The Inflation-Output Volatility Tradeoff and Exchange Rate Shocks in Mexico and Turkey

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Abstract

Using a standard Vector Autorregresion with Autocorrelated Time Varying Covariances this paper finds evidence of a vertical inflation-output volatility tradeoff in Mexico and Turkey. It is found, contrary to common economic wisdom, that there is no tradeoff between output and inflation so that monetary policy affects only prices. In addition, it is observed that the exchange rate crucially affects the dynamics of prices, inflation and output. The pass-through from exchange rate to inflation is high and significant in both economies and periods of high exchange rate volatility are associated with unstable rates of inflation. Also, in agreement with many other studies, it is shown here that nominal depreciations are contractionary

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1. Introduction

Perhaps due to the promise of long-run economic growth, low and stable inflation has been regarded as the ultimate goal of monetary policy by both Central Banks (CB) and international creditors. This has been particularly true in Emerging Markets (EM) where monetary regimes have been subject to periodic changes: from the intermediate targeting of exchange rates and money, to the increasingly popular Inflation Targeting (IT) regimes in which CB explicitly announce the targets of inflation for some periods ahead and are fully accountable.

Attention has already been devoted to the study of inflation stabilization and the impact on output variability in developed markets. One of the first proposals to examine the inflation-output variability tradeoff was made by (Taylor 1994) who suggested that monetary authorities attempts to keep prices stable may cause production to fluctuate more, while attempts to smooth the production cycle may induce a higher variability in prices.

(Ceccheti 1999) has examined the experience of industrial and developing countries using inflation targets. Among other findings, he observes that countries that have introduced targets to inflation have also increased their revealed aversion to inflation variability and more likely suffered increases in output volatility as a result.

The study made by (Fuhrer 1997) for the US suggests that the existence of a short run tradeoff (in levels) between inflation and output implies a long run tradeoff in variability. By estimating an optimal policy frontier, i.e., the set of efficient weighted combinations of inflation and output variances, they find that output (inflation) variances increase substantially when policy attempts are devoted to reduce inflation (output) variability.

While there is now strong evidence in favor of the successful achievement of inflation stabilization in many EM[1], the resulting stability or likely instability of output in these economies is as yet to be examined. We investigate here the existence of an inflation-output volatility tradeoff and the role of the nominal exchange rate in two developing countries. The first one, Mexico, has recently introduced an explicit IT and the second, Turkey, is currently undertaking policies

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[1] See (Schmidt-Hebbel and Werner 2002) for more on this.

consistent with this monetary framework. Both economies officially pursue floating exchange rate regimes.

The results found in this paper add up in general to the now widespread view that there is no long-run volatility tradeoff between output and inflation so that monetary policy affects only prices in the long run. They are also consistent with the proposition that low and stable inflation may, at best, promote economic growth stability -see (Bernake and Mishkin 1997). The vertical shape of the tradeoff curve and the potentially positive slope in Mexico and Turkey respectively are explained, in agreement with the models of (Masson et. al. 1998) and (Sargent 1999), as the likely consequence of the changing beliefs of policy makers and of the frequent occurrence of internal and foreign shocks.

In addition, it is observed that the exchange rate crucially affects the dynamics of prices and output. Despite the voices claiming that the size of the pass through has diminished in the last few years in Mexico, our results indicate a high and significant association of these two variables for this country and for EM. Also, in agreement with many other studies, it is shown here that nominal depreciations are contractionary.

We divide the paper as follows: In the second section we give a brief description of the relevant economic features of both Mexico and Turkey. In section three we present the methods employed to obtain our tradeoff measures. In particular, we present a standard Vector Autorregression (VAR) with Generalized Autorregressive Conditional Heteroscedastic (GARCH) disturbances known in the literature as the BEKK model. In section four we present the data analysis, description of the individual time series and a causality analysis. Section five shows the estimation results including impulse response functions. The main findings and policy implications are outlined in the last section.

2. Brief Economic Review of Mexico and Turkey

The aim of this section is to describe the evolution of some key variables in Mexico and Turkey in the transition to the floating exchange rate regimes.

2.1. The Mexican Context

The devaluation of the Peso in December 1994 was the end of a long period of exchange rate-based stabilization programs in Mexico in which the spot rate was employed as the nominal anchor. In the years that followed, the exchange rate has experienced a dirty floating in which destabilizing pressures and sudden shocks have been consistently controlled by direct and indirect mechanisms of intervention.

In the aftermath of the crisis of 1995 and under rather adverse global conditions, the monetary authorities started to set "soft" inflation objectives that constituted, it is now clear, the primitive form of the explicit Inflation Targeting (IT) framework formally initiated in 1999. Explicit inflation targets for the short and medium term have been established and a long term stable inflation level of around 3 percent[2] is expected for 2003. Volatility intervals have also been set at +/ - one percentage point.

Possibly to maintain consistency with IT, the direct intervention of the Banco de México in the foreign exchange market via sales and purchases was finally abandoned in June 2001. Despite the absence of direct targeting of interest or exchange rates, Banco de Mexico still uses an *indirect* mechanism of intervention in the money market known as the 'short' that has proved to be successful in increasing interest rates and controlling inflation in the long run.[3]

Although, interest rates are said to be market determined, the Banco de México has intervened in the money market when interest rates appear inconsistent with the accomplishment of the target of inflation. There seems in fact to exist a synchronization of these money market operations and the behavior of the nominal exchange rate. Indeed, monetary policy seems to react to nominal exchange rate shocks. The effect of the exchange rate not only on inflation but also on output volatility in Mexico will be investigated below.

2.2. The Turkish Scene

The Turkish economic experience during the eighties and nineties can be broadly described, as in many other EM (Mexico included), by the implementation of stabilization programs based on targeting exchange rates, along with a set of measures leading to the liberalization of the external sector, to a structural reform and to fiscal discipline.

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[2] The annual inflation in 1995 and 1996 was at levels around 50 percent.

[3] The 'short' is the liquidity stance of the Banco de México indicating the amount of cash it is willing to satisfy at market rates. It serves as a signal to the market of the restrictive or expansionary monetary policy intents. For a thorough revision of this tool and the Mexican monetary framework under a floating exchange rate regime see (Carstens and Werner 1999).

Different exchange rate arrangements have been tried in the past to stabilize inflation. However, the intermediate objective of the authorities after the devaluation of February 22nd, 2001, has been first of all to recover credibility and to build up confidence in the financial system. It is said now that the monetary policy in Turkey is in transition to Inflation Targeting.

Indeed, price stability continues to be the primary objective of the monetary policy as a prerequisite for achieving long term growth. An important step towards IT is the pre-announcement of "soft" inflation targets. The monetary authority expects for instance to end 2002 with an inflation rate of 35%, to achieve 20% in 2003 and to finally reach one-digit levels by 2005.

The autonomy of the Central Bank was granted by the parliament on the 25 of April 2001, just months after the authorities let the Lira float. There have been also critical amendments to the law to ensure instrument independence, accountability and transparency.[4]

Despite all these important changes there seem to remain unresolved credibility issues. Arguably, the main impediment of IT in Turkey so far has been, as (Duman 2002) notes, fiscal dominance. The high levels of external debt and subsequent payments have left little room for fiscal adjustment. The use of expansionary policies to fight recessionary effects on output may be generating inflationary pressures. What is more, this phenomenon may be behind a potential positive tradeoff between output and inflation.

The exchange rate dynamics in Turkey, as well as in many other Emerging Markets, remains of critical importance due the potential effects on inflation and output growth. For instance, in contrast with (Schmidt-Hebbel and Werner 2002) who have recently reported that the exchange rate pass-through seems to have reduced in the last few years in Mexico, (Lim and Papi 1997) and (Agenor and Hoffmaister 1997) have found for Turkey that the pass-through is in fact rapid and effective and should be viewed as an important determinant of inflation.

3. Modeling Inflation/Output Variability

In this section we present the standard Vector Autorregression (VAR) with multivariate Generalized Autorregressive Conditional Heteroscedastic (GARCH)

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[4] See Monetary Policy Reports of the Central Bank of the Republic of Turkey 2002 at www.tcmb.gov.tr.

disturbances used to derive a measure of the inflation-output volatility tradeoff and to examine the role of the nominal exchange rate in these countries.

3.1. VAR-GARCH Models

Let us denote $\mathbf{y}_t=[g_t,\pi_t,e_t]$ as the vector of stationary random variables -output growth, inflation and the rate of depreciation respectively - and $\boldsymbol{\varepsilon}^2_t=[\varepsilon_{1t},\varepsilon_{2,t},\varepsilon_{3,t}]$ the vector of disturbances or shocks with zero means and constant variances. The standard fourth order vector autorregression VAR(4) for these variables is represented as

$$y_t=c+\phi_1 y_{t-1}+\phi_2 y_{t-2}+\phi_3 y_{t-3}+\phi_4 y_{t-4}+\varepsilon_t \qquad (1)$$

$$\begin{bmatrix} g_t \\ \pi_t \\ e_t \end{bmatrix}=\begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix}+\begin{bmatrix} \phi_{1,11}\phi_{1,12}\phi_{1,13} \\ \phi_{1,21}\phi_{1,22}\phi_{1,23} \\ \phi_{1,31}\phi_{1,32}\phi_{1,33} \end{bmatrix}\begin{bmatrix} g_{t-1} \\ \pi_{t-1} \\ e_{t-1} \end{bmatrix}+\begin{bmatrix} \phi_{2,11}\phi_{2,12}\phi_{2,13} \\ \phi_{2,21}\phi_{2,22}\phi_{2,23} \\ \phi_{2,31}\phi_{2,32}\phi_{2,33} \end{bmatrix}\begin{bmatrix} g_{t-2} \\ \pi_{t-2} \\ e_{t-2} \end{bmatrix}$$

$$+\begin{bmatrix} \phi_{3,11}\phi_{3,12}\phi_{3,13} \\ \phi_{3,21}\phi_{3,22}\phi_{3,23} \\ \phi_{3,31}\phi_{3,32}\phi_{3,33} \end{bmatrix}\begin{bmatrix} g_{t-3} \\ \pi_{t-3} \\ e_{t-3} \end{bmatrix}+\begin{bmatrix} \phi_{4,11}\phi_{4,12}\phi_{4,13} \\ \phi_{4,21}\phi_{4,22}\phi_{4,23} \\ \phi_{4,31}\phi_{4,32}\phi_{4,33} \end{bmatrix}\begin{bmatrix} g_{t-4} \\ \pi_{t-4} \\ e_{t-4} \end{bmatrix}+\begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \end{bmatrix}$$

The coefficients $\phi_{p,ij}$ with $p=1,..,4$ and $i,j=[1,2]$ measure the impact of past values of output growth and inflation respectively on the time path of both variables. For instance, $\phi_{1,11}$ is the first order autoregressive term of industrial production while $\phi_{1,12}$ measures the effect of past values of inflation on the current values of industrial production. A similar interpretation is given for the rest of the parameters and also for the higher order coefficients.

The representation in equation (1) can be further restricted to the case where the off-diagonal elements are zero. In such a case, excluding the constant terms, the system now contains half of the parameters and equation (1) becomes:

$$\begin{aligned} g_t&=c_1+\phi_{1,11}g_{t-1}+\phi_{2,11}g_{t-2}+\phi_{3,11}g_{t-3}+\phi_{4,11}g_{t-4}+\varepsilon_{1t} \\ \pi_t&=c_2+\phi_{1,22}\pi_{t-1}+\phi_{2,22}\pi_{t-2}+\phi_{3,22}\pi_{t-3}+\phi_{4,22}\pi_{t-4}+\varepsilon_{2t} \qquad (2) \\ e_t&=c_3+\phi_{1,33}e_{t-1}+\phi_{2,33}e_{t-2}+\phi_{3,33}e_{t-3}+\phi_{4,33}e_{t-4}+\varepsilon_{3t} \end{aligned}$$

Additionally, a restricted standard second order VAR(2) can also be estimated and in such a case we have:

$$g_t=c_1+\phi_{1,11}g_{t-1}+\phi_{2,11}g_{t-2}+\varepsilon_{1t}$$

$$\pi_t=c_2+\phi_{1,22}\pi_{t-1}+\phi_{2,22}\pi_{t-2}+\varepsilon_{2t} \qquad (3)$$

$$e_t=c_3+\phi_{1,33}e_{t-1}+\phi_{2,33}e_{t-2}+\varepsilon_{3t}$$

Stability and stationarity conditions for the second and fourth order autorregression are derived by solving the following expressions respectively:

$$|\lambda^2 I-\lambda\phi_1-\phi_2|=0 \qquad (4)$$

and

$$|\lambda^4 I-\lambda^3\phi_1-\lambda^2\phi_2-\lambda\phi_3-\phi_4|=0 \qquad (5)$$

It is required that the roots (λ_i) of this expression are less than one in absolute value.

For the variance equation we relax the assumptions of constant variances and time independence. Let us assume that and $\boldsymbol{\varepsilon}_t=[\varepsilon_{1t},\varepsilon_{2,t},\varepsilon_{3,t}]$ is conditional on the past $\boldsymbol{\psi}_{t-1}$ so that the tri-variate GARCH model can be specified as:

$$\boldsymbol{\varepsilon}_t|\boldsymbol{\psi}_{t-1}\sim D(0,H_t) \qquad (6)$$

where H_t is the $3X3$ variance-covariance matrix

$$H_t=\begin{bmatrix} h_{11,t}h_{12,t}h_{13,t} \\ h_{21,t}h_{22,t}h_{23,t} \\ h_{31,t}h_{32,t}h_{33,t} \end{bmatrix}$$

If we consider $\boldsymbol{\varepsilon}_t=\xi_t\sqrt{H_t}$ an explicit generating equation for GARCH processes, where ξ_t denotes an *i.i.d.* random vector with mean zero and covariance matrix the identity matrix I_n, it would be evident that

$$E(\boldsymbol{\varepsilon}_t|\boldsymbol{\psi}_{t-1})=E(\xi_t)\sqrt{H_t}=0 \text{ and } Var(\boldsymbol{\varepsilon}_t|\boldsymbol{\psi}_{t-1})=H_tVar(\xi_t)=H_t.$$

A critical task is to formulate a suitable specification for H_t which allows each element in H_t to depend on q lagged values of the squares and cross products of the elements in $\boldsymbol{\varepsilon}_t$ and on the p lagged values of the elements in H_t.

Different formulations are possible, some of them are attractive to our purposes due the cross effects and covariances that could be used to analyze tradeoffs and transmission effects.[5] The VECH representation for instance would allow for such estimations but requires the computation of a large number of parameters. In order to estimate such a model one would have to impose some exclusion restrictions.

A sensible alternative for the VECH model would be to assume that the conditional variance depends only on its own lagged squared residuals and lagged values. This *Diagonal VECH* representation however has two drawbacks, first it does not allow us to have an idea of the volatility transmissions and second, as with the general VECH, the positive definiteness of the resulting H_t is not easy to check and it is often difficult to impose at the estimation stage –see (Engle and Kroner 1995).

3.2. Multivariate BEKK Model

We use instead a convenient alternative parametrization for H_t proposed by (Engle and Kroner 1995) which allows us to examine the direct dependence of the individual conditional variances on the history of its own and cross innovations, as well as on the association with their own and cross conditional variances. In the multivariate case the first order BEKK model, as it is known in the literature, becomes:

$$H_t = W_0^{*}{}'W_0^{*} + A_1^{*}{}'\varepsilon_{t-1}{}'\varepsilon_{t-1}A_1^{*} + B_1^{*}{}'H_{t-1}B_1^{*} \qquad (7)$$

where W_0^{*}, A_0^{*} and B_{11}^{*} are *nXn* parameter matrices with W_0^{*} triangular.

In their paper, (Engle and Kroner 1995) derived the conditions under which H_t is positive definite and the necessary and sufficient conditions for covariance stationarity of this multivariate GARCH representation. In turn, $\{\varepsilon_t\}$ is covariance stationary if and only if all the eigenvalues of $A_{11}^{*} \otimes A_{11}^{*} + B_{11}^{*} \otimes B_{11}^{*}$ are less than unity in modulus.[6] Due to the paired transposed matrix factor for each of the matrices, positive definiteness is achieved irrespective of the parameters in W_0^{*}, A_{11}^{*} .and B_{11}^{*}.

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[5] We do not explore all the properties of these models or the great variety of other multivariate GARCH formulations. For the processes to be presented here we refer the interested reader to the works by (Bera and Higgins 1993) or (Engle and Kroner 1995) whose work greatly influenced this section.

[6] In the univariate case the stationarity of a GARCH(1,1) process is achieved if the mean reverting parameter $(\alpha + \beta)$ is less than unity. Similarly, in bivariate Diagonal VECH models covariance stationarity is obtained when when $(\alpha_{ii} + \beta_{ii}) < 1$ for *i=1,2*. It is only in diagonal BEKK models that stationarity is also verified in a similar way, i.e., when the sum $(\alpha_{ii}^{*2} + \beta_{ii}^{*2})$ is less than one for all *i*. In non-diagonal models like the ones estimated here, we could have diagonal elements exceeding one yet the process be stationary. For a complete discussion on this matter we refer the reader to (Engle and Kroner 1995).

Identification of the model is achieved whenever the diagonal elements of W_0^* and the upper left elements of A_0^* and B_{11}^* are restricted to be greater than zero. The unconditional variance of this BEKK(1,1) representation is calculated as follows:

$$E[vec(\varepsilon_t\varepsilon_t')] = (I_{n^2} - A_{11}^* \otimes A_{11}^* - B_{11}^* \otimes B_{11}^*)^{-1} vec(W_0^*{}'W_0^*) \qquad (8)$$

In particular, we propose the following process to model the exchange rate depreciations and the inflation-output variability tradeoff:

$$H_t = W_0^*{}'W_0^* + \begin{bmatrix} a_{11}^* a_{12}^* a_{13}^* \\ a_{21}^* a_{22}^* a_{23}^* \\ a_{31}^* a_{32}^* a_{33}^* \end{bmatrix}' \begin{bmatrix} \varepsilon_{1t-1}^2 & \varepsilon'_{1t-1}\,\varepsilon_{2t-1} & \varepsilon'_{1t-1}\,\varepsilon_{3t-1} \\ \varepsilon'_{1t-1}\,\varepsilon_{2t-1} & \varepsilon_{1t-1}^2 & \varepsilon'_{2t-1}\,\varepsilon_{3t-1} \\ \varepsilon'_{1t-1}\,\varepsilon_{3t-1} & \varepsilon'_{2t-1}\,\varepsilon_{3t-1} & \varepsilon_{3t-1}^2 \end{bmatrix} \begin{bmatrix} a_{11}^* a_{12}^* a_{13}^* \\ a_{21}^* a_{22}^* a_{23}^* \\ a_{31}^* a_{32}^* a_{33}^* \end{bmatrix} \qquad (9)$$

$$+ \begin{bmatrix} \beta_{11}^* \beta_{12}^* \beta_{13}^* \\ \beta_{21}^* \beta_{22}^* \beta_{23}^* \\ \beta_{31}^* \beta_{32}^* \beta_{33}^* \end{bmatrix}' \begin{bmatrix} h_{11t-1} h_{12t-1} h_{13t-1} \\ h_{21t-1} h_{22t-1} h_{23t-1} \\ h_{31t-1} h_{32t-1} h_{33t-1} \end{bmatrix} \begin{bmatrix} \beta_{11}^* \beta_{12}^* \beta_{13}^* \\ \beta_{21}^* \beta_{22}^* \beta_{23}^* \\ \beta_{31}^* \beta_{32}^* \beta_{33}^* \end{bmatrix}$$

where the off-diagonal elements of A_0^* and B_{11}^* are usually interpreted as volatility transmissions and volatility tradeoffs respectively.

4. Data Analysis

4.1. Data Analysis and Description

Our aim is to model the short-run tradeoff between the variability of output and inflation as well as to identify the role of the nominal exchange rate. In tune with the studies of (Kim 2000), (Lee 2000), (Grier and Perry 1999) and (Grier et al. 2001), we use the monthly industrial production index, nominal exchange rate and the producer price index for Mexico from April 1987 to August 2003 with 197 observations and for Turkey from February 1987 to August 2003 with 199 observations. The Whole Price Index is used in Turkey.[7] The inflation, output growth and exchange rate depreciation series used for the analysis are obtained by taking the first log differences of the data. The time series are taken from the OECD database in Datastream.

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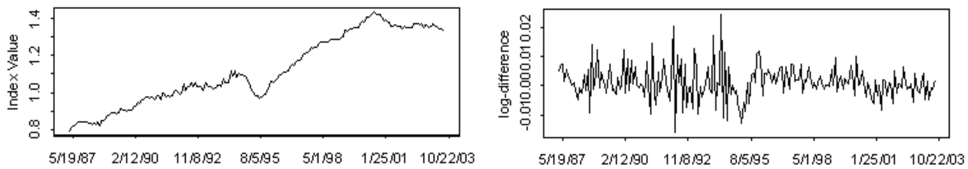
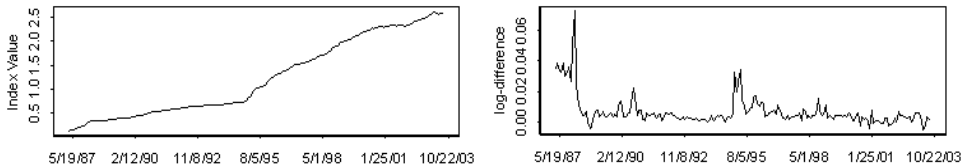
[7] In analyses of the inflation/output trade-off the following variables have been used in the literature: quarterly GDP per capita and GDP deflator as in (Fuhrer 1997); quarterly potential GDP and Consumer Price Index as in Lee (1999); monthly real GNP and wholesale price index as in (Koray 1993) and monthly industrial production and consumer price index as in (Lee 2000).

Figures 1 and 2 show the temporal behavior of production, prices, exchange rates as well as the growth of output, inflation and the rate of depreciation in Mexico and Turkey respectively.

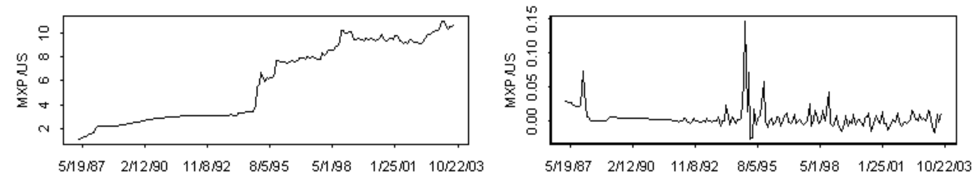
Fig. 1. Mexico. Inflation, Output and Exchange Rate Depreciation, April 1987-August 2003



(a) Industrial Production (b) Industrial Growth

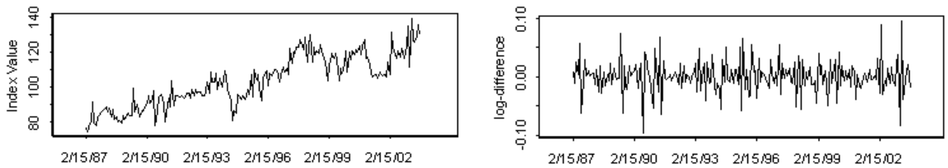


(c) Consumer Price Index (d) Rate of Inflation



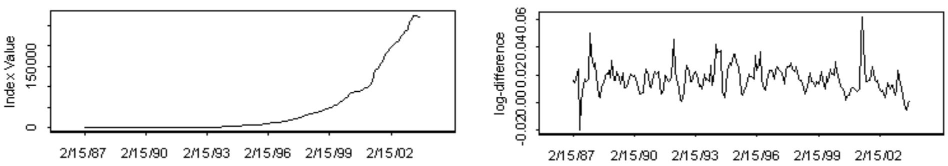
(e) Spot Exchange Rate (f) Rate of Depreciation

Fig. 2. Turkey. Inflation, Output and Exchange Rate Depreciation, February 1987-August 2003



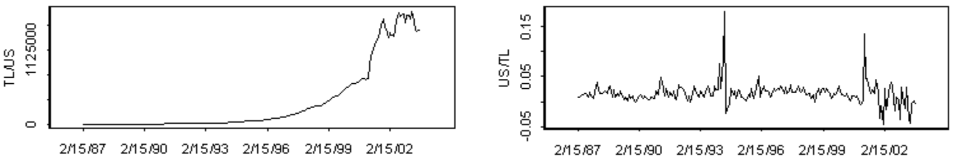
(a) Industrial Production

(b) Industrial Growth



(c) Whole Price Index

(d) Rate of Inflation



(e) Spot Exchange Rate

(f) Rate of Depreciation

Table 1 presents descriptive statistics of inflation and output growth. It is interesting to observe the similarity of the unconditional means of output growth in both countries which are, however, in contrast with the marked difference in their of volatility as measured by the unconditional standard deviations and statistical ranges. In general, the Turkish variables are more volatile than the Mexican counterparts. As indicated by the Shapiro-Wilk test for small samples, normality is only verified for the output growth in Mexico and for the inflation rate in Turkey.

Table 1
Descriptive Statistics for the Growth of Output (*g*), the Rate of Inflation (π) and Exchange Rate Depreciation (*e*) for Mexico and Turkey Respectively.

	Mean	Std. Dev.	Skewness	Kurtosis	SW[a]	Min.	Max.	n
$g_{mx;t}$	0.0012	0.0058	0.4374	1.6789	0.9747***	-0.0162	0.1469	197
$\pi_{mx;t}$	0.0067	0.0097	3.2397	13.666	0.6604	-0.0050	0.0245	197
$e_{mx;t}$	0.0050	0.0163	4.4593	30.645	0.6561	-0.0269	0.0727	197
$g_{tk;t}$	0.0012	0.0282	0.0197	1.4098	0.9783	-0.0960	0.0964	199
$\pi_{tk;t}$	0.0172	0.0098	0.6408	2.8524	0.9709**	-0.0194	0.0615	199
$e_{tk;t}$	0.0164	0.0213	2.8539	20.665	0.7767	-0.0446	0.1787	199

[a] Reject the null at the 1% level. Notes:a SW is the Shapiro-Wilk test for normality.

Although the presence of volatility clusters will be formally tested in the following section, with the exception of the volatility proxy of the Mexican Peso (MXP), there is preliminary evidence suggesting strong time dependency in levels (not shown) and their squared transformations for different orders -see Table 2 below.

Table 2
Ljung-Box Tests for the Presence of Autocorrelation in Output Growth (*g*), Inflation (π) and Exchange Rate Depreciation (*e*) in Mexico and Turkey

	Mexico			Turkey		
	$g^2_{mx,t}$	$\pi^2_{mx,t}$	$e^2_{mx,t}$	$g^2_{tk,t}$	$\pi^2_{tk,t}$	$e^2_{tk,t}$
Q(6)	19.14*	150.35*	12.75*	24.87*	50.22*	7.40
Q(12)	34.43*	171.15*	17.19*	44.59*	50.59*	7.92
Q(18)	39.10*	171.51*	17.83*	57.59*	51.97*	8.56

* Reject the null hypothesis at the 1% level. Notes: Q is the Ljung-Box statistic for autocorrelation.

The output from the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests is reported in Table 3. Standard unit root tests show that inflation rate, output growth and exchange rate depreciation are stationary processes in Mexico. In contrast, the same battery of tests reports mixed evidence for Turkey. In line with the findings of (Metin 1998) and (Özlale and Özcan 2003) the inflation rate appears non-stationary, while the depreciation of the exchange rate does not seem to reject the null at orders higher than six months as reported by ADF tests. Industrial growth in turn seems to be stationary.[8]

4.2. Causality Analysis

In order to explore the causality between inflation, output growth and the rate of depreciation, Table 4 shows the results from Granger causality tests applied to our variables for the whole sample, for the stabilization and for the floating exchange rate periods.[9] A first issue in this study is the association between output growth and inflation. Considering the overall and floating exchange rate sample periods in Mexico, there is a weak sign of causality running from inflation to output growth. This is consistent with the findings of (Nas and Perry 2001) who suggest that this could be the result of the high degrees of uncertainty embedded. This result would also point to a time inconsistency problem-previously analyzed by (Özlale and Özcan 2003)-in which the loss of credibility that emerges as result of discretionary

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[8] Given this contrasting evidence and to keep consistency with the Mexican case we do not carry out a cointegration analysis.

[9] Two proxies of volatility (squares and absolute transforms) were also tested but not shown to save space. The results are consistent with the conclusions drawn in this section.

incentives of the policy makers could have generated such relationship between these two variables.

Table 4 also reveals that exchange rate depreciation does Granger cause output in both countries-see overall sample. This result seems to be in line with the findings of (Kamin and Rogers 2000) for Mexico using real exchange rates and quarterly data. In fact, from the recent experience of devaluation in Mexico and Turkey we would expect that depreciations are contractionary. Interestingly, economic performance in Turkey influences the behavior of exchange rates-a positive sign should be expected.

Another concern in this paper is the role of the exchange rate in Emerging Markets during the new monetary frameworks. Despite the findings of some authors-see (Schmidt-Hebbel and Werner 2002) for instance-who found that cross correlations between inflation and the exchange rate have diminished in the last few years, the size of the pass-trough from exchange rate to inflation remains an important empirical issue to study. The tests presented here strongly indicate that lags of nominal exchange rate depreciation do help explain movements in the inflation rate in both countries-levels and volatility. There is in fact causality running from the exchange rate to inflation and a positive sign would be expected.

Similarly, there seems to be a weak suggestion of causality running from inflation to exchange rate depreciation. This would be much in line with the results of (Rittenberg 1993). The finding however would be difficult to defend on the basis of the tests reported here.

Two further insights can be drawn from this analysis. First, albeit the sustained causality from exchange rate depreciation to inflation in both subperiods, any association between these variables and output growth isunlikely to remain constant in time. Hence a time varying specification in levels and in volatilities needs to be employed. Second, the short nature of the sample data during the floating period, mainly for Turkey, calls also for an analysis on the overall sample to enhance the estimation and analysis.

Table 3
Augmented Dickey Fuller (ADF) and Phillips Perron (PP) Unit Root Tests

	ADF		PP	
	(6)	(12)	(6)	(12)
$g_{mx;t}$	-3.9320*	-3.8513*	-16.7998*	-17.0903*
$\pi_{mx;t}$	-3.1658*	-3.1100*	-3.9973*	-4.0240*
$e_{mx;t}$	-4.0608*	-3.1842*	-9.3514*	-9.8807*
$g_{tk;t}$	-6.0581*	-4.2396*	-30.2645*	-30.9556*
$\pi_{tk;t}$	-1.4205	-0.7994	-2.7547*	-2.8817*
$e_{tk;t}$	-2.2916**	-1.5719	-8.3009*	-9.5935*

*,** Significant at the 1% and 10% levels respectively. Notes: The tests do not include a time trend nor drift term. Order of augmentation in parenthesis.

5. Estimation Results

We present now the estimated equations (2), (3) and (9). We are primarily interested in the size and direction of the tradeoff parameters and also on the effect of the exchange rate on output and inflation.

5.1. The Mean equation and Impulse Responses

Let us begin the analysis by examining the estimated parameters in the mean equation. To choose the order of the VAR-BEKK models we use Likelihood Ratio tests and the Bayes Information Criterion (BIC) that penalizes for the inclusion of additional regressors.[10] It turns out that in Turkey a VAR(2) system is strongly preferred while in Mexico a VAR(4) system is chosen. The estimated parameters for both systems are presented in Table 5. Bayes and Akaike information criteria, as well as the maximized log-likelihood value are presented at the bottom of the Table.

Table 4
Linear Granger Causality Tests for Inflation (π), Output Growth (*g*) and the Rate of Depreciation (*e*) in Mexico and Turkey (F-statistics)

	Overall		Peg		Float	
Ho	G(6)^{b}	G(12)	G(6)	G(12)	G(6)	G(12)
$\pi_{mx,t}$->$^{c}g_{mx,t}$	1.54	1.72***	0.53	0.42	0.77	2.17**
$g_{mx,t}$-> $\pi_{mx,t}$	0.52	0.60	1.23	0.77	0.42	1.94**
$e_{mx,t}$-> $\pi_{mx,t}$	3.18*	1.98*	7.76*	4.89*	5.54*	2.99*
$\pi_{mx,t}$->$\varepsilon_{mx,t}$	1.93***	0.73	1.53	1.99**	1.58	0.83
$\varepsilon_{mx,t}$-> $g_{mx,}$	1.47	2.16*	0.45	0.50	1.97**	2.55*
$g_{mx,t}$->$e_{mx,t}$	0.26	1.39	1.13	0.91	1.35	3.47*
$\pi_{tk,t}$->$g_{tk,t}$	0.78	0.85	0.82	0.77	0.54	1.15
$g_{tk,t}$-> $\pi_{tk,t}$	0.42	0.90	0.28	0.61	1.34	0.43
$e_{tk,t}$-> $\pi_{tk,t}$	6.95*	4.64*	3.65*	2.71*	3.02*	3.26**
$\pi_{tk,t}$->$\varepsilon_{tk,t}$	1.86***	1.17	2.69*	1.58	1.11	0.65
$\varepsilon_{tk,t}$-> $g_{tk,t}$	4.34*	2.58*	2.53*	1.88**	2.03	1.78
$g_{tk,t}$->$e_{tk,t}$	1.80	2.00**	1.13	1.25	0.91	0.55

*, ** and *** denote rejection of the null Ho at the 1% , 5% and 10% levels respectively. [a]The floating period in Mexico starts in January 1995 and on March 2001 in Turkey. [b] Denotes Granger causality test, number of lags included in parenthesis. [c] stands for "does not Granger cause...".

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[10] The simultaneous estimation of the VAR-BEKK(1,1) model employs (Berndt et al. 1974) numerical optimization method. The mean and variance equations are shown separately for editorial convenience.

Table 5
VAR(2) Estimations for Inflation (π), Output Growth (g) and Exchange Rate (e) Depreciation in Mexico and Turkey

	Mexico		Turkey	
	Estimate	Std. Error	Estimate	Std. Error
c1	0.0007	(0.0005)	1.6e-05	(0.0021)
c2	0.0021*	(0.0007)	0.0087*	(0.0023)
c3	0.0028***	(0.0017)	0.0122*	(0.0035)
$\phi_{1,11}$	0.206**	(0.0984)	0.6924*	(0.0933)
$\phi_{1,22}$	0.5874*	(0.1354)	0.6357*	(0.1006)
$\phi_{1,33}$	0.2850*	(0.1158)	0.0560	(0.1513)
$\phi_{2,11}$	0.2484*	(0.1021)	0.2070*	(0.1016)
$\phi_{2,22}$	0.2252	(0.1429)	0.1891***	(0.1373)
$\phi_{2,33}$	0.4222	(0.1636)	0.0265	(0.1203)
$\phi_{3,11}$	0.1991**	(0.0965)	-	
$\phi_{3,22}$	0.4300*	(0.1441)	-	
$\phi_{3,33}$	0.6173	(0.1321)	-	
$\phi_{4,11}$	0.2110**	(0.0943)	-	
$\phi_{4,22}$	0.1950	(0.1303)	-	
$\phi_{4,33}$	0.0126	(0.1532)	-	
Likelihood Value and Decisión Criteria				
$L(\theta)^a$	2,188.7		1,664.9	
AIC^b	-4,299.4		-3,263.8	
BIC^b	-4,171.4		-3,155.1	

*, **, *** denote significance at the 1%, 5% and 10% respectively. ^{a}L(θ) is the maximised likelihood value; ^{b}AIC= Akaike Information Criterion and BIC=Bayes Information Criterion.

The main limitation of the restricted VAR version presented above is that, apart from the analysis of the effects on its own, we cannot directly infer about cross dynamic impacts. Hence, to overcome this a full vector autoregression with the same orders, including off diagonal terms, has been estimated.[11]

A variance decomposition analysis of this full VAR version for forecast horizons 1, 3, 6 and 12 months is presented in Table 6. The table is divided in three panels, the first line of each indicating the variable being decomposed (in italics) and the fraction of forecast error variance that is attributable to its own innovations for each country. The second and third rows indicate the proportion of the forecast variance explained by the other variables. For instance, at the sixth month horizon, 4.48% and 5.36% of the variance in the Mexican and Turkish output growth respectively are attributable to innovations of nominal exchange rates.

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[11] The VARs in Table 5 constitute the mean equations estimated simultaneously with the BEKK models in the next subsection. The individual estimates of the full VARs are not shown to keep space but the output is readily available from the author.

In line with previous findings -see (Kamin and Rogers 2000) and references therein for instance- we observe that the main sources of variation in output growth and exchange rate depreciation forecast variances are their own innovations, accounting for no less than 93 per cent of the variance. The main source of the variation of output growth and inflation (after their "own" variances) is the nominal exchange rate depreciation.

Indeed, it is observed for both countries that a great proportion of the inflation forecast variance is explained by nominal exchange rate shocks. In the case of Mexico, the proportion of variance explained by the exchange rate surpasses the proportion of variance attributable to inflation itself by the second month horizon. In fact, nominal exchange rate shocks represent more than 53% of the variance of inflation from the third month, while inflation "own" shocks account for around 46% to 40% of the variance depending on the horizon. Accordingly, the contribution of output shocks to inflation ranges only from 0.10% to 1.60% of the variance.

This inevitably leads us to highlight the supreme importance of the pass-through from exchange rates to inflation in Emerging Markets. The significance of nominal exchange rates for the dynamics of inflation is increasing with time in the two cases considered. This phenomenon is not exclusive of floating exchange rate regimes, such pass-through has been reported equally significant during the exchange rate based stabilization periods.[12]

Table 6
Variance Decomposition of Inflation, Output and Exchange Rate Depreciation in Mexico and Turkey

	Mexico				Turkey			
	(1)[a]	(3)	(6)	(12)	(1)[a]	(3)	(6)	(12)
Output Growth	100.00	98.16	94.63	94.37	100.00	95.45	93.44	93.42
Inflation	0.00	0.31	0.89	0.99	0.00	1.09	1.20	1.20
Exchange rate	0.00	1.54	4.48	4.62	0.00	3.47	5.36	5.38
Inflation	63.47	46.35	40.31	40.66	95.58	72.51	70.91	70.89
Output	0.14	0.19	0.70	1.96	0.26	1.28	1.59	1.59
Exchange rate	36.40	53.46	58.99	57.38	4.16	26.21	27.50	27.51
Exchange rate	99.24	96.83	95.36	94.88	99.56	94.65	94.27	94.26
Inflation	0.00	1.83	3.21	3.58	0.00	0.95	2.33	2.33
Output	0.76	1.35	1.43	0.02	0.44	0.44	0.02	0.02

[a] The month horizon is indicated in parenthesis.

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[12] The author wishes to acknowlege an anonymous referee for this observation.

To enhance this analysis further, the effect of a permanent change in the levels of the exchange rate, inflation and output on each of our endogenous variables is investigated.[13] Figure 3 shows the response of the levels of output growth, inflation and the nominal exchange rate for both Mexico and Turkey in each column respectively. The title at the top of each plot indicates the variable responding to shocks originated in its own and from other endogenous variables -see labels at the bottom. For instance, a sustained positive shock to the level of the exchange rate (thick line in all plots) induces a sustained increase in the level of prices in both Mexico and Turkey.

Some interesting results emerge from this analysis. First, nominal depreciations are contractionary as indicated by the response of industrial production in both countries following a positive shock (depreciation) of the exchange rate. This result is consistent with the findings of (Copelman and Werner 1996) and (Santaella 1996) for Mexico. Second, inflationary shocks seem to exert a positive influence on the level of industrial production, i.e., inflationary shocks are not contractionary. This positive association is reinforced in Mexico by the response of prices to permanent shocks arising from output. In Turkey however, there is a negative response of prices following unexpected permanent changes in the level of industrial production, a finding that is consistent with the claims of (Yeldan 1993), (Metin 1995) and (Metin 1998). This somewhat conflicting results, i.e., positive and negative price responses in our two country cases, may probably indicate that there is not a clear association between prices and output whatsoever. This hypothesis is investigated further in the analysis below. Another possibility is that, given the nature of this standard VAR, we may be omitting the influence of inflationary shocks from other variables.

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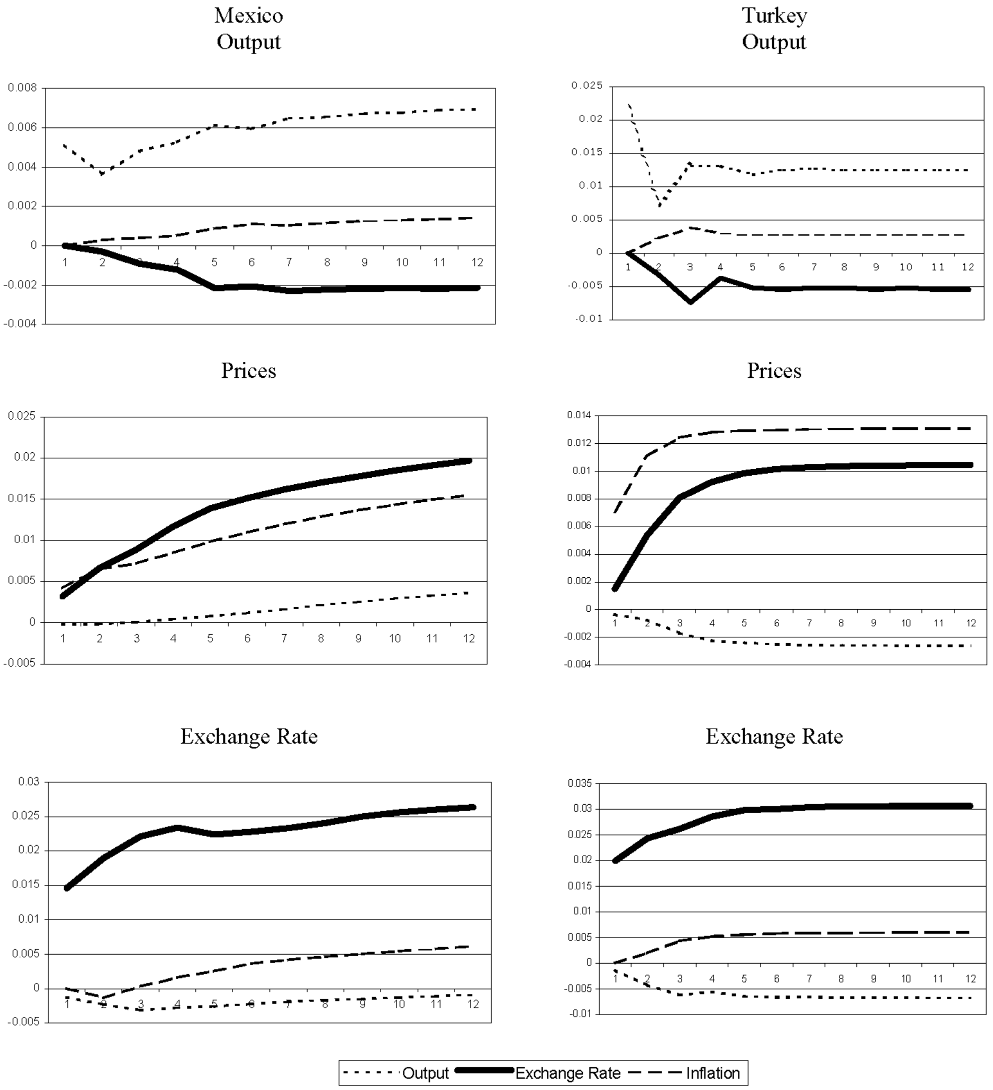
[13] Recall that since in this standard system the variables are estimated as first log-differences, a one-time shock to the first difference in one variable translates into a permanet shock to the level of that variable. These level responses are obtained by accumulating the first difference Responses -see (Kamin and Rogers 2000).

Fig. 3. Impulse Responses of Output, Prices and Exchange Rates in Mexico and Turkey



Mexico
Output

Turkey
Output

Prices

Prices

Exchange Rate

Exchange Rate

5.2. The Variance Equation

We now examine the BEKK models introduced in equation (9).[14] The estimation results are shown in Table 7. The elements of the 3X3 lower triangular matrix W_0^* indicate the output growth (w_{11}^*), inflation rate (w_{22}^*) and exchange rate depreciation (w_{33}^*) mean levels of the conditional variances. w_{ij}^* represents the mean conditional covariance levels.

The diagonal elements in A_{11}^*, i.e., α_{11}^*, α_{22}^* and α_{33}^* show the extent of the correlation of the conditional variances of output (h_{1t}), inflation (h_{2t}) and exchange rate depreciation (h_{3t}) with past squared residuals $\varepsilon_{i,t-1}^2$ for $i=[1,2,3]$. Similarly, the off-diagonal elements (α_{ij}^*) show the contemporaneous impact on the conditional variance of one of the variables originated by past squared shocks on the other.

The diagonal elements of B_{11}^* indicate the association of current conditional volatility with own past conditional variances. The off-diagonal parameters in B_{11}^* are of particular interest for our analysis. They show the potential inflation-output volatility tradeoffs. A negative sign in any of those parameters would be much in the spirit of a Taylor downward sloping curve relationship, just as the one found by (Lee 1999), and the optimal policy frontiers by (Fuhrer 1997).

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[14] A seminal work using a bivariate GARCH model was proposed by (Lee 1999), who analyzed the inflation-output trade-off for the US during the period 1960-1997. He reported a significant tradeoff between the conditional variances of output and inflation for the post-1979 subsample but not for the overall sample.

Table 7
BEKK(1,1) Estimation Results for Mexico and Turkey

	Mexico		Turkey	
	Estimates	Std. Errors	Estimates	Std. Errors
Intercept Matrix				
w_{11}^{*}	0.0016**	(0.0008)[a]	0.0108**	(0.0055)
w_{21}^{*}	-0.0002	(0.0015)	0.0026	(0.0035)
w_{31}^{*}	0.0034	(0.0031)	0.0050	(0.0082)
w_{22}^{*}	0.0021*	(0.0007)	0.0001	(0.1045)
w_{32}^{*}	0.0041	(0.0028)	-0.0065	(7.5953)
w_{33}^{*}	1.4e-06	(12.108)	0.0027	(18.2261)
Volatility Transmissions				
α_{11}^{*}	0.3470*	(0.1257)	0.2753**	(0.1363)
α_{21}^{*}	-0.0129	(0.1537)	0.0511	(0.0545)
α_{31}^{*}	0.3374	(0.5290)	0.0902	(0.1433)
α_{12}^{*}	-0.0803	(0.1439)	-0.0021	(0.4328)
α_{22}^{*}	0.5952*	(0.2102)	0.2041***	(0.1221)
α_{32}^{*}	0.2460	(0.5485)	-0.1143	(0.4026)
α_{13}^{*}	0.0162	(0.0433)	0.0577	(0.1463)
α_{23}^{*}	0.0339***	(0.0187)	0.1078	(0.0744)
α_{33}^{*}	0.4355*	(0.1682)	0.5188*	(0.1701)
Volatility Tradeoffs				
β_{21}^{*}	-0.0077	(0.1204)	-0.0776	(0.0734)
β_{31}^{*}	-0.3418	(0.2369)	-0.0962	(0.2029)
β_{12}^{*}	0.0386	(0.0592)	0.1185	(0.3377)
β_{32}^{*}	-0.1418	(0.3859)	-0.0531	(0.4408)
β_{13}^{*}	-0.0010	(0.0212)	-0.0485	(0.0899)
β_{23}^{*}	-0.0257	(0.0369)	-0.0464	(0.0519)
Volatility feedbacks				
β_{11}^{*}	0.8922*	(0.0748)	0.8613*	(0.1331)
β_{22}^{*}	0.7944*	(0.1317)	0.8896*	(0.1500)
β_{33}^{*}	0.8511*	(0.0815)	0.8191*	(0.0826)
Ljung-Box tests on residuals				
$Q_g(12)$[b]	9.56	[0.6542][b]	15.98	[0.1921]
$Q_{\square}(12)$	13.32	[0.3462]	8.74	[0.7253]
$Q_e(12)$	8.46	[0.7483]	16.00	[0.1912]
$Q^2{}_g(12)$	15.63	[0.2088]	5.61	[0.9344]
$Q^2{}_{\square}(12)$	0.66	[1.0000]	17.18	[0.1430]
$Q^2{}_e(12)$	19.23	[0.0831]	7.23	[0.8420]

*, **, *** Denotes significance at the 1%, 5% or 10% level respectively. [a] $Q_i(12)$ and $Q^2{}_i(12)$ are the Ljung-Box tests for serial correlation in the standardised residuals and the squares of the standardised residuals respectively, order of the test in parenthesis; [b] P-values in brackets.

With respect to the output and inflation parameters (1 and 2 respectively), the results in Table 7 suggest no significant negative cross-effect running from lagged output squared residuals to the variance of inflation (see α^{*}_{21}) or viceversa (α^{*}_{12}). In fact, this is also the case with volatility tradeoffs: none of the parameters β^{*}_{ij} (for *i,j={1,2}*) is significantly different from zero.

The results provide a strong indication of a rather vertical Taylor curve. This finding in turn seems to be absolutely consistent with the evolution of inflation and the growth of output during the 1980's and 1990's in both Mexico and Turkey. The monetary authorities for instance may have strengthened the measures of inflation stabilization when output growth was relatively stable.

Hence, the statistical evidence strongly supports the finding of no tradeoff between inflation and output volatility. In such a likely case, the evidence would support the view indicating that inflation instability is associated with increases in the volatility of output and, vice versa, more stable rates of inflation would bring about more stable output growth rates.[15]

Interestingly however, in Mexico there is a significant volatility transmission running from exchange rate depreciation to the rate of inflation (see α^{*}_{23}), i.e., the instability of the exchange rate is associated with a higher inflation volatility. In particular, 1% increase in the volatility of the exchange rate is associated with a 4% increase in the instability of inflation. This finding reinforces and is consistent with the results outlined by the analysis of variance and impulse responses presented above.

Finally, to check the stability and stationarity of the models, Table 8 shows the roots of the estimated VARs and the eigenvalues associated with ($A^{*}_{11} \otimes A^{*}_{11} + B^{*}_{11} \otimes B^{*}_{11}$) for the variance equation. As required all the roots and eigenvalues associated with the VARs and BEKK models respectively, are less than unity in modulus indicating convergence of the VARs and that the estimated H_t is covariance stationary. The models are also identified as observed by the upper diagonal coefficients of matrices A^{*}_{11} and B^{*}_{11}, which are strictly positive. The positive definiteness of the variance-covariance matrix is verified for all the

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[15] This statistical conclusion was explored further by employing Likelihood Ratio (LR) tests for the existence of cross effects. The evidence overwhelmingly rejects the significance of trade off or transmission effects from inflation to output and viceversa. In addition, a LR test rejects the hypothesis of constant correlations between the variables for the time period under study, i.e., the time varying covariances assumption is valid.

estimated models. Apart from the non-normality indicated before, the models are adequately specified.

Table 8
Estimated Eigenvalues |λ| for the VAR-BEKK Representations

	Mexico		Turkey	
root/eig.[a]	Mean[b]	Variance	Mean	Variance
$\|\lambda_1\|$	0.7388	0.9863	0.1932	0.9105
$\|\lambda_2\|$	0.5977	0.9465	0.1372	0.8638
$\|\lambda_3\|$	0.6341	0.9186	0.4549	0.8514
$\|\lambda_4\|$	0.0201	0.9083	0.4349	0.8247
$\|\lambda_5\|$	0.9933	0.9071	0.4549	0.8224
$\|\lambda_6\|$	0.7246	0.9036	0.4349	0.8150
$\|\lambda_7\|$	0.6005	-	-	-
$\|\lambda_8\|$	0.8074	-	-	-

[a] Denote the eigenvalues in modulus associated to the VAR and BEKK representations in Tables 5 and 7 respectively.
[b] Redundant values are omitted.

6. Conclusions

The aim of this work has been to explore the evidence concerning the short run inflation output variability tradeoff for Mexico and Turkey and the role of the exchange rate under a floating regime. To this end we employed a VAR-GARCH specification in which the conditional covariances of these variables are assumed time varying.

Among other findings we report the non-existence of a downward short run volatility tradeoff between inflation and output growth. The results suggest instead a vertical or even an upward slope tradeoff curve in Mexico and Turkey respectively. What is more, the causality seems to be running from inflation to output and in Turkey inflation exerts a positive impact on output growth, i.e., inflationary shocks are not contractionary.

This outcome is not completely surprising. Such a scenario is especially possible due to the pursuit of stable rates of inflation during the past two decades in Mexico and the stabilization plans in Turkey. The authorities may have in fact conveniently followed more aggressive stabilization policies in the periods when there were signs of growth stability in which restrictive policies would presumably be less costly.

This conjecture is in agreement with the propositions of (Haldane and Quah 2000) who present a model in which it is optimal for fully informed policymakers to reduce the rate of inflation when unemployment is low and to raise the rate of inflation when unemployment is high, hence generating a positive tradeoff curve. (Trehan 1999) in fact goes further by suggesting, based on the conclusions of (Haldane and Quah 2000)[16], that the conventional downard-sloping Phillips curve may not be after all a fundamental (stable) economic relationship.

Another possible interpretation of the vertical curve is the one provided by (Sargent 1999), who considers an economy subject to random shocks where the slope is constantly changing and eventually a vertical slope is observed (no inflation output tradeoff). Accordingly, we could claim that, given the fact that foreign and local shocks are an almost stylized fact in Emerging Markets (EM), those events may well be behind the observed verticality of the parameter. A zero-tradeoff may simply be the result of the rather regular regime changes experienced not only in these two countries but in many EM.

Moreover, the authorities may be already all the more aware of the potential positive form of the tradeoff so that with the introduction of Inflation Targeting further stability of output might be expected.

In addition, we also confirm that the main source of variation of output growth and inflation, apart from their own influence, is the nominal exchange rate depreciation. As it has been reported before and contrary to the text-book economic wisdom, this variable conveys a contractionary impact on output.

Finally, the variance analysis highlights the critical role of the nominal exchange rate on the kinetics of inflation in EM. In Mexico for instance, exchange rate depreciation accounts for more than 50% of the variance of inflation, while in Turkey this proportion is no less than 26 percent. Moreover, periods of high exchange rate volatility are associated with greater inflation instability.

The results obtained here may help to acknowledge that a sensible foreign exchange policy, even under free floating regimes, is still a critical issue for EM whose policies are mainly devoted to stabilize inflation.

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[16] The role of beleifs with respect to the temporal nature of the tradeoff (short or long run) and subsequent policy use in (Haldane and Quah 2000) model is crucial. Based on the experience of the UK the authors show that the positive (or negative) form of the tradeoff can be directly affected by the beleifs of the monetary authority.

References

Agenor, P. and Hoffmaister, A. 1997. Money, Wages and Inflation in the Middle Income Developing Countries. *IMF Working Paper* No. 97/174.

Bera, A. and Higgins, M. 1993. ARCH Models: Properties, Estimation and Testing. *Journal of Economic Surveys* 7(4): 305–366.

Bernanke, B. and Mishkin, F. 1997. Inflation Targeting: A New Framework for Monetary Policy. *The Journal of Economic Perspectives* 11: 97–116.

Berndt, E., Hall, B., Hall, R., and Hausman, J. 1974. Estimation and Inference in Nonlinear Structural Models. *Annals of Economic and Social Measurement* 3: 653–665.

Carstens, A. and Werner, A. 1999. Mexico's Monetary Policy Framework under a Floating Exchange Rate Regime. *In Research Documents. Banco de México*, Dirección General de Investigación Económica. 23.

Cecchetti, Stephen, G. and Ehrmann, Michael. 1999. Does Inflation Targetting Increases Output Volatility? An International Comparison of Policy Makers, Preferences and Outcomes. *NBER Working Paper* No. 7426.

Copelman, M. and Werner, A. 1996. The Monetary Transmission Mechanism in Mexico. *Working Paper*, Federal Reserve Board.

Duman, A. 2002. Inflation Targeting as a Monetary Policy and its Applicability to Developing Countries. *Working Paper*, Central Bank of the Republic of Turkey.

Engle, R. and Kroner, K. 1995. Multivariate Simultaneous Generalized ARCH. *Econometric Theory* 11(1): 122–150.

Fuhrer, J. C. 1997. Inflation/Output Variance Tradeoffs and Optimal Monetary Policy. *Journal of Money Credit and Banking* 29-2 : 214–234.

Grier, K., Olan, T. and Olekalns, N. 2001. The Asymmetric Effects of Real and Nominal Uncertainty on Inflation and Output Growth. *Mimeo*.

Grier, K. and Perry, M.1999. The Effects of Real and Nominal Uncertainty on Inflation and Output Growth: Some GARCH-M Evidence. *Journal of Applied Econometrics* 115 : 45–48.

Haldane, A. and Quah, D. 2000. U.K. Phillips Curves and Monetary Policy. *CEPR Discussion Papers*, LSE, 0444.

Kamin, S. B. and Rogers, J. 2000. Output and Real Exchange Rate in Developing Countries: An Application to Mexico. *Journal of Development Economics* 61(1): 85–109.

Kim, J. 2000. The Relationship Between the Monetary Regime and Output Volatility: A Multivariate GARCH-M Model of the Japanese Experience, 1919-1996. *Japan and the World Economy* 12: 49–69.

Koray, F. 1993. Inflation Variability and the Turkish Economy. *Applied Economics* 25(6): 787–793.

Lee, J. 1999. The Inflation and Output Variability Tradeoff: Evidence from a GARCH Model. *Economics Letters* 62(1): 63–67.

_______ . 2000. Monetary Policy and the Inflation-Output Variability Tradeoff. Texas A&M University-CC. *Mimeo*.

Lim, C. and Papi, L. 1997. An Econometric Analysis of the Determinants of Inflation in Turkey. *IMF Working Paper* No. 97/170.

Masson, P., Savastano, M. and Sharma, S., 1998. Can Inflation Targeting be a framework for Monetary Policy in Developing Countries. *Finance and Development IMF* 35(1): 34–37.

Metin, K. 1995. An Integrated Analysis of Turkish Inflation. *Oxford Bulletin of Economics and Statistics* 57(4): 513–531.

________ . 1998. The Relationship Between Inflation and the Budget Deficit in Turkey. *Journal of Business and Economic Statistics* 16(4): 412–422.

Nas, T. and Perry, M. 2001. Turkish Inflation and Real Output Growth, 1963-2000. *Russian and East European Finance and Trade* 37(6): 31–46.

Özlale, U. and Özcan, K. 2003. Does Time Inconsitency Problem Apply for Turkish Monetary Policy. Bilkent University, Department of Economics, Ankara Turkey. *Mimeo*.

Rittenberg, L. 1993. Exchange Rate Policy and Price Level Changes: Causality Tests for Turkey in the Post Liberalization Period. *The Journal of Development Studies* 29(2): 245–259.

Santaella, J. 1996. The 1997 Mexican Disinflation Program: An Exchange Rate Based Stabilization? *IMF Working Paper* WP/96/24.

Sargent, T. 1999. The Conquest of American Inflation. Princeton, N.J.: Princeton University Press.

Schmidt-Hebbel, K. and Werner, A. 2002. Inflation Targeting in Brazil, Chile, and Mexico: Performance, Credibility, and the Exchange Rate. *Central Bank of Chile Working Papers* 171.

Taylor, J. 1994. The Inflation/Output Variability Trade-off Revisited. In *Goals, Guidelines and Constraints Facing Monetary PolicyMakers*. Proceedings of the Conference Series No. 38, pages 21–38. Federal Reserve Bank of Boston.

Trehan, B. 1999. Economic Activity and Inflation. FRBS. *Economic Letter* 99(9): 1-5.

Yeldan, E. 1993. Conflicting Interests and Structural Inflation: Turkey, 1980-1990. *The Pakistan Development Review* 32(3): 303–327.

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