"The role of central banks in maintaining monetary stability during the global financial crisis"

AUTHORS	Christopher A. Hartwell

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Christopher A. Hartwell (Russia)

The role of central banks in maintaining monetary stability during the global financial crisis

Abstract

The issue of central bank independence (CBI) and its relation to growth and inflation has been a subject of lively debate over the past two decades. Prior empirical work has suggested a relationship between CBI and inflation, with only a tenuous link to growth. In the wake of the global financial crisis, did CBI continue to influence inflation? Did CBI have any effect on either interest rate policies or the growth of credit seen before the crisis? Examining 91 countries from 2003-2010, the author finds that more independent central banks were correlated with lower interest rates from 2003 onward, but showed lower inflation and more restrained bank credit. The results suggest that, in line with earlier theory, independent central banks are a more desirable form of institutional arrangement, but other, better arrangements may exist.

Keywords: central bank independence, global financial crisis, inflation, bank credit, new institutional economics.
JEL Classification: E58, H11, O23.

Introduction

The story of the global financial meltdown has been told in many different ways, but the basic facts and effects are familiar to all: the collapse of the real estate bubble in the United States became a financial crisis that reversed the growth of economies around the world and brought skyrocketing unemployment. The effect of the crisis was varied depending on the particular economy, with advanced economies hardest hit and developing and emerging in the aggregate weathering the storm; however, even within emerging markets, there were wildly different effects.

While much attention has been paid to the governmental responses to the crisis (including the fiscal "stimulus" approach led by the United States and adopted by other countries), the focus on central banks in *creating* the conditions leading to the crisis has been somewhat relegated to the fringes of economic research. Moreover, research that has been done in this area has focused on policies of the central banks during the years preceding the crisis (see, for only one of many examples, Taylor 2008). However, the role of Central Banks (CBs) as the *institutions* in fostering the crisis has been relatively less examined by mainstream economics, an interesting oversight given that Central Banks have been front and center in policy maneuvers to bring the crisis to an end. Indeed, the consensus on the desirability of an independent central bank in the economics profession is so established that even Jürgen Stark, a Member of the Executive Board of the European Central Bank (ECB), noted in a speech in 2011 that "Some aspects of the [pre-crisis monetary] framework, in my

view, will undoubtedly survive the crisis. One is the great and increasingly shared emphasis on central bank independence (CBI)" (Stark 2011).

This paper will attempt to examine a little-explored facet of the CBI debate, a factor that was predominant in the recent financial crisis: the effects of central bank actions and, by extension, central bank independence on the expansion of bank credit in the run-up to and during the global financial crisis. Did central bank independence at the end of the previous global recession (i.e. 2003, when the developed world emerged from the dot-com crash) have an impact on bank credit in the lead-up to, explosion of, and attempted resolution of the crisis in 2008-10? Were more independent central banks able to manage the economy better, including in reining in inflation and credit expansion, than less independent ones? Did the established relationship between independence and inflation continue to hold during the financial crisis?

The paper is organized as followed. Section 1 provides an introduction to the evidence on central bank independence and how it influences economic outcomes, while section 2 explores the relationship between CBI and the effects of the recession, using data on inflation, bank credit, and central bank independence to test the various hypotheses noted above. Section 3 presents the results. Finally, the last section concludes with some thoughts for the future of central bank independence and central banks as institutions in the wake of the global financial difficulties.

1. Literature review: central bank independence and economic outcomes[1]

The question of the institutional imperatives of a central bank, and how they contributed to creating the global financial crisis, is a doubly interesting

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[1] This section is loosely based on work done by Hartwell (2010).

research question, as a large and lively literature about central bank independence (CBI) has already dominated empirical research into the nature of CBs over the past 20 years. The literature on central bank independence derives from a central problem of modern macroeconomic policy, the prevalence and persistence of inflation in both developing and developed economies. With the theoretical Philips curve trade-off between unemployment and inflation challenged by stagflation in the developed world in the 1970s, researchers turned their thoughts to the root causes of inflationary pressures in an economy, focusing on the role of government and its (perhaps paradoxical) incentive in actually creating inflation. In particular, researchers identified three specific incentives for government to generate inflation (Gutierrez, 2003):

1. *Time-inconsistency.* Governments have an incentive to create bursts of inflation in order to boost employment in a supposed Phillips-curve relationship (according to Cukierman (2006), this should lead to moderate, but not necessarily high inflation).
2. *Fiscal chicanery.* Inflation is a boon for the government's fiscal position, as it lowers the burden of debt, and thus governments would be motivated to continue inflating away the debt burden (if not accrue more).
3. *The "revenue motive". G*overnments may print money to finance a deficit, which can trigger sustained and recurring episodes of inflation and hyperinflation (Cukierman (2006) cites Bolivia).

Early debates on the conduct of monetary policy focused on "dynamic inconsistency theories of inflation" (Kydland and Prescott, 1977; Barro and Gordon, 1983), where policymakers have greater incentive to inflate today (due to the theoretical short-term boost to employment this would generate) than not to inflate; thus, the negative political consequences of inflation would be pushed off to another day while the "benefits" would accrue immediately to the benefit of the politicians in power (see Nordhaus, 1975). Extending this model, however, actors outside of the government would already know the incentive of the policymaker to push for inflation, and would factor these expectations into their pricing. With perfect knowledge of policymaker's intent, the theoretical boost from inflation would never materialize, but, however, the inflation would. In Cukierman's (2006, p. 3) words, "employment [would] remain at its nature level but monetary policy is subject to a suboptimal inflationary bias."

In order to resolve this inconsistency and presumably limit inflation, attention shifted to designing mechanisms to either limit the incentives for inflation, or, more importantly, to remove from govern-

ment the power to create this inflation. The well-known "rules versus discretion" debate was a first attempt to resolve this problem, with Barro and Gordon (1983) designing a model to show that monetary rules would provide a lower inflation rate than discretion (however, unfortunately, rules alone would still fail to achieve an optimal rate of inflation for society as a whole). Building on this work, Rogoff (1985) surmised that the problem may not have been the rules *per se* but the actors involved, and suggested that appointing a better policymaker who was more conservative than society in his preferences for inflation would offer the best of both worlds[1].

Rogoff's solution, while somewhat flawed, did trigger a new avenue of research, focusing on the institutional arrangements of monetary policy in an economy and how these facilitated (or hindered) growth. In the context of inflation, the emphasis moved from examining the people running the monetary system and instead to the design of the institutions overseeing monetary policy themselves. It was here, as the institution of central banking itself came under scrutiny, that the literature on central bank independence (CBI) emerged. While not formally under the rubric of "new institutional economics" and the focus on institutions in facilitating economic outcomes, the CBI debate both implicitly and explicitly emphasized similar themes, including the importance of the central bank's own goals and modalities in influencing broader economic metrics.

1.1. Transmission channels. Theoretically, why would an independent central bank be good for an economy? As Laurens, Arnone, and Segalotto (2009, p. 6) note, "in the 1990s, a consensus emerged… that price stability should be the primary objective of monetary policy, and the [central bank] should have sufficient independence as a means to attain this goal." In particular, a central bank that was "independent" from the normal political process and public administration appeared to mitigate the three incentives government had to continue inflation noted above. In the first instance, an independent central bank could avoid the time-inconsistency problem, as an independent bank it would not have the pressure or incentive to deliver temporary boosts to the economy via inflation (presumably because of the lack of political incentive for the bank's governors). Additionally, in regards to fiscal chicanery, an independent bank (and bankers) would be insulated

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[1] Rogoff's solution, familiar to any earnest student of public administration, suffered in that it ignored public choice literature, as well as the emerging literature on institutional economics. Additionally, Alesina et al. (1992) worked within the confines of Rogoff's model to show a case where the "median voter" would ex post wipe out gains of the conservative banker, by replacing the banker with someone more amenable to inflationary temptations.

from the budget process, and thus have no incentive to inflate away the debt burden; indeed, their only concern would be price stability, and this would remove the government's ability to lower debt via debasing the currency. Finally, the "revenue motive" could also be defeated by an independent bank, as, once again, the emphasis on price stability would remove the government's ability to run the printing presses in order to finance a deficit.

These theories were defined and expanded in papers such as Alesina (1988, 1989), Grilli, Masciandaro, and Tabellini (1991), Eijffinger and Schaling (1993), and Cukierman (1992), all of which posited that *de jure* independence led to monetary stability which led to more beneficial macroeconomic outcomes. Assumed under the CBI literature is that a central bank would make use of commonly available transmission mechanisms to effect price stability; indeed, central bank independence and its chain of causality to lower inflation implicitly relies on a rich and full literature on the subject of monetary policy transmission, which investigates how central bank policy would influence the real economy. Papers such as Bernanke and Gertler (1995), Mishkin (1996), and more recently Egert and MacDonald (2009) and Gigineishvili (2011) have noted that there are four transmission channels for monetary policy from the central bank to the economy:

1. *Exchange rates.* Exchange rates are thought to react quickly to monetary policy changes, which then feeds through to domestic prices and affects supply. As Gigineishvili (2011) notes, exchange rate pass-through is usually observed in less-developed countries.
2. *Interest rates.* The most common channel observed in developed economies, changes in interest rates adjust both the price of money and the intertemporal cost of consumption, affecting investment and savings.
3. *Asset prices.* Monetary policy changes, as with interest rate manipulations, changes the cost of capital and thus changes at the margin decisions on consumption and investment.
4. *Credit allocation.* More direct than interest rate adjustments, credit transmission channels involve increasing or decreasing credit supply via central bank purchases/sales or the acquisition of external debt, which then affect consumption, savings, and investment decisions which may change due to the changing supply of credit.

Implicit in the CBI argument is the assumption that an independent central bank will focus its energies on whichever transmission mechanism is most important for price stability, as there is little within the CBI literature that explicitly names the correct transmission channel for monetary policy. The flip side of this argument is thus that a non-independent central bank would succumb to the inflationary bias of discretionary monetary policy also through all means necessary. For example, a key attribute of all measures of central bank independence (see more below) is the presence of legal limits against extension of central bank credit to the government; a non-independent bank would be presumed to extend this credit, thus working through the credit allocation transmission channel and altering both the stock of credit to the private sector and the fiscal policies of the public sector. Additionally, a politically-beholden bank would most likely not only finance deficits through money creation, but also possibly direct credit lending to favored industries. In either case, we should expect to see much higher bank credit available due to the actions of a dependent central bank, than an independent one. Through this channel, inflation would also become a problem as credit outpaced productivity gains in the economy.

The empirical evidence on the relationship between inflation and central bank independence appears to bear out these theoretical precepts on CBI and its influence on macroeconomic outcomes, with some caveats. Early work by Cukierman (1992) showed that the inverse independence/inflation relationship did indeed hold, but only for industrial countries; if developed countries were included in the econometric methodology (which controlled for potential inflation determinants other than CBI), the relationship was barely significant. Later work showed the sensitivity of CBI to other aspects of a nation's economy, with Fuhrer (1997) and Campillo and Miron (1997) presenting cross-country evidence that "if the set of inflation determinants is expanded to include not only a measure of CBI but also a broad range of characteristics… then the negative inflation-CBI correlation evaporates" (Brumm, 2002, p. 205). Brumm (2002) showed that this result may be a part of incorrect econometric methodology, as the methods chosen did not correct for the bias inherent in the indices that were utilized to measure independence (the most popular being those created by Cukierman in his 1992 paper)[1]. On the whole, the literature has somewhat come to a consensus that central bank independence, within a properly functioning legal framework (Hayo and Voigt, 2008; Klomp and de Haan, 2009), can have positive effects, "lower[ing] the mean and variance of inflation" (Eijffinger et al. 1998, p. 73) in both developed and developing countries (Brumm, 2005), but that there may be other factors at play.

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[1] More importantly, Brumm extended this work in 2005 to show that a sample of only developing countries, using a different methodology, would also show a correlation between CBI and lower inflation.

While the prior literature has established a link between CBI and inflation, there has also been an assumption that the legal emphasis in central bank constitutions on price stability means that this is indeed the only goal of an "independent" central bank. However, merely removing the legal requirement to focus on other metrics does not mean that central bank governors will not also target growth or other metrics, nor does "independence" mean that political pressures are entirely removed. As an institution beholden to pressures from both government and the private sector (especially the financial sector), central banks may set their policies to try and split the difference: that is, maintain headline price stability while encouraging other policy goals such as growth. At times, even independent central banks may jettison their focus on price stability in pursuit of other goals.

Following on from the lessons from Rogoff (and as Gutierrez (2003) points out), the central bank and its bankers itself must be held accountable for its actions in pursuing monetary stability in order not to veer from this focus, both to elected officials and to the public at large. The structure of this accountability could take various forms, including the appointment of directors by elected officials for longer-terms (the preferred solution in practice), or an arrangement suggested by Walsh (1995), where a contract is concluded with the central banker that imposes costs on the banker when inflation deviates for an "optimal" level[1]. No matter which oversight mechanism is chosen, however, at no point can a Central Bank ever wholly "independent," as it should have some ultimate accountability to politicians or the public, and can never be wholly insulated from politics. Indeed, the idea that a central bank's independence may be evanescent has been termed by Moser (1999) the "second-order commitment problem," as "if government has the capacity to create a formally independent central bank, it might also be strong enough to overrule its decisions, simply ignore them, or abolish the independent central bank again" (Hayo and Voigt, 2008, p. 752). This problem of second-order commitment has thus far received little attention, but in the era of runaway fiscal policies and global recession, may be an area that can no longer be ignored.
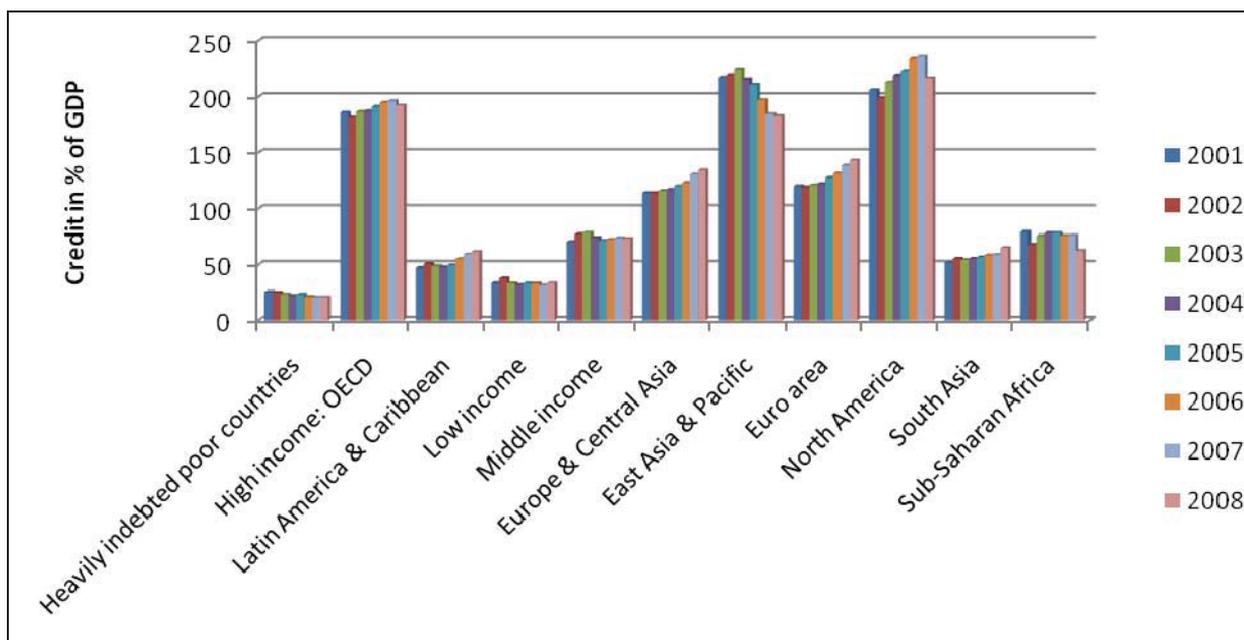
Source: World Bank WDI Database.

Fig. 1. Bank credit as % of GDP in the world (2001-2008)

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[1] Unfortunately, this measure of accountability is rarely, if ever, present in a government bureaucracy and would most likely be difficult to enforce.
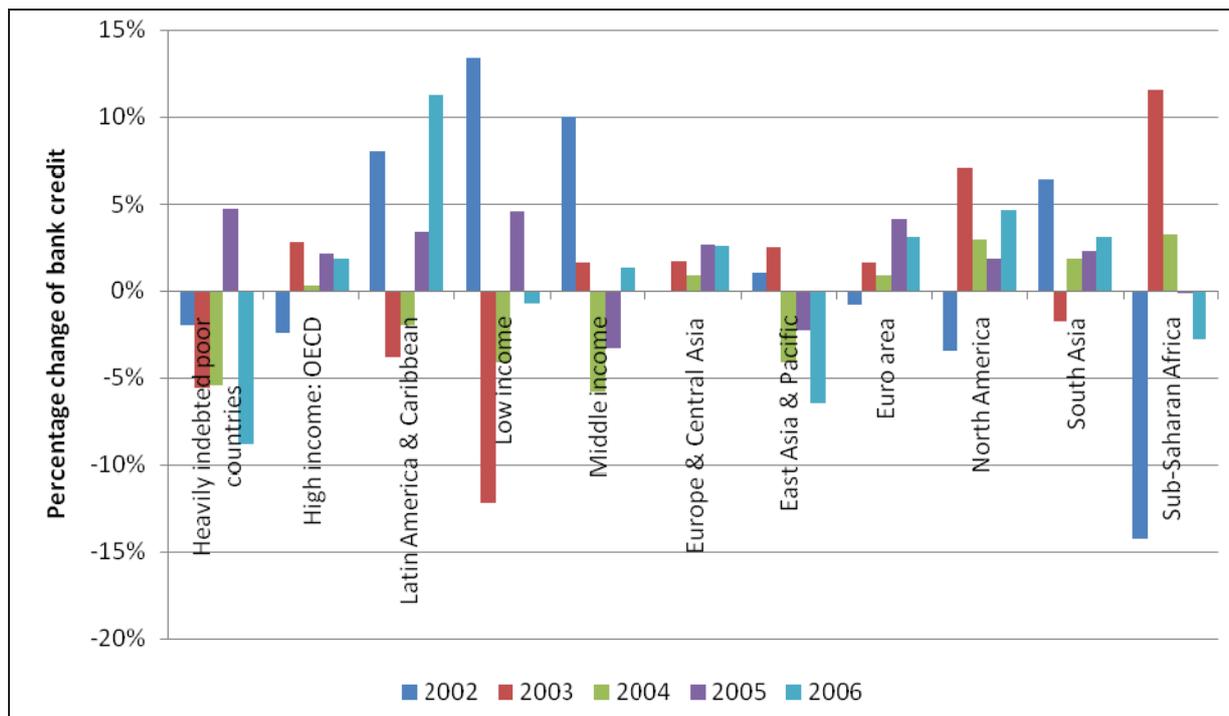
Source: World Bank WDI Database.

Fig. 2. Increase in bank credit as % of GDP in the world (2002-2006)

2. An empirical analysis of CBI and response and recovery during the GFC

Given this theoretical backing for the effects of central bank independence, we come to the heart of the research question: did CBI have an effect on outcomes during the global financial crisis (GFC), one way or the other? While the story of the global financial crisis has been written a million times over, and the root causes and chronology of the crisis is well beyond the scope of this paper, central banks have been tagged by several commentators as the starting point for the GFC, claiming that central banks *pursued overly accommodative monetary policy over an extended period following the recession of 2000-2001 and the initial slow recovery. Monetary policy thus created credit market conditions producing various real estate and related-asset price bubbles... according to the [Taylor] rule the Federal Reserve was overly stimulative in the formative years of the bubble and remained much too stimulative long after the bubble began to deflate* (Foster, 2009).

Using a Taylor rule analysis, researchers at the OECD (Ahrend, Cournède and Price, 2008) concurred that interest rates in the developed countries were indeed far too accommodative during the period from 2002-2005. In tandem with these interest rate policies, bank credit throughout the world was on the increase throughout the period of 2001-2008, as Figure 1 shows. However, in terms of percentage increases, the developed world saw less increase in credit than developing regions of the world, with

Latin America and the Caribbean seeing the largest increases in bank credit as a percentage of GDP (Figure 2). Regardless, absolute increases in bank credit were consistent throughout the world in the 2000s, fueling the asset bubble that eventually burst in 2008.

2.1. Central bank independence and GFC behavior. With the behavior of central banks in the 2000s appearing to have converged on similar policies, specifically focused on lower interest rates, and bank credit in nearly every economy increasing at a fast pace, the question for this section is to examine this reality in light of the CBI literature. While CBI has been linked conclusively to favorable inflation outcomes (and less conclusively to favorable growth outcomes) in periods prior to the global financial crisis, how important was central bank independence in the run-up to the crisis in determining interest rates, inflation, and the expansion of bank credit? Given what we know about the behavior of central banks, is CBI even relevant?

The current global financial crisis has sparked a large amount of research examining the role of central banks in both fostering and quelling the crisis (see, for example, Davies (2008) or Reinhart and Reinhart (2011)), but the current literature on the crisis ignores the expansive literature on CBI and how this may have impacted not only the run-up to the crisis, but how economic outcomes such as inflation were affected. In this section, I'll examine the correlation between central bank independence and the effects of the crisis. Did the extent of CBI influ-

ence monetary policy in the 2000s, as measured by both interest rates and extension of credit by the banking sector? After the crisis hit, were countries with a more independent CBI more or less effective in responding to the crisis? Is there empirical evidence that more independent central banks had fewer effects from the recession?

2.2. The data. I have constructed a database using World Bank and IMF data for 91 countries over 2003-2010 to cover a range of macroeconomic variables, including inflation and credit to the private sector extended by the banking sector, to examine the effects of CBI during this period. A major challenge for this examination is, of course, measuring just how independent a central bank is indeed, this measurement has been its own cottage industry in the economics profession, with Alesina (1988, 1989), Grilli, Masciandaro, and Tabellini (1991), Eijffinger and Schaling (1993), and Cukierman (1992), focusing on the legal, formal mechanisms that separated a Central Bank from a government. These first attempts to quantify independence coded central bank laws according to several dimensions of political independence:

♦ the legal relationship between the central bank and the executive;

♦ the procedure to nominate and dismiss the head of the central bank;

♦ the role of government officials on the central bank board; and

♦ the frequency of contacts between the executive and the bank (Alesina and Summers, 1993).

The gold standard of CBI, led by Cukierman, Webb, and Neyapti (1992, hereafter CWN), combined the legal approach with an emphasis on operational aspects, creating an index based on:

♦ an index of *de jure* legal independence based on the country's Central Bank law;

♦ the actual frequency of turnover of central bank governors; and

♦ questionnaire responses from specialists on monetary policy in 23 countries.

While many economists have criticized the CWN index, with Banaian (2008) providing a comprehensive overview of how a new index could be constructed, for the most part it remains the base methodology for measuring CBI. There is movement afoot to create other measures, however, including a transparency index, formulated by Crowe and Meade (2008), and a plethora of alternative measure suggested in Laurens, Arnone, and Segalotto (2009). Additionally, recent work based on a comprehensive database compiled by the University of Illinois Urbana Champaign may point the way to a more inclusive index based on principal com-

ponents analysis, but remains a work in progress (Hartwell, 2010).

For the purpose of this analysis, I have included the CWN indices from 2003 (the latest year available and the year in the midst of the credit boom) as a determinant of behavior during the run-up to and during the global financial crisis. We will also use Crowe and Meade's transparency index from 1998 and the turnover of central bank governors from 1995-04 as further institutional proxies for central bank independence in the regressions shown below. Finally, recognizing that both monetary policy has a lag of effectiveness and that also that organizations exhibit bureaucratic inertia, the "initial" CWN CBI index from 1989 will be interacted with institutions to examine the "institutional memory" and starting point effects of CBI on inflation and credit over a longer time-series.

2.3. Methodology. To investigate the questions posed above on the effects of CBI on inflation and bank credit during the crisis, we will utilize time-series panel data for a series of regressions with a complement of controls, derived from the literature, specific to each Y variable[1]. In order to counteract the well-known issues with time-series panel data, for most regressions, a fixed-effects estimator using robust standard errors will be utilized to capture country-specific effects (subject to exceptions noted below).

The first research question concerns our survey of central bank behavior in the run-up to the global financial crisis, specifically in the abnormally (as predicted by Taylor rules) low interest rates in the developed economies. As noted above, interest rates are generally the most popular ways for central banks to transmit monetary policy changes; if price stability was indeed the goal, did central bank independence have anything to do with monetary policy in the period 2003-10? Were more independent banks likely to have more "accurate" interest rate policies, or was there another factor driving interest rates? To test this, I will model the following equation

$$IntRate_{it} = \alpha InstQual_{it} + \beta MACRO_{it} +$$

$$+ FinancialSector + \varepsilon_{it}, \quad (1)$$

where *InstQual* is a measure of institutional quality, including central bank independence, *MACRO* is a series of macroeconomic variables derived from previous research found to determine interest rates, and *FinancialSector* is a matrix of various financial sector proxies that are either contemporaneous or

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[1] Unlike the pioneering work from Eiffinger et al.'s (1996) specifications on the effects of CBI, as well as Campillo and Miron (1997) and Sturm and de Haan (2001), I will eschew the use of univariate regressions and move directly into multivariate analysis.

pre-date the period in question and can have influence on current period interest rates.

As this paper in some sense tries to draw on previous NIE empirics and place the central bank independence literature in this approach, the work of institutions in determining interest rates, inflation, and bank credit is our primary question. To this end, a general quality of governance indicator is included in all equations to measure the effects of the institutional environment in affecting inflationary and credit outcomes, beyond just central bank independence. Institutional quality is checked in equations (1)-(3) via two separate proxies, one objective and one subjective: as an objective indicator, I will use change in per capita GDP level as a proxy for general institutional quality, an approach justified on the grounds that higher GDP per capita is correlated with higher institutional quality (and an approach utilized in, among others, Demirgüç-Kunt, and Detragiache (2002)). Additionally, as a subjective measure of institutional quality, I have constructed an institutional quality index derived to measure bureaucratic quality, corruption, and rule of law independent of the central bank in affecting growth. Data for this indicator is taken from the International Country Risk Group's (ICRG) annual rankings of political risk, as compiled by Teorell, Charron, Samanni, Holmberg & Rothstein (2011) for data from 1989-2009 (and updated using the author's calculations), where the three sub-components noted above are combined and standardized to yield a score from 0 to 1.

Under the macro heading of equation (1), inflation is the prime driver of interest rate policies in most central banks (independent or dependent), and has shown in prior research to be a highly significant correlate with interest rates (if not across all time-horizons, as the Fisher hypothesis would suggest, see Mishkin (1992) and Yuhn (1996)). In this specification we will use the lag of inflation, with inflation transformed in equation (a) as in CWN (1992) and Calderon and Schmidt-Hebbel (2009), to avoid giving excessive weight to periods of high inflation. Additionally, the other important macroeconomic control that will be used is the lag of growth, as growth is often utilized by central bankers as a signal of inflationary expectations. We would expect to see higher growth in a prior period correlate with higher interest rates in the current period.

$$\Delta D = \pi / (1 + \Delta \pi) . \qquad (1.1)$$

Finally, the financial sector conditions shown in equation (1) will proxy for the financial sector development of the country in question via two specific indicators, financial system deposits as a percentage of GDP and the bank concentration ratio, both of which come from Beck and Demirgüç-Kunt (2009) and can

proxy respectively for the depth and liberalization of the financial sector. The bank concentration ratio is the ratio of a country's three largest banks' assets to the total banking sector, and is an indicator of the banking structure of a country; more tightly concentrated banking sectors should show more pass-through from central banks than a more fragmented, decentralized sector[1]. These variables will be used both contemporaneously and at their level from 1995, in order to correct for a country's initial conditions and how these may determine interest rates from 2003-2010. Additionally, GDP per capita in 1995 will be included to capture any level effect that is present in regards to interest rate dynamics.

Given the econometric problems that come from utilizing initial conditions in a fixed-effects specification, these variables (and other initial conditions variables noted in equations (2) and (3) below) are utilized in a FGLS regressions with heteroskedastic error structures across panels in order to remove the collinearity effects that would come with FE. More importantly, this FGLS estimator is also used because (as in Havrylyshyn and van Rooden (2003)) the initial condition variables chosen capture more "economic" effects than either a simple fixed-effects specification or initial level of GDP.

After this examination of interest rate behavior in independent central banks, we will turn to the outcomes of CBI, re-opening the debate regarding inflationary outcomes and central bank independence. The base equation for this specification is shown below:

$$\Delta D_{it} = \tau InstQual_{it} + \beta MACRO_{it} +$$

$$+ \delta InitialConditions_{it} + \theta D_{it-1} + \varepsilon_{it} . \qquad (2)$$

Equation (2) examines inflationary outcomes as a function of institutional quality (including central bank independence), initial conditions, and macroeconomic variables. Following Campillo and Miron (1997), Sturm and de Haan (2001), and Andersson, Masuch, and Schiffbauer (2009), macroeconomic variables included under MACRO will include the rate of growth (to capture convergence effects), openness, debt-to-GDP, and lagged inflation as control macroeconomic variables in equation (2) that can influence inflation (openness here, as elsewhere, is defined as the sum of exports and imports in relation to GDP).

Moreover, several iterations of initial conditions are used to measure different facets of development. We eschew the Campillo and Miron (1997) approach of

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[1] As noted by Beck and Demirgüç-Kunt (2009, p. 83), "concentration ratios are still the most readily available market structure indicator across countries and over time," and thus are used here as a proxy for financial sector liberalization.

(log) level of GDP per capita in 1989 (which they use to proxy for financial sector development and/or "inflation-coping" mechanisms) in favor of financial sector development indicators taken from Beck and Demirgüç-Kunt (2009). These include the ratio of deposit money bank claims on domestic nonfinancial real sector to the sum of deposit money bank and Central Bank claims on domestic nonfinancial real sector, bank deposits to GDP, and financial system deposits to GDP and will be utilized to proxy for financial sector development[1]. Under each variable, we will use the level of the variable in 1995 (pre-crisis) as an initial condition. Finally, as noted below, many of these financial sector indicators will be used as instruments in 4 regressions to check for endogeneity.

In addition to financial sector conditions, another initial condition that can prove influential is the history of inflation in a country, shown in our specifications below as the average of inflation from 1960-1988. As above, the addition of initial conditions will shift the estimation technique from FE to FGLS in order to lessen collinearity. It is hoped that the addition of these variables, already proven in the literature to be drivers of inflationary outcomes, can further shed light on the relationship between (the different measurements of) CBI and inflation.

$$\Delta BankCredit_{it} = \alpha INSTITUTIONS_{it} +$$

$$+\tau MACRO_{it} + \beta FINSECTOR_{it} + \varepsilon_{it} \ . \qquad (3)$$

This third base equation examines bank credit as a function of several different factors, as used in recent studies on the determinants of bank credit (see Aisen and Franken, 2010; Guo and Stepanyan, 2011). The first grouping is a series of institutional factors (including central bank independence), while the second grouping is a series of macroeconomic variables to establish economy-wide factors driving credit, and the third grouping is a set of financial sector indicators. As shown above and in equations (1) and (2), the error term is a country-specific term, owing to the fixed-effects specification, while the institutions cluster includes both CBI and the institutional quality indicators noted above.

As a control, under the heading of *MACRO*, we will use variables that have shown significance in past research (see Iossifov and Khamis (2009), who derive their control set from previous literature) for

influencing the amount of bank credit in a country, including[2]:

♦ *Lagged growth*. The state of an economy should affect the amount of credit available to the private sector, with a better economy leading to more credit. As in Guo and Stepanyan (2011, p. 8), the lag of GDP per capita growth will be used "in order to avoid the problem of reverse causality, namely high credit growth leading to higher GDP growth".

♦ *Current account balance*. As in Iossifov and Khamis (2009), the current account balance is utilized as a measure of a country's external financial flows and of the funding costs of a bank. Guo and Stepanyan (2011) second this point by noting that higher current account deficits signal a country's vulnerability, raising the costs of funding bank loans.

♦ *Inflation*. Inflationary environments are bad for lenders, as money lent out in nominal terms is returned lower in real terms. We would expect to see high inflation correlate with lower bank credit. For this check, we use our transformed inflation variable from equation (a).

♦ *External debt*. As a determinant of bank credit, we should expect to see higher levels of external debt act as a deterrent to credit growth. This would be due to two primary effects: first, government borrowing would crowd out private investment (Frait, Geršl, and Seidler, 2011), and second, high levels of debt would cause concerns about a country's overall capacity to meet its external obligations (in the words of Montoro and Rojas-Suarez (2012), a country's debt levels act as a "solvency indicator"). Here, total debt-to-GDP is utilized as the variable.

Finally, a series of financial sector indicators to gauge the depth and breadth of financial intermediation are used, including:

♦ *Money multiplier*. Defined as the ratio of broad money to reserve money, the money multiplier can help to point towards institutional interactions between the central bank and the greater financial sector, as we will utilize it (as per Iossifov and Khamis) as an indicator of efficiency of financial intermediation.

♦ *Foreign bank claims on domestic banks*. Measured in millions of US dollars and taken from BIS data, the extent of foreign bank claims can show the maturity and liberalization of the financial sector. However, as Kamil

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[1] As Campillo and Miron (1997, p. 349) note, "High-income countries might be better at innovating technologies for reducing the costs of inflation, so their inflation aversion might be lower." These indicators are meant to capture these effects directly, more so than an indirect GDP effect.

[2] While their sample is limited to sub-Saharan Africa; their empirical finding can be plausibly theoretically extended to encompass all countries.

and Rai (2010, p. 3) note in the context of Latin America and the Caribbean, "foreign banks were potential vehicles for spreading a crisis that originated in advanced economies into emerging markets. As their financial health deteriorated sharply, banks' global scramble for dollar liquidity and the need to deleverage balance sheets raised concerns that these bank flows could retrench significantly." Thus, during the crisis phase we may expect to see foreign bank claims leading to much less credit in general.

♦ *Lag deposit interest rate*. As the interest rate policies of central banks were a major contributor to the global financial crisis, we should attempt to isolate the interest rate effects on bank credit apart from the other effects that CBI may have. The deposit rate is thus used as a proxy for the overall monetary policy stance of a central bank, rather than its institutional structure. It is lagged to acknowledge the time needed for monetary policy changes to take effect in the real economy.

♦ *Lagged bank credit.* Bank credit, especially to worthy lenders, faces its own inertia that changes only due to major firm-specific events (i.e. bankruptcy) or more gradual macroeconomic events. Thus, bank credit of the prior period should be a major determinant of the future stock of bank credit.

As a final diagnostic check on the data before any statistical analysis is conducted, stationarity tests were performed on each of the variables to ascertain the presence of a unit root. These results, not reported, show that foreign bank claims exhibit unit roots at their levels, and thus these variables are differenced (showing stationarity at their first lags); all other variables, dependent and independent, will be retained "as is" in their regressions.

3. Results

The first metric to be tested is the deposit interest rate of a country from 2003-2008 as a function of institutions, macroeconomic variables, and initial conditions. Using a fixed-effects specification without initial conditions but with contemporaneous financial sector indicators, we see in columns 1-5 of Table 1 that the model is a poor fit, indeed; central bank independence has little influence on interest rates, as does every other variable apart from the lag of inflation (the R-squared for the fixed-effects specification, not shown in Table 1, hovers around the 0.01 mark for each regression). The only central bank independence measure that shows significance is in column 5, an interaction term between the insti-

tutional quality measure and Crow and Meade's (2008) measure of transparency for 1998. The marginal significance of this measure and the overall poor fit of the model, however (R-squared of less than 0.01), argue that this result is a statistical mirage rather than a real relationship.

Interestingly, when we shift to a specification that includes initial conditions as a proxy for country-specific effects, we see a much different picture start to emerge (columns 6-12). Throughout each specification, central bank independence is highly significant and negative. This could be an effect of a lower risk profile for a country, in that a country more likely to have an independent central bank is also likely to have lower political/economic/institutional risks and thus command a lower premium. However, the CBI effect is robust when controlling for institutional quality, GDP per capita, inflation, and financial sector depth, suggesting that the legal independence of a central bank over the period 2003-10 was indeed correlated with lower interest rates than non-independent banks (as the overview above suggested). Indeed, the strongest correlation is found when indicators for both financial sector depth and liberalization are included (column 8).

With lower interest rates, we should expect to one of two effects in the inflationary realm: either interest rates were kept low because of low inflationary pressures, or low interest rates precipitated an increase in inflation through cheap money policies. Moving to test this hypothesis, we return to the area of inflation versus CBI, where empirically there has been the strongest link between CBI and inflationary outcomes. We see the results of the fixed-effects analysis presented in Table 2, using the full set of controls and varying proxies for institutional development. Across all regressions, the previous empirical results hold, as the CBI of a country in 2003 consistently correlates negatively with inflation; higher CBI levels in 2003 are significantly lower from 2003-2010 than lower CBI scores. This result holds even though the effects of institutional quality, as measured by both the ICRG index and GDP level, is consistently insignificant. A further interaction variable between the institutional index and CBI level remains significant (albeit less so), showing that perhaps it is CBI itself and the monetary policy institutions that remain the prime determinant of inflationary outcomes, even in countries with functioning and solid institutional arrangements.

This relationship holds while utilizing another commonly-used proxy for central bank independence, turnover of central bank governors. Taken from Laurens, Arnone, and Segalotto (2009), governor turno-

ver is proxied by an "irregular turnover" dummy, which takes the value of 1 if there is an unscheduled change in central bank management and 0 if otherwise; this variable too behaves as expected, with an irregular turnover correlated with higher inflation (and, presumably, less central bank independence).

Amongst the control variables, openness is consistently positively correlated with inflation (except in the turnover regression, where it flips sign and becomes insignificant), while the initial level of GDP per capita and prior period inflation are also excellent predictors for inflationary performance over 2003-2010. The *R*-squared for these models are somewhat low (generally in the 0.3 range), however, pointing to other factors that need to be explored in order to track determinants of inflation over the past decade.

Introducing the initial conditions variables shown in equation (2) changes our specification, as noted above, to an FGLS regression with heteroskedastic error terms, the results of which are shown in Table 3. Across all financial sector initial conditions, the results are remarkably stable, with only deposit money assets as a percentage of all assets showing significance across all CBI indicators (and bank deposits/GDP and financial system deposits only showing significance when used as a control against turnover). Institutional quality as well throughout the economy is consistently significant and negative, as expected; better institutions should handle inflation better. More importantly, central bank independence by itself, as measured by either the Cukierman index or as irregular turnover, shows no significant relationship (although the direction is as predicted), apart from marginal significance in the presence of the deposit money initial condition. When interacted with institutional quality, however, there is a stable and negatively significant correlation between institutions and inflation. This result validates the theory that central bank independence, in conjunction with other economic institutions within society, ultimately can determine inflation more so than just the legal standing of the central bank alone.

As noted above, early results from CWN (1992) and others have shown that the inflationary outcomes created by CBI only held for developing countries. Checking this hypothesis, the FLGS/Initial conditions results in Table 4 are stratified by a country's income level to see if inflationary outcomes are different at different levels of development (in this specification, only the initial condition of deposit money found to be significant in Table 3 was retained). These regressions suffer from a low number of observations for the low income countries, owing to limited

coverage in terms of the CWN CBI index, increasing somewhat for the irregular turnover dummy. In general, the CBI metrics are the strongest for the low-income countries (with all independence measures showing significance), while institutional quality is the most important determinant of inflationary outcomes in the highest income countries. However, if bank deposits/GDP are included as an initial condition, the outlook somewhat changes (see Table 5) – for the lowest and highest income countries, both CBI in 2003 and the interaction between central bank independence and institutional quality significantly results in lower inflation. For the middle-income countries, there is almost no correlation with any central bank independence measures.

While these results across pooled FGLS and fixed-effects estimations confirm earlier research findings, the sensitivity to initial conditions points to an econometric problem that sometimes seems omnipresent in institutional analysis: endogeneity, an issue that may especially be present in these regressions due to institutions being formed to combat prior episodes of inflation (indeed, this is to some extent the rationale of CBI). To lessen this issue, we also provide in Table 6 a series of reduced form general-to-specific (GETS) instrumental variable equations utilizing the Baltagi and Li (1992) EC2SLS estimator, which should increase gains in small sample efficiency (Baltagi and Li, 2009). In these regressions, we have instrumented both the central bank independence level in 2003 and the institutional interaction between institutions and CBI with the average inflation rate from 1960-1988. This follows from the belief that institutions throughout the economy, including central banks, at one point in time are determined by the environment in which they faced in prior periods. As a further check, we also utilize the various financial sector initial conditions just utilized in the FGLS regressions, including deposit money in 1995 and bank accounts to GDP in 1995.

Using these metrics, Table 6 shows that the GETS modeling has resulted in reduced form equations that have central bank independence as significant across every specification except for in column 5, where bank deposits in 1995 is used as the main instrument. However, even this result changes in the face of the institutional interactions with central bank independence, showing a strong negative correlation with inflation. Indeed, across the IV regressions, central bank independence and institutions, both on their own and interacting with the central bank, appear to be very important determinants of inflation outcomes.

Table 1. Interest rate versus CBI (all specifications)

	1	2	3	4	5	6	7	8	9	10	11	12
	FE	FE	FE	FE	FE	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS
INSTITUTIONAL VARIABLES												
CBI03	-2.42	-1.28	-2.06	-1.11		-1.79	-1.42	-1.92	-1.59	-1.54		
	1.48	0.71	1.26	0.59		5.37**	2.67**	5.45**	4.40**	2.94**		
Institutional quality index	7.10	32.45				-1.72	3.82	-3.96				
	1.41	1.16				2.02*	2.68**	3.95**				
Δ GDP per capita			0.0001	0.0003					0.0005	0.0005		
			0.45	0.65					2.90**	1.70*		
Institutions*transparency					28.15						-3.00	-3.51
					2.08*						4.49**	4.85**
MACRO VARIABLES												
Lag of growth	-0.16	0.07	-0.15	0.04	-0.49	0.006	0.02	-0.001	-0.04	0.04	0.01	0.03
	1.42	0.29	1.4	0.20	2.71**	0.23	0.58	0.37	1.15	0.62	0.24	0.71
Lag of inflation	28.17	70.82	26.79	63.64	25.12	43.71	65.20	42.15	45.00	63.64	61.91	68.07
	2.96**	1.87*	2.78*	1.90*	1.44	13.49**	11.98**	11.80**	13.99**	11.76**	18.15**	20.01**
FINSECTOR VARIABLES												
Financial system deposits/GDP	3.06		1.81		-0.77							
	1.07		0.73		0.19							
Bank concentration		0.72		0.56								
		0.20		0.16								
Financial system deposits/GDP (1995)						-2.19		-2.65	-2.30		-3.24	
						7.03**		7.50**	7.26**		6.49**	
Bank concentration (1995)							-0.96	-1.83		-1.12		1.28
							1.43	3.63**		1.67		1.76*
GDP per capita (1995)						0.0008	-0.0008	0.0004	-0.0002	-0.0002	0.0002	0.0002
						0.57	4.25**	2.41*	1.93*	1.18	1.02	1.57
C	0.55	-16.39	5.07	2.76	0.31	5.78	1.12	8.44	5.01	3.10	5.20	2.12
	0.19	0.74	4.62**	0.44	0.07	9.01**	1.16	10.00**	13.76**	3.93**	10.81**	3.49**
n	360	385	384	411	466	406	410	372	390	393	497	436

Note: Absolute values of *t*-stats are under the coefficients; *, ** denote significance at the 10% and 1% level, respectively.

Table 2. Inflation versus various metrics of CBI, all countries, FE specification

	1	2	3	4	5
	FE	FE	FE	FE	FE
CBI03	-0.05	-0.04	-0.04		
	7.80**	3.86**	3.84**		
Institutional quality index	-0.008		0.02		-0.005
	0.19		0.48		0.17
ΔGDP level		0.00002	0.00002		
		0.65	0.78		
Institutions*CBI (2003)				-0.04	
				2.09*	
Irregular governor turnover					0.02
					2.29*
Lag of growth	0.0005	0.0004	0.0004	0.003	-0.001
	1.63	0.61	0.59	3.67**	0.52
Openness	0.04	0.04	0.04	0.03	-0.003
	4.05**	3.39**	3.37**	3.46**	0.54
Debt/GDP	-0.0001	0.0001	0.00	0.0002	0.0003
	0.45	0.3	0.43	0.81	1.24
Lag inflation	0.34	0.238	0.25	0.26	0.69
	3.81**	2.75**	2.75**	3.27**	8.95**

Table 2 (cont.). Inflation versus various metrics of CBI, all countries, FE specification

	1	2	3	4	5
	FE	FE	FE	FE	FE
C	2482.48	2212.89	2125.79	2778.03	3294.18
	9.30**	8.16**	6.82**	12.59**	7.54
n	315	299	291	315	613
R-squared	0.31	0.31	0.32	0.31	0.16

Note: Absolute values of t-stats are under the coefficients; *, ** denote significance at the 10% and 1% level, respectively.

Table 3. Inflation versus various metrics of CBI, all countries, FGLS specification

	1	2	3	4	5	6	7	8	9	10	11	12
	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS
CBI03	-0.003	-0.01	-0.01	-0.01								
	1.04	1.78*	1.79*	1.49								
Institutional quality index	-0.02	-0.02	-0.02	-0.02					-0.008	-0.02	-0.02	-0.009
	3.88**	3.81**	3.84**	3.44**					1.61	10.13**	7.38**	2.21*
Institutions*CBI (2003)					-0.01	-0.01	-0.01	-0.01				
					1.98*	2.75**	2.77**	2.43*				
Irregular governor turnover									0.004	0.003	0.003	0.0008
									1.80*	1.31	1.33	0.34
Lag of growth	0.002	0.0002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	7.72**	7.85**	7.81**	6.36**	8.56**	8.58**	8.55**	7.06**	8.31**	7.67**	7.91**	7.42**
Openness	-0.0002	0.0002	0.0003	0.001	-0.001	-0.0002	-0.0002	0.001	-0.002	-0.004	-0.004	-0.002
	0.16	0.16	0.22	0.42	0.69	0.18	0.17	0.33	2.04*	3.97**	4.09**	1.66
Debt/GDP	-0.00008	-0.0001	-0.00001	-0.0005	-0.0005	-0.00002	-0.00003	-0.00005	0.0002	0.0002	0.00002	-0.0002
	2.90**	2.08*	2.14*	1.47	1.92*	1.06	1.13	0.20	0.94	0.87	1.06	0.82
Lag inflation	0.46	0.51	0.50	0.53	0.53	0.57	0.57	0.59	0.72	0.70	0.71	0.78
	10.13**	10.66**	10.49**	9.66**	13.02**	13.36**	13.19**	11.63**	37.63**	33.55**	32.70**	31.77**
Deposit money assets/All bank assets (1995)	-0.02				-0.02				-0.009			
	2.87**				3.10**				2.06*			
Bank deposits/ GDP (1995)		-0.002				-0.002				0.04		
		0.97				1.18				2.63**		
Financial system deposits/GDP (1995)			-0.002				-0.003				0.005	
			1.22				1.34				3.42**	
Average inflation (1960-1988)				-0.0002				-0.00005				-0.0001
				0.60				0.17				0.3
C	0.05	0.03	0.03	0.03	0.03	0.012	0.012	0.01	0.013	0.02	0.015	0.009
	5.47**	4.65**	4.70**	3.84**	4.13**	3.39**	3.44**	2.28*	2.02*	5.92**	3.89**	1.83*
n	315	302	302	233	315	302	302	233	606	575	575	475

Note: Absolute values of t-stats are under the coefficients; *, ** denote significance at the 10% and 1% level, respectively.

Table 4. Inflation versus various metrics of CBI, differentiated by income level,
FGLS specification, deposit money initial conditions

	Low income			Middle income			High income		
	1	2	3	4	5	6	7	8	9
	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS
CBI03	-0.34			-0.006			-0.003		
	2.67**			0.66			1.10		
Institutional quality index	-0.49		-0.05	0.02			-0.03		-0.01
	2.76**		1.18	1.06			5.15**		2.01*
Institutions*CBI (2003)		-0.37			-0.017			-0.005	
		1.85*			1.42			1.47	

Table 4 (cont.). Inflation versus various metrics of CBI, differentiated by income level,
FGLS specification, deposit money initial conditions

	Low income			Middle income			High income		
	1	2	3	4	5	6	7	8	9
Irregular governor turnover			0.028			0.002			-0.0005
			2.37*			0.30			0.29
Lag of growth	-0.0007	-0.005	0.004	0.003	0.003	0.002	0.002	0.002	0.002
	0.28	0.18	3.06**	3.70**	3.67**	3.93**	12.86**	12.23**	7.97**
Openness	0.392	0.33	0.03	-0.003	-0.004	-0.003	0.0005	0.0002	-0.002
	3.66**	2.87**	1.06	0.80	1.62	1.14	0.48	0.16	2.66**
Debt/GDP	-0.005	-0.0003	0.0004	0.00005	0.00002	0.00003	-0.0001	-0.00004	-0.00004
	0.48	0.04	2.17*	0.45	0.19	0.57	3.89**	1.71*	2.10*
Lag inflation	0.22	0.29	0.64	0.5	0.51	0.79	0.47	0.54	0.57
	0.86	1.08	9.04**	6.55**	6.67**	22.67**	9.54**	12.85**	12.00**
Deposit money assets/All bank assets (1995)	-0.18	-0.28	-0.024	-0.037	-0.039	-0.019	-0.007	-0.01	0.003
	1.41	2.13*	0.64	2.91**	3.08**	1.66*	1.07	1.44	0.89
C	0.45	0.24	0.009	0.057	0.051	0.016	0.04	0.02	0.12
	3.68**	3.07**	0.33	2.33*	2.35*	1	5.49**	2.77**	2.00*
n	17	17	97	116	116	199	182	182	310

Note: Absolute values of *t*-stats are under the coefficients; *, ** denote significance at the 10% and 1% level, respectively.

Table 5. Inflation versus various metrics of CBI, differentiated by income level,
FGLS specification, bank deposits/GDP initial condition

	Low income			Middle income			High income		
	1	2	3	4	5	6	7	8	9
	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS
CBI03	-0.36			-0.002			-0.006		
	2.95**			0.13			2.00*		
Institutional quality index	-0.48		-0.082	-0.02		-0.006	-0.03		-0.009
	2.76**		1.81*	0.53		0.66	6.37**		1.78*
Institutions*CBI (2003)		-0.42			-0.006			-0.008	
		2.12*			0.51			2.30*	
Irregular governor turnover			0.03			0.0003			-0.0008
			2.24*			0.04			0.43
Lag of growth	-0.0007	-0.001	0.004	0.004	0.004	0.002	0.002	0.002	0.002
	0.28	0.44	2.65**	4.52**	4.58**	3.42**	14.00**	11.99**	8.01**
Openness	0.39	0.33	0.008	0.001	0.0009	-0.006	0.001	0.0009	-0.002
	3.66**	2.92**	0.24	0.42	0.29	2.38*	1.04	0.64	2.10*
Debt/GDP	-0.0005	-0.0001	0.0005	0.0002	0.0003	0.00003	-0.00009	-0.00004	-0.0005
	0.48	0.22	2.29*	2.18*	2.24*	0.59	3.90**	1.50	2.40*
Lag inflation	0.22	0.28	0.61	0.62	0.62	0.81	0.48	0.54	0.55
	0.86	1.02	7.19**	8.46**	8.66**	23.81**	8.98**	9.72**	11.40**
Bank deposits/GDP (1995)	-0.37	-0.59	-0.02	-0.008	-0.01	0.002	-0.003	-0.003	-0.001
	1.41	2.14*	0.19	0.77	1.20	0.29	1.40	1.34	0.73
C	0.43	0.20	0.02	-0.004	-0.01	0.007	0.39	0.012	0.02
	3.61**	3.04**	0.56	0.22	0.69	0.76	6.59**	3.60**	2.81**
n	17	17	83	111	111	197	174	174	295

Note: Absolute values of *t*-stats are under the coefficients; *, ** denote significance at the 10% and 1% level, respectively.

Table 6. Inflation versus various metrics of CBI, all countries, IV-EC2SLS specification

	1	2	3	4	5	6
	EC2SLS	EC2SLS	EC2SLS	EC2SLS	EC2SLS	EC2SLS
CBI03	-0.12		-0.19		-0.03	
	2.30*		2.65**		1.02	
Institutional quality index	-0.02		-0.03		-0.04	
	1.85*		2.21*		5.58**	
Institutions*CBI (2003)		-0.32		-0.09		-0.15
		4.59**		3.80**		6.27**
Lag of growth		0.001			0.001	0.0007
		2.71**			3.10**	1.78*

Table 6 (cont.). Inflation versus various metrics of CBI, all countries, IV-EC2SLS specification

	1	2	3	4	5	6
	EC2SLS	EC2SLS	EC2SLS	EC2SLS	EC2SLS	EC2SLS
Openness	0.01	0.03				
	2.00*	2.79**				
Debt/GDP						
Lag inflation	0.97	0.41	0.85	0.89	0.58	0.35
	37.76**	9.48**	22.87**	32.52**	17.96**	7.97**
C	0.08	0.14	0.15	0.42	0.06	0.09
	2.45*	5.14**	2.97**	3.86**	2.82**	7.47**
n	452	452	565	565	535	535
R-squared	0.82	0.42	0.64	0.80	0.61	0.39
Prime instrument	Inflation 1960-1988	Inflation 1960-1988	Deposit money (1995)	Deposit money (1995)	Bank deposits (1995)	Bank deposits (1995)

Note: Absolute values of t-stats are under the coefficients; *, ** denote significance at the 10% and 1% level, respectively.

Table 7. Bank credit versus various metrics of CBI, all countries, FE specification

	Full control set						GETS modeling		
	1	2	3	4	5	6	7	8	9
INSTITUTIONAL VARIABLES									
CBI (2003)	-12.33	5.09	-13.47				-12.63		
	2.16*	1.68	2.60*				2.31*		
Institutional quality index	-12.82		-6.80						
	0.96		0.47						
Δ GDP per capita		-0.01							
		3.63**							
Institutions*CBI (1989)				-18.36					
				1.99*					
Institutions*CBI (2003)					-20.08			-20.54	
					2.24*			2.41*	
Institutions* Turnover (1995-2004)						-80.84			-24.20
						3.62**			3.18**
MACRO VARIABLES									
Inflation	-45.10	-41.46	-56.90	-11.69	-45.55	-23.92	-39.63	-44.83	-22.6
	4.34**	3.79**	5.42**	2.26*	4.37**	3.11**	3.99**	4.30**	2.85**
Lag GDP growth	0.03	0.05	0.005	0.04	0.04	0.04			
	0.19	0.36	0.04	0.30	0.24	0.32			
Current account balance	-0.32	-0.38	-0.32	-0.28	-0.32	-0.34	-0.33	-0.32	-0.35
	4.04**	4.59**	3.39**	3.33**	4.12**	4.23**	4.19**	3.98**	4.24**
Total debt to GDP	0.0001	0.001	0.001	0.001	0.0005	0.0004			
	0.34	0.68	1.04	1.14	0.36	0.32			
FINSECTOR VARIABLES									
Money multiplier	0.42	0.94	0.44	-0.02	0.41	0.44	0.42	0.41	0.43
	1.89*	3.24**	2.19*	5.83**	1.91*	2.62*	1.90*	1.90*	2.56*
ΔForeign bank claims	-0.001	-0.0001	-0.001	-0.0004	-0.001	-0.0001			
	1.39	1.22	1.46	0.64	1.38	0.82			
Lag deposit interest rate	-0.17	-0.18	-0.006	-0.003	-0.17	-0.004	-0.19	-0.18	-0.004
	2.58*	2.61*	0.07	2.48*	2.59*	7.23**	2.35*	2.22*	7.97**
Lag bank credit	0.85	0.82	0.79	0.88	0.85	0.77	0.85	0.84	0.76
	9.41**	8.15**	8.55**	15.60**	9.54**	14.15**	12.36**	11.34**	14.54**
C	27.97	9.05	26.46	13.82	19.88	25.37	21.03	21.36	29.21
	1.95*	1.13	1.81*	3.65**	2.31*	5.71**	3.75**	3.49**	5.32**
n	404	386	404	1116	404	683	436	407	686
R-squared	0.98	0.96	0.97	0.96	0.98	0.96	0.98	0.97	0.97

Note: Absolute values of t-stats are under the coefficients; *, ** denote significance at the 10% and 1% level, respectively.

Table 8. Bank credit regressions by country income level, FE specification

	1	2	3	4	5	6	7	8
	Income <6050	Income >6050	GETS, Income <6050	GETS, Income >6050	Income <6050	Income >6050	GETS, Income <6050	GETS, Income >6050
INSTITUTIONAL VARIABLES								
CBI (2003)	11.98	-20.19	10.77	-22.41				
	2.91**	2.42*	3.51**	3.61**				
Institutional quality index	-11.28	-53.04						
	1.17	0.69						
Institutions* Turnover (1995-2004)					-60.51	-84.13	-14.20	-81.48
MACRO VARIABLES								
Inflation	-47.92	-8.06	-40.19		-24.18	4.42	-22.39	
	4.60**	0.22	3.81**		2.79**	0.20	3.37**	
Lag GDP growth	-0.07	-0.20			0.29	-0.55	0.29	-0.48
	0.49	0.61			1.71*	1.97*	1.73*	2.07*
Current account balance	-0.32	-0.73	-0.31	-0.27	-0.40	-0.06	-0.44	
	4.71**	2.30*	4.62**	1.78*	4.37**	0.33	5.47**	
Total debt-to-GDP	0.0005	0.001			0.0004	0.003		
	0.29	0.51			0.30	0.72		
FINSECTOR VARIABLES								
Money multiplier	1.12	0.56	1.15	0.67	0.54	0.48		0.42
	5.20**	2.23*	6.22**	2.89**	0.77	1.94*		2.23*
Δ Foreign bank claims	-0.001	-0.001	-0.002		-0.001	-0.0004		
	1.74*	0.56	2.27*		1.66	0.11		
Lag deposit interest rate	-0.08	-0.30			-0.003	0.002	-0.05	
	0.96	2.18*			6.94**	0.04	12.33**	
Lag bank credit	0.85	0.82	0.88	0.63	0.79	0.69	0.79	0.73
	13.29**	4.20**	16.46**	8.08**	20.75**	6.05**	18.44**	8.53**
C	6.83	65.49	-0.31	48.91	15.53	42.19	17.62	39.10
	1.21	0.91	0.20	5.83**	3.68**	2.41*	6.08**	2.84**
n	237	167	267	230	422	261	425	300
R-squared	0.97	0.92	0.97	0.87	0.95	0.94	0.95	0.94

Note: Absolute values of *t*-stats are under the coefficients; *, ** denote significance at the 10% and 1% level, respectively.

With the earlier research results confirmed, we turn to our last, and perhaps more interesting, equation, examining the effect of central bank independence on bank credit. If the result from equation (1) shows that interest rates were lower due to CBI and equation (2)'s analysis confirms that inflation was also lower in countries with more independent central banks, does this mean that the credit channel is instead utilized by central banks to influence the economy? The results of this analysis are shown in Table 7, first as a series of complete regressions with all controls (columns 1-6) and then as a general-to-specific (columns 7-9) analysis in the vein of Hendry (1995). Amongst the control variables across all regressions, inflation, the current account balance, the money multiplier, and the lags of the deposit interest rate and bank credit retain significant (with the money multiplier only marginally significant), and total debt in each specification insignificant. In general, the control variables perform as expected, with inflation, the previous period's interest rate, and current account negatively related to bank credit and the money multiplier and lag of bank credit positively related (although the insignificance of total debt may show that other measurements of debt would perform better as an explanator).

Beyond the controls and in regards to our research question, the majority of regressions with the full control set show that CBI has a negative correlation with bank credit, in line with the theory that more independent banks feel fewer pressures to lend by political masters. The only specification where CBI is insignificant is with the inclusion of GDP per capita as a proxy for institutions (which actually turns CBI positive but again insignificant), but this may be a result of GDP per capita capturing the effects of CBI as well as institutional quality and possibly other variables. In the baseline regression of column 1, we see that CBI, even when other institutions are controlled for, shows up as negatively related to bank credit. This result is robust to a further specification that uses both country-level and time-level fixed effects, shown in column 3 of Table 7; indeed, the CBI effect is more pronounced with time effects, and the year variables (not reported) show significance for 2003, 2004, and 2006. Apparently, other institutional or macroeconomic variables were driving the explosion of bank credit in the 2000s other than legal central bank independence; indeed, it appears that legal central bank independence helped to restrain credit growth that might have been even more accelerated.

Moreover, this result holds in the face of the addition of a full complement of institutional interactions (columns 4-6 and columns 8 and 9). Here, institutional interactions between institutional quality and CBI are utilized to solve two issues; firstly, an econometric issue, is to lessen collinearity that comes from the central bank independence variables, and the other, theoretical issue, is to measure how effective institutions throughout the economy interact with central bank independence (the theory being that an independent central bank may be thwarted without effective economic institutions around it). The institutional interaction variables show the same pattern in regards to bank credit – a mild yet significant negative correlation between central bank independence and bank credit holds across every single CBI metric utilized, including CWN CBI in 2003, and a more significant negative correlation between the interaction of institutions and turnover from 1995-2004[1]. Interactions with CBI in 1989 were also included to extend the time series out 21 years, well before the global financial crisis, and this longer series showed a similar magnitude and significance of CBI on bank credit. In short, it appears that quality institutions and an independent central bank can help to rein in excess, at least in contrast to less independent banks.

But does this effect hold across all types of economies? While Cukierman's (1992) original study famously found that CBI influenced inflationary outcomes for developing countries only, a result we confirmed in Tables 4 and 5, does a similar pattern hold for bank credit? As a check on this question, I have repeated the regressions from Table 6 on various income levels (beyond merely including a dummy for "developed" versus "developing"), and some incredibly interesting results obtain. Under this specification, more independent central banks actually are correlated with much *higher* levels of bank credit at lower levels of per capita GDP. Utilizing various thresholds of income (Table 8), we find that the effect of a more independent central bank on bank credit becomes more significant and more positive the poorer a country is, with the sign flipping of the influence of CBI on bank credit above a threshold of about $6,050 per person; above this amount, CBI is significant and *negative*, while below this amount CBI is significant and *positive* (columns 1 and 2). This result is robust to a GETS analysis, shown in columns 3 and 4 of Table 8; indeed, the GETS modeling leads to a much more significant result for CBI's influence on bank credit in both the higher-income (i.e. above $6,050 per

capita GDP) and lower income countries. This econometric issue comports with the trends noted in Figure 2 above – notably, the vast majority of countries in Latin American and the Caribbean have per capita income under $6,050 and also have the highest increase in bank credit.

There are several possible economic explanations for the behavior of CBI at lower and higher levels of income. The most plausible, I believe, can be explained by standard theories regarding institutional development, including the correlation between better institutions writ large and income levels. At lower levels of development, we expect to see poorer formal institutions (such as a central bank), but stronger informal and societal institutions. If a central bank is given more leeway in determining policies while itself not having the capacity to implement these policies, and at the same time being more susceptible to non-governmental pressure, there is a high probability that the bank will not really be "independent" and thus may be susceptible to politically-motivated credit generation.

This hypothesis is mostly confirmed if we use another metric of CBI, the interaction between institutions and turnover, as an explanator for bank credit. Using this variable (columns 5-8 of Table 8, including a GETS analysis), we see that even for lower levels of GDP per capita, lower turnover and better institutions lead to more judicious issuance of bank credit, while for higher levels of income the interaction of institutions and turnover is insignificant (the greater prevalence of turnover data also gives us more data points to examine, lending more credence to its effects at lower levels). Thus, even if a central bank is legally independent, unless it can utilize this independence, it may still be subjected to political pressures, especially in countries with lower incomes.

Conclusion

The issue of central bank independence has been a thriving and rich source of research in the economics literature over the past two decades, an area that continues to be investigated as the economics profession becomes more interested in the way that institutions influence outcomes. This paper has re-opened the debate regarding central bank independence and inflation by including the influence of institutions during the global financial crisis; more importantly, it has broken new ground in examining the link between expansion of bank credit and central bank independence (again with reference to institutions) during the same period.

In particular, the results of our regressions showed that interest rates were lower in countries with more independent central banks, while inflation remained low and bank credit also appeared

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[1] Given that higher turnover should be less desirable, while institutional quality is rated with higher numbers meaning better quality, turnover is standardized in the variables as (1-turnover) to preserve the correct direction.

to be lower in countries with more independent central banks. This last result is tempered by the further finding that lower income countries with more independent central banks actually saw higher levels of bank credit, suggesting that low-income independent banks may not be as independent as their legal charters purport.

These findings suggest further avenues of research regarding CBI, the run-up to the crisis, and the response thereafter. The key area that could stand further research is if CBI did actually maintain itself through the financial crisis. Given that the last coding of CBI indices was either for 2003 (CWN) or 2006 (Crowe-Meade), we still have no sense if independence shifted as governments mobilized a response. Was CBI reined in so that the recessionary contraction was mitigated, with central banks shifting from their normal focus on inflation targeting to output targeting or credit expansion? There is evidence under the heading of "quantitative easing" that this is indeed what happened, as central banks sought to cushion the crisis through credit transmission channels. Finding if CBI changed from 2003 to 2008

would perhaps explain better the behavior during the crisis; as it stands now, we can only roughly state that banks that were more independent in 2003 had lower bank credit than perhaps what might have been. In short, independence might have mitigated some of the damage through institutional memory.

The key question that emerges from this examination, however, is an old one: does CBI even matter? Given the role central banks may have played in creating the crisis and then their work in responding to it, does the institutional make-up of a central bank have as much of an effect as the models and policies pursued? This may be a throw-back to the early days of the CBI literature (such as with Barro and Gordon (1983)), but if the institution of the central bank was independent during the asset price boom of the 2000s and the price bubble still occurred (albeit at less damage than if a central bank was not independent), might there still be other institutional arrangements that can bring still better outcomes? That is, is central bank independence the pinnacle of what a monetary institution should look like, or is there something better? This remains to be seen.

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