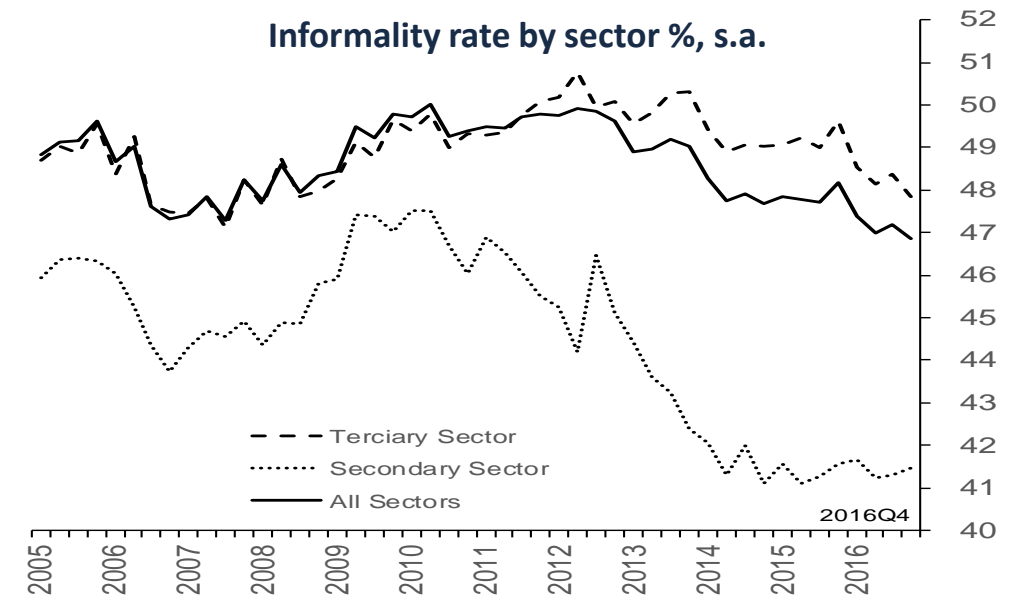
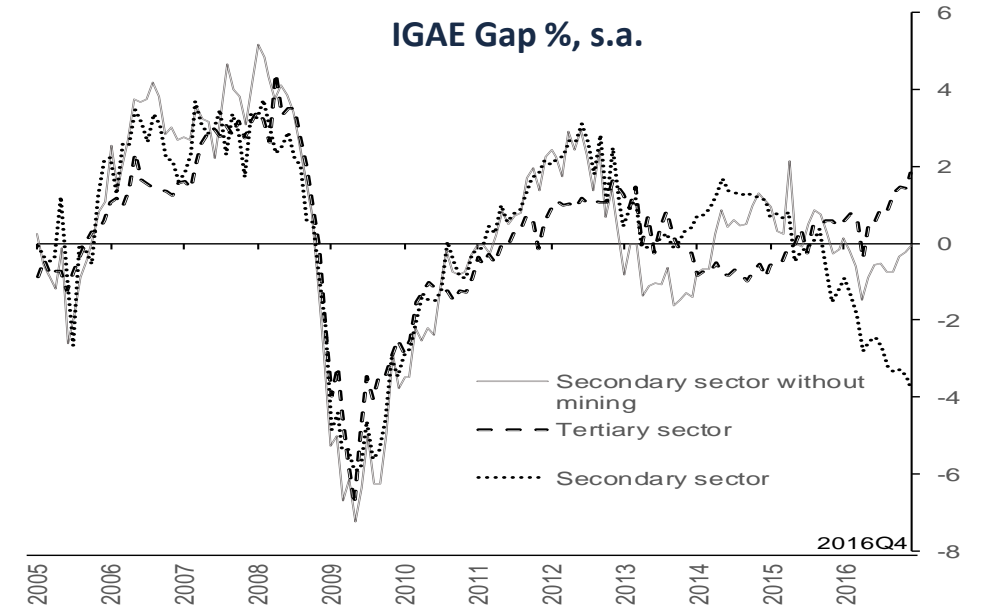
- The estimated measures of labor slack seem to be consistent with the economic cycle:
  - ✓ *first period characterized by tightness in the labor market,*
  - ✓ *a post-crisis period with important labor slack, and*
  - ✓ *a reduction in this slack beginning in 2014.*



# The Mexican Labor Market along the Economic Cycle

## ➤ Period III (2014Q3-2016Q4)

- ✓ The slack in the labor market—measured both by NAIRU-trad and NAIRU-inf— started declining.
- ✓ Wages barely grew during this period
- ✓ *This did not seem to have been reflected in inflationary pressures*
- It is possible to find an explanation when considering **sectorial differences**
  - ✓ Negative output gap in the secondary sector and positive in the tertiary sector
  - ✓ Tertiary sector has a higher level of informal employment
  - ✓ Informal sector has lower wages than the formal sector
- Workers without formal employment could be absorbed by the service sector into lower-paying jobs, without implying significant inflationary pressures from aggregate demand.
- ***Slack-inf suggests less tightness in the labor market than slack-trad, which is consistent with an absence of wage pressures***



# Final Remarks

- We proposed a new indicator of labor market slack that takes into account informal employment in Mexico.
- Using traditional methodologies we estimate two measures of NAIRU:
  - *A traditional NAIRU (unemployment rate) and*
  - *An alternative measure (NAIRU-inf) that also considers informal wage earners.*
- Our results show no drastic differences in the labor market slack between both indicators over the economic cycle. However, in **some particular periods we found subtle differences.**
- The inclusion of informal employment **can complement the analysis** of the Mexican economic cycle and can be a useful tool for monetary policy formulation not only in Mexico, but also in other developing countries.
  - *So, we do not suggest replacing the traditional labor-market slack indicator (slack-trad) with the indicator that includes informal employment (slack-inf), but we propose using it as a complement.*

# Annex. Estimation Results

**Table A1. Summary of NAIRU and NAIRU-Inf Estimations, 2005M01-2016M12**

<i>Dependent variable: <math>\Delta\pi_{core,t}</math></i>	(1) NAIRU	(2) NAIRU-Inf
Recursive estimation	4.43*** (0.239)	27.46*** (0.498)
Random Walk	4.75*** (0.304)	28.29*** (0.483)
Random Walk & Unemployment Gap	4.50*** (0.248)	27.44*** (0.382)
Random Walk & Unemployment Gap (Okun's Law)	4.32*** (0.067)	27.40*** (0.138)
N	144	144

Note: Standard errors are reported in parentheses for the recursive estimation and root mean squared errors are reported in parentheses in the rest of the estimations. We include dummy variables for 2010M1, the period 2013M1-2014M1, and 2015M1.

\*, \*\*, \*\*\* indicate significance at the 90%, 95%, and 99% level, respectively.

# Annex. Estimation Results

**Table A2. Recursive Estimation of NAIRU, 2005M01-2016M12**

<i>Dependent variable:</i> $\Delta\pi_{core,t}$	(1) Traditional Unemployment Rate	(2) Extended Unemployment Rate
$u_t$	-0.04** (0.014)	-0.02** (0.008)
$\Delta\pi_{core,t-1}$	0.21** (0.066)	0.22*** (0.066)
$\Delta\pi_{core,t-2}$	0.01 (0.066)	0.02 (0.066)
$\Delta\text{Real depreciation}_{t-1}$	-0.01* (0.003)	-0.01* (0.003)
$\Delta\text{Real depreciation}_{t-2}$	-0.01** (0.003)	-0.01** (0.003)
$\_cons$	0.18** (0.062)	0.53** (0.226)
NAIRU	4.43*** (0.239)	27.46*** (0.498)
N	144	144
R-squared	0.48	0.47
Adjusted R-squared	0.45	0.44
S.E. of regression	0.11	0.11
Log likelihood	113.58	112.11

Note: Standard errors are reported in parentheses. We include dummy variables for 2010M1, the period 2013M1-2014M1, and 2015M1.

\*, \*\*, \*\*\* indicate significance at the 90%, 95%, and 99% level, respectively.

# Annex. Estimation Results

**Table A3. Random Walk (NAIRU) using the Kalman Filter, 2005M01-2016M12**

<i>Dependent variable:</i> $\Delta\pi_{core,t}$	(1) Traditional Unemployment Rate	(2) Extended Unemployment Rate
$u_t - \bar{u}$	-0.06** (0.021)	-0.05*** (0.012)
$\Delta\pi_{core,t-1}$	0.18** (0.058)	0.19*** (0.056)
$\Delta\pi_{core,t-2}$	0.00 (0.078)	-0.01 (0.073)
$\Delta\text{Real depreciation}_{t-1}$	-0.01** (0.003)	-0.01** (0.002)
$\Delta\text{Real depreciation}_{t-2}$	-0.01** (0.003)	-0.01** (0.003)
NAIRU	4.75***	28.29***
Root MSE	(0.304)	(0.483)
N	144	144
Log likelihood	112.03	105.85

Note: Standard errors are reported in parentheses. We include dummy variables for 2010M1, the period 2013M1-2014M1, and 2015M1.

\*, \*\*, \*\*\* indicate significance at the 90%, 95%, and 99% level, respectively.

# Annex. Estimation Results

**Table A3 Random Walk & Unemployment Gap NAIRU using the Kalman Filter, 2005M01-2016M12**

<i>Dependent variable:</i> $\Delta\pi_{core,t}$	(1) Traditional Unemployment Rate	(2) Extended Unemployment Rate
$u_t - \bar{u}$	-0.08** (0.030)	-0.03** (0.013)
$\Delta\pi_{core,t-1}$	0.17** (0.062)	0.22*** (0.050)
$\Delta\pi_{core,t-2}$	-0.01 (0.086)	0.01 (0.074)
$\Delta\text{Real depreciation}_{t-1}$	-0.01* (0.003)	-0.01** (0.003)
$\Delta\text{Real depreciation}_{t-2}$	-0.01** (0.003)	-0.01** (0.003)
NAIRU	4.50***	27.44***
Root MSE	(0.248)	(0.382)
$(u_t - \bar{u})_{t-1}$	0.60*** (0.090)	0.99*** (0.012)
$(u_t - \bar{u})_{t-2}$	0.35*** (0.092)	
Unemployment gap	-0.66**	-0.74*
Root MSE	(0.294)	(0.393)
N	144	144
Log likelihood	138.60	203.68

Note: Standard errors are reported in parentheses. We include dummy variables for 2010M1, the period 2013M1-2014M1, and 2015M1.

\*, \*\*, \*\*\* indicate significance at the 90%, 95%, and 99% level, respectively.

# Annex. Estimation Results

**Table A4. Random Walk & Unemployment Gap (Okun's Law) NAIRU  
using the Kalman Filter, 2005M01-2016M12**

<i>Dependent variable:</i> $\Delta\pi_{core,t}$	(1) Traditional Unemployment Rate	(2) Extended Unemployment Rate
$u_t - \bar{u}$	-0.09*** (0.015)	-0.10*** (0.006)
$\Delta\pi_{core,t-1}$	0.17** (0.059)	0.18*** (0.053)
$\Delta\pi_{core,t-2}$	-0.01 (0.077)	-0.01 (0.069)
$\Delta\text{Real depreciation}_{t-1}$	-0.01** (0.002)	-0.01** (0.002)
$\Delta\text{Real depreciation}_{t-2}$	-0.01** (0.003)	-0.01*** (0.002)
NAIRU	4.32*** (0.067)	27.40*** (0.138)
Unemployment gap	-0.02 (0.259)	-0.01 (0.425)
Okun	0.55** (0.189)	0.14 (0.182)
N	144	144
Log likelihood	-17.37	-296.69

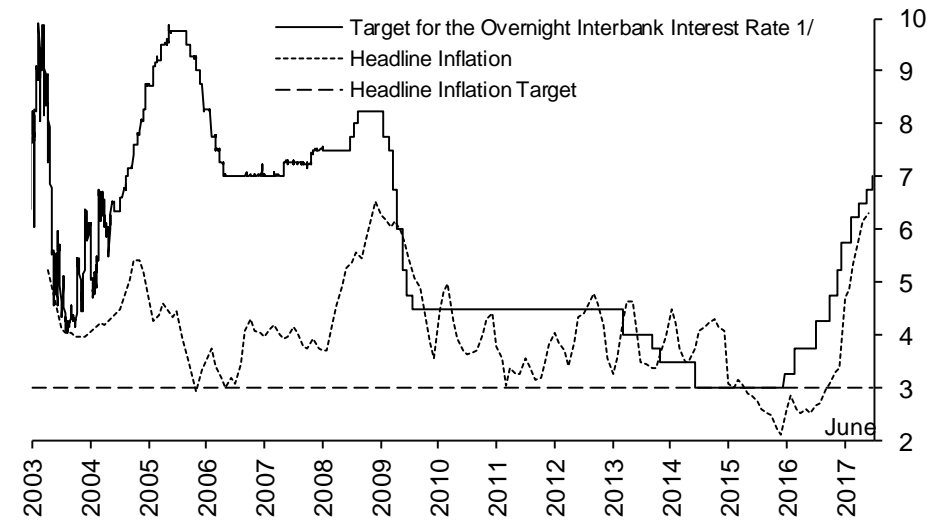
Note: Standard errors are reported in parentheses. We include dummy variables for 2010M1, the period 2013M1-2014M1, and 2015M1.

\*, \*\*, \*\*\* indicate significance at the 90%, 95%, and 99% level, respectively.

# Annex. The Mexican Labor Market along the Economic Cycle

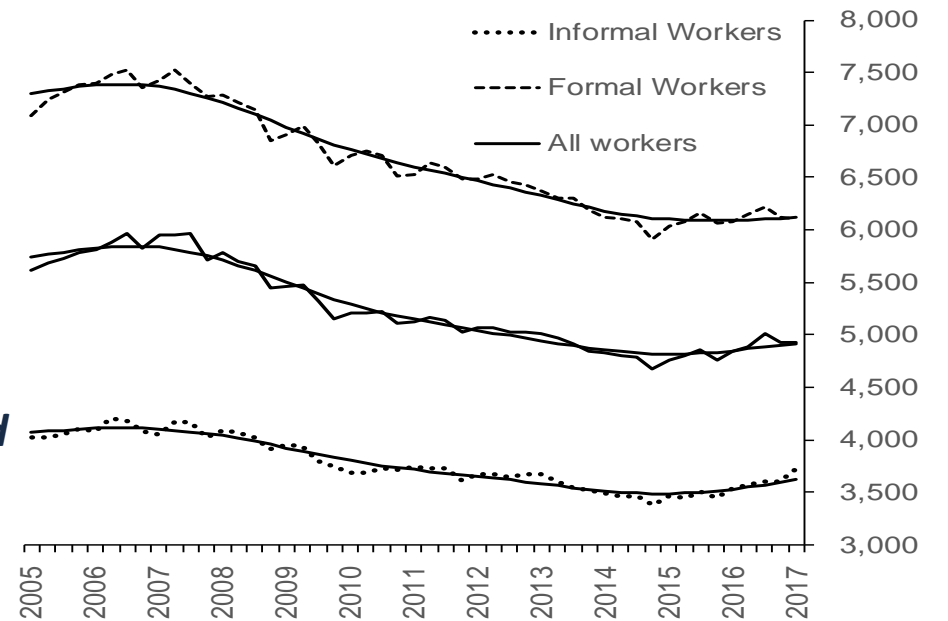
## ➤ Period I (2005Q1-2008Q4)

- ✓ Inflation began to pick up.
- ✓ Wages showed important gains.
- ✓ Unit labor costs were particularly high
- ***Slack-inf showed greater tightness than slack-trad***



## ➤ Period II (2009Q1-2014Q2)

- ✓ The Mexican economy decelerated significantly
- ✓ Wages and labor costs plunged deeply
- ✓ The policy interest rate decrease from 8.25 to 4.5
- ✓ Both measures of slack showed an important increase.
- ***Slack-inf suggested a greater degree of slack than slack-trad***





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