An Estimation of the Mexican Peso´s Overvaluation for 2023

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ABSTRACT

We estimate the overvaluation of the Mexican peso for the second quarter and June 2023. The equilibrium real exchange rate is approximated by reestimating a cointegration equation where the variable of interest depends on Mexico's GDP, the US Industrial Production Index, the sum of private consumption, the government consumption and exports of Mexico, and US private fixed investment. We use these variables to approximate the relative supply and demand of the two countries. Under certain assumptions, we estimate that the Mexican peso is overvalued by 13.7% and 15.3% in the second quarter and in June 2023, respectively, with information available as of mid-July of the same year. We provide an estimate of the nominal exchange rate compatible with the elimination of the exchange rate misalignment, if this variable were the only one that adjusts.

Keywords: *real exchange rate; cointegration; currency overvaluation.*

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Estimación de la sobrevaluación del peso mexicano para 2023

RESUMEN

Estimamos la sobrevaluación del peso mexicano para el segundo trimestre y junio de 2023. El tipo de cambio real de equilibrio se aproxima reestimando una ecuación de cointegración donde la variable de interés depende del PIB de México, el Índice de Producción Industrial de EE. UU., la suma del consumo privado, el consumo y las exportaciones del gobierno de México y la inversión fija privada de EE. UU. Usamos estas variables para aproximar la oferta y la demanda relativas de los dos países. Bajo ciertos supuestos, estimamos que el peso mexicano se encuentra sobrevaluado en 13.7% y 15.3% en el segundo trimestre y en junio de 2023, con información disponible a mediados de julio del mismo año. Proporcionamos una estimación del tipo de cambio nominal compatible con la eliminación del desajuste cambiario, si esta variable fuera la única que se ajusta.

Palabras clave: *tipo de cambio real; cointegración; sobrevaluación cambiaria*

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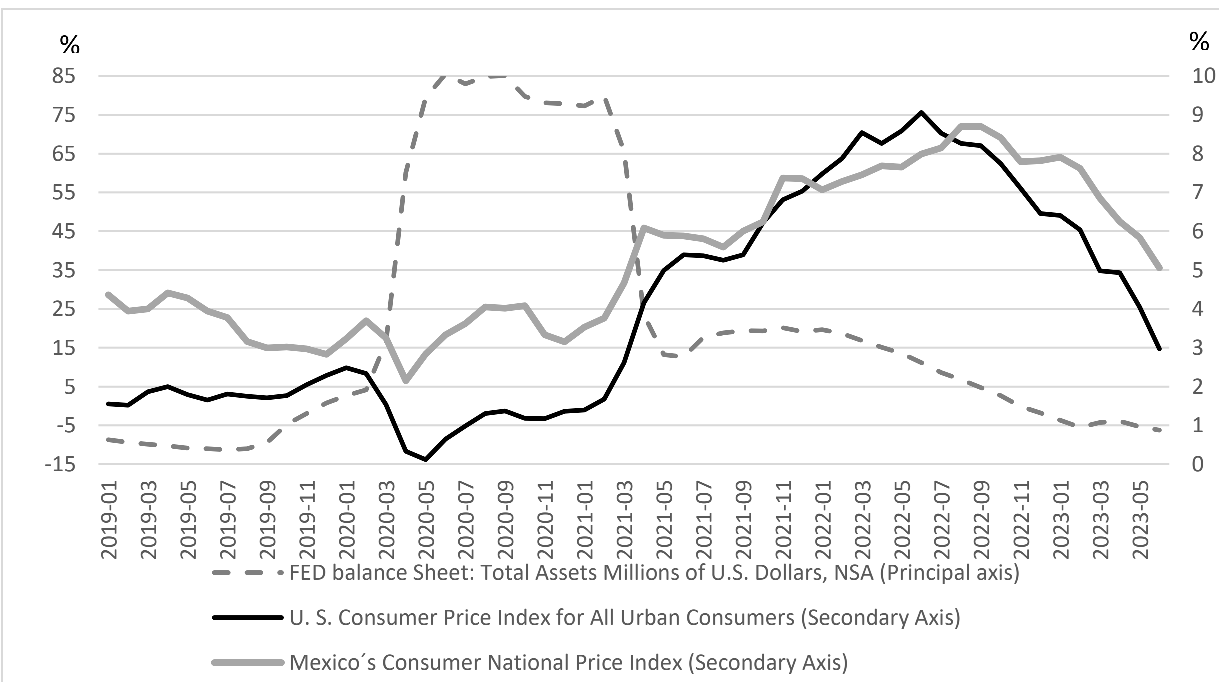
INTRODUCTION

The SARS-COV-2 pandemic led to the Great Recession in 2020. In this context, the FED instrumented a second quantitative easing program and dramatically increased the total assets of its balance sheet and decreased its nominal interest rate. The total assets in the balance sheet of the FED increased from 4.1 trillion of US dollars in December 2019 to 7.3 trillion of US dollars in December 2020. Meanwhile, Banco de México decreased its objective interest rate. Although these monetary policies eased the recession in 2020 and boosted the recovery in 2021, they also caused inflation. In Figure 1, the FED total assets growth rate and inflation rates for Mexico and the U. S. are depicted for the period January 2019 to June 2023. The minimum inflation rates were registered in April of 2020 for Mexico (2.1%) and one month later for the U.S. (0.1%), while in June of the same year the total assets registered the highest annual growth rate (85.5%).

Figure 1

Annual growth rates of the total assets in the FED´s balance sheet and inflation for Mexico and the U. S. January 2019 - June 2023



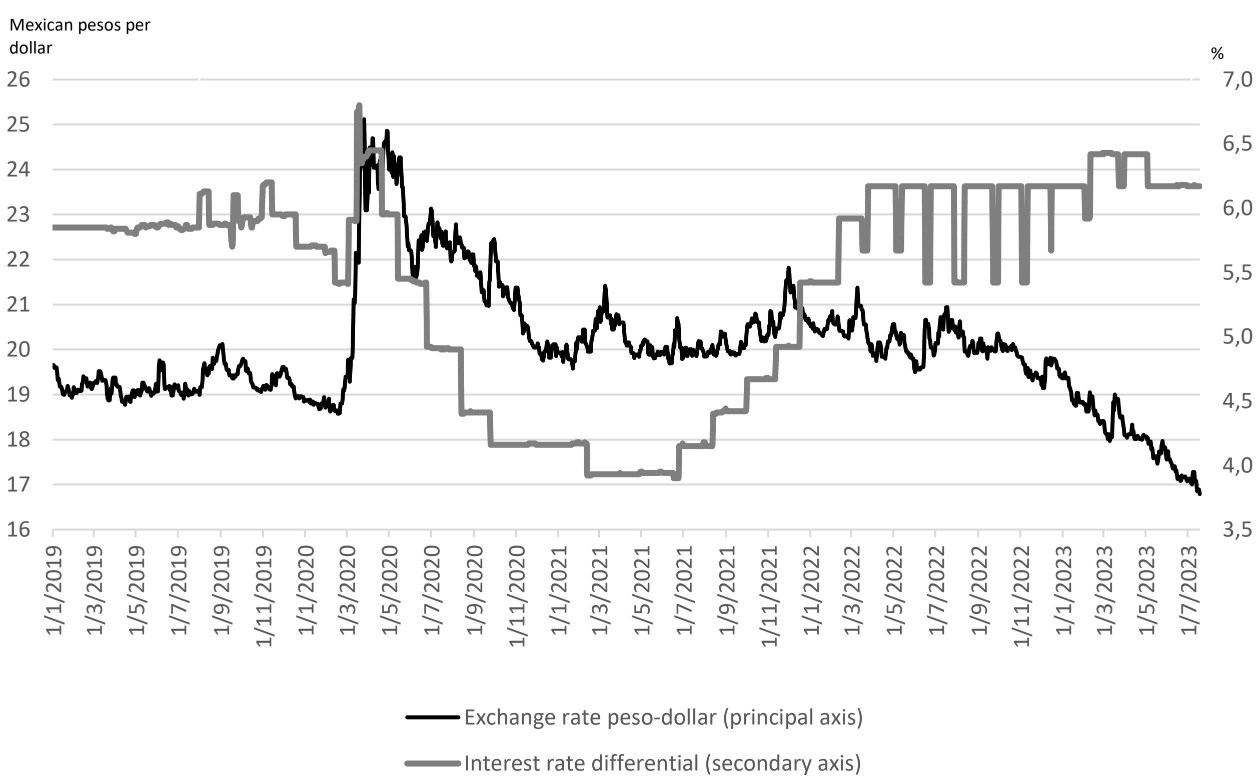
Source: Own calculations with information of St. Louis FED and INEGI.

From December 2020 to October 2022 the total assets growth rates were positive and particularly high from April 2020 to April 2021. This expansive monetary policy and the beginning of the war in Ukraine in February 2022 fueled inflation from those minimum levels until reaching 9.1% in June 2022 for the U. S. and 8.7% in September 2022 for Mexico. Both central banks increased rapidly their interest rates to curb inflation. Banco de México started increasing its objective interest rate on the 25th of June of 2021 from a minimum level of 4%, while the FED started increasing its interest rate in March 2022 from a minimum range between 0 and 25 base points. The fact that Banco de México started increasing its interest rate before than FED and more aggressively provoked that the interest rate differential began to widen.

Figure 2

Nominal exchange rate Mexican peso - dollar and interest rate differential

January 2019 - July 2023



Source: Own calculations. Information of St. Louis FED and Banco de México.

When this differential reached at least 600 base points, the nominal exchange rate appreciated rapidly from 19.36 Mexican pesos per dollar at the beginning of 2023 to less of 17 pesos per dollar by mid-July of the same year (-13.3%). In Figure 2 the interest rate differential and the nominal exchange rate are depicted. This appreciation of the Mexican peso was simultaneous to an increase of 5,170 million dollars (MD) in gross international reserves in the first quarter of 2023, which means the exchange rate appreciation could have been larger If Banco de México did not accumulate reserves.

The evolution of the nominal exchange rate has influenced the observed real exchange rate (RER), diverting it from its long-run equilibrium value. The hypothesis of this paper is that the Mexican peso is currently overvalued, and its aim is to estimate the real exchange rate misalignment during the second quarter and June of 2023. The rest of the paper is organized as follows: in section 2 we survey some papers that have estimated exchange rate misalignment for Mexico and other countries, mainly Latin American. In section 3, we re-estimate the VAR and VEC models of Jiménez-Gómez (2023) with information available to the first quarter of 2023. In this section we estimate the cointegration equation that it will be useful to identify the theoretical equilibrium real exchange rate (ERER), relative to which the exchange rate misalignment is going to be measured. In addition, we perform the necessary statistical tests. In section 4, we present the overvaluation estimations and discuss the potential nominal exchange rate depreciation needed to eliminate the currency misalignment, and finally we present some concluding remarks and suggestions for further investigation.

2 A selective review of the literature on currency misalignment estimation

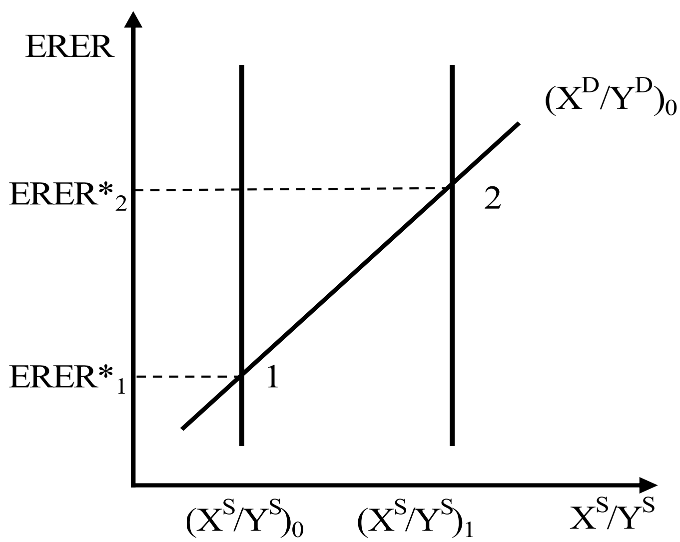
2.1 theoretical model

The currency misalignment is estimated as the difference between the ERER and the observed RER. The first problem that researches face is to identify the equilibrium real exchange rate. They must choose a theoretical approach and then to estimate a "moving target" as it was named by Gil Díaz and Carstens (1996: 11). Hinkle and Montiel (1999) and Lee et al. (2008) present surveys on the determination of the equilibrium exchange rate and propose a classification of them. Montiel and Hinkle (1999: 4) classify the models within 4 methodologies to empirically estimate the ERER: the first is the Purchasing Parity Power

(PPP), the second is based on models of trade, the third is based on computable equilibrium models general and the fourth approach consists in econometric estimates, which use time series with unit roots.

Figure 3

Theoretical equilibrium real exchange rate. An increase in relative supply



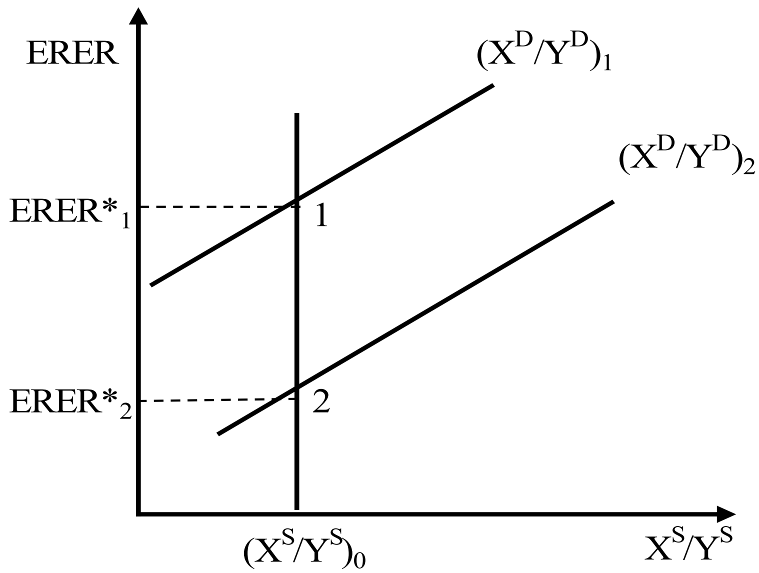
Source: Krugman et al. (2012: 420).

We follow the latter empirical approach, based on the theoretical model of Stockman (1987) and Krugman et al. (2012). These authors propose that the ERER depends on interaction of relative supplies and demands of two countries, in this case Mexico and the U. S. The relative supply is defined as the supply of Mexico relative to the supply of the U. S., while the relative demand is defined as the demand of Mexico relative to the demand of the U. S. This case is represented in figure 3. Assume that the economy initially is at $ERER_1$ and that the supply of Mexico grows relatively to the supply of the U. S. keeping the relative demand constant, then the relative supply shifts to the right reaching $ERER_2$. The depreciation of the ERER is because the prices in Mexico grows less than in the U. S. as a result of a larger growth in the supply of the former country than of the latter[3], in relative terms.

[3] The RER is equal to the nominal exchange rate times the price level of the U. S. divided by the price level of Mexico. If the latter Price level grows less than the former one the real exchange rate depreciates.

Figure 4

Theoretical equilibrium exchange rate. An increase in relative demand



Source: Krugman et al. (2012: 420).

On the other hand, assume that the economy initially is at $ERER_1$ and if the demand in Mexico grows relative to the demand in the U. S., maintaining the relative supply constant, then the relative demand shifts to the right reaching $ERER_2$. The appreciation of the ERER is because the prices in Mexico grows more than in the U. S. as a result of a larger growth in the demand of the former country than of the latter. This case is represented in figure 4.

2.2 Estimates for Mexico[4]

The studies that estimate the overvaluation or undervaluation of the Mexican peso can be divided in two groups. The first one refers to the period in which Mexico had a fixed exchange rate regime or a band for the exchange rate. Zedillo (1992: 36) estimated overvaluations of -16 and -23% for 1980 and 1981, and undervaluations of 45 and 15% for 1982 and 1983, respectively. It should be emphasized that Zedillo (1992) used the closing values at December of each year, for what the nominal exchange rate in December 1982 already reflected the devaluations of February and September that occurred that year. Solís (1996: 87)

[4] This section draws heavily on Jiménez-Gómez (2023).

estimated an exchange undervaluation of 32% for 1987. For the period in which Mexico had a currency band, Elbadawi and Soto (1997, 102) estimated that the RER it was overvalued by about 20% in 1992 and 1993. Dornbusch and Werner (1994: 286) pointed out that Mexico needed a devaluation of 20% to correct the overvaluation of the Mexican peso. Montiel (1999: 259) reported that the Mexican peso was overvalued -18% in 1994. Solís (1996: 87) pointed out that, before December 1994, the Mexican peso had an overvaluation of -45%, according to the theory of the currency parity.

The second group of estimations refers to the period in which Mexico has had a flexible exchange rate regime. However, in this period the estimates are scarce. We have to remark that a flexible exchange rate regime does not eliminate the possibility of TCR misalignment. For example, Carrera et al. (2021: 71) use a panel data model to assess the degree of exchange rate misalignment and its persistence for a group of countries. The authors manage to find that under a fixed exchange rate regime the misalignment between the observed RER and ERER tends to be more persistent, while under a flexible exchange rate regime it reduces said persistence, but increases the size of the misalignment. Galindo and Guerrero de Lizardi (2001: 8) point out that the real value of the Mexican peso in 2000 was "in a similar level to that which prevailed before the exchange rate crisis of 1994". On the other hand, Jiménez-Gómez (2003: 187) estimates the currency overvaluation or undervaluation for each year of the period 1995-2021. The largest undervaluations were estimated for 1995 (45.4%) and 1996 (22.7%), which were the first two years of the current flexible exchange rate regime, and they still were still influenced by the exchange rate overshooting[5]. On the other hand, the largest overvaluations were estimated for 2000 (-8.8%), 2001 (-10.3%) and 2021 (-8.8%). The latter was transitory and eliminated at the end of the fourth quarter of that year. González-García et al. (2022) estimate an equation where the RER is a function of the trade openness, credit to the private sector and domestic inflation. The three estimated coefficients are negative. The authors conclude that: "… an overvaluation is usually associated with periods of crisis, an undervaluation with

[5] See Dornbusch (1976).

periods of higher or lower growth, while equilibrium is associated with higher growth", González-García et al. (2022, 148).

2.3 Estimates for other countries.

A series of Penn studies documented the robust empirical association between the relative prices of two countries expressed in the same currency (bilateral real exchange rates) with relative real per capita incomes. Samuelson coined the term the "Penn effect" referring to this result.

Cheung and Fujii (2014, 94) estimate a regression in which the reciprocal of real exchange rate (r_i)[6] in terms of the real per capita income of a country relative to the USA (Y_i) and a stochastic error, for a panel data for 154 countries using two different samples for 2005.

$$\boldsymbol{r_i = \beta_0 + \beta_1 Y_i + \mu_i} \qquad \textbf{for i = 1, …, 154} \qquad \textbf{(1)}$$

The estimated degree of misalignment is given by the estimated residual $(\hat{\mu}_t)$, where a positive value means overvaluation and a negative value undervaluation. These authors conclude that the currencies of China, India, Russia, and Brazil were undervalued in 2005 with respect to the US dollar, in both samples. The difference in the degrees of the estimated undervaluation depended on the samples themselves.

Following a structuralist-keynesian approach, Nassif, et al (2011, 8-11) estimate a model for the RER as a function of variables that represent long-term structural forces and short term variables. Within the first group, these authors include Brazilian real GDP per capita expressed in US dollars, terms of trade, and the current account balance as a ratio of GDP. In the second group, they include interest rate differential, stock of international reserves as a ratio of GDP, Brazil´s risk premium, and a stochastic error. They found statistically significant the estimated coefficients associated to the GDP per capita, the current account, the interest rate differential, the stock of international reserves and the Brazil´s risk premium. According to their approach, this estimation allows them to estimate the long-term real exchange rate in order to identify if the currency is overvalued or undervalued. The authors conclude that Brazil reached its long-term optimal real exchange rate in 2004, and that by April 2011 the Brazilian currency was overvalued around 80%.

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[6] Based on the purchasing parity power approach.

Villegas et al. (2013) estimate an ERER for Venezuela for the period 1999-2010 through a cointegration vector following the Engle and Granger methodology and an error correction model. These authors found a long-term stable relationship between the RER, aggregate productivity, terms of trade, government spending as a percentage of gross domestic product, capital flows, and the degree of openness. The analysis of the results suggests that in Venezuela there have been temporary periods of misalignment of the RER: overvaluation and undervaluation. However, the RER does not seem to return to its equilibrium level, so the exchange rate misalignment tend to persist.

Tashu (2018) identifies the determinants of the ERER rate in Peru by means of a cointegration analysis. Specifically, the author tries to find out if the sol is a commodity currency for the period 1992-2013 using quarterly data. His results show that the prices of the raw materials for export do not have a statistically significant impact on the Peru's real effective exchange rate, suggesting that the sol is not a commodity currency. He argues that Perú ERER is mainly driven by productivity and consumption of the government.

González-Sánchez (2020) estimate an autoregressive distributed lag (ARDL) model through the application of the Behavioral Equilibrium Exchange Rate (BEER) methodology for Dominican Republic for the period between the first quarter of 1996 and the first quarter of 2020. The economic fundamental variables that this author used were: public consumption, gross capital formation, terms of trade, commercial openness and real interest rate differential. However, the last two variables were not statistically significant. According to his estimates, the author concludes that: "For 2019 the average total misalignment was 0.8%, maintaining the same trend during the first quarter of 2020, this suggests the need for a slight real appreciation and is indicative that the RER is practically in equilibrium", González-Sánchez (2020: 14).

On the other hand, García-Solanes and Torrejón-Flores (2013, 10) use the model of tradable and non-tradable goods, emphasizing total factor productivity, following the Balassa-Samuelson hypothesis. If factor productivity in the tradable sector in the home country is higher than in the same sector in the foreign country, then inflation in the non-tradable sector in the home country is higher than inflation in the same sector in the foreign country. This is explained as follows: increasing factor productivity in the tradable sector of the home country will increase wages, not only in the tradable sector but also in the non-tradable sector, as a result of the free labor mobility between the those sectors. As a consequence, companies in the non-tradable sector rise prices as a consequence of the increase in wages. In this way, countries with higher productivity growth rates in the tradable sector will have real exchange rates that will appreciate over time. Using a panel data, these authors estimate that the Spanish real exchange rate was overvalued between 27 and 29% in 2008, according to the Penn effect (García-Solanes and Torrejón-Flores (2013, 14)).

Noureldin (2018) identifies Egypt's ERER and exchange rate misalignment based on economic fundamentals over the period 2001-2017 through the estimation of a cointegration vector and a VEC model. With regard to the determinants of the Egyptian ERER, this author finds that the productivity differential with respect to its trade partners and trade openness are the most significant factors. Specifically, he finds that the Egyptian pound was undervalued by about 22.3% in in the first quarter of 2017 due to overshooting with respect to its equilibrium value after floating the currency in the fourth quarter of 2016.

Most of the papers surveyed use a cointegration vector to obtain the estimate of the ERER which is used to calculate the currency misalignment. The main difference among them is the theoretical approach they follow and the variables they use.

3 Re-estimating the ERER with updated information.

Jiménez-Gómez (2023) estimated the theoretical model of Stockman (1987) and Krugman et al. (2012) for the period between the first quarter of 1995 and the first quarter of 2021. That model is re-estimated with information updated until the first quarter of 2023. The approximate variables for Mexico and the U. S. supplies are PIB (Y: chained pesos of 2013) and the Industrial Production Index (IPI: 2017=100), respectively. The approximate variables for Mexico and the U. S. demands are the sum of private consumption, government expenditure and exports for the first country (CGX: chained pesos of 2013) and fixed private investment (FPI: in real terms) for the second one. The RER is obtained using the nominal exchange rate times the U. S. Consumer Price Index divided by the Mexican National Consumer Price

Index. The model is estimated with the natural logarithms of these variables. The data was obtained from the St. Louis FED, Banco de México, and INEGI[7]. We use E-views as statistical software.

We carry out the augmented Dickey-Fuller and the Phillips-Perron unit root tests to each variable in levels and differences and the results are reported in Table 1.

Table 1

The augmented Dickey-Fuller and the Phillips-Perron unit root tests for RER, Y, IPI CGX and FPI. 1995 1st quarter - 2023 1st quarter

Variables	Augmented Dickey-Fuller				Phillips-Perron			
in levels	Lags	Specificación[1]	Statistic[2]	p-value	Bandwidth	Specificación[1]	Statistic[2]	p-value
RER	0	I	-2.42	0.14	1	I	-2.47	0.13
Y	3	I	-2.54	0.11	9	I	-1.80	0.38
IPI	0	I y T	-2.91	0.16	5	I y T	-2.96	0.15
CGX	3	I	-2.09	0.25	8	I	-1.94	0.31
FPI	1	I y T	-2.41	0.37	7	I y T	-2.28	0.44
Variables in	Augmented Dickey-Fuller				Phillips-Perron			
differences	Lags	Specificación[1]	Statistic[2]	p-value	Bandwidth	Specificación[1]	Statistic[2]	p-value
RER	0	N	-9.88	0.00	5	N	-9.90	0.00
Y	2	I	-10.18	0.00	4	I	-19.90	0.00
IPI	0	I	-11.05	0.00	5	I	-11.05	0.00
CGX	3	N	-4.68	0.00	7	N	-16.32	0.00
FPI	0	I	-5.86	0.00	3	I	-5.87	0.00

1 I means intercept, T linear trend and N nothing. 2 Significative 5%.

Source: Own elaboration.

When the time series for a variable is I(1), the null hypothesis of the unit root tests when the variable is expressed in levels must not be rejected. However, the null hypothesis of the unit root tests when the same variable is expressed in differences must be rejected. The results reported in Table 1 allow us to carry on with the VAR model estimation considering the five variables described above that are I(1). Following the Akaike information criterion, the VAR is estimated with 6 lags. In addition, we incorporate 6 dummy variables are included to deal with outliers for the following quarters: 2008q4, 2009q1, 2009q2, 2017q2, 2020q1 and 2020q2.

[7] www.stlouisfed.org; www.banxico.org.mx, and www.inegi.org.mx are the web pages, respectively.

Table 2

Maximum likelihood analysis for the RER-1995-2023

i) Cointegration analysis					
Eigenvalues	0.49	0.18	0.13	0.08	0.00
Null hypothesis	rank = 0	rank ≤ 1	rank ≤ 2	rank ≤ 3	rank ≤ 4
λ trace statistic	115.33	44.72	24.09	8.89	0.15
Critical values (95%)	69.82	47.86	29.80	15.49	3.84
ii) Cointegration vector and adjustment coefficients (Johansen)					
Variables	RER	Y	IPI	CGX	FPI
Normalized cointegration coefficients	1.00	-3.55	2.17	2.14	-1.09
(standard error)		0.59	0.23	0.45	0.11
Adjustment coefficients	-0.25	0.09	0.07	0.08	0.08
(standard error)	0.07	0.02	0.02	0.03	0.02
iii) Specification tests					
Trace correlation		Test statistic			
		0.62			
Normality		Test statistic			p-value
Jarque-Bera		13.02			0.22
Skewness (Chi-sq)		4.56			0.47
Kurtosis (Chi-sq)		8.47			0.13
Heteroscedasticity		Test statistic			p-value
White (no crossed terms, 990 d. of f.)		953.61			0.79
Serial correlación LM		Test statistic			p-value
Null hypothesis: no serial correlation from lags 1 to h					

lag "h"	4	5	6	7	8	9
Rao F Statistic (p-value)	1.0 (0.574)	0.9 (0.795)	1.1 (0.287)	1.2 (0.153)	1.2 (0.094)	1.2 (0.183)

Source: Own estimation.

The first three dummy variables are justified for the subprime mortgages crisis, the fourth dummy variable reflects the increase in the price of gasoline in the first quarter of 2017 that influenced the RER in the next quarter. The last two dummy variables are justified by the SAR-COV-2 pandemic. The VAR estimates are reported in Table 2.

We decide to follow the Johansen (1991, 1995) procedure to test cointegration. According to this approach, Juselius (2006: 132) points out that:" …the magnitude of the eigenvalues λ_i is an indication of how strongly the linear relation $\beta_i^{\prime} R_{1,t-1}$ is correlated with the stationary part of the process $R_{0,t}$". In this way, the Johansen (1991, 1995) procedure derives a test that "… discriminate between those λ_i, i=1, …, r which correspond to stationary relations and those λ_i, i=r+1, …, p which correspond to non-stationary relations", (Juselius (2006: 132)).

The first section of Table 2 shows that the null hypothesis that there is no cointegration vector is rejected because the trace statistic is larger than the critical value. The subsequent null hypothesis that there is one cointegration vector is not rejected at the 95% confidence. The signs of the estimated coefficients the cointegration vector correspond to what the Stockman (1987) and Krugman et al. (2012) model predict. The sign of the adjustment coefficient corresponding to the RER is negative and relatively large.
We can estimate a measure of goodness of fit, equivalent to the R^2 in the traditional regression model that is the trace correlation, which is 0.62 for the present model. The last test statistics reveal that the assumptions of normality, homoscedasticity and no serial correlation of errors are fulfilled.

We check the constancy of the parameters using the likelihood ratio logarithm calculated recursively, using the following bias-corrected test statistic (Juselius, 2006: 152). The test statistic is constructed according to the following formula:

$$\boldsymbol{Q_T^{Corr}(t_1) = \frac{t_1}{T}\sqrt{\frac{T}{2p}}\left[\left\{log\left|\widehat{\Omega}_{t1}\right| - log\left|\widehat{\Omega}_T\right|\right\} + \frac{1}{T}\left\{\left(\frac{1}{2}p(1-p) + r + p(k-1) + 1\right)\left(1 - \frac{t_1}{T}\right)\right\}\right]}$$

Where:

$\widehat{\Omega}_T$ is the covariance matrix of the errors obtained by the estimation using the complete subsample, in this case from 1995q1 to 2023q1.

$\widehat{\Omega}_{t1}$ is the covariance matrix of the errors obtained by the estimation using a just a part of the subsample, which changes as $t_1$runs.

t_1 is the time index that runs to enlarge the part of the subsample.

T is the full subsample size.

p is the number of variables.

r is the number of cointegration vectors.

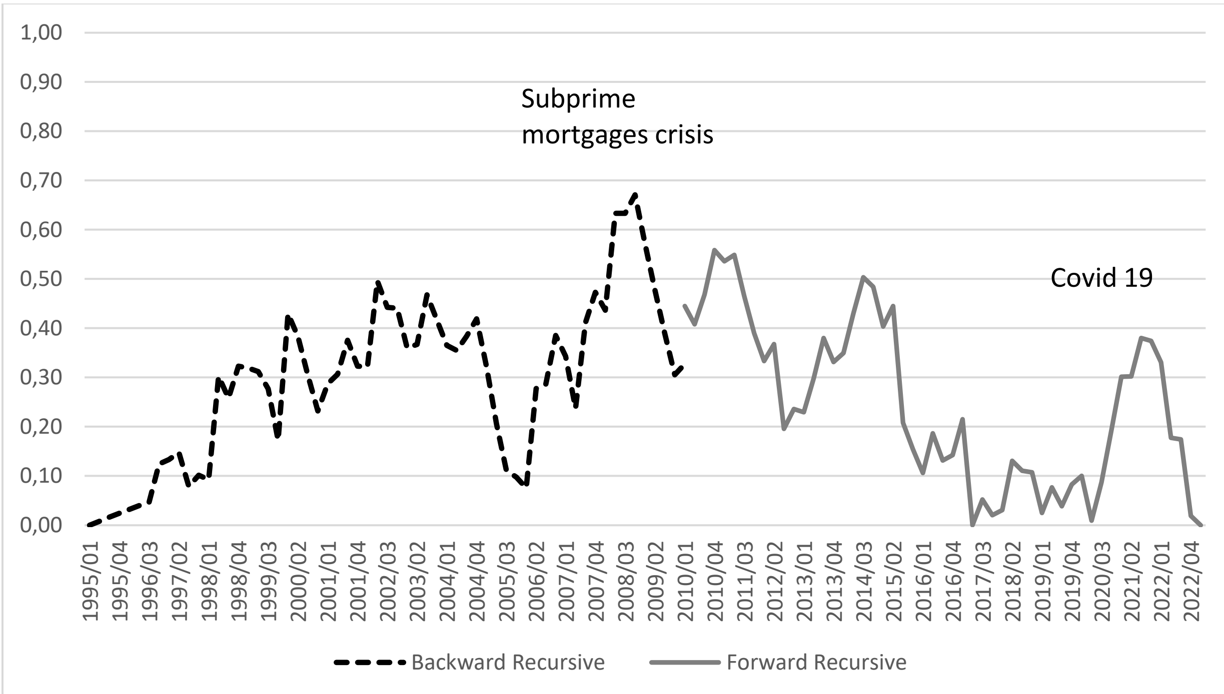
k is the number of lags in the variables in levels.

As the size of the sample is increased, either forward or backward, we can obtain a plot for the statistic. As we are interested in the stability of the cointegration vector estimated coefficients, we will check the constancy of parameters using the R-model.

The first step is to estimate two auxiliary regressions. The first is to estimate the first differences of the variables in the period "t" (ΔX_t) based on first lagged differences (ΔX_{t-i}), the constant and the dummy variables to obtain the residuals $R_{0,t}$. The second auxiliary regression consists of estimating the levels of the variables lagged one period (X_{t-1}) based on first lagged differences (ΔX_{t-i}), the constant and the dummy variables to obtain the residuals $R_{1,t}$. Finally, we estimate the model $R_{0,t} = \alpha\beta' R_{1,t} + error$ (R model). If the bias-corrected test statistic is divided by 1.36, the new reference value for rejecting the null hypothesis is 1.0. The results of this test calculated recursively forward and backward are reported in Figure 5. As the values of the statistics are strictly lower than 1, then we have some evidence that any structural break took place within the sample. Figure 5 reveals that the maximum value of the statistic in the backward recursive estimation is associated to the subprime mortgages crisis. The test statistic in the forward recursive estimation also increases because the Covid-19 pandemic.

Figure 5

Recursive Tests of Constancy of the cointegration vector estimated coefficients $Q_T^{Corr}(t_1)$. *(Forward and backward) 1995 - 2023*



We proceed to estimate of the error correction model (ECM), whose results are in Table 3. From the first section we can obtain the cointegration equation, in which the estimate for the RER will be considered as the ERER. In the second section, the coefficient significance tests shows that the estimated coefficients in the cointegration equation for the five variables are statistically significant. The weak exogeneity tests show that the adjustment coefficients for RER and FPI are statistically significant, therefore these can be considered as reaction variables, while Y, IPI and CGX are "push" variables. The last section of Table 3 shows that the VEC model fulfills the assumptions of normality, homoscedasticity and no serial correlation of error. From the cointegration equation we obtain:

$$\boldsymbol{\widehat{RER}_t = 3.95Y_t - 2.85IPI_t - 2.43CGX_t + 1.37FPI_t - 19.01} \qquad \textbf{(2)}$$

From equation (2), the error correction term can be obtained:

$$\boldsymbol{ECT_t = RER_t - 3.95Y_t + 2.85IPI_t + 2.43CGX_t - 1.37FPI_t + 19.01} \qquad \textbf{(3)}$$

Table 3

Error Correction Model, Coefficients Significance, Weak Exogeneity and diagnostic tests: RER, Y, IPI, CGX and FPI 1995 -2023

i) Cointegration equation and adjustment coefficients						
Variables	RER	Y	IPI	CGX	FPI	Constant
Normalized Coint. Coef.	1.00	-3.95	2.85	2.43	-1.37	19.01
Stardard error		0.86	0.32	0.65	0.16	
t statistic		-4.60	8.77	3.76	-8.76	
Adjustment coefficients	-0.20	0.02	0.00	-0.03	0.05	
Stardard error	0.07	0.02	0.02	0.03	0.02	
t statistic	-3.06	0.73	0.31	-0.99	2.57	
ii) Cointegration equation coefficients significance tests						
Variables	RER	Y	IPI	CGX	FPI	
$\chi2_{(1)}$	7.58	7.30	4.69	8.16	11.87	
p-value	0.01	0.01	0.03	0.00	0.00	
iii) Weak exogeneity tests						
Variables	RER	Y	IPI	CGX	FPI	
$\chi2_{(1)}$	8.97	0.60	0.10	1.29	5.35	
p-value	0.00	0.44	0.76	0.26	0.02	
iv) Specification tests						
Normality			Test statistic			p-value
Jarque-Bera			10.46			0.40
Skewness			4.30			0.51
Kurtosis			6.16			0.29
Heteroscedasticity			Test statistic			p-value
White (no crossed terms)			832.28			0.90
Serial correlación LM			Test statistic			
	Null hypothesis: no serial correlation from lag 1 to lag "h"					
lag "h"	4	5	6	7	8	9
Rao F statistic (p-value)	1.10 (0.28)	1.14 (0.20)	1.25 (0.07)	1.17 (0.15)	1.26 (0.07)	1.24 (0.09)

Source: Own estimation.

In order to estimate the specific VEC model for RER, we follow “from the general to particular approach” when we estimate ΔRER_t using Ordinary Least Squares as a function of i) the error correction term; ii) differences of Y, IPI, CGX and FPI including 1 to 5 lags, and iii) all the dummy variables in differences. Then we test the restrictions that some estimated coefficients are simultaneously equal to cero. The null hypothesis is that a group of coefficients are not statistically significant. If the null hypothesis is not rejected, the group of variables can be removed from the model, otherwise the variables cannot be excluded from the model. The results are presented in Table 4.

Table 4

Error correction model specific for ΔRER_t 1995q1 - 2003q1

Variable	Estimated coefficient	Standard error	t or F statistic	p-value
ECT_{t-1}	-0.13	0.05	-2.48	0.01
ΔRER_{t-1}	0.22	0.09	2.47	0.02
ΔY_{t-4}	0.19	0.09	2.15	0.03
ΔIPI_{t-1}	-0.41	0.19	-2.16	0.03
C	0.00	0.00	-0.10	0.92
DV 2008q4	0.14	0.03	4.82	0.00
DV 2009q1	0.14	0.03	4.90	0.00
DV 2020q2	0.15	0.03	5.86	0.00
R^2			0.46	
R^2 ajusted			0.42	
Standard error			0.03	
Jarque-Bera			0.74	0.69
Skewness			0.12	
Kurtosis			3.33	
Breusch-Godfrey LM F(12, 88)			0.87	0.58
White Heteroscedasticity F(7, 100)			0.18	0.99
CUSUM test			Inside bands	

Source: Own estimation

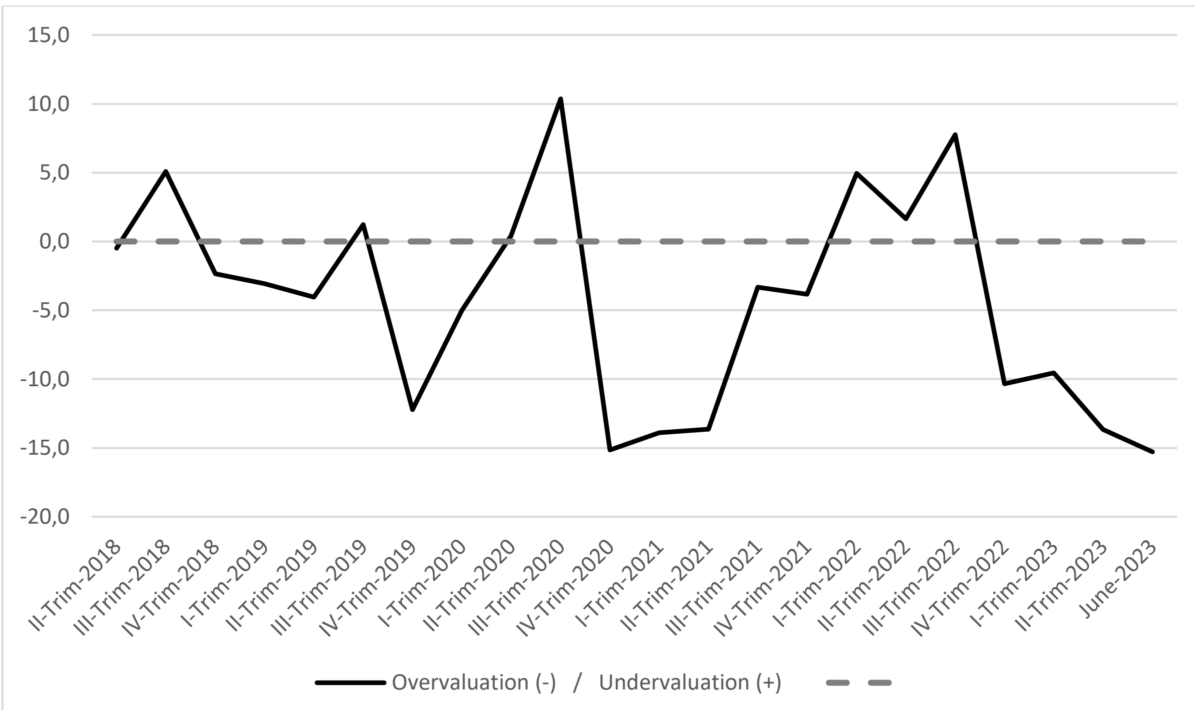
Form Table 4, we realize that the ECM specific to the RER incorporates few variables. It is worth noting that none difference lagged of CGX or FPI remains in the model. This implies that the only influence these variables have on ΔRER_t is through the error correction term. The number of dummy variables is halved, remaining only three of them. The specification tests reveal that the assumptions of normality, no serial correlation, homoscedasticity of the errors and model stability are fulfilled. The results obtained through the different stages of the econometric exercise give us confidence that the estimate of the overvaluation of the Mexican peso is reliable.

4 Estimate of the overvaluation of the Mexican peso

We must assume that the ERER prevailing in the first quarter remains at the same level for the second quarter of 2023 to estimate the currency misalignment. The reason is that the figures for Y, IPI, CGX and FPI are not still available at the time we are finishing this paper. We recognize that this assumption can be a source of an error in the estimation. In addition, we calculate the RER for the second quarter and for June 2023 to have the most recent possible overvaluation estimation. The currency misalignment is represented in Figure 6. We estimate that the Mexican peso is overvaluated in 13.7% in the second quarter of 2023 and 15.3% in June of the same year. These overvaluation estimations are relatively large in comparison to the annual estimates of Jiménez-Gómez (2023, 187) mentioned in the survey.

Figure 6

An estimation of Mexican peso misalignment. 2018q2 - 2023June



Source: Own estimation.

There are two alternative explanations for the current RER appreciation that are not exclusive from each other. The first one is that the country is facing its second "Mexico´s moment"[8] meaning that the near shoring will increase the direct investment in the territory. However, the balance of payments for the second quarter of 2023 are not still available and financial markets always go-ahead official figures publication. The income from remittances reached 58,497 MD in 2022, and in the first quarter of 2023 they grow 11.6%

[8] The "Mexican moment" was a term coined and used when the country finished implementing the first-generation structural reforms. That moment ended with the beginning of the 1994 financial and economic crisis.

with respect the same period of the previous year. However, the current account deficit reached 14,282 MD in the first quarter of 2023.

The second alternative is that the current nominal exchange rate appreciation is due to currency speculation justified for the interest rate differential. Nassif, et al (2011, 5) point out:

The systematic increase in the short term interest rate differential represents an additional incentive to sustain the exceeding flows of foreign short-term capital, especially those of a speculative nature. In practical terms, according to this stylized fact, since foreign investors tend to bet on the appreciation trend of currencies in emerging economies in the near future, the use of these currencies for carry-trade strategies implies that the uncovered interest rate parity is explicitly violated in the short term. That is to say, instead of reflecting expectation of depreciation, this fact reveals that the higher the interest rate differential, the greater the expectation that the domestic currency will continue to appreciate. So, in this case, the effect of an increase in the interest rate differential on exchange rate appreciation occurs with some time lag due to the attractiveness of large short-term capital inflows. This tendency will only be interrupted by sudden stop.

If the latter turns out to be the most important explanation, a sudden nominal exchange rate depreciation will be necessary to correct the misalignment. If the misalignment was corrected only by the nominal exchange rate, then the exchange rate would pass its new equilibrium level (MX$20.41 per dollar), plus the "overshooting", respect to the June 2023 level. Capistrán et al. (2017) study the case of a restrictive monetary policy and they find that "a restrictive monetary policy shock appears to have a temporary negative effect on output and prices, and to induce a strong appreciation followed by a gradual depreciation of the exchange rate". The latter showed the existence of an overshooting in the Mexican exchange market, Capistrán et al. (2017, 22).

FINAL REMARKS AND SUGGESTIONS FOR FURTHER INVESTIGATION

We have re-estimated the VAR and VEC models of Jiménez-Gómez (2023) with updated information until the first quarter of 2023. Under certain assumptions, we estimated that the Mexican peso is overvalued 13.7% and 15.3% in the second quarter and June of 2023, respectively. If the equilibrium real exchange rate is also appreciating because the second "Mexican moment", then the observed real exchange rate appreciation is not cause for concern in terms of a possible currency misalignment. But if it is caused mainly by carry trade or currency speculation, the correction of the currency misalignment would depreciate the nominal exchange rate drastically and this would feedback inflation. The latter would be paradoxical, because what the central bank wants to achieve with high interest rates is precisely to curb inflation. More research should be done in order to be able to discriminate between these two alternatives.

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