Journal of Money and Economy
Vol. 12, No. 3, Summer 2017
pp. 345-367

Derivation of Optimal Transparency of the Central Bank for Minimizing the Output Volatility: The Case Study of Organization of Islamic Cooperation

Mohammadali Ehsani[*] **Asadollah Farzinvash**[†]
Nasser Elahi[‡] **Reza Izadi**[§]

Received: 6 Oct 2018 Approved: 19 Jan 2019

This paper aims to optimize the Central Bank transparency level which corresponds to the minimum of output volatility in 28 states of the Organization of Islamic Cooperation (due to the maximum data availability) during the period 2003-2014. For this purpose, the Dincer-Eichengreen index is used, which includes five aspects covering political, economic, procedural, policy, and operational transparency. The index ranges in numerical value from 0 to 15 with 0 being the most opaque and 15 the most transparent. Applying the Arellano-Bond GMM estimation and using the Dincer-Eichengreen index as a proxy of transparency, the result indicates that an increase in the level of central bank transparency will decrease output volatility up to a certain point, after which additional information from central banks begin to exacerbate it. In addition, the effects of other variables (financial depth, first lag of inflation, oil rents-GDP ratio) on output volatility are positive. Therefore, moving with caution towards monetary policy transparency is recommended as output volatility is reduced considerably, implying significant benefits for output stability.

Keywords: Central Bank Transparency, Output Volatility, Optimal Transparency Level, Generalized Method of Moments
JEL Classification: E0, E4, F0

1 Introduction

The central bank is one of the most important economic institutions in each country, and stability of prices level, interest rate, foreign exchange markets, high employment, and economic growth are its most important goals.

[*] Mazandaran University, Iran; m.ehsani@umz.ac.ir.
[†] University of Tehran, Iran; farzinv@ut.ac.ir.
[‡] Mofid University, Iran; elahi@mofidu.ac.ir.
[§] Mofid University, Iran; r.izadi@mohaddes.ac.ir (Corresponding Author)

This paper has been extracted from a Ph.D. thesis by Mr. Reza Izadi. He is a student of Economics at Mofid University.

According to Klomp and De Haan (2009), the central bank independence can help achieve these goals. Central bank independence is studied in three areas: independence in financial operations (financial independence), personnel independence and independence of policy making (Mojtahed, 2010). Financial independence is the power that is given to the government to finance its costs through loan from the central bank. Personnel independence refers to the amount of involvement in determining the procedures of administration, choosing of officials, managers and the employees of the central bank.[1] Independence of policy making is related to the authorities that are entrusted to the central bank in the formulation and implementation of the main central bank's functions in monetary policy and the choice of strategic measures. Central bank transparency is a subset of the independence of policy making.

The issue of the relationship between transparency and independence of central banks began when central banks officially announced their independence. In other words, transparency has made central bank independence more effective. The crucial prerequisites for the central bank independence include a comprehensive agreement on the role of this institution, as well as its commitment to transparency and accountability. Central bank transparency is complementary to the central bank independence (Geraats, 2002; Mathew, 2006; Cendron & Tusset, 2014). Geraats (2002) finds that there is a strong and positive relationship between the independence and central bank transparency. Dincer and Eichengreen (2014) point out that the independence and transparency of central banks have similar effects and consequences and it is difficult to distinguish the effects of these two dimensions from central bank measures.

The idea of central bank transparency has been used in various forms and meanings. According to Neumann (2002), transparency of monetary policy is a continuous flow of information from monetary authorities to public about their policies and objectives, central bankers' preferences, their interpretation of the performance of the economy, their knowledge of data, their expectations of the future, and finally, the strategy chosen is policy making. Dincer and Eichengreen (2014) interpret monetary policy transparency as the symmetrical information between the central bank and the private sector.

Fluctuations is in fact the deviation of a variable from its trend. Thus, output fluctuations refers to output deviations from its trend. In this paper, volatility is the standard deviation of changes in the relative values of GDP.

[1] Personnel independence is refers to the influence the government has in appointment procedures within the bank.

Since the standard deviation is the square root of the expected deviations between the (relative) value change of real output and the change in the expected value of output, this notion of volatility clearly distinguishes between expected changes in the output value and its unexpected changes. (Brummer et al., 2013). Volatility index is changes through time and it has clustering properties.

On the other hand, based on empirical evidence in the context of the output volatility, for a significant of time period, large changes tend to be followed by large changes and small changes tend to be followed by small changes (Franses and van Dijk, 2003). This means that the observation of market volatilities suggests that volatility is a self-sustaining and stationary variable (Antell, 2004). This concept was firstly discovered by Mandelbrot (1963) and Fama (1965). This pattern of volatility behavior (clustering of volatility) suggests that although real variations in output values may be uncorrelated, second-order conditional moments may be time-dependent (Hosseini et al., 2007). In other words, the volatility is related to the second-order moment, and refers to variations which have a volatile attitude, while fluctuations refers to the first-order moment and to conditions in which the frequency of a quantity changes. In this paper, the standard deviation of the GDP growth rate is used to calculate the output volatility (Blanchard & Simon, 2001; Chortareas et al., 2002; Dincer & Eichengreen, 2007; Giovannoni & Dios Tena, 2008).

There are very few studies that examine the effects of central bank transparency on output volatility. The effects of central bank transparency on the output volatility in the country have not been studied or we have not been aware of it. There is no consensus in the literatures, regarding to theoretical debates on whether increased central bank transparency affects the output volatility. Dincer and Eichengreen (2007) examine these effects in empirical studies using the seminal index of transparency.

For those who accept the impact of central bank transparency on the output volatility, the move towards greater transparency by central banks has been a desired performance. But given the fact that the banking system is, to a certain extent, inherently opaque, could there be an optimal level of transparency?

Eijffinger and Geraats (2002) identify five aspects of central bank transparency including political, economic, procedural, policy, and operational transparency. Political transparency reveals the objectives of monetary policy to the public. Economic transparency focuses on economic information that is used for monetary policy. Procedural transparency describes the way monetary policy decisions are made (including policy

deliberations and voting records). Policy Transparency refers to immediate disclosure and explanation of policy decisions. Operational transparency is referred to actions taken to implement the monetary policy actions by the central bank. Each of the five features of central bank transparency is measured in the range of zero to three. Therefore, the maximum value for transparency is 15. The present study is based on the works of Eijffinger and Geraats (2006) and Dincer and Eichengreen (2007, 2014) who expand the transparency index for a wide range of central banks over a long period. It should be noted that this type of index is more suitable for panel data analysis, given its availability in a limited annual frequency and for a large number of countries.

The main question of this research is whether there is an optimal level of transparency for the central bank which corresponds to the minimum output volatility. The research hypothesis is a positive answer to the question. The innovation of the present study is to utilize the seminal index of Dincer and Eichengreen (2014) to examine the hypothesis. The results of this study can be used by researchers and used by policy makers and planners of central banks, producers and investors.

The paper is organized in six sections. In the next two sections, the theoretical foundations and the literature review are presented. The fourth part deals with research methodology, introducing variables, model, and descriptive statistics. In the fifth part, the model is estimated and the hypotheses are tested. Finally, this article ends with the conclusion in section six and the introduction of references.

2 Theoretical Foundations

In the presence of uncertainty in the economy, there can be an output volatility. The central bank transparency can reduce uncertainty in the economy and, consequently, reduce the output volatility. Increased transparency in monetary policy leads to a reduction in inflation variability, but the co-movement of transparency and output volatility has not been confirmed (Chortareas et al., 2002). Dincer and Eichengreen (2007) found that transparency could theoretically exacerbate or counteract the output volatility. Some previous studies have shown that increased transparency brings more stability, because people can quickly adjust themselves to policy measures.

However, there are other studies that suggest that greater transparency can increase the output volatility, because it prevents authorities from using effective policies to reduce output fluctuations or that externalities of coordination makes it possible for public to interpret signals incorrectly (see

for instance, Sorensen (1991), Geraats (2002) and Dincer and Eichengreen (2007)). There are two views in this context. First, it is believed that an increase in central bank transparency will increase the output volatility. Some studies have shown that increase in central bank transparency tends to reduce inflation variability. But, due to the trade-off between inflation variability and output volatility, the output volatility increases with increase in central bank transparency. Second, an increase in central bank transparency leads to a reduction in the inflation variability and output volatility simultaneously. These two perspectives are explained below.

a. The central bank transparency could increase the output volatility:

A state is considered where there is a trade-off between output gap volatility and inflation variability. Under these circumstances the private sector uses the output gap to predict the next period's inflation. In such conditions, increased operational transparency allows the private sector to be more precise in their estimates, reducing the inflation bias. Therefore, with increasing operational transparency, central banks may have to pay more attention to inflation rather than output gap stabilization (Jensen, 2002). On the other hand, transparency can often exacerbate crises, when media pays more attention to sensational stories rather than calming statements (Finel & Lord, 1999).

b. The central bank transparency could reduce the output volatility:

The most important factors based on which the central bank transparency leads to the reduction of output volatility are as follows:

The monetary target that is obtained, will reduce output volatility and increase growth (Fatas et al., 2007).

- Greater operational transparency makes the public more responsive to inflation via their inflation expectations. This offers a reason to reduce the inflation bias. Therefore, there would be less room for surprise inflation, which reduces the variance of output (Faust & Svensson, 2002).
- Due to increased transparency, uncertainty, about how the policy makers perceive the economy, might be reduced which in turn reduces forecast errors and expected variability (Geraats, 2002).
- Increased transparency and release of central bank forecasts improve macroeconomic performance, as published information reduces the uncertainty of the private sector about the central bank's objectives (Tarkka & Mayes, 1999).

According to Ceccheeti and Krause (2002), performance is measured as a weighted average of output and inflation variability, while the measurement of the policy efficiency (or inefficiency) is related to the distance of the economy's performance from the inflation-output variability frontier.

Measurements of macroeconomic performance and policy efficiency is achieved using the inflation-output variability trade-off, or efficiency frontier. The easiest concept of an inflation-output variability frontier is a simple economy that is affected by two general types of disturbances; both of which may require policy responses.

These are aggregate demand shocks—which move output and inflation in the same direction—and aggregate supply shocks—which move output and inflation in opposite directions. Since monetary policy can move output and inflation in the same direction, it completely offsets the effect of aggregate demand shocks. By contrast, aggregate supply shocks will force the monetary authority to face a trade-off between the output and inflation variability. This trade-off constructs an efficiency frontier for monetary policy that traces the points of minimum inflation and output variability. This curve is shown in the following figure as the Taylor curve (Taylor, 1979). The location of the efficiency frontier depends on the variability of aggregate supply shocks—the smaller such variability, the closer the frontier will be to the origin. If monetary policy is optimal, the economy will be on this curve. The location of the economy on the frontier depends on the policymaker's preferences for inflation and output stability.

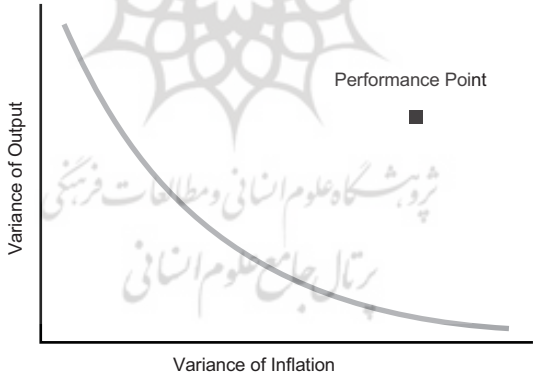

Figure 1. Efficiency frontier and performance point.
Source: Cecchetti and Krause (2002)

When policy is abnormal, the economy will not be on this frontier. Instead, the performance point will go up and to the right and shows more variability in inflation and output compared to the other feasible points. Movements of the performance point toward the frontier are an indication of improved policymaking. Therefore, the central banks' credibility and transparency,

improve macroeconomic performance. Accordingly, release of central bank forecasts improves the macroeconomic performance, as published information reduces the uncertainty of the private sector about the central bank's objectives. For further explanation, we assume that central banker's objectives are written as a simple quadratic loss function. That is, the major goal of the policymaker is to minimize the discounted sum of squared deviations of output and prices from their target paths. The resulting loss function can take the following form:

$$L = E[\alpha(\pi - \pi^*)^2 + (1 - \alpha)(y - y^*)^2] \quad (1)$$

E states the mathematical expectation, π is inflation rate, y is the logarithm of aggregate output, π^* and y^* are the desired levels of inflation rate and output, and α is the relative weight given to the squared deviations of output and inflation from their desired levels.[1] The parameter α is the intended quantity, which expresses the policymaker's aversion to inflation variability. In Equation (1), the objective function is assumed to be symmetric, which contains only quadratic terms. The underlying assumption is that policymakers are equally averse to extremely positive and extremely negative events.

Of course, this is not the case: policymakers normally make a reaction when the mean and the variance of forecast distributions do not change but there is the probability of an increase in some extreme events. That is, even if the variance remains constant, an increase in the probability of a severe economic downturn is likely to trigger action. The loss function is the result of only output and inflation and not the exchange rates. The underlying rationale here is that domestic inflation and output are what the policymakers are concerned with.

According to Ceccheeti and Ehrmann (2002), the intermediate objective is to focus on the exchange rate path in the formulation of policy. Policymakers are not preoccupied with the behavior of intermediate objective per se, but with the domestic inflation and growth outcomes resulted from their decision. Exchange rate targeting is like monetary aggregate targets. Both denote a certain behavior for output and inflation and an objective function such as Equation (1).

[1] It is possible to write the loss function in a more complex, dynamic form, in which case a discount factor and a time horizon should be expressed explicitly. Moreover, we could add a term which explicitly leads to a change in the cost of interest rates. These refinements do not have an effect on the analysis here.

Based on Ceccheeti and Ehrmann (2002) the policymaker cannot get rid of his problem without knowing the dynamics of output and inflation and their relationship to the interest rate (r_t) instrument controlled by the policymaker. This can be written in the following simple way:

$$y_t = \gamma(r_t - d_t) + s_t \quad (2)$$
$$\pi_t = -(r_t - d_t) + \omega s_t \quad (3)$$

Where d_t and s_t are shocks to aggregate demand and aggregate supply, respectively. These are the main sources of exogenous disturbances to the economy. The parameter γ denotes the ratio of the responses of output and inflation to a policy shock and is considered as the inverse of the slope of the aggregate supply curve. The parameter ω is the slope of aggregate demand.

The output, inflation, and interest rates are interrelated in many ways and in some cases very complex. As previously mentioned, what is important for our purposes here, and is captured in Equations (2) and (3), is the notion that two kinds of disturbances strike the economy and require policy responses. The main dilemma facing the policymakers is the movements in aggregate supply, which forces the policy makers to make a decision.

The idea that the policymaker's objectives are treated as a simple function of the variances of output and inflation, and that the structure of the economy is considered to be linear, implies that the optimal policy response to demand and supply shocks is a simple linear rule. This is written as

$$r_t = ad_t + bs_t \quad (4)$$

It is now possible to easily solve the rule. The result is that policy nullifies the aggregate demand shocks one for one, and so a is equal to 1. As expected, since the response to supply shocks creates a trade-off in policy, it is more complex. The extent of the reaction is a function of economic structure as measured by the slopes of the aggregate demand (ω) and aggregate supply curves (γ), as well as the policymaker's aversion to inflation variability (α).[1]

[1] The resulting expression is given by $b^* = [-\alpha\omega + (1-\alpha)\gamma]/[\alpha + (1-\alpha)\gamma^2]$. It would be possible to rewrite equation (4) in the form used by Taylor (1993). To accomplish this, simply note that, using equations (2) and (3), the supply shock (s_t) can be written in terms of output (y_t) and inflation (π_t). Simple substitution would then allow to rewrite the policy rule in terms of output and inflation directly—the form of a Taylor rule.

The optimal policy has several outcomes for the variability of output and inflation. First, both are sensitive to the variance of aggregate supply shocks, not the variance of demand shocks.[1] This is because of the fact that according to the optimal policy rule the demand shocks are offset completely by interest rate moves. Second, changes in the volatility of aggregate supply shocks lead to a change in the variance of output and inflation in the same proportion. As a result, the following ratio is derived:

$$\frac{\sigma_y^2}{\sigma_\pi^2} = \left[\frac{\alpha}{\gamma(1-\alpha)}\right]^2 \tag{5}$$

This expression has several interesting properties. First, it is considered that when $\alpha = 0$ (that is, the policymaker cares only about output variability), $\frac{\sigma_y^2}{\sigma_\pi^2} = 0$. Likewise, for $\alpha = 1$ (the policymakers cares only about inflation variability), $\frac{\sigma_y^2}{\sigma_\pi^2} = \infty$. Significantly, varying α between 0 and 1 allows to trace out the entire output-inflation variability frontier, the shape of which is related to the slope of the aggregate supply curve ($\frac{1}{\gamma}$) and is unaffected by the slope of the aggregate demand curve (ω) and the variance of aggregate supply shocks.

On the other hand, increased transparency is not always desirable. Based on the hypotheses, central bank transparency not only affect the output volatility, but there should be an optimal level of transparency. Full transparency surely cannot be the best scenario. The theoretical issues raised in the context of transparency point out that increased transparency is not always desirable and central banks should choose the optimal level of transparency.

At its worst, information can be confusing, inundating, incomplete, irrelevant or incomprehensible. Full openness may also expose central banks to political pressures. If policy makers' decisions, thoughts, and discussions are available to the public, it is inevitable that politicians will have more ammunition to criticize the central bankers. Van der Cruijsen et al. (2010) warn that an extreme level of transparency may cause the public to think that the central bank is uncertain about economic conditions, which would exacerbate volatility.

Similarly, Clare and Courtenay (2001) find that if released minutes show discussion among bank board members, this could increase asset price

[1] The resulting expressions are $\sigma_y^2 = (1 - \gamma b^*)^2 \sigma_s^2$ and $\sigma_\pi^2 = (\omega + b^*)^2 \sigma_s^2, where\ \sigma_s^2$ is the variance of the supply shocks and b^* is the optimal reaction to s_t.

volatility, and again imply that profuse amounts of information will only confuse investors. Clearly, these cases indicate that full transparency is not desirable and may exacerbate volatility and uncertainty; a state of transparency between zero and full openness that is optimal must exist.

If output volatility is a function of central bank transparency and also there is an optimal level of transparency, then it is necessary to consider the above function as a quadratic form. In this case, there is a U-shaped relationship between central bank transparency and output volatility. This means that the slope of this function (or the first derivative of the above function) should be negative, to achieve the optimal level of transparency. In the optimal level of the central bank transparency, this slope (f') is zero and then becomes positive. Clearly, the second derivative of the above function (f'') is a positive number. In the present study, this possibility (quadratic function) is investigated with squared values of central bank transparency (also called transparency intensity).

Regarding the relationship between financial deepening and output volatility, there are two different perspectives. The first group argues that financial deepening can increase the risk appetite of banks and financial institutions, which in turn leads to increased output volatility (Shlifer & Vishny, 2010). The group believes that deeper financial systems provide less stability and more risk in parts of the economic agents. In other words, deeper financial systems will reduce the output volatility. At very high levels, such as industrialized and developed countries, excessive financial deepening can lead to output volatility. The results of these surveys show that there is a U-shaped relationship between financial deepening and output volatility. According to these theories, the financial depth and expansion of its indices would initially reduce the output volatility, and then further financial deepening would increase the output volatility. Therefore, an excessive financial deepening can be a factor in exacerbating the output volatility (Dabla-Norris & Srivisal, 2013).

The other group believes that the financial sector of a country's economy can play an important role in reducing output volatility. Countries with a more developed financial sector are expected to experience less volatility in output. There are several reasons for this claim. The more developed financial markets communicate more efficiently between depositors and investors. It also reduces lending constraints and increases risk hedging through diversification of assets. In a situation where the economy is faced with a shock, this causes the economy cope easily and in fact, the economy's ability will increase to

absorb more shocks. On the other hand, financial deepening, by providing a diversity in loans and adjusting corporate's cash constraints, will cover the risk and reduce the economic volatility. Also, managerial risk and the information processing provided by the banking system can play a significant role in reducing output volatility (Acemoglu & Zillibotti, 1997; Aghion et al., 2004; Caballero & Krishnamurthy, 2001; Cevdet et al., 2002).

3 Literature Review

Dincer and Eichengreen (2007) find that transparency is greater in countries with more stable and developed political systems and more developed financial markets. In fact, the more developed a country is, the more transparent it is. The transparency is regressed on a vector of political determinants (rule of law, political stability, voice and accountability, and government efficiency) as well as economic determinants (per capita income, inflation history, the de facto exchange rate regime, and financial depth) and is shown that per capita GDP is the most robust correlate of overall transparency. Moreover, countries with flexible exchange rate systems also tend to be more transparent. In addition, greater transparency is evident in countries that rank higher in terms of rule of law, that have more stable political systems, have higher ratings in terms of accountability, and are more favorably regarded in terms of government efficiency. Their results refer to the favorable but relatively weak effects of central bank transparency on the output volatility.

Dincer and Eichengreen (2009) investigate the optimal transparency of the central bank by adding a squared term in transparency index (transparency intensity) and show that there are evidence from diminishing returns to transparency. Mishkin (2004) also confirms that there are diminishing returns to transparency. Geraats (2002) argues that it might be imprudent to apply a blanket statement that transparency is always beneficial. He believes that if the release of information by a central bank was vague or unreliable then it could reduce welfare. Also the author shows that transparency would be undesirable if the central banker is conservative and subject to political pressures.

Van der Cruijsen et al. (2010) find that there is an optimal intermediate degree of central bank transparency. If central banks are not operating at this point, it would improve private sector inflation forecasts if they moved towards this desirable transparency level. Above this optimal point of transparency, the authors find that there are two probabilities: the public might

start to attach too much weight to the conditionality of their forecasts; and/or the large amount of information received might confuse the public.

At the optimal intermediate degree of transparency inflation persistence is minimized. They argue that there is a potential obfuscation to the public if large amounts of information from a very transparent central bank are released. Moreover, not every board member will view the economy in the same light and there may be contentious discussions about policy. They caution that an extreme level of transparency may cause the public to think that the central bank is uncertain about economic conditions, which would exacerbate volatility.

Freedman (2002) also argues that if deliberations were televised, a few issues could arise: members would be reserved and less likely to argue both sides of an issue; members would find it more difficult to change their minds after initially declaring a stance out of fear of being indecisive, because people might think that they are not decisive in their opinions; and that these informal discussions could replace formal information releases that come later.

Landerretche et al. (2001) find that inflation targeting reduces the output volatility while it increases output persistence. There is a well-founded trade-off between inflation and output. If the output volatility reduces, there may be an inverse reaction from inflation. The results indicate that increased central bank transparency reduces output volatility.

Jensen (2002) finds that there is an optimal degree of transparency. In contrast, Faust and Svensson (2001) find that high levels of transparency are beneficial.

According to Faust and Svensson (2001), greater operational transparency makes the public more responsive to inflation via their inflation expectations. This offers a reason to reduce the inflation bias. There would be less room for surprise inflation, which reduces the variance of output.

Cecchetti and Krause (2002) state that more information is always better than less. With full information, people should make the most efficient decisions. Tarkka and Mayes (1999) find that the publication of central bank's forecasts leads to a better performance of macroeconomic, as the released information reduce the uncertainty of the private sector about the central bank's objectives. According to Chortareas et al (2002), the results suggest a negative correlation between transparency and output volatility. Fatas et al. (2007) conclude that having a monetary target, which is reached, will reduce output volatility and increase growth.

This paper, similar to Tarkka and Mayes (1999), Landerretche et al. (2001), Faust and Svensson (2002), Chortareas et al (2002), and Fatas et al. (2007),

examines the negative impact of the increased central bank transparency on output volatility. Also, in this study, the optimal level of transparency will be investigated similar to Geraats (2002), Jensen (2002), Freedman (2002), Mishkin (2004), Dincer and Eichengreen (2009), and Van der Cruijsen et al. (2010).

In this paper, the GMM is used. The variables of financial depth and the first lag of inflation are control variables. Rule of law and the lagged variables are used as instrumental variables. Moreover, as Dincer and Eichengreen (2009), the optimal level of central bank transparency is reviewed by adding a squared term in the transparency index (transparency intensity) to determine the diminishing returns to transparency. The difference between this paper and many of the previous studies is that, in addition to examining the negative effects of central bank transparency on output volatility, it also examines the optimal level of transparency.

In the Dincer and Eichengreen studies (2007, 2009, 2014), the type of financial system of countries (bank-based or market-based), their level of development, as well as the dependence of their economies on natural resources (oil resources) have not been addressed. For example, as mentioned in this paper, the use of the variable M2 / GDP, which measures the financial depth, is often used in bank-based financial systems and it can be misleading for countries with a market-based financial system. In this study, the sample financial systems are mainly bank-based. In addition, using the "oil rents-GDP ratio" index, examines whether the economic dependence of some countries on oil resources influences output volatility.

4 Methodology

4.1 Model

In econometric models, the dynamic linkage is determined by the lags of the dependent variable as an explanatory variable in the model (Baltagi, 2008). In this study, due to the existence of an endogenous variable in the right-hand side of the equation and the presence of unobserved effects in each country, we use generalized method of moment (Arellano & Bond, 1991). So, we need some instrumental variables. This study uses rule of law[1] and lags of control variables as instrumental, according to Dincer and Eichengreen (2007).[2]

[1] The rule of law is used as an instrument for central bank transparency to overcome the issue of the endogeneity transparency of monetary policy.

[2] The rule of law index has been extracted from the World Bank's database of the Good Governance Index.

The rule of law, in the sense of limiting the arbitrary power of the state to preserve individual fundamental rights and freedoms, is an essential pillar of democracy (Hajizadeh et al., 2017). The decision and practice of the state in a rational manner based on legal grounds is considered as the essence of the concept of the rule of law (Markaz Malmiri, 2006). The rule of law measures the success of a community in an environmental development in which fair and predictable laws are formed on the basis of economic and social interactions, and more importantly, to what extent property rights are preserved. This index refers to the concepts such as people's trust in the law, the likelihood of success in a lawsuit against government, and etc. The GMM estimation method is a reliable by choosing the correct instrumental variables and by applying a weight matrix for heteroscedasticity conditions as well as unknown autocorrelation. This method is used when the number of sections (N) exceeds the number of time series data (T) (Bond, 2002), which is the case in this study.

To estimate the model, it is necessary to specify the instrumental variables used in the model. The GMM estimator compatibility depends on the reliability of the assumption of non-serial correlation of error terms and instruments, which is examined by using the two tests presented by Arellano and Bond (1991) and Blundell and Bond (1998). The first, Hansen test, is a predetermined restrictions that examines the validity of instruments. The latter is the M2 statistic that tests the existence of second-order serial correlations in first-order differential error terms. In other words, the GMM estimate is consistent if the second-order serial correlation does not exist in the first-order differential equation error terms. The non-rejection of the zero hypothesis in both tests shows the lack of serial correlation and the validity of the instruments.

A model to examine the impact of central bank transparency on output volatility is similar to the model provided by Dincer and Eichengreen (2007). This model will include lagged values of the endogenous variables, making it an Arellano-Bond dynamic panel. In addition to examining the impact of central bank transparency on output volatility, the output model includes a variable of squared transparency index to look for diminishing returns to transparency and extract the optimal level of transparency. Financial depth, measured as M2/GDP, and first lag of inflation variable are included as control variables. Considering the theoretical foundations and empirical studies done in this regard, the justification of the basis of the model and the variables used is as follows:

$$Y_{it} = \alpha_i + \theta Y_{it-1} + \beta_1 X_{it1} + \beta_2 X_{it1}^2 + \beta_3 X_{it2} + \beta_4 X_{it3} + \beta_5 X_{it4} + \upsilon_{it} \quad (6)$$

Where, Y_{it} is output volatility, X_{it1} is transparency index, X_{it2} is financial depth, X_{it3} is first lag of inflation, X_{it4} is oil rents-GDP ratio, α_i is unobserved effect, and υ_{it} is error term. It is expected that all of the coefficients of the parameters of the regressors will be positive with the exception of transparency index, which has a negative relationship. The positive coefficients on the squared term indicate the diminishing returns to transparency and therefore there exists some optimal level of transparency.

4.2 Research Variables

In this study, Dincer and Eichengreen index is used to measure the central bank transparency. The most important and commonly used indices for measuring financial depth is the liquidity-GDP ratio (M2 to GDP), which measures the degree of monetization of the economy (Roodposhti et al., 2013). It often shows the financial depth in bank-based financial systems and may be misleading for countries whose financial system is market-based. An updated version of the World Bank's Global Financial Development Database (GFDD) has been used to measure the level of monetization of the economy by the first lag of inflation. In some countries, revenues from natural resources, especially fossil fuels and minerals, account for a significant share of GDP, and most of these revenues come in the form of economic rents. Natural resources give rise to economic rents because they are not produced.

Rentier governments do trivial effort to obtain taxes on output activities, they focus on distributed and consuming (and not productive) activities, and do not bother to boost production, improve productivity and increase the competitive ability of domestic producers against foreign producers (Momeni and Naghsheh Tabrizi, 2015; Humphreys et al., 2007). Oil rents-GDP ratio can be used as a criterion for estimating the dependency of each country's economy on rents. In this study, we use the “oil rents-GDP ratio” index, extracted from World Bank Indicators. Oil rents are the difference between the value of crude oil production at world prices and total costs of production.

A crucial challenge is the endogeneity of explanatory variables, which causes the bias in estimation. The central bank transparency affects output volatility, and output volatility affects the central bank transparency. Increased output volatility may improve the level of transparency of central banks and would endogenate the central bank transparency and create a measurement error problem and reverse causality and create spurious correlation. High

correlations between the central bank transparency index and some of the control variables used in the research (such as the financial depth and the first lag of inflation) are also among the problems that create a collinearity in the model. Considering theoretical foundations and literature review, and these constraints, the above model is used.

The Organization of Islamic Cooperation or the OIC (formerly known as the Organization of the Islamic Conference) is the second largest inter-governmental organization after the United Nations with a membership of 57 states spread over four continents. These countries are including: Afghanistan, Albania, Algeria, Azerbaijan, Bahrain, Bangladesh, Benin, Brunei Darussalam, Burkina Faso, Cameroon, Chad, Comoros, Djibouti, Egypt, Gabon, Gambia, Guinea, Guinea-Bissau, Guyana, Indonesia, Islamic Republic of Iran, Iraq, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lebanon, Libyan Arab Jamahiriya, Malaysia, Maldives, Mali, Mauritania, Morocco, Mozambique, Niger, Nigeria, Oman, Pakistan, Palestine, Qatar, Republic of Cote d'Ivoire, Saudi Arabia, Senegal, Sierra Leone, Somalia, Sudan, Suriname, Syrian Arab Republic, Tajikistan, Togo, Tunisia, Turkey, Turkmenistan, Uganda, United Arab Emirates, Uzbekistan, Yemen, and United Republic of Tanzania. Given the maximum data availability, 28 countries[1] (from 57 countries) have been used in this study.

4.3 Descriptive Statistics

The maximum amount of financial depth is for Lebanon in 2014 that is equivalent to 256.93 and at least amount is in Tajikistan in 2002 with a value of 7.865. The descriptive analysis of data is presented in the following table.

[1] These countries are including: Albania, Azerbaijan, Bahrain, Bangladesh, Egypt, Indonesia, Iran, Iraq, Jordan, Kuwait, Kyrgyzstan, Lebanon, Libya, Maldives, Malaysia, Mozambique, Nigeria, Oman, Pakistan, Qatar, Saudi Arabia, Sudan, Tajikistan, Tunisia, Turkey, United Arab Emirates, and Yemen.

Table 1
Descriptive Statistics

Variable Description	Maximum	Minimum	Mean	Median	Std. Dev.	Skewness	Kurtosis
Transparency Index	10	0.5	3.69	3.5	2.122	0.9	0.5
Output volatility	44.775	0	3.076	1.99	4.23	5.31	42.55
Financial depth	256.93	7.865	55.53	45.33	43.1	2.374	6.937
Inflation rate	54.915	-35.84	7.33	5.8	8.11	1.94	10.52
Oil rents-GDP ratio	65.42	0	14.79	5.89	17.01	1.07	0.11

Source: Research Findings

In Table 1, the maximum transparency value is 10 and the minimum value is 0.5. The mean of the central banks transparency is 3.69. The median of central banks transparency is 3.5. The form of distribution of the central banks transparency index is positively skewed (it indicates that transparency index are skewed right) and kurtosis coefficient indicates a "light-tailed" distribution. The descriptive statistics of other variables are also interpreted in the same way. Therefore, according to the above table, it can be noted that none of the variables studied in this study are completely symmetric and normal.

5 Results

In the model of output volatility, the period of study is from 2003 to 2014. Testing for the output volatility model is required to ensure that the estimates are bias-free and consistent. The results are presented in Table 2.

As shown in Table 2, the probability values of Arellano-Bond tests indicate that there is no second-order serial correlation in residual terms, and the validity of the results is confirmed by the GMM method. According to Hansen's test, the hypothesis of any kind of correlation between instrumental variables and residuals is rejected. Also, the instrumental variables used in model estimation are valid. The value of the Wald statistic, which replaces the F statistic (the null hypothesis of the F statistic is that the coefficients have no significant difference with zero), implies the general significance of the estimation of GMM method. (Wald statistic does not support the null hypothesis)

Table 2
Tests Related to Estimation of GMM Method

Model	Tests	
	Number of groups	28
	Number of observation	304
	Number of instruments	44
Output volatility	Arellano-Bond test for AR(1)	Z=-0.05
		Pr>z=0.961
	Arellano-Bond test for AR(2)	Z=-1.80
		Pr>z=0.071
	Hansen test	Chi2=22.55
		Prob>chi2=0.978
	Wald test	Chi2=890.25
		Prob>chi2=0.000

The model is estimated by Stata.
Source: Research Findings.

Now, after reassuring about the validity of the estimation, the coefficients of the variables are interpreted. Table 3 shows the results of estimation of the output volatility model by the GMM method.

According to the results obtained from the model estimation in Table 3, the coefficients of the variables are as expected and statistically significant at 95% confidence level.

Table 3
Estimated Results of Output Volatility Model

Dependent variable: output volatility				
variable	Coefficient	Standard error	Z statistic	P>lzl
Transparency index	-6.277	0.844	-7.43	0.000
Transparency intensity	0.283	0.066	4.28	0.000
Financial depth	0.317	0.042	7.5	0.000
First lag of inflation	0.58	0.018	3.24	0.001
Oil rents (%GDP)	0.472	0.059	7.95	0.000
First lag of output volatility	0.167	0.034	4.94	0.000

The model is estimated by Stata.
Source: Research Findings.

Based on the results of the estimation of the output volatility model in Table (3), as expected, the central bank transparency index has a negative relation with the output volatility, but the sign of other coefficients of the regression parameters are positive. In the above table, there is a positive and significant relation between the output volatility and its lag. This result

indicates the dynamics of the output volatility. When the central bank transparency increases one unit, the output volatility decreases 6.277 unit. Since the coefficient of "squared term in transparency index" (transparency intensity) is positive and significant, the optimal level of transparency is statistically confirmed. Optimal level for central bank transparency is $\frac{6.277}{2(0.283)} = 11.09$.

When the transparency value is 11.09, the first derivative (slope) is zero and in the transparency interval of [0, 11.09), the first derivative (slope) will be negative and in the transparency interval of (11.09, 15], the value of the first derivative is positive. Thus, there is a U-shaped relationship between central bank transparency and output volatility in the sample. Obviously, the second derivative is a positive number. Also, the results show that financial depth, the first lag of inflation and the oil rents-GDP ratio have a significantly positive effect on output volatility. In other words, if the financial depth, the first lag of inflation, and the oil rents-GDP ratio increase one unit, output volatility will increase by 0.317, 0.058 and 0.472 units, respectively. Also, if the first lag of volatility increases one unit, the output volatility will increase by 0.167 units.

6 Conclusion

Central bank transparency has been much discussed in the area of monetary policy making and central banking in recent years. Transparency in monetary policy means information symmetry between the central bank and the private sector. On the other hand, the central bank should publish the information available to the public on monetary policy making and the economy performance in the macro-scale.

The access of economic agents to this information leads to improved decision-making. This paper utilizes the seminal index of Dincer and Eichengreen to measure central bank transparency, which includes five aspects of transparency: political, economic, procedural, policy and operational transparency. The difference in the economic structure of the 28 countries studied in this paper is largely anticipated with five aspects of the transparency index. In other words, the above-mentioned index considers these differences to a large extent. Output volatility is the standard deviation of the GDP growth rate. The volatility index is an index that changes over time and has clustering properties. This volatility pattern suggests that although the real changes in output values may be uncorrelated, the second-order conditional moments are time-dependent.

Using the "oil rents-GDP ratio" index, which considers the economic dependence of some countries on oil resources, this paper aims to optimize the central bank transparency level which corresponds to the minimum output volatility in the sample during the period of 2003 to 2014. Therefore, the contribution of this paper is to examine the possibility of nonlinear and diminished returns to the transparency of the central bank. There may be an optimal level of central bank transparency. Also, with the assumption that there is no significant structural difference between the central banks of the member countries of the Organization of Islamic Cooperation, these countries have been selected to examine the above effects (based on the maximum availability of data).

Applying the Arellano-Bond GMM estimation method and using the Dincer and Eichengreen index, the optimal level of central bank transparency is derived. The result indicates that an increase in the level of central bank transparency will decrease output volatility up to a certain point, after which additional information from central banks begins to exacerbate it. Also, the other coefficients of the regression parameters are positive in accordance with expectations.

The results are similar to the results of many studies in this field (among them: Freedman, 2002; Dincer and Eichengreen, 2007; Van der Cruijsen et al., 2010). Based on the results of this paper, the central bank transparency is construed to be a positive step and will bring various benefits. In other words, these results recommend moving with caution towards monetary policy transparency, since the output volatility can be reduced considerably, implying significant benefits for output stability (because output stability ultimately results in economic growth). Thus, policy makers and planners of central banks, policy makers and planners of manufactures, as well as investors can take the results of this paper for consideration.

References

Acemoglu, D., & Zilibotti, F. (1997). Was Prometheus Unbound by Chance? Risk, Diversification, and Growth. *Journal of Political Economy*, 105(4), 709–751.

Aghion, P., Angeletos, M., Banerjee, A., & Manova, K. (2004). *Volatility and Growth: The Role of Financial Development*. Mimeo. Department of Economics, Harvard University.

Antell, J. (2004). *Essays on the Linkages between Financial Markets, and Risk Asymmetries*, Publications of Swedish School of Economics and Business Administration, Helsingfors.

Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies*, 58(2), 277-297.

Baltagi, B. H. (2008). *Econometric Analysis of Panel Data*. John Wiley & Sons Ltd., Chichester.

Blanchard, O. & Simon, J. (2001). The Long and Large Decline in U.S. Output Volatility *Brookings Papers on Economic Activity,* 1, 135-174.

Blundell, R., & Bond, S. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel-Data Models. *Journal of Econometrics,* 87, 115-143.

Brummer, B., Korn, O., Schlubler, K., Jaghdani, T. J., & Saucedo, A. (2013). *Volatility in the After Crisis Period: A Literature Review of Recent Empirical Research*, Working Paper, No. 1.

Caballero, R. J., & Krishnamurthy, A. (2004). *Fiscal Policy and Financial Depth*, MIT Department of Economics Working Paper No. 04-22.

Cecchetti, S. G., & Krause, S. (2002). *Central Bank Structure, Policy Efficiency, and Macroeconomic Performance: Exploring Empirical Relationships.* The Federal Reserve Bank of St. Louis. (July/August).

Cendron, F., & Tusset, G. (2014). Central banks' transparency: words as signals, *History of Economic Thought and Policy*, 3(2), 49-76.

Cevdet, D. A., Murat F. Iyigun, & Owen, A. (2002). Finance and Macroeconomic Volatility. *Contributions to Macroeconomics,* 2(1), Article 7.

Chortareas, G., Stasavage, D., & Sterne, G. (2002). *Does It Pay to Be Transparent? International Evidence from Central Bank Forecasts*. The Federal Reserve Bank of St. Louis, (July/August).

Clare, A., & Courtenay, R. (2001). *What Can We Learn About Monetary Policy Transparency From Financial Market Data*? Bundesbank Discussion Paper 06/01.

Dabla-Norris, E., & Srivisal, N. (2013). *Revisiting the Link between Finance and Macroeconomic Volatility*. IMF Working Papers, 13(29), 1.

Dincer, N. N., & Eichengreen, B. (2007). *Central Bank Transparency: Where, Why, and with What Effects?* NBER Working Paper Series, 13003.

Dincer, N. N., & Eichengreen, B. (2009). *Central Bank Transparency: Causes, Consequences, and Updates*. NBER Working Paper Series, 14791.

Dincer, N. N., & Eichengreen, B. (2014). Central Bank Transparency and Independence: Updates and New Measures. *International Journal of Central Banking*, 10(1), 189-259.

Eijffinger, S. C. W., & Geraats, P. M. (2002). *How Transparent are Central Banks?* CEPR Discussion Paper 3188.

Eijffinger, S. C. W., & Geraats, P. M. (2006). How Transparent are Central Banks? *European Journal of Political Economy,* 22(1), 1-21.

Fama, E. (1965). The Behavior of Stock-Market Prices. *Journal of Business,* 38, 34-105.

Fatas, A., Mihov, I., & Rose, A. K. (2007). Quantitative Goals for Monetary Policy. *Journal of Money, Credit and Banking,* 39(5), August.

Faust, J. and Svensson, L. E. O. (2002). The Equilibrium Degree of Transparency and Control in Monetary Policy. *Journal of Money, Credit, and Banking*, 53(3), 520-539.

Faust, J., & Svensson, L. E. O. (2001). Transparency and Credibility: Monetary Policy with Unobservable Goals. *International Economic Review*, 42(2), 369-397.

Finel, B. I., & Lord, K. M. (1999). The Surprising Logic of Transparency. *International Studies Quarterly*, 43(2), 315-339.

Franses, P. H., & van Dijk, D. (2003). *Non-Linear Time Series Models in Empirical Finance.* Cambridge University Press: Cambridge.

Freedman, C. (2002). The Value of Transparency in Conducting Monetary Policy. Panel Discussion: Transparency in the Practice of Monetary Policy. *Federal Reserve Bank of St. Louis Review (July/August)*, 155-160.

Geraats, P. M. (2002). Central Bank Transparency. *The Economic Journal, (*November), F532-F565.

Giovannoni, F., & de Dios Tena, J. (2008). Market Concentration, Macroeconomic Uncertainty and Monetary Policy. *European Economic Review*, 52(6), 1097-1123.

Hajizadeh, M., Nazhandimanesh, H., & Zarei, M. A. (2017). The Statute of Rule of Law in International Law. *Public Law Research*, 54, 171-196.

Hosseini, S., Salami, H., & Nikookar, A. (2007). The Pattern of Price Transmission in the Broiler Market of Iran. *Journal of Economic and Agriculture*, 1(2), 1-21.

Humphreys, M., Sachs, J., & Stiglitz, J. E. (Eds.) (2007). *Escaping the Resource Curse*. New York: Columbia University Press.

Jensen, H. (2002). *Optimal Degrees of Transparency in Monetary Policymaking*. CEPR Discussion Paper 2689.

Klomp, J. and De Haan, J. (2009). Central Bank Independence and Financial Instability. *Journal of Financial Stability*, 5 (4), 321-338.

Landerretche, O., Corbo, V., & Schmidt-Hebbel, K. (2001). *Does Inflation Targeting Make a Difference?* Central Bank of Chile, Working paper No 106. Available at: http://www.bcentral.cl/estudios/documentos-trabajo/pdf/dtbc106.pdf [Accessed 29 November 2008].

Mandelbrot, B. (1963). The Variation of Certain Speculative Prices. *The Journal of Business*, 36(4), 394-419.

Markaz Malmiri, A. (2006). *Rule of law (concepts, bases, and approaches)*, 1st Ed, Tehran: Parliamentary Researches Center Pub.

Mathew, J. J. (2006). *Measuring Central Bank Independence in Twenty- Five Countries: A New Index of Institutional Quality*. 8th Annual Conference on Money and Finance in Indian Economy.

Mishkin, F. (2004). *Can Central Bank Transparency Go Too Far?* NBER Working Paper No. 10829.

Mojtahed, A. (2010). Transparency, Communication and Accountability in the Central Bank of Iran. *Journal of Monetary and Banking Research*, 2(3), 57-92.

Momeni, F., & NaghsheTabrizi, B. (2015). *Iranian Economy During the National Government*. Tehran: Nahadgara Publishing.

Neumann, M. J. (2002). Transparency in Monetary Policy. *Atlantic Economic Journal*, 30(4), 353–365.

Roodposhti, F. R., Taghavi, M., & Shahverdiyani, Sh. (2013). Financial Deeping and Financial System Development, *Quarterly Financial Knowledge of Security Analysis*, 6(17), 15-28.

Shleifer, A., & Vishny, R. (2010). Unstable Banking. *Journal of Financial Economics*, 97(3), 306–318.

Sorensen, J. R. (1991). Political Uncertainty and Macroeconomic Performance. *Economics Letters,* 37, 4377–381.

Tarkka, J., & Mayes, D. G. (1999). *The Value of Publishing Official Central Bank Forecasts*. Bank of Finland Discussion Papers 22/99.

Taylor, J. B. (1979). Estimation and Control of a Macroeconomic Model with Rational Expectations. *Econometrica*, 47(5), 1267-86.

Van der Cruijsen, C. A. B., Eijffinger, S. C. W., & Hoogduin, L. H. (2010). Optimal Central Bank Transparency. *Journal of International Money and Finance,* 29(8), 1482-1507.