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EFFECTS OF GROWTH VOLATILITY ON ECONOMIC PERFORMANCE: EMPIRICAL EVIDENCE FROM TURKEY

M. Hakan Berument, N. Nergiz Dincer, and Zafer Mustafaoglu

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Abstract

This paper examines the relationship between growth and growth volatility for a small open economy with high growth volatility: Turkey. Quarterly data for the period from 1987Q1 to 2007Q3 suggests that growth volatility reduces growth and that this result is robust under different specifications. This paper contributes to the literature by focusing on how growth volatility affects a set of variables that are crucial for growth. Empirical evidence from Turkey suggests that higher growth volatility reduces total factor productivity, investment, and the foreign currency value of local currency (depreciation). Moreover, employment increases, however the evidence for this is not statistically significant.

ملخص

تبحث هذه الورقة العلاقة بين النمو و تقلب النمو لاقتصاد صغير مفتوح ذى نمو شديد التقلب، تركيا. تشير البيانات الربع سنوية خلال الفترة من الربع الأول لعام 1987 إلي الربع الثالث لعام 2007 إلي أن تقلب النمو قد تسبب في خفض النمو، و أن هذه النتيجة يفرزها وجود مواصفات متنوعة. كما تسهم هذه الورقة في هذا الموضوع بإلقاء الضوء علي كيفية تأثير تقلب النمو علي مجموعة من المتغيرات المهمة لعملية النمو. و يشير الدليل التجريبي من تركيا إلي أن ارتفاع معدل التقلب للنمو يقلل من إنتاجية كافة العوامل و الاستثمار كما يخفض قيمة العملة المحلية أمام العملة الأجنبية (إهلاك). و علاوة علي ذلك, فإن فرص العمل زادت في تركيا, و مع ذلك, فليس ثمة دليل يذكر علي ذلك من الناحية الإحصائية.

1. Introduction

Discussion about the relationship between growth and growth volatility is old and important. Although growth theory has been studied independently of business cycle theory for a long time, there has been growing interest in linking these two areas (Ramey and Ramey, 1995). The observed high volatility— especially in developing countries— has led economists to focus on understanding the relationship between growth and growth volatility. Neither theoretical nor empirical studies, however, have provided conclusive results. This study analyzes the effects of growth volatility on growth and contributes to the literature by focusing on how growth volatility affects a set of variables that are crucial for growth in Turkey — a developing country suffering from high growth volatility.

Different macroeconomic theorists have argued that output volatility has no effect, a positive effect, and a negative effect on output growth. Firstly, Friedman (1968) implicitly argues that fluctuations of output around a non-stochastic trend are independent of each other and that the fluctuations are caused by price misperceptions resulting from monetary shocks. In other words, the output growth rate is determined by real factors such as labor skills and technology. Speight (1999) provides empirical evidence that output volatility has a positive but insignificant effect on output growth rate.

Secondly, a positive effect of output volatility on growth can be justified by the argument that volatility is associated with recessions, which lead to higher research and development spending and/or the destruction of the least productive firms. This is the “creative destruction” view, which dates back at least to Schumpeter (1939). Shleifer (1986), Caballero and Hammour (1994), and Aghion and Saint-Paul (1998) support this idea. Another argument for a positive effect is that more income volatility (uncertainty) leads to a higher savings rate (Sandmo, 1970) for precautionary reasons, and hence, a higher equilibrium economic growth rate. Black (1987) provides yet another argument for a positive effect, arguing that investments in risky technologies occur only if the expected return on such investments (average rate of output growth) is large enough to compensate for the extra risk. Kormendi and Meguire (1985), Grier and Tullock (1989), Caporale and McKiernan (1996, 1998), and Grier et al. (2004) provide empirical support for a positive relationship.

Thirdly, a negative impact of output volatility on growth can be justified with the theoretical underpinnings going back to Keynes (1936), who argues that entrepreneurs, when estimating the return on an investment, consider fluctuations in economic activity. Output fluctuations increase the perceived riskiness of investment projects and thus lower the demand for investment, which in turn reduces output growth. The literature on sunspot equilibria (Woodford, 1990) obtains a similar result.

Theoretical analyses suggest that if investments cannot be reversed, then increased volatility may lead to lower investment (Bernanke, 1983; Pindyck, 1991; and Aizenman and Marion, 1993.) Ramey and Ramey (1991) argue that if firms must commit to their technology in advance, then volatility could lead to lower mean output because these firms find themselves producing at suboptimal levels ex post. If lower current output affects the accumulation of resources, then growth is adversely affected.

A negative relationship between volatility and growth could also be caused by a tie between recessions and a worsening of financial and fiscal constraints. Such ties are more likely to occur in developing countries. If such ties exist, recessions can lead to less human capital development (a decrease in learning-by-doing, for instance), fewer productivity-enhancing expenditures, and thus lower growth rates (see Martin and Rogers, 1997; and Talvi and Vegh, 2000). Other reasons to expect volatility to have a negative effect on growth are political insecurity (Alesina et al.; 1996), macroeconomic instability (Judson and Orphanides; 1996), and institutional weaknesses (Rodrik; 1991). Certain structural characteristics such as poor financial development, labor market restrictions, inadequate laws, and pro-cyclical fiscal policy, are bound to worsen the impact of volatility and uncertainty on a country's economic growth (see Caballero; 2000, and Hnatkovska and Loayza; 2005).

On the empirical front, Ramey and Ramey (1995) find a negative relationship between volatility and growth for a sample of 92 countries as well as in a sample of OECD countries. Although Aizenman and Marion (1999) find no evidence of a relationship between investment and overall volatility and they trace the cost of volatility directly to uncertainty-induced planning errors of firms, they do find that volatility is correlated with investment when it is disaggregated as public and private.

Finally, Norrbin and Yigit (2005) examine the robustness of Ramey and Ramey's results to the time specification with a slightly different set of countries. Their results are sensitive to the selection of countries, but a centered-moving-period volatility provides a robust negative correlation with growth even though it is less robust for OECD countries. Fountas et al. (2004) examine the relationship between output variability and output growth using quarterly data from 1961 to 2000 for Japan. Using three different GARCH-model specifications (Bollerslev's, Taylor/Schwert's, and Nelson's EGARCH), they find robust evidence that the "in-mean" coefficient is not statistically significant, which implies that output variability does not affect output growth.

Although the link between growth volatility and growth has recently been the focus of many theoretical and empirical studies, the results are inconclusive regarding the direction of the effect, and various possible transmission variables causing both negative and positive impacts have been suggested. To the best of our knowledge, however, no study has explicitly assessed the role of growth volatility on a set of variables that are crucial to growth itself (we call them transmitting variables), except for the role played by investment. In this paper, we contribute to the literature by analyzing the impact of growth volatility on growth, taking into account a set of transmission variables. In this context, we focus on Total Factor Productivity growth (TFP), investment (as a ratio to GDP), and employment generation (employment growth). We also consider the exchange rate (percentage of change in the real exchange rate) as a possible transmission variable. The exchange rate has a detrimental effect on developing countries due to the high debt and inflationary pressures of these countries.

This study first uses a version of the Autoregressive Conditional Heteroskedasticity (ARCH) method and quarterly Turkish data to empirically investigate the relationship between growth volatility and growth. Turkey provides a good environment for assessing this relationship, since it had high and persistent inflation along with an unstable economic and political environment for more than three decades.

Our findings suggest that the effect of growth volatility on growth is negative, which supports the theoretical literature suggesting a negative relationship and the empirical findings of Ramey and Ramey (1995). An additional contribution of this paper is that the negative impact is shown to be working through the adverse effect of growth volatility on TFP, investment, and exchange rates for Turkey. The remainder of the paper is organized as follows: Section 2 presents the model, Section 3 discusses the data, Section 4 outlines the results, and Section 5 concludes.

2. Modeling

Modeling growth is a difficult task in time series analysis. A number of variables affect growth in a structural (behavioral) model framework, and problems with this strategy such as low degrees of freedom and endogeneity of the explanatory variables arise. As a solution, Sims (1980) suggests using lag values of dependent variables as explanatory variables (vector autoregressive models). These problems are especially important to address if one likes to use non-linear models such as those in the ARCH class. Using Autoregressive (AR) models we can capture the dynamics of the growth variable with lagged dependent variables. It is plausible that growth rate is also affected by growth variability. Therefore, we include the conditional variance of the residual (ε_t) as h_t in the growth equation:

$$Growth_t = \beta_0 + \sum_{i=1}^{n} \beta_i Growth_{t-1} + \beta_h h_t + \varepsilon_t \quad (1)$$

where $Growth_t$ is the growth rate at time t, ε_t has a zero mean and a time varying conditional variance of h_t at the given information set at time t-1, Ω_{t-1}.

$$\varepsilon_t \;/\; \Omega_{t-1} \sim (0, h_t). \quad (2)$$

Here h_t captures the variability of growth. Nelson (1991) proposed the following model for the logarithm of the conditional variance.

$$Log\ h_t = \varsigma + \sum_{j=1}^{P} P_j\ Log\ h_{t-j} + \sum_{j=1}^{q} \theta_j \left\{ \left| \frac{\varepsilon_{t-j}}{\sqrt{h_{t-j}}} \right| - E\left| \frac{\varepsilon_{t-j}}{\sqrt{h_{t-j}}} \right| + \delta \frac{\varepsilon_{t-j}}{\sqrt{h_{t-j}}} \right\} \quad (3)$$

This model is referred to as the Exponential-Generalized Autoregressive Conditional Heteroskedastic (EGARCH) model. If one interprets P_j as the coefficients of the lag values of the logarithm of the conditional variance, then the characteristic roots of the process should be outside the unit circle for the non-explosiveness of the conditional variance.

Nelson's (1991) specification models the logarithm of the conditional variance rather than the conditional variance, which provides some advantages. One advantage of the EGARCH model is that the variance (h_t) itself will be positive, regardless of whether the P_j and θ_j coefficients are positive or negative. This makes numerical optimization simpler and allows a more flexible class of possible dynamic models of the variance (Hamilton, 1994). Moreover, this specification allows asymmetry to be measured through the leverage effect (positive and negative innovations to growth specification affect volatility differently).

In order to permit interaction between growth and the transmission variables, multi-AR models are used instead of Vector-AR specifications. The conventional Vector-AR model uses the lag values of all elements in an X vector to explain the behavior of each variable in the X vector. Specifically, if X includes growth, TFP, employment, exchange rate, and investment, then in the first equation, the right hand side will include their lag values, that is, putting too many variables to the right-hand side to explain growth and each of these variables and ending up with a low degree of freedom. Moreover, note that TFP, investment (as a ratio to GDP), and growth all use GDP in their calculations. A non-linear relationship exists among these variables. Due to the high collinearity among these variables (multicollinearity), estimates will also be less efficient if we use a Vector-AR specification.

In order to account for this, we suggest the following:

i. Instead of modeling all these variables simultaneously, two variables are modeled at a time. The first variable is growth, to extract the growth volatility, and the second variable is TFP, investment, exchange rate, or employment. If we had only one variable set (X_t includes only one variable), this model would be similar to Speight's (1999) work and the references cited therein.

ii. Each variable is modeled with its own lags rather than the lags of other variables, to stop the high collinearity among each set of variables from affecting the results.

Next, the effects of the conditional variance of growth on a set of variables, including TFP, investment, exchange rate, and employment are examined using the following specification,

$$z_t = \gamma_0 + \sum_{i=1}^{n} \gamma_i z_{t-i} + \gamma_h h_t + \eta_t \qquad (4)$$

where z_t is the variable for TFP, investment, exchange rate, or employment.

Specifically, growth is regressed on its own lag and the conditional variance of growth, and each TFP, investment, exchange rate, and employment variable is regressed on its own lag and the conditional variance of growth. Then, we assess how the conditional variance of growth rates affects growth itself as well as each TFP, investment, exchange rate, and employment variable. Equations 1, 3, and 4 could be estimated individually. Pagan (1984) argues that using generated variables from a stochastic process in an estimation process could lead to biased estimates. Pagan and Ullah (1988) suggest using Full Information Maximum Likelihood estimates to avoid biased estimates. Therefore, equations 1, 3, and 4 are estimated jointly using the Full Information Maximum Likelihood estimation method with the Broyden, Fletcher, Goldfarb, and Shanno algorithm.

3. Data

The data set used in this paper is quarterly data for Turkey from 1987Q1 to 2007Q3[1]. The GDP growth, investment and employment data are from the Turkish Statistical Institute (TURKSTAT). The investment variable used in the model is the ratio of investment to GDP, while GDP growth is the logarithmic first difference of real GDP. Capital stock is calculated from investment data using the methodology of the OECD and is taken from Cihan, Saygili, and Yurtoglu (2005). TFP, the usual Solow residual from a Cobb-Douglas type production function with constant returns to scale, was obtained from the State Planning Organization of Turkey. The real exchange rate is calculated in terms of US dollars and deflated with the USA All Urban Consumer Price Index, where an increase in the index represents (real) appreciation. All the series enter into the analysis in their logarithmic first difference form, except investment; investment is entered in the analysis as its ratio to GDP. All data is seasonally adjusted.

4. Estimates

Table 1 reports the growth-growth volatility relationship for Turkey[2]. The growth volatility is captured by the EGARCH (1, 2) specification of conditional variance under generalized error distribution.[3&4] The estimates of the parameters for the first growth equation include constant

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[1] The Turkish Statistical Institute made a methodological change in calculating the national account data starting at the beginning of 2008. It is important to note that it is not easy to combine these two data sets for extending the period as they are based on different methodologies. As GDP based on the new methodology is around 30 percent higher in nominal terms than the previous one, we use the previous version of the national accounts data, which covers the period 1987Q1-2007Q3.

[2] An earlier version of estimates for Turkey is reported as part of the World Bank's (2006) Country Economic Memorandum for Turkey.

[3] The EGARCH model can be estimated using maximum likelihood by specifying a density for $\frac{\varepsilon_t}{\sqrt{h_t}}$

Nelson proposed the following functional form using the generalized error distribution, normalized to have zero mean and unit variance for the distribution function of the error term:

$$f\left(\frac{\varepsilon_t}{\sqrt{h_t}}\right) = \frac{D \exp\left[-(1/2)\left|\frac{\varepsilon_t}{\sqrt{h_t}} / \lambda\right|^{D}\right]}{\lambda \cdot 2^{[(D+1)/D]}\Gamma(1/D)}$$

where Γ(.) is the gamma distribution, λ is a constant given by $\lambda = \left[\frac{2^{[-2/D]}\Gamma(1/D)}{\Gamma(3/D)}\right]^{1/2}$ and D is a positive parameter determining the thickness of the tails. For D=2, the equation becomes the standard Normal density. If D<2, the density has thicker tails than the Normal, but for D>2, it has thinner tails.

[4] The lag orders of the EGARCH specifications are determined such that standardized errors are no longer autocorrelated.

term, the first four lags of growth, and the conditional variance of growth (growth volatility).[5] In the first part of Table 1, the coefficient of growth volatility in the equation is negative and statistically significant at the 5% level,[6] which suggests that growth volatility adversely affects growth for Turkey. This finding is consistent with Bernanke (1983), Pindyck (1991), Ramey and Ramey (1991 and 1995), Aizenman and Marion (1993), Martin and Rogers (1997), Caballero (2000), and Talvi and Vegh (2000). Similar to the AR specification, the coefficients for the lag values of the growth variable are not interpreted because they are used to capture the dynamics of the series. For the estimates of the EGARCH specifications, the lag value of the logarithmic conditional variance (log h_{t-1}) is positive and less than 1, suggesting that the conditional variance is non-explosive (Hamilton, 1994)[7]. The estimated coefficient for the leverage effect (δ) is positive and significant at the 10% level. This suggests that positive shocks increase volatility more than negative shocks for Turkey.

After we obtain the negative relationship between GDP and GDP volatility, we consider four variables that are crucial for growth using the two-variable multi AR-ARCH models. The estimates of the model are reported in Table 2. These four variables are TFP, investment, depreciation, and employment. We consider these variables transmission variables.

Panel A of Table 2 reports the estimates of the growth specification, Panel B reports the estimates of the transmission variable, and Panel C shows the estimates of the conditional variance specification of the growth equation. Column 1 of Table 2 reports the estimates that use GDP growth and the first transmission variable that we consider (TFP). The estimated growth equation includes the first three lags of growth and the conditional variance of growth (growth volatility).[8] Note that the estimated coefficient for growth volatility is negative and statistically significant in the growth equation. This same finding in Table 1 indicates that growth volatility has an explanatory power for growth. Coefficients for the constant term and the lag values of growth were not interpreted the same way as in an AR specification, as these are used to capture the data-generating process. We will not elaborate on the effect of growth volatility on growth when we incorporate the other transmission variables, but the results are robust.

In Panel B, the next set of coefficients reported in Column 1 is for the transmission variable TFP. As suggested by the FPE criteria, TFP is modeled with a constant term, its two lags, and growth volatility. The estimated coefficient for growth volatility is negative and statistically significant. This suggests that uncertainty in growth decreases TFP, which is consistent with the theory of a negative relationship between volatility and growth through the productivity channel (see Martin and Rogers, 1997; and Talvi and Vegh, 2000).

The second column of Table 2 is for the analysis that uses GDP growth and investment as a second transmission variable. Panel B of Column 2 is for the investment equation. The estimated coefficient for the growth volatility is statistically significant and negative (i.e., growth volatility decreases investment), suggesting that growth volatility decreases output via investment. This supports the irreversible investment argument of Bernanke (1983) and Pindyck (1991) and the empirical study by Aizenman and Marion (1999).

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[5] The order of the AR process is determined by the Final Prediction Error (FPE) criteria. Jansen and Cosimona (1988) argue that autocorrelated residuals wrongly indicate the presence of the ARCH effect. The FPE criteria determine the optimum lag such that the residuals are no longer autocorrelated; thus the selection of the FPE eliminates this problem.

[6] The level of significance is at 5%, unless otherwise noted.

[7] For our specification, we also conducted a set of non-parametric robustness tests that did not reject our specification. These tests are available from the authors on request.

[8] The lag orders both for growth and transmission variables are chosen using FPE criteria. The specification of the conditional variance equation is the same as the one reported in Table 1.

Column 3 reports the estimates for the relationship between growth volatility and real exchange rate changes, a rarely discussed issue in the literature. The equation for the real exchange rate change in Column 3 includes its lags and growth volatility (Panel B). The estimated coefficient of growth volatility is negative and statistically significant. This suggests that growth volatility decreases the real value of the Turkish lira. Note that the real exchange rate change is the real value of the percentage change in the foreign currency value of the Turkish lira; thus lower values of the exchange rate indicate depreciation.

The last column in Table 2 lets us examine the effects of growth volatility on employment. Estimates in Panel B suggest that in contrast to the previous specifications, growth volatility has a positive estimated coefficient in the employment equation. The coefficient is not statistically significant, however. The labor market is not flexible in Turkey due to the existence of high non-wage labor costs, such as payroll taxes and high severance payments (Turkey pays one of the highest rates of the OECD countries). A considerable amount of informal employment and real wage flexibility are partly a result of this rigidity. Therefore, it is plausible that during business cycle downturns firms are able to renegotiate real wages in exchange for providing job security.

Panel C reports the estimate of the conditional variance of the specification of the growth equation. The estimated coefficients for the lag values of the logarithm of the conditional variance are always less than one. Observing a coefficient of less than one satisfies the non-explosiveness of the conditional variance (Hamilton, 1994). The estimated coefficients for $\{|\nu_{t-1}| - E|\nu_{t-1}| + \delta\nu_{t-1}\}$ and $\{|\nu_{t-2}| - E|\nu_{t-2}| + \delta\nu_{t-2}\}$ have alternating signs across specifications. The negative coefficients for $\{|\nu_{t-i}| - E|\nu_{t-i}| + \delta\nu_{t-i}\}$ do not violate the non-negativity of the conditional variance because the logarithm of h_t (which can be negative) is modeled, not h_t itself.

In our specification, we model GDP growth as an ARCH process, but do not allow time-dependent variance for the other (transmission) variables. Allowing time dependent variance for the other variables would lead to the over-parameterization of the system. Since the effect of volatility in the TFP, investment, exchange rate, and employment on other variables is not our main concern, we do not model the volatilities of other variables.

5. Conclusion

Using quarterly data from 1987Q1 to 2007Q3, we analyze the relationship between growth and growth volatility. Our estimates suggest that there is a negative relationship between growth and growth volatility for Turkey and that this result is robust through different specifications. This finding provides support for previous empirical results (Ramey and Ramey (1995) among others).

The next step was to examine the effects of growth volatility on transmission variables. The literature suggests presence of more transmission channels, including consumption (Miman, 1971), political instability (Alesina et al., 1996), and level of financial development (Cabellero and Hammour, 1994). We focus on the supply channels. The empirical evidence gathered here suggests that growth volatility decreases TFP and investment and depreciates the exchange rate for Turkey.

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Table 1: Growth and Growth Volatility

	$Growth_t$
Constant	1.0125**
	(0.138)
$Growth_{t-1}$	0.7892**
	(0.017)
$Growth_{t-2}$	0.1947**
	(0.070)
$Growth_{t-3}$	-0.1649
	(0.099)
$Growth_{t-4}$	0.1008
	(0.074)
$Growth\ Volatility_t$	-0.040**
	(0.518)
	Conditional Variance
Constant	-2.0034*
	(1.054)
$\log h_{t-1}$	0.5468
	(0.381)
$\left\{ \lvert \nu_{t-1} \rvert - E \lvert \nu_{t-1} \rvert + \delta \nu_{t-1} \right\}$	-1.3983**
	(0.663)
$\left\{ \lvert \nu_{t-2} \rvert - E \lvert \nu_{t-2} \rvert + \delta \nu_{t-2} \right\}$	-0.6508
	(0.783)
δ	0.3757*
	(0.217)
Log Likelihood:	4.9711

Note: Standard errors are reported under the corresponding estimated coefficients in parentheses.
* denotes 10% significance and ** denotes 5% significance.

Table 2: Growth Models for Turkey

	I	II	III	IV
	Panel A: Growth Specification			
	Growth	**Growth**	**Growth**	**Growth**
Constant	1.8558**	1.1847**	1.0975**	0.8262**
	(0.080)	(0.001)	(0.026)	(0.055)
Growth$_{t-1}$	-0.1001**	-0.0522**	0.0101	-0.1108
	(0.042)	(0.010)	(0.060)	(0.199)
Growth$_{t-2}$	-0.0073	0.0076**	-0.0110	
	(0.049)	(0.002)	(0.025)	
Growth$_{t-3}$	0.0077	-0.0144	0.0027	
	(0.038)	(0.010)	(0.025)	
Growth$_{t-4}$		-0.1138**		
		(0.006)		
Growth Volatility$_t$	-0.0786**	-0.0101**	-0.0385**	-0.0209**
	(0.014)	(0.000)	(0.004)	(0.023)
	Panel B: Transmission Variable			
	(Estimated equation: $Z_t = \gamma_0 + \Sigma\gamma_i Z_{t-i} + \gamma_{h1} h_t + \eta_t$)			
	Z_t=TFP	**Z_t= Investment**	**Z_t= Depreciation**	**Z_t= Employment**
Constant	1.2231**	2.0193**	2.3017**	0.3851
	(0.100)	(0.082)	(0.640)	(0.969)
Z_{t-1}	-0.0711	0.9401**	0.2459**	-0.0226
	(0.046)	(0.003)	(0.083)	(0.171)
Z_{t-2}	-0.0126		-0.1373*	0.0229
	(0.065)		(0.075)	(0.261)
Z_{t-3}			-0.1392**	
			(0.069)	
Growth Volatility$_t$	-0.0786**	-0.046**	-0.2128**	0.0005
	(0.014)	(0.011)	(0.085)	(0.023)
	Panel C: Conditional Variance of Growth			
Constant	0.9443**	0.5839**	0.3038**	1.0118**
	(0.009)	(0.001)	(0.003)	(0.012)
log h_{t-1}	0.5298**	0.6303**	0.8378**	0.5141**
	(0.005)	(0.000)	(0.001)	(0.006)
$\left\{\lvert\nu_{t-1}\rvert - E\lvert\nu_{t-1}\rvert + \delta\nu_{t-1}\right\}$	0.0607**	-0.4110**	0.0045	-0.0691
	(0.023)	(0.038)	(0.102)	(1.550)
$\left\{\lvert\nu_{t-2}\rvert - E\lvert\nu_{t-2}\rvert + \delta\nu_{t-2}\right\}$	0.3545**	-0.9468**	-0.5260**	-1.3175
	(0.020)	(0.022)	(0.068)	(0.059)
δ	0.6044**	0.3610**	0.4135**	0.3856
	(0.068)	(0.015)	(0.073)	(0.072)
Log Likelihood:	-159.7752	-159.3787	-268.7702	-168.6483

Note: Standard errors are reported under the corresponding estimated coefficients in parentheses.
* Denotes 10% significance and ** denotes 5% significance.