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Does Greater Transparency Stabilize Output? Evidence from Panel Data

Ummad Mazhar

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Does Greater Transparency Stabilize Output? Evidence from Panel Data[1]

Ummad Mazhar

Abstract. While transparency is following a non-decreasing trend across countries, the theoretical predictions concerning transparency and output volatility are mixed. We investigate the link between monetary policy transparency and output volatility in a panel data set of 80 countries from 1998-2007. Controlling the influence of other structural variables, we find a significant impact of transparency on output stability. Two novel aspects of our analysis are that (a) the effect of transparency on output volatility is independent of its effect on inflation; (b) its effect on output volatility is independent of its correlation with central bank independence. Our findings are robust against different measures of transparency, different samples, and different measures of output volatility.

Key Words: Transparency, Great Moderation, Inventory changes, Instrumental variables, Endogeneity, Arellano-Bond estimator, 3SLS estimator, Panel data.

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For correspondence:

Ummad Mazhar
Monetary Policy Department,
State Bank of Pakistan,
I.I.Chundrigar Road, Karachi.
Email: umad.mazhar@sbp.org.pk
Telephone: +92 21 32453854
Fax: +92 21 99221372

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Non-Technical Summary

The current practice of monetary policy assigns special importance to management of agents' expectations about the macroeconomic fundamentals. The logic behind this practice stems from the theoretical finding that with rational expectations, actual inflation rate will be the one expected by the agents. Therefore, it is important that agents' expectations do not deviate consistently from the target or desirable rate of inflation. It is in view of these considerations that the strategy of monetary policy is sometimes called forecast targeting, which means that monetary authority tries to keep the expectations of agents closer to the path forecasted by the monetary authorities.

Transparency about policy processes is considered as a principal tool to manage agents' expectations. However, transparency is a multidimensional concept with different dimensions entailing different things and having different effects on the macroeconomic variables. The most widely used index of transparency is the one developed by Eijffinger and Geraats (2006). It quantifies five different dimensions of transparency namely political, economic, procedural, policy and operational. Political transparency is about the clarity of objectives, economic transparency covers information used for the policy decision, procedural transparency relates to the decision making process, policy transparency to the monetary policy stance, and operational transparency to the effects of monetary policy implementation. This index has been updated and extended by different authors and most recently by Siklos (2011).

With the availability of transparency indeces, empirical literature has extensively searched the effects of transparency on inflation expectations and on private sector forecasts. Most of these studies suggest a stabilizing impact of transparency on inflation, inflation volatility, inflation expectations, and private sector inflation forecasts.

Surprisingly there is not much research on the link between transparency and output volatility. This is despite the fact that many authors argue that greater attention towards inflation as a policy objective may cause greater output volatility. It is in this context that this paper contributes by providing comprehensive empirical evidence on the link between output volatility and transparency.

Importantly, focusing on indicators relating to different aspects of policy processes an attempt is made to delineate their individual influences. Thus, this paper particularly attempts to answer the following two questions: (1) what is the effect of transparency on output volatility in

the presence of other sources of output stabilization?; (2) do different aspects of transparency differ qualitatively or quantitatively in terms of their effects on output volatility?

These questions have not been properly studied before, partly due to lack of comprehensive time varying transparency measures that have become available lately. By focusing on these issues, therefore, this study provides insights of direct policy relevance. For instance, in light of the current financial crisis many central banks started a series of unconventional monetary policy measures to cope with the crisis. To use these instruments credibly central banks are enhancing information disclosure about policy processes (Bernanke, 2011). For this reason, the link between central bank transparency, its different aspects, and output stability is crucial for policy effectiveness. Therefore, policymakers must be aware of the nature and strength of any trade-off between greater transparency and macroeconomic volatility, if it exists. Similarly, it is an empirical issue that to what extent operational transparency allows central bank flexibility to stabilize economic shocks without destabilizing output and employment.

It is important to note that output volatility depends crucially on various other factors. Previous literature has identified, for instance, inventory change investments, degree of openness, government budget balance, Oil-to-GDP ratio, and geo-political external shocks as important determinants of output volatility. Therefore, it is also important to see the relevance of central bank transparency in the presence of these structural variables that have been identified as the sources of the greater macroeconomic stabilization in recent years.

Using a panel data set of 80 countries over 1998 to 2007 period we find that transparency has a stabilizing influence on output volatility. Our results do not suffer from the problem of reverse causality and are robust against different specifications that control for important determinants of output volatility. Digging deeper, we find, among various dimensions of measured transparency, that operational transparency has the greatest relevance for output stabilization; while political transparency is either unrelated to or tends to increase output volatility. We also find that volatility of output reduces with more efficient inventory management, with increasing share of services in GDP, with declining risk of external shock and increasing credit to private sector.

1. Introduction

The extant practice of monetary policy assigns special importance to transparency. The general acceptance of transparency as a requirement for policy conduct is evident from the issuance of the *Code of Good Practices on Transparency in Monetary and Financial Policies* (henceforth, IMF Code) by International Monetary Fund (1999).[2]

In the context of monetary policy, transparency covers various aspects. According to the IMF Code, 'transparency refers to an environment in which the objectives of policy, its legal, institutional, and economic framework, policy decisions and their rationale, data and information related to monetary and financial policies, and the terms of agencies (accountability), are provided to the public on an understandable, accessible and timely basis.'

However, the findings, particularly theoretical, on the net benefits of transparency are not conclusive (Van der Cruijsen and Eijffinger, 2008). Two main issues concerning transparency are that to what extent it is beneficial and to what extent it is feasible. For example, while Eijffinger et al. (2000) show that uncertainty about central bank's preferences is welfare improving, Beetsma and Jensen (2003) point out that this finding is not robust against the way uncertainty is modeled. On a different note, there existsskepticism about the economic effects of transparency due to incomplete knowledge of policymakers' about underlying policy variables (e.g. Cukierman, 2001). This incomplete knowledge increases the risks associated with being transparent as pointed out byGeraats (2007), Walsh (2008), and Cukierman (2009), and renders it non-feasible. In general, however, theoretical findings depend on the way transparency is introduced in the model, as argued byHahn (2008).

The same inconclusiveness prevails at more specific aspects of transparency like disclosing the voting records of committee members (e.g. see Buiter, 1999; Issing, 1999; Sibert, 2001; and Gersbach and Hahn, 2008).

Transparency about economic shocks is also an unsettled issue. For instance, Gersbach (2003) consider it detrimental in the case of supply shocks.ButGeraats(2005), Rudebusch and Williams (2008) and Laskar (2010) in contrast findthat central bank forecast transparency reduces the magnitude of shocks and enhances macroeconomic stability. More recently,

[2] The "Code of Good Practices on Transparency in Monetary and Financial Policies: Declaration and Principles", p.4.

Baeriswyl and Cornand (2011) note that transparency is welfare improving if output stabilization is not the principle objective of the central bank.

A main theoretical argument against transparency is based on the long run trade-off between inflation volatility and output volatility under optimal policy choices (Rogoff, 1985; Taylor, 1999). This trade-off, represented by Taylor curve, implies that in the face of supply shock a policymaker can stabilize either output or inflation. Any deviation from this optimal framework will cost credibility to the central bank under transparency. Thus, opacity is preferable if central bank wants flexibility to care both inflation and output objectives.

On empirical side,the findings on transparency are largely supportive of its economic effects. It can be one reason why transparency is steadily increasing across central banks since its first measurement by Fry et al. (2000) (see Geraats, 2009; Siklos, 2011 and Table 1 in this paper). But the findings are limited, incomplete, and lack robustness (Van der Cruijsen and Eijffinger, 2008).

Moreover, what is still unexplained in the literature is the steady increase in transparency across central banks and a simultaneous decline in inflation and output volatility (often called Great Moderation), across large number of countries (Cechetti, et al. 2006b; and Coric, 2011).[3] There are three possible explanations to account for these apparently conflicting patterns: firstly, that only actual transparency, and not the perceived transparency, has increased (Geraats, 2007). The second possibility is that policy is not optimal but credible. It requires that agents understand the policymakers' constraints and distortions that make the optimal policy non-feasible[4]. In this context, communication and transparencyhelp agents' learn about the actual economic environment and build credibility (Fry et al. 2000; Bernanke, 2004). The final possibility is an exogenous improvement in the economic structure. The economies have become more stable because frequency and variability of shocks have reduced and thus there is a simultaneous decline in output and inflation volatility (Stock and Watson, 2003; Canova et al. 2007).

To some extent, the first possibility is supported by the survey based evidence produced by Van der Cruijsen and Eijffinger (2010). However, their evidence lacks time variation as it is at

[3] According to Coric (2011) the starting date of the Great Moderation is roughly, mid 1980s for the developed countries while mid 1990s for the developing countries. Therefore, the 'Great' Moderation, in the true sense of the word, started in mid 1990s.

[4]Cukierman, 2009 discusses many of these constraints. For example, output gap and natural rate of interest, two main ingredients of optimal policy framework, are unobservable besides the real distortions that reduce policy objectives only to second best options.

apoint of time. It is unlikely, assuming rational learning on the agents' part that such a gap between actual and perceived transparency persists over long run. Hence, we focus on other two possibilities below.

A large empirical literature has investigated this simultaneous decline in inflation and output volatility in the pre-Great Recession years with only a handful of studies focusing on the role of changes in the monetary policy in a cross country setting (e.g. Cechetti and Krause, 2002; Cechetti et al. 2006a; Cabanillas and Ruscher, 2008). Moreover, existing empirical evidence is inconclusive. Most of the literature is US-centric and use VAR methodology which has been criticized as biased against detecting policy effects (Benati and Surico, 2009; Giannone et al., 2008), and, importantly, it is unable to consider the role of institutional changes in the monetary policy.

This state of affairs with inconclusive findings on the effects of monetary policy, transparency, and dissatisfaction with the existing empirical findings, warrant a comprehensive enquiry on how transparency effects output volatility. In this paper, therefore, we investigate the role of transparency in the decline of output volatility using a panel data set of 80 countries. Our main findings suggest that transparency has a stabilizing influence on the output volatility independent of its effect on inflation stabilization. Importantly, it is not confounded with the influence of the central bank independence. The sensitivity analysis suggests that our results are robust against different ranges of sample, different techniques of estimation, and are not caused by omitted variables', simultaneity/endogeneity bias, and different measures of output volatility.

This study contributes to theliterature from different directions. First, it provides support to the theoretical arguments of Beetsma and Jensen (2003), and Laskar (2010) that transparency negatively affects output volatility. Secondly, by simultaneously considering the various causes of volatility reduction from the literature on Great Moderation, this study contributes to the debate on whether or not monetary policy has played a role in this stabilization. Thirdly, many theoretical studies predict the harmful effects of transparency on output stability and thus favour opacity especially when central bank is following dual objectives (Geraats, 2007). However, as we will show, there are 23 central banks in our sample that are fully transparent about their objectives (quantification, prioritization, and contract between government and the central bank) but it does not have any perverse effect on output volatility. Finally, our findings generalize the

scope of the empirical literature on the real effects of monetary policy by considering large number of countries and by suggesting causality from policy to greater stability.

The rest of the paper is structured as follows. The following section deals with the empirical specification, data, and the results. In section 3 the evidence is verified both by focusing more narrowly on different forms and measures of transparency, by considering alternative regressors, and by using a standard battery of sensitivity checks. The final section concludes the study.

2. Empirical Methodology

This section develops an integrated empirical framework based on structural variables to gather evidence from an analysis of 80 countries[5]. Our data confirms the basic empirical finding that volatility of output and inflation has declined in recent years. After justifying the empirical specification in section one, the second subsection presents results and interprets them.

2.1 Empirical Specification

To get a broader view of the changes in our main variables of interest we construct Tables 1a and 1b. Table 1a reports standard deviation of output growth and inflation for the countries of our sample[6]. The last column of the table reports percentage change in transparency over the sample end points. One message of Table 1a is that both output volatility and inflation volatility fall for and transparency increases significantly for all the countries in the sample. Table 1b presents descriptive statistics of major variables.

Table 1a and 1b here

In our empirical specification we rely on the previous literature on the sources of the Great Moderation and try to represent all three hypotheses in our model. In other words, the right hand side of our regression equation comprises of three vectors controllingthe effects of

[5] The countries included in the sample are listed in the Data Appendix at the end of the paper. We have excluded monetary unions like Euro and union of Central African States to avoid outliers' affects and also because of non-availability of their data on all the variables.

[6] Our sample comprises of high income and middle income countries according to World Bank classificastion. The middle income group in our sample includes World Bank's upper middle income and lower middle income categories. Moreover, following previous cross sectional studies notably Cecchetti et al. (2006b) and Ćorić (2011), we compare volatility across two periods, before and after 1990.

macroeconomic policy, structural change, and external shocks. We try to consider more than one variable to proxy each of the hypotheses to make the analysis devoid of biases.

The good policy hypothesis is captured both by monetary and fiscal policy indicators. Thus, for the good monetary policy hypothesis we take an updated version of Eijffinger and Geraats (2006) index as provided by Siklos (2011). A second measure of transparency, constructed by Crowe and Meade (2008) on the basis of Fry et al.'s (2000) survey of central banks, is used in the subsequent section to test the robustness of our results.

Many authors point out the significance of fiscal policy in output stabilization (e.g. Gambetti et al., 2005 and Canova et al., 2007, and Cabanillas and Ruscher, 2008). Fiscal policy can influence the variance of output by discretionary interventions and by automatic stabilizers. We prefer to consider automatic stabilizers given the lesser role that has been assigned to discretionary fiscal policy in recent years. The indicator for fiscal policy that we consider is the net lending (or borrowing) as a percentage of national output. This indicator is considered as a standard measure of the financial impact of general government activity on the rest of the economy[7].

The structural hypothesis is primarily considered, following Cecchetti et al., (2006b), through changes in the private inventory investment and commercial openness captured by the ratio of trade to GDP. Previous cross sectional studies e.g. Cecchetti et al. 2006a, Dincer and Eichengreen (2007) and Cabanillas and Ruscher (2008) find only a weak positive relation between openness and output volatility. But it is important to control for this variable to account for the increased economic dependence between countries (Stock and Watson, 2003b). To verify the sensitivity of our main results we also consider other possible sources of structural change like ratio of the credit to private sector, oil intensity of output, and share of services in the national output.

The influence of the good luck hypothesis can be controlled in two ways. One can take benefit of the panel data structure and incorporate country heterogeneity and time effects to control, respectively, for idiosyncratic shocks and common external shocks. However, given the inherent inertia in the macroeconomic variables, the use of panel fixed effects may cause bias.

[7] See IMF Government Finance Statistics Manuel (GFSM), 2001, section 4.17. Another possible indicator for the government's role in the economy is the cyclically adjusted fiscal balance (called government structural balance by the IMF). Our results (available on request) remain (qualitatively) unchanged if consider structural balance as a fiscal policy indicator.

Therefore, our strategy is to control common shocks through time effects and for country specific real shocks we use Political Risk Services Group's measure of external conflict. It measures risk that a country faces from war, cross-border conflict and other foreign pressures by assigning higher values to the countries that are facing lesser risk of the external conflict. The explicit consideration of a proxy for real shocks is a novel featuregiven the extant practice that infer the effects of shocks from the residuals of the estimated model (Giannone et al., 2008).

In econometric terms the above discussion can be summarized as follows.

$$Output\ Volatility_{it} = \alpha + \beta\ [Policy\ Set]_{it} + \delta\ [Structural\ Change]_{it} + \zeta\ [Shocks] + \gamma_t + \varphi[Controls]_{it} + \varepsilon_{it} \quad (1)$$

where subscript *'i'* is for country and *'t'* for time, and α is the common constant term. *Output volatility* is the deviation of real outputfrom its trend. Policy set comprises of two vectors, one is the transparency scores and second is the net fiscal lending or borrowing. In *structural Change* vector we include private inventory changes in the main regressions while include other determinants of output volatility in the robustness analysis. The time fixed effects are represented byγ_t. In the *Controls* vector we include inflation[8] and log of real national output. Finally, $\varepsilon_{it}$is the composite error term satisfying the usual assumptions. In our sample *i*range from 1 to 80 while *t* is from 1998 to 2007. The Data Appendix given at the end of the paper describes variables and their sources while Table 1b provides summary statistics of the variables use in our analysis.

2.2 Results

Table 2 reports the results with our baseline model. The dependent variable is the volatility of output measured as deviation of real output in time period *t* from its long term trend[9]. The

[8]Following Cukierman et al. (1992) we have transformed inflation as $\pi/(1+\pi)$ to avoid outliers influence.

[9]There are different ways to measure output volatility in the literature. With longer time dimension one can calculate moving standard deviation to measure volatility. For example, studies using long series of quarterly data like Blanchard and Simon (2001) use 20 quarters moving window while Stock and Watson (2003b) and Cecchetti et al. (2006) both use 4 quarter window to calculate volatility of output. Dincer and Eichengreen (2007), in an annual data set, calculate volatility using a moving standard deviation with 3 years window. With small time dimension the moving standard deviation is unlikely to capture long term volatility. Therefore, to avoid any imprecision due to the measurement of outputvolatility we estimate the reported results using 3, 4, and 6 years moving standard deviation. Additionally, we also check the results using variation of the log growth rate around its long term mean (as used by

long term trend is the average output level over the period from 1970 to 2007[10]. The first two columns (2.1 and 2.2) report the results, respectively, with and without adding any control variables. In the last two columns (2.3 and 2.4) we estimate our model separately for high income and middle income countries in our group[11].

Table 2 here

All the four models in Table 2 are reporting Driscoll and Kraay (1998) standard errors to control for country interdependence due to common shocks or economic linkages. This is motivated by the finding of Stock and Watson (2003b) that interdependence among countries' has increased during 1990s (although they do not find any increase in the business synchronization). Moreover, these standard errors are robust against heteroskedasticity and autocorrelation in the error term[12]. The baseline model with and without fixed effects and the general model with controls have been run on the same observations and countries to avoid any influence due to change in the sample size.

Focusing on our results, all the models are highly significant as indicated by the *p*-value of the joint *F*-test in the lower panel of the table. Among policy regressors, transparency is highly significant across all the specifications. Among structural variables, openness is significant and positive while inventory change has predicted negative influence but its significance lacks consistency.

Interpretation

Our dependent variable is in logs whereas transparency scores are numerical values. It means a log/level (or semi-elasticity) interpretation. Thus, as per our baseline estimates, a 10 percent increase in transparency, for instance, decreases output volatility by 0.15 percent. Given that average transparency score in our sample is (roughly) 5, a 10 percent increase amounts to an addition of 0.5 to the transparency score of a country, which is realistic and feasible.

Blanchard and Simon, 2001). With all these different measures of volatility, our results remain similar to those reported in Table 2.

[10] For transition economies, the average is from 1991 to 2007.

[11] The countries included in high income and middle income groups are listed in the Data Appendix at the end of the paper.

[12] Using Pesaran (2004) test for cross sectional independence we cannot reject the null hypothesis of independence among the variables of our analysis.

Among structural variables, inventory management appears to have a stabilizing effect but it is not significant in our baseline model. From model (2.2) however, its coefficient suggest that a 10 percent increase in the inventory investment will decrease the output volatility by 1.3 percent.

For openness, which is measured as a proportion of GDP, our baseline model suggests that a 10 percent increase will increase the volatility by 0.64 percent. The positive link between openness and GDP verifies the earlier findings of Cachetti et al. (2006b) and Dincer and Eichengreen (2007).

3. Robustness Analysis

This section refines the findings of the previous section by performing additional tests and sensitivity analysis. In the first subsection, we consider two possible hypotheses to focus more precisely on transparency's effects on volatility. Secondly, given the importance of other structural variables, it is plausible to consider them in turn to see whether our earlier macroeconomic policy effects hold in their presence or not. Finally, it is important to take into account the econometric issues related to endogeneity, simultaneity, and alternative measures of the dependent variable.

3.1 Different forms of transparency

The theoretical arguments of Laskar (2010) and Svensson (2010) about transparency and output variability suggest that economic and operational transparency components are more likely to affect the output volatility because they contain information about the policy deliberations, shocks, and forecasts. Assuming that these two aspects of transparency are prime responsible for stabilizing output, it is important to see their influence on output volatility separately from the influence of other components of transparency.

Moreover, as shown by Geraats (2009), the political transparency component of the transparency index is significantly correlated with the Cukierman et al. (1992) central bank independence index. Therefore, it is possible that this correlation affects the coefficient on transparency scores. If that is the case then we cannot say that transparency per se helps in macroeconomic stability.

These two observations lead us to test whether transparency about shocks and economic forecasts has any independent effect on output volatility; and secondly, whether the influence of transparency is independent or not from the confounding influence of central bank independence which is not specifically controlled for in our models.

The first hypothesis is reported in column (3.1) where we focus on only the disclosure of information about shocks. This is a subcomponent of the Eijffinger and Geraats (2006) with three possible values 0, 0.5 and 1. The value of 1 indicates maximum transparency about the shocks and zero indicates no information. To avoid subsuming the influence of political transparency in the error term and to help separate out the influence of central bank independence, we nonetheless control it as an additional regressor. As shown in Table 3, Column (3.1) the coefficient on 'information about shocks' isgreaterthan the corresponding baseline estimates (in Column 2.1). Whereas the coefficient on political transparency turns insignificant. All the other results remain unchanged qualitatively.

Table 3 here

In Column (3.2) we replace 'information about shocks' by 'publication of forecasts'. It is also a subcomponent of Eijffinger and Geraats (2006) index and can assume three values as 0, 0.5, and 1; where higher values indicate greater transparency about forecasts. The results in Column (3.2) follow the earlier pattern: the magnitude of coefficient on forecast transparency is higher than our baseline estimates while political transparency is not significant.

In Columns (3.3) and (3.4) we attempt to gather evidence on the link between transparency and output volatility in a more straight forward way. The average transparency score in our sample is roughly 5 with a standard deviation of 3.08. Thus, a one standard deviation interval is given by the range from 2 to 8. Using this interval, we divide our countries into two groups, namely, relatively transparent or those with transparency scores greater than or equal to 8, and relatively opaque or those with transparency scores less than or equal to 2. As shown in Columns (3.3) and (3.4) the coefficient on the variable 'relatively transparent' has increased 24 times while still highly significant. Contrarily, the coefficient of 'relatively opaque' turns insignificant. It clearly indicates that greater transparency affects real output volatility.

Finally, in column (3.5) we replace the transparency scores by the transparency measure of Crowe and Meade (2008). It is available for 54 countries of our sample and for two time periods

1998 and 2006[13]. This change poses the challenges of the lack of common sample and inability to calculate standard deviation of output growth with two observations. Therefore, following Blanchard and Simon (2001), we take first difference of the log GDP as a measure of output volatility. It reduces our sample to just 26 observations. However, our results still indicate a significant negative impact of transparency on changes in output[14].

3.2 Alternative sources of structural change

In table 4 we report the results of some alternative regressors on the basis of the literature on the Great Moderation (e.g. Coric, 2011). The first three columns include three alternative sources of structural change in our model of Table 2 Column (2.3). Thus, Column (4.1) incorporates credit to private sector, Column (4.2) incorporates GDP to oil ratio, and Column (4.3) incorporates share of services in the GDP. As is shown in Table 4, these changes affect neither the overall significance of the models nor the significance of core coefficients.

Among the additional structural variables credit to private sector and share of services in the GDP are highly significant and display stabilizing effect on output volatility. Thus, providing some support to the studies that favor multiple causes behind output stabilization (e.g. Boivin and Giannoni, 2006; Canova et al. 2007). Surprisingly, there is no effect of GDP/Oil ratio on output volatility. This may be because of difference in the level of economic development across the countries of our sample.

Table 4 here

The last column of table 4 includes the Political Risk Services Group's index of external conflict as a measure of country specific real external shocks. Higher values of this index are associated with lesser external risk. As shown, its coefficient is positive indicating a stabilizing effect of reduced external shocks on output growth while all the other results are unchanged.

[13] Meade and Crowe (2008) cover the same aspects of transparency as Eijffinger and Geraats (2006) but their index is based on the methodology of Fry et al. (2000). The Data Appendix at the end of the paper list the countries included in the estimation that uses Meade and Crowe transparency measure.

[14] The value of the F-test for the overall significance of the model is F(2, 21) = 2.31 which is significant at 10 percent.

3.3 Endogeneity and simultaneity

In Table 5 we consider simultaneity and endogeneity issues. Admittedly, it is not easy to determine who comes first: macroeconomic stability or transparency. These issues arise because macroeconomic policies neither focus on one variable nor are they independent of the evolution of these variables. Statistically, therefore, it is possible that our results, rather than reflecting the effect of our regressors on output volatility are, in fact, reflecting the effect of some omitted variable that is correlated with the dependent variable. In that case the causality would be reverse. To take into account this possibility we have estimated our regressions using Arellano and Bond (1991) estimator and system 3SLS model.

Table 5 here

Arellano and Bond estimator allows the dynamic effects through the lagged values of the dependent variable. Moreover, in addition to exogenous instruments, it uses lagged values of the endogenous variables as their own instruments, an advantageous feature because good instruments are hard to find. The specification that we consider takes one lag of dependent variable as an additional regressor to control for the feedback effects. The transparency is included as endogenous regressors with its two immediately previous lags as instruments. In addition, following previous literature, we also consider two governance indicators as exogenous instruments for transparency. These include World Governance Indicators' Voice and Accountability and ICRG's Law and Order indicator. We implement this estimator to get results in Column (5.1) using the specification of our baseline model with control variables. But it differs from the baseline model in that the model in Column (5.1) includes lagged value of output volatility rather than real output.

Our results are similar to those on previous occasions. The coefficient of transparency has increased further to 0.87 and is highly significant. It is necessary, however, to verify the consistency of Arellano and Bond estimator. It requires,first, a serially uncorrelated error term. As is shown in the lower panel of Table 5, we cannot reject the null hypothesis of no autocorrelation in error terms at and beyond order 1, thus our model qualifies this requirement.

The second assumption for consistency of Arellano and Bond estimator requires the validity of over-identifying restrictions.As indicated by the Sargan test statistic, the null hypothesis of

valid over-identifying restrictions cannot be rejected. Therefore, we can trust the estimates of our dynamic model.

In the 3SLS estimator we estimate a system of two equations assuming that transparency effect inflation volatility and output volatility simultaneously. It allows us to test whether transparency has an effect on output volatility that is different from its effect on inflation volatility or not. Like in the previous case, we are assuming transparency as endogenous using exogenous variables as its instruments. The results are shown in columns (5.2 to 5.3) which estimates small dynamic model considering the lagged values of both dependent variables as regressors along with transparency. The test of the null hypothesis that transparency has identical effects on both inflation volatility and output volatility reported in the bottom panel is clearly rejected. It indicates that the effects of transparency on output volatility are not due to its effect on inflation. This result supports the theoretical prediction that transparency can reduce the propagation of shocks which in turn implies that it can have an independent influence on output volatility (Laskar, 2010).

3.4 Alternative measures of output volatility

Table 6 here

Table 6 reproduces the baseline estimates of Table 2, with and without controls, using two alternative measures of output volatility as used in the extant literature. In the first two models (Columns 6.1 and 6.2) the output volatility is measured by deviation of actual growth rate of annual GDP from its long term trend. The long term trend is the average of annual GDP growth rates from 1960 to 2007 (or from 1991 to 2007 for transition economies). The data on growth rates are taken from the IMF. As shown in the table, all the models are highly significant. The coefficient on transparency still exhibiting negative influence on the output volatility although other variables are no more significant[15].

In Columns (6.3) and (6.4) we measure output volatility by taking 4 year moving standard deviation of GDP growth. It has reduces the number of observations but has no effect on our core findings. The coefficient on fiscal policy becomes significant with a positive sign. As government borrowing/lending is measured in absolute terms,the positive sign on its coefficient

[15] For both models (6.1) and (6.2) we cannot accept the null hypothesis that individually insignificant variables are jointly insignificant.

implies that it will take the sign of the variable. Thus, a positive balance (i.e. government surplus) will increase output volatility while a negative sign (i.e. government deficit) will reduce volatility. This is in line with the logic of automatic fiscal stabilizers and supports the finding of Cabanillas and Ruscher (2008) and Égert (2012).

4. Conclusion

This paper provides comprehensive evidence on hitherto not well explored theoretical link between transparency and output volatility. This inquiry is motivated by the apparently conflicting observations of increase in transparency across central banks over the years and simultaneous decline in inflation and output volatility. We argue that transparency can enhance credibility, reduce the propagation mechanism of shocks, and thus ensue output stability. In this way, the findings of the paper highlight the role of macroeconomic policies in output stabilization by considering not only a different method from the prevalent ones but also by extending the scope of previous studies by (a) considering all the important factors simultaneously, (b) verifying all the findings through careful sensitivity analysis for a large set of countries. The empirical evidence favors monetary policy as a leading factor in the stabilization of output and, less robustly, other structural sources like inventory management increase in the share of services, and more certain external environment.

The study can be extended in many directions. First, the effects of transparency can be explored through natural experiment by comparing the relatively transparent policy period (after 1990s) with the relatively opaque period (before 1980s) while controlling for the relevant factors. Secondly, a separate enquiry for the low income countries, which are not considered in this study, could increase our understanding about the effect of transparency in an environment with less developed financial system and with many bottlenecks.

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Appendix Tables

Table 1a: Output volatility has decreased and transparency has increased across countries

	Standard Deviation						
	Output growth			Inflation			Transparency
	1970-1990	1994-2007	% change	1970-1990	1994-2007	% change	% change in mean from
High income	0.959	0.327	-66 %	0.421	0.222	-0.47%	0.44
Middle income	0.454	0.377	-18 %	0.412	0.334	-0.19%	0.51

Source: World Bank online data base. Our sample comprises of 33 high income economies, 47 middle income economies according to World Bank classification.

Table 1: Summary Statistics

Variable	Mean	Sd	N
Output volatility	0.427	0.726	741
Transparency scores	5.496	3.032	741
Govt. borrowing/lending (logs)	0.956	1.157	741
Openness	95.08	57.37	741
Inflation transformed	0.769	1.251	741
Real output (logs)	24.66	2.084	741
Credit to private sector	60.56	51.74	740
GDP/Oil Ratio	6.658	8.793	682
Share of services in GDP	58.28	12.72	694
External conflict ICRG	10.34	1.241	661

Table 2: Output volatility and transparency; dependent variable: log deviation of real output from its trend

	(2.1) Basic	(2.2) With controls	(2.3) HIE	(2.4) MIE
Transparency scores	-0.015***	-0.056***	-0.012***	-0.035***
	(0.003)	(0.002)	(0.003)	(0.005)
Govt. borrowing/lending (logs)	0.040	0.025	0.002	0.051
	(0.025)	(0.028)	(0.005)	(0.040)
Inventory change (logs)	0.003	-0.135***	0.002	-0.249***
	(0.002)	(0.008)	(0.006)	(0.023)
Openness	0.001***	0.002***	0.001***	0.006***
	(0.000)	(0.000)	(0.000)	(0.001)
Inflation transformed		-0.002	-0.006**	-0.017
		(0.005)	(0.003)	(0.011)
Real output (logs)		0.233***	0.021***	0.420***
		(0.010)	(0.006)	(0.030)
Constant	0.580***	-2.273***	-0.012	-4.995***
	(0.060)	(0.178)	(0.058)	(0.360)
Observations	741	741	316	425
R-squared	0.040	0.194	0.401	0.330
Number of groups	80	80	33	47
Effects specification	Time	Time	Time	Time
Overall F-test(p-value)	0.000	0.000	0.000	0.000

*** p<0.01, ** p<0.05, * p<0.1.

Notes: Driskoll and Kraay standard errors are in parenthesis. They are robust against cross sectional interpendence, heteroskedasticity, and autocorrelation in the error term.

Table 3: Different forms of transparency

	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)
Political Transparency	0.003	-0.008			
	(0.013)	(0.010)			
Govt. borrowing/lending (logs)	0.047	0.050*	0.041	0.063**	-0.004
	(0.031)	(0.030)	(0.029)	(0.031)	(0.003)
Inventory change (logs)	-0.129***	-0.125***	-0.136***	-0.125***	
	(0.009)	(0.009)	(0.008)	(0.009)	
Openness	0.002***	0.002***	0.001***	0.002***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation transformed	0.001	0.002	0.003	0.006	-0.005
	(0.005)	(0.006)	(0.005)	(0.005)	(0.055)
Real output (logs)	0.200***	0.195***	0.228***	0.191***	
	(0.011)	(0.011)	(0.009)	(0.010)	
information about shocks	-0.105***				
	(0.014)				
publication of forecasts		-0.073***			
		(0.019)			
Relatively transparent			-0.357***		
			(0.014)		
Relatively opaque				-0.048	
				(0.030)	
Transparnecy Crowe-Meade					-0.058**
					(0.023)
Constant	-1.740***	-1.711***	-2.362***	-1.818***	0.118*
	(0.204)	(0.163)	(0.133)	(0.149)	(0.058)
Observations	741	741	741	741	26
R-squared	0.175	0.164	0.185	0.157	0.323
Number of groups	80	80	80	80	26
Overall F-test (p-value)	0.000	0.000	0.000	0.000	0.091
Effect specification	Time	Time	Time	Time	None

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Dependent variable in regressions (3.1) to (3.4) is the log deviation of real output from its long term trend. In column (3.5) the log difference of output is taken as a measure of output volatility for the reasons explained in the text.

Table 4: Robustness Analysis: Effects of other possible regressors

	(4.1)	(4.2)	(4.3)	(4.4)
Transparency scores	-0.037***	-0.056***	-0.045***	-0.060***
	(0.002)	(0.002)	(0.001)	(0.003)
Govt. borrowing/lending (logs)	0.023	0.046*	0.017	0.022
	(0.022)	(0.027)	(0.027)	(0.031)
Credit to pvt sector % of GDP	-0.001***			
	(0.000)			
Openness	0.002***		0.002***	0.001***
	(0.000)		(0.000)	(0.000)
Inflation transformed	-0.009**	0.001	-0.002	0.001
	(0.004)	(0.004)	(0.006)	(0.007)
Real output (logs)	0.116***	0.247***	0.243***	0.267***
	(0.006)	(0.018)	(0.014)	(0.013)
Inventory change (logs)		-0.138***	-0.143***	-0.135***
		(0.010)	(0.008)	(0.012)
GDP/OIL Ratio		-0.001		
		(0.001)		
Share of Services in GDP			-0.008***	
			(0.002)	
ICRG Risk of External Conflict				0.084***
				(0.009)
Constant	-2.111***	-2.911***	-1.966***	-3.931***
	(0.162)	(0.345)	(0.141)	(0.271)
Observations	764	606	694	661
R-squared	0.119	0.191	0.215	0.220
Number of groups	80	79	77	72
Effects specification	Time	Time	Time	Time
Overall F-test (p-value)	0.000	0.000	0.000	0.000

Driskoll-Kraay standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Dependent variable is the log output deviation from the long term trend. Trend is the average of real output (evaluated at constant US $ value of 2005) from 1970 to 2007.

Table 5: Robustness Analysis: Simultaneity and Endogeneity

	(5.1)	(5.2)	(5.3)
	Arellano and Bond	3SLS[1]	
		Inflation	Output Vol.
Transparency scores	-0.873***	-0.090**	-0.016*
	(0.066)	(0.035)	(0.009)
Govt. borrowing/lending	-0.011		-0.022
	(0.016)		(0.015)
Inventory change (logs)	-0.043*		0.008
	(0.026)		(0.008)
Openness	0.008**		0.000
	(0.003)		(0.000)
Inflation transformed	-0.012		
	(0.031)		
Lagged output deviation	3.083***		0.828***
	(0.441)		(0.024)
Lagged Inflation volatility		0.488***	
		(0.014)	
Constant	3.569***	1.246***	0.069
	(0.770)	(0.230)	(0.153)
Observations	353	473	473
R-squared	n.a	0.733	0.724
Number of countries	72	80	80
Sargan test[2] (over id restrictions) p-value	0.170		
Arellano-Bond test[3]	AR(1) = 0.425		
	AR(2) = 0.356		
Chi-square (p-value)	n.a	0.000	0.000

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

[1] We can reject the null hypothesis of equality of transparency coefficient in two equations at 5 percent level of significant. (Chi-square (1 df) = 4.12, p-value = 0.042).

[2] H0: Overidentifying restrictions are valid.

[3] H0: No autocorrelation in errors.

Table 6: Alternative measures of output volatility

	(6.1)	(6.2)	(6.3)	(6.4)
	Deviation growth from trend		Moving standard deviation	
	Basic	With controls	Basic	With controls
Transparency scores	-0.117***	-0.107***	-0.129***	-0.141***
	(0.022)	(0.016)	(0.016)	(0.023)
Govt. borrowing/lending (logs)	-0.064	-0.060	0.172***	0.170***
	(0.052)	(0.048)	(0.040)	(0.037)
Inventory change (logs)	0.011	0.046*	-0.035	-0.084
	(0.008)	(0.026)	(0.024)	(0.051)
Openness	-0.000	-0.000	0.002	0.002
	(0.001)	(0.001)	(0.002)	(0.002)
Inflation transformed		-0.004		0.077**
		(0.021)		(0.037)
Real output (logs)		-0.058		0.082
		(0.042)		(0.054)
Constant	1.238***	1.955**	2.688***	1.608**
	(0.351)	(0.790)	(0.749)	(0.699)
Observations	741	741	547	547
R-squared	0.077	0.080	0.139	0.144
Number of countries	80	80	80	80
Effects specification	Time	Time	Time	Time
Overall significance (p-value)	0.000	0.000	0.000	0.000

Robust Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Notes: In Columns (6.1) and (6.2) the dependent variable is deviation of annual output-growth from the trend growth. Trend growth is the average growth rate from 1960 to 2007. In the case of former Soviet block country the range is from 1991 to 2007.

In Columns (6.3) and (6.4) the dependent variable is standard deviation of year on year GDP growth. Standard deviation is estimated using 4 year moving window.

Data Appendix

Inflation (CPI): Annual percentage change in Consumer Price Index (CPI). Source: IMF.

Transparency Index: Eijffinger and Geraats (2006) index as updated by Siklos (2011).

Openness: Ratio of imports plus exports to GDP. Source: Penn World Tables version 7.

Real output: It is measured as total value added in constant 2005 US dollars. Source: United Nations Statistics.

Output volatility: Deviation of the log of real GDP (measured as total value added in constant 2005 US dollars) from log of its trend. Where trend is the average of its values from 1970 to 2007 (for transition economies it is the average from 1991 to 2007). Source: United Nations Statistics.

Annual GDP growth: Annual percentages of constant price GDP are year-on-year changes; the base year is country-specific. Source: IMF.

Government lending/borrowing: Net lending (+)/ borrowing (-) is calculated as revenue minus total expenditure as percent of GDP. This is a core GFS (Global Financial Statistics) balance that measures the extent to which general government is either putting financial resources at the disposal of other sectors in the economy and non residents (net lending), or utilizing the financial resources generated by other sectors and non residents (net borrowing). This balance may be viewed as an indicator of the financial impact of general government activity on the rest of the economy and non residents (GFSM 2001, paragraph 4.17). Source: IMF.

Inventory change: It is value of the change in inventories (measured in constant 2005 US dollars). Source: United Nations National Accounts Estimates of the main aggregates.

Credit to private sector: It refers to financial resources provided to the private sector, such as through loans, purchases of non equity securities, and trade credits and other accounts receivable that establish a claim for repayment. Source: World Bank world development indicators.

Share of services in value added: Percentage value addition by services sector in GDP of a country. Source: World Bank world development indicators.

Oil to GDP Ratio: GDP per unit of energy use is the GDP per kilogram of oil equivalent of energy use, where GDP is measured in 2005 constant purchasing power parity dollars. Source: World Bank.

External Shocks: It is an assessment of the risk to the incumbent government from foreign action, ranging from non-violent external pressure (diplomatic pressures, withholding of aid, trade restrictions, territorial disputes, sanctions, etc) to violent external pressure (cross-border conflicts to all-out wars). High scores indicate low value of external risk. Source: Political Risk Services, international Country Risk Guide, http://www.prsgroup.com/ICRG.aspx

Voice and Accountability: Measuring perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. Source: World Bank aggregate governance indicators, Kaufmann et al. (2008).

Law and Order: It measures strength and impartiality of the legal system and the observance of the law. Higher values indicate greater effectiveness of the law and order. Source: Political Risk Services, International Country Risk Guide.

Countries in the Sample
High income countries (World Bank Classification) (33)

Australia Bahamas Bahrain Barbados Canada Croatia Cyprus Czech Republic Denmark Estonia Hong Kong Hungary Iceland Israel Japan Korea Kuwait Malta New Zealand Norway Oman Poland Qatar Saudi Arabia Singapore Slovakia Slovenia Sweden Switzerland Trinidad Tobago UAE UK USA

Middle Income countries (World Bank Classification) (47)

Albania Argentina Armenia Belarus Belize Bhutan Brazil Bulgaria Chile China Colombia Egypt El Salvador Fiji Georgia Ghana Guatemala India Indonesia Jamaica Jordan Kazakhstan Latvia Lesotho Libya Lithuania Malaysia Mauritius Mexico Moldova Mongolia Namibia Nigeria Pakistan Papua New Guinea Peru Philippines Romania Russia Solomon Islands South Africa Sri Lanka Thailand Tunisia Turkey Ukraine Uruguay