Does monetary policy transparency affect financial assets stability?

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Abstract: The paper addresses the issue of impacts of Central Banks transparency on stock market volatility. Using a simple theoretical macroeconomic model we find an analytical link between stock price volatility, interest rate volatility and central bank transparency. Empirical research has been focused on various levels of transparency of the Central Bank of 40 countries from 1998 to 2005. By applying panel data analysis sufficient evidence for (a) a negative relationship between stock market volatility and transparency level and (b) a positive relationship between stock market volatility and interest rate volatility, are provided. Therefore, moving toward monetary policy transparency is recommended as financial assets volatility can be reduced considerably, implying significant benefits for financial stability.

Keywords: Central bank transparency, stock market volatility, panel data.

JEL classification numbers: E52, E58, F41

1. Introduction

The conduct of monetary policy has moved during the last two decades to a new paradigm, which gives accent to central bank's independence and transparency. In effect, as central banks became independent, being transparent gained importance based on accountability arguments. Moreover, since the pioneer work of Cukierman and Meltzer (1986), a large literature on the economic desirability of central bank transparency has been developed, mostly for the case of developed countries and limited to the interaction between monetary authorities and private agents.[1] Most economists are instinctually of the view that more information is better than less and hence agree that openness and communication with the public are crucial for the effectiveness of monetary policy, in allowing the private sector and financial operators to improve expectations and therefore to make Pareto improving decisions (Blinder, 1998; Eijffinger *et al.*, 2000; Hoeberichts *et al.*, 2009).

The empirical literature concerning the effects of transparency on inflation and output gap has so far yielded mixed results. According to Chortareas *et al.* (2002), disclosure of inflation forecasts reduces inflation but is not necessarily associated with higher output volatility. Demertzis and Hughes-Hallet (2007) have found that greater transparency benefits to inflation volatility, but has a less clear effect on output volatility and no effects on the average level of inflation and output. The analysis of Dincer and Eichengreen (2007) suggests broadly favourable but relatively weak impacts on inflation and output volatility.

A large strand of the literature studies the effects that monetary policy actions can have on financial assets and therefore the identification of monetary policy's effects on equities.[2] To identify monetary policy shocks several papers have conducted event studies by analyzing how equity markets react to monetary policy announcements. More specifically, an increase in interest rates has a negative effect on equity prices. However, the significance of this effect is not uniform across sectors and firms (Ehrmann and Fratzscher, 2004). Regarding the volatility of equity markets, it tends to be relatively lower on days before and higher on days after, monetary policy decisions (Bomfim, 2003). In this context, the effects of monetary policy transparency on financial markets are important since it affects the stock channel of monetary policy transmission. There is very little *theoretical research* on the effects of central bank transparency on financial markets. Eijffinger *et al*. (2006) show that greater transparency should enhance central bank

[1] See, for a survey, Geraats (2002) and Eijffinger and van der Cruijsen (2007).

[2] Darrat, 1990; Jensen *et al*., 1996; Thorbecke, 1997; Lastrapes, 1998; Fair, 2002; Jensen and Mercer, 2002; Ehrmann and Fratzscher, 2004; Rigobon and Sack, 2004; Bernanke and Kuttner, 2005; Murdzhev and Tomljanovich, 2006; Honda and Kuroki, 2006; Bredin *et al*, 2007; Farka, 2009.

credibility, flexibility and reputation. These effects of transparency should influence the level of interest rates. In particular, enhanced flexibility would allow a reduction in policy and short-term interest rates without increasing long-term nominal interest rates. In addition, improved reputation would reduce inflation expectations and thereby long term nominal interest rates.

Empirically, there are only few studies examining the direct effects of central bank transparency on capital markets and especially bond markets. Siklos (2004) notices that nominal interest rates are lower for countries with a clear inflation objective. Eijffinger *et al*. (2006), analysing the effects of various transparency changes, they found that greater transparency have had a significant beneficial effect on the level of government bond rates.

Furthermore, there is an important strand of empirical research analysing the role of transparency concerning the reaction of bond markets to news related to monetary policy. Most of the existing studies show that greater transparency (particularly political[3], policy[4] and economic[5]) improves the predictability of central banks decisions. Concerning the reaction of bond markets to news, Clare and Courtenay (2001) and Chadha and Nolan (2001) argue that greater central bank transparency should increase the reaction of interest rate level to news related to monetary policy and reduce the effects of that news on interest rate volatility.

Moreover, recent empirical studies examine how the communication method has affected the magnitude of the surprises in the financial markets and whether the desired reactions of asset prices occur (Ehrmann and Fratzscher, 2007). Reeves and Sawinski (2007) for UK find that the *Minutes of Monetary Policy Committees* meetings and the publication of the *Inflation Report* result in increased variance of asset prices, particularly of short sterling futures. However, the publication of the inflation report reduces the volatility of the stock market index FTSE 100. Similarly for USA, according to Kohn and Sack (2003) central bank talk (Statements released by the Federal Open Market Committee – FOMC, and congressional testimony by Chairman) appears to be most influential (and hence potentially effective) when it focuses on issues about which the central bank is directly concerned and may have relevant information to convey. However, they find that other types of talk—particularly statements about asset valuations—are less important.

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3 See Lildholdt and Wetherilt, 2004; Biefang-Frisancho Mariscal and Howells, 2006.

4 See Demiralp, 2001; Poole et al., 2002; Rafferty and Tomljanovich, 2002; Kohn and Sack, 2003; Poole and Rasche, 2003.

5 For instance, Fujiwara (2005) is interested in the predictability effects of publications of forecasts and Gerlach (2004) in those of the voting records.

While the above studies, looking at the transparency effects on interest rates on higher degree and a less one on stock prices, can be characterised as event study analyses at a national level. We contribute to the existing literature by developing a theoretical model which shows the link between stock market volatility and central bank transparency, and providing empirical evidence following panel data analysis for 40 countries over the period 1998 to 2005.

Our results imply that a high level of transparency can reduce stock market volatility while interest rate volatility is strongly correlated with the latter. An interesting policy implication is that high level of transparency can contribute to the financial stability which plays a crucial role on investment decisions.

The remainder of the paper is structured as follows. The next section describes the main theoretical model developed. Section 3 presents the empirical analysis. We conclude in the last section.

2. An analytical setting

The main objective of this section is to show the theoretical relationship between central bank transparency and stock market volatility. To do so, we should derive the equation for share prices and then investigate how share prices volatility is affected by central bank transparency (opacity) as well as interest rate volatility.

Our closed economy framework consists of a Phillips curve for the supply side and an IS curve for the demand side to show the relationship of inflation with financial variables as follows:

$$y = -\theta r + \delta q + \varepsilon_d , \qquad \theta, \delta > 0 . \tag{1}$$

The aggregate demand is negatively affected by the real interest rate and positively by stock prices, where the real interest rate, $r = i - \pi^e$ is the difference between the nominal interest rate i, and the expected inflation rate, π^e. The variable q is added to incorporate a wealth effect and which can be justified on the ground that it is a shortcut within the spirit of the debate about the role of asset prices in the transmission mechanism of monetary policy (see, e.g., Cecchetti *et al.*, 2000). It can also be interpreted as the total market capitalization of firms or equivalently the Tobin's *q*.[6] Finally, ε_d indicates a demand shock.

Inflation and output are linked through the inflation augmented Phillips curve as follows:

$$\pi = \pi^e + \gamma y - \varepsilon_\pi , \qquad \gamma > 0 , \tag{2}$$

[6] The Tobin's *q* positively influences consumption by net wealth effects as well as investment by determining the value of existing capital relative to its replacement cost (Blanchard, 1981).

where π denotes the inflation rate, y the output, and ε_π a supply stock.

It is assumed that the Rogoff (1985) type conservative central banker, in order to control inflationary expectations, minimizes a loss function of the following form:

$$L = \frac{1}{2} E\left[\pi^2 + b(y-k)^2\right],\ b > 0 \qquad (3)$$

where E is the expectation operator, b the weight associated with the output objective, k [7], relative to the inflation objective (is equal to zero). [8]

We complete the description of our model with the sequence of events as follows: (i) the public forms its inflationary expectations π^e; (ii) shocks ε_d, and ε_π occur; (iii) the central bank fixes the inflation rate; and (iv) finally firms decide their level of production, y, and price level p.

In our study, we consider that transparency issues arise from one possible source, which is the ambiguity about the true value of the preference parameter b or political transparency in the sense of Geraats (2002). In fact, in this case, we assume that monetary authorities are able to modify their preferences (i.e., the relative weight attached to output stabilization) without preliminary communication. Thus, the public is uncertain about the parameter b which means that the public's perception about the central bank preferences, β, on output differs from the values that the bank itself actually considers, b. The above can be illustrated by assuming that $\beta = b + \eta$, where η is a random error with zero mean $E(\eta) = 0$ and a variance σ_η^2. The public therefore is correct on average $E(\beta) = b$, but may be mistaken when making guesses about the central bank preferences in individual cases or at certain points in time. Perfect transparency occurs when the monetary authorities communicate to the public all available information concerning their preferences, which corresponds to a zero variance of the random error η : $\sigma_\eta^2 = 0$ (see Demertzis and Hallet, 2007).

Assuming that the central bank correctly anticipates what the public thinks the minimization of the central bank's problem (3) constrained by equation (2) leads to the following equilibrium solution:

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[7] The parameter k reflects the central bank's will to offset distortions affecting the labour market.

[8] We assume that the weight attached to the inflation objective is normalized to unity. This is in fact the normalization adopted in most studies in the related literature: see Muscatelli (1998), Cukierman (2000), Sibert (2002) and Demertzis and Hallet (2007) among others.

$$\pi = \frac{b\gamma\left(1+\frac{\beta}{\gamma^2}\right)}{b+\gamma^2}k - \frac{b\gamma}{b+\gamma^2}\varepsilon_\pi \qquad (4)$$

Note that $\pi^e = \frac{\beta}{\gamma}$. The expected inflation π^e is obtained by solving the minimization problem of the central bank under the assumption that parameter b is replaced by β. From the point of view of the public, the inflation rate that the central bank is expected to implement is: $\pi = \frac{\beta\gamma^2+\beta^2}{\gamma\left(\beta+\gamma^2\right)}k - \frac{\beta\gamma}{\beta+\gamma^2}\varepsilon_\pi$.

Substituting equation (4) into equation (2) and rearranging the terms, it is straightforward to find the expression for the equilibrium output as follows[9]:

$$y = \left[\frac{b\gamma\left(\gamma^2+\beta\right)-\beta\left(b+\gamma^2\right)}{\gamma^2\left(b+\gamma^2\right)}\right]k + \frac{\gamma^2}{b+\gamma^2}\varepsilon_\pi .$$

Substituting then $\beta = b+\eta$ in the above equation, we obtain the expression of output in relation with the random error η given by:

$$y = -\frac{\eta}{b+\gamma^2}k + \frac{\gamma^2}{b+\gamma^2}\varepsilon_\pi . \qquad (5)$$

Substituting (5) in equation (1), taking account of $\pi^e = \frac{\beta}{\gamma}$ and solving for the stock prices we get:

$$q = \theta i + \theta\frac{\beta}{\gamma}k - \eta k + \frac{\gamma^2}{\delta\left(b+\gamma^2\right)}\varepsilon_\pi - \varepsilon_d \qquad (6)$$

As our aim is to look at the impact of central bank transparency on the variability of stock prices, we take the variance of the above equation given by:

$$Var(q) = \left(\frac{\theta}{\delta}\right)^2 Var(i) + \left(\frac{\theta}{\gamma\delta}\right)^2 k^2\left(\sigma_\eta^2\right) + \left(\frac{k}{\delta}\right)^2\sigma_\eta^2 + \left[\frac{\gamma^2}{\delta\left(b+\gamma^2\right)}\right]^2\sigma_{\varepsilon_\pi}^2 + \frac{1}{\delta^2}\sigma_{\varepsilon_d}^2 . \qquad (7)$$

The volatility of stock prices is related to the volatility of interest rate, the volatility of exogenous shocks and the volatility of the random error denoting the lack of transparency.

[9] Similarly to Demertzis and Hallet (2007), we show that the variability of inflation and output is negatively related to political transparency.

Since central bank opacity is positively related to stock prices variability it is straightforward to see that there is a clear-cut negative link between stock market volatility and central bank transparency leading to the following proposition.

Proposition: *The volatility of stock prices is negatively related to transparency about central bank preferences.*

Proof: *Taking the* volatility of stock prices, $Var(q)$, with respect to the variance of the random error, σ_η^2, we obtain:

$$\frac{\partial Var(q)}{\partial \sigma_\eta^2} = \left(\frac{\theta}{\gamma\delta}\right)^2 k^2 + \left(\frac{k}{\delta}\right)^2 > 0. \qquad (8)$$

Since more opacity about central bank preferences (a higher value of σ_η^2) positively affects the volatility of stock prices, we conclude in this theoretical framework that central bank transparency is beneficial enhancing financial stability.

3. EMPIRICAL ANALYSIS

3.1 Data

In the literature, there are mainly two types of methods to determine the index of central bank transparency. The first one is proposed by Fry et al. (2000) that measure central bank transparency on the basis of a survey focusing on the information published by central banks that enhances the public understanding of the central bank policy, analysis and forecasts. Contrary to this approach, some authors construct an index of transparency by taking account of the actual information disclosed by central banks (Eijffinger and Geraats, 2006; Dincer and Eichengreen, 2007). The majority of these studies constructed an index of transparency either for a very limited number of central banks or a single point in time. Exception being the study of Dincer and Eichengreen, where a transparency index for a large range of central banks (124) and for a long period (1998-2005), is constructed[10]. Their index is more suitable for panel data analysis, and therefore we retain it in our analysis.

For the purposes of the analysis that follows, quarterly prices of stock market general indices for fourty countries (see table 1) are drawn from the database Ecowin Reuters. Concerning inflation,

[10] Specifically, Dincer and Eichengreen used the methodology proposed by Eijffinger and Geraats which use Geraats' (2002) transparency terminology. They extend transparency indices of Eijffinger and Geraats (2006).

money market rate and GDP, quarterly data are taken from the IFS database of the IMF. The sample covers the period 1998 to 2005 on a quarterly frequency. Every year the standard deviation of the variables of interest is calculated, as a proxy for volatility measures, by using the quarterly data.

3.2 Empirical methodology

Our empirical methodology consists of two main steps. Firstly, panel data analysis is employed in a bivariate context in order to investigate empirically the theoretical relationship implied by the analytical setting between (a) the level of transparency and inflation volatility, and (b) the level of transparency and economic activity volatility. The level of transparency is measured by the broad central bank transparency index presented by Dincer and Eichengreen (2007) for our sample countries

Secondly by using panel data analysis the theoretical model concerning stock price volatility determinants that is developed in the previous section is investigated in a multivariate context. Panel data methodology presents a number of significant advantages compared to times series analysis. Among others Baltagi (2001) and Hsiao (1986) indicate that panel data methodology controls for individual heterogeneity, reduces problems associated with multicollinearity and estimation bias, and specifies the time varying relation between dependent and independent variables. This study by using panel data analysis tries to empirically investigate the theoretical relations developed in the paper concerning the role of central bank transparency on stock market volatility but also its relation with inflation volatility and variability of economic activity.

Following theoretical analysis this study tests empirically the relation between stock price volatility with interest rate volatility and the level of central bank transparency by using the following general form:

$$\sigma(q)_{j,t} = a_0 + a_1\sigma(i)_{j,t} + a_2 Tr_{j,t} + \mu_j + z_t + e_{j,t} \qquad (9)$$

Where $\sigma(q)_{j,t}$, the standard deviation of quarterly stock prices is the dependent variable; the standard deviation of quarterly interest rates $\sigma(i)_{j,t}$, and the transparency index $Tr_{j,t}$ are the regressors, while $e_{j,t}$ are the error terms for j=1,2…,M cross-sectional units, observed for t=1,2,…,T dated periods. The parameter a_0 represents the overall constant in the model, while the μ_j and z_t represent cross-section or period specific effects (random or fixed).

An F-test is used in order to determine whether the fixed effects model outperforms the pooled OLS. Then the appropriateness of the random effects model relative to the fixed effects model is examined by applying the Hausman's (1978) test. In case that we gain much efficiency by assuming that random specific effects exist, then we proceed by using Feasible Generalised Least Squares (FGLS) for the estimation of equation (9).

3.3 Preliminary analysis

Table 1, provides information about the average level of transparency in the whole sample period for every country and the average volatility for the variables of interest. There have been countries presenting low level of Central bank transparency like for example Egypt, Jordan, Ukraine, Turkey, S. Arabia, Russia, Mexico and others, that their financial markets are usually characterized as emerging. Average inflation volatility and GDP volatility are quite similar while the volatility is higher in stock prices and interest rates. European monetary Union presents one of the lowest numbers concerning inflation and GDP volatilities. Moreover the figures from financial markets are below the average in the Eurozone indicating that financial stability is one of the economic targets and an advantage for a monetary union.

Table 1 Summary Statistics (Averages over the period1998 –2005)

Country	Symbol	Inflation Volatility	GDP Volatility	Stock Price Volatility	Interest Rate Volatility	Transparency Index	Country	Symbol	Inflation Volatility	GDP Volatility	Stock Price Volatility	Interest Rate Volatility	Transparency Index
Argentina	**ARG**	0.0218	0.0254	0.1434	0.4293	3.9375	**Korea**	**KOR**	0.0210	0.0187	0.1878	0.1214	7.9375
Australia	**AUS**	0.0058	0.0118	0.0543	0.0390	8.5000	**Malaysia**	**MAL**	0.0273	0.0186	0.1248	0.0839	4.7500
Canada	**CAN**	0.0100	0.0111	0.0871	0.1144	10.5000	**Malta**	**MAT**	0.0189	0.0113	0.1206	0.0335	5.9375
China	**CHI**	-	-	0.0944	0.0552	2.3750	**Mexico**	**MEX**	0.0221	0.0104	0.1331	0.1855	4.4375
Chile	**CHIL**	0.0101	0.0144	0.0854	0.3428	7.3750	**Norway**	**NOR**	0.0284	0.0139	0.1400	0.1387	7.0625
Croatia	**CRO**	0.0241	0.0150	0.1082	0.3306	2.1250	**New Zealand**	**NZL**	0.0108	0.0117	0.0563	0.1267	12.9375
Cyprus	**CYP**	0.0091	0.0128	0.2292	0.1083	4.5000	**Philipines**	**PHI**	0.0093	0.0146	0.1093	0.0822	7.4375
Denmark	**DKN**	0.0045	0.0098	0.1021	0.0922	5.3750	**Romania**	**ROM**	0.0437	0.0344	0.1933	0.2061	3.5000
Egypt	**EGY**	-	-	0.0804	0.1037	1.1250	**Russia**	**RUS**	0.0563	0.0236	0.2328	0.4883	1.7500
Eurozone	**EMU**	0.0054	0.0063	0.1082	0.0889	9.5625	**S. Africa**	**SAF**	0.0107	0.0107	0.1562	0.1030	7.2500
Estonia	**EST**	0.0152	0.0240	0.1487	0.1558	5.3750	**S. Arabia**	**SAR**	-	-	0.1272	0.1438	1.0000
Hong Kong	**HON**	0.0104	0.0204	0.1148	0.4389	6.3750	**Singapore**	**SGX**	0.0184	0.0322	0.1225	0.2161	4.7500
Hungary	**HUG**	0.0241	0.0139	0.1348	0.0890	6.1875	**Slovenia**	**SLO**	0.0090	0.0143	0.0730	0.1075	6.2500
Iceland	**ICL**	0.0132	0.0438	0.1041	0.1537	6.8750	**Sweden**	**SWE**	0.0051	0.0112	0.1305	0.0777	11.2500
Indonesia	**IDO**	0.0456	0.0180	0.1587	0.2278	5.5000	**Switzerlan**	**SWI**	0.0037	0.0063	0.0935	0.3292	8.0625
India	**IND**	0.0115	0.0215	0.1581	0.0276	2.0000	**Thailand**	**THA**	0.0179	0.0181	0.1429	0.2587	6.0625
Israel	**ISR**	0.0111	0.0208	0.0987	0.1123	7.8125	**Turkey**	**TRK**	0.0610	0.0207	0.2620	0.1994	6.0625
Jamaica	**JAM**	0.0215	0.0082	0.0797	0.0691	4.9375	**Unite Kingdon**	**UK**	0.0042	0.0088	0.0745	0.0764	11.8750
Jordan	**JOR**	0.0138	0.0192	0.1074	0.1233	1.1875	**Ukraine**	**UKR**	-	-	0.2112	0.4651	2.5000
Japam	**JPN**	0.0031	0.0068	0.1159	0.7080	8.4375	**United States**	**USA**	0.0021	0.0108	0.0735	0.1670	8.3750
Avg Across Countries		0.0175	0.0165	0.1270	0.1855	5.9813							

Note: - indicates unavailability of data.

Before getting into regression results, as preliminary analysis, scatter plot figures among two variables can show some of the hidden part in a relation. More specifically, figure one shows the relationship between the average historical volatility of inflation and the average level of transparency over the whole period. Similarly figure two presents the average GDP volatility versus average transparency, and figure three stock price volatility versus transparency level. The

first two graphs confirm what we expected from the theoretical model. Higher level of transparency in the way that monetary policy is conducted coexists with lower level of variability in macro data like inflation and GDP variability.

On the one hand, Eurozone, Sweden, UK, Canada and New Zealand present some of the countries with the combination of high transparency with low level of variability in inflation and GDP numbers. However, the picture that emerges is that there is also a negative relationship between stock market volatility and central bank transparency, indicating that transparency does not only affect inflation (Alesina and Summers, 1993) but also investors' behaviour. On the other hand countries like Turkey, Romania, Russia and Ukraine present low level of transparency in monetary policy processes and high level of variability in their stock markets.

Figure 1: Average Transparency Index Vs. Average Volatility of Inflation 1998-2005

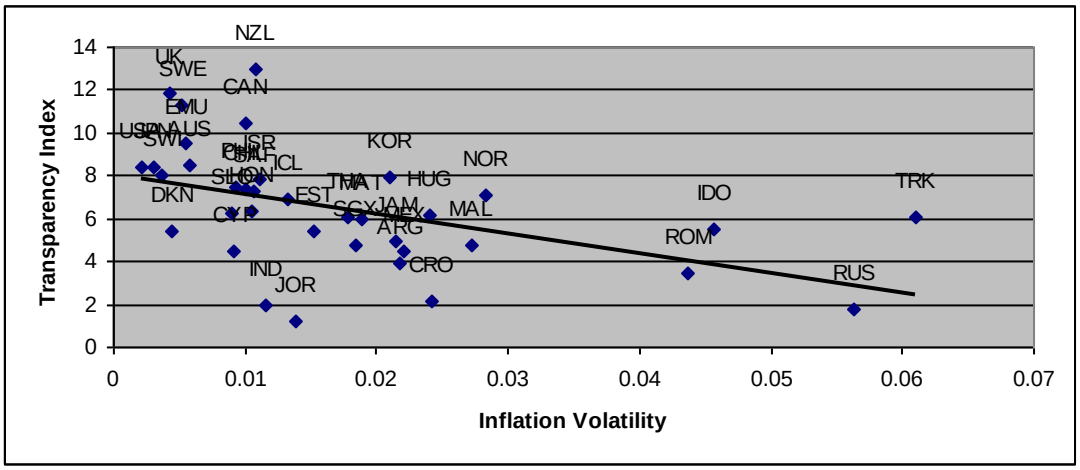


Figure 2: Average Transparency Index Vs. Average Volatility of Gross Domestic Product 1998-2005

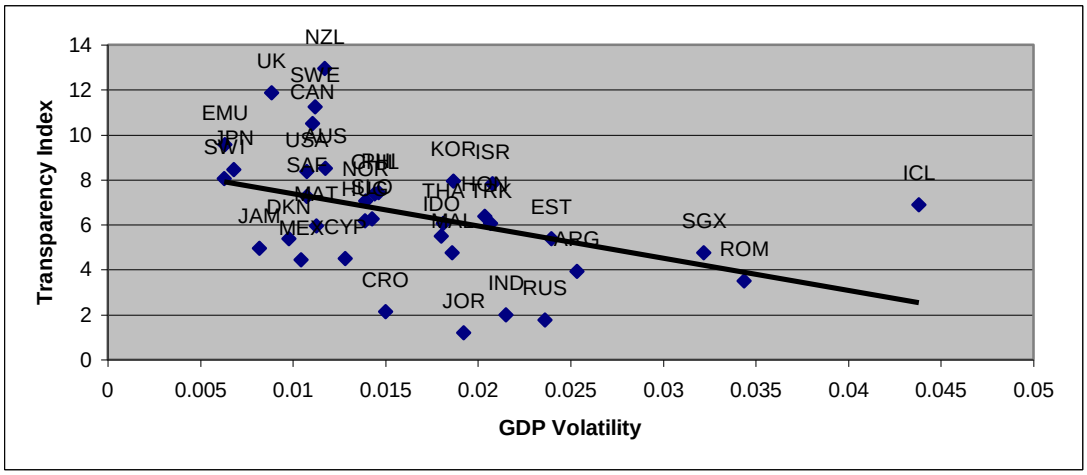
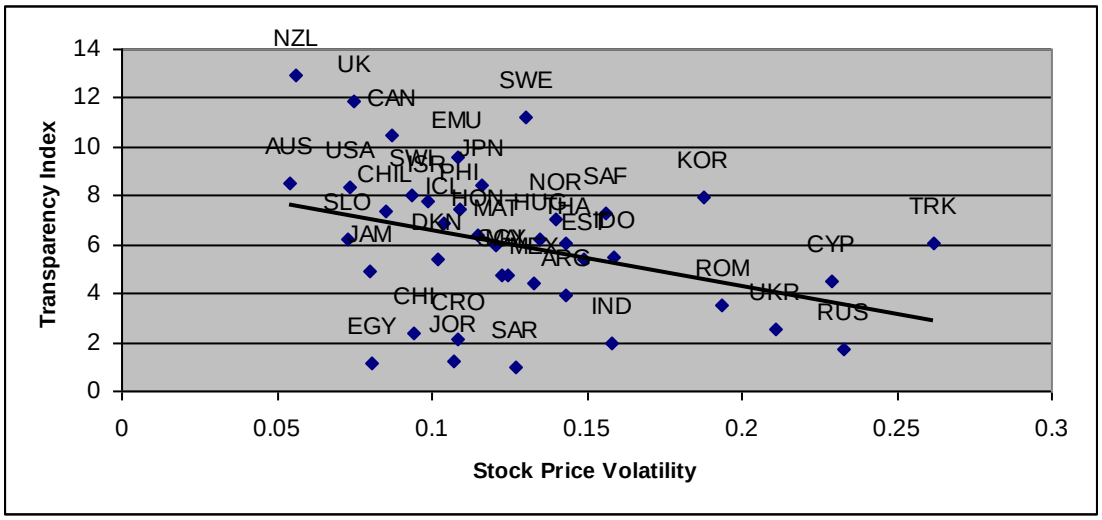


Figure 3: Average Transparency Index Vs. Average Volatility of Stock Market Returns 1998-2005



3.4 Estimation Results from panel data analysis

In the first step of our empirical investigation by using panel data analysis techniques a number of unit root tests are applied on the variables of interests (i.e. volatility measures for GDP, Inflation and stock prices, as well as, transparency index). By looking the results of the unit root tests in table 2, it can be seen that there is evidence against non-stationarity for all the variables studied. More specifically, in all cases and according to the tests adopted, the variables are stationary in all levels of statistical significance.

Table 2 Summary of panel unit root tests

Variable of interest	Levin, Lin & Chu t*	Im, Pesaran and Shin W-stat	ADF -Fisher Chi-square	PP - Fisher Chi-square
σ(stock prices)	-18.4172	-7.4711	215.238	235.558
	(0.00)***	(0.00)***	(0.00)***	(0.00)***
σ(interest rates)	-56.7852	-11.0033	210.737	209.495
	(0.00)***	(0.00)***	(0.00)***	(0.00)***
σ(inflation)	-53.0859	-9.0273	150.684	219.88
	(0.00)***	(0.00)***	(0.00)***	(0.00)***
σ(GDP)	-23.3514	-10.6181	229.328	217.483
	(0.00)***	(0.00)***	(0.00)***	(0.00)***
Transparency Index	-68.8019	-9.42808	90.5176	105.93
	(0.00)***	(0.00)***	(0.00)***	(0.00)***

Note: H_0: unit root is present. P-values are in parentheses. *****,** and ***indicate statistical significance at the 10%, 5%, and 1% level respectively.

The last column of Table 3 presents the results of estimating equation (9), by using Pooled OLS and Random Effects. The rest two columns investigate similarly the effect of transparency on inflation and on GDP volatility respectively, implied by the theoretical model. The F- tests in the specification tests indicate that the fixed effects models outperform the pooled OLS. Moreover the Hausman test generally indicates that the random-effects model is superior to the fixed-effects model. Therefore the random-effects results are presented in Table 3, and for comparison purposes, the OLS results are also reported.

Because the data are pooled, heteroskedasticity and autocorrelation may influence the OLS results. For the panel data analysis, the heteroskedasticity and autocorrelation tests provide evidence of heteroskedasticity and autocorrelation respectively. Thus, following Arellano (1987) and Wooldridge (2002) cluster-robust variance and covariance estimators are used to resolve these issues.

The random effects specification indicates that when inflation volatility is used as the dependent variable transparency presents a significant negative relation with it. The results are quite similar for the relation between economic activity volatility and transparency index. All theses imply that central bank transparency works through theses variables affects economy and probably stock market volatility as well. Last column of table 3 verifies that there is empirical evidence of a negative relation between stock market volatility and central bank transparency. While interest rate volatility is directly correlated with stock market volatility as expected, given that interest rate variability plays a crucial role in a dividend discount model.

Table 3 Estimation results by using Pooled OLS & Random Effects models

Dependent Variable		**Inflation Volatility**		**GDP Volatility**		**Stock Prices Volatility**	
Independent Variables	Expected Sign	Pooled OLS	Random Effects	Pooled OLS	Random Effects	Pooled OLS	Random Effects
Constant	+	0.03576	0.03848	0.02344	0.02156	0.15414	0.15912
		(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***
Transparency Index	-	-0.00282	-0.00323	-0.00108	-0.00079	-0.00615	-0.00679
		(0.00)***	(0.00)***	(0.00)***	(0.01)***	(0.00)***	(0.00)***
Interest Rate Volatility	+	-	-	-	-	0.05165	0.04542
						(0.01)***	(0.01)***
R^2		0.114	0.115	0.066	0.064	0.152	0.160
F-Statistics		(0.00)***	(0.00)***	(0.00)***	(0.02)**		(0.00)***
N =(ixT)		280	280	288	288		320
Specification tests							
F-test (pooled OLS vs. FEM)							
-Cross-section F			(0.00)***		(0.00)***		(0.00)***
-Period F			(0.35)		(0.04)**		(0.00)***
-Cross-Section/Period F			(0.00)***		(0.00)***		(0.00)***
Hausman test (FEM vs REM)			(0.15)		(0.12)		(0.50)
Heteroskedasticity tests:							
White test			11.93***		3.88**		5.41
Harvey test			50.40***		3.99**		19.92***
Glejser test			33.60***		10.34***		20.10***
Autocorrelation tests:							
Durbin-Watson			1.02***		1.39***		1.71**
Breusch-Godfrey LM test			78.08***		45.36***		19.57***

Note: *,** and ***indicate statistical significance at the 10%, 5%, and 1% level respectively. Cluster-robust standard errors (to account for both heteroskedasticity and autocorrelation) are used in order to calculate the p-values in parenthesis. All values in parenthesis are p-values of the tests.

To check for robustness concerning the effect of transparency on stock market volatility a supplementary analysis is performed on daily data frequency, but is not reported for economy of space. Our methodological approach consists of two main steps. Firstly by applying French et al. (1987) methodology, a measure for historical volatility of stock market returns for each country is constructed. Additionally, GARCH models are used in order to estimate conditional volatilities for stock market returns. Based on the coefficients estimated in the GARCH model[11], we construct the daily conditional standard deviation (conditional volatility), and then we aggregate up the daily volatilities to annual frequency.[12] Following this, panel data analysis is employed in order to investigate the relationship between the broad central bank transparency index and stock market measures of volatility (historical and conditional). The results are consistent with the negative relationship between transparency and stock market volatility.

4. CONCLUDING REMARKS

This paper examined the relationship between stock market volatility and central bank transparency. Our analytical setting in the theoretical model proves to be a negative relation

[11] The standard approach used in the relevant literature, is the GARCH modeling technique by Bollerslev (1986), which extends the ARCH framework introduced by Engle (1982).

[12] To aggregate volatilities from daily to lower frequencies, say annually, we take the average over that year and scale by $\sqrt{365}$, allowing for the possibility of missing days, due to, for instance holidays.

between central bank transparency and stock market volatility. This theoretical relationship has been confirmed by our empirical analysis. By using panel data analysis for 40 countries, we provide empirical evidence supporting our analytical proof.

Moreover our study is in line with previous studies using a smaller number of countries that argued for a negative relationship between inflation variability and central bank transparency (see among others Chortareas et al. 2002). However, in contrast to Demertzis and Hughes-Hallet (2007), we argue for transparency benefits to GDP volatility also. In this line we should remember the findings of Dincer and Eichengreen (2007) who suggested only weak favourable impact of transparency on inflation and output volatilities.

Concerning stock market volatility and central bank transparency previous studies are absent from the literature as far as we know. Only one study can be characterized as related by Errunza and Hogan (1998). They investigated seven European stock markets and found that the time variation in stock market volatility can be affected by the variability of monetary factors for Germany and France. Our study therefore shed light in an international setting of the importance on the way monetary policy is conducted about stock market variability.

As a result our empirical analysis on data for 40 countries is consistent with our argument that central bank transparency affects significantly not only inflation expectations and GDP variability but also to the stock market volatility. Low stock market volatility plays crucial role on investment decisions and financial stability. This is another reason why central banks should move towards monetary policy transparency.

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