Central bank transparency: examining volatility in output and financial markets

CENTRAL BANK TRANSPARENCY:

EXAMINING VOLATILITY IN OUTPUT AND FINANCIAL MARKETS

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Table of Contents

I. Introduction

This research takes an extensive, fresh look at central bank transparency and its effects on the economy. I utilize the seminal index from Dincer and Eichengreen (2013), which contains values of the level of central bank transparency for over 100 countries from 1998 to 2010. This thesis is an extension of and a contribution to Dincer and Eichengreen's research[1].

While most of the literature focuses on inflation volatility and persistence, there have been a few studies examining the effects of central bank transparency on financial markets and even less attention paid to output. My research therefore aspires to extend the investigation of these two very important areas. There is no absolute consensus in the existing literature regarding whether or not the increase in central bank transparency since the 1990s influences volatility in financial markets and output. Moreover, no published research utilizes this seminal measure of transparency to examine the effect on financial market volatility and there has only been a limited investigation using this same index into output volatility in Dincer and Eichengreen (2007). My main objective is to further clarify transparency's effects on both of these economic variables while using the aforementioned influential transparency index presented in Dincer and Eichengreen (2013).

In addition to interpreting the effects on financial markets and output volatility, I pursue the notion that there may be an optimal level of transparency. Transparency might have a maximum beneficial effect followed by diminished returns if it exceeds a certain point. It is almost universally agreed that the original move towards greater transparency by central banks was a good thing – but can there be too much of a good thing? Is a certain amount of mystique a

[1] See Dincer and Eichengreen (2007), (2009), and (2013).

benefit for both central banks and the economy? Is there a limit to the benefit of openness? I aim to investigate if there are non-linear and diminishing returns to transparency.

One final theory I explore is whether transparency has smoothing effects in calm periods and volatile, panic inducing effects in times of economic turmoil. Keynes (1936), and in modern times Akerlof and Shiller (2009), cautioned that 'animal spirits' exist, for better or worse. It is my claim that these animal spirits, combined with too much information from central banks, can exacerbate times of turmoil. I will investigate specific date ranges in particular to explore whether there is a tendency to have greater volatility in periods of crisis.

The idea of central bank transparency has taken on many forms and meanings. I define transparency as information that central banks release to the public. Eijffinger and Geraats (2002) identify five aspects of transparency: political, economic, procedural, policy, and operational transparency; I will use the same definition and qualification of transparency. While the main influences are Dincer and Eichengreen (2007) and Dincer and Eichengreen (2013), additional foundations for my research are Kydland and Prescott (1977), Barro and Gordon (1983), Goodfriend (1986), Geraats (2002) as well as Eijffinger and Geraats (2006).

The remainder of this thesis is organized into five main sections. First I review all of the relevant literature on central bank transparency including how it relates to output and financial market volatility. I then expound a theoretical framework for measuring the effect of the level of central bank transparency on both output and financial market volatility. Following an illustration of the models, I will review the data utilized. In the penultimate section I present empirical tests and findings. Finally, I will summarize the pertinent results and provide concluding remarks.

II. Literature Review on Central Banking Transparency

> The overwhelming contribution that the international community can make toward preventing crises is to succeed in encouraging sound national economic policies. And the most important thing that the international community can do in achieving this goal is to promote transparency. Summers (2000)

Starting with New Zealand in 1989, there has been a vast increase in central bank transparency as well as the amount of information released to the public by central banks[2]. One of the first groundbreaking papers on central bank transparency was Goodfriend (1986). The paper is one of the first to discuss the costs and benefits of secrecy in monetary policy and asks how central banks respond to increasing evidence of the importance of expectations in economic decision making. Goodfriend argues that there are very few circumstances where opacity would be desirable for a central bank. My research seeks to further explore whether transparency has an effect on output and financial market volatility as well as investigate if there is an optimal level of transparency. Using Eichengreen and Dincer's 1998-2010 transparency index to investigate these matters makes the research presented here a unique and valuable contribution to the field. There have been numerous other relevant and significant studies. This section is divided into three subsections: an overview of the related transparency literature; a review of the literature on transparency as it relates to output; and a review of the literature as it relates to financial markets.

[2] See Tables 3 and 4 in Appendix.

i. Overview of Transparency

Dincer and Eichengreen (2007) note that since the late 1990s a large number of central banks have moved towards greater transparency. The authors' goal is to contribute new evidence in the area of trends in transparency, correlations, and implications of transparency. Dincer and Eichengreen attribute the move towards greater transparency in part to the removal of currency pegs and the move towards more flexible exchange rates, financial liberalization and political liberalization. They analyze the impact of transparency on inflation persistence and variability as well as output variability to a limited extent. Dincer and Eichengreen construct an index that is based on the components of Geraats (2002) and Eijffinger and Geraats (2006) with 15 subindices. They find that the average transparency score rises from 3.4 in 1998 to 5.2 in 2005. In addition, the authors find that no central bank moves further towards opacity in the period reviewed, though 11 of the 100 reported no change. The study finds that transparency is greater in countries with more stable and developed political systems and with more developed financial markets. In fact, the more developed a country is, the more transparent it is. They use regression analysis on a cross section from 1998-2004 with all variables averaged over the period. The authors regress transparency on a vector of political determinants (rule of law, political stability, voice and accountability, and government efficiency) as well as economic determinants (per capital income, inflation history, the de facto exchange rate regime, and financial depth). They find 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. Dincer and Eichengreen then pool the annual observations and estimate FE models, including separate intercepts for each country. They find evidence that more advanced countries with extremely transparent central banks cannot move much further towards transparency and therefore offer little variation in the data, while countries that do not have as much political stability or rule of law have been moving towards greater transparency. This analysis confirms their hypothesis that transparency is greater in countries with more stable and developed political systems and more developed financial markets.

Dincer and Eichengreen (2009) update their index through 2006 and use the data to study the determinants and consequences of monetary policy transparency on inflation, but not output. The authors highlight that transparency can enhance the effectiveness of monetary policy as effective communication with all markets can create stabilizing effects. If market participants can anticipate central bank actions, they can more effectively manage expectations, which should mitigate disruptions when changes take place. Transparency allows central banks to communicate with markets more effectively. The authors illustrate a few examples when transparency might not be optimal. If asymmetrical information is distorting then the theory of second best says that removing one distortion, when there are other distortions, might not be welfare enhancing. The authors argue that it is easy to construct scenarios where additional transparency destabilizes expectations and exacerbates financial market volatility. Dincer and Eichengreen set out to document changes in central bank transparency, analyze the determinants of the degree of transparency while focusing on the function of political variables, and investigate consequences of monetary policy effects on inflation variability and inflation persistence. They do not investigate output variability in this study. Finally, the authors set out to provide a provisional answer to Mishkin (2004) and examine whether there are diminishing

returns to transparency. Dincer and Eichengreen explore optimal central bank transparency by adding a squared term in transparency to try and determine whether there are diminishing returns to transparency.

As in Dincer and Eichengreen (2007), Dincer and Eichengreen (2009) again follow the work of Eijffinger and Geraats (2006) and include the same 15 subindices covering political, economic, procedural, policy, and operational transparency, extending Eijffinger and Geraats' data set to include 100 central banks to include all large and systematically significant countries. They use regression analysis to examine the differences in central bank transparency across countries and over time in order to provide an explanation for variations and to identify instruments for use in the analysis of the consequences of transparency. The authors use a cross section from 1998-2006 of all variables averaged over the period and regress transparency on a vector per capita income, inflation history, the de facto exchange rate regime, financial depth, rule of law, political stability, voice and accountability, government efficiency, and democratic orientation. They find that policy transparency is significantly related to every one of their measures of policies and institutions and use their specification to look at trends in transparency. The authors pool the annual observations and estimate an FE model with separate intercepts for each country. Rather than looking at a cross section, the authors now look at time series variation in the data to see how central bank transparency is evolving over time. Utilizing instrumental variables (IV) and generalized method of moments (GMM), they find the main variables to explain the move towards greater transparency to be the move to more flexible exchange rates, per capita GDP, rule of law and government efficiency. Dincer and Eichengreen then turn to the issue of optimal central bank transparency by adding a squared term in transparency to try and determine whether there are diminishing returns to transparency. They estimate second-stage

coefficients using GMM to correct for heteroskedasticity and serial correlation present in the data. Their results suggest that increased transparency has the strongest effect on inflation variability for the most secret of central banks and they do find evidence of diminishing returns to transparency. As in their previous paper, the authors find transparency is more likely in countries with strong and stable political institutions and democracies. The authors conclude that increased transparency is associated with less inflation variability but not with less inflation persistence.

Siklos (2011) extends the data index provided by Dincer and Eichengreen (2009) and examines central bank transparency. The author finds that there are significant increases to the level of transparency in Central and Eastern Europe compared to much smaller rises in other countries. Siklos concludes that it is ambiguous whether or not the additional years in the data demonstrate diminishing returns to transparency. Dincer and Eichengreen (2013) continue with Siklos' update and extend the index up through 2010. They confirm their previous studies and find that there has been an increase in transparency and independence over the time period. The authors also confirm previous studies that conclude the variability of inflation is significantly affected by transparency and independence, though isolating the two effects is difficult.

Geraats (2002) reviews developments in central bank transparency and major contributions to the research area. The author also illustrates five main ways to evaluate transparency in detail: political; economic; procedural, policy, operational[3]. This paradigm for measuring central bank transparency is utilized by Eichengreen and Dincer (2007), (2009), and (2013). Geraats points out that transparency is a necessary complement to central bank independence. The openness allows accountability of central banks, which enables the independence of central banks. Geraats points out that there is a strong and positive relationship

[3] I will expand on the paradigm in the Data Selection section.

between independence and transparency across countries; however, there is no cross-country relationship between central bank independence and accountability. The author also provides us with a clear definition of what she perceives central bank transparency to be. Central bank transparency is, according to Geraats, the absence of asymmetric information between monetary policy makers and other economic agents. It reduces uncertainty about how the policy makers perceive the economy and what, if any, policy changes are forthcoming. Transparency, however, is not the same as perfect information. As long as the public and the central bank have the same information, then we will have a transparent situation. However, this is not the same as perfect information because both parties may face uncertainty about the economy's structure. Moreover, it might be imprudent to apply a blanket statement that transparency is always beneficial. Transparency will remove information asymmetries; however, lack of transparency is probably not the only source of market failure. Therefore, Geraats also argues that the theory of second best implies that greater transparency might not increase welfare. Though one might expect a decline in uncertainty due to increased transparency to be welfare enhancing because it reduces forecast errors and expected variability, this might not always be the case. One exception to this rule would be that if the release of information by a central bank was vague or unreliable then it could be welfare reducing. Geraats argues that political transparency, via formal objectives, quantitative targets and clarity about institutional structure, is the most vital of the five transparency aspects. This is because political transparency provides a means and benchmark for judgment and evaluation. Finally, the author finds that transparency would be undesirable if the central banker is conservative and subject to political pressures.

Geraats (2001a) evaluates the effects of transparency on strong and weak central banks. The author describes a strong central bank as a bank with a lower, unpublished, inflation target

compared to weaker banks. The study finds that if transparency is imposed by the public, a weaker central bank will favor confidentiality because it is easier for the bank to conduct stabilization policies without their preferences for a higher inflation being revealed. However if transparency is self-imposed by a central bank, weak banks will still choose more transparency. This is due to the fact that a central bank that portrays any secrecy in itself will be seen by the public as a sign of weakness. Therefore even weak central banks will opt instead for transparency. Similarly, Geraats (2001b) highlights that benefits of economic transparency depend on institutional framework. There are negative uncertainty effects when a conservative central bank is subject to political interference. On the other hand, positive incentive effects exist when monetary policy is conducted by an independent central bank.

Mishkin (2004) provides a convincing argument claiming that central bank transparency does have an optimal level, which can be damaging if passed. He reviews examples of positive and undermining transparency. To answer his question, 'Can transparency go too far?' Mishkin considers whether or not further increased transparency will help a central bank to operate, enabling it to conduct optimal monetary policy while being able to focus on long-run objectives. To do this, the author considers a simple new Keynesian framework and asks three questions: should central banks publish forecasts including further path of policy rates projections; should central banks announce objective functions; and how should central banks talk about output fluctuations? One of the benefits of increased transparency, according to the author, is that output volatility has fallen. Mishkin believes that transparency is beneficial up to the point that it simplifies communication with the public and generates support for the central banks to conduct policy optimally while being able to focus on long-run objectives. However, he argues that the communication process could be complicated to the point of detriment if transparency is

increased too much. For example, Mishkin considers a central bank announcing its objective function or projection of the path of the policy interest rate as too open. Showing disagreement and dissent amongst policy members would only heighten uncertainty. In addition, announcing a projection of the policy rate path to the public would prove problematic because the public would not be able to understand that this path is subject to changes in the state in the economy. Recent confusion in the US and the UK over 'forward guidance' could be evidence of this. Intermediate policy instruments are conditional on the future state of the economy and are subject to changes or deviations from forecast and realized rates. The public might not see these changes as course corrections, and instead they might view them as the central bank not fulfilling its commitments or, even worse, not being able to anticipate future policy accurately. Mishkin draws the analogy of political elections; if a candidate changes his views, even on something he did 10 years ago, voters feel this reflects on his judgment and leadership qualities. The same negative effects could be said for central bankers, which could result in a reversal of bank independence. One area where Mishkin believes transparency should be improved is central banks' unwillingness to discuss that they wish to reduce output variability.

Goodhart (2001) also queries whether the public would be confused about the proficiency of central bank members if, after providing information about intermediate targets, these intermediate targets are missed. Here the author inquires whether it is beneficial to provide information about forecasts for the future path of monetary policy in addition to inflation targets. It would be extremely difficult for the entire board to agree on a trajectory ahead of time and any dissention may be seen as undermining.

Gersbach and Hahn (2001a) examine voting records and find that voting record transparency could be harmful. They look at a two-period monetary policy game where the

government elects central bankers for one period, after which they need to be reappointed. When first elected the central banker's ability is private information. If voting records are not released to the public sector then the central banker's capabilities will still be hidden and the same uncertainty will prevail during the second period. However, if there is increased transparency and voting records are made public initially, the authors find that central bankers will refuse to abstain from voting as to not appear incompetent. Instead, central bankers will cast random votes in order to maximize their chances of re-election. In this paper, the authors find that the random voting effect dominates and determine that the publication of individual voting records does more harm than good. On the other hand, Gersbach and Hahn (2001b) find that voting transparency is advantageous. Here the authors adjust their assumptions from their previous article. They assume that there exists unobservable heterogeneity in central bankers' preferences. In addition, private benefits from re-election are sufficiently small. The authors find that there is a positive uncertainty effect in disclosing voting records because it allows governments to witness central bankers' preferences, enabling only those central bankers with socially desirable preferences to be re-elected. Finally, Gersbach and Hahn caution that publishing voting records or minutes may subject central bankers to political pressures.

Dotsey (1987), Rudin (1988b), and Tabellini (1987) are all similar studies with different conclusions, further example of how the existing literature is indecisive about the effects of central bank transparency. Dotsey (1987) finds central bank policy opacity to be desirable. The author assumes the central bank has a stochastic short term money target and that the average target would be known to the public. Nevertheless, there would still be asymmetric information about the white noise target disturbance. This would give rise to an uncertainty effect, increasing the variance of private sector forecast errors of the interbank rate. However, the central bank

secrecy reduces the variance of the interbank rate because it responds less to the unobserved money target disturbance.

Rudin (1988b) extends Dotsey's model and shows that an increase in transparency may have an increase in volatility when there are central bank watchers. Rudin finds that less secrecy about the non-borrowed reserves target could reduce the accuracy of interbank rate forecasts. Though this might seem contradictory, the reason for this reduced accuracy is that the reduction in secrecy makes central bank information easier to interpret. If it is less costly to monitor central banks, logically this would increase the amount of central bank watchers. This increase in the amount of watchers will result in a stronger response whenever there is a market disturbance, which will increase the interbank rate volatility. The ultimate consequence of the increase in transparency would be that it is harder to forecast.

Tabellini (1987) also expands Dotsey's research and comes to a different conclusion about transparency. Here the author assumes central banks have a constant non-borrowed reserves target. Financial markets are unable to observe the policy target and use the interbank rate instead. In this study, Tabellini finds that central bank policy secrecy increases the interbank rate variance.

Cosimano and Van Huyck (1993) also find a circumstance when central bank policy secrecy is preferred. The authors review asymmetric information about central bank policy for reserve targets when the bank's policy is to meet the reserve target while keeping the interbank rate low. They argue that the central bank's trading desk has an incentive to manipulate current reserves because commercial banks use the interbank and deposit rates to infer the reserve target. By manipulating the current reserves, the central bank maintains a more favorable trade-off

between obtaining the reserve target and keeping the federal funds rate low. In this case, limiting public information is beneficial.

Cukierman and Meltzer (1986) contribute towards the foundations of operational transparency. They say that transparency is connected to how easily the public can deduce central bank goals and intentions from observables. The authors use an infinite horizon version of a monetary policy game to show that there is asymmetric information about a central bank's preference parameter for output stimulation, which is stochastic and has positive autocorrelation. The policy maker does not reveal the planned policy instrument and has imperfect control over inflation. Using observed past inflation outcomes, the private sector predicts what the policy maker's future preference parameter for output stimulation will be. With greater precision, the private sector hones its inflation predictions and reduces the inflation bias. However, looser monetary control creates an uncertainty effect, which can be advantageous. Inflation uncertainty allows the policy maker to create surprise inflation when it is desirable. The authors find that the uncertainty effect could potentially outweigh incentive effect, which means that looser monetary control may be optimal.

Eijffinger and Hoeberichts (2002) investigate the effects of accountability on macroeconomic outcomes. The authors focus on two types of accountability: accountability through final responsibility and accountability through transparency. The theoretical model utilized builds upon Lohmann (1992), Schaling and Nolan (1998) and Eijffinger et al. (2000). The conservative central banker has quasi-control (the government can override the central bank's decision at a cost) over monetary policy and preferences for inflation stabilization relative to output stabilization are uncertain. Depending on whether the cost of overriding is prohibitive or negligible, final responsibility will rest either with the central bank or the government. The

authors review these two types of accountability and their effects on macroeconomic outcomes. Using a simplified Lucas supply function, a loss-function for the central bank and a loss-function for the government, their research shows that although transparency makes the region of independence smaller, effective central bank independence increases with transparency. Even though the region of independence turns out to be smaller, as transparency is increased macroeconomic outcomes move in the direction that the central bank prefers. Accountability via transparency leads to lower expected inflation and less stabilization of supply shocks. The authors also discuss the contentious topic of revealing voting records. They assert that making voting records public has limited benefits and furthermore, releasing the records could undermine the decision made by the majority.

Faust and Svensson (2001) explore credibility, transparency, and reputation of central banks when their preferences are not conveyed publicly. The private sector infers central bank characteristics from policy outcomes. Three transparency regimes are considered: unobservable goal and intension; observable intention; observable goal and intention. The authors find that banks with more transparency fall under more public scrutiny over their actions than banks with less transparency, which makes banks more temperate and more likely to follow a policy similar to the socially optimal one. Faust and Svennsson find that while full transparency is socially beneficial, this scenario is generally worse for central banks. Moreover, central banks often want minimal transparency. The authors utilize a variation of the Cukierman and Meltzer (1986) model in the context of a stationary, low-inflation equilibrium, which they say has received less attention than moderate and high inflation equilibriums.

Faust and Svensson (2002) investigate a central bank's choice of degree of control and transparency under discretion and commitment. The authors also investigate the optimal degree

of control, which they define as the degree of equivalence between the intended and actual outcome of policy actions by the central bank. They define transparency as the degree to which central bank intentions can be inferred by the public. The authors use a backwards-looking new Keynesian approach with a quadratic loss function. They conclude that discretion is the most realistic assumption for control and commitment is the most realistic choice for transparency. Under commitment, the optimal choice of transparency for a central bank with a low average inflation bias will be minimal. However, under discretion both minimum and maximum transparency could be optimal. Faust and Svensson find that, if they have a low enough inflation bias, sufficiently patient central banks will always choose to have the least amount of transparency possible.

Cukierman (2002) investigates models used in making policy decisions and the operational objectives of the central bank. The author has two main purposes: to evaluate the degree of transparency about the recent economic models used by central banks and their objective functions. Using both sticky-price and flexible-price transmission mechanisms, he finds that there is vagueness about the economic models used by central banks in forecasting as well as for their objective function. While there is relatively prevalent information about inflation targets, central banks are substantially less informative about output targets. Finally, Cukierman raises the question of full transparency, its feasibility, and if it is always beneficial. He summarizes by calling for further understanding of the costs and benefits of transparency.

Walsh (2003) focuses on the role that the target inflation rate and the weight on the target objective have in affecting the incentives of a discretionary central bank. The paper's contribution is to provide a framework for deriving an optimal weight to place on achieving the inflation target, which can be related to optimal performance measures as well as issues of

accountability and transparency. The author uses a new Keynesian model that analyzes monetary policy in models based on optimizing private sector behavior and nominal rigidities, which is similar to Clarida, Gali, and Gertler (1999). Walsh finds that the trade-off between accountability and stabilization depends on the degree of transparency.

Van der Cruijsen, Eijffinger, and Hoogduin (2010) uses the index from Eichengreen and Dincer (2007) and examine whether or not central banks should increase their degree of transparency any further. They 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 one of two things might happen: the public might start to attach too much weight to the conditionality of their forecasts; and/or the public might get confused by the large amount of information received. Both of these potential consequences would decrease the quality of private sector inflation forecasts, causing inflation to be set in a more backward looking manner and resulting in higher inflation persistence. At the optimal intermediate degree of transparency inflation persistence is minimized. The authors find that some central banks could increase transparency while others have already reached their optimal level.

Van der Cruijsen, Eijffinger, and Hoogduin (2010) argues that there is the potential for public obfuscation 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. The authors 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. Similarly, Clare and Courtenay (2001) find that if

minutes are released that describe debatable discussion among bank board members that this could increase asset price volatility, again implying that profuse amounts of information will only confuse investors.

Swanson (2006), using a simple theoretical framework, determines that since the late 1980s United States financial markets have been: better able to forecast the federal funds rate several months out; less surprised by policy announcements; more certain of their interest rate forecasts; and less diverse in the cross sectional variety of their interest rate forecasts. The author attributes these improvements to increases in the transparency of the Federal Reserve. He argues that while there appears to be a consensus that increased transparency is beneficial, there are few studies proving these benefits. Swanson defines transparency as the amount of information released to the public about the goals and conduct of monetary policy. Pointing out that there has been a dramatic deterioration in financial market forecast accuracy since 2001, the author attempts to shed light on two important questions: what are the reasons for the forecast deterioration; and is the forecast improvement prior to 2001 robust or does it disappear once controlling for factors that explain the deterioration since 2001? Swanson argues that if we blame the recent losses in accuracy on increased volatility in the federal funds rate then we might also have to attribute earlier gains to accuracy to reductions in federal funds rate volatility rather than increases to central bank transparency. He considers variables such as implied volatility from interest rate options and panel data from private sector forecasts of output, inflation, and interest rates, to investigate these two questions. The author concludes that January 2001 corresponds to a period of significant uncertainty about the future United States output and employment and therefore the deterioration in private sector forecasts of interest rates in 2001-2002 might reflect a general deterioration in the private sectors ability to forecast the economy. Despite this increase

in private sector forecast errors and uncertainty since 2001, improvement in interest rate forecasts appears to be a robust feature of the data, even after controlling for uncertainty about the state of the economy and changing in the federal funds rate momentum. Swanson finds strong evidence that the increase in Federal Reserve transparency has improved forecasting performance. Firstly, market forecast errors and cross sectional forecast dispersion of interest rates have fallen substantially while forecast errors of GDP and inflation have not. Secondly, market uncertainty about the future course of interest rates generally falls after explicit policy announcements. However, there is no significant response to implicit or unexplained policy announcements that were made by the Federal Reserve prior to February 1994.

Bordo et al. (2007) takes a novel approach in investigating three great disinflations: the post-Civil War deflation, the post-WWI deflation, and the Volker disinflation. Many previous studies have focused on these periods, but here the authors analyze the role transparency and credibility during these three eras of deliberate monetary contraction.

Freedman (2002) examines why central banks have become more transparent and discusses if there are limits to what information should be released to the public. Freedman contends that the reasons for an increase in transparency are twofold: transparency allows monetary policy to be more effective; and because of the link between transparency and accountability. Increased transparency benefits the view of the central bank and monetary policy in the eyes of the public, via increased understanding of policy and decision, and in the eyes of financial market participants, via increased understanding and anticipations of central bank actions. Freedman argues that if expectations are concurrent with policy decisions, this should lead to less volatility in financial markets and smoother absorption of policy actions. However, the author also warns that too much transparency could be counterproductive and reviews an

example of televising policy making meetings. Freedman says that if deliberations were televised that 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; and that these informal discussions could replace formal information releases that come at later dates.

Poole, Rasche, and Thornton (2002) examine how much market participants anticipate policy actions. They argue that the reason behind the move towards greater transparency is twofold: monetary policy is a main driving force behind inflation; and market expectations and bank credibility are vital to monetary policy success. The authors conclude that increased transparency has assisted market participants in predicting rate changes in addition to allowing the participants to forecast changes further in advance than prior to 1994. They note that this is especially important since it is the changes in longer-term interest rates that generate significant changes in economic variables. Finally the authors draw the conclusion that since 1994 there has been exceptional economic stability and that this has occurred at the same time as the move to greater transparency; Poole, Rasche, and Thornton attribute this stability in part to the increase in transparency. However, one wonders what their thoughts on greater transparency would be in the current economic climate.

Lapp, Pearce, and Laksanasut (2003) investigate whether or not the public can predict Federal Open Market Committee (FOMC) policy changes. They review all possible policy decisions (tightening, easing, or left unchanged) and estimate probabilities of each choice using a probit model. They find a relationship between policy decisions and economic activity, but also find that the relationship does not predict the decisions themselves. The authors argue that short-term interest rate changes can help anticipate policy decisions. However, on the whole they find

that FOMC decisions are not reliably predictable given the data available at the time. In addition they find that models which included money supply growth, trade deficits, exchange rate changes, and stock price movements did not accurately predict FOMC changes. Finally, based on these results the authors deduce that FOMC decisions are not transparent enough for accurate public predictions of policy changes.

Finel and Lord (1999) looks at transparency and its effects in the realm of politics. They argue that transparency informs the public of levels of risk and is related to legal, political, and institutional structures. The authors consider two extremes of transparency, first where transparency defuses international crises and second where transparency exacerbates international crises. They also suggest, but do not test, that there could be nonlinear effects of transparency. They develop a qualitative index based on three different aspects of transparency: debate, control, and disclosure. Debate considers the degree to which there is debate over ideas; control refers to how the government releases information to the public; and disclosure refers to how often the government releases the same information. The authors conclude that often transparency can exacerbate crises, particularly because media will often pay more attention to sensational stories rather than calming statements. Additionally they contest that transparency may derail negotiations.

ii. Transparency as it relates to Output

The effect of transparency on output volatility is an area not often explored in the literature. Most of the research surrounding transparency effects focuses on inflation variability and persistence. The studies that do attempt to explain output volatility use limited central bank transparency data sets. It is puzzling why output volatility is not investigated more as output stabilization is a key component of economic stability. Utilizing the most comprehensive indices available, my research investigates the relationship between transparency and output volatility in the hope of clarifying the connection between the two variables.

Two studies that offer significant contributions towards measuring output volatility are Chortareas, Stasavage and Sterne (2002) and Corbo et al. (2001). Chortareas, Stasavage and Sterne (2002) measure output volatility based on the standard deviation of GDP growth using quarterly GDP data where available or annual data. Corbo et al. (2001) find that inflation targeting reduces inflation forecast errors, inflation persistence and the volatility of output while it increases output persistence. It is important to remember that there is a well-founded tradeoff

between inflation and output. If we mitigate output volatility there may be repercussions on inflation.

In addition to a thorough review of their index and determinants of central bank transparency, Dincer and Eichengreen (2007) also examine the relationship between output variation and the level of transparency. The authors consider the impact on output variability, inflation variability, and inflation persistence. Past inflation is found to be positively related to inflation variability and financial depth is negatively related to inflation variability. Additionally, Dincer and Eichengreen find that transparency tends to reduce inflation persistence. For output variability the authors use the standard deviation of the growth rate over the most recent three-year period; my analysis includes this measure of output volatility and contributes an additional measure by using the standard deviation of the growth rate over the most recent five-year period to incorporate the typical business cycle length. The authors' results show an increase in transparency reduces output volatility. Their examination reflects favorable, but relatively weak impacts on inflation and output volatility. My research takes the groundbreaking work of Dincer and Eichengreen (2007), extends it by utilizing the additional years of data provided by Dincer and Eichengreen (2013), and goes beyond pooled regressions to include fixed effects, random effects, and GMM in two different models of central bank transparency's effect on output volatility.

Jensen (2001) finds that increases in transparency can be potentially welfare reducing. Using a framework similar to Faust and Svensson (2001), the author looks at a simple, two-period, forward-looking model where the central bank has imperfect control over the output gap through an unobservable policy instrument. The model features the trade-off between output gap volatility and inflation. Here not every firm is able to change its prices at the beginning of every

period, meaning that there are implications for output in the current period. Under these circumstances the private sector uses the output gap to predict the next period's inflation. The author finds that increased operational transparency allows the private sector to be more precise in their estimates, reducing the inflation bias. The study also shows that operational transparency may be detrimental for central banks. This form of transparency can reduce central bank flexibility via an adverse uncertainty effect; openness regarding control errors can exacerbate the inflation-output trade-off as central banks may have to pay more attention to inflation rather than output gap stabilization. Jensen finds that there will exist an optimal degree of transparency. Faust and Svensson (2001) have a very different result. They find that high levels of transparency are beneficial. The reason for this distinction is the assumptions in the model framework. Faust and Svensson utilize a Lucas-style supply function and inflation expectations are formed at the beginning of the period.

Faust and Svensson (2001) extend Cukierman and Meltzer (1986). The former alter the central bank's objective function so that inflation responds to private sector inflation expectations. Here the central bank cares about output stabilization. The output target is not released to the public, so the public attempts to infer the policy maker's optimal target from inflation. The authors define operational transparency as the extent to which the monetary control errors are disclosed to the private sector. Their research finds that greater operational transparency will usually improve social welfare, but is probably not preferred by central banks. 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 is socially beneficial since it reduces the variance of output.

Cecchetti and Krause (2002) look at the variability of inflation and output and analyze the effects of central bank independence, accountability, and transparency using the Fry et al. (2000) indices. The Fry et al. indices create a measure of transparency by looking at the responses to the extent and frequency at which central banks provide reports. The index is a simple average of three reporting criteria: policy decisions, assessments about the state of the economy, and public explanations of forecasts. Cecchetti and Krause argue that more information is always better than less. With full information, people should make the most efficient decisions possible. Along these lines, the authors state that good and transparent policy should allow markets and the economy to respond to the data released only and not to the policymakers themselves. Cecchetti and Krause recognize that there are economists who argue that there are forms of central bank secrecy that can be efficient, citing that policy surprises can be effective and that released information can be misinterpreted. However the authors feel that these arguments have not been persuasive and full transparency is best. The level of transparency continues to be a contentious issue. Ceccheeti and Krause study a cross section of countries and measure performance as a weighted average of output and inflation variability. The authors derive measures of macroeconomic performance and policy efficiency using the inflation-output variability trade-off or efficiency frontier. Their measure of policy efficiency is related to the distance of the economy's performance point to the inflation-output variability frontier. Their results suggest that credibility and transparency, albeit to a lesser extent than credibility, improve macroeconomic performance.

Chortareas, Stasavage, and Sterne (2002) consider questions regarding the institutional characteristics of central banks and their effect on economic performance. Particularly they review recent analyses that have attempted to identify optimal degrees of independence,

accountability, and transparency in monetary policy. They point out that there is a plethora of research regarding the importance of central bank independence; however, there is limited literature regarding the issues of transparency and accountability in monetary policy. In their article, they focus on how published economic forecasts are associated with inflation and output in a cross section of 87 countries, utilizing the data set based on the survey conducted by Fry et al. (2000). Their results show that a higher degree of transparency in monetary policy is associated with lower inflation. Furthermore, they do not find any evidence to support the idea that increased transparency is associated with increased output volatility. Chortareas, Stasavage, and Sterne note that increased transparency may reduce uncertainty in financial markets, though the authors mention that a high degree of transparency is not always desirable. The authors find that there is a statistically significant negative correlation between transparency and inflation; however, there is no evidence of a cost of transparency in terms of increased output volatility. Instead of taking the average of different transparency measures, they measure transparency using a Guttman scale. A Guttman scale is created by arranging binary variables in a sequence such that a positive value for one indicator implies a positive value for all previous variables in the sequence. The main advantage for using a Guttman scale is that the scale is constructed from several indicators and no information is lost by aggregation. The authors measure output volatility based on the standard deviation of GDP growth using quarterly GDP data where available or annual data. Generally, they find that correlation between transparency and output volatility is negative. Their article is one of the first to provide cross-country empirical evidence using macroeconomic data. They conclude that in order to be sure that their tests using cross section data eliminate all possible biases that they will need more data. They argue that existing literature is almost entirely unanimous that increased transparency in monetary policy leads to

lower inflation. The authors do not find that increased transparency is associated with an increase in output volatility.

Fatas, Mihov, and Rose (2007) help to bridge the gap between theoretical support and empirical support of increased transparency. They use annual data from 1960 to 2000 for over 40 countries and look at three types of quantitative monetary targets: exchange rates, money growth rates, and inflation targets. The authors investigate not only the effects of having transparent monetary policies in place, but also the effects of these successful transparency policies. Utilizing ordinary least squares, the authors find that countries with clear targets for monetary policy will have lower inflation and that countries that reach their policy targets will lower inflation even further. The authors also look into how different regimes affect output volatility and growth. They conclude that having a monetary target, which is achieved, will reduce output volatility and increase growth.

iii. Transparency as it relates to Financial Markets

One of the main objectives of central banks is to conduct effective monetary policy, focusing on macroeconomic variables such as inflation and often output and employment. However the tools they use to influence the economy are indirectly linked to these variables, and usually manipulated via a myriad of different financial assets. Ceteris paribus, stock and bond markets are an indication of financial strength and by extension the health and wealth of a nation. The ability to isolate the effect of the level of central bank transparency on financial markets characteristics is vitally important as these immediate targets and indicators bridge the gap between monetary policy and its objectives.

The effect of transparency on financial market volatility is a point of contention in the literature. Authors do not universally agree if transparency is beneficial or detrimental. Geraats (2002) notes that an unsolved empirical issue is whether or not central bank transparency increases volatility in financial markets. Blinder (1998) is seminal research which argues for further transparency. The author finds that greater openness is fundamental to any democracy. Blinder (1998) and Blinder et. al. (2001) find that public disclosure of policies may improve the efficiency of financial markets by curtailing excessive speculation, thereby reducing the volatility of markets, which is in contrast to what Dotsey (1987) and Rudin (1988) conclude. Tabellini (1987) concludes that increased levels of transparency reduce a source of market uncertainty. Thornton (1996) finds that the Fed's policy shift towards immediate disclosure results in a lower forecast error in all interest rates since 1994 as measured by mean squared error. However, more research needs to be done as the author finds that this may be the case because financial markets were relatively quiet during the time range studied and not due to the policy shift. Coppel and Connolly (2003) research how Australian financial markets anticipate monetary policy changes of the central bank. The author's conclusions maintain Tabellini's findings that increased transparency should lower unconditional volatility and improve anticipation of changes in policy. Policy moves seem to be more integrated over a two-week period prior to the policy change, decreasing immediate effects to financial markets on the day of the announcement, which could prove to also be a negative effect as it removes central banks' ability to make surprise, unanticipated policy decisions. Muller and Zelmer (1999) find that the greater transparency the better the predictions by markets. Anticipation and reaction speed improve with increased transparency. My research explores the relationship between

transparency and financial market volatility in hopes of clarifying the connection between the two variables.

Murdzhev and Tomljanovich (2006) describe how central banks around the world have transformed over the past 15 years and have become more transparent. Central banks used to operate under a veil of secrecy. Murdzhev and Tomljanovich state that until recently central bankers believed that monetary policy was most effective when market participants were unable to accurately forecast the timing, direction and magnitude of future policy moves. Starting in 1989 with the Reserve Bank of New Zealand, the authors found that central banks began to disclose greater information to the public consisting of public statements immediately after policy meetings, voting records, minutes and transcripts of policy meetings, and inflation forecasts. Their paper identifies the extent that monetary policy meetings and announcements have influenced the corresponding financial markets after transparency shifts of the central banks of Australia, Canada, New Zealand, Sweden, the United Kingdom and the United States using daily data from January 1, 1990 to December 31, 2003. They study their selected six central banks as they become more open during the 1990s to determine whether more open disclosure improved or worsened financial markets predictability. The authors used both ordinary least squares (OLS) and exponential generalized auto-regressive conditional heteroskedasticity (EGARCH) frameworks and find that all countries' bond markets were better able to anticipate official rate changes. There is a reduction in the policy lag as interest rates begin to move before the policy shift occurs. The authors also use OLS and EGARCH to study the effects on the stock market. They find that traders move from reacting to policy changes to incorporating predictions into stock market prices so any policy changes do not affect the stock indices at the time of announcement, making the announcement itself a non-event. One might induce that this makes

stock market indices less volatile, which is one question that I aim to expand on later. The authors find that increased openness removes a source of uncertainty and helps smooth the functioning of financial markets. Murdzhev and Tomljanovich also identify if the increase in transparency has a marginal effect on bond markets once other macroeconomic factors are controlled for. Depending on the country, they examine weekly unemployment claims, unemployment rates, inflation rates, and real GDP. The authors find that their results are unchanged and markets use information given by the central bank, in addition to other key macroeconomic variables, to determine future policy rate decisions.

Tomljanovich (2007) examines the degree of information that central banks release to the public to see if there is any effect on financial markets. The study analyzes the move towards greater transparency and how this has influenced financial markets, rather than macroeconomic factors on which most articles focus. The author suggests that it is possible that central banks have become too candid in their discussions with the public. The research considers seven industrialized countries to see whether the selected central banks' movement toward more candid disclosure in the 1990s enhanced or deteriorated the predictability of each country's financial markets. Using autoregressive conditional heteroskedasticity (ARCH) and vector autoregressions (VARs), the author finds that, with the exception of Germany, all countries' forecasting error on interest rates for government bonds decreased for most maturity lengths. The author's results are consistent with Tabellini (1987), which argues that increased central bank openness removes uncertainty and smoothes the functioning of financial markets. Tomljanovich also finds that the effect is stronger for central banks that have moved towards greater disclosure.

Ehrmann and Fratzscher (2007) explore the move by central banks towards independence, accountability, and transparency. Numerous people within central banks are

responsible for monetary policy decisions, but only one policy direction is announced. However, given the new age of transparency, central banks have to decide how individual committee members should communicate their views with the public, if at all. The authors seek to define an optimal communication strategy and review the strategies of the Federal Reserve, the European Central Bank, and the Bank of England and their efficacy. They point out that it largely depends on the decision-making process of the committee. Often decisions are made after considering every individual's opinion within the group; on the other hand decisions can be made in more of an individual manner. The authors consider two questions: do communication strategies in the three aforementioned central banks differ and how; secondly, they assess the effectiveness of communication by considering whether it allows financial markets to better anticipate monetary policy decisions. Communication may have a dual effect on the level of asset prices as well as the degree of uncertainty and volatility. To test for both, they model the effect of communication on asset price returns and on asset price volatility in a standard EGARCH framework. The authors find that central bank communication is both statistically and economically important when considering the effect on financial markets. They show that the Federal Reserve pursues a highly individualistic communication strategy and a collegial decision making approach, the European Central Bank has both a collegial approach to its communication and its decision making strategies, and the Bank of England uses a collegial communication strategy but an individualistic decision making approach. Considering the three strategies, the authors find that the predictability of policy decisions and the responsiveness of financial markets to central bank communication are equally good for the European Central Bank and the Federal Reserve, suggesting that there might not be one best approach to communication strategy.

Born, Ehrmann and Fratzscher (2010) builds upon Ehrmann and Fratzscher (2007) and looks at central bank communication as a policy tool. The authors examine how communication affects financial markets by building a data set that encompasses an empirical assessment of financial market reactions to more than 1,000 releases of Financial Stability Reports (FSR) and speeches in 36 countries over a 14-year period. They find that these reports have a significant and long-lasting effect on stock market returns and tend to reduce market volatility, whereas speeches and interviews have little effect on market returns and tend to increase volatility. Their results show that not only is increased communication from central banks important, but the method of communication is potentially even more important. Born, Ehrmann and Fratzscher (2013) expands on their previous research, extends the panel to 37 central banks and includes data for the 2007-2010 global crisis. The authors' research suggests that optimistic FSRs result in significant positive abnormal stock market returns and find no effect with pessimistic FSRs. Interestingly, their findings suggest that speeches and interviews have smaller effects on financial market returns during calm periods compared to the more influential effect they had during the recent financial crisis. Born, Ehrmann and Fratzscher (2012) finds similar results but for emerging market countries.

Bekaert, Hoerova, and Lo Duca (2010) prove a strong co-movement between the VIX and monetary policy. Their research is the first to provide an empirical link between monetary policy and risk aversion in asset markets. The authors enhance their argument to understand the link between monetary policy and the VIX by reviewing Bloom (2009) and Bloom, Floetotto and Jaimovich (2009), which show that heightened economic uncertainty decreases employment and output. Moreover, Thorbecke (1997), Rigobon and Sack (2004), and Bernanke and Kuttner

(2005) all find that expansionary monetary policy affects the stock market positively while contractionary monetary policy affects the stock market negatively.

Bernanke and Gertler (2001) ask whether central banks should react to asset price volatility. The authors believe that this is an important question because asset booms and busts have often been responsible for macroeconomic swings across the world in recent years. My research asks if central bank transparency affects stock market price volatility; therefore the question posed by Bernanke and Gertler (2001) is particularly important. The authors argue that any changes to prices should affect policy decisions only if these changes affect the inflation forecast. In the modern era of macroprudential supervision, it is necessary to identify if stabilization policy decisions made by central banks are in themselves destabilizing.

Bernanke and Kuttner (2005) highlights the importance of understanding the connection between monetary policy and asset prices, particularly the market for equities. Distinguishing between expected and unexpected policy actions utilizing Federal funds futures, the authors try to quantify the average stock market reaction as well as try to explain the economic reasons for the reaction. They also use a VAR to calculate changes in expectations of future interest rates, dividends, and excess returns. Bernanke and Kuttner prove that equity markets react strongly to surprise rate changes. In fact, the authors show that the CRSP value-weighted index will reflect a 1% gain in response to a surprise 25-basis-point easing. As expected, anticipated Federal funds rate changes elicit little or no market reactions. Interestingly, they conclude that surprise monetary policy actions have differing affects across industries; high-tech and telecommunication sectors have a more substantial response than broad market indices, while energy and utilities do not seem to be affected by monetary policy changes.

Thornton (1996) reviews how information announcements by the FOMC affect the market as well as if the policy of immediate disclosure has changed financial market uncertainty. Until February 1994, the FOMC announced their policy directive 45 days after their meeting. The FOMC claimed that immediate announcements of policy decisions would create an announcement effect, which could increase the volatility of financial markets. Looking at the federal funds rate from January 1988 through January 1996, the author finds that there was indeed an announcement effect. However, the effect appeared both before and after the FOMC adopted a policy of immediate disclosure and the magnitude of the effect was the same in both cases. He also found a delay in the market's reaction when disclosure was not immediate but no such delay when it was immediate. Thornton then goes on to investigate whether or not immediate disclosure increases or decreases uncertainty using mean square error (MSE) and mean absolute forecast error (MAE). Both of these variables measure uncertainty or the error that individuals make in forecasting the future. If there is no uncertainty, then the individuals' forecasts of the federal funds rate would fall within the range of random error. Using autoregressive (AR) models, Thornton shows that MSE and MAE decline after 1994, suggesting that a portion of the improvement in the futures market forecasts is due to a reduction in the volatility of the funds rate. The results suggest that the Fed's policy of immediate disclosure may have reduced the market's volatility and uncertainty, which is contrary to the Fed's argument for privacy. There are noticeable improvements in forecasts by the federal funds rate futures market relative to statistical models since their disclosure policy has been implemented. Thornton finds that the Fed's policy of immediate disclosure has been beneficial.

Romer and Romer (2000) investigate the presence of asymmetric information between the Federal Reserve and the public. Confidential information is destined to lead to asymmetric

information. However, if the information withheld is relevant for effective monetary policy, this might still be a beneficial circumstance. The authors look at Federal Reserve and commercial inflation forecasts and find that the Federal Reserve has a considerable amount of private information to which the public is not privy. The Federal Reserve staff forecasts for inflation and output outperform commercial forecasts. The reason for this discrepancy and information asymmetry is due to the extensive resources devoted to forecasting at the Federal Reserve. Romer and Romer also find that commercial forecasters modify their forecasts in response to the central bank's policy actions, which might explain why long-term interest rates often rise in response to shifts to tighter monetary policy. Peek, Rosengren, and Tootell (1999) comes to a similar conclusion. They find that forecasts in the United States could be improved with the use of confidential data on bank supervision. Romer and Romer conclude by suggesting that the Federal Reserve could reduce the asymmetric information advantage by releasing Green Book forecasts as soon as they are available. The immediate release would increase transparency by showing the motivation behind FOMC meetings, which could reduce financial market volatility.

Artis, Mizen, and Kontolemis (1998) review the consequences of publicizing voting patterns of Monetary Policy Committee (MPC) members. The authors suggest that the results in the United Kingdom have cautioned the European Central Bank from following suit. Publishing minutes too soon forces the justification of monetary policy instruments before the outcome for inflation two years later. If there is a policy lag the results of instrument implementation will not be immediately evident, which may disturb or confuse markets.

Zavodny and Ginther (2005) investigate whether or not the Beige Book affects stock prices and interest rates. They note that there have been many studies that indicate that macroeconomic data releases cause movement in financial markets and financial instruments;

however, little research has investigated whether financial markets respond to qualitative indicators. There are many reasons why the Beige Book would influence financial markets: it is a good indicator of economic activity; a significant predictor of both current and next-quarter GDP; it is a good summary of economic activity going into FOMC meetings; and it is a significant predictor of changes in the federal funds rate. Using varying maturities of treasury yields from 1983 through 2001, the authors employ a simple random walk model and OLS. The authors find that the Beige Book index is significantly associated with changes in the six-month and one-year rate at the 10% level and the two-year, five-year and 10-year rate at the 5% level as well as the 30-year rate, though not with the three-month t-bill rate or with changes in the 30-day federal funds futures rate. However, they do not find a significant relationship between stock returns and the Beige Book index. The authors also suggest that FOMC increased transparency may have reduced the validity of the Beige Book as an indicator of monetary policy. In sum, financial markets view the Beige Book as a summary indicator of economic growth, but not an indicator of monetary policy moves.

Vishwanath and Kaufmann (2001) postulate that transparency is vital to the financial sector. The motivation behind their research is the Asian financial crisis of the late 1990s. The authors claim not enough transparency is one of the factors that cause and contribute towards financial crises. The article contends that transparency is vital to the timeliness, relevance, and quality of the operation of the financial sector. The argument is that more relevant information will increase efficiency and resource allocation will improve. For financial markets, this would mean that with increased transparency capital should be directed towards its most productive uses. However, they caution that information imperfections could exist, which would introduce a new element of risk. Transparency may not be ideal when there are issues of confidentiality,

national security, and market instability. The authors review the wide range of meanings of transparency and argue that defining a good empirical measure of transparency is necessary in order to assess its true effects.

Two studies that find that the implementation of increased information disclosure in monetary policy is associated with a decline in the response of market interest rates to changes in the official interest rate are Muller and Zelmer (1999) and Haldane and Read (2000). Muller and Zelmer (1999) find an exchange rate response to the release of Monetary Policy Reports in Canada. Haldane and Read (2000) look at the United Kingdom and the United States and decompose the effect of an official interest rate change on the yield curve into macroeconomic news and information about monetary policy preferences. The former would affect the short end and the latter would affect the long end. The authors conclude that there is a significant decrease in the effect of monetary policy actions on the short end of the yield curve, which suggests that transparency has decreased asymmetric information.

Chadha and Nolan (2001) find that since the independence of the Bank of England, there has been an increase in the daily volatility of short term interest rates. Interestingly, though, they find that this does not seem to be due to monetary policy announcements. Clare and Courtenay (2001) look at United Kingdom financial markets on announcement versus non-announcements days and analyze the effect of monetary policy decisions and the release of macroeconomic data. Their results find that the independence of the Bank of England has had effects on exchange rates, equity and interest futures. Additionally, they find that there is a significantly smaller lasting effect of macroeconomic announcements on bond and equity futures.

Rogoff (1999) reviews changes that developing countries should take in order to reduce the possibility of financial crises. The author recommends that the G22 increase central bank

transparency and improve regulations. Rogoff argues that increased transparency would aid in achieving more efficient global markets. However, he adds that as long as banks have currency mismatches then the financial system would still be vulnerable to bank runs regardless of how transparent the market is.

Neuenkirch (2012) sampling nine major central banks from January 1999 through July 2007, the author examines central bank transparency's influence and central bank communication on money market expectations. The research finds that informal communications reduce the variation of expectations and therefore aid in managing financial market expectations. In addition, transparency reduces bias in money market expectations. A similar study is Siklos (2000), which examines survey data and finds that private sector inflation forecasts diminish months after inflation reports are published.

Boudoukh, Feldman, Kogan and Richardson (2012) seeks to disprove Roll (1988), which finds that there is little relation between stock prices and news. The authors argue that the issue with current finance literature is that it has done a poor job of identifying relevant news from noise. To pinpoint relevant news, the authors use textual analysis to convert qualitative information in both news stories and company announcements into a measurable quantity by analyzing the positive or negative tone of the information released. By analyzing the tone of releases rather than just a positive and negative word count comparison, they find considerable evidence of a relationship between stock price changes and information. Their results find that on identified news versus no news days that the variance ratios of returns are 120% higher versus only 20% for unidentified news versus no news. Moreover, on identified news days they find the volatility of stock prices is more than double that of other days, which supports my theory that the increase in information adds to volatility.

III. A Theoretical Framework

Whether or not increased central bank transparency has an effect on output and financial market volatility and whether it does or does not lead to optimal outcomes are all important questions for consideration. In this section I illustrate models and methodologies to investigate the effects of transparency on output and financial markets. The literature argues for various levels of transparency. Cukierman and Metzler (1986) find that ambiguity is preferred to transparency by a central authority with frequently changing political objectives and a relatively high rate of time preference. Opacity gives the central authority greater control over the timing of monetary shocks.

The transmission mechanism between central bank transparency and output and financial market volatility may not be entirely clear. The clarity, detail and speed with which central banks convey information to the public should allow businesses and investors to make more informed decisions, both concerning the immediate economic climate and the future. Improved information concerning the current and future state of the economy, and therefore interest rates, should generally permit businesses and investors to make more knowledgeable decisions. More transparency surrounding monetary policy tools will convey more tangible information about the expense of doing business, the state of the economy, the future of asset prices, amongst many other factors. Therefore, the amount of central bank transparency should have a direct relationship on both output and financial market volatility.

Hypothetically, not only could central bank transparency affect output and financial market volatility, but there should be an optimal level of transparency. Full transparency, revealing everything the central bank thinks about the state of the economy, surely cannot be the most advantageous scenario. At its worst, information can be confusing, inundating, incomplete, irrelevant or incomprehensible. Live video coverage of policy meetings that capture dissension

between central bankers would probably make the public very uncomfortable, especially if there is dissension. Revealing which banks receive aid through emergency short-term lending programs could lead to the demise of said banks either from runs or a new shortage funding from other sources. 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. Clearly these would be instances when full transparency would not be desirable and may exacerbate volatility and uncertainty; a state of transparency between zero and full openness that is optimal must exist. I explore this possibility in my analysis with squared values of central bank transparency.

It is important that research presented here does not explore normative economic arguments, nor judge whether a decline in financial market and output volatility is welfare enhancing or reducing. A decline in output volatility is likely welfare enhancing as this would mean that output growth is smoothed, more accurate to predict, and therefore the economic climate is easier for governments and businesses to forecast and make decisions. However, it is less clear whether financial market volatility is welfare enhancing as investors can profit from changing market conditions. Furthermore the central bank welfare function will differ from the public welfare function; do we assume we have a benevolent central banker? If a decline in volatility is beneficial for society, then one could assume both loss functions are equal for simplicity. These questions are worth pursuing; however, they are outside the scope of this research.

The theoretical framework I utilize most closely resembles the model presented in Arellano and Bond (1991). I include individual, country effects in the models using the Arellano and Bond method of using differencing rather than the Arellano and Bover (1995) approach of

using orthogonal deviations, which is more useful with small samples. My data is a panel that consists of a large number of observations (N) and a small time period (T). I expound linear functional relationships including dynamic variables, independent variables that are not strictly exogenous, and data that are likely to have both heteroskedasticity and autocorrelation present within countries but not across them.

Dincer and Eichengreen (2007) assess the impact on output variability, inflation variability, and inflation persistence. The authors note that transparency could theoretically either exacerbate or thwart output variability. Some previous studies suggest that an increase in transparency is associated with more stability because the public is able to adjust more quickly to policy actions. However, there have been other studies that suggest that more transparency could increase output volatility because it prevents authorities from using policy as effectively to correct for output fluctuations or because coordination externalities will make individuals misread the public signals. They use the rule of law as an instrument for central bank transparency to overcome the issue of endogeneity of monetary policy transparency and find that their results are consistent with a negative impact of transparency on output volatility. Following Dincer and Eichengreen (2007), I use the rule of law as an instrument for transparency in order to address the problem of endogeneity.

i. Output Model

I consider two primary models to examine output volatility, both of which are similar to the model presented in Dincer and Eichengreen (2007). When they modeled output volatility, Dincer and Eichengreen (2007) solely used instrumental variable pooled regressions to examine the effects of transparency. They find evidence of a negative effect on output volatility; however their findings are limited to a pooled regression only. I compare additional models and methodologies in an attempt to find a better fit for the data.

The first model examines transparency's relationship with output volatility; later this model will include lagged values of the endogenous variable, making it an Arellano-Bond dynamic panel. The second includes a squared transparency index variable in the equation to look for diminishing returns to transparency. Financial depth, measured as M2/GDP, and past inflation, measured as the previous period's inflation, are included as control variables in both models. These control variables may or may not be statistically significant and will most likely not be economically significant. In microeconometrics it is often good practice to include such variables as controls if the economic theory supporting their inclusion is strong. Including control variables, even insignificant ones, reduces the possibility of inconsistent parameter estimates due to omitted variables; however, this may be accomplished at the expense of a decrease in precision in the model estimate.

Transparency Model

$$Y_{it} = \beta_1 X_{it1} + \beta_2 X_{it2} + \beta_3 X_{it3} + \alpha_i + \upsilon_{it}$$

Where,

Y_{it} = output volatility

X_{it1} = transparency index

X_{it2} = financial depth

X_{it3} = past inflation

α_i = unobserved effect

υ_{it} = error term

Though other models will be tested for comparison and validity, the model here is presented in fixed effects form as this should be the best fit for the data. I conjecture that all of the coefficients of the parameters on the regressors will be positive with the exception of transparency index, which I conjecture will be a negative relationship.

Optimal Transparency Model

$$Y_{it} = \beta_1 X_{it1} + \beta_2 X_{it1}^2 + \beta_3 X_{it2} + \beta_4 X_{it3} + \alpha_i + \upsilon_{it}$$

Where,

Y_{it} = output volatility

X_{it1} = transparency index

X_{it2} = financial depth

X_{it3} = past inflation

α_i = unobserved effect

υ_{it} = error term

Again the model is presented in fixed effects form. I conjecture that all of the coefficients of the parameters on the regressors will be positive with the exception of transparency index, which I conjecture will be a negative relationship. The positive coefficient on the squared term should indicate the diminishing returns to transparency and therefore that there exists some optimal level of transparency.

ii. Financial Market Model

I present two primary models to examine financial market volatility. The first model examines transparency's relationship with financial market volatility; later this model will include lagged values of the endogenous variable, making it an Arellano-Bond dynamic panel. The second includes a squared transparency index variable in the equation to look for diminishing returns to transparency. Financial depth, measured as M2/GDP, inflation, and the unemployment rate are included as control variables in both models.

Transparency Model

$$Y_{it} = \beta_1 X_{it1} + \beta_2 X_{it2} + \beta_3 X_{it3} + \beta_4 X_{it4} + \alpha_i + \upsilon_{it}$$

Where,

Y_{it} = financial market volatility

X_{it1} = transparency index

X_{it2} = financial depth

X_{it3} = past inflation

X_{it4} = unemployment rate

α_i = unobserved effect

υ_{it} = error term

Though other models will be tested for comparison and validity, the model is presented in fixed effects form as this should be the best fit for the data. I conjecture that all of the coefficients of the parameters on the regressors will be positive with the exception of transparency index, which I conjecture will be a negative relationship.

Optimal Transparency Model

$$Y_{it} = \beta_1 X_{it1} + \beta_2 X_{it1}^2 + \beta_3 X_{it2} + \beta_4 X_{it3} + \beta_5 X_{it4} + \alpha_i + \upsilon_{it}$$

Where,

Y_{it} = financial market volatility

X_{it1} = transparency index

X_{it2} = financial depth

X_{it3} = past inflation

X_{it4} = unemployment rate

α_i = unobserved effect

υ_{it} = error term

Again the model is presented in fixed effects form. I conjecture that all of the coefficients of the parameters on the regressors will be positive with the exception of transparency index, which I conjecture will be a negative relationship. The positive coefficient on the squared term should indicate the diminishing returns to transparency and therefore that some optimal level of transparency exists.

iii. Methodology

My methodology is thorough and compares FE, random effects (RE), two-stage least squares (2SLS) and GMM models in order to find the most consistent and least biased estimators for each of the four models. In order to address the problem of endogeneity, I also utilize IV prior to estimation of the models.

A joint factor may exist that reduces volatility and increases transparency at the same time. It may be that more transparent democracies have more stable levels of output and financial markets. Systematic reasons having to do with a country's economic structure, political structure, or history may exist, which is why a particular country's central bank might be more or less transparent. This is important to the research because it means there could be omitted variable bias. Adding control variables to the equations presented will help mitigate the problem as will some of the methods expounded in this section.

IV methods provide consistent estimation when explanatory variables are correlated with the error term, which often happens when there are relevant explanatory variables missing from a model or if there is measurement error. If an instrument is available, the regression estimates will no longer suffer from bias and inconsistency. There are two main requirements for using IV: the instrument must be correlated with the endogenous explanatory variable(s); and the instrument cannot be correlated with the error term. Often lags of the endogenous variable(s) are utilized. I follow Dincer and Eichengreen (2007) and use rule of law as an IV as well as lags of the endogenous variables. I then adjust the standard errors for heteroskedasticity and confirm whether or not serial correlation exists.

The IV technique consistently estimates parameters when one or more explanatory variables are endogenous. This method is often followed with 2SLS, which allows one to include more IVs than there are explanatory variables. The first stage of the 2SLS technique involves estimating the reduced form by regressing each endogenous variable acting as a regressor in the equation being estimated on all the exogenous variables in the system of simultaneous equations, and then calculate the estimated values of these endogenous variables. In the second stage, one uses the estimated values as instrumental variables for the endogenous variables. An alternate way would be to use the estimated values and the included exogenous variables as regressors in an OLS regression.

By utilizing panel data rather than a cross section, I am able to use earlier time periods to examine dynamic relationships in the data. The advantage of using panel data versus cross section is that it enables me to observe repeated observations for the same countries and uncover variation in the data that would not be apparent with neither time series nor cross section. Panel data allows for the inclusion of country fixed effects.

Panel data have both space and time dimensions. If each cross-sectional country has the same number of time series observations then the panel will be balanced. The panel is unbalanced if the number of observations across countries differs. Given that panel data have both time and space dimensions, one needs to use caution when estimating and make assumptions about the intercept, slope coefficients, and the error term. There are five possibilities: the intercept and slope coefficients are constant across time and space; slope coefficients are constant, but the intercept varies across individuals; slope coefficients are constant, but the intercept varies over individuals and time; the intercept and slope coefficients vary across individuals and time; the intercept and slope coefficients vary across individuals. The

scenario which the data behave most like will determine which model will give the best fit. With panel data, one cannot assume that the observations are independently distributed across time; there may be unobserved factors in year t-1 that affect X, which also affect X in time period t.

There are a variety of methods available to examine panel data. Pooling the data and using OLS is a standard method of estimation and serial correlation is not a concern since the samples are independent across time. Pooled regression is the simplest way to handle panel data, however it is often an oversimplification. Pooled regressions ignore the space and time dimensions of the data and simply pool the data and use OLS. If all estimated parameters are constant over time and countries then this would be an acceptable method. If there is strict exogeneity, a general differenced model can be estimated, using time period dummies in addition to the intercept. However, if after eliminating the unobserved effect by differencing, the reality is that the model suffers from endogeneity then our resulting estimators will be biased and inconsistent.

If the panel data models contain unobserved effects, the FE or RE estimators are more applicable. The FE, or the within, estimator also uses a transformation to remove unobserved effects from the equation before estimation. FE models allow the intercept to vary across individuals, while the slope coefficients remain constant across countries. This is usually depicted with a subscript *i* on the intercept term to show that intercepts across individuals may be vary. However, it is important to note that in this case the intercepts as well as the slope coefficients are still time invariant. FE allows us to model for country-specific effects by including differential intercept dummies. However, one could also use dummy variables to model differences over time with the inclusion of time dummies. In this circumstance we would denote these with the subscript *t.* Moreover, you could model the equation to have slope

coefficients that are constant, but allow the intercept to vary over individuals as well as over time. This would capture individual country effects as well as time effects. One final consideration is if all coefficients on both intercepts and slopes vary across all individuals. In this circumstance it might be prudent to include interactive or differential slope dummies, which would involve including the product of each country dummy with each of the exogenous variables.

There are a few potential problems that could arise with the above method. The model could suffer from the loss of degrees of freedom by introducing too many dummy variables. In addition, with the addition of numerous other variables the issue of multicollinearity could arise. Perhaps most importantly are the potential problems that arise with our error term, u_{it}. The error term is affected by both cross-sectional observations, *i*, and to time series observations, *t*. The practitioner could assume that the error variance is the same for all cross-sectional units or we may need to assume that the error variance is heteroskedastic. We may also need to assume that there is no autocorrelation over time for each individual, or we could assume that the correlation follows an AR(1) process. It is also possible that the error term for one country is correlated with the error term for another country. Depending on which problems arise, it might be best to use the RE model instead.

An FE model attempts to remove unobserved effects from the error term with the use of dummy variables. RE leaves the unobserved effects in the error term, therefore keeping them as 'random'. Instead of treating an intercept as fixed, we assume that there is a mean value for the intercept and that we can separate the country-specific error associated with the intercept. By doing this we treat the intercept as an average value for all countries and that any differences in the intercept values of each country would be incorporated into the error term. Combining both

the traditional error term, u_{it} , with our individual-specific and unobservable error term, which is removed from the intercept, will yield a combined new error term:

$$w_{it} = \epsilon_i + u_{it}$$

This is why the RE model is also referred to as the error components model. Here we assume that the individual error components are not correlated with each other and that they are not autocorrelated across both cross-section and time series units. If the error term w_{it} is heteroskedastic, which it is likely to be, then we should use generalized least squares (GLS) for estimation.

Determining whether to use FE or RE depends on the assumptions we make about the correlation between the cross-section specific error, ϵ_i, and the regressors. If ϵ_i and the regressors are uncorrelated then RE is appropriate; if ϵ_i and the regressors are correlated then FE should probably be used. The Hausman test is vital in determining which way to model the error. Hausman null states that the RE and FE estimators do not differ substantially; if we reject the null hypothesis, it may be best to use FE.

FE is efficient when the errors are homoskedastic, serially uncorrelated, and if we make no assumptions about correlation between the unobserved effect and the explanatory variables. Any time-constant variables drop out of the analysis, as they do with differencing. RE estimators are applicable if the unobserved effect is uncorrelated with all the explanatory variables. If this is the case, the practitioner can leave the unobserved effect in the error term and serial correlation can be mitigated using GLS estimation.

Judge et al (1982) describes circumstances where one model may be preferred to the other. If the number of time series data, T, is large and the number of cross-sectional units, N, is small there is likely to be little difference between the two methods and one should use FE for

convenience. If N is large and T is small and if underlying RE assumptions hold then RE estimators are more efficient than FE estimators. When N is large and T is small, estimates from the two models can differ significantly – if it is strongly believed that the cross-sectional units in the sample are not random drawings from a larger sample then FE is appropriate; however, if it is strongly believed that the units are random drawings then RE is applicable. Finally, if the individual error, ϵ_i, and one or more regressors are correlated then using RE will yield biased results and we should opt for the unbiased FE estimators.

Baltagi and Kao (2001) gives a starting point for handling panel data. The authors state to begin by testing the null that the intercepts are equal; if the null is not rejected then the data are pooled and we use OLS. If you do reject the null, a Hausman test is applied to determine if RE estimators are unbiased. If the null is not rejected, then we use RE; if the null is rejected then we use FE. It is common to use a FE model for data similar to what I examine in this research.

Arellano and Bond (1991) provide the following model for estimation:

$$\mathrm{y}_{it} = y_{it-1}\gamma + \mathbf{X}_{it}\,\beta + \mathrm{u}_i + \epsilon_{it}$$

For $i = \{1,\ldots, N\}$ and $t = \{1,\ldots, \mathrm{T}\}$ using datasets with large N and small T. y_{it-1} is correlated with the unobserved country-level effect u_i. Removing u_i using the within transformation and removing the panel-level means will yield an inconsistent estimator. We need to first difference both sides of the equation and look for IVs and GMM estimators. First differencing our initial model gives us:

$$\Delta y_{it} = \Delta y_{it-1}\,\gamma + \Delta\mathbf{X}_{it}\,\beta + \Delta\epsilon_{it}$$

First differencing eliminates the u_i from the model. However, first differencing also leaves Δy_{it-1} correlated with $\Delta\epsilon_{it}$. In order to correct for this, Anderson and Hsiao (1981) suggest using

a 2SLS estimator with further lags of Δy_{it} (i.e. Δy_{it-2}) to instrument for Δy_{it-1}. The authors also suggest using lagged levels of Δy_{it} (i.e. y_{it-2}).

Bond (2002) considers single equation models with autoregressive-distributed lag dynamics and potentially predetermined explanatory variables where the process generating the series are not completely specified. He expounds utilizing the GMM estimator to take endogeneity into account and focuses on panels where there are a large number of individuals, firms, or countries (N) over a small time period (T). Bond illustrates a simple, lagged AR(1) model:

$$y_{it} = \propto y_{i,t-1} + (\eta_i + \upsilon_{it});\ |\alpha| < 1; i = 1, 2, \dots, \mathrm{N}; t = 2, 3, \dots, \mathrm{T}$$

Here y_{it} is an observation for some series for individual *i* in period *t*, $y_{i,t-1}$ is the corresponding observation for the same series for the same individual in the previous period, η_i is the unobserved individual-specific and time-invariant effect that allows for heterogeneity in the means of the y_{it} series across individuals, and υ_{it} is the error term. He assumes that the errors (υ_{it}) are independent across individuals and that they are serially uncorrelated. Bond treats the individual effects (η_i) as stochastic, which means that they are correlated with the lagged dependent variable ($y_{i,t-1}$) unless the distribution of the η_i is degenerate. Since the lagged dependent variable is positively correlated with the error term because of the presence of individual effects, using OLS would yield inconsistent estimators. Bond suggests using the Within Groups (WG) estimator to eliminate this inconsistency by transforming the equation and eliminating η_i. However, the WG estimator will be biased downwards. Since both the OLS and WG estimators are likely biased in opposite directions, we hope that we can utilize other methods to find a consistent estimator that lies between the OLS and WG estimate.

Roodman (2006) reviews linear GMM estimators designed for a large number of observations over a small time period. He compares the models presented in Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998) and guides the reader through the steps and tests of various programs in Stata, in particular the indispensable xtabond2. Roodman considers endogenous variables that are correlated with past and current realizations of the error, fixed effects models, the use of time dummies, and heteroskedasticity and autocorrelation within observations. He surveys different variations of GMM estimators as well as the test for autocorrelation developed by Arellano and Bond (1991), which is useful when using lags as instruments for linear GMM regressions. Another central problem that Roodman covers is the problem of overidentified models, where instruments outnumber parameters; he discusses the Sargan and Hansen tests for overidentifying restrictions. Finally, Roodman cautions to remember the assumptions required for system GMM; in particular, the validity of instruments depends on the critical assumption that any changes in the instrumenting variables are uncorrelated with the fixed effects.

With GMM the practitioner uses theory to generate a set of moment restrictions. OLS is a special case of GMM where it is assumed that there is no correlation between the error term and the exogenous variables. GMM chooses parameter estimates to fit the theoretical model as closely as possible; the estimates are chosen so that they minimize the weighted distance between the actual and theoretical values. GMM is useful to uncover parameters. It is also used to correct for both heteroskedasticity as well as serial correlation. The method works in a similar way to 2SLS in that one needs to specify the instrument list and requires that we have more cross-section observations than time series periods. The GMM method requires that the sample correlations between exogenous variables and instruments are as close to zero as possible, or that

the orthogonality conditions are satisfied. Using a dynamic panel and GMM allows the practitioner to model the partial adjustment of the dependent variable. The coefficient on the lagged dependent variable measures the speed of the adjustment.

IV. Data Selection

There are several central bank transparency indices in the literature, but I believe that the Dincer and Eichengreen (2013) is the most comprehensive, informative and influential index compiled to date. It describes the changes in transparency over a 13-year period for 120 central banks around the world. However, I will also review a few of the alternative important contributions below. I will then describe the merits of the transparency index chosen as well as explain other data included in the financial market and output research.

Fry et al. (2000) provide data on monetary policy frameworks with a thorough survey of 94 central banks. Before the Dincer and Eichengreen (2007) index of 100 central banks, this was by far the vastest study. They construct several indices, including a measure of policy explanations based on: the prompt explanation of policy decisions, discussions in central bank bulletins, minutes and voting records; the frequency and publication of forward-looking analysis, risks to forecasts and forecast errors; and the explanation of assessment and analysis, frequency of bulletins, speeches and research papers. While this is an extensive survey of central banks, the limitations here are the use of only three aspects of transparency and that the data are for 1998.

Additional, though more narrow, indices are briefly mentioned here. Bini-Smaghi and Gros (2001) consider 15 aspects of transparency for four countries: the Federal Reserve, the

Bank of England, the Bank of Japan, and the European Central Bank. De Haan, Amtembrink and Waller (2004) also look at the 15 point index but for six countries. Siklos (2002) expands this to cover 20 central banks, all from advanced industrial countries.

Eijffinger and Geraats (2002) review another index that covers the five aspects of transparency: political (formal objectives, quantitative targets, and institutional arrangements), economic (economic data, policy models, and central bank forecasts), procedural (monetary policy strategy, minutes, and voting records), policy (prompt announcement and explanation of policy decisions and policy inclinations), and operational transparency (control errors, transmission shocks, and monetary policy evaluation). In this study, Eijffinger and Geraats look at nine central banks. Eijffinger and Geraats (2006) also consider 15 aspects of central bank transparency for nine central banks.

Dincer and Eichengreen (2007) feel that the Eijffinger and Geraats (2006) 15 point index is comprehensive and a multidimensional definition of transparency. They also point out that most existing empirical research does not agree nor come to consistent conclusions. Moreover, many of the indices are based on very limited central bank samples or have data for a single point in time. Unlike panels, cross sectional data do not allow the inclusion of country fixed effects, which is troubling because the correlation between transparency and economic outcomes might actually be picking up effects of other country characteristics instead. Furthermore, theoretically there are reasons, having to do with a country's history or economic structure, why a central bank may choose a level of transparency. Dincer and Eichengreen state that for a study to be convincing that it would need to take these systematic reasons into account as well.

Geraats (2002) gives us a definition for the five main aspects of central bank transparency[4]:

1. *Political transparency:* refers to openness about policy objectives and institutional arrangements that clarify the motives of monetary policy makers. This could include explicit inflation targets, central bank independence and contracts. Opposite of transparency would be asymmetric information about policy makers' preferences.

2. *Economic transparency:* focuses on the economic information that is used for monetary policy, including economic data, policy models and central bank forecasts.

3. *Procedural transparency:* describes the way monetary policy decisions are taken. This includes the monetary policy strategy and an account of policy deliberations, typically through minutes and voting records.

4. *Policy transparency:* means a prompt announcement and explanation of policy decisions, and an indication of likely future policy actions in the form of a policy inclination.

5. *Operational transparency:* concerns the implementation of monetary policy actions, including a discussion of control errors for the operating instrument and macroeconomic transmission disturbances.

The transparency index utilized in my research is Dincer and Eichengreen's (2013) index, which surveys 120 central banks from 1998 through 2010[5]. The index ranges in numerical value from 0 to 15 with 0 being the most opaque and 15 the most transparent. It is a replication and extension of Eijffinger and Geraats (2006), which takes data from central banks' websites, their statutes, annual reports, and other published documents and compiles the information into 15 subindices[6]. Dincer and Eichengreen compile their data into the five categories from Geraats (2002) mentioned above. The data includes all of the central banks in the world with the exception of Bolivia, Ecuador, Chad, and Afghanistan. First, we will consider the characteristics of the index compiled by Dincer and Eichengreen before we discuss the other data utilized.

[4] See Figure 1 in the Appendix for a visual overview of how these five aspects are related.
[5] See Tables 1 and 2 in the Appendix.
[6] See Data Appendix in the Appendix.

When reviewing the regional weighted transparency[7], we see that all regions have moved to a higher level of transparency over the period studied with the exception of Middle Africa, which exhibits no change. The greatest sub-regional change is in South-East Asia (2.95 to 8.19), while the sub-region with the least amount of change is Eastern Asia (6.48 to 7.23). The region with the greatest increase in transparency is Oceania (8.2 to 11.23); the region with the smallest increase is Asia (5.54 to 6.73).

With the exception of Africa and Oceania, all regions' highest level of transparency is not in the most recent year.[8] Africa's highest level of transparency was in 2010 (5.8), Americas' was in 2006 (10.23), Asia's was in 2004 (7.15), Europe's was in 2004 (10.69), and Oceania's was in 2010 (11.23). This move away from the peak of transparency could suggest, albeit in the slightest way, that central banks realized that there could be too much openness. Taking an average of all main regions, we find that transparency increases from 6.572 in 1998, to a high of 8.848 in 2010.[9]

If we move away from the weighted index and review general transparency[10], we witness moves towards greater transparency by most individual countries[11]. Angola, Bahamas, Cayman Islands, Cuba, Bermuda, Iran, Lebanon, Libyan Arab Jamahiriya, Syria, and Solomon Islands have no increase in transparency over the 13-year period. However, it is important to note that only Uruguay displays a decrease in transparency over the period studied. Hungary displays the greatest increase (3.5 to 13.5), Eastern Europe is the sub-region with the highest increase (3.5 to 7.6), and Europe is the region with the greatest increase (5.3 to 8.4). Cayman Islands is the least transparent country with a value of 0 for the entire period of study. Sweden has the highest

[7] See Table 2 in the Appendix.
[8] See Figures 3 through 8 in the Appendix.
[9] See Figure 9 in the Appendix.
[10] See Table 1 in the Appendix.
[11] See Figure 2 in the Appendix.

amount of transparency, which ranges from 9.0 in 1998 to a chart-topping high of 14.5 in 2010. Considering the average transparency score by year, we see a steady increase from a value of 3.3 to 5.7 from 1998 to 2010.

Following Dincer and Eichengreen (2007), the measure of output volatility is the standard deviation of the growth rate over the most recent three-year period (the current calendar year and its two immediate predecessors). However, since the typical business cycle in more developed countries is longer, output volatility is also measured as the standard deviation of the growth rate over the most recent five-year period for comparison. The data is limited to this volatility configuration because annual data exists for the broadest sample of countries; quarterly data is available for a limited set only.

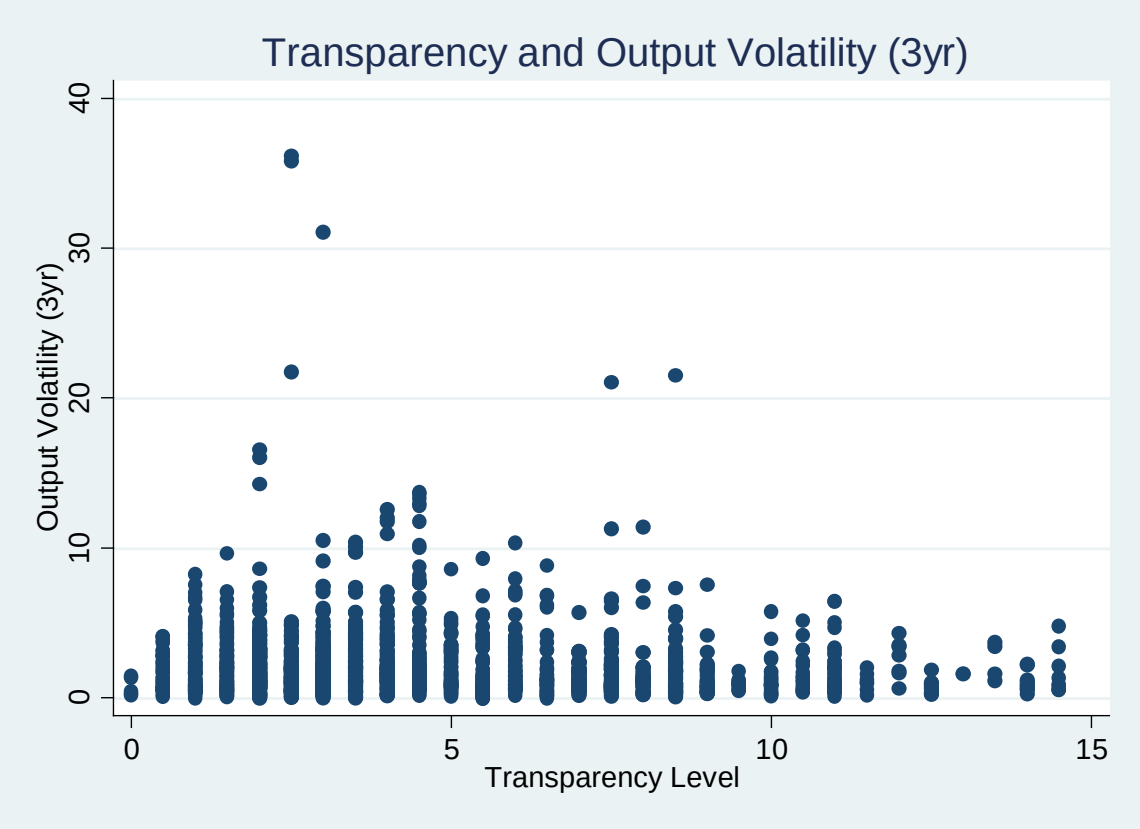
Čihák, Demirgüç-Kunt, Feyen, and Levine (2012) introduce The World Bank's Global Financial Development Database (GFDD) of financial system characteristics for 205 economies from 1960 to 2010. The database includes measures of the size of financial institutions and markets (measuring financial depth), degree to which individuals can and do use financial services (measuring access), efficiency of financial intermediaries and markets in intermediating resources and facilitating financial transactions (measuring efficiency), and stability of financial institutions and markets (measuring stability). The authors include measures for both financial institutions as well as both equity and bond financial markets. I utilize the November 2013 version of The World Bank's (GFDD). The database is a wealth of information and provides a variable to measure M2 to GDP (to measure financial depth) as well as a variable to measure the volatility of stock price indices, where available. The volatility of stock price index variable is

measured as the 360-day standard deviation of the return on the national stock market index and is an annual variable. It provides us with a good measure of domestic stock market stability.[12]

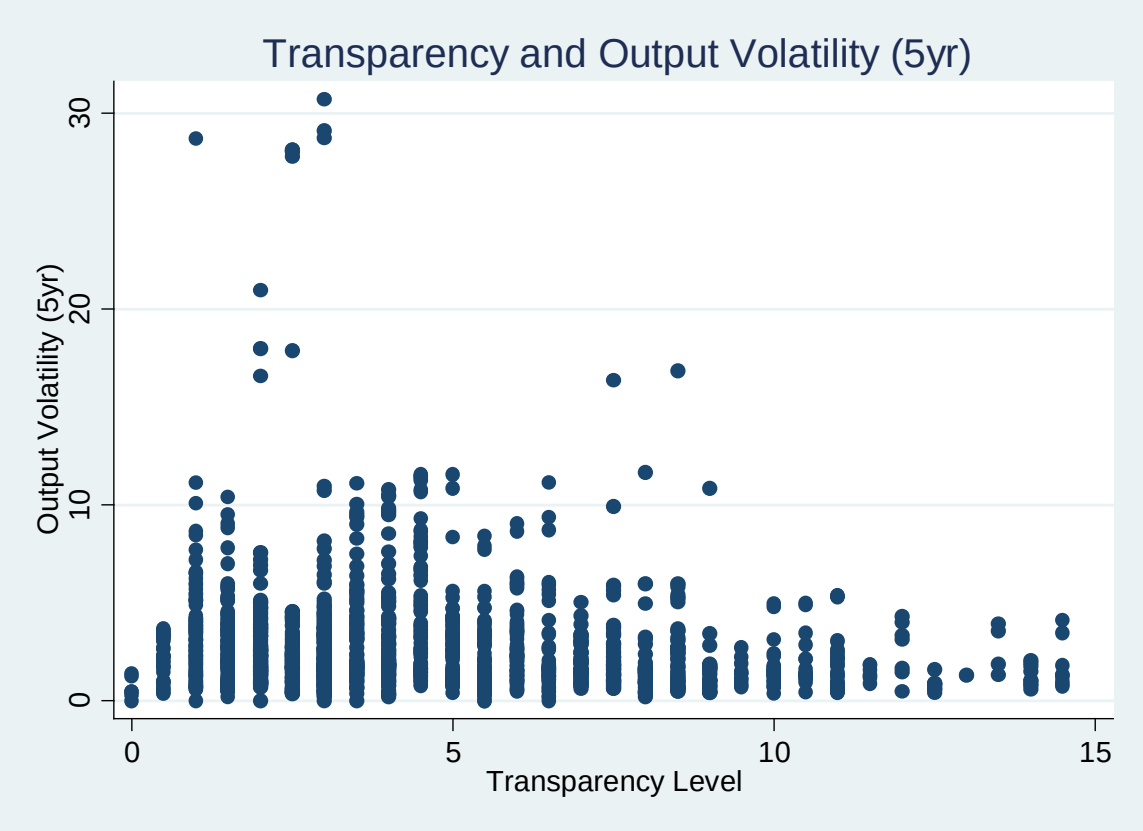
V. Empirical Testing and Findings

When examining the below diagram displaying the relationship between output volatility and the level of transparency, it is evident that as the level of central bank transparency increases the output volatility decreases overall. The highest level of output volatility is associated with the least transparent central banks.

[12] See Data Index in the Appendix for a detailed identification of variables and their measurements.

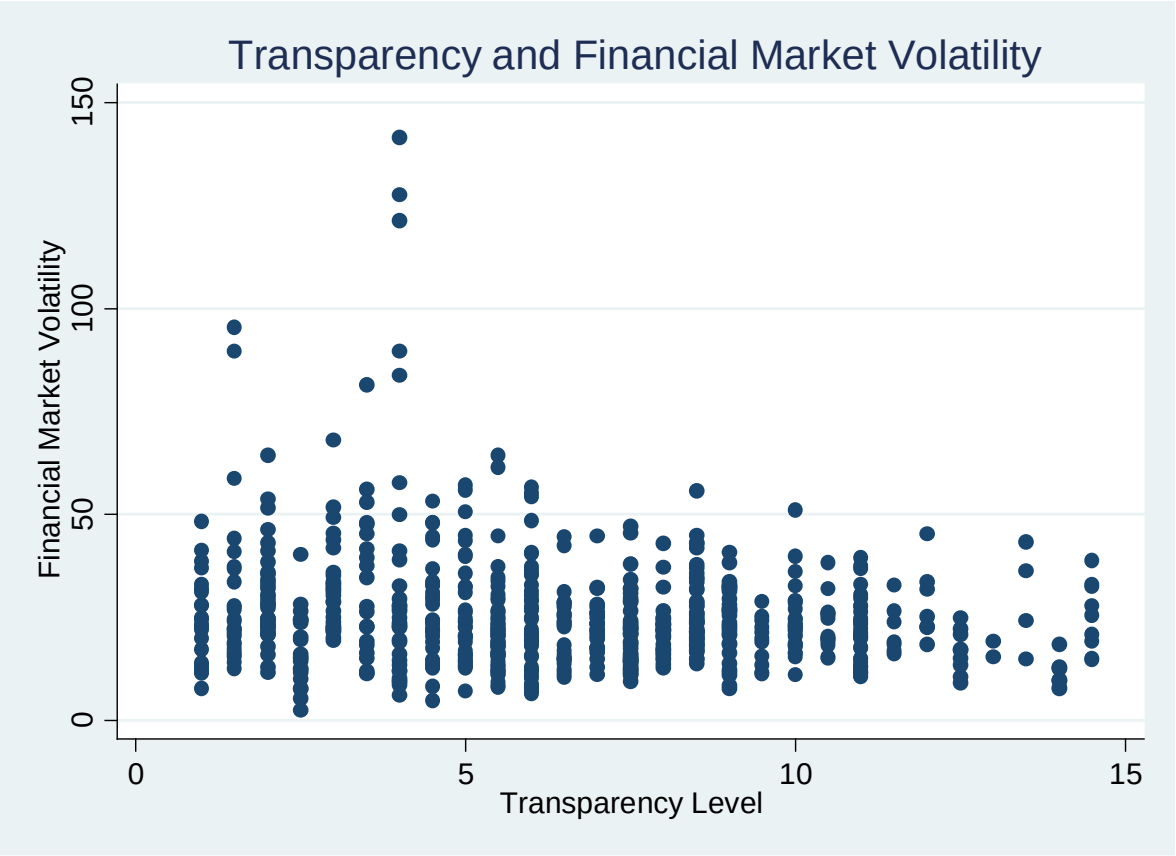


The extreme outliers here are Iraq (2.5, 36.17), (2.5, 35.87), and (2.5, 21.77); Bosnia and Herzegovina (3.0, 31.11); and Armenia (8.5, 21.54), and (7.5 21.10).



The extreme outliers here are Bosnia and Herzegovina (3.0, 30.71), (3.0, 29.12), and (3.0, 28.74); Rwanda (1.0, 28.69); and Iraq (2.5, 28.12), (2.5, 28.11), (2.5, 28.04), (2.5, 27.79), and (2.0, 20.96).

Moreover, the diagram displaying the relationship between financial market volatility and the level of transparency is even more telling. As central bank transparency increases, the level of financial market volatility drastically decreases although it tends to zero much less than output volatility does. Again we see that the highest level of financial market volatility is associated with the least transparent central banks.



Mongolia represents the most extreme outliers here with data points of (4.0, 141.58), (4.0, 127.64), and (4.0, 121.36).

The summary of data below displays the wide range of values that the study utilizes across all four models.[13] In order to standardize the transparency data, the values are normalized prior to econometric analysis. The new potential data range is from 1 to 10 with 1 being the least and 10 being the most transparent.

[13] Summaries of all variables are included in Tables 5 – 12 in the Appendix.

Variable	Obs	Mean	Std. Dev.	Min	Max
Obs	1560	780.5	450.4775	1	1560
Country	1560	60.5	34.65092	1	120
Year	1560	2004	3.742875	1998	2010
Transparency Index	1560	4.716026	3.088101	0	14.5
Normalized Transparency Index	1560	3.927188	1.916752	1	10
Output Volatility (3yr)	1520	2.213046	2.653652	0	36.17792
Output Volatility (5yr)	1525	2.802425	2.967505	0	30.71081
Financial Depth	1482	61.81856	46.58257	6.723815	325.3392
Past Inflation	1412	9.163403	33.84087	-10.06749	1058.374
Financial Market Volatility	707	24.78227	13.77089	2.393469	141.5828
Unemployment Rate	1097	9.061958	6.237902	.1	38.4
Rule of Law	1305	0.067564	0.9331937	-1.923883	1.99964

We can also see some of the preliminary relationships in the data by examining the correlations of transparency index (TI), normalized transparency index (NTI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), financial market volatility (FMV), unemployment rate (UR) and the rule of law (RL) listed below.

	YR	TI	NTI	OV3	OV5	FD	PI	FMV	UR	RL
YR	1.000									
TI	0.206	1.000								
NTI	0.206	1.000	1.000							
OV3	0.129	-0.126	-0.126	1.000						
OV5	0.070	-0.200	-0.200	0.862	1.000					
FD	0.083	0.235	0.235	-0.042	-0.091	1.000				
PI	-0.079	-0.241	-0.241	0.255	0.288	-0.329	1.000			
FMV	-0.034	-0.213	-0.213	0.298	0.308	-0.158	0.308	1.000		
UR	0.015	-0.126	-0.126	0.068	0.084	-0.271	0.088	-0.006	1.000	
RL	-0.042	0.562	0.562	-0.130	-0.185	0.514	-0.367	-0.280	-0.300	1.000

Attention is now refocused from the preliminary analysis to pooled OLS, FE, RE, 2SLS and GMM models for both output and financial market volatility.

i. Output Model

Evaluating the preliminary pooled regression of output volatility provides a perfunctory view of the relationship between our variables. Since theory strongly suggests the models will suffer from endogeneity, this is solely a starting point and provides a glimpse at the fundamental relationships in the data.

The four pooled OLS fitted equations below utilize the normalized transparency index, which is used in all analysis going forward unless otherwise specified.

Model Comparison of Output Volatility Pooled OLS

	(1) OV3	(2) OV5	(3) OV3	(4) OV5
NTI	-0.0817*	-0.1666***	0.1809	0.0440
	(0.0365)	(0.0383)	(0.1432)	(0.1503)
FD	-0.0006	-0.0029	-0.0005	-0.0028
	(0.0016)	(0.0016)	(0.0016)	(0.0016)
PI	0.0054**	0.0053**	0.0055**	0.0053**
	(0.0019)	(0.0020)	(0.0019)	(0.0020)
NTI2			-0.0274	-0.0219
			(0.0144)	(0.0151)
_cons	2.4081***	3.4409***	1.8907***	3.0261***
	(0.1609)	(0.1689)	(0.3166)	(0.3323)
N	1378	1380	1378	1380
r2	0.0118	0.0303	0.0144	0.0317
F	5.4765	14.3094	5.0146	11.2655
pvalue	0.0010	0.0000	0.0005	0.0000
ll	-3174.6516	-3246.2144	-3172.8485	-3245.1617

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: normalized transparency index (NTI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), normalized transparency index squared (NTI2)

The R-squared values are relatively low, which is not uncommon in microeconometric studies. While much of the variation in the models remains unexplained, the regressors are jointly statistically significant for each model based on the p-values of the overall F statistic. There are

also numerous variables in the equations that are either the incorrect sign or statistically insignificant, which is to be expected as the model is misspecified. Since pooled regressions ignore country-specific effects of panel data, we explore more complex models in order to capture the true data relationship.

The Breusch-Pagan Lagrange multiplier test strongly implies the presence of heteroskedasticity for the above pooled OLS models. Heteroskedastically robust standard errors are therefore considered below, which improve the statistical significance of some of the parameter estimates on these preliminary models.

Model Comparison of Output Volatility Pooled OLS with Heteroskedastically Robust Errors

	(1) OV3	(2) OV5	(3) OV3	(4) OV5
NTI	-0.0817**	-0.1666***	0.1809	0.0440
	(0.0309)	(0.0306)	(0.1119)	(0.1285)
FD	-0.0006	-0.0029*	-0.0005	-0.0028*
	(0.0013)	(0.0013)	(0.0013)	(0.0013)
PI	0.0054**	0.0053*	0.0055**	0.0053*
	(0.0018)	(0.0026)	(0.0019)	(0.0026)
NTI2			-0.0274**	-0.0219
			(0.0103)	(0.0116)
_cons	2.4081***	3.4409***	1.8907***	3.0261***
	(0.1455)	(0.1759)	(0.2565)	(0.3284)
N	1378	1380	1378	1380
r2	0.0118	0.0303	0.0144	0.0317
F	5.8817	15.6238	7.8274	19.6742
pvalue	0.0005	0.0000	0.0000	0.0000
ll	-3174.6516	-3246.2144	-3172.8485	-3245.1617

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: normalized transparency index (NTI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), normalized transparency index squared (NTI2)

Attention is now turned to comparing FE and RE models, initially ignoring the issue of endogeneity in order to document the benefits of utilizing IV in the models. Determining

whether to use FE or RE depends on the assumptions made about the correlation between the cross-section specific error and the regressors. If v_{it} and the regressors are uncorrelated then RE is appropriate; however, if v_{it} and the regressors are correlated then FE models capture the relationship better. Econometric theory suggests that if the cross-sectional units in the sample are not random drawings from a larger sample then FE is applicable, as is the case with the data utilized in this study. RE would be useful if the unobserved effect is uncorrelated with all of the explanatory variables; however, if the error and one or more regressors are correlated then using RE will yield biased results. FE allows for arbitrary correlation between the unobserved effect, α_i, and our explanatory variables in any time period. The Hausman test is vital in determining which way to model the error. The Hausman test null states that the RE and FE estimators do not differ substantially; if we reject the null hypothesis, it may be best to use FE.

The below FE models do not account for the endogeneity problem; this estimation technique is explored later.

Model Comparison of Output Volatility Fixed Effects with Heteroskedastic Robust Errors

	(1) OV3	(2) OV5	(3) OV3	(4) OV5
NTI	0.0866	-0.0330	-0.1606	-0.4516
	(0.1425)	(0.1467)	(0.2498)	(0.2770)
FD	0.0072	0.0014	0.0068	0.0007
	(0.0084)	(0.0075)	(0.0083)	(0.0075)
PI	0.0048*	0.0034	0.0047*	0.0034
	(0.0020)	(0.0021)	(0.0020)	(0.0021)
NTI2			0.0260	0.0441
			(0.0193)	(0.0223)
_cons	1.2486*	2.6501***	1.7526*	3.5036***
	(0.5587)	(0.5026)	(0.6919)	(0.6760)
N	1378	1380	1378	1380
Within r2	0.0086	0.0035	0.0094	0.0065
Between r2	0.0257	0.0232	0.0346	0.0002
Overall r2	0.0011	0.0092	0.0021	0.0008
F	2.3438	0.8896	2.3992	1.6487
pvalue	0.0767	0.4489	0.0542	0.1669
ll	-2927.2205	-2807.1652	-2926.6258	-2805.1195
sigma_u	1.6686	2.1330	1.6786	2.1492
sigma_e	2.1172	1.9347	2.1171	1.9326
rho	0.3831	0.5486	0.3860	0.5529

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: normalized transparency index (NTI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), normalized transparency index squared (NTI2)

Sigma_u is the standard deviation of the individual effect, α_i, and sigma_e gives the standard deviation of the error, v_{it}. Rho is the intraclass correlation of the error. It is quite noticeable that the F-statistic is no longer significant and most of the variables are no longer statistically significant.

Model Comparison of Output Volatility Random Effects with Heteroskedastic Robust Errors

	(1) OV3	(2) OV5	(3) OV3	(4) OV5
NTI	-0.0020	-0.0829	-0.0487	-0.3742
	(0.0824)	(0.1039)	(0.1936)	(0.2403)
FD	0.0005	-0.0015	0.0005	-0.0018
	(0.0025)	(0.0037)	(0.0025)	(0.0037)
PI	0.0048*	0.0036	0.0048*	0.0035
	(0.0020)	(0.0022)	(0.0020)	(0.0022)
NTI2			0.0049	0.0306
			(0.0172)	(0.0211)
_cons	2.0768***	3.1523***	2.1710***	3.7365***
	(0.3306)	(0.4626)	(0.4694)	(0.6380)
N	1378	1380	1378	1380
Within r2	0.0048	0.0028	0.0051	0.0052
Between r2	0.0143	0.0738	0.0075	0.0387
Overall r2	0.0063	0.0299	0.0052	0.0173
Wald chi2	6.06	4.01	6.27	6.01
pvalue	0.1086	0.2603	0.1802	0.1981
sigma_u	1.3757	1.9893	1.3711	1.9933
sigma_e	2.1172	1.9347	2.1171	1.9326
rho	0.2969	0.5139	0.2955	0.5155

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: normalized transparency index (NTI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), normalized transparency index squared (NTI2)

The same models but with RE are considered above. Most of the coefficients are either insignificant and/or the wrong sign. The overall models are also not significant.

Consistent with theory, the Hausman test on all four model comparisons supports the rejection of the null hypothesis that RE provides consistent estimates. Therefore the analysis presented proceeds focusing only on FE models. In order to have consistency for least-squares estimators, one needs to assume that the error term of the model is not correlated with any of the regressors. If the assumption $E(\upsilon|\mathbf{x}) = 0$ does not hold then there is an endogeneity issue and the estimator is inconsistent. Introducing an IV will address this estimation problem.

Before addressing the issue of endogeneity, it is important to confirm that there is indeed a problem. Below are the IV estimations for exactly identified models for both measures of output volatility along with their corresponding standard errors. Compared to the earlier pooled OLS regressions on output volatility, the results below are much more statistically significant. Importantly our IV, rule of law, is highly statistically significant. Normalized transparency has a large effect economically and is statistically significant.

IV Regression for Output Volatility with Heteroskedastic Robust Errors

	(1) OV3	(2) OV5
NTI	-0.3200*	-0.5115***
	(0.1248)	(0.1295)
FD	0.0027	0.0021
	(0.0019)	(0.0018)
PI	0.0055**	0.0047*
	(0.0019)	(0.0023)
_cons	3.2126***	4.5949***
	(0.4815)	(0.5156)
N	1167	1169
r2	0.3249	0.3241
F	198.53	198.21
pvalue	0.0000	0.0000
Wald Chi2	14.04	25.48
pvalue	0.0028	0.0000

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: normalized transparency index (NTI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI)

The Durbin-Wu-Hausman test is often employed to test whether or not a regressor is endogenous. If the regressor is indeed endogenous, the parameter estimates will still be consistent, but they will be much less efficient. Therefore, if there is negligible difference between the OLS and IV estimators then the variable is treated as exogenous and an IV is not necessary.

Comparing our initial pooled OLS regressions with the above estimates, it is clear that the coefficient on NTI becomes much more economically significant (-0.081734 compared to -0.319971 for OV3 and -0.166608 compared to -0.511456 for OV5); this supports the theory that normalized transparency index is endogenous. The loss of precision from utilizing IV is visibly reinforced by the increase in the standard errors (0.0309446 to 0.124786 for OV3 and 0.0306348 to 0.1295012 for OV5). The Durbin-Wu-Hausman test leads to the rejection of the null hypothesis that NTI is exogenous for both output volatility models; therefore it is safe to conclude that the normalized transparency index is endogenous and the use of IV is appropriate.

Thus far, analysis has shown that the models suffer from endogeneity and FE estimation is preferred to RE. However, both of these cases have been considered independently. It is imperative to consider both FE and IV simultaneously in order to begin properly estimating the model and appreciate the data characteristics. Below, basic FE panel estimation with IV is considered for all four output models.

Instrumental Variable Fixed Effects Panel Model Comparison of Output Volatility

	(1) OV3	(2) OV5	(3) OV3	(4) OV5
NTI	-1.1518	-10.4887	0.2091	-32.9222
	(9.7230)	(31.6435)	(39.5953)	(121.3684)
FD	0.0411	0.2516	0.0603	-0.0677
	(0.2302)	(0.7509)	(0.1546)	(0.4719)
PI	0.0047	-0.0018	0.0047	-0.0013
	(0.0059)	(0.0190)	(0.0060)	(0.0183)
NTI2			-0.2100	3.4752
			(4.4510)	(13.6383)
_cons	4.2678	30.5020	1.8342	70.5636
	(26.0450)	(84.6956)	(80.3889)	(246.4673)
N	1167	1169	1167	1169
Wald chi2	909.15	139.07	739.47	124.59
pvalue	0.0000	0.0000	0.0000	0.0000
sigma_u	2.7644	18.6312	3.8589	14.2932
sigma_e	2.3942	7.6601	2.6583	8.1023
rho	0.5714	0.8554	0.6782	0.7568

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: normalized transparency index (NTI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), normalized transparency index squared (NTI2)

The rule of law is used as an instrument for the normalized transparency index, while past inflation squared is used as an instrument for the normalized transparency index squared. Interpreting the fourth regression, the estimates imply that five-year output volatility decreases by 32.9222 for each additional unit increase of transparency, though the coefficient is statistically insignificant and a little large in value to be plausible. Estimates also suggest that output volatility will decrease to a minimum at a value of 4.7367 level of transparency [= 32.9222 / (2 x 3.4752)], after which output volatility may begin to increase.

To more easily compare these optimal transparency results, the results are rerun with the original, non-normalized Dincer and Eichengreen index, which allows review of which countries and regions have transparency levels beyond the potential optimum point.

Instrumental Variable Fixed Effects Panel Model Comparison of Output Volatility with Original Transparency Index

	(1) OV3	(2) OV5	(3) OV3	(4) OV5
TI	-0.7149	-6.5102	-0.1309	-16.1204
	(6.0350)	(19.6408)	(19.0542)	(58.4116)
FD	0.0411	0.2516	0.0603	-0.0677
	(0.2302)	(0.7509)	(0.1546)	(0.4719)
PI	0.0047	-0.0018	0.0047	-0.0013
	(0.0059)	(0.0190)	(0.0060)	(0.0183)
TI2			-0.0809	1.3388
			(1.7148)	(5.2543)
_cons	3.1160	20.0133	1.8333	41.1167
	(16.3236)	(53.0572)	(45.2443)	(138.7365)
N	1167	1169	1167	1169
Wald chi2	909.15	139.07	739.47	124.59
pvalue	0.0000	0.0000	0.0000	0.0000
sigma_u	2.7644	18.6312	3.8589	14.2932
sigma_e	2.3942	7.6601	2.6583	8.1023
rho	0.5714	0.8554	0.6782	0.7568

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: transparency index (TI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), transparency index squared (TI2)

Interpreting the fourth regression again, the estimates imply that five-year output volatility decreases by 16.1204 for each additional unit increase of transparency, though the coefficient is statistically insignificant. Estimates also suggest that output volatility will decrease to a minimum at a value of 6.0205 level of transparency [= 16.1204 / (2 x 1.3388)], after which output volatility may begin to increase. This is a marked increase to minimal optimal level of transparency previously found when examining the same model but with the normalized transparency index, suggesting fewer countries' and regions' central banks may operate at levels of transparency that exacerbate output volatility.

While most of the parameter estimates of the normalized transparency index regressions

have the correct sign, it is evident that there are no longer statistically significant estimates. The standard errors are much larger than with previous estimates; the IV regression leads to a substantial loss in estimator efficiency here. Moreover, the coefficients, signs of coefficients, and conclusions drawn from the estimates are not consistent with theory. However, the small p-value from the test concludes that at least one of the regression coefficients is not equal to zero in each model. There may be a problem with the IV chosen; it is therefore imperative to consider the Arellano-Bond estimator, which uses lags of the dependent variable to identify a more proper model.

The general, autoregressive, dynamic model for Arellano-Bond estimation is:

$$y_{it} = \gamma_1 y_{i,t-1} + \ldots + \gamma_p y_{i,t-p} + \mathbf{x}'_{it}\beta + \alpha_i + \upsilon_{it},\ t = p + 1, \ldots, T$$

The above equation allows for many reasons of potential correlation in *y* over time, one of which being unobserved heterogeneity which is observed through the time-invariant individual country effect α_i. The Arellano-Bond estimator focuses on FE models with short panels where there is at least one lag of the dependent variable included as a regressor. In this case, the fixed effect, α_i, needs to be eliminated by first-differencing instead of mean-differencing. The FE estimator will be inconsistent once lagged regressors (IV) are added to the model. Therefore the first-difference (FD) model is estimated; if the FD model utilizes appropriate lags of y_{it} as instruments then the IV estimators will lead to consistent parameter estimates. Anderson and Hsiao (1981) suggest performing IV estimation with $y_{i,t-2}$ as an instrument for $\Delta y_{i,t-1}$ since it is uncorrelated with $\Delta \upsilon_{it}$. However, with lagged dependent variables, one needs to check the model for serially correlated error. If serial correlation is present then the parameter estimates are inconsistent. Heteroskedastic-consistent estimates of the variance-covariance matrix of the estimator are ensured by using heteroskedastic robust standard errors in the estimation.

Below are the 2SLS estimates for output volatility. Each model strongly rejects the presence of serial correlation, therefore the estimations are consistent. Lags of output volatility, normalized transparency, and, where applicable, normalized transparency squared are used to identify the model and control for endogeneity.

2SLS Arellano-Bond Model Comparison of Output Volatility with Heteroskedastic Robust Errors

	(1) OV3	(2) OV5	(3) OV3	(4) OV5
NTI	-0.2238	-0.1787	-1.1567*	-0.7416*
	(0.2660)	(0.2407)	(0.6219)	(0.3880)
FD	0.0290***	0.0176*	0.0118	0.0038
	(0.0107)	(0.0093)	(0.0100)	(0.0073)
PI	0.0075	0.0131	0.0076	0.0132
	(0.0137)	(0.0138)	(0.0134)	(0.0138)
NTI2			0.1296**	0.0885**
			(0.0639)	(0.0410)
_cons	0.1437	0.2283	2.3778	1.5683
	(0.8123)	(0.5378)	(1.7084)	(1.0043)
N	1052	1054	1052	1054
Wald chi2	340.98	486.66	338.54	503.83
pvalue	0.0000	0.0000	0.0000	0.0000

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$
Note: normalized transparency index (NTI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), normalized transparency index squared (NTI2)

The coefficients on the estimated parameters are all the correct sign, while not all of the pertinent regressors are significant. Moreover, all of the corresponding Wald test statistics indicate very strong significance for these one-step models.

The two-step, GMM model is now considered and estimates are presented below. Each model strongly rejects the presence of serial correlation, therefore the estimations are consistent. As with the 2SLS estimations, lags of output volatility, normalized transparency, and, where applicable, normalized transparency squared are used to identify the model and control for

endogeneity. Coefficients on the estimated parameters are all the anticipated signs and output volatility models including a squared variable of the normalized transparency index have statistically significant key regressors. All of the Wald test statistics indicate very strong significance for the models.

GMM Arellano-Bond Model Comparison of Output Volatility with Heteroskedastic Robust Errors

	(1) OV3	(2) OV5	(3) OV3	(4) OV5
NTI	-0.1622	-0.2262	-1.1353**	-0.7101**
	(0.2476)	(0.2565)	(0.4831)	(0.3412)
FD	0.0271**	0.0182*	0.0090	0.0030
	(0.0120)	(0.0108)	(0.0096)	(0.0073)
PI	0.0085	0.0186	0.0063	0.0167
	(0.0139)	(0.0176)	(0.0129)	(0.0154)
NTI2			0.1312**	0.0851**
			(0.0511)	(0.0373)
_cons	-0.1067	0.2312	2.3688*	1.5071*
	(0.7414)	(0.5280)	(1.2849)	(0.8682)
N	1052	1054	1052	1054
Wald chi2	222.98	341.18	257.36	369.70
pvalue	0.0000	0.0000	0.0000	0.0000

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$
Note: normalized transparency index (NTI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), normalized transparency index squared (NTI2)

As anticipated, GMM estimation produces the best estimates of the output volatility model. GMM allows for panel data characteristics via FD, IV, corrects for serial correlation and heterogeneity. Both measures of output volatility (three-year and five-year) regressed on normalized transparency, normalized transparency squared, financial depth, and past inflation yield estimated models that are both significant and produce coefficients of anticipated signs.

Since one of the main questions this research seeks to answer is whether or not there is an optimal level of transparency, it is apropos that both models that account for diminishing benefits

of transparency are the most significant and applicable. Models of output volatility without the squared normalized transparency term do not appear to be correctly specified under any of the estimation methods considered in this section; this is further evidence that output volatility needs to be modeled with a squared transparency variable.

Considering each variable on its own, as predicted from previous studies and theory, the control variables, past inflation and financial depth, are neither economically nor statistically significant. However, as with control variables in many microeconometric studies, their inclusion in the model allows for more appropriate specification. The coefficients on the normalized transparency index variables are negative for both models, indicating that as the level of transparency increases output volatility will decrease. As predicted, the coefficients on the squared normalized transparency index variables are positive for both models, suggesting that there could be diminishing returns to transparency. Constant terms for both models are also the anticipated sign, but only statistically significant at the 10% level.

Considering the estimated coefficients on the model of output volatility (three-year) allows the first glance at the relationship between transparency and output volatility. The coefficient on normalized transparency indicates that as normalized transparency increases by one unit that output volatility decreases by 1.135 units. Taking the squared transparency term into account allows one to estimate the optimal level of transparency. Evaluating the minimum point given the coefficients yields a value of 4.33 [= 1.135348 / (2 x 0.1312451)]. As there are numerous data points to the right of the potential minimum of 4.33, there is strong evidence that there may exist an optimal level of transparency. Theory here suggests that once past a level of transparency of 4.33 that there may exist diminishing returns to transparency. On the other hand, given that there are numerous countries that have sustained transparency levels above this

threshold, one should be reserved when considering the potential impact of this finding. Additional analysis and possible explanations are provided in the Additional Results portion of this section, where the same models are considered with only developed countries rather than all 120 included in the index.

Considering the estimated values on the model of output volatility (five-year) allows further inspection of the effect of transparency levels on output volatility. The coefficient on normalized transparency implies that as normalized transparency increases by one unit that output volatility decreases by 0.71 units. Evaluating the minimum point yields a values of 4.17 [= 0.7101057 / (2 x 0.0851442)]. As with the minimum point for the other measure of output volatility, there are numerous data points to the right of this potential minimum of 4.17. This provides a strong indication that there may be an optimal level of transparency.

For ease in comparing these optimal transparency results, the results are rerun with the original, non-normalized Dincer and Eichengreen index, which allows review of which countries and regions have transparency levels beyond the potential optimum point.

GMM Arellano-Bond Model Comparison of Output Volatility with Heteroskedastic Robust Errors and Original Transparency Index

	(1) OV3	(2) OV5	(3) OV3	(4) OV5
TI	-0.1130	-0.1740	-0.7475**	-0.5608**
	(0.1687)	(0.1791)	(0.3248)	(0.2844)
FD	0.0271**	0.0186*	0.0095	0.0021
	(0.0116)	(0.0108)	(0.0094)	(0.0065)
PI	0.0082	0.0194	0.0062	0.0163
	(0.0136)	(0.0175)	(0.0126)	(0.0159)
TI2			0.0650**	0.0486**
			(0.0265)	(0.0217)
_cons	-0.2134	0.1470	1.8506*	1.5378*
	(0.6421)	(0.4363)	(1.1128)	(0.8719)
N	1052	1054	1052	1054
Wald chi2	201.68	302.27	230.07	362.22
pvalue	0.0000	0.0000	0.0000	0.0000

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$
Note: transparency index (TI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), transparency index squared (TI2)

Examining output volatility (three-year), the estimates imply that volatility decreases by 0.7475 for each additional unit increase of transparency. Estimates also suggest that output volatility will decrease to a minimum at a value of 5.75 level of transparency [= 0.7475 / (2 x 0.0650)], after which output volatility may begin to increase. Considering output volatility (five-year) yields equally interesting results with volatility decreasing by 0.5608 for each additional unit of transparency to a potential minimum at a value of 5.77 level of transparency [= 0.5608 / (2 x 0.0486)].

The question begs, if central banks minimize output volatility at such a low level (4.33, 4.17, 5.75, or 5.77 depending on the model and variable used) then why do many central banks have transparency levels of well over this minimum, some even as high as non-normalized transparency levels of 14 or 14.5? Clearly there are a myriad of other important variables that

central banks examine, inflation and unemployment to name a few. While smoothing output growth is generally accepted to be welfare enhancing, it may not be the most important target for central banks. Moreover, more vital targets may be pursued to the detriment of output volatility targeting. Therefore while there may exist some optimum level of central bank transparency to minimize output, this point may be ignored and surpassed to attain other bank targets. Additional empirical evidence to support high levels of transparency is provided in the Additional Results portion of this section.

In conclusion, it is apparent that output volatility for both three-year and five-year measures is correctly modeled under the GMM framework. GMM allows for the use of FD estimation with IV while controlling for heteroskedasticity and serial correlation. The models are correctly specified when squared terms of normalized transparency are included in the estimation, which is consistent with theory. This study contributes to central bank transparency research literature by indicating that increased levels of transparency will decrease the output volatility both measured over three and five-year periods. Moreover, following previous studies such as Dincer and Eichengreen (2007) and Mishkin (2004), evidence supporting an optimal level of transparency is also presented.

ii. Financial Market Model

In examining the preliminary linear regression of financial market volatility, the country-specific effects are, again, ignored initially and the observations are pooled. The pooled OLS estimates provide a brief look at the potential relationship between our variables.

Model Comparison of Financial Market Volatility Pooled OLS

	(1) FMV	(2) FMV
NTI	-1.0529***	-2.6051*
	(0.2831)	(1.2411)
FD	-0.0134	-0.0132
	(0.0117)	(0.0117)
PI	0.4547***	0.4531***
	(0.0608)	(0.0608)
UR	-0.1609	-0.1501
	(0.1069)	(0.1071)
NTI2		0.1418
		(0.1104)
_cons	30.2028***	33.7952***
	(2.2080)	(3.5627)
N	598	598
r2	0.1498	0.1521
F	26.1118	21.2423
pvalue	0.0000	0.0000
ll	-2378.3890	-2377.5569

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: normalized transparency index (NTI), financial market volatility (FMV), financial depth (FD), past inflation (PI), unemployment rate (UR), normalized transparency index squared (NTI2)

R-squared values are still relatively low, though higher than for the output volatility models. The regressors for each model are jointly statistically significant based on the p-values of the overall F statistic. As with the pooled output volatility OLS regressions, these results are very preliminary. There are numerous variables in the equations that are either the incorrect sign or statistically insignificant, which is to be expected as the model is misspecified. These pooled

regressions ignore country-specific effects of panel data; we explore more complex models in order to try and capture the true data relationship.

The Breusch-Pagan Lagrange multiplier test strongly implies the presence of heteroskedasticity for both of the above pooled OLS models. Therefore heteroskedastically robust standard errors are presented, which improve the statistical significance of some of the parameter estimates.

Model Comparison of Financial Market Volatility Pooled OLS with Heteroskedastically Robust Errors

	(1) FMV	(2) FMV
NTI	-1.0529***	-2.6051*
	(0.2732)	(1.1410)
FD	-0.0134	-0.0132
	(0.0122)	(0.0123)
PI	0.4547***	0.4531***
	(0.0559)	(0.0570)
UR	-0.1609	-0.1501
	(0.1038)	(0.1058)
NTI2		0.1418
		(0.0981)
_cons	30.2028***	33.7952***
	(3.0452)	(3.9794)
N	598	598
r2	0.1498	0.1521
F	30.4298	23.5467
pvalue	0.0000	0.0000
ll	-2378.3890	-2377.5569

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: normalized transparency index (NTI), financial market volatility (FMV), financial depth (FD), past inflation (PI), unemployment rate (UR), normalized transparency index squared (NTI2)

While more of the parameter estimates are now statistically significant, pooled OLS ignores many important features of the data. In order to begin considering the data as a panel, the

models are estimated under FE and RE.

Model Comparison of Financial Market Volatility Fixed Effects and Random Effects with Heteroskedastic Robust Errors

	(1) FMV (FE)	(2) FMV (FE)	(3) FMV (RE)	(4) FMV (RE)
NTI	-1.6637*	-6.1984*	-1.4032*	-5.3180*
	(0.6481)	(2.6617)	(0.5489)	(2.2546)
FD	0.0232	0.0146	0.0035	-0.0004
	(0.0376)	(0.0376)	(0.0256)	(0.0266)
PI	0.2859**	0.2673*	0.3107***	0.2961**
	(0.0983)	(0.1066)	(0.0910)	(0.0974)
UR	0.4578	0.4256	0.1985	0.2096
	(0.4534)	(0.4411)	(0.2873)	(0.2826)
NTI2		0.4248		0.3655*
		(0.2124)		(0.1806)
_cons	26.4897***	37.9773**	28.0556***	37.4024***
	(7.5728)	(11.1381)	(7.0973)	(9.7286)
N	598	598	598	598
Within r2	0.0867	0.0990	0.0830	0.0960
Between r2	0.0464	0.0444	0.0905	0.0770
Overall r2	0.0833	0.0889	0.1217	0.1198
F	11.57	7.28		
pvalue	0.0000	0.0000		
Wald chi2			64.72	50.08
pvalue			0.0000	0.0000
ll	-2180.3288	-2176.2979		
sigma_u	10.9860	10.9976	9.7004	9.8118
sigma_e	9.8221	9.7652	9.8221	9.7652
rho	0.5558	0.5591	0.4938	0.5024

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: normalized transparency index (NTI), financial market volatility (FMV), financial depth (FD), past inflation (PI), unemployment rate (UR), normalized transparency index squared (NTI2)

The above estimations are a vast improvement compared to the earlier output volatility estimates. Most of the coefficients are in line with theory, and some of the parameters are also statistically significant. However, full analysis should wait until after the endogeneity problem is addressed.

As theory suggested, the Hausman test on both model comparisons supports the rejection

of the null hypothesis that RE provides consistent estimates. Therefore the analysis presented proceeds focusing only on FE models.

As with output volatility, before adjusting the model for endogeneity it is important to confirm that there is indeed a problem. Below is the IV estimation for an exactly identified model of financial market volatility. The first-stage regression of the endogenous variable (normalized transparency index) is run on all of the exogenous variables, which in this case means financial depth, past inflation, unemployment rate, and rule of law. Our IV, rule of law, is highly statistically significant. The second part of the output, shown below, reports the results of interest from the IV regression of financial market volatility on the normalized transparency index as well as the other exogenous regressors. Normalized transparency has a large effect economically and is highly statistically significant. Compared to the earlier pooled OLS regression on financial market volatility, this is a much more statistically significant model.

IV Regression for Financial Market Volatility with Heteroskedastic Robust Errors

	(1) FMV
NTI	-2.6252***
	(0.5402)
FD	-0.0058
	(0.0132)
PI	0.3616***
	(0.0665)
UR	-0.2097
	(0.1165)
_cons	38.6861***
	(4.2561)
N	517
r2	0.3231
F	68.67
pvalue	0.0000
Wald chi2	93.72
pvalue	0.0000

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: normalized transparency index (NTI), financial market volatility (FMV), financial depth (FD), past inflation (PI), unemployment rate (UR)

Comparing our initial pooled OLS regressions with the above estimates, it is clear that the coefficient on NTI becomes much more economically significant after the inclusion of an IV (-1.052943 compared to -2.625236). The loss of precision from utilizing IV is also visible by the increase in the standard errors (0.27318856 to 0.5401943). The Durbin-Wu-Hausman test leads to the strong rejection of the null hypothesis that NTI is exogenous; it is safe to conclude that the normalized transparency index is endogenous and the use of IV is appropriate.

Thus far, the analysis has shown that the model does suffer from endogeneity and FE estimation is preferred to RE. Estimations are now extended into an initial model to consider both FE and IV simultaneously.

Instrumental Variable Fixed Effects Panel Model Comparison of Financial Market Volatility

	(1) FMV	(2) FMV
NTI	-8.4129	-16.5013
	(6.4750)	(23.4364)
FD	0.1671	0.1261
	(0.1249)	(0.0796)
PI	0.0111	0.0383
	(0.2348)	(0.1831)
UR	0.0288	0.0498
	(0.4377)	(0.3886)
NTI2		0.8778
		(1.9827)
_cons	56.2753	73.9230
	(29.9291)	(64.6061)
N	517	517
Wald chi2	2413.03	2662.43
pvalue	0.0000	0.0000
sigma_u	17.6717	15.9230
sigma_e	11.3912	10.8467
rho	0.7065	0.6830

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: normalized transparency index (NTI), financial market volatility (FMV), financial depth (FD), past inflation (PI), unemployment rate (UR), normalized transparency index squared (NTI2)

The rule of law is used as an instrument for the normalized transparency index while financial depth squared is used as an instrument for the normalized transparency index squared. The results here are more promising than similar output volatility results previously reported. All of the parameter estimates have the correct sign and the small p-value from the test concludes that at least one of the regression coefficients is not equal to zero in each model. Interpreting the second regression, the estimates imply that financial market volatility decreases by 16.5013 for each additional unit increase of transparency, though the coefficient is statistically insignificant and slightly large in value to be entirely plausible. Estimates also suggest that volatility will

decrease to a minimum at a value of 9.3992 level of transparency [= 16.5013 / (2 x 0.8778)], after which financial market volatility may begin to increase. Although these results are very superficial, it is striking that this suggested level of optimum transparency is much higher for minimizing financial market volatility than it was for minimizing output volatility.

When the models are estimated with the original, non-normalized transparency index the potential minimum points increase once again as they did when output volatility was the main concern.

Instrumental Variable Fixed Effects Panel Model Comparison of Financial Market Volatility with Original Transparency Index

	(1) FMV	(2) FMV
TI	-5.2218	-9.1525
	(4.0190)	(12.1245)
FD	0.1671	0.1261
	(0.1249)	(0.0796)
PI	0.0111	0.0383
	(0.2348)	(0.1831)
UR	0.0288	0.0498
	(0.4377)	(0.3886)
TI2		0.3382
		(0.7639)
_cons	47.8623*	58.2995
	(23.5325)	(43.3284)
N	517	517
Wald chi2	2413.03	2662.43
pvalue	0.0000	0.0000
sigma_u	17.6717	15.9230
sigma_e	11.3912	10.8467
rho	0.7065	0.6830

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: transparency index (TI), financial market volatility (FMV), financial depth (FD), past inflation (PI), unemployment rate (UR), transparency index squared (TI2)

Here the estimates of the second regression imply that financial market volatility decreases by 9.1525 for each additional unit increase of transparency, though the coefficient is statistically insignificant. Estimates also suggest that volatility will decrease to a minimum at a value of 13.5312 level of transparency [= 9.1525 / (2 x 0.3382)], after which financial market volatility may begin to increase; this possible minimum point is substantially larger in value than the minima found when output volatility was considered.

As with the early output volatility models, the coefficient estimates are no longer statistically significant. The standard errors are much larger than with previous estimates; the IV regression leads to a substantial loss in estimator efficiency here. There may be a problem with the IV chosen; it is therefore imperative to consider the Arellano-Bond estimator, which uses lags of the dependent variable to identify the model.

Below are the 2SLS estimates for financial market volatility. Each model strongly rejects the presence of serial correlation, therefore the estimations are consistent. Lags of financial market volatility, normalized transparency, and, where applicable, normalized transparency squared are used to identify the model and control for endogeneity.

2SLS Arellano-Bond Model Comparison of Financial Market Volatility with Heteroskedastic Robust Errors

	(1) FMV	(2) FMV
NTI	-0.7164	-2.7359
	(1.8168)	(4.7763)
FD	0.1953****	0.1161****
	(0.0558)	(0.0335)
PI	0.2990***	0.3302***
	(0.1153)	(0.1250)
UR	0.4182*	0.3816
	(0.2423)	(0.2340)
NTI2		0.3383
		(0.4265)
_cons	0.5098	5.7989
	(8.9490)	(14.5992)
N	428	428
Wald chi2	139.31	140.23
pvalue	0.0000	0.0000

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Note: normalized transparency index (NTI), financial market volatility (FMV), financial depth (FD), past inflation (PI), unemployment rate (UR), normalized transparency index squared (NTI2)

The coefficients on the estimated parameters are all the correct sign, while none of the pertinent regressors are statistically significant. All of the corresponding Wald test statistics indicate very strong significance for these one-step models.

The two-step, GMM model is now considered and estimates are presented below. The first model strongly rejects the presence of serial correlation; therefore the estimations are consistent, though the most relevant coefficients are not statistically significant. However there is strong serial correlation present in the second, squared term model. As theory suggests, additional lags were added to mitigate the presence of serial correlation; however, there was little or no effect in eliminating the correlation.

Another way of controlling for serial correlation would be to use the Arellano and Bover (1995) and Blundell and Bond (1998) estimation. Arellano-Bond uses IV estimator(s) under the assumption that lags of the endogenous variable can be used as instruments in the first differenced equation, for which $E(y_{is}\Delta\upsilon_{it}) = 0$ for $s \leq t - 2$ is a necessary assumption as well. However, Arellano-Bover and Blundell-Bond suggest using additional moment conditions for estimators with improved precision. Both estimators use the additional condition that $E(\Delta y_{i,t-1}\upsilon_{it}) = 0$ to include levels of the original equation and use $\Delta y_{i,t-1}$ as an appropriate instrument. Moreover, with the Arellano-Bover and Blundell-Bond estimators, additional moment conditions can be utilized for endogenous and predetermined variables by using their first-differences as instruments.

Using the Arellano-Bover and Blundell-Bond estimators eliminates the problem of serial correlation and also reduces most of the standard errors on the estimated coefficients.

As with the 2SLS estimations, lags of financial market volatility, normalized transparency, and, where applicable, normalized transparency squared are used to identify the model and control for endogeneity. Coefficients on the estimated parameters are all the anticipated signs (aside from the control variable unemployment rate, which switches signs based on the estimated model). All of the Wald test statistics indicate very strong significance for all of the models.

GMM Arellano-Bond and Arellano-Boyer / Blundell-Bond Model Comparison of Financial Market Volatility with Heteroskedastic Robust Errors

	(1) FMV-AB	(2) FMV-AB	(3) FMV-AB/BB	(4) FMV-AB/BB
NTI	-0.7434	-2.4710	-1.0348	-1.3134
	(1.7471)	(6.3600)	(0.8357)	(6.2495)
FD	0.1968****	0.1227	0.0613	0.0283
	(0.0529)	(0.2384)	(0.0528)	(0.0530)
PI	0.3009***	0.3344	0.2365	0.2795
	(0.1165)	(0.9925)	(0.2301)	(0.2775)
UR	0.4287*	0.3754	-0.1753	-0.2178
	(0.2572)	(3.6879)	(0.5508)	(0.4845)
NTI2		0.3156		0.0677
		(0.5681)		(0.5590)
_cons	0.4748	4.7551	12.8472	14.8035
	(8.7831)	(23.3124)	(10.0104)	(17.9644)
N	428	428	490	490
Wald chi2	127.23	86.67	157.36	105.75
pvalue	0.0000	0.0000	0.0000	0.0000

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Note: normalized transparency index (NTI), financial market volatility (FMV), financial depth (FD), past inflation (PI), unemployment rate (UR), normalized transparency index squared (NTI2)

Considering each variable on its own, the control variables (past inflation, financial depth and unemployment rate) are usually not statistically significant. However, their inclusion in the model allows for more appropriate specification. The coefficients on the normalized transparency index variables are negative for both models, indicating that as the level of transparency increases output volatility will decrease. As predicted, the coefficients on the squared normalized transparency index variables are positive for both models, suggesting that there could be diminishing returns to transparency.

While the important estimated coefficients all have the anticipated signs, it is striking that none of these estimated effects are statistically significant. The above results imply that there

may be diminishing returns to transparency's effect on financial market volatility as there was with output volatility; however, since the estimated crucial coefficients of the model are not significant it would be imprudent to draw too many conclusions. GMM estimations appear to have captured the correct models for output volatility, but results for financial market volatility GMM estimators are insignificant. Additional tests were performed, including adding previous financial market volatility as an exogenous variable and as a variable with lags; however these variables were of course dropped from estimations due to multicollinearity with the existing lags of the dependent variable. In fact, the most appropriately fitted model for financial market volatility appears to be the simple pooled IV OLS regression that was performed earlier. This simple model ignores many important characteristics of the richness of panel data and simply pools all of the observations and includes an IV to account for endogeneity.

In conclusion, due to the imprecise estimates from the 2SLS and GMM dynamic panels, it is pragmatic to conclude that while there may exist the hypothesized relationship between central bank transparency and financial market volatility it is not accurately nor significantly captured given the data. There are many reasons why the relationship could be obscured. For instance, effects on financial market volatility may be based on only some forms of central bank transparency and not all five sub-indices that are included in the data. Financial market volatility might mainly be affected by procedural transparency (i.e. accounts of policy deliberations, disclosure of voting records) and policy transparency (i.e. disclosure of policy decisions, indications of future policy actions) and not the other three types of transparency. The relationship between procedural and policy transparency may be obfuscated by the inclusion of the other three irrelevant types of central bank transparency, which would muddle the results. Unfortunately this theory is not testable as the sub-indices data is unavailable. Another reason

could be that there is a relationship between transparency and financial market volatility, but that the relationship is not as apparent in annual data. Central bank transparency may strongly affect financial market volatility on certain days or even weeks; however, the annualized data used in this study may not put enough weight on these volatile days. Times of relative calm in financial markets might overwhelm the annualized data and mitigate any brief tumultuous periods.

iii. Additional Results

The richness of the data supplied by Dincer and Eichengreen (2013) allows research over a 13-year period. It is of interest, however, to consider the period before the financial crisis and see if the GMM output volatility models predict the same relationship. Below are the same ultimate output volatility models presented earlier for a data range of 1998 – 2006.

GMM Arellano-Bond Model Comparison of Output Volatility from 1998 – 2006 with Heteroskedastic Robust Errors

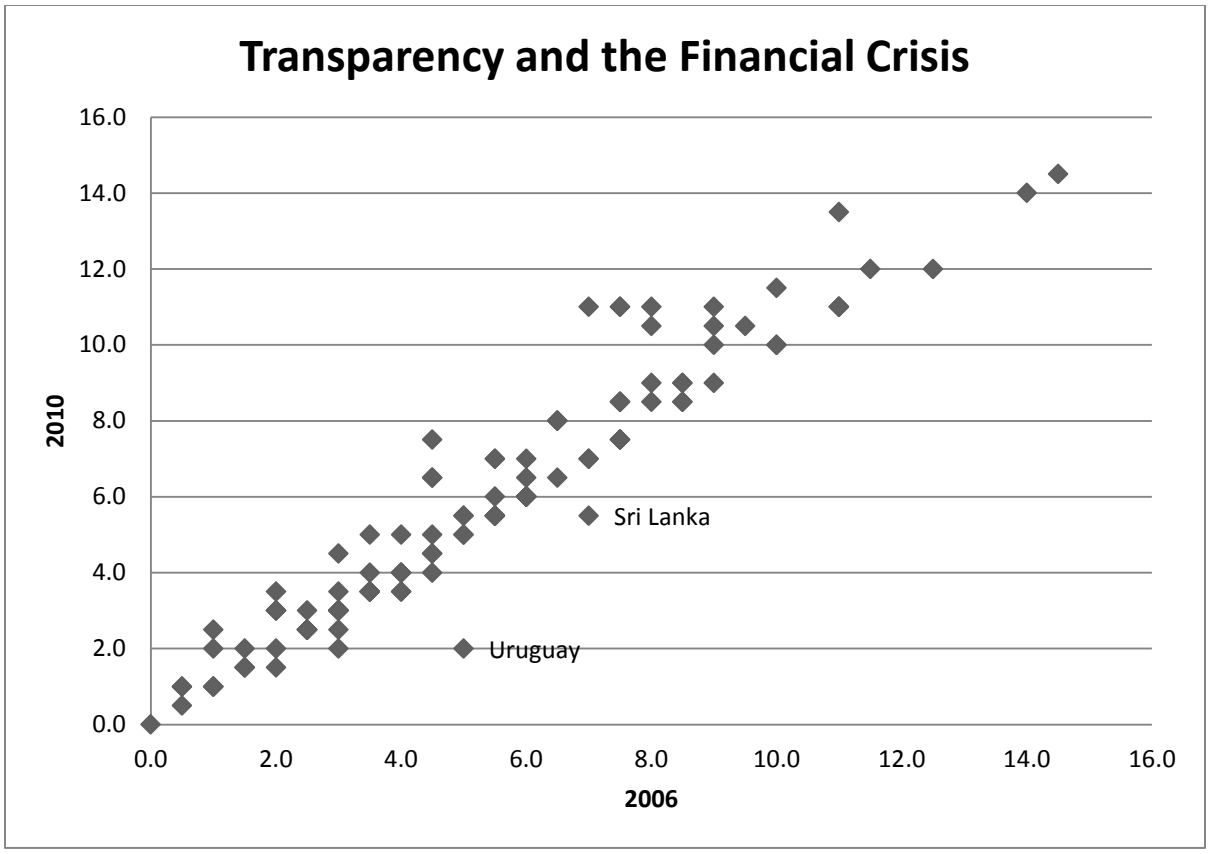
	(1) OV3	(2) OV5	(3) OV3	(4) OV5
NTI	-0.4390**	-0.3763*	-0.2321	-0.1172
	(0.2094)	(0.1955)	(0.3365)	(0.3274)
FD	-0.0086	0.0016	-0.0062	-0.0055
	(0.0120)	(0.0070)	(0.0120)	(0.0079)
PI	0.0012	-0.0050	-0.0037	-0.0032
	(0.0103)	(0.0062)	(0.0082)	(0.0067)
NTI2			-0.0124	-0.0059
			(0.0318)	(0.0308)
_cons	3.3643****	1.9442***	2.5621***	1.5626*
	(0.9208)	(0.7205)	(0.8371)	(0.8146)
N	632	634	632	634
Wald chi2	67.44	19.16	116.51	61.93
pvalue	0.0000	0.0018	0.0000	0.0000

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$
Note: normalized transparency index (NTI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), normalized transparency index squared (NTI2)

While all models reject the presence of serial correlation, the Wald Chi-Square statistics have dropped in comparison to the same models that utilized the full data set. Moreover, some signs of the coefficients have changed and while others are no longer statistically significant. The coefficient on normalized transparency index is still negative, indicating an inverse relationship between the level of transparency and output volatility. Noteworthy, in particular, is that the coefficients on the squared transparency term are now negative, though they are also

insignificant. This may imply that in times of relative stability (i.e. from 1998 – 2006) that additional information coming from central banks has no limitations or diminishing effects. If this is true, it would support the theory highlighted in the introduction that transparency could have smoothing effects in calm periods while it has volatile or panic inducing effects in times of economic turmoil. If central banks release a plethora of information while animal spirits exist, the combination of the two factors could exacerbate the economic climate, which could lead to greater volatility in periods of crisis.

Given the economic and political climate both during and after the financial crisis of 2007 – 2010 it would be understandable if central banks decreased their level of transparency. Looking at the effect of the financial crisis on transparency levels, it is notable that most central banks maintained or increased their level of transparency during this time period. There are only two countries that exhibit a decrease in transparency immediately after the crisis: Uruguay and Sri Lanka.



Considering the relationship between output volatility and central bank transparency during the financial crisis is more difficult to examine as a dynamic panel due to the four-year data limitation. Instead, output volatility during 2007 – 2010 is explored with pooled OLS and pooled IV OLS regressions. The results are mainly suggestive, but very interesting. The difference in the measures of output volatility for three years versus five years is the most distinct in the following regressions.

Pooled OLS and Pooled IV OLS Model Comparison of Output Volatility from 2007 – 2010 with Heteroskedastic Robust Errors

	(1) REGOV3	(2) REGOV5	(3) IVREGOV3	(4) IVREGOV5
NTI	0.5064**	0.1098	4.5167**	-2.3565
	(0.2484)	(0.2598)	(1.7898)	(3.3957)
NTI2	-0.0387*	-0.0113	-0.3621**	0.2186
	(0.0215)	(0.0236)	(0.1503)	(0.2882)
FD	-0.0020	-0.0015	-0.0095**	-0.0011
	(0.0026)	(0.0033)	(0.0041)	(0.0053)
PI	0.0557**	0.1119	0.0809***	0.1179
	(0.0237)	(0.0778)	(0.0292)	(0.0760)
_cons	0.7893	1.9183**	-9.1315**	7.3816
	(0.5244)	(0.8479)	(4.3280)	(8.1121)
N	429	429	429	429
Wald chi2			13.47	10.40
pvalue			0.0092	0.0343
r2	0.0296	0.0654		
F	3.03	3.55		
pvalue	0.0296	0.0074		

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Note: normalized transparency index (NTI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), normalized transparency index squared (NTI2)

Aside from the fourth model, the coefficients on normalized transparency are now positive whereas the coefficients on transparency squared are now negative, both the opposite of what was originally hypothesized. This should not come as a surprise, however. Since the above models focus on the relationship between output volatility and transparency during the financial crisis, the coefficients are in line with the proposed theory that information released from banks could exacerbate volatility. In times of tranquil market conditions, one would expect the opposite relationship. However, in times of turmoil, there could be larger, often panicked or negative, reactions to information released from central banks. So while initially the results above seem inconsistent, they actually support the hypothesis proposed by this research.

One final important point to draw attention to is the difference in estimates for both pooled OLS and pooled IV OLS when the dependent variable changes from three-year output volatility to five-year output volatility. Not only do the estimates on transparency and transparency squared lose significance, but the estimated coefficients also change signs when three-year output volatility is modeled compared to five-year output volatility. As the only change in the model comparison is the number of previous years considered when calculating output's volatility, it demonstrates the distinction in the results based on the chosen measure of the dependent variable. Examining the fourth model, pooled IV OLS with five-year output volatility as the dependent variable, provides estimates that are more consistent with the hypothesized overall relationship between transparency and output volatility. This may be because volatility is measured over the current year and four previous years instead of the current year and two previous years. If a period of tranquility is followed by a period of turmoil, using the five-year output volatility measure will pull more placid years into the calculated variable and therefore weigh less volatile output growth over a longer period than the three-year output measure would.

Similarly developed countries are now considered to investigate potential relationships. This decreases the sample size even more than when the data were split into pre- and post-crisis years; results should be interpreted with caution and are mainly suggestive. Less developed countries (LDC) do not have much variation in the data and are therefore not considered with regressions; however, preliminary analysis supported the original relationship implications that were presented in the general Output Model section.

Countries that fall under the Organization for Economic Co-operation and Development (OECD) are now considered. Due to the much smaller sample size, panel data models are not considered since the number of instruments in each estimation approach the sample size.

Pooled OLS and Pooled IV OLS Model Comparison of Output Volatility from 1998 – 2010 for OECD Countries with Heteroskedastic Robust Errors

	(1) OV3	(2) OV5	(3) OV3IV	(4) OV5IV
NTI	0.4039	0.5236*	2.2077	2.2582
	(0.3158)	(0.3025)	(2.2919)	(2.3245)
NTI2	-0.0272	-0.0394*	-0.1866	-0.2034
	(0.0233)	(0.0221)	(0.1642)	(0.1681)
FD	-0.0007	-0.0021	0.0003	0.0001
	(0.0017)	(0.0015)	(0.0048)	(0.0048)
PI	0.0507****	0.0572****	0.0469**	0.0535***
	(0.0119)	(0.0086)	(0.0217)	(0.0189)
_cons	-0.0533	0.0994	-4.6170	-3.8655
	(1.0222)	(0.9767)	(7.3038)	(7.3484)
N	278	278	234	234
Wald chi2			21.73	70.77
pvalue			0.0002	0.0000
r2	0.1019	0.1496		
F	5.18	15.02		
pvalue	0.0005	0.0000		

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$
Note: normalized transparency index (NTI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), normalized transparency index squared (NTI2)

While the panel data models are not displayed here, they all exhibited similar coefficient estimations as above. The key difference between these estimated coefficients and the coefficients estimated for all 120 countries is that the signs on transparency and squared transparency have switched. The suggested relationship for OECD countries, while not statistically significant, is that transparency increases volatility up to a certain point. It then diminishes and at a certain point starts to mitigate volatility. While this relationship at first may

seem incongruous, it does coincide with most OECD countries having a very high level of central bank transparency. Regressions are run for G20 countries below, which yield similar suggestive results to the results displayed for OECD countries.

Pooled OLS and Pooled IV OLS Model Comparison of Output Volatility from 1998 – 2010 for G20 Countries with Heteroskedastic Robust Errors

	(1) OV3	(2) OV5	(3) OV3IV	(4) OV5IV
NTI	0.0058	0.1666	5.8934	1.5381
	(0.2379)	(0.2450)	(32.9151)	(20.4570)
NTI2	-0.0135	-0.0351	-0.5550	-0.1658
	(0.0231)	(0.0239)	(2.9894)	(1.8561)
FD	-0.0001	-0.0033*	-0.0010	-0.0021
	(0.0019)	(0.0019)	(0.0156)	(0.0093)
PI	0.0545****	0.0491****	0.0454	0.0473**
	(0.0123)	(0.0095)	(0.0465)	(0.0228)
_cons	1.7601****	2.3479****	-11.6522	-0.7827
	(0.5084)	(0.4931)	(75.3781)	(47.0049)
N	217	217	183	183
Wald chi2			13.54	78.77
pvalue			0.0089	0.0000
r2	0.2206	0.2701		
F	9.16	19.66		
pvalue	0.0000	0.0000		

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$
Note: normalized transparency index (NTI), three-year output volatility (OV3), five-year output volatility (OV5), financial depth (FD), past inflation (PI), normalized transparency index squared (NTI2)

The above models also support a theory earlier expounded in the Output Model portion of this section. The final specified GMM models of output volatility for both three and five years and utilizing the normalized transparency index found that an optimal level of transparency might exist at 4.33 or 4.17 respectively depending on the number of years provided in the output volatility estimate. At the time this result seemed rather low, especially given the high levels of non-normalized transparency exhibited by many developed countries. However, if one considers

only the most developed countries then, given supporting evidence from the above estimated OECD and G20 models, it may be the case that the more developed a country is that the more information its central bank needs to release before it reaches a point where the level of transparency reduces volatility levels.

Finally, financial market volatility is explored once more by focusing solely on G20 countries to see if these preliminary regressions are comparable to the earlier regressions in the Financial Market Model section.

Pooled OLS and Pooled IV OLS Model Comparison of Financial Market Volatility from 1998 – 2010 for G20 Countries with Heteroskedastic Robust Errors

	(1) FMV	(2) FMV	(3) FMVIV	(4) FMVIV
NTI	-1.8547****	-2.0731	-3.0122****	-12.0673
	(0.4127)	(2.2964)	(0.6047)	(43.0462)
FD	-0.0016	-0.0019	0.0251	0.0285
	(0.0115)	(0.0113)	(0.0162)	(0.0268)
PI	0.4724****	0.4729****	0.4306****	0.4319****
	(0.0654)	(0.0664)	(0.0791)	(0.1041)
UR	0.1464	0.1478	0.1813	0.2675
	(0.1295)	(0.1350)	(0.1385)	(0.4640)
NTI2		0.0222		0.8262
		(0.2056)		(3.9025)
_cons	32.6452****	33.0852****	36.3864****	56.6149
	(2.7881)	(5.6873)	(3.1775)	(96.2267)
N	201	201	169	169
Wald chi2			79.50	83.50
pvalue			0.0000	0.0000
r2	0.4139	0.4139	0.3559	0.2459
F	22.81	22.35		
pvalue	0.0000	0.0000		

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Note: normalized transparency index (NTI), financial market volatility (FMV), financial depth (FD), past inflation (PI), unemployment rate (UR), normalized transparency index squared (NTI2)

As with output volatility, the data is too limited to properly consider dynamic panel models and

the analysis is limited to pooled OLS and pooled IV OLS models. While the above models do not take advantage of the characteristics of panel data, the pooled estimates provide a glimpse of the relationship between transparency levels and financial market volatility for G20 countries. Though not all of the coefficients are significant and some of the standard errors are particularly large, the implied relationship of all the models is what was originally hypothesized. The level of transparency is inversely related to financial market volatility and there appears to be a diminishing return to transparency since the coefficient attached to the squared transparency term is positive.

VI. Summary and Concluding Remarks

This research aims to make a contribution to the central bank transparency literature by examining the effect of transparency levels on output and financial market volatility. The most thorough transparency index available is utilized in the analysis in order to capture as many central banks as possible. This research does not make any normative judgments about the benefits or drawbacks to transparency; this is important research nonetheless and is worth pursuing.

The most promising results from this study are found in the analysis of central bank transparency on output volatility. Utilizing the entire data set, the Arellano-Bond GMM estimators for output volatility over a three- and five-year periods supported the initial hypotheses that an increase in the level of central bank transparency will decrease output volatility up until a certain point, where after this point additional information from central banks begins to exacerbate output volatility. An interesting result is suggested, however, when considering the same relationship on a subset of the most developed countries. When examining OECD and G20 countries, the opposite relationship is potentially highlighted; output volatility seems to increase as central bank transparency increases up until a maximum point where it then potentially begins to mitigate volatility. This result may help explain why many developed central banks have higher levels of transparency compared to the rest of the world. An optimal level of central bank transparency may exist, but this specific level may differ depending on the

status of economic development demonstrated by each country or group of countries. Additional research in this area could help explain why countries' central banks choose certain amounts of transparency.

Results from the models exploring the relationship between financial market volatility and central bank transparency were equally as promising and supported the initial hypotheses, though they were not statistically significant. Similar to the output volatility results, dynamic GMM panel models demonstrated a decrease in financial market volatility up until a certain point at which an increase in central bank transparency would then exacerbate volatility rather than mitigate it. However, more research, and potentially a different measure of financial market volatility, is needed before any concrete conclusions can be drawn.

In order to compare the relationship between volatility and transparency in times of calm versus turmoil, the subset periods of 1998 – 2006 and 2007 – 2010 were also considered to see if output volatility's relationship with transparency differed for these periods compared to the full data set of 1998 – 2010. The results for 1998 – 2006 suggested that in times of relative economic tranquility that additional information provided by central banks has no diminishing effects and continually decreases volatility. Comparing this result to the full model estimates for the period 1998 – 2010 supports the theory that transparency may have smoothing effects in calm periods while it has more volatile effects during economic or financial crises. An examination of the data for 2007 – 2010 provides further evidence. Most models for this time period indicated that an increase in transparency could instead increase output volatility rather than mitigate it.

Finally, given the aforementioned relationship uncovered, brief descriptive analysis was conducted to look at the pre- and post-crisis levels of transparency to see if any central banks moved towards opacity after the financial crisis of 2007-2010. Somewhat surprisingly, however,

only two of the 120 central banks in the study demonstrated a decrease in transparency after the crisis. Central bank transparency may not be as fleeting a notion as its critics claim.

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VIII. Appendices

Data Appendix: Index Description, reproduced from Dincer and Eichengreen (2009)
The index is the sum of the scores for answers to the 15 questions below (min = 0, max = 15).
1. Political Transparency
Political transparency refers to openness about policy objectives. This comprises a formal statement of objectives, including an explicit prioritization in case of multiple goals, a quantification of the primary objective(s), and explicit institutional arrangements.
(a) Is there a formal statement of the objective(s) of monetary policy, with an explicit prioritization in case of multiple objectives?
No formal objective(s) = 0.
Multiple objectives without prioritization = 1/2.
One primary objective, or multiple objectives with explicit priority = 1.
(b) Is there a quantification of the primary objective(s)?
No = 0.
Yes = 1.
(c) Are there explicit contacts or other similar institutional arrangements between the monetary authorities and the government?
No central bank contracts or other institutional arrangements = 0.
Central bank without explicit instrument independence or contract = 1/2.
Central bank with explicit instrument independence or central bank contract although possibly subject to an explicit override procedure = 1.
2. Economic Transparency
Economic transparency focuses on the economic information that is used for monetary policy. This includes economic data, the model of the economy that the central bank employs to construct forecasts or evaluate the impact of its decisions, and the internal forecasts (model based or judgmental) that the central bank relies on.
(a) Is the basic economic data relevant for the conduct of monetary policy publicly available? (The focus is on the following five variables: money supply, inflation, GDP, unemployment rate and capacity utilization.)
Quarterly time series for at most two out of the five variables = 0.
Quarterly time series for three or four out of the five variables = 1/2.
Quarterly time series for all five variables = 1.
(b) Does the central bank disclose the macroeconomic model(s) it uses for policy analysis?
No = 0.
Yes = 1.

(c) Does the central bank regularly publish its own macroeconomic forecasts?
No numerical central bank forecasts for inflation and output = 0.
Numerical central bank forecasts for inflation and/or output published at less than quarterly frequency = 1/2.
Quarterly numerical central bank forecasts for inflation and output for the medium term (one to two years ahead), specifying the assumptions about the policy instrument (conditional or unconditional forecasts) = 1.

3. Procedural Transparency

Procedural transparency is about the way monetary policy decisions are taken.
(a) Does the central bank provide an explicit policy rule or strategy that describes its monetary policy framework?
No = 0.
Yes = 1.
(b) Does the central bank give a comprehensive account of policy deliberations (or explanations in case of a single central banker) within a reasonable amount of time?
No or only after a substantial lag (more than eight weeks) = 0.
Yes, comprehensive minutes (although not necessarily verbatim or attributed) or explanations (in case of a single central banker), including a discussion of backward and forward-looking arguments = 1.
(c) Does the central bank disclose how each decision on the level of its main operating instrument or target was reached?
No voting records, or only after substantial lag (more than eight weeks) = 0.
Non-attributed voting records = 1/2.
Individual voting records, or decision by single central banker = 1.

4. Policy Transparency

Policy transparency means prompt disclosure of policy decisions, together with an explanation of the decision, and an explicit policy inclination or indication of likely future policy actions.
(a) Are decisions about adjustments to the main operating instrument or target announced promptly?
No or only after the day of implementation = 0.
Yes, on the day of implementation = 1.
(b) Does the central bank provide an explanation when it announces policy decisions?
No = 0.
Yes, when policy decisions change, or only superficially = 1/2.
Yes, always and including forwarding-looking assessments = 1.
(c) Does the central bank disclose an explicit policy inclination after every policy meeting or an explicit indication of likely future policy actions (at least quarterly)?
No = 0.
Yes = 1.

5. Operational Transparency

Operational transparency concerns the implementation of the central bank's policy actions. It involves a discussion of control errors in achieving operating targets and (unanticipated) macroeconomic disturbances that affect the transmission of monetary policy. Furthermore, the evaluation of the macroeconomic outcomes of monetary policy in light of its objectives is included here as well.

(a) Does the central bank regularly evaluate to what extent its main policy operating targets (if any) have been achieved?
No, or not very often (at less than annual frequency) = 0.
Yes, but without providing explanations for significant deviations = 1/2.
Yes, accounting for significant deviations from target (if any); or, (nearly) perfect control over main operating instrument/target = 1.
(b) Does the central bank regularly provide information on (unanticipated) macroeconomic disturbances that affect the policy transmission process?
No, or not very often = 0.
Yes, but only through short-term forecasts or analysis of current macroeconomic developments (at least quarterly) = 1/2.
Yes, including a discussion of past forecast errors (at least annually) = 1.
(c) Does the central bank regularly provide an evaluation of the policy outcome in light of its macroeconomic objectives?
No, or not very often (at less than annual frequency) = 0.
Yes, but superficially = 1/2.
Yes, with an explicit account of the contribution of monetary policy in meeting the objectives = 1.

Output volatility is measured as the standard deviation of the growth rate over the most recent three-year period (the current calendar year and its two immediate predecessors) and the most recent five-year period (the current calendar year and its four immediate predecessors). The annual percentage growth rate of GDP is measured at market prices based on constant local currency. Aggregates are based on constant 2005 US dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data is provided by the World Bank.

Financial depth and stock market volatility measurements utilize the following data source: The World Bank's Global Financial Development Database (GFDD), updated November 2013.

Financial depth is measured as M2/GDP; the data is taken from the GFDD as well as Data Market. Money and quasi money consist of the sum of currency outside banks, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government.

Past inflation is measured as the previous period's inflation. Inflation is measured by the consumer price index and reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, usually yearly. Data is provided by the World Bank.

The volatility of the stock price index is the 360-day standard deviation of the return on the national stock market index. The data is taken from the GFDD via Bloomberg.

Unemployment rate is measured as the percentage of the labor force actively seeking employment over the total labor force and is sourced from the World Bank and the IMF.

Rule of law is taken from the World Bank Worldwide Governance Indictors. Rule of law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, ranging from approximately -2.5 to 2.5.

East Caribbean refers to Antigua and Barbuda, Dominica, Grenada, Montserrat, Saint Kitts and Nevis, Saint Lucia, Saint Vincent, and the Grenadines.

European Union refers to countries within Europe who have adopted the Euro and fall under the jurisdiction of the European Central Bank.

Table 1: Dincer and Eichengreen's Transparency Index (0 is least transparent and 15 is most transparent)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Africa	2.4	2.4	2.6	2.9	3.1	3.3	3.5	3.8	3.9	4.2	4.4	4.5	4.4
Eastern Africa	2.1	2.1	2.3	2.6	2.9	2.9	3.1	3.3	3.5	3.7	3.8	4.0	3.8
Ethiopia	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.5
Kenya	2.5	2.5	3.0	4.0	4.0	4.0	4.0	4.5	6.0	7.0	7.0	7.0	7.0
Malawi	1.0	1.0	1.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0
Mauritius	4.0	4.0	4.0	4.5	6.0	6.0	6.0	6.0	6.0	6.5	6.5	6.5	6.5
Mozambique	4.0	4.0	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5.0	6.0	5.0
Rwanda	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.5	3.5	3.5	3.5
Seychelles	2.0	2.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	3.5	3.5	3.5
Tanzania	1.5	1.5	1.5	1.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Uganda	2.0	2.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Zambia	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	2.5	2.5	2.5	2.5	2.5
Northern Africa	1.5	1.5	1.8	1.8	2.1	2.3	2.4	2.8	3.3	3.6	3.6	3.6	3.6
Egypt	1.0	1.0	1.0	1.0	1.0	1.5	2.0	3.5	5.0	5.0	5.0	5.0	5.0
Libyan Arab Jamahiriya	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sudan	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
Tunisia	3.0	3.0	3.0	3.0	4.5	4.5	4.5	4.5	5.0	5.5	5.5	5.5	5.5
Middle Africa	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Angola	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Southern Africa	3.8	3.9	4.4	5.0	5.3	5.5	6.0	7.0	7.0	7.0	7.0	7.3	7.0
Botswana	5.0	5.5	5.5	5.5	5.5	5.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lesotho	2.0	2.0	2.5	2.5	2.5	3.5	3.5	6.0	6.0	6.0	6.0	6.0	6.0
Namibia	3.0	3.0	3.5	3.5	4.5	4.5	6.0	7.5	7.5	7.5	7.5	8.5	7.5
South Africa	5.0	5.0	6.0	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Western Africa	3.7	3.7	3.7	4.0	4.3	4.8	4.8	4.8	4.8	5.5	6.7	6.7	6.7
Ghana	3.0	3.0	3.0	3.0	4.0	5.5	5.5	5.5	5.5	6.5	7.0	7.0	7.0
Nigeria	4.0	4.0	4.0	4.5	4.5	4.5	4.5	4.5	4.5	5.0	6.5	6.5	6.5
Sierra Leone	4.0	4.0	4.0	4.5	4.5	4.5	4.5	4.5	4.5	5.0	6.5	6.5	6.5

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Americas	3.8	4.0	4.2	4.5	4.7	4.9	5.3	5.3	5.4	5.4	5.3	5.4	5.4
Latin America and the	2.4	2.5	2.6	3.0	3.3	3.4	3.6	3.7	3.6	3.6	3.6	3.6	3.6

Caribbean													
East Caribbean	3.0	3.0	3.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Aruba	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.0
Bahamas	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Barbados	2.5	3.0	3.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	3.5	3.5	3.5
Cayman Islands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cuba	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Curacao	3.0	3.0	3.0	3.0	3.0	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Jamaica	3.0	3.0	3.0	4.5	6.5	6.5	6.5	6.5	5.5	5.5	5.5	5.5	5.5
Trinidad and Tobago	3.0	3.0	3.0	3.0	3.0	3.5	5.0	6.0	6.0	6.0	6.0	6.0	6.0
Central America	2.5	2.5	2.5	3.0	3.1	3.3	4.4	4.4	4.8	4.8	4.8	4.8	4.8
Belize	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
El Salvador	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Guatemala	1.5	1.5	1.5	1.5	2.0	2.0	5.5	5.5	7.0	7.0	7.0	7.0	7.0
Mexico	4.5	4.5	4.5	4.5	4.5	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
South America	3.4	3.8	4.5	4.9	5.3	5.6	5.7	5.7	5.6	5.4	5.3	5.5	5.8
Argentina	2.0	2.0	2.0	2.0	2.0	4.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Brazil	3.5	5.5	9.0	9.0	9.0	9.0	9.0	9.0	8.0	6.5	6.0	6.0	8.5
Chile	7.0	7.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Colombia	2.5	3.5	5.0	5.0	5.5	5.5	5.5	5.5	5.5	8.5	8.0	7.5	7.0
Guyana	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.0	2.0	2.0	2.0
Peru	5.0	5.0	5.0	6.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Uruguay	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	2.0	2.0	2.0	2.0
Venezuela	1.0	1.0	1.0	2.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Northern America	6.7	7.2	7.2	7.2	7.2	7.2	7.3	7.3	7.7	7.7	7.7	7.7	7.7
Bermuda	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Canada	10.5	10.5	10.5	10.5	10.5	10.5	11.0	11.0	11.0	11.0	11.0	11.0	11.0
United States	8.5	10.0	10.0	10.0	10.0	10.0	10.0	10.0	11.0	11.0	11.0	11.0	11.0

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Asia	2.8	3.0	3.3	3.5	3.9	4.2	4.4	4.7	4.9	5.0	5.1	5.0	5.1
Central Asia	2.7	2.7	2.7	3.0	3.0	2.7	3.3	4.5	4.5	4.7	4.7	4.7	4.7
Kazakhstan	3.5	3.5	3.5	3.5	3.5	3.5	3.5	6.0	6.0	6.0	6.0	6.0	6.0
Kyrgyzstan	3.0	3.0	3.0	4.0	4.0	3.0	5.0	5.0	5.0	5.5	5.5	5.5	5.5
Tajikistan	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	2.5	2.5	2.5	2.5	2.5
Eastern Asia	4.3	4.4	4.8	4.9	5.3	6.1	6.3	6.3	6.3	6.3	6.7	6.7	6.7
China	1.0	1.0	1.0	1.0	1.5	4.5	4.5	4.5	4.5	4.0	4.0	4.0	4.0
Hong Kong	5.0	6.0	6.0	6.0	7.0	7.0	7.0	7.0	7.5	7.5	7.5	7.5	7.5
Korea	6.5	6.5	8.0	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Japan	8.0	8.0	8.5	8.0	8.0	8.0	9.5	9.5	9.0	9.0	10.5	10.5	10.5
Macao	3.0	3.0	3.0	3.0	3.0	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Mongolia	2.0	2.0	2.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0	5.0
Southern Asia	2.3	2.3	2.3	2.5	2.9	3.3	3.4	3.4	3.9	3.9	3.9	3.6	3.9
Bangladesh	0.0	0.0	0.0	0.5	0.5	3.0	3.5	3.5	4.0	4.0	4.0	4.0	4.0
Bhutan	1.5	1.5	1.5	1.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	4.5
India	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
Iran	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Maldives	2.5	2.5	2.5	3.5	3.5	3.5	3.5	3.5	4.0	4.0	4.0	4.0	4.0
Pakistan	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0
Sri Lanka	5.0	5.0	5.0	5.0	6.5	6.5	7.0	7.0	7.0	7.0	7.0	5.5	5.5
South-Eastern Asia	2.5	3.1	4.1	4.3	5.0	5.6	5.8	5.9	6.0	5.9	5.9	6.0	6.2
Cambodia	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Indonesia	3.0	4.5	4.5	4.5	4.5	7.0	8.0	8.0	8.5	8.5	8.5	8.5	9.0
Lao People's Democratic	0.0	0.0	1.5	1.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Malaysia	4.5	4.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0

Philippines	3.5	5.0	5.0	6.0	10.0	10.0	10.0	10.0	10.0	9.0	9.0	9.0	10.0
Singapore	2.5	4.0	4.0	4.0	3.0	4.5	4.5	5.5	5.5	5.5	5.5	5.5	5.5
Thailand	2.0	2.0	6.0	6.5	8.0	8.0	8.0	8.0	8.0	8.0	8.5	9.0	9.0
Western Asia	2.5	2.3	2.5	2.9	3.2	3.3	3.4	3.5	3.9	4.1	4.2	4.2	4.3
Armenia	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	7.5	7.5	7.5	7.5	8.5
Azerbaijan	1.0	1.0	1.0	3.0	3.0	3.0	3.0	3.5	3.5	3.5	3.5	3.5	3.5
Bahrain	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.5	3.5	4.0	4.0	4.0	4.0
Cyprus	2.5	3.5	3.5	4.5	7.0	7.0	7.5	7.5	7.5	7.5	11.0	11.0	11.0
Georgia	3.0	3.0	3.0	3.0	3.0	4.0	4.0	4.0	4.5	5.5	6.5	7.5	7.5
Iraq	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Israel	5.5	7.0	7.5	8.5	8.5	8.5	8.5	8.5	10.0	10.0	11.0	11.0	11.5
Jordan	1.0	1.0	1.0	1.0	1.0	1.0	1.5	2.0	2.0	2.5	2.5	2.5	1.5
Kuwait	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.5	3.5	3.5	3.5	3.5	3.5
Lebanon	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Oman	1.5	1.5	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	3.0	3.0	3.0
Qatar	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.5	3.5	3.5	3.5
Saudi Arabia	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0
Syria	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Turkey	3.0	2.0	4.0	5.5	8.5	8.5	8.5	8.5	10.0	10.0	10.0	10.0	10.0
United Arab Emirates	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
Yemen	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Europe	5.3	5.6	6.0	6.4	7.0	7.4	7.7	7.8	8.0	8.1	8.1	8.3	8.4
Eastern Europe	3.5	4.0	4.4	4.7	5.6	5.7	6.3	6.6	7.1	7.2	7.3	7.3	7.6
Belarus	1.5	3.5	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Bulgaria	4.5	4.5	4.5	4.5	4.5	4.5	5.0	5.5	5.5	5.5	5.5	5.5	5.5
Czech Republic	8.5	9.5	9.5	9.5	10.0	11.0	11.5	11.5	11.5	11.5	12	12	12
Hungary	3.5	3.5	5.5	6.5	9.0	9.0	9.0	10.5	11.0	12.0	13.5	13.5	13.5
Poland	3.0	5.0	5.0	6.5	6.5	6.5	7.0	8.0	9.0	10.0	9.0	9.0	9.0
Republic of Moldova	5.0	5.0	5.0	6.0	6.5	6.5	6.5	6.5	6.5	6.5	7.0	7.0	8.0
Romania	1.5	1.5	1.5	1.5	4.5	4.5	7.0	7.0	7.5	7.5	7.5	7.5	7.5
Russian Federation	1.5	1.5	1.5	1.5	1.5	1.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Slovakia	4.0	4.0	4.5	3.5	5.5	5.5	5.5	6.0	8.0	11.0	11.0	11.0	11.0
Ukraine	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.5	3.5	3.5	3.5	5.0
Northern Europe	6.6	6.8	7.4	7.7	8.1	8.3	8.3	8.4	8.9	9.1	9.3	9.4	9.6
Denmark	5.5	5.5	5.5	5.5	5.5	6.5	6.5	6.5	6.5	7.5	8.0	8.0	8.0
Estonia	5.0	5.0	5.5	5.5	5.5	5.5	5.0	5.5	6.5	6.5	6.5	6.5	6.5
Iceland	5.5	5.5	7.0	7.0	7.5	7.5	7.5	7.5	8.0	8.0	8.0	10.5	10.5
Latvia	7.0	7.0	7.0	7.0	7.0	7.5	7.5	7.5	8.5	8.5	8.5	8.0	9.0
Lithuania	4.0	4.0	4.5	5.0	5.0	5.0	5.0	5.0	5.5	5.5	6.0	6.0	6.0
Norway	6.0	6.0	6.0	7.5	7.5	7.5	8.0	8.0	9.0	10.0	10.0	10.0	10.0
Sweden	9.0	9.5	11.5	11.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
United Kingdom	11.0	12.0	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.0	12.0
Southern Europe	3.7	3.7	4.0	4.3	5.0	5.9	6.0	6.0	6.0	5.8	5.8	5.8	5.8
Albania	4.5	4.5	4.5	4.5	4.5	6.0	6.5	6.5	6.5	8.0	8.0	8.0	8.0
Bosnia and Herzegovina	3.0	3.0	3.0	3.0	3.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Croatia	1.5	1.5	1.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Macedonia	3.0	3.0	4.5	5.0	6.5	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Malta	5.0	5.0	5.5	5.5	5.5	7.0	7.0	7.0	7.0	11.0	11.0	11.0	11.0
Slovenia	5.0	5.0	5.0	5.0	7.5	7.5	7.5	7.5	7.5	11.0	11.0	11.0	11.0
Western Europe	7.3	7.8	8.0	9.0	9.3	9.8	10.3	10.3	10.3	10.3	10.3	10.8	10.8
Switzerland	6.0	7.0	7.5	8.0	8.0	9.0	9.5	9.5	9.5	9.5	9.5	10.5	10.5
European Union	8.5	8.5	8.5	10.0	10.5	10.5	11.0	11.0	11.0	11.0	11.0	11.0	11.0

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Oceania	4.0	4.4	4.4	4.7	5.1	5.2	5.3	5.3	5.4	5.5	5.8	5.8	5.8
Australia and New Zealand	9.3	10.5	10.5	10.8	11.5	11.5	11.5	11.5	11.5	11.5	12.5	12.5	12.5
Australia	8.0	8.0	8.0	8.0	9.0	9.0	9.0	9.0	9.0	9.0	11.0	11.0	11.0
New Zealand	10.5	13.0	13.0	13.5	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Melanesia	1.5	1.5	1.5	2.1	2.3	2.4	2.6	2.6	2.6	2.6	2.6	2.6	2.5
Fiji	1.5	1.5	1.5	1.5	1.5	2.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Papua New Guinea	1.5	1.5	1.5	3.0	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Solomon Islands	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Vanuatu	1.5	1.5	1.5	2.5	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	2.5
Polynesia	1.3	1.3	1.3	1.3	1.5	1.8	1.8	1.8	2.0	2.3	2.3	2.3	2.3
Samoa	2.0	2.0	2.0	2.0	2.5	3.0	3.0	3.0	3.5	3.5	3.5	3.5	3.5
Tonga	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0

Table 2: Dincer and Eichengreen's Weighted Transparency Index

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Africa	3.05	3.03	3.39	4.18	4.32	4.92	5.23	5.40	5.48	5.60	5.65	5.69	5.80
Eastern Africa	2.03	2.09	2.28	2.57	2.99	3.01	3.01	3.18	3.48	3.75	3.69	3.81	3.82
Northern Africa	1.37	1.37	1.41	1.43	1.76	2.21	2.59	3.44	4.39	4.66	4.65	4.70	4.69
Middle Africa	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Southern Africa	4.94	4.96	5.89	8.19	8.31	8.23	8.30	8.36	8.36	8.36	8.34	8.39	8.36
Western Africa	3.81	3.82	3.90	4.35	4.45	4.60	4.59	4.59	4.62	5.19	6.56	6.57	6.57
Americas	7.73	9.16	9.33	9.35	9.48	9.53	9.60	9.56	10.23	10.07	9.91	9.95	10.05
Latin America and Caribbean	3.27	3.33	3.33	3.85	4.67	4.71	5.29	5.72	5.44	5.47	5.48	5.40	5.38
Central America	4.30	4.33	4.35	4.38	4.39	4.87	5.92	5.92	5.97	5.97	5.97	5.97	5.98
South America	3.25	4.22	6.11	6.14	7.11	7.42	7.52	7.57	7.02	6.39	6.01	6.05	7.49
North America	8.63	10.03	10.03	10.03	10.03	10.04	10.08	10.08	11.00	11.00	11.00	11.00	11.00
Asia	5.54	5.70	6.19	5.80	5.92	6.52	7.15	6.98	6.79	6.47	6.87	6.80	6.73
Central Asia	3.36	3.35	3.38	3.44	3.44	3.38	3.48	5.83	5.85	5.87	5.86	5.84	5.86
Eastern Asia	6.48	6.58	7.02	6.46	6.47	7.16	8.04	7.89	7.42	6.99	7.47	7.35	7.23
Southern Asia	1.92	1.92	1.92	1.96	2.01	2.18	2.21	2.21	3.15	3.13	3.16	3.12	3.11
South-East Asia	2.95	3.87	5.04	5.28	5.98	7.02	7.34	7.48	7.70	7.58	7.70	7.82	8.19
Western Asia	2.71	2.54	3.29	3.86	4.82	5.05	5.09	4.93	5.55	5.85	6.01	6.08	6.18
Europe	8.34	8.59	8.69	9.80	10.25	10.28	10.69	10.62	10.58	10.57	10.45	10.50	10.43
Eastern Europe	2.78	3.71	3.63	4.04	4.53	4.55	5.38	5.54	5.61	5.76	5.62	5.83	5.67
Northern Europe	9.84	10.61	11.21	11.32	11.65	11.72	11.76	11.70	11.80	11.96	11.92	11.58	11.62
Southern Europe	2.34	2.44	2.70	3.28	3.45	4.03	4.08	4.07	3.53	3.71	3.75	3.76	3.77
Western Europe	8.43	8.46	8.47	9.94	10.43	10.46	10.96	10.96	10.96	10.96	10.96	10.99	10.98
Oceania	8.20	8.54	8.46	8.59	9.62	9.69	9.64	9.62	9.56	9.60	11.23	11.23	11.23
Australia and New Zealand	8.30	8.64	8.55	8.67	9.71	9.78	9.72	9.70	9.64	9.68	11.33	11.34	11.33
Melanesia	1.50	1.50	1.50	2.40	2.65	2.81	3.01	3.04	3.06	3.06	3.10	3.13	3.13
Polynesia	1.34	1.31	1.35	1.39	1.67	1.98	2.03	2.03	2.32	2.59	2.55	2.57	2.56

Table 3: Murdzhev and Tomljanovich (2006) and Tomljanovich's (2007) Timetable of Selected Countries and Central Bank Transparency Shifts

Country	Date	Nature of Change
Australia	8/1996	Formalization of inflation-targeting framework.
Canada	2/1991	Inflation targets first announced.
	7/1994	50 basis point operating band for overnight rate announced.
	2/1996	Announcement of official overnight rate target. Press release whenever change in band occurs, including explanation for change.
Germany	-	None for time-period studied.
Japan	4/1998	Central bank granted operational independence through Bank of Japan Act; this was accompanied by major shift in transparency.
New Zealand	1/1989	Adoption of inflation targeting, via Reserve Act of 1989. Operational independence also granted through Act.
Sweden	1/1993	Adoption of inflation targeting framework.
United Kingdom	10/1992	Explicit inflation target announced. Also, minutes of policy meetings released within six weeks.
	5/1997	Bank of England Act, establishing operational independence. Immediate disclosure of policy decisions.
	6/1998	Minutes of policy meetings released within 15 days.
United States	2/1994	Target announcements made on day of FOMC meeting. Release of minutes (six week delay), transcripts (five-year delay).
	1/2000	Slight revision to language used in public statement following FOMC meetings. No more 'neutral bias', etc.
	12/2004	Release of minutes accelerated to three-week delay following FOMC meetings.

Table 4: Swanson (2006) Highlighted Changes in FOMC Transparency, 1990 – 2003

Date	FOMC Transparency Change
March 2002	Begins releasing votes of individual Committee members and preferred policy choices of any dissenters
October 2001	Chairman Greenspan delivers a speech highlighting FOMC's moves toward greater transparency
January 2000	Replaces "tilt" with statement describing "balance of risks" to economic outlook
May 1999	Begins announcing policy "tilt" indicating most likely future interest rate action
May 1999	Begins releasing statement about economic outlook even after no change in federal funds rate target
1994-2003	Gradual shifts to longer, more descriptive press releases after FOMC decisions
August 1994	Begins describing state of economy and more detailed rationale for policy action after FOMC decisions
February 1994	Begins explicitly announcing changes in federal funds rate target and rationale for policy action
November 1993	Begins releasing transcripts of FOMC meetings (with five-year lag)
March 1993	Begins releasing minutes of FOMC meetings (with six-eight week lag)
1992-2000	Gradually shifts policy actions to regularly scheduled meeting dates

Table 5: Summary of Output Volatility (3yr)

OutputVol3yr

Percentiles		Smallest		
1%	.0924937	0		
5%	.2825442	0		
10%	.4155731	0	Obs	1520
25%	.7559222	0	Sum of Wgt.	1520
50%	1.516512		Mean	2.213046
		Largest	Std. Dev.	2.653652
75%	2.81859	21.77712		
90%	4.420524	31.11283	Variance	7.041868
95%	6.357056	35.87794	Skewness	5.443117
99%	12.0033	36.17792	Kurtosis	53.73974

Table 6: Summary of Output Volatility (5yr)

OutputVol5yr

	Percentiles	Smallest		
1%	.2496493	0		
5%	.5041845	0		
10%	.7492891	0	Obs	1525
25%	1.229714	0	Sum of Wgt.	1525
50%	1.965599		Mean	2.802425
		Largest	Std. Dev.	2.967505
75%	3.468867	28.68752		
90%	5.321388	28.73524	Variance	8.806084
95%	7.572837	29.12179	Skewness	4.603489
99%	11.65715	30.71081	Kurtosis	35.14156

Table 7: Summary of Financial Market Volatility

FinMktVol

	Percentiles	Smallest		
1%	7.457788	2.393469		
5%	10.37338	4.897316		
10%	12.10873	5.286853	Obs	707
25%	16.12151	6.057586	Sum of Wgt.	707
50%	22.34265		Mean	24.78227
		Largest	Std. Dev.	13.77089
75%	29.06802	95.46481		
90%	39.92401	121.3643	Variance	189.6373
95%	47.62304	127.6435	Skewness	3.014972
99%	81.548	141.5828	Kurtosis	19.89223

Table 8: Summary of Normalized Transparency Index

NormTransIndex

	Percentiles	Smallest		
1%	1	1		
5%	1.62069	1		
10%	1.931034	1	Obs	1560
25%	2.551724	1	Sum of Wgt.	1560
50%	3.482759		Mean	3.927188
		Largest	Std. Dev.	1.916752
75%	5.034483	10		
90%	6.586207	10	Variance	3.67394
95%	7.827586	10	Skewness	.8454788
99%	9.689655	10	Kurtosis	3.200155

Table 9: Summary of Financial Depth

FinDepth

	Percentiles	Smallest		
1%	10.57166	6.723815		
5%	16.21111	7.079881		
10%	19.91758	7.444931	Obs	1482
25%	31.661	7.865406	Sum of Wgt.	1482
50%	48.9179		Mean	61.81856
		Largest	Std. Dev.	46.58257
75%	75.71412	297.3588		
90%	124.055	299.6048	Variance	2169.936
95%	155.4763	324.4374	Skewness	2.016886
99%	238.556	325.3392	Kurtosis	8.152568

Table 10: Summary of Past Inflation

PastInflation

	Percentiles	Smallest		
1%	-2.637336	-10.06749		
5%	-.2856663	-9.797647		
10%	.6993596	-9.616154	Obs	1412
25%	2.237703	-8.813938	Sum of Wgt.	1412
50%	4.708091		Mean	9.163403
		Largest	Std. Dev.	33.84087
75%	9.016831	248.1959		
90%	15.05015	293.6788	Variance	1145.204
95%	23.43543	324.9969	Skewness	22.8761
99%	85.73324	1058.374	Kurtosis	668.2765

Table 11: Summary of Unemployment Rate

UnemployRate

	Percentiles	Smallest		
1%	1	.1		
5%	2	.3		
10%	3.1	.3	Obs	1097
25%	4.8	.4	Sum of Wgt.	1097
50%	7.69		Mean	9.061958
		Largest	Std. Dev.	6.237902
75%	11.5	37.2		
90%	16.2	37.3	Variance	38.91142
95%	21.9	37.6	Skewness	1.776141
99%	32.4	38.4	Kurtosis	7.182487

Table 12: Summary of Rule of Law

RuleLaw

Percentiles		Smallest		
1%	-1.605873	-1.923883		
5%	-1.244672	-1.887967		
10%	-1.059531	-1.843243	Obs	1305
25%	-.6913216	-1.790619	Sum of Wgt.	1305
50%	-.0357404		Mean	.067564
		Largest	Std. Dev.	.9331937
75%	.7547212	1.974424		
90%	1.48567	1.98432	Variance	.8708505
95%	1.776184	1.987512	Skewness	.315838
99%	1.945328	1.99964	Kurtosis	2.147094

Figure 1: Geraats (2002) provides a visual of the theoretical framework of the content and context of information disclosure:

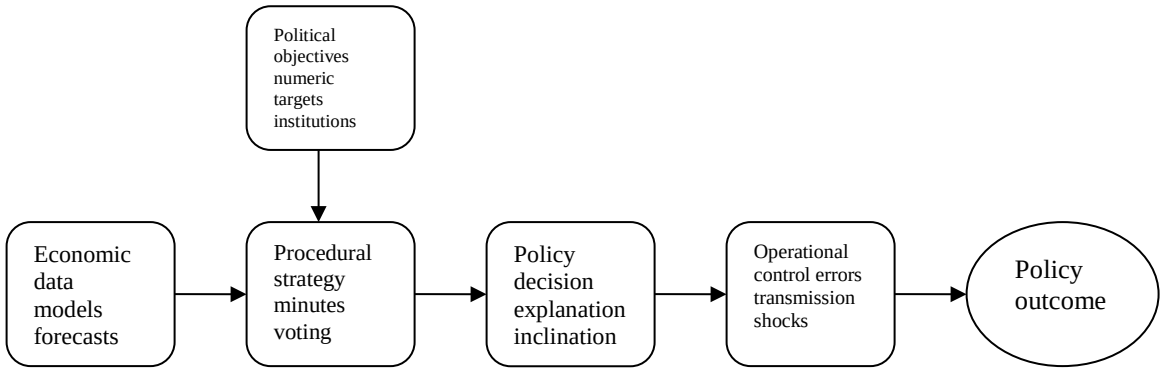


Figure 2:

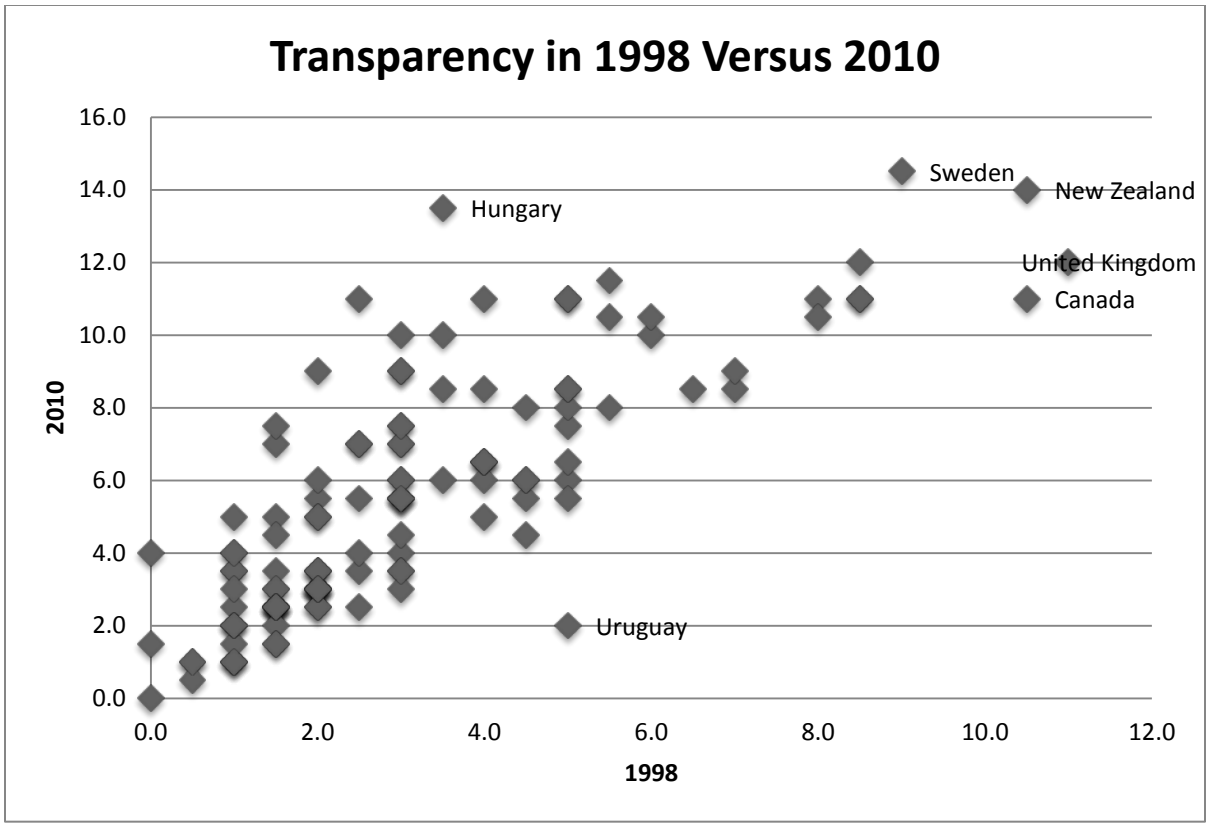

Transparency in 1998 Versus 2010
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2010
0.0
2.0
4.0
6.0
8.0
10.0
12.0
1998
Sweden
New Zealand
Hungary
United Kingdom
Canada
Uruguay

Figure 3:

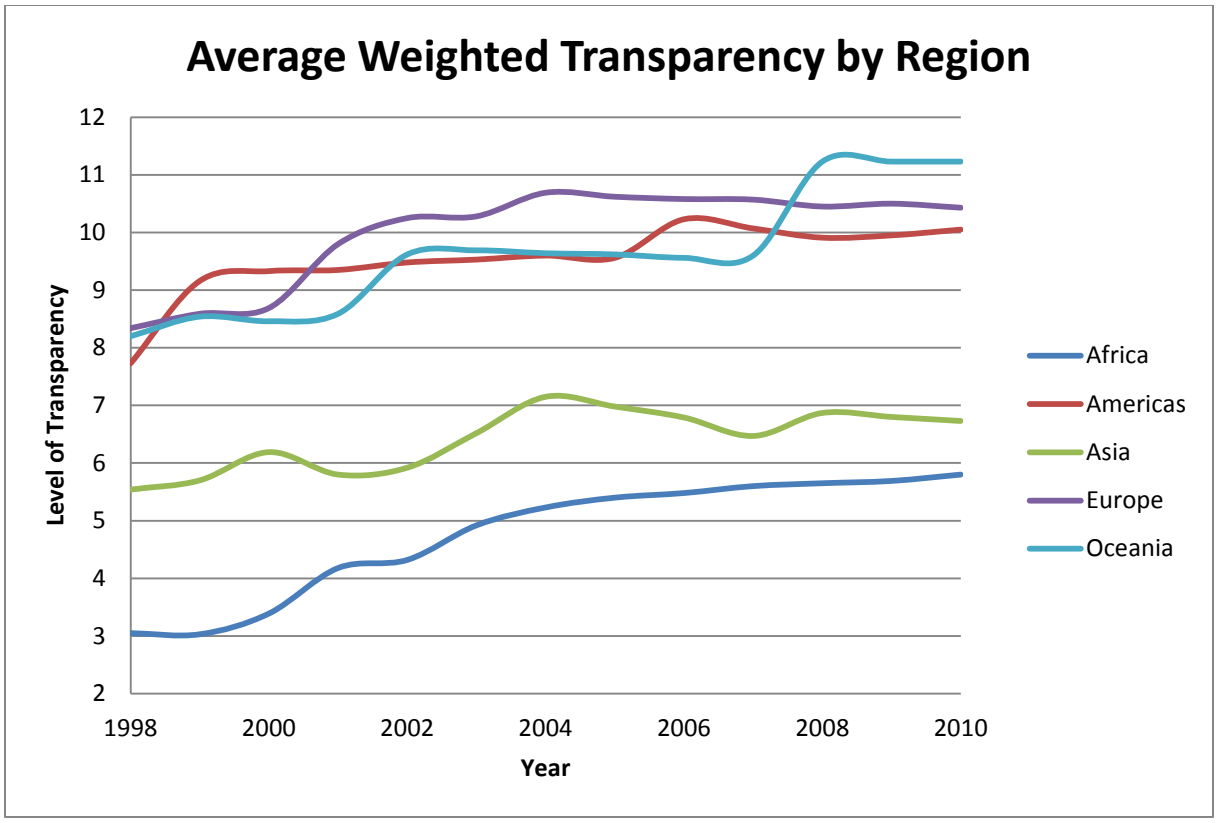


Figure 4:

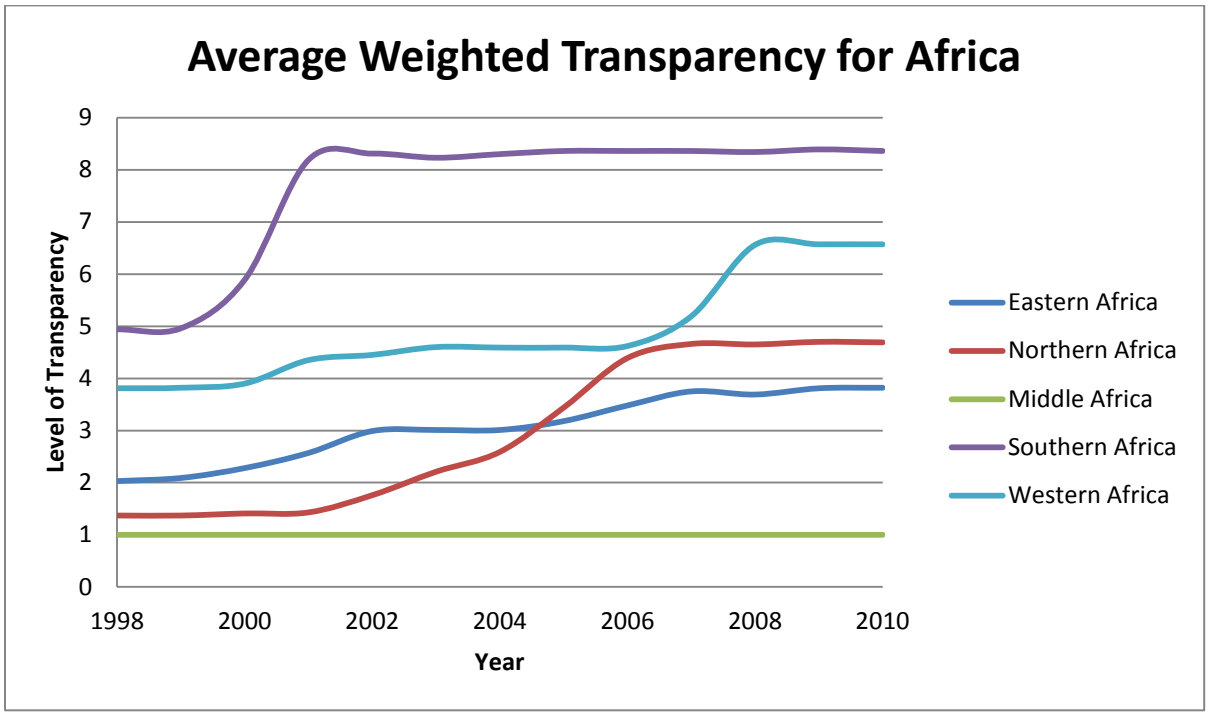


Figure 5:

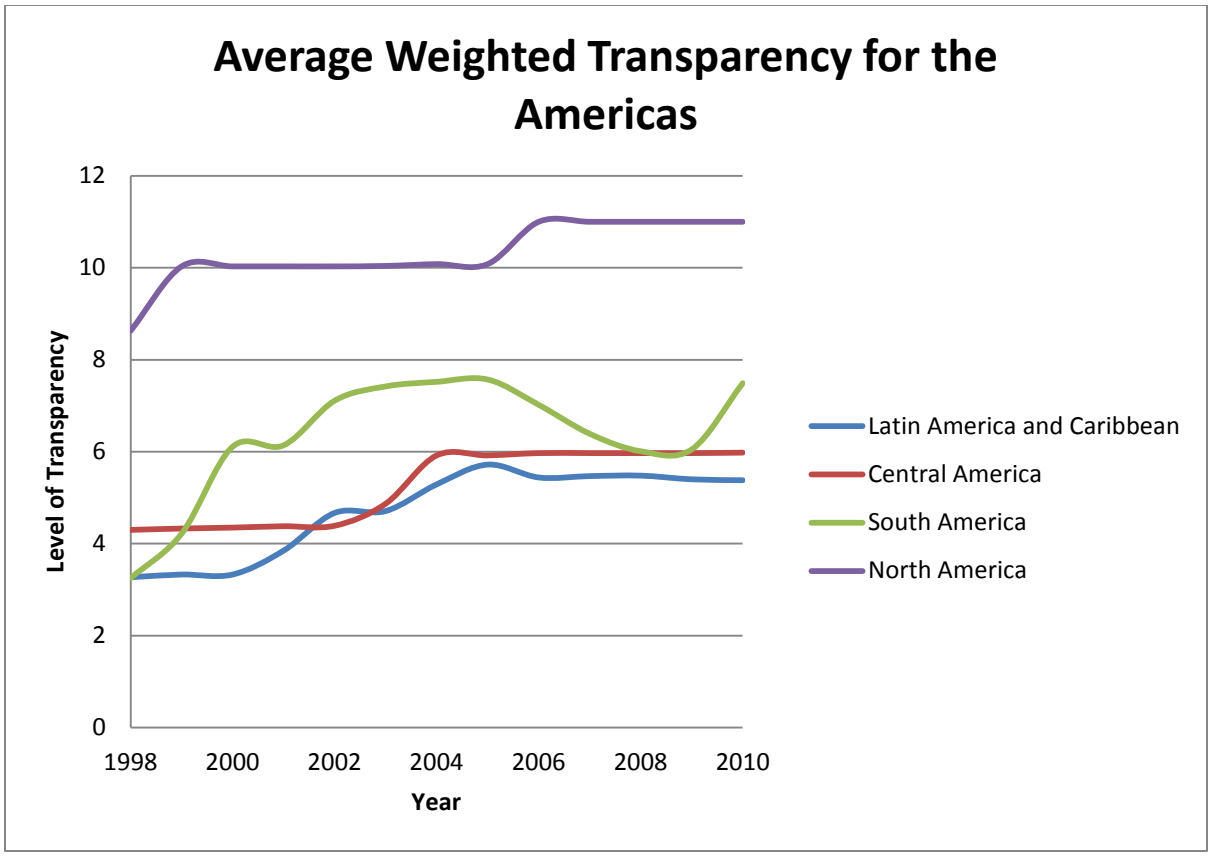

Average Weighted Transparency for the Americas
Level of Transparency
12
10
8
6
4
2
0
1998
2000
2002
2004
2006
2008
2010
Year
Latin America and Caribbean
Central America
South America
North America

Figure 6:

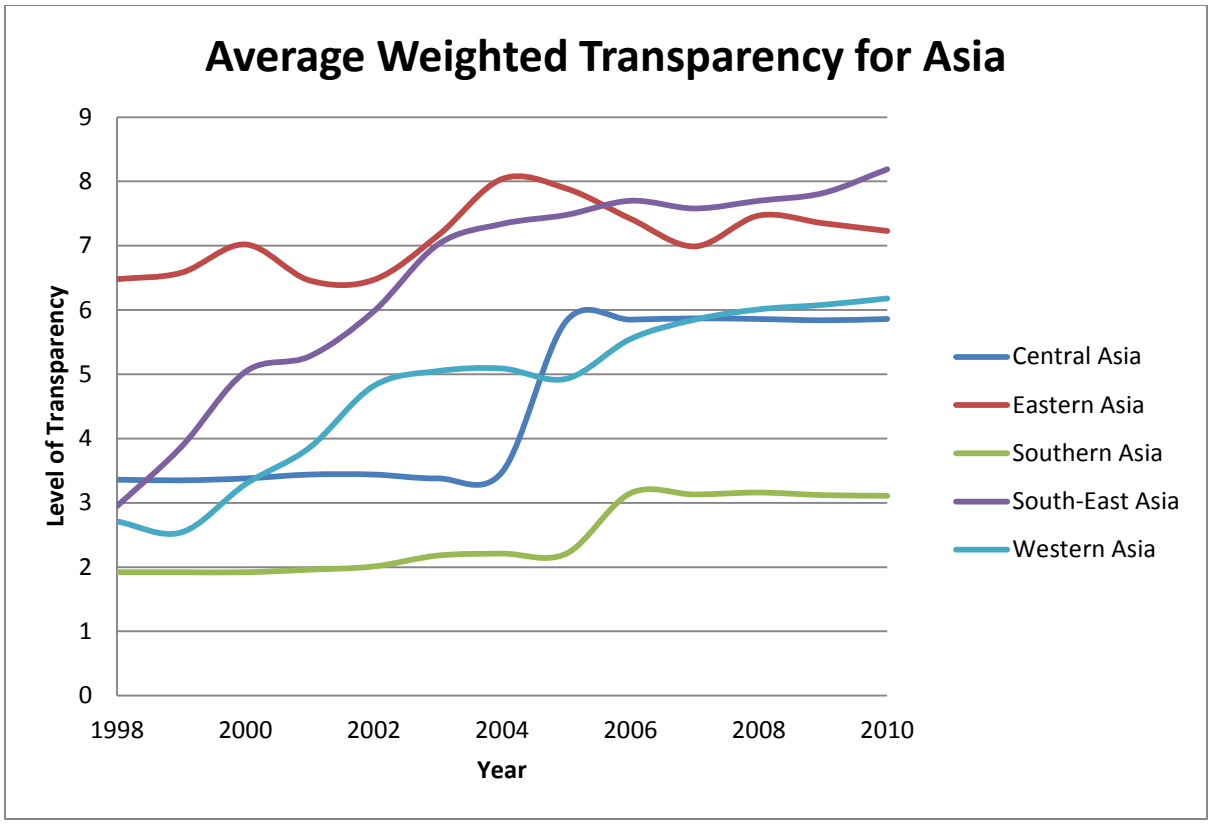


Figure 7:

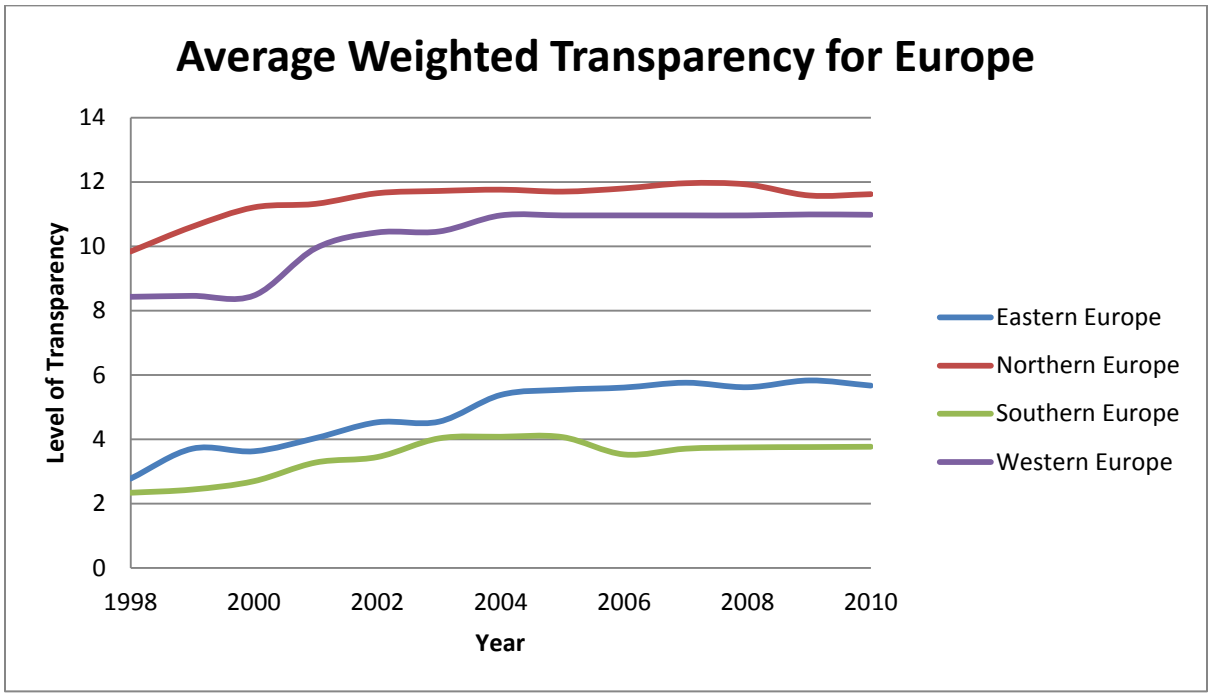


Figure 8:

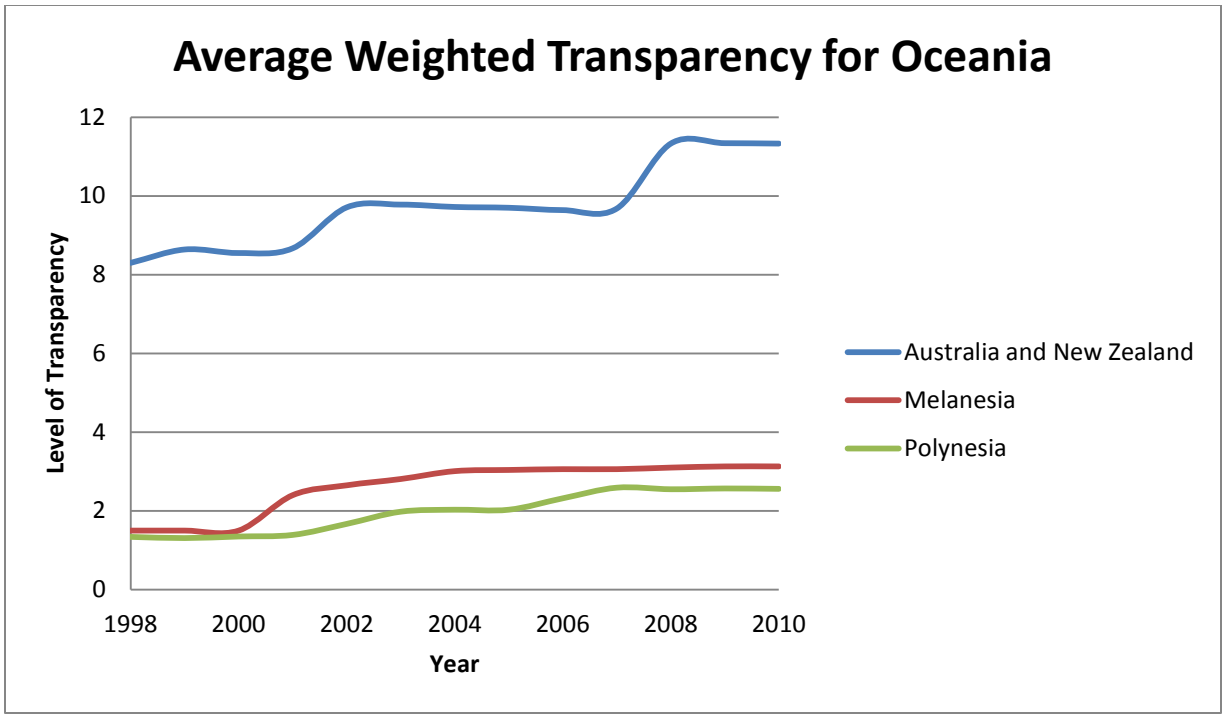
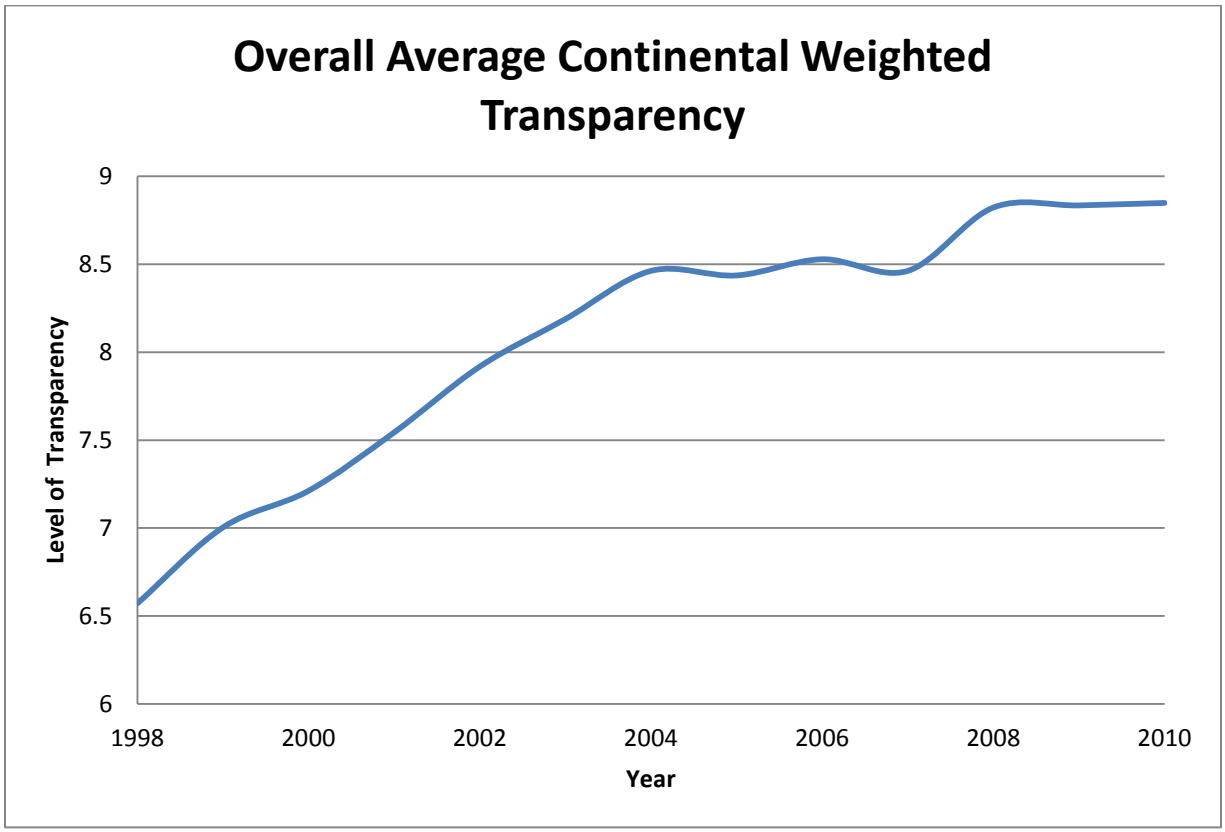

Average Weighted Transparency for Oceania
Level of Transparency
12
10
8
6
4
2
0
1998
2000
2002
2004
2006
2008
2010
Year
Australia and New Zealand
Melanesia
Polynesia

Figure 9:


Overall Average Continental Weighted Transparency
Level of Transparency
9
8.5
8
7.5
7
6.5
6
1998
2000
2002
2004
2006
2008
2010
Year

IX. Abstract

Justine A. Wood

BA, Fordham University

MA, Fordham University

Central Bank Transparency: Examining Volatility in Output and Financial Markets

Dissertation directed by Bartholomew Moore, Ph.D.

This research utilizes the seminal index from Dincer and Eichengreen (2013), which includes values for 120 countries from 1998 to 2010, to examine the effects of the level of central bank transparency on output and financial market volatility. In addition, this paper explores whether a degree of optimal transparency exists.

X. Vita

Justine A. Wood, daughter of Gale Guyre and Ronald Alessandroni, was born in Bronx, NY in 1980. She was raised in New Rochelle, NY until aged 13 and then moved to Mamaroneck, NY. She received a Bachelor of Arts degree in Economics in 2002 from Fordham University and was admitted into the Economics PhD program immediately following her undergraduate degree. Justine received a Master's in Economics in 2006 and her PhD in Economics in 2014. Her areas of specialty are Monetary, International, and Financial Economics. Justine moved to Luton, England to get married in 2010 and has since worked as a Lecturer in Business Economics at Loughborough University.