Central Bank Independence and Fiscal Policy: Incentives to Spend and Constraints on the Executive

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Abstract

Independent central banks prefer balanced budgets due to the long-run connection between deficits and inflation and can enforce their preference through interest rate increases and denial of credit to the government. We argue that legal central bank independence (CBI) deters fiscal deficits predominantly in countries with rule of law and impartial contract enforcement, a free press and constraints on executive power. More, we suggest that CBI may not affect fiscal deficits in a counter-cyclical fashion, but, rather, depending on the electoral calendar and government partisanship. We test our hypotheses with new yearly data on legal CBI for 78 countries from 1970 to 2007. Results show that CBI restrains deficits only in democracies, during non-election years and under left government tenures.

1. Introduction

In the 1990s countries worldwide started to reform their central bank laws, removing monetary policy from the hands of the government. This means that the newly independent central banks can change interest rates, target the exchange rate or the money supply to ensure price stability or low inflation[1], without regard to incumbent approval ratings or re-election prospects. Because central bank independence (CBI) has been designed as an institutional mechanism for keeping a check on inflation, most analyses focus on the effect of such independence on inflation and its potential trade-off with economic growth (Grilli 1991, Cukierman et al. 1992, Franzese 1999, Franzese 2002a, Broz 2002, Keefer and Stasavage 2003, Crowe and Meade 2008).

This article analyzes the effect of the independent status of the central bank on countries' budget deficits or surpluses, with a focus on the preferences of independent central banks vis-à-vis fiscal policy and the ability and willingness of the bank to enforce such preferences. The consequence of the trend towards CBI is that governments lose an important means to influence the economy and rely increasingly on their remaining policies, especially fiscal spending. Still, time and again, independent central bankers respond to governments' budget plans with public statements urging them to limit spending to available taxes and avoid deficits. For example, the European Central Bank's introductory statement to its President's monthly press conference habitually asks for euro area fiscal restraint. Also, Alan Greenspan, the former Chairman of the US Federal Reserve, pled with Congress in 2002 to control spending: "The budget enforcement rules are set to expire.[2] Failing to preserve them would be a grave mistake. For without clear direction and constructive goals, the inbuilt political bias in favor of budget deficits likely will again become entrenched" (Greenspan 2008: 235). Anecdotal evidence also shows more direct threats of tight monetary policy in response to fiscal deficits: In 2010, Axel Weber, then

[1] Central banks have other legal tasks, including balanced economic growth or financial stability. More independent banks are tasked exclusively with price stability.

[2] Greenspan refers to the expiration of the Budget Enforcement Act of 1990.

German Bundesbank president, warned that "excessive deficits can cause tensions with monetary policy and may require higher interest rates if not corrected" and Mervyn King, at the time Bank of England governor, noted that "uncertainty about how and when fiscal policy will respond has a direct bearing on monetary policy"[3]. Why do central bankers venture into a clear domain of political choice like fiscal policy and does it matter for fiscal discipline?

Independent central banks prefer budget discipline because of the long run connection between deficits and inflation and can pursue their fiscal policy preference through interest rate hikes and refusal to lend to the government. CBI is, however, generally granted via regular legislation and there are risks to bank independence that come from implicit or explicit threats to amend the law. We argue therefore that legal central bank independence has a deterrent effect on fiscal deficits that is conditioned by domestic political institutions. Democracies with strong rule of law have overlapping mechanisms that increase the chance that the central bank can de facto deter the government in fiscal spending. We suggest that political constraints and transparency are prominent among such mechanisms. We further argue that, even in democracies, central banks will pragmatically guard their formal, de jure, independence by accommodating deficits under conditions related to the electoral calendar and government partisanship. The central bank will thus avoid pushing for lower deficits when the government has an intense distaste for fiscal consolidation or is ideologically close to the central bank.

Legal CBI has been adopted in countries with a wide range of political institutions. We test our argument on a sample of 78 democracies, mixed regimes and dictatorships from 1970 to 2007. We use an author coded central bank independence index based on the Cukierman et al. (1992) criteria that is an empirical improvement over existing data sources: The index covers a large number of countries in an annual fashion and captures the legal reforms of the past twenty years.[4] Our estimations strongly support

[3] The Wall Street Journal Europe, 1/ 20/2010: "Weber seen in ECB race"; "King warns on deficit".

[4] Previous CBI data is aggregated to decade averages (Grilli et al. 1991, Cukierman et al. 1992) or focuses on single regions (Cukierman 2002, Jacome and Vasquez 2008, Bodea 2013), two points in time

the argument: Democracies with independent central banks have lower fiscal deficits and this effect is driven both by constraints on the executive and by media freedom. We also find that, in democracies, CBI reduces fiscal deficits in non-election years and during the tenure of left-wing executives. In contrast to this politically non-neutral behavior, bank independence does not improve fiscal balance in an optimal, counter-cyclical fashion, during periods of economic growth. These results are robust to different estimation methods, exclusion of outliers and inclusion of numerous controls.

The paper makes important contributions to extant research. First it provides a unifying theoretical framework linking institutional CBI to fiscal performance across political regimes and extends the empirical tests of this relationship beyond research in developed countries (Grilli et al. 1991, Jonsson 1995, Franzese 2002a). Second, the literature already suggests ways to reform the budget process to mitigate deficit spending, including through budget transparency, centralization of fiscal decisions or balanced budget provisions (Alt and Lawry 1994, Alesina et al. 1999, Hallerberg and Marier 2004, Alt and Lassen 2006). We show that legal CBI (conditioned by political institutions) not just contributes to low inflation but also deters fiscal deficits.

We proceed as follows: Section 2 reviews the causes and remedies for fiscal deficits. Section 3 explains how independent central banks can pursue their fiscal policy preferences. Section 4 identifies political conditions that allow a de facto influence of the central bank and derives testable hypotheses. Section 5 describes the research design. Section 6 discusses the empirical results. Section 7 concludes.

2. Fiscal deficits

Fiscal policy, including temporary deficits that result from counter-cyclical government policy during recessions (Grilli et al. 1991, Alt and Lowry 1994), can be a powerful contributor to investment in human and physical capital or risk sharing. A significant body of empirical research shows, however, that there are important benefits to sound public finance (Easterly et al. 1994, Fatas and Mihov 2003,

(Crowe and Meade 2008) or a particular decade (Polillo and Guillen 2005; Eichengreen and Dincer 2010). The data is available on the authors' websites.

Ardagna et al. 2007). This work shows that fiscal deficits and high debt reduce economic growth, increase its volatility and increase long term interest rates. Fiscal crises are also costly, with immediate and long term declines of growth around episodes of sovereign debt default (Furceri and Zdzienicka 2012, Borensztein and Panizza 2009).

Much deficit spending defies the economic cycle and can be traced to political conditions that drive countries to accumulate excessive debt.[5] For example, the common pool resource problem generates deficits because benefits are targeted at specific groups, while revenues come from general taxation. According to this logic, more spending occurs when politicians appeal directly to voters rather than party bosses (Hallerberg and Marier 2004), in proportional electoral systems (Milesi-Ferretti et al. 2002) or in democracies (Gasiorowski 2000). Partisanship is argued to be another source of spending beyond available taxes: Deficits may occur under the left (Hibbs 1987) due to constituency pressures, or, under conservative governments who are uncertain about re-election and aim to constrain the future choices of the left (Persson and Svensson 1989).[6] Deficits can also result from election year manipulation of the economy (Nordhaus 1975). Part of the literature finds that electoral cycles only occur in new democracies or less developed countries (Schuknecht 1996, Brender and Drazen 2005, Hallerberg et al. 2002), while other research identifies circumstances altering the benefits of fiscal cycles, including budget transparency (Alt and Lassen 2006) or the exchange rate regime, trade and capital account openness (O'Mahony 2011, Clark and Hallerberg 2000).

Because of the negative consequences of debt, policy-makers have turned to institutional designs to limit fiscal deficits. Several institutions are shown to promote budget discipline, including: balanced budget laws (Alt and Lawry 1994); delegation to the executive of agenda power and monitoring over the budget (Alesina et al. 1999, Von Hagen 2002, Hallerberg and Marier 2004); contracts among key veto players for multi-annual fiscal programs and spending targets (Hallerberg 2004); and limits on

[5] Eslava (2011), Franzese (2002b) survey the politics of fiscal deficits.

[6] The evidence on partisan budget cycles is mixed (Franzese 2002b), reflecting ambiguous predictions.

parliamentary budget amendments (Wehner 2010). In the next two sections we argue that an important constraint on fiscal deficits comes from the interaction between fiscal and monetary authorities, i.e. the government and the central bank.

The link between fiscal deficits and CBI is an important potential effect of CBI. The early research thought that an autonomous central bank could be an institutional solution for low inflation, that would also lower the cost of capital and improve fiscal performance, without costs in terms of economic growth (Grilli et al. 1991, Alesina and Summers 1993). The direct connection from CBI to fiscal deficits has been tested before, with mixed findings for both developed countries (Grilli et al 1991, Leone 1991, Barnhart and Darrat 1987, Franseze 2002a, Burdekin and Laney 1988, Jonsson 1995) and developing nations (Sikken and de Haan 1998, Bodea 2013). The mixed results have remained un-reconciled for several reasons: First, extant research made little progress covering consistently the central bank reforms in the last two decades: Data remained aggregated to decade averages, or focused on single regions, two points in time or a particular decade of the most recent reforms. This has limited not just work on the interaction of fiscal and monetary policy, which is at the heart of this paper, but also research on the posited key effect of CBI on inflation (Bodea and Hicks 2012).

In addition, CBI should deter deficits only if the bank's concern with inflation is credible. Political economy research has made strides in understanding when legal CBI is credible and thus able to lower inflation (Keefer and Stasavage 2003, Broz 2002). Yet these theoretical innovations have lagged application to the interaction between central banks and fiscal policy. Instead, recent work has downplayed the role of central banks in fiscal policy. Research focused on the effectiveness of fiscal policy in an open economy Mundell-Fleming framework has generated important insights on electoral cycles and the convergence of partisan policies (Oatley 1999, Clark and Hallerberg 2000, Clark 2003). In this work CBI is argued to be ineffective under fixed exchange rates and mobile international capital because of an assumption that the central bank is tied to defending the fixed rate. Under flexible exchange rates, on the other hand, fiscal policy lacks effectiveness when capital is mobile internationally

and will therefore not be used by governments, rendering CBI superfluous as a check on fiscal choices. Both of these claims can be plausibly countered, we argue. Simply put, it is governments and not central banks that make exchange rate commitments. Independent banks tend to be focused on inflation rather than exchange rate stability, so they will not necessarily accommodate expansionary fiscal policy. The consequence is that fiscally irresponsible governments facing CBI may have to adjust their exchange rate regimes, as seen in increased exchange rate volatility (Bearce 2008) or less cooperation in the gold standard (Simmons 1996). In addition, O'Mahony (2011) points out that rigidities in international asset markets and consumer's lack of anticipation of higher future taxes, may explain why more government spending generates (surprisingly) output and consumption growth even under flexible exchange rates. This implies that governments still have incentives to use fiscal deficits even under flexible exchange rates, which, theoretically, leaves room for CBI's influence.

It remains therefore a theoretical and empirical question whether and when central banks influence fiscal deficits. We tease out the preferences of an independent central bank in fiscal policy and explain how deterring fiscal deficits may work. In the next step we tie successful deterrence of deficits to conditions when central banks can credibly pursue an independent monetary policy.

3. Fiscal policy and central bank preferences

CBI has long been linked to low inflation.[7] Central bankers are on average more conservative with regards to price stability than elected politicians (Rogoff 1985, Lohmann 1992, Blinder 1998) and legal independence can insulate monetary policy from political cycles, thus, moving it closer to the central banker's preferences. Central bankers also have conservative preferences over fiscal policy, reflecting the idea that, over the long term, one way to deal with persistent budget deficits is to allow inflation to diminish the value of debt. Recent research substantiates the link convincingly: Developed countries with large debt or fiscal deficits pay a premium on long term interest rates, reflecting bond markets'

[7] Early work includes Cukierman et al. (1992), Grilli et al. (1991), Alesina and Summers (1993).

higher inflationary expectations (Ardagna et al. 2007, Laubach 2009, Baldacci and Kumar 2010).[8] Also, Treisman (2000) and Neyapti (2003) show that deficits contribute to inflation when the central bank lacks independence. Thus, recurring fiscal deficits breed the specter of political pressure to accommodate future inflation.

Yet, the central bank, if independent, can deter deficits by raising government borrowing costs through short-term interest rate increases and by refusing to lend directly to the government. Higher short-term interest rates affect long-term bond rates, thus raising the costs of government financing debt. That is, a combination of fiscal deficits and retaliatory tight monetary policy is likely to increase the interest rates at which markets are willing to finance fiscal deficits. Also, while the central bank is not intent on provoking recessions, higher short-term interest rates also reduce economic growth.

Real world examples of central bank statements or retaliatory increases of short-term interest rates are rare, both because interactions between the central bank and the government are not public[9] and because central bank retaliation need not materialize if the bank is actually successful at deterring fiscal deficits. Still, one clear example comes from the German Bundesbank. In January 1955 the German central bank warned the government not to turn to fiscal deficits while the economy was experiencing economic growth. The initial admonitions were followed by the "highly visible warning signal of a

[8] Default risk associated with high debt may be another cause for interest rate increases. However, Laubach (2009) shows that, even for the US, one percentage point rise in the projected deficit raises long-term interest rates by 25 basis points.

[9] Lohmann (1998) notes that even the archetypal independent German Bundesbank was aware it could endanger its independence by quarrelling in public with a popular government. Still, surveys show that in industrial countries fiscal policy is the topic of 40% of high level talks between the central bank and the government (Moser-Boehm 2006). Also, central bank official communication on fiscal policy increases as a reaction to fiscal deficits, showing clear concern for fiscal policy (Allard et al. 2013). More directly, in 2011 the European Central Bank (ECB) used secret correspondence (that leaked to the press) to demand sweeping deficit cutts from Italy and Spain. These and additional measures were required as a condition for ECB buying from the market Italian and Spanish bonds to try to reduce the high interest rates markets demanded of these countries.

higher discount rate in August 1955" (Berger 1997: 440). It was followed by two additional interest rate increases in 1956, both linked very publicly by the central bank's Council to government's fiscal policy. In another example, Beck (1984) shows that the US Federal Reserve responded with interest rate increases to fiscal deficits starting in the 1970s and he attributes the Fed's reaction to its newly found independence.[10]

Besides interest rate retaliation, central banks laws limit a bank's ability to provide funds directly to governments or give the bank more control of the financing conditions, including the maturity and cost of lending. Losing access to cheap money provided by the central bank increases the costs of fiscal deficits that need to be financed by markets. Franzese (2002a), for example, argues that CBI may dissuade debt accumulation because governments anticipate future inability to inflate debt.[11] Tabellini (1987) suggests that this was precisely the interaction between the Italian Treasury and the Bank of Italy in 1981, after the Bank stopped having a legal obligation to purchase any public debt unsold directly to investors. Central bank financing of budget deficits is likely a larger problem in developing countries with weak financial markets (Fry 1998). Still, even industrial countries derive utility from access to borrowing from their central bank. For example, the British government maintains its ability to borrow directly from the Bank of England and has used it in the most recent financial crisis.

4. When do central banks pursue their fiscal policy preference?

As explained above, the legal, institutional independence of monetary policy has the potential to influence fiscal deficits. Yet, politicians have incentives to subvert the institutional independence of the central bank. The central bank law is inherently incomplete and can be changed or threatened to be changed by politicians in order to make central bankers more subservient. Central bank governors can

[10] See Canzoneri et al. (2002), Melitz (2002) for more evidence of interest rate retaliation.

[11] Franzese's argument also suggests that, alternatively, fiscally "imprudent or recalcitrant" governments with massive debt when facing CBI may see higher fiscal deficits because debt inflation is not an option. Empirically we find the opposite: high debt levels are associated with lower fiscal deficits.

also be fired prematurely and their appointment may be conditioned by a subservient monetary policy. Therefore, rather than the legal independence codified in the central bank law, some of the economics literature looks at central bank governor tenure or expert surveys to distinguish de facto bank autonomy (e.g., Cukierman et al. 1992). Long tenures, however, may be a result of both autonomy and the lack of it. Dreher et al. (2008), for example, show that central bankers lose their jobs for high inflation, which makes turnover a poor indicator of de facto CBI. Also, surveys are limited to small samples and could be biased as they are filled out by central bank experts.

We favor a political economy approach that emphasizes legal rules and the conditions when such rules have practical effects on behavior. Extant work shows that political institutions determine the degree to which central bank law is enforceable and, thus, when the de facto behavior of the central bank reflects its aversion to inflation (Bernhard 1998, Moser 1999, Broz 2002, Hallerberg 2002, Keefer and Stasavage 2003). Democracies have an advantage over autocracies in the application of the rule of law due to higher strength of ex-post constraints and more transparency. This advantage increases the credibility of monetary policy delegation to an independent central bank and, we argue, raises the likelihood of retaliatory monetary policy in response to fiscal policy, which can deter fiscal deficits.

Yet, even if we uncover an average CBI effect on fiscal deficits in countries with rule of law and impartial contract enforcement, this effect may come from fundamentally different central bank behaviors. On the one hand, the central bank may prompt governments to have a fiscal policy countering the macro-economic cycle, incentivizing surpluses or balanced budgets in good times. On the other hand, as we argue, the alternation of surpluses and deficits can emerge from the central bank pragmatically guarding its formal, de jure, independence by accommodating politicians under circumstances related to the electoral calendar or government partisanship. Below we detail our argument and derive testable hypotheses.

Broadly, a lasting democracy is linked to secure property rights and contract enforcement, and both are premised on the judiciary's independence and respect for the rule of law and individual rights (Olson

1993). This means that, in dictatorships, the enforcement of legislation aimed to tie the hands of government is highly uncertain. A first condition that helps the broad rule of law prevail in democracies is the strength of constraints on government power. Very directly, the political opposition has an interest in guarding the independence of the central bank because independence denies the incumbent the opportunistic use of monetary policy and limits the use of fiscal policy. Additionally, coalition partners in the executive and the opposition have reasons to protect the independence of the central bank because such a bank provides information about government policy choices (Bernhard 1998, Crowe 2008). Indeed, the presence of two or more veto players reduces the probability that the central bank will be overridden on decisions regarding inflation or that the central bank law will be amended. This in turn increases the credibility of independent central banks for pursuing the mandated task of maintaining price stability and results in lower inflation (Keefer and Stasavage 2003, Moser 1999).

A second condition that helps the broad rule of law is the transparency of political decisions. Relatively more transparent political systems like democracies impose costs against opportunistic behavior by the government (Broz 2002). Central banks by themselves are opaque in their decision-making and therefore the "true" independence of some of their actions is more difficult to monitor (Broz 2002, Bodea 2010). In democracies, the political opposition can denounce transgressions against CBI and the voters themselves can punish transgressions at the ballot box. Such actions from domestic political actors and the public are more likely when the press is free to report and when elections are free and competitive.[12] Following the theoretical discussion, a first testable hypothesis links deterrence of fiscal deficits to credible institutional CBI[13]:

[12] Evidence on this causal chain comes from the literature on political business cycles: Electoral fiscal cycles are smaller when the local press is developed (Akhmedov and Zhuravskaya 2004), where voters have access to information via a free press (Shi and Svensson 2006) or when the transparency of fiscal policy is high (Alt and Lassen 2006).

[13] A similar hypothesis is derived in Bodea (2013) and tested for a much smaller sample of post-communist states (1990-2002).

H1. *Central bank independence reduces fiscal deficits predominantly in democracies, countries with strong rule of law, political constraints on the executive and a transparent political system.*

The features of democracy described above should aid legal CBI in deterring fiscal deficits. Still, even in countries with strong rule of law and contract enforcement it is not necessary for the bank to use political capital to oppose deficits in every budget. First, this is the case because deficits are not consistently bad for inflation and macroeconomic stability if fiscal consolidation subsequently follows. More important however, fiscal policy is not part of the legal mandate of an independent central bank, even if, in the long run, debt accumulation through deficit spending affects inflation expectations and inflation, which are directly of concern to the bank. As long as they are market financed, fiscal deficits are not the formal domain of central banks. There is little dispute that CBI remains contested in the political arena (Beck 1984, Lohmann 1992, Lohmann 1998, Franzese 1999). As we note above, politicians can threaten to change the law and can work around the law through the process of appointment and dismissal of central bank governors and boards. Our argument is that the central bank needs to be selective in choosing fights related to policies outside its direct mandate, like fiscal policy.

Lohmann (1992) provides a framework we use to identify conditions when the central bank voluntarily backs down. In her model, the central bank is independent, but, reflecting reality, the government retains the flexibility to override the bank at some cost.[14] In this interaction, Lohmann shows it is optimal for the central bank to accommodate government's demands in extreme situations for fear of being overridden. Thus, in normal times, the central bank decides on monetary policy. When facing large negative shocks to economic growth, however, the bank adopts politicians' preferences since the government's utility loss from low growth is higher than the cost of overriding the central bank. We would expect a similar situation for office-seeking politicians when they bid for reelection:

[14] Being overridden may mean losing one's job or facing changes in the central bank law or the governance structure of the bank, and hostile appointments to the bank's governing bodies. Costs entail the reaction of financial markets, political opposition and the press.

Large losses in government's utility will occur from a conservative monetary policy response to fiscal policy around election times, prompting the central bank to accommodate the government.[15]

Therefore, even if the central bank prefers fiscal balance, it may be reluctant to pursue it at times when the government has little appetite for fiscal consolidation and, consequently, the risk of backlash against independence is higher. Recent work indicates that electoral cycles continue to exist in less-developed countries or new democracies (Shi and Svensson 2006, Brender and Drazen 2005).[16] So, particularly in such countries, election years entail strong incentives for incumbents to manipulate the economy and are therefore not ideal for the central bank to press for budget surpluses. This discussion leads to the following hypothesis:

H1(a). *Especially in new democracies, central bank independence is more likely to contribute to fiscal consolidation outside the electoral cycle.*

Moreover, the central bank may find it preferable to push the political costs of expenditure cuts or tax increases on particular political actors. A key premise in the CBI literature is that the bank has more conservative preferences than politicians and the public at large (Rogoff 1985). The assumption is needed to derive the result that delegation of monetary policy leads to lower inflation. This conservatism is generally argued not to have a partisan element but to be an objective preference (Blinder 1998, Bernhard 1998, Crowe 2008, Bernhard and Leblang 2002).[17] Others, however, argue that there is a

[15] Future work could consider the credibility of threats to amend central bank law in election years by considering the cost of electoral defeat (Bernhard and Leblang 1999) or the size of government's parliamentary majority.

[16] Alt and Lassen (2006) find fiscal cycles even in developed democracies with low fiscal transparency. Consequently, there may be more countries where incumbents are hard to deter from fiscal deficits in elections years.

[17] CBI is, rather, supposed to generate sustainable economic growth in the absence of inflation (Blinder 1998). An independent central bank is also argued to be a reliable source of information about the government's policies and a reason for legislators and coalition partners with diverse preferences to favor delegation in the first place (Bernhard 1998, Crowe 2008), or an aid to cabinet longevity

political bias in the way that independent central banks set interest rates (Cusack 2001 and Clark and Arel-Bundock 2013). The non-neutrality of interest rates arises in this view because the preferences of independent and conservative central banks are a natural fit to the agenda of right wing governments, as evidenced by central bankers' backgrounds, financial markets constraining their appointment and the professional socialization of bankers. This fit between independent central bankers and the political right is reflected in the coordination of fiscal and monetary policies (Cusack 2001) or monetary policy aimed at keeping the right in office (Clark and Arel-Bundock 2013).[18]

For us, the potential bias and the fact that left wing parties may see higher central bank interest rates imply that the left has incentives to reduce fiscal deficits. This is because high interest rates imply additional costs for financing debt, and, more importantly, because recessions induced by such high rates tend to hurt disproportionally those with lower skills and income, which are the left's constituency (Hibbs 1987, Cusak 2001). In addition to the non-neutrality of central banks, there may be other reasons for CBI to have more influence on fiscal policy when the left is in power. The left may simply be more receptive to prods for fiscal discipline due to higher expectations of inflation under left wing governments (Hibbs 1987) and thus higher market interest rates on government debt. The central bank's push for fiscal balance then usefully serves to placate left's own constituency and supply information on the likely capital market reaction to budget plans, as well as provide focal point estimates on amounts of

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(Bernhard and Leblang 2002). CBI may additionally depend on whether incumbents can win elections given party and federal veto players (Hallerberg 2002), or whether fixed exchange rates are also considered by the executive (Clark 2002, Bodea 2010).

[18] Cusack (2001) shows that, in OECD countries, the central bank has a retaliatory monetary policy reaction (higher discount rates) only to left wing government induced deficits. For the US, Clark and Arel-Bundock (2013) find that interest rates decline in election years when Republicans control the White House.

deficit cutting and time horizons for the cuts.[19] Following, independent central banks can be expected to contribute differently to fiscal consolidation during the tenure of left versus right wing governments.

H1(b). *In democracies, central bank independence is more likely to lead to budget surpluses / lower deficits under left wing governments.*

5. Data and Methodology

We use an annual dataset covering 78 countries from 1970 to 2007. The core dependent variable is the budget deficit or surplus relative to GDP. This data is based on Brender & Drazen (2005), updated and expanded for non-democracies using the International Monetary Fund (IMF) International Financial Statistics (IFS 2002), the IMF Government Financial Statistics (GFS 2010) and the European Bank for Reconstruction and Development (EBRD) transition reports (2011). Fiscal balance is computed as revenue minus expenditure.[20] The central bank may care more about other operationalizations of fiscal policy, like the primary deficit (interest payments are excluded). Yet this variable is not available for large samples including developed and developing countries.

The key explanatory variables operationalize the independence of a country's central bank, the features of its political regime, the rule of law, as well as election years and government partisanship. A country's CBI level is based on the seminal work of Cukierman et al. (1992). Their paper covers 72 countries with decade indicators for 1950-1989. Here we use an original dataset that codes independence annually, identifies directly reform years and extends the well-known Cukierman et al.

[19] The description matches well Alan Greenspan's role in President Clinton's 1993 budget proposal.

[20] Expenditure is total central government expenditure relative to GDP. Revenue is central governments' total revenue plus grants to GDP. For some of the countries consistent historical information is not available for more recent years (Appendix Table A6). We do not include the euro area countries because our argument that the central bank deters the fiscal authority to overspend has little traction with the ECB focusing on price stability on the euro area and fiscal policy being decided at national level.

coding to cover reforms in the last twenty years.[21] The CBI index is based on a weighted aggregation of 16 legal indicators in four categories regarding the tenure of the bank's governor, policy formation, objectives, and limitations on lending to the government, using the criteria and weights in Cukierman et al. The index varies between 0 and 1, with larger values indicating independence.[22] A central bank is legally more independent when the governor's term in office is longer; the appointment and dismissal procedures are more insulated from the government; the mandate is more focused on price stability; the formulation of monetary policy lies squarely with the central bank; and the provisions on direct central bank lending are restrictive.

To measure democracy we use Polity IV scores. We add 10 to the Polity IV score and convert the range to a scale from 0 to 20, with high scores indicating democracies. We supplement Polity scores with Freedom House data, which is the sum of a country's political rights (1-7) and civil liberties (1-7). We rescale the original data, so that lower scores correspond to autocratic regimes and high score denote democracies, ranging from 0 to 12. In addition, we use Linzer and Staton (2012) for a measure of latent judicial independence that varies between 0 and 1. Linzer and Staton use eight distinct sources of data that code various aspects of de facto judicial independence and their measure aims to capture the commonality of coding across the different data sources.[23] We also test the specific mechanisms that should aid democracies with legal CBI lower fiscal deficits. We use three available measures that maximize the sample size: political constraints (Henisz 2002, 2010 data); the executive constraints component of the Polity IV democracy score (xconst); and press freedom (Freedom House). Henisz's

[21] The coding uses central bank laws and publications, as well as Hicks (2004), Jacome and Vazquez (2008) and Bodea (2013). Appendix A 6&7 show the criteria and weights in the Cukierman et al. index and the years of central bank reform.

[22] The average legal CBI level is 0.42 for developed nations and, owing to the reforms in the last twenty years, 0.46 for developing countries. We also use an indicator variable, equal to one for CBI levels above the mean and zero for levels below the mean. This transformation does not affect our findings.

[23] Among these data sources, the best coverage is for: political constraints (Polity IV), law and order (Political Risk Service) and judicial independence (Cingranelli and Richards-CIRI).

political constraints index aggregates constraints over three veto points (the executive, the lower and the upper houses of the legislature) and ranges from 0 (low constraints) to 1 (high constraints). Polity IV executive constraints measure shows the degree to which the executive considers the preferences of other societal actors when making decisions, ranging from unlimited authority (0) to strong opposition (7). Freedom House provides press freedom scores starting in 1980, and ranging from 0 (not free), to 1 (partially free) and 2 (free), with missing data coded as not free. For elections, we use Hein Goemans' election dates dataset[24], NELDA (v3) and author corrections (Appendix Table A2). The election variable is a dummy with a value of 1 for presidential and parliamentary elections. Also, from the Database of Political Institutions (Beck et al. 2010) we use the partisanship of the executive (execrlc) to create a dummy variable taking the value of 1 for left executives.

Figure 1 graphs the average level of central bank independence and fiscal balance in our sample from 1960 to 2007. Fiscal balance has a remarkable time variation, with two periods of large fiscal deficits in the early 1980s and middle 1990s and a fiscal improvement from around 1995 to 2007. On the other hand, legal central bank independence dramatically increases after the Cold War, after a stable average (still, with a large variance) during the 70s and 80s. Figure 1 suggests that the legal CBI index on its own is not strongly associated with fiscal balance over time, perhaps because central bank laws have a conditional effect on fiscal discipline, as we argue.

[Figure 1about here]

In addition to the core variables, we use standard controls based on the literature. These include: GDP per capita (Maddison 2012), GDP growth (WDI), inflation (GDP deflator, WDI), capital controls (Chinn Ito 2008), trade openness (WDI), the de facto exchange rate regime,[25] the proportion of population aged over 65 (WDI), oil and gas rent per capita (Ross 2012) and strikes (Cross-National

[24] http://www.rochester.edu/college/faculty/hgoemans/data.htm Accessed on February 6th, 2013.

[25] We recode a standard measure (Reinhart & Rogoff 2004, Ilzetzki et al. 2008) such that 1 stands for de facto pegs and crawls (Ilzetzki et al. coarse coding 1, 2, 3). Empirical results are similar when the exchange rate regime and inflation are excluded, or when we only code de facto pegs.

Time-Series Data Archive). To control for time and regional specific factors, we include 5 year time interval dummies and region dummies. To mitigate endogeneity concerns[26], all economic variables are lagged one year. The empirical model takes the following form, where fiscal balance is positive for surpluses and negative for deficits: [27]

$$Fiscal\ Balance_{i,t} = \alpha_1 + \alpha_2\ Fiscal\ Balance_{i,t-1} + \alpha_3\ CBI_{i,t} + \alpha_4\ Polity_{i,t} + \alpha_5\ CBI_{i,t} * Polity_{i,t} + [Controls] + \varepsilon_{i,t}$$

The basic regressions are Ordinary Least Squares (OLS) estimations, with panel corrected standard errors to correct for potential group-wise heteroscedasticity and contemporaneous correlation of errors (Beck & Katz 1995) and lagged dependent variable to capture the sluggish dynamics of government fiscal choices[28]. Using Madalla & Wu and Pesaran panel unit root tests we find no evidence of unit root in the fiscal balance dependent variable. We expect that α_5 is positive indicating that as countries become more democratic (Polity IV increases), CBI should work to reduce fiscal deficits or generate surpluses. We do not have a clear expectation about the effect of CBI on the fiscal balance in undemocratic countries (α_3). However, based on Gasiorowski (2000), we expect that democracies with dependent central banks will tend to incur deficits or have lower surpluses (α_4 is negative).

While we control for regional effects and other specific factors like oil rents and strikes, we are still concerned about time invariant country characteristics that are not captured by our dependent variables and could therefore lead to potentially biased estimates. However, fixed effects estimation is not optimal

[26] While our specifications, including the choice of exogenous variables, are supported by the standard tests associated with the GMM estimation, other issues may be important. In particular, both CBI and fiscal deficits may be driven by a country's culture and aversion to macro-economic instability. Our results are robust to including a country's inflation history to proxy for such aversion, mitigating this concern.

[27] This research design does not capture the strategic interaction of governments and central banks, but the outcome of equilibrium behavior.

[28] The lagged dependent variable also addresses potential autocorrelation (Beck & Katz 2004).

in our case. First, using country fixed effects in an OLS regression with lagged dependent variable also introduces bias, a problem aggravated by the relatively small time duration for many countries in our data. For example, post-communist countries are in the sample for 9 to 15 years, which does not allow for shocks to fixed effects to diminish over time (the Nickell bias, Wooldridge 2002, Beck & Katz 2004). Second, both the CBI index and Polity IV scores vary little within countries and fixed effects models lead to greatly inefficient estimation (Plümper & Troeger 2007). To address these problems, we present system GMM estimates developed by Arellano and Bover (1995) and Blundell and Bond (1998). The GMM estimation deals with several shortcomings of the data, including the short time span in the sample, fixed individual effects, and potential heteroscedasticity and auto-correlation within countries (Roodman 2009). In the GMM regressions, we use only up to the second lag of the variables for the regression in levels, to reduce the number of instruments and the risk of over-fitting the data. Also, we report two standard specification tests: The Hansen test of over-identifying restrictions tests the overall validity of the instruments and failure to reject the null hypothesis gives support for the model, including our choice of endogenous variables. The Arellano–Bond test for AR(2) in first differences tests whether the residuals from the regression in differences is second order serially correlated and failure to reject the null hypothesis supports the model specification.

6. Results and Discussion

Table 1 shows the results of our statistical analysis. Model 1 investigates whether legal CBI by itself has an impact on fiscal balance regardless of the political regime. Using the CBI index and Polity IV scores individually in the model, we find that the coefficient of the CBI index is positive but statistically insignificant. While not reported, this result maintains when we use different estimation methods (fixed effects or system GMM). Polity IV scores negatively impact fiscal balance, which is consistent with extant work (Gasiorowski 2000), but, again, the variable is not statistically significant.

[Table 1 about here]

Next, Models 2-6 test our first hypothesis (H1) by considering the conditional effect of the CBI index on fiscal deficits. To estimate the impact of legal central bank independence conditional on a country's level of democracy, we introduce an interaction term between the CBI index and the Polity IV score. Models 2 and 3 use the statistical methodologies described earlier (OLS with PCSEs and system GMM), and, as predicted, the interaction terms in the models are positive and statistically significant at the 5% confidence level.[29] The CBI coefficient is negative, implying that, given the positive interaction term, higher legal central bank independence works to improve fiscal balance only at high values of the the rescaled Polity IV, or in democracies. Moreover, absent an independent central bank, the fiscal performance of democracies is worse than that of autocracies (the coefficient on the Polity IV score is negative and statistically significant).[30] As expected, using the fixed effects estimation (Model 4) reduces the efficiency of our estimates. The coefficient of the Polity IV score remains statistically significant, while the coefficient of the interaction term between the CBI index and the Polity IV score goes below the usual threshold for statistical significance. However, graphing the marginal effect of CBI from the fixed effects model shows a significant effect for high levels of Polity IV scores (Appendix Figure A1), similar to the figures based on system GMM models shown below.[31] Model 5 shows that the results are robust to using the Freedom House index: The interaction of the CBI index with the democracy measure is positive and statistically significant. Finally, Model 6 uses the Staton and

[29] For the system GMM model (Model 3) both the Hansen test of over-identifying and Arellano–Bond test for AR(2) support our specification and choice of instruments.

[30] This result suggests that as the CBI index goes up, the impact of Polity IV on fiscal balance will change from large fiscal deficits to smaller deficits or surpluses.

[31] The Hausman test for fixed vs. random effects rejects random effects specifications. Using the fixed effects vector decomposition estimation (Plümper and Troeger 2007) supports our first hypothesis.

Linzer measure of judicial independence, showing, as expected a positive and highly statistically significant interaction effect between CBI and judicial independence.[32]

More than just examining multiplicative interaction terms for direction and statistical significance, Brambor et al. (2006) prescribe that inference should be done with meaningful marginal effects and standard errors to determine the conditions under which the variable of interest has a statistically significant effect. Figure 2(a) uses our preferred system GMM Model 3 and shows graphically the marginal effect of the CBI index on the fiscal balance at all levels of the Polity IV score (Figure 2(b) uses Freedom House scores). The solid line is the marginal effect and the dotted lines show the 90% confidence interval. The marginal effect is upward sloping, as expected, and the CBI index has a positive impact on the fiscal balance when the Polity IV score exceeds 14 and becomes statistically significant when the score is greater than about 18. Similarly, Figure 2(c) shows a positive marginal effect of CBI when judicial independence is high (above 0.8). These findings support our hypothesis H1: Strong democracies and rule of law and impartial contract enforcement enable independent central bankers to deter fiscal deficits. The marginal effect shows an improvement in the fiscal deficit of about 0.7 percentage points in democracies. Given that the average fiscal deficit for democracies in the sample is -1.6 percent of GDP, the marginal effect of CBI is quite large.

[Figure 2 about here]

In Latin America, Chile and Uruguay provide an illustration for the results. Chile started off the continent-wide reform to central bank legislation. That is, in 1989 Chile both transitioned to democracy and reformed the institutional foundations of its central bank making it one of the most independent in the world (CBI index=0.89). At the same time, Uruguay returned to democracy in 1985, yet failed to reform its central bank until 1995/97 and, even then, far from the legislation passed in Chile (CBI

[32] Instead of the Linzer and Staton measure we also use a binary variable that takes a value of 1 for those countries with high constraints (xtconst =7); high Political Risk Service rule of law (PRS =6) and high Cingranelli-Richards CIRI judicial independence (CIRI=2). Results continue to support our hypothesis.

index=0.49). The fiscal performance of the two countries between 1989 and 2007 reflects plausibly the difference in central bank legislation, with Uruguay having an average deficit of -1.2% of GDP and Chile an average surplus 1.5% of GDP. While we do control here for other factors that affect the fiscal balance, Hallerberg and Marier (2004) support our comparison as they have the two countries closely ranked both on executive strength and incentives for personal vote in the legislature, two key features they show are strongly related to fiscal indiscipline.

Regarding our controls, only the oil and gas rents per capita variable, trade openness and inflation have a statistically significant effect across the models. Intuitively, higher oil revenue leads to fiscal surpluses. Also, high inflation countries and trade-open countries have surpluses. For other variables, the coefficients go in the expected direction but many do not achieve statistical significance: Both better economic growth and higher GDP/capita tend to improve fiscal performance, but are not consistently significant; Election years worsen the fiscal balance, but the variable is significant only in some of the specifications; On the other hand, de facto fixed exchange rates, capital controls, old-age population or strikes do not appear to significantly affect our results.

To test the hypothesized causal mechanisms, we use interactions of the CBI index with two measures of constraints on the power of the executive and one measure of press freedom. Overall, the results indicate that CBI improves fiscal balance only in countries with political constraints and where the press can report on government actions. Appendix Table A3 shows the estimated coefficients and Figure 2 (d-f) graphs the marginal effect of CBI on the fiscal balance. Hypothesis H1 continues to be supported: Model 7 uses Henisz's political constraints (polcon iii) and coefficients show a positive and statistically significant interaction effect. In Figure 2(d) the marginal effect of CBI turns positive where PolCon III is about 0.35 and becomes statistically significant when it is more than around 0.5. Model 8 uses of the executive constraints component of the Polity IV score with similar estimates. Figure 2(e) graphs the marginal effect of the CBI index using Model 7 and shows that the effect of CBI turns positive when the xconst variable goes above 5 and becomes statistically significant when xconst is

above 6.5. Model 9 includes an interaction between the CBI index and the press freedom indicator. The interaction term is positive, as expected, but is short of statistical significance at the 10 % level. Still, Figure 2(e) shows that while the marginal effect of the CBI index is insignificant when the press is not free or only partly free, the same marginal effect becomes significant when the press is fully free.

Robustness

To verify the robustness of our findings so far, we focus on Model 3 and add other variables likely to affect the fiscal balance including: international and civil war duration dummies (Correlates of War); European Community/European Union membership dummy; dummy for countries of the former Soviet Union; dummy variables for presidential systems, proportional representation electoral systems and closed list electoral systems (Beck et al. 2010). Our results remain almost identical. To expand coverage to 1960-2007, we exclude the capital account openness variable (available only from 1970) and re-estimate our models. To reflect the bulk of CBI reform in developing countries we limit our sample to years beginning in the 1980s or the 1990s. Increasing or reducing the number of observations does not affect the substance of the results. The results are also robust if we do not use observations with high inflation rates (yearly inflation of 50% or 100%).To mitigate a possible simultaneity bias between Polity IV and the fiscal balance, we use the lagged five-year moving average of the Polity IV score and the results remain supportive. Excluding prominent outliers (Germany, the US, Switzerland) does not change our results. We also include five or ten year moving average inflation lags to capture country inflation aversion and our results remain robust, while past inflation reduces fiscal deficits.[33] To further try to alleviate concerns about the role of such aversion, we also use the average CBI in the past 5 years and the five year lag of CBI in our models, and the estimates remain similar.

Government debt may be another important determinant of fiscal balance, as large outstanding liabilities likely increase the cost of new debt. In addition, fiscal deficits may result from governments' reaction to severe financial crises, a situation in which central banks concerned with financial stability

[33] Hayo (1998) suggests this is a reasonable strategy.

may accommodate deficits. Also, international financial conditions may be yet another determinant of fiscal deficits. We include these variables in our GMM models and the results continue to hold, while greater debt to GDP ratios reduce fiscal deficits[34], banking crises[35] indeed result in fiscal deficits, and increases in the US federal funds rate[36] improve fiscal balance. We also include the deposit interest rate (WDI) in our Model 3. It may be the case that CBI does not deter fiscal spending, but rather that fiscal deficits react consistently to central bank raising interest rates. Estimations show that higher interest rates reduce deficits, while out results remain unchanged.[37] Furthermore, the application of the Mundell-Fleming open economy model to our theory (Oatley 1999, Clark and Hallerberg 2000, Clark 2003), suggests that the effect of CBI on fiscal deficits may be contingent on the exchange rate regime and the international mobility of capital. That is, the ability of central banks to deter fiscal spending (through interest rate increases) may be lower under fixed exchange rates and mobile capital. We include in Model 3 interactions of CBI and fixed exchange rates, triple interactions of CBI, fixed rates and capital mobility, in both the full sample and for democracies only, as well as a triple interaction of CBI, fixed exchange rates and democracy. We do not find that CBI's effect on fiscal deficit is conditioned by the exchange rate regime and the mobility of capital.

Finally, fiscal balance is accomplished either by reducing expenditure or increasing revenue. Appendix Table A4 (Models 10&11) uses as dependent variables the government's fiscal revenue, and, respectively, expenditure scaled to GDP. The CBI index, the Polity IV score and their interaction have no effect on fiscal revenue relative to GDP (Model 10). Model 11 shows, however, that for fiscal spending the interaction between the CBI index and the Polity IV score is negative and statistically

[34] The ratio of central government (foreign and domestic) debt (Reinhardt and Rogoff 2011). We lose 470 observations when using this variable.

[35] Reinhardt and Rogoff (2011). We lose 374 observations when banking crises are included.

[36] http://www.federalreserve.gov/releases/h15/data.htm accessed 9/23/2013.

[37] 446 observations are lost. We use deposit rates because they react to central bank monetary policy and using directly central bank discount rates means losing 50% of the sample.

significant. Looking at the conditional relationship graphically, the marginal effect of the CBI index on fiscal expenditure is negative and statistically significant at high levels of the Polity IV score (Appendix Figure A2). This means that CBI likely affects the fiscal balance through less spending (smaller government), rather than boosting revenue.

Elections and partisanship

Central banks may react to deficits in an optimal counter-cyclical fashion, allowing fiscal policy to respond to recessions with additional spending and opposing deficits during good times. We find, however, no evidence that the effect of CBI is conditioned by economic growth and this holds both in our full sample or just in democracies, with a continuous measure of economic growth or cut-offs for various levels of positive growth. To test our own view of a strategic central bank that guards its legal independence and hypotheses (H1a-b) we limit our sample to democracies.[38] We then first re-estimate the system GMM model of fiscal balance to include an interaction of the CBI index with the indicator variable for elections. Coefficients are in Appendix Table A5 (Models 12&13). Figure 3a shows graphically the marginal effect of the CBI index in election years versus non-election years for all democracies: In non-elections years, the marginal effect of CBI is 1.2% (statistically significant at the 90% confidence level). In contrast, in election years, the CBI marginal effect is on average zero and statistically insignificant. Next, we exclude from the sample western democracies (Figure 3b). For new (non-western) democracies, the effects are larger, but similar in terms of statistical significance: In non-election years, the marginal effect of the CBI index is 2.6% and statistically significant (90% confidence level), while the marginal effect in election years is about 1% but statistically insignificant. This evidence indicates that the effect of central bank independence on fiscal consolidation is likely to come

[38] We use the range for which CBI was found to affect budget balance (a cut-off of 8 on the original Polity IV scale). Using the smallest cut-off possible is preferable to increase sample size. We collapse the GMM instruments (Roodman 2009) and control for regions for these smaller country samples.

from non-election years, and the average effect appears larger in new democracies.[39] We also use our whole sample (democracies and dictatorships included) to estimate a model that includes an interaction between the CBI index and the indicator for election years. The estimations yield no statistically significant result: CBI does not improve fiscal balance, even outside election years. The lack of findings in the broader sample supports our argument that legal CBI needs rule of law and impartial contract enforcement as a precondition to having a de facto deterrent effect.

[Figure 3 about here]

To test hypothesis (H1b) we again use only democracies and re-estimate system GMM models of fiscal balance to include an interaction between the CBI index and the indicator variable for left governments.[40] The results indicate that CBI is more effective in deterring fiscal deficits during the tenure of left-wing executives. Estimates are shown in Appendix Table A5 (Models 14&15), while Figure 4 shows the marginal effect of CBI for executives that are on the left, respectively on the right of the partisanship spectrum. For all democracies (Figure 4a), the marginal effect of CBI is about 1.7% and statistically significant (90 percent confidence level) for left-wing executives, while it is about 0.6% and statistically insignificant for the right. The same holds for the sample of non-western democracies: The marginal effect of CBI for left-wing executives is large, at about 4% and statistically significant (90% confidence). The marginal effect is statistically insignificant for the right.

[Figure 4 about here]

As explained earlier, two different mechanisms could drive this finding and we find support for both. It may be the case that the left takes advantage of the nominally independent central bank to counter spending demands by its own constituency. We test this explanation by using our whole sample (democracies and dictatorships) to estimate a model that includes an interaction between CBI and the

[39] The findings hold if we look at legislative or presidential elections only. Confidence intervals for the marginal effect of CBI in presidential election years are large.

[40] Results also hold if we use a dummy variable for center and left governments together.

indicator for left wing governments. The whole sample results resemble closely the estimates from using just democratic countries, indicating fiscal consolidation under the left even with a central bank that is nominally independent but virtually under the thumb of the government. The alternative explanation is that the independent central bank is more eager to prevent spending by the left, due to an ideological proximity to the political right. If the central bank is successful at deterrence we need not observe actual reactions of monetary policy to fiscal deficits. Still, we follow earlier work and look at the reaction of deposit rates (WDI) and changes in money supply (M2 change, IFS and WDI)[41] in models that include as independent variables a triple interaction of the fiscal deficit, CBI and the indicator for left wing governments.[42] The results show no conditional effect of CBI on deposit rates. However, there is support for non-neutral central banks coming from the M2 change models: Similar to Cusack (2001) we find that the central bank accommodates the right. For large fiscal deficits of the left (greater than about 5% of GDP), the central bank reduces rates of money growth, responding with contractionary monetary policy to fiscal stimulus. On the other hand, central banks do not appear to reduce the rates of money growth in response to right wing fiscal deficits.

7. Conclusion

Our argument is that legal central bank independence is an important deterrent of fiscal deficits and that the effect is conditioned by a country's political institutions. The estimation results using data from 78 countries (1970-2007) are robust and strongly support our theory: CBI reduces fiscal deficits in democracies and countries with rule of law, high constraints on the executive and a free press. Reforming a country's central bank and granting it more legal independence has been a clear trend in

[41] Cusack (2001) and Clark and Arel-Bundock (2013) use central bank discount rates. Clark and Hallerberg (2000) use both M1 and M2 changes.

[42] Estimations are fixed effects models with lagged dependent variable and standard errors clustered on countries. We use the log of the dependent variables. Control variables include the election year, the de facto exchange rate and lagged GDP per capita, GDP growth, capital controls and trade openness. Deposit rate models include lagged inflation.

the past two decades. Following the trend, non-democracies like Venezuela, Belarus, Kazakhstan or Russia have central banks with great nominal independence. However, extant research finds that the anti-inflationary effect of central bank independence is conditioned on political institutions (Broz 2002, Keefer and Stasavage 2003, Bodea and Hicks 2012). Our research shows that CBI is also unlikely to affect the fiscal balance of autocratic countries. Given this inability to improve outcomes like inflation or fiscal deficits, why do non-democracies delegate in the first place? Making use of our new data, future work on institutional authoritarianism can provide answers to this question, expanding extant explanations related to countries' perceived higher need for investment (Maxfield 1997) or diffusion (Polillo and Guillen 2005).

On the other hand, several democracies in our sample have either been late to give more independence to their central bank (Turkey, Thailand), or have delegated only partially (Uruguay, South Africa, Mongolia, South Korea, Israel). For such countries we show that fiscal discipline can be strengthened by further reforming the central bank. Since the 2007 economic crisis, central bank independence has again become a hotly debated issue, with many arguing that politicians should be more active in monetary policy and central banks should be more responsive to recessions.[43] Globally, inflation is currently not a great concern, so political interference in monetary policy may seem inconsequential. Our research suggests, however, that fiscal deficits will be a likely consequence of curtailed central bank independence.

Yet we also bring evidence that, when pressing for fiscal consolidation, legally independent central banks may be political and non-neutral. In democracies, where legal CBI is credible, we find no evidence that, on average, central banks have an interest in fiscal policy being used in a counter-cyclical fashion. Rather, our results show that, the central bank is more likely to contribute to fiscal surpluses outside election years. Thus, even if CBI can contribute to fiscal consolidation, it is unlikely to reduce

[43] "The twilight of the central banker" The Economist, June 26 2012; Bank for International Settlements Annual Report (2013); "No-So-independent Central banks" *The Wall Street Journal* Jan. 8 2013.

political business cycles similar to increased transparency of budgets (Alt and Lassen 2006) or a better informed electorate (Shi and Svensson 2006). Fiscal institutions have been shown to mitigate the common pool resource problem in fiscal policy (e.g., Hallerberg and Marier 2004). Future work, can, however, investigate whether such budgetary institutions, similar to CBI, are more or less effective in reducing deficits depending on the electoral cycle. Moreover, an independent central bank appears more likely to contribute to a balanced budget under left wing governments. We find mixed reasons for this behavior, and future work can investigate further the reasons why CBI is more successful at deterring the deficits of the left.

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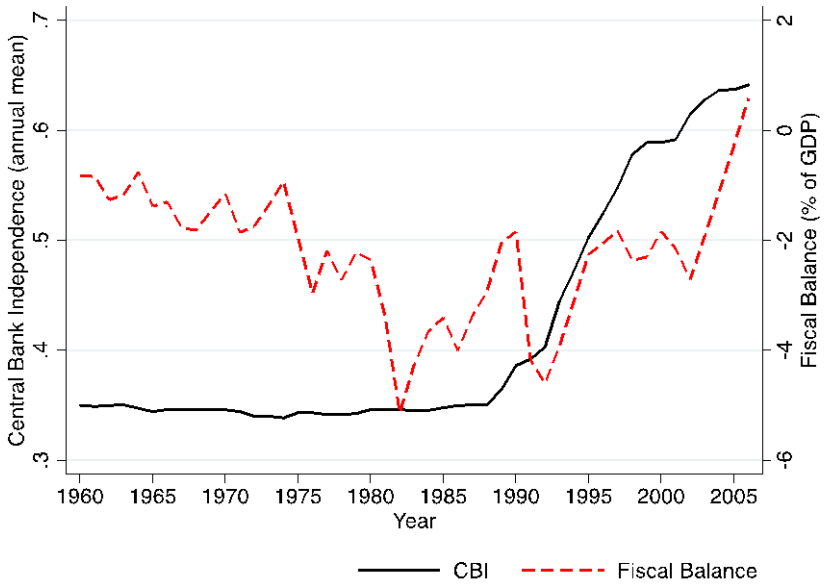
Tables and Figures

Table 1. Determinants of Fiscal Balance

	Model 1 OLS-PCSEs	Model 2 OLS-PCSEs	Model 3 System GMM	Model 4 FE	Model 5 System GMM	Model 6 System GMM
Central Bank Independence (CBI)	0.202	-2.050*	-2.070**	-0.636	-1.504*	-1.397**
	(0.363)	(1.148)	(0.987)	(1.289)	(0.912)	(0.667)
Polity IV	0.002	-0.049*	-0.067**	-0.071*		
	(0.016)	(0.028)	(0.027)	(0.038)		
CBI*Polity IV		0.135**	0.136**	0.099		
		(0.062)	(0.056)	(0.077)		
Freedom House Index (FHI)					-0.082	
					(0.052)	
CBI*FHI					0.183*	
					(0.094)	
Judicial Independence						-0.959*
						(0.556)
CBI*Judicial Independence						2.472***
						(0.910)
Fiscal Balance (t-1)	0.738***	0.736***	0.845***	0.600***	0.854***	0.849***
	(0.031)	(0.031)	(0.044)	(0.029)	(0.044)	(0.043)
Elections	-0.202	-0.202	-0.187	-0.257*	-0.193	-0.193
	(0.134)	(0.134)	(0.128)	(0.129)	(0.128)	(0.128)
GDP Growth (t-1)	0.039**	0.041**	0.019	0.061***	0.017	0.018
	(0.016)	(0.017)	(0.024)	(0.018)	(0.025)	(0.024)
GDP per capita (t-1)	0.322*	0.313*	-0.040	0.086	-0.111	-0.111
	(0.188)	(0.188)	(0.140)	(0.510)	(0.135)	(0.140)
Trade Openness (t-1)	0.005**	0.005**	0.003**	0.003	0.003**	0.003**
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
Capital Controls (t-1)	0.036	0.029	0.057	0.099	0.064	0.056
	(0.053)	(0.054)	(0.042)	(0.085)	(0.040)	(0.042)
Fixed Exchange Rate Regime	0.042	0.047	0.053	0.457*	0.019	0.030
	(0.120)	(0.119)	(0.137)	(0.258)	(0.135)	(0.135)
Population over 65	0.005	-0.010	0.002	-0.068	0.004	-0.001
	(0.029)	(0.029)	(0.020)	(0.078)	(0.021)	(0.021)
GDP Deflator (t-1)	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Oil-Gas Rent (t-1)	0.035***	0.037***	0.023***	0.036***	0.022***	0.023***
	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Number of Strikes (t-1)	-0.061	-0.050	-0.022	0.027	-0.016	-0.026
	(0.094)	(0.093)	(0.117)	(0.130)	(0.128)	(0.116)
Constant	-4.119**	-3.157*	1.457	-0.744	1.394	1.099
	(1.623)	(1.702)	(1.155)	(4.118)	(1.110)	(1.119)
Observations	1,968	1,968	1,968	1,968	1,929	1,950
R-squared	0.69	0.69		0.51		
Countries	78	78	78	78	78	78
Wald chi-squared	1998.81***	2104.31***	6482.81***	142.11***(a)	6525.77***	5686.27***
GMM specification tests (p values)						
The Arellano-Bond test for AR(2) in first differences			0.352		0.343	0.353
The Hansen test of overidentifying restrictions			0.248		0.303	0.332

Note: Dependent variable is fiscal balance (positive values for surpluses; negative values for deficits). *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parenthesis. All models include half-decade period dummies. Models 1&2 include region dummies. (a) F values.

Figure 1. Fiscal Balance and Central Bank Independence (1960-2007)



Note: Solid line: Yearly average CBI. Dotted line: Yearly average of fiscal deficits/surplus.

Figure 2. Conditional Effects: Marginal effect of Central Bank Independence

Figure 2(a)

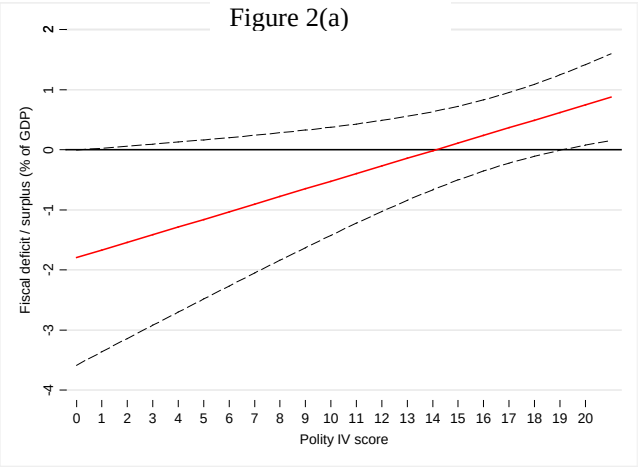


Figure 2(b)

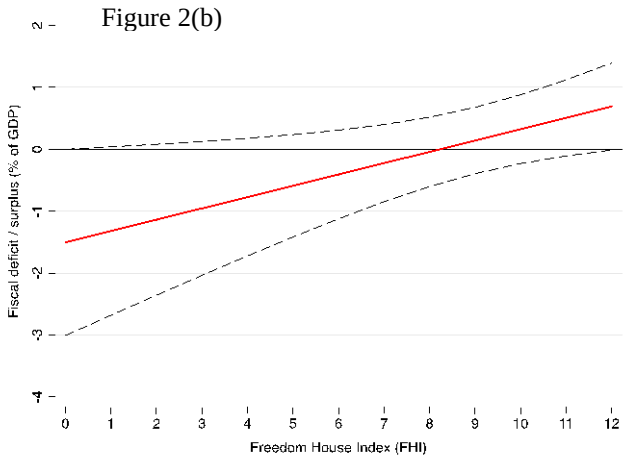


Figure 2(c)

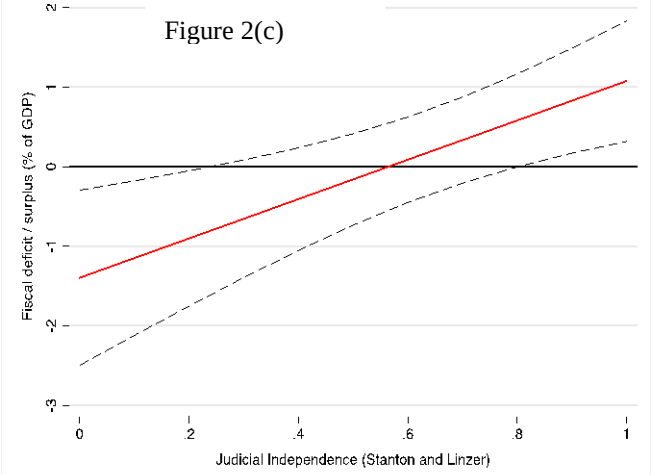


Figure 2(d)

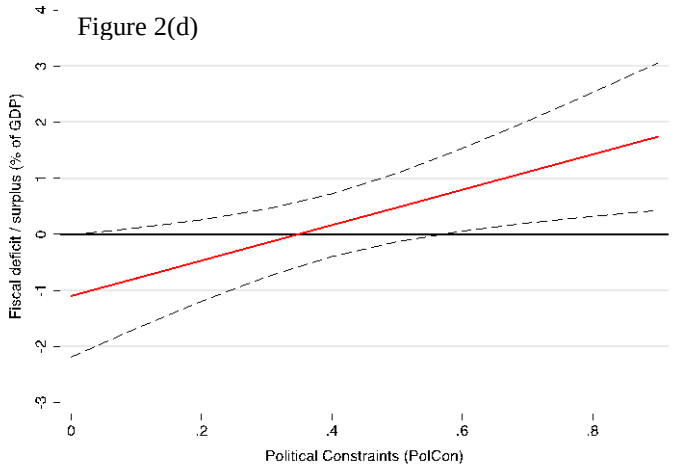


Figure 2(e)

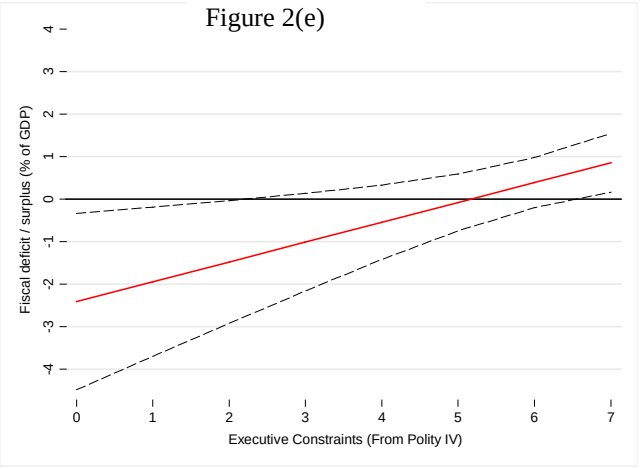
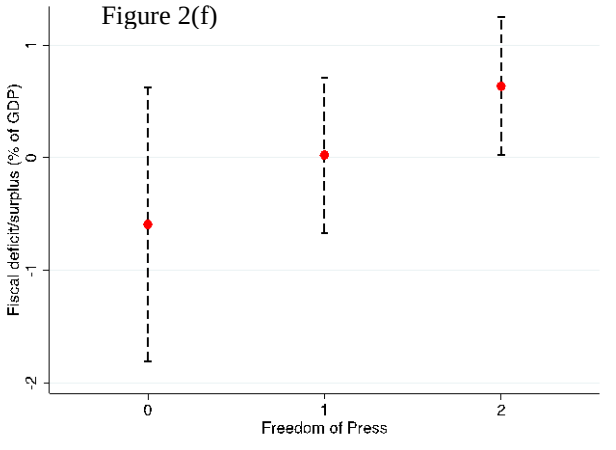


Figure 2(f)

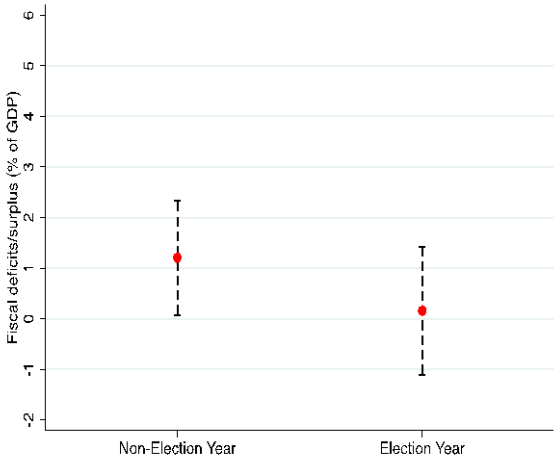


Note: Solid line: Marginal effect of CBI on fiscal deficit/surplus to GDP. Dotted lines: 90% confidence intervals

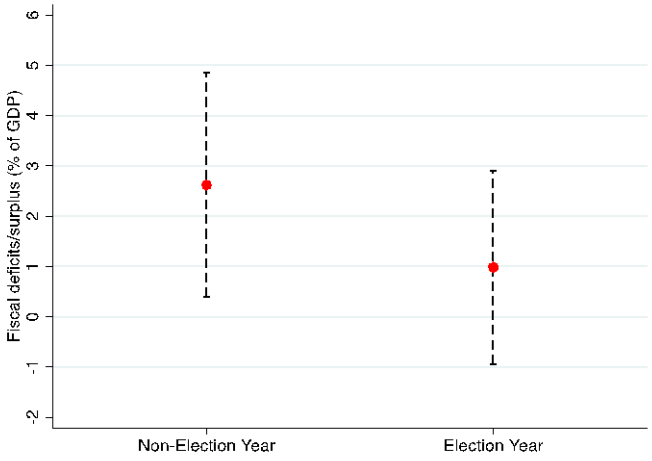
.

Figure 3. CBI and Fiscal Balance in Democracies: Elections

All democracies 3(a)

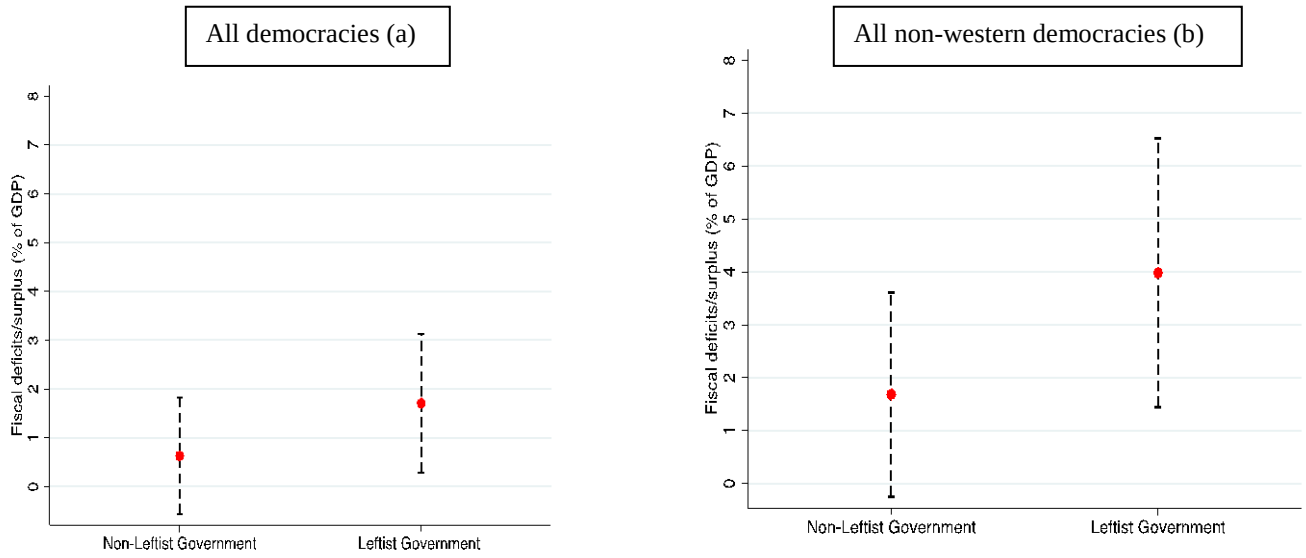


All non-western democracies 3(b)



Note: Points: Marginal effect of CBI. Dotted lines: 90% confidence intervals.

Figure 4. CBI and Fiscal Balance in Democracies: Partisanship



Note: Points: Marginal effect of CBI. Dotted lines: 90% confidence intervals.

Appendix- Supporting Information

Table A1. Fiscal Balance across Regions and Time

	Fiscal deficits (% of GDP)	Observations	Revenue (% of GDP)	Observations	Expenditure (% of GDP)	Observations
All Observations	-2.19	5,355	24.01	5,247	26.14	5236
Western World	-1.55	1,252	27.79	1,255	29.33	1233
Eastern Europe	-2.56	481	33.02	473	35.45	473
Latin America	-2.35	1,033	17.84	1,021	20.24	1016
Sub-Saharan Africa	-2.71	1,038	20.73	992	23.06	1006
Asia	-1.69	713	18.56	699	20.36	694
North Africa and the Middle East	-2.06	552	29.79	521	32	524
1960s	-1.29	519	18.26	539	19.30	528
1970s	-1.96	935	22.36	924	24.09	925
1980s	-3.44	1,029	25.13	1,023	28.44	1030
1990s	-2.81	1,368	25.24	1,339	27.95	1340
2000's (2000-2007)	-1.35	1,237	27.38	1,145	28.91	1140

Table A2. Descriptive Statistics

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum	Data Sources
Fiscal balance	2,031	-1.92	4.99	-36.65	26.1	Various Data Sources (a)
Fiscal Expenditure	1,997	27.35	11.04	0.14	78.83	Various Data Sources (a)
Fiscal Revenue	1,997	25.43	10.7	0.16	73.1	Various Data Sources (a)
Central Bank Independence (CBI)	2,031	0.46	0.21	0.06	0.95	Bodea & Hicks (2012)
Polity IV scores	2,031	15.78	5.81	1	20	Polity IV Project
Freedom House Index	1,952	8.69	3.15	0	12	Freedom House
Political Constraints (PolCon)	2,028	0.35	0.18	0	0.7	Henisz (2002)
Executive Constraints	2,009	5.64	1.9	1	7	Polity IV Project
Freedom of Press	1,610	1.34	0.75	0	2	Freedom House
Elections	2,031	0.31	0.46	0	1	Goemans (2009), NELDA, and author corrections (b)
GDP percapita	2,031	8.74	0.84	6.7	10.35	Maddison (2012)
GDP Growth	2,031	3.57	4.61	-30.9	34.5	World Development Indicators
Trade Openness	2,031	63.21	52.05	1.26	412.87	World Development Indicators
Capital Account Openness	2,031	0.46	1.51	-1.83	2.5	Chin & Ito (2008)
Fixed Exchange Rate Regime	2031	0.56	0.49	0	1	Ilzetzki, Reinhart & Rogoff (2008)
Population over aged 65	2,031	8.73	4.7	2.4	20.9	World Development Indicators
GDP deflator	2,031	54.02	478.61	-9.21	13611.6	World Development Indicators
Oil-Gas Rent percapita (100s)	2,031	3.07	11.26	0	191.69	Ross (2011)
Judicial independence	2012	0.614304	0.271294	0.0254	0.9869	Linzer and Staton (2012)
The Number of Strikes	2,031	0.22	0.67	0	7	Cross-National Time-Series Data Archive

Note: (a): Government Financial Indicators (IMF) , International Financial Indicators (IMF), IMF Annual Country Report, OECD Statistics, EBRD Transition Reports, and Brender & Drazen (2006). (b): Nohlen, Dieter eds, Elections in Asia (2001), Elections in Africa (1999), Elections in the Americas (2005), Elections in Europe (2010).

Table A3. Fiscal Balance and Democracy: Mechanisms

	Model 7 System GMM	Model 8 System GMM	Model 9 System GMM
Central Bank Independence (CBI)	-1.099*	-2.666**	-0.591
	(0.660)	(1.170)	(0.738)
Political Constraints (PolCon)	-1.707*		
	(0.876)		
CBI*PolCon	3.155**		
	(1.430)		
Executive Constraint		-0.248***	
		(0.088)	
CBI*Executive Constraint		0.480***	
		(0.186)	
Freedom of Press			-0.272
			(0.229)
CBI*Freedom of Press			0.614
			(0.409)
Elections	-0.197	-0.181	-0.211
	(0.128)	(0.129)	(0.147)
GDP Growth (t-1)	0.019	0.019	0.022
	(0.024)	(0.025)	(0.028)
Logged GDP per capita (t-1)	-0.041	-0.040	-0.154
	(0.127)	(0.141)	(0.138)
Trade Openness (t-1)	0.003**	0.003**	0.003**
	(0.001)	(0.001)	(0.002)
Capital Controls (t-1)	0.058	0.058	0.069
	(0.041)	(0.045)	(0.047)
Fixed Exchange Rate Regime	0.058	0.062	-0.003
	(0.134)	(0.146)	(0.171)
Population over 65	0.002	0.003	0.014
	(0.021)	(0.021)	(0.020)
GDP Deflator (t-1)	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)
Oil-Gas value per capita (t-1)	0.022***	0.023***	0.023***
	(0.005)	(0.005)	(0.005)
Number of Strikes (t-1)	-0.029	-0.024	0.040
	(0.118)	(0.115)	(0.142)
Constant	0.470	1.801	1.604
	(1.038)	(1.148)	(1.255)
Observations	1,947	1,928	1,579
Countries	78	78	78
Wald chi-squared	7126.24***	6765.02***	5671.96***
GMM specification tests (p values)			
Arellano-Bond test for AR(2) in first differences	0.35	0.34	0.30
The Hansen test of overidentifying restrictions	0.37	0.38	0.43

Note: Dependent variable is fiscal balance (positive values for surpluses; negative values for deficits. *** p<0.01, ** p<0.05, * p<0.1, Robust standard errors in parenthesis. All models include 5 year period dummies.

Table A4. CBI, Fiscal Revenue and Expenditure

	Model 10	Model 11
Dependent Variable	Fiscal Revenue	Fiscal Expenditure
Statistical Model	System GMM	System GMM
Central Bank Independence (CBI)	0.960	3.003**
	(0.920)	(1.170)
Polity IV	0.057***	0.124***
	(0.020)	(0.032)
CBI*Polity IV	-0.062	-0.201***
	(0.051)	(0.066)
Fiscal Revenue (t-1)	0.893***	0.062
	(0.045)	(0.049)
Fiscal Expenditure (t-1)	0.046	0.861***
	(0.045)	(0.053)
Elections	-0.411***	-0.219
	(0.136)	(0.168)
GDP Growth (t-1)	0.085***	0.058
	(0.029)	(0.035)
Logged GDP per capita (t-1)	-0.139	-0.134
	(0.150)	(0.195)
Trade Openness (t-1)	0.002	-0.001
	(0.002)	(0.002)
Capital Controls (t-1)	-0.052	-0.116*
	(0.042)	(0.061)
Fixed Exchange Rate Regime	0.128	0.090
	(0.142)	(0.174)
Population over 65	0.081**	0.104**
	(0.036)	(0.044)
GDP Deflator (t-1)	0.0001***	-0.001***
	(0.00001)	(0.00001)
Oil-Gas value per capita (t-1)	0.014***	-0.010
	(0.006)	(0.006)
Number of Strikes (t-1)	-0.008	0.001
	(0.098)	(0.099)
Constant	1.010	0.583
	(1.325)	(1.788)
Observations	1,930	1,930
Number of Countries	78	78
Wald chi-squared	22762.43***	23012.24***
	GMM specification tests (p values)	
Arellano-Bond test for AR(2) in first differences	0.83	0.99
The Hansen test of overidentifying restrictions	0.97	0.86

Note: *** p<0.01, ** p<0.05, * p<0.1, Robust standard errors in parenthesis. All models include 5 year period dummies. Both models include the lagged dependent variable. [F]: significant at p<0.1 in a joint F test.

Table A5. Fiscal Balance: CBI, Elections and Partisanship in Democracies

	Model 12	Model 13	Model 14	Model 15
Dependent Variable	Fiscal Balance	Fiscal Balance	Fiscal Balance	Fiscal Balance
Statistical Model	System GMM	System GMM	System GMM	System GMM
Sample	All Democracies	Non-Western Democracies	All Democracies	Non-Western Democracies
Central Bank Independence	1.207*	2.621*	0.628	1.683
(CBI)	(0.686)	(1.357)	(0.722)	(1.171)
Elections	0.363	0.967	-0.173	0.031
	(0.475)	(0.860)	(0.156)	(0.234)
CBI*Elections	-1.048	-1.641		
	(0.818)	(1.337)		
Leftist Government			-0.168	-0.794
			(0.545)	(0.650)
CBI*Leftist Government			1.077	2.301**
			(0.936)	(1.108)
Fiscal Balance (t-1)	0.638***	0.507***	0.610***	0.489***
	(0.064)	(0.058)	(0.064)	(0.059)
GDP Growth (t-1)	0.080**	0.048	0.078**	0.034
	(0.034)	(0.037)	(0.036)	(0.033)
Logged GDP per capita (t-1)	0.280	0.322	0.096	0.194
	(0.249)	(0.344)	(0.261)	(0.351)
Trade Openness (t-1)	0.002	0.003	0.003*	0.004
	(0.002)	(0.003)	(0.002)	(0.003)
Fixed Exchange Rate Regime	-0.051	0.576	-0.086	0.707
	(0.219)	(0.468)	(0.248)	(0.475)
Population over 65	0.003	0.046	0.025	0.094
	(0.038)	(0.072)	(0.040)	(0.075)
GDP Deflator (t-1)	0.001***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Capital Controls (t-1)	0.085	0.003	0.089	0.010
	(0.084)	(0.126)	(0.092)	(0.127)
Oil-Gas Value per capita (t-1)	0.043***	0.046**	0.047***	0.051**
	(0.009)	(0.021)	(0.009)	(0.022)
Number of Strikes (t-1)	-0.206*	-0.366**	-0.215*	-0.400**
	(0.111)	(0.170)	(0.122)	(0.171)
Constant	-4.123*	-5.761*	-3.773	-4.538
	(2.462)	(3.002)	(2.654)	(2.985)
Observations	1,218	597	1124	597
Number of Countries	63	42	62	42
Wald chi-squared	3076.75***	4391.42***	4491.32***	9029.27***
GMM specification tests (p values)				
The Arellano-Bond test for AR(2) in first differences	0.437	0.477	0.455	0.492
The Hansen test of overidentifying restrictions	0.61	0.379	0.705	0.383

Note: *** p<0.01, ** p<0.05, * p<0.1, Robust standard errors in parenthesis All models include regional and 5 year period dummies. Sample is restricted to observations with a Polity IV score greater or equal to 8.

Table A6. Countries Included in the Empirical Models

Albania	1991-2007	Kenya	1970-2007
Argentina	1970-2004	Korea (South)	1970-2007
Armenia	1993-2007	Kyrgyzstan	1992-2007
Australia	1970-2007	Latvia	1993-2007
Austria	1970-1998 (a)	Lithuania	1992-2007
Azerbaijan	1992-2007	Macedonia	1994-2007
Belarus	1992-2007	Malaysia	1970-2007
Belgium	1970-1998 (a)	Mexico	1971-2007
Bolivia	1970-2007	Moldova	1992-2007
Botswana	1974-2007	Mongolia	1995-2007
Brazil	1970-2007	Netherlands	1970-1998 (a)
Bulgaria	1990-2007	New Zealand	1970-2007
Canada	1970-2007	Nicaragua	1970-2004
Czech Republic	1993-2007	Norway	1970-2007
Chile	1970-2007	Panama	1980-1998
Columbia	1970-2007	Paraguay	1989-2007
Costa Rica	1970-2007	Peru	1970-2007
Croatia	1992-2007	Philippines	1970-2007
Denmark	1970-2007	Poland	1991-2007
Dominican Republic	1989-2007	Portugal	1970-1998 (a)
El Salvador	1993-2007	Romania	1990-2007
Estonia	1992-2007	Russia	1992-2007
Finland	1970-1998 (a)	Singapore	1970-2004
France	1971-1998 (a)	Slovenia	1992-2007
Georgia	1994-2007	Slovak Republic	1994-2007
West Germany	1971-1989	South Africa	1970-2007
Germany	1990-1998	Spain	1970-1998 (a)
Greece	1970-2000	Sweden	1970-2007
Guatemala	1989-2007	Switzerland	1996-2001
Honduras	1970-2007	Tajikistan	1992-2007
Hungary	1990-2007	Thailand	1992-2003
India	1970-2007	The United Kingdom	1970-2007
Indonesia	1970-2007	The United States	1971-2007
Ireland	1970-1998 (a)	Trinidad	1993-2007
Israel	1970-2007	Turkey	1970-2001
Italy	1970-1998 (a)	Turkmenistan	1992-2007
Jamaica	1992-2007	Ukraine	1992-2007
Japan	1970-2007	Uruguay	1970-2007
Kazakhstan	1992-2007	Venezuela	1970-2005
		Zimbabwe	1984-2001

Note: (a) Due to the introduction of the euro (January 1999) we do not extend the data to 1999-2007 for these countries.

Table A7. Central Bank Independence Index and Reform Years

Creation of the CBI index

For each of the indicators, possible scores run in intervals from 0 to 1 with the intervals depending on the number of categories. For example, there are five categories in the central bank governor's term of office indicator: 0=under four years or at the discretion of the appointer; .25=4 year appointment; 0.50=5 years; 0.75=6 to 8 years; 1=more than 8 years. Scores from the individual indicators are then aggregated into their broader categories as such: the four indicators in the CEO category are averaged; policy formation is a weighted average of the 3 components with who formulates monetary policy and role in government's budgetary process worth a quarter and resolution of conflict worth one half; objectives and the first four indicators in limitations on lending were each treated separately; finally the last four indicators in limitations on lending were averaged. These aggregate scores were then summed to get an unweighted average independence score.[44] To get the weighted average used in most studies, including this one, the weights listed in the Appendix were applied to each of the aggregate scores and then the totals were summed. The aggregate CWN scores range from a possible 0 to a possible 1, with 1 representing the most independent possible central bank.

Components of the Cukierman, Webb, and Neyapti index

Chief Executive Officer (weight = .20)

- (a) Term of office (6 categories)
- (b) Who appoints CEO? (6 categories)
- (c) Dismissal (7 categories)
- (d) May CEO hold other offices in government (3 categories)

Policy Formation (weight = .15)

- (a) Who formulates monetary policy? (4 categories)
- (b) Resolution of conflict (6 categories)
- (c) Role in government's budgetary process (2 categories)

Objectives (weight = .15; 6 categories)

Limitations on lending to the government

Part 1 (weight = .40)

- (a) Advances (weight = .15; 4 categories)
- (b) Securitized lending (weight = .10; 4 categories)
- (c) Terms of lending (weight = .10; 4 categories
- (d) Potential borrowers from bank (weight = .05; 4 categories)

Part 2 (weight = .10)

- (e) Limits on central bank lending determined by? (weight = .025; 4 categories)
- (f) Maturity of loans (weight = .025; 4 categories)
- (g) Interest rates on loans must be? (weight = .025; 5 categories)
- (h) Is central bank prohibited from buying or selling government securities in primary market? (weight = .025; 2 categories)

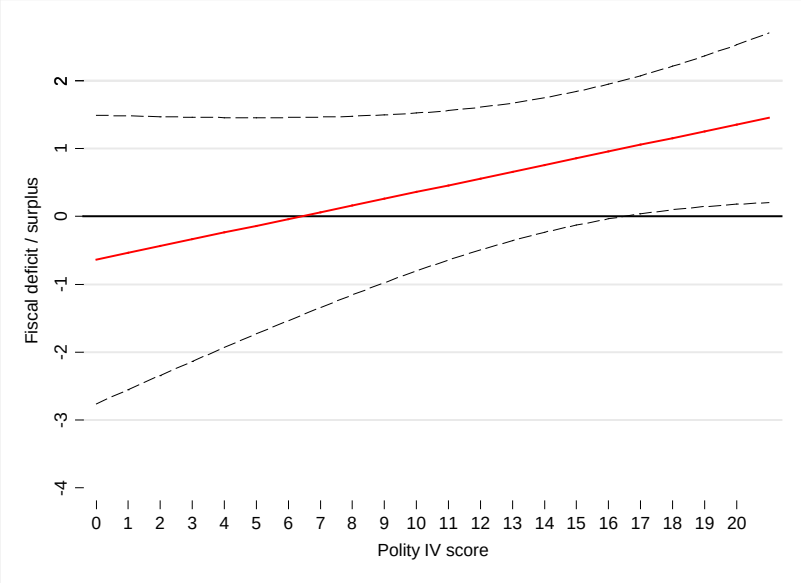
[44] If the legislation does not cover one of the indicators, it is not coded as 0. Instead, "the weights of the missing variables are allocated proportionally to the remaining variables within the subgroup" (Cukierman, Webb, and Neyapti 1992, p. 12).

CBI reform years

Country	Reforms	Country	Reforms
Albania	1997	Kyrgyz Republic	1997
Argentina	1975, 1992, 2002	Latvia	1998, 2001, 2002
Armenia	1996, 2001	Lithuania	1996
Australia	--	Macedonia, FYR	2002
Austria	1984	Malaysia	--
Azerbaijan	1996, 2004	Mexico	1985, 1994
Belarus	2001	Moldova	1995, 2006
Belgium	1993	Mongolia	1996
Bolivia	1977, 1995	Netherlands	--
Botswana	--	New Zealand	1990
Brazil	--	Nicaragua	1992, 1999
Bulgaria	1997, 2005	Norway	1972, 2003
Canada	--	Paraguay	1995, 2003
Chile	1975, 1989	Peru	1993
Colombia	1993	Philippines	1993
Costa Rica	1996	Poland	1997
Croatia	2001, 2002, 2008	Portugal	1975, 1980 ,1990, 1995, 1998
Czech Republic	2001	Romania	1998, 2004
Denmark	--	Russian Federation	1995, 2002
Dominican Republic	2002	Singapore	--
El Salvador	--	Slovak Republic	1999, 2002
Estonia	2006	Slovenia	2002, 2007
Finland	1998	South Africa	1989, 1996
France	1972, 1993	Spain	1980, 1994
Georgia	--	Sweden	1998
Germany	--	Switzerland	1979, 2003
Greece	1995	Tajikistan	1996
Guatemala	2002	Thailand	2008
Guyana	1998	Trinidad and Tobago	--
Honduras	1997	Turkey	1990, 2001
Hungary	2001	Turkmenistan	1994
Iceland	--	Ukraine	1999
India	--	United Kingdom	1997
Indonesia	1998	United States	--
Ireland	--	Uruguay	1995, 1997, 2008
Israel	--	Uzbekistan	1995
Italy	1994	Venezuela, RB	1975, 1987, 1993, 2001
Jamaica	--	Zimbabwe	1984, 1999
Japan	1998	Kenya	1985, 1996
Kazakhstan	1995, 1997, 2003, 2006	Korea, Rep.	1998

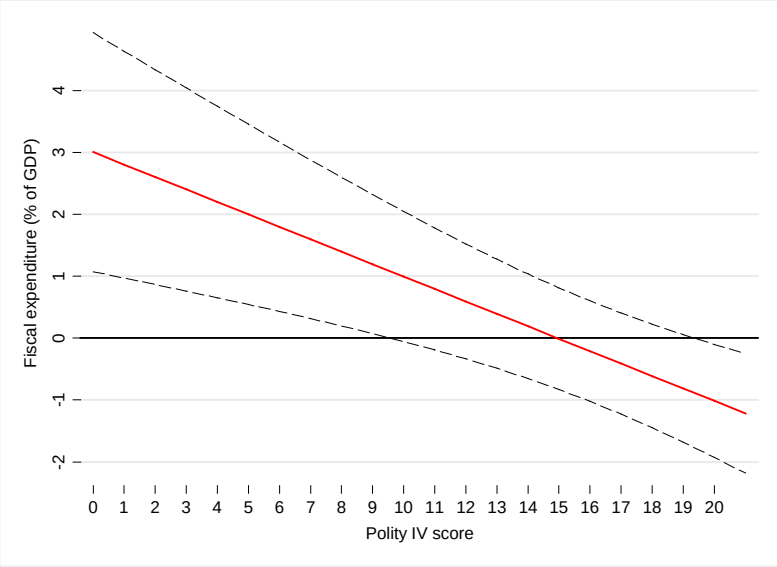
Appendix Figures

Figure A1. Marginal effect of CBI on fiscal deficit / surplus (% of GDP)



Note: Figure is based on Model 4 in Table 1 – the fixed effects model. Dotted lines reflect the 90% confidence intervals.

Figure A2. Marginal effect of CBI on fiscal expenditure (% of GDP)



Note: Figure is based on Model 11 in Appendix Table A4. Dependent variable is the ratio of fiscal expenditure to GDP. Dotted lines reflect the 90% confidence intervals.

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