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Effects of Volatility of the Exchange Rate on Inflation Expectations and Growth Prospects in Mexico (2002-2014)

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Abstract

This paper is aimed at assessing the impact of exchange rate volatility on inflation expectations and economic growth prospects in Mexico. In order to examine whether there is some degree of causality, we will be using standard multivariate volatility models. The goal of this research is to measure the direction of causality, that is, we will analyze, econometrically, potential relationships in both directions. The main finding is that there is only a statistically significant relationship between the exchange rate volatility and the volatility of inflation expectations, while no statistically significant association with growth prospects was found; these results provide important information that could be used in monetary policy design.

***JEL Classification*:** C180; C120; F310; E520.
***Keywords*:** Exchange Rate Volatility; Monetary Policy; Time Series Analysis.

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Resumen

Esta investigación tiene como objetivo evaluar el impacto de la volatilidad del tipo de cambio en las expectativas de inflación y las perspectivas de crecimiento económico en México. Con el propósito de examinar si existe algún grado de causalidad, se utilizarán modelos de volatilidad multivariados estándar. El objetivo de esta investigación es medir la direccionalidad de la causalidad, es decir, se analizará econométricamente la posible relación en ambas direcciones. La principal conclusión es que sólo hay una relación estadísticamente significativa entre la volatilidad del tipo de cambio y la volatilidad de las expectativas de inflación, mientras que no se encontró una asociación estadísticamente significativa con las perspectivas de crecimiento; estos resultados proporcionan información importante que podría ser utilizada en el diseño de la política monetaria.

***Clasificación JEL*:** C180, C120, F310, E520.
***Palabras Clave*:** volatilidad del tipo de cambio; política monetaria; análisis de series de tiempo.

Introduction

Specialized literature regarding exchange rate volatility and its impact on fundamental variables, as inflation and growth, is extensive and still growing; see, for instance: Engle and Kroner (1995), Calvo and Reinhart (2000a and 2000b), and Devereux and Engle (2002), among many others. Most research has been concerned with identifying potential relationships among exchange rate volatility, inflation volatility, and output growth prospects, which can be attributed either to short-term market conditions, such as arbitrage strategies, rebalancing portfolios, and speculative positions, or longer-term market conditions, such as equilibrium relationships.

The main objective of this research is to assess the impact of exchange rate volatility on the volatility of inflation expectations and growth prospects in Mexico during the period 2002-2014. This could shed some light on the degree of influence of monetary policy on foreign exchange rate volatility, which, in turn, may explain the impact on other expectation variables; see, for instance, Barro and Gordon (1983) and Bleaney and Fielding (2002).

Most of the literature on the subject is based on Autoregressive Conditional Heteroscedastic (ARCH) and Generalized Autoregressive Conditional Heteroscedastic (GARCH) models. For example, proposals from Engle (1982), and Bollerslev (1990) allow the conditional variance to change over time as a function of past errors, leaving the unconditional variance constant.

Also, in Shephard and Andersen (2009) the topic is analyzed under the framework of stochastic volatility. Caporale and Pittis (1995) use parametric measures of persistence to estimate volatility based on ARCH models under several exchange rate regimens. Hammoudeh and Li (2008) show the importance of incorporating exchange rate regime shifts. Finally, Backus and Kehoe (1992) study the dynamics of the real exchange rate volatility in OECD countries.

It is also important to examine whether there is causality in the degree of response of the volatility of the exchange rate and inflation expectations. To do this, it would be useful to analyze whether there is a transfer not only unidirectional (exchange rate to expectations), but also bidirectional (expectations towards exchange rate); the latter raises the important issue of causality. That is, if the degree of influence from one direction to the other is not the same. Another contribution of this investigation is the estimation of econometric models to find empirical evidence on the subject for the Mexican case. We will be using a multivariate GARCH model[1]. Specifically, we will be using the BEKK model (Baba, Engle, Kraft, and Kroner, 1990), which provides a richer dynamic structure. This approach will be applied in section 1.

This paper is organized as follows: next section presents the econometric methodology and specifies the model that is used to analyze the effect of exchange rate volatility on inflation expectations and growth prospects in Mexico; section 2 shows the descriptive statistical analysis and the estimation model; section 3 presents and discusses the estimation results; finally, section 4 provides conclusions and acknowledge limitations.

1. Methodology and Model Specification

In this section a multivariate GARCH, the BEKK model is proposed to assess the impact of the exchange rate volatility on expectations for the Mexican case during the period 2002-2014 with monthly data.

1.1. BEKK Model

Before detailing the technical aspects of the BEKK model, it is important to state its main advantages. This is a very useful model in the research on volatility of financial variables, which has statistical robustness, especially in comparing it with other similar models. For example, the estimation of the BEKK requires that the variance-covariance matrix be positive definite. This

[1] See Engle (2002).

ensures that the estimated variances are always positive, which makes statistical sense in forecasting models linked with volatility. Other related models like the VECH or Diagonal-VECH have the limitation that they do not ensure that the variance-covariance matrix be positive definite. Therefore, it is possible to estimate negative variances, which makes no statistical sense. In Addition to the above, the model BEKK can incorporate additional tests of statistical robustness, such as Wald test coefficient restriction. This test is useful to find out whether there is joint statistical significance of the coefficients that are relevant to capture the effect of volatility from one variable to another. We next formulate the hypotheses to be tested in this research:

1) H_0: There is no statistical relationship between the effect of the volatility of the exchange rate and the volatility inflation expectations and growth in Mexico.
2) H_0: There is no statistical relationship symmetric (bidirectional) between the volatility of the exchange rate and the volatility of inflation expectations and growth in Mexico.

Alternative hypotheses for each of the above scenarios would be affirmative. Regarding the specification of the variance there are different possibilities such as the Diagonal-Vec (Bollerslev, Engle, and Wooldridge, 1988), the BEKK restriction (Engle and Kroner, 1995), and the dynamic conditional correlation (Engle, 2002). However; only convergence is achieved with the BEKK restriction and it also provides more robust estimates.

It is worth mentioning that the use of a multivariate GARCH model for our analysis has several advantages since it allows the estimation of conditional variances and covariances for the time series under study. These time series exhibit ARCH-effects with monthly frequency. That is, the series under study have ARCH-effects[2]. The estimates will be robust if the diagnostic test is satisfactory. This could be observed if the standardized residuals from the estimated model are *i.i.d*. The obtained results in this research are consistent with such a condition when looking at the correlogram of the standardized residuals and seeing that only few coefficients are statistically significant; showing no structure in the data.

1.2. Model Specification

The BEKK model from Engle and Kroner (1995) is solved as a system of equations taking into account essentially the equation of the mean and the

[2] These estimations are perform with an ARCH-LM test (Engle, 1982) and available upon the readers request.

variance. Errors in the multivariate case evolve as a multivariate normal distribution, *i.e.*,

$$\varepsilon_t \big| I_{t-1} \sim N(0, H_t) \tag{1}$$

where ε_t is the error or innovation vector, which come from the data returns *i.e.*, the returns minus its mean value (returns usually have a mean value of zero, therefore ε_t are basically the returns of the analyzed series), I_{t-1} is the set of all available information (historical) at time *t-1*, and H_t stands for the variance-covariance matrix. The model is usually expressed in a quadratic form as follows:

$$H_t = \omega\omega' + \sum_{i=1}^{q} \alpha(\varepsilon_{t-i}\varepsilon'_{t-i})\alpha' + \sum_{i=1}^{p} \beta H_{t-i}\beta' \tag{2}$$

In the above equation, the first component of the right-hand side of the equation is a symmetric and positive definite matrix. The second and third components are expressed in quadratic form, which ensures that the left-hand side of the equation is always positive.

The BEKK model estimates 11 parameters. The relevant equations of the model are shown below, and the parameters representing the transfer of volatility from one series to other are marked with circles, here the subscripts take values $i = 1$, $j = 2$;

$$H_{11} = \omega_{11} + \alpha_{11}^2\varepsilon_1^2 + 2\alpha_{11}\alpha_{21}\varepsilon_1\varepsilon_2 + \alpha_{21}^2\varepsilon_2^2 + \beta_{11}^2 H_{11} + 2\beta_{11}\beta_{21}H_{12} + \beta_{21}^2 H_{22} \tag{3}$$

$$\begin{aligned} H_{22} &= \omega_{13} + \alpha_{12}^2\varepsilon_1^2 + 2\alpha_{12}\alpha_{22}\varepsilon_1\varepsilon_2 + \alpha_{22}^2\varepsilon_2^2 + \beta_{12}^2 H_{11} + 2\beta_{12}\beta_{22}H_{12} + \beta_{22}^2 H_{22} \\ &+ (\beta_{12}\beta_{21} + \beta_{11}\beta_{22})H_{12} + \beta_{21}\beta_{22}H_{22} \end{aligned} \tag{4}$$

$$H_{12} = H_{21} = \omega_{12} + \alpha_{11}\alpha_{12}\varepsilon_1^2 + (\alpha_{12}\alpha_{21} + \alpha_{11}\alpha_{22})\varepsilon_1\varepsilon_2 + \alpha_{21}\alpha_{22}\varepsilon_2^2 + \beta_{11}\beta_{12}H_{11} \tag{5}$$

where the coefficients of cross products with pairs have subscripts 1 and 2. It is important to mention that H_t is positive definite only if either ω or β has full rank and that equations (3)-(5) satisfy[3] $q = p = 1$. The information criteria test is performed in order to choose the correct equation order.

The diagnostic model is improved if statistical robustness tests are incorporated. In this case, a test of joint statistical significance is performed for the relevant coefficients, thus

$$H_0: a_{12}=a_{21}=b_{12}=b_{21}=0 \tag{6}$$

To test the above hypothesis, the joint hypothesis, it will be used the standard Wald test coefficient restriction by using the method of maximum likelihood estimation. With this type of robustness test it is then possible to observe statistically that the relevant coefficients under study (those that show the cross-influence) are jointly statistically different from zero in case of a rejection of the null hypothesis. Notice that the BEKK model is estimated by maximizing the following objective logarithmic likelihood function (under the assumption that errors have a normal distribution)

$$l(\theta) = \frac{TN}{2}\log 2\pi - \frac{1}{2}\sum_{t=1}^{T}\left(\log\left|H_t\right| + \varepsilon_t' H_t^{-1}\varepsilon_t\right) \tag{7}$$

where θ is a vector containing the parameters, N=2 is the number of variables examined with a bivariate specification, and T is the total number of observations. This algorithm is provided by Berndtand, Hall, Hall and Hausman (1974). Also, the BEKK model ensures that the results are statistically consistent: for example, the variances are positive, and given its quadratic accumulations it helps to detect volatility clusters. In what follows, tests of structural change as those from Andrews (1993), Quandt (1960) will be performed[4].

2. Statistical Analysis of Data

In order to obtain the coefficient estimates, we consider two periods. One of which is from January 2002 to September 2014 for a total of 151 monthly observations. For this subsample the data of the exchange rate and inflation

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[3] We thank an anonymous referee for asking us to clarify this point.
[4] Structural testing is referred to Andrews (1993).

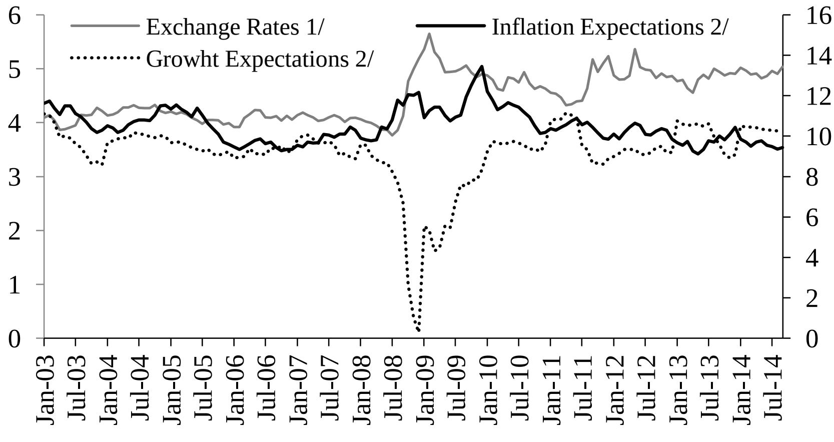
expectations are used. The other period is from January 2003 to September 2014. The total number of observations for this subsample is 140. The latter series of the exchange rate (FIX) of pesos *versus* US dollar is used on a monthly basis. The source of the data is the Bank of Mexico SIE. The series of inflation expectations is obtained from the central bank survey, which is a public report. The analysis in this research is mainly focused on the short-term period.

The data of growth prospects in Mexico is also obtained from the survey of central bank, which always considers the expectation for next year. As before, the study horizon is focused on the short-term period; there is also the possibility of considering the average expectations for each year in a horizon of 4-8 years.

Figures 1 and 2 showed below illustrate the series in levels and squared first differences; being the latter a “proxy” of the volatility. However, it is important to mention that for other authors, volatility is measured as the variance of the first differences, see for instance Engel and Rogers (2001). On the other hand, Levy-Yeyati and Sturzenegger (2001), Parsley and Wei (2001), Chen (2004), Hausmann, Panizza, and Stein (2001), and Bleaney and Fielding (2002) measure volatility as the deviation standard of the series. While Flood and Rose (1995) and Barone-Adesi and Yeung (1990) use volatility as the standard deviation of the first difference of the series in the sub-samples. However, we calculate it as the squared first differences for robustness.

Figure 1

Series in Levels (Pesos per Dollar, %)



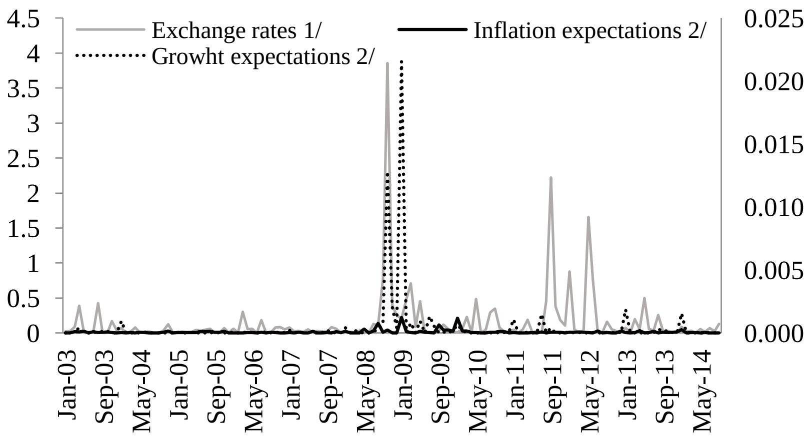
Note: 1 / Main shaft. 2 / Secondary Axis.
Source: Bank of Mexico.

Figure 1 shows the dynamics of the series under investigation. The series have a relatively stable dynamics even before the global financial crisis in 2008-2009. Once the crisis occurred at the end of 2008, we can see a sharp currency depreciation, which coincides with a rise in inflation expectations and a significantly marked decrease in growth prospects. Also, after the crash of 2008, a relative stabilization of the series can be appreciated, and it continues with a variation margin greater than that shown at the end of 2008.

Figure 2 shows the series in first differences squared of the expectations and squared log first differences for the exchange rate, truncated at 1%. Needless to say, Figure 2 shows volatility in all series. It can be seen that significant volatility is presented during the episode of the global financial crisis of 2008-2009. After that period it is observed high volatility, especially when compared with the sub-sample before the crisis. The latter is most notable for the series of expectations and to a lesser extent for the exchange rate. One possible explanation for the observed dynamics could be the post-crisis events, which also affected the markets with highly volatile; for example, the crisis of sovereign debt of the countries of the European periphery (Greece, Portugal, Ireland, Spain), and the crisis of US debt deficit in 2011.

Figure 2

First Differences Squared (%)



Note: 1 / Main shaft. 2 / Secondary Axis. To change the type of log first differences squared apply. 1% truncated Figure.
Source: Bank of Mexico.

In Table 1, we present some descriptive statistics. It can be seen that the kurtosis of growth prospects in levels is significantly higher than that in the other series since extreme movements in expectations in levels of the series have higher kurtosis. This makes sense given the volatility in economic activity in Mexico in recent years.

Table 1

Descriptive Statistics of Levels and First Differences Squared

(Pesos per Dollar, % s/u)

Serie	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	N
Levels							
Exchange rate	11.79	11.41	1.27	0.13	2.09	5.72*	153
Inflation expectation	3.96	3.91	0.32	0.60	3.07	9.24***	153
Growth expectations	3.43	3.53	0.62	-2.89	13.39	830.52***	141
Volatility Proxy							
Exchange rate	0.00	0.00	0.00	6.50	53.54	17248.38***	152
Inflation expectation	0.00	0.00	0.00	4.76	29.61	5058.04***	152
Growth expectations	0.09	0.00	0.75	10.91	124.72	89205.59***	140

Notes: *** / ** represents rejection of the null hypothesis of normality at 99% and 95% confidence level respectively by $\chi 2$ test (df). N = total number of observations.

Source: authors' estimates using data from Central Bank and *Eviews8.0*.

In analyzing changes in the squared first differences representing a proxy of volatility, we observed that the number of growth prospects shows a higher bias and higher kurtosis. Notice that none of the series approach to the normal distribution (according to the Jarque-Bera statistic). We next perform unit root tests and find that the series in levels are integrated of order one $I(1)$; while the series in differences are $I(0)$, see Table 2.

The fact that the series in differences are not distributed as a normal distribution is a stylized fact in volatility.

Table 2
Unit Root Tests

	Levels			Differences		
	Growth expectations	**Inflation expectations**	**Exchange rates**	**Growth expectations**	**Inflation expectations**	**Exchange rates**
Augmented Dickey-Fuller (ADF)	-3.195096	-2.573181	-3.071032	-9.946549	-10.5529	-11.07022
1. Test critical values:						
1% level	-4.025426	-4.019561	-4.019561	-2.581705	-2.580366	-2.580366
5% level	-3.442474	-3.439658	-3.439658	-1.94314	-1.942952	-1.942952
10% level	-3.145882	-3.144229	-3.144229	-1.615189	-1.615307	-1.615307
Dickey-Fuller GLS (ERS)	-2.759962	-2.184612	-2.675089	-9.897385	-10.41087	-11.09842
2. Test critical values:						
1% level	-3.5332	-3.5176	-3.5176	-2.581705	-2.580366	-2.580366
5% level	-2.991	-2.978	-2.978	-1.94314	-1.942952	-1.942952
10% level	-2.701	-2.688	-2.688	-1.615189	-1.615307	-1.615307
Phillips-Perron (PP)	-2.916637	-2.757641	-3.071032	-9.762609	-10.49323	-11.05487
3. Test critical values:						
1% level	-4.024935	-4.019561	-4.019561	-3.477835	-2.580366	-2.580366
5% level	-3.442238	-3.439658	-3.439658	-2.882279	-1.942952	-1.942952
10% level	-3.145744	-3.144229	-3.144229	-2.577908	-1.615307	-1.615307
Kwiatkowski-Phillips-Schmidt-Shin (KPSS)	0.168218	0.137473	0.065955	0.075559	0.051239	0.039468
4. Test critical values:						
1% level	0.216	0.216	0.216	0.739	0.739	0.739
5% level	0.146	0.146	0.146	0.463	0.463	0.463
10% level	0.119	0.119	0.119	0.347	0.347	0.347
Elliott-Rothenberg-Stock Point-Optimal (ERS-PO)	6.464871	10.79757	7.438418	0.360094	0.34644	0.36986
5. Test critical values:						
1% level	4.1739	4.1487	4.1487	1.934	1.9292	1.9292
5% level	5.6482	5.6506	5.6506	3.134	3.1412	3.1412
10% level	6.8187	6.8271	6.8271	4.234	4.2532	4.2532
Ng-Perron (NP)	0.17869	0.23579	0.19447	0.08607	0.08239	0.08149
6. Test critical values:						
1% level	0.143	0.143	0.143	0.174	0.174	0.174
5% level	0.168	0.168	0.168	0.233	0.233	0.233
10% level	0.185	0.185	0.185	0.275	0.275	0.275

Notes: the optimal lag lengths for the tests were chosen based on the SC. We used a regression including intercept and time trend for tests in the levels series. On the other hand, we used a regression including only intercept for the tests on series with Differences.
Source: authors' estimates using data from Central Bank and Eviews8.0.

3. Analysis of empirical results

In this section the results from the BEKK model are shown in both directions. Subsequently, the test Wald test is carried out on the coefficients. The estimated coefficients and their statistical significance are provided, and, finally, tests of structural change are performed.

Table 3
Coefficient Estimates

Estimated coefficient	***tc* hits *ei***	***ei* hits *tc***	**Estimated coefficient**	***tc* hits *ei***	***ei* hits *tc***
ω_1	0.0011	0.0229	α_4	0.0938	-0.3397
	0.002	(0.0128)**		(0.0168)***	-0.3016
	0.541	*2.2784*		*5.5613*	*-1.1264*
ω_2	-0.0129	0.0021	β_1	0.81605	0.9203
	0.0099	-0.0079		(0.06756)***	(0.0536)***
	-1.302	*0.2761*		*12.0776*	*17.1557*
ω_3	0.0007	0.0064	β_2	0.93721	0.7872
	3.1628	-0.0056		(0.0492)***	(0.0597)***
	0.0002	*1.1488*		*19.048*	*13*
α_1	0.3912	0.2529	β_3	0.34011	-0.03
	(0.0956)***	(0.0922)***		-0.2473	-0.022
	4.0925	*2.7431*		*1.3748*	*-1.3581*
α_2	0.1905	0.4708	β_4	-0.03634	0.341
	(0.0980)**	(0.0920)***		(0.0181)**	-0.3575
	1.9431	*5.1173*		*-1.9996*	*1.0101*
α_3	-0.3318	0.0837	**L**	452.0322	454.7653
	(0.2633)*	(0.0232)***	**AIC**	-5.8537	-5.8902
	-1.26	*3.6082*	**N**	150	150

Notes: estimates following the method of Engle and Kroner (1995). tc = exchange rate. i = inflation expectations. d.f. = degrees of freedom. Equal test Wald coefficients is performed with a $\chi2(1)$ distribution. The critical value at 10% confidence level for $\chi2(1)$ is 2.706.
*** / ** / * Statistical significance at 1%, 5% and 10% respectively. N = 150.
Source: authors' estimates using data from Banco de Mexico and Eviews8.0

Regarding the estimated BEKK model, in which the statistical relationship between exchange rate volatility and volatility variables are quantified, table 3 shows that the estimated coefficients relevant to the measurement of the transfer between the volatilities, a_{34} and b_{34}, are statistically significant, which is consistent with the exchange rate pass-through inflation expectations (column 2). This results hold for the whole sample period. The difference in sample sizes are related with data limitations *i.e.*, different number of observations for the economic activity variable.

The above results are confirmed by the Wald test coefficient restriction, which indicates that the relevant coefficients are jointly statistically different from zero (see Table 5). The transfer of volatile inflation expectations to the volatility of the exchange rate is statistically significant. This result does not reject the null hypothesis of coefficients. The intuition behind this result is related to an exchange market affecting the volatility of expected inflation, but not *vice versa*. Table 4 shows that the transfer coefficients are not different from zero.

Table 4
Results of Estimates from the BEKK Model

Estimated coefficient	***tc* hits *pc***	***pc* hits *tc***	**Estimated coefficient**	***tc* hits *pc***	***pc* hits *tc***
ω_1	0.0043	0.1037	α_4	-0.0218	-0.02
	-0.0121	(0.0160)***		-0.0157	(-0.0195)
	0.3598	*6.471*		*-1.3856*	*-0.7831*
ω_2	0.1341	0.0077	β_1	0.8624	0.4152
	-0.4827	-0.0102		(0.1101)***	(0.1529)***
	0.2777	*0.7627*		*7.8321*	*2.7144*
ω_3	0.0142	0.0001	β_2	0.3913	0.8727
	-4.4582	-0.016		(0.2147)*	(0.0990)***
	0.0032	*0.0001*		*1.8218*	*8.8068*
α_1	0.5279	0.9282	β_3	-1.8383	0.0201
	(0.0854)***	(0.0754)***		(-1.3002)	-0.0182
	7.8321	*12.3078*		*-1.004*	*1.006*
α_2	0.61	0.4157	β_4	0.0202	-1.4212
	(0.1487)***	(0.1150)***		(0.0240)***	(-1.2452)
	4.1019	*3.613*		*0.8425*	*-1.1414*
α_3	-1.8383	-0.0442	**L**	341.8296	332.1558
	(-0.8517)**	(0.0248)*	**AIC**	-4.7314	-4.5921
	-2.1581	*-1.7906*	**N**	139	139

Notes: estimates following the method of Engle and Kroner (1995). tc = exchange rate. pc = growth prospects. d.f. = degrees of freedom. Equal test Wald coefficients is performed with a $\chi 2$ (1) distribution. The critical value at 10% confidence level for $\chi 2$ (1) is 2.706. *** / ** / * Statistical significance at 1%, 5% and 10% respectively. N = 139.
Source: authors' estimates using data from Banco de Mexico and *Eviews8.0*.

The significant negative coefficients can be explained according to the argument of Albuquerque and Portugal (2006). These authors explain that in scenarios of high volatility of the exchange rate, the prices in the domestic market are not sufficiently volatile due to the costs facing businesses to move their prices (menu costs).

When volatility of the exchange rate decreases, it is observed a relatively greater volatility in prices in the domestic market because operators can adjust their prices more comfortably in a less volatile exchange scenario. It should be pointed out that the use of conditional variances (or conditional volatility) is common practice in the literature (see Bollerslev, Chou and Kroner, 1992).

Table 5
Wald Test Coefficient Restriction

Results Wald test coefficient restriction	H_0: Together all coefficients are zero ($\alpha(3)=0$ and/or $\alpha(4)=0$ and/or $\beta(3)=0$and/or $\beta(4)=0$). H_1: All coefficients are non-zero whole ($\alpha(3)\neq 0$ and/or $\alpha(4)\neq 0$ and or $\beta(3)\neq 0$ and/or $\beta(4)\neq 0$).
Exchange rate volatility explains the volatility of inflation	Statistical (m = number of constraints): $\chi^2_{m=4}$ =33.30221 *P*-value =0.0000
Inflation volatility explained volatility of the exchange rate	Statistical (m = number of constraints): $\chi^2_{m=4}$ =16.8627 *P*-value =0.0021
Exchange rate volatility explains growth expectations	Statistical (m = number of constraints): $\chi^2_{m=4}$ =14.0307 *P*-value =0.0072
Volatility of expected growth explains the volatility of the exchange rate	Statistical (m = number of constraints): $\chi^2_{m=4}$ =6.3777 *P*-value =0.1727

Source: author's own elaboration with *Eviews8.0*.

Finally, following the methodology of Andrews-Quandt (1993), the test of structural change shows that for the three series a statistical breakdown is observed around the end of 2008. The series of exchange rate volatility identified in November 2008. For the series of volatility of inflation expectations a statistical breakdown is identified in August 2008. Finally, the series of volatility growth prospects has a statistical breakdown in December 2008. For all the above tests were considered the statistical *F* and 15% are truncated, this by following suggestions from Bai and Perron (2003). Broadly speaking, the results are quite intuitive, since they show that the crash happens during the 2008 crisis, a situation that makes sense considering the sharp magnitude of the event[5].

Conclusions

This research has shown the impact of exchange rate volatility on the volatility of inflation expectations and growth prospects in Mexico. We examined causality in terms of the degree of response of the volatility of the exchange rate and inflation expectations. Another contribution of this investigation is the use of econometric models to find empirical evidence of these relations for the Mexican case during the period 2002-2014. In particular, we used a multivariate GARCH model, namely the BEKK model proposed by Baba, Engle, Kraft, and Kroner (1990) and Engle and Kroner (1995).

The findings of this study are summarized as follows: 1) there is a statistically significant relationship between exchange rate volatility and the volatility of inflation expectations; 2) there is no statistical relationship going the other way around, *i.e.*, the volatility of inflation expectations towards the exchange rate volatility; 3) the relationship between the transfers of exchange rate volatility to the volatility of the growth prospects is not statistically significant; this applies in both directions. These results provide important information that could be used in monetary policy design since analyzing inflation volatility is relevant for the monetary authority decisions, which may explain the impact on other expectation variables in the sense of Barro and Gordon (1983), and Bleaney and Fielding (2002).

Structural breaks were observed, as it is to be expected considering the magnitude of the shock during the financial crisis of late 2008. The results also showed that there are many implications for monetary policy decisions. This can be appreciated from the degree of transfer (or impact) of the volatility of one variable over the other. In future extensions of this research we could include elements from the models in Berndtand *et al*. (1974) and Engle (2002). The link from exchange rate volatility to inflation may be explored in an international perspective as Kocenda and Poghosyan (2009). These authors find that EU inflation is an important determinant of the exchange rate risk in several European emerging markets.

[5] In this paper for the sake of brevity the above estimates are not presented but would be available on request from the reader.

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