(Why) do central banks care about their profits?

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Abstract

We document that central banks are significantly more likely to report slightly positive profits than slightly negative profits, especially amid greater political pressure, the public's receptiveness to more extreme political views, and when governors are reappointable. Profit concerns are absent when no such factors are present. The propensity to report small profits over small losses is correlated with a more lenient monetary policy and greater tolerance for inflation. We conclude that profitability concerns, although absent from standard theory, are present and effective in practice. These findings inform a debate about monetary stability and the effectiveness of non-traditional central banking.

Keywords: Central Banks, Profitability, Non-Traditional Central Banking, Monetary Stability

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"Central bankers frequently say… profits are an afterthought to higher economic goals, such as controlling inflation. Even losses aren't such a big deal…"

Wall Street Journal, May 8, 2016

"…to many Eurozone central bankers the idea that a central bank might lose money seems almost taboo, if not shameful; it undercuts everything that is supposed to make a central bank credible."

Financial Times, February 16, 2012

"[The Swiss National Bank's Governor] had faced calls to go after he ran up record losses in 2010 to try to halt the rise of the Swiss franc, an effort which cost the central bank 26.5 billion francs."

BBC News, January 9, 2012

"The Swiss National Bank expects an annual profit of 54 billion Swiss francs ($55.25 billion) for 2017, the biggest profit in its 110-year history… Its stock price more than doubled last year… the Swiss federal government and the country's 26 cantons will get more cash than usual. Credit Suisse said the result would help the SNB to defend its expansive monetary policy… "A large profit makes it easier for the SNB to explain why it has built up all these foreign currency reserves than if they reported a loss.'"

Reuters, January 9, 2018

"[T]he fear of losses could deter [central banks] from pursuing policies that would benefit the broader economy, economists and former central bankers say... In Japan in the 1990s, concerns over potential losses appear to have lessened the central bank's resolve to expand its balance sheet aggressively…"

Wall Street Journal, May 8, 2016

1. Introduction

Do central banks care about their profits? A fast-growing theoretical literature has emerged that controversially debates this question. The answer is important because whether or not central banks care about their profits is a crucial determinant for the effectiveness of monetary policy, as well as for long-term monetary stability.[1] Specifically, one strand of the literature debates the normative question regarding under which conditions central banks *should* or should not care about their profitability. Another strand *assumes* central banks care at least about the sign of their profits, and shows the likely desirable and undesirable consequences of such preferences or constraints. Interestingly, the debate thus far lacks an

[1] See, among others, Sims (2005), Berriel and Bhattarai (2009), Reis (2013, 2015), Bhattarai et al. (2015), Del Negro and Sims (2015), Hall and Reis (2015), Mendes and Berriel (2015), Benigno (2017), and Benigno and Nisticò (2018).

empirical investigation into its very premise, namely, the positive question of whether central banks *are* in fact concerned with the level or sign of their profits. This paper provides a first answer to this question.

The question is timely because, due to the widespread adoption of non-traditional monetary policy (i.e., large-scale asset purchases in the United States, Japan, and the Euro area), interest rate changes can have profound effects on central bank profits,[2] and politicians even in advanced economies link the continuation of central bankers' careers to their policy choices.[3] Central banks' willingness or ability to support the financial system in crises periods may also depend on whether central bank balance sheet considerations are important.[4] Lastly, especially in times of populism, central bank profitability is discussed as a guarantor of central bank independence.[5]

Investigating this question empirically is difficult because counterfactual profit levels (i.e., central banks' hypothetical profit levels in the absence of profit concerns) are in general difficult to observe. This paper addresses this challenge by focusing on a set of central-bank-year observations close to the zero-profit threshold for which the counterfactual can arguably be discerned. Our approach is similar to the one used in the literature to study how corporate executives manage firm earnings. Because of market pressures and career concerns, corporate executives inflate their firm profits to meet profit targets, often

[2] Stress tests in Christensen et al. (2015) for the Fed conclude that losses on its Treasury and mortgaged-backed securities holdings from interest-rate risk are moderate, partly because the Fed does not mark-to-market and "may have been lucky in this episode" with a slow recovery, an unusually low and stable inflation, and a delayed liftoff from the zero lower bound. Simulations in Cavallo et al. (2018) indicate that the likelihood of the Fed realizing net losses is around 30 percent at its current levels of reserve balances (of around $2.3 trillion).

[3] "[Trump] left open the possibility of renominating Federal Reserve Chairwoman Janet Yellen once her tenure is up next year, a shift from his position during the campaign that he would 'most likely' not appoint her to another term. 'I do like a low-interest rate policy, I must be honest with you,' Mr. Trump said at the White House, when asked about Ms. Yellen" (*Wall Street Journal*, April 12 2017; see also *Reuters*, April 12, 2017).

[4] According to Friedman and Schwartz (1963), the Fed's fear of losses was a factor preventing an aggressive expansionary response to the emerging Great Depression, leading to a more profound and prolonged recession. Turning to present-day anecdotes, "analysts had widely expected the ECB to start buying bonds yielding less than its deposit rate of minus 0.4%... But Bundesbank President Jens Weidmann warned shortly before the ECB's March policy meeting that such a move would lead to "guaranteed losses" for the central bank. The ECB subsequently… said it would start buying corporate bonds" ("Windfall for Central Banks Fuels Political Pressure," *Wall Street Journal*, May 8, 2016).

[5] "As the Fed *raises interest rates* in coming years, *remittances* almost certainly will *decline*… This mix could easily fuel a populist assault on Fed independence in Congress…" (emphasis added, see https://www.moneyandbanking.com/commentary/2015/5/26/do-central-banks-need-capital).

taking myopic actions that are harmful in the long term (Jensen 1986; Stein 1989; Graham et al. 2005). The key insight from this literature is that observations with small positive profits are more likely to result from earnings management, whereas profits that fall just below zero are less likely to be driven by such practices (Burgstahler and Dichev 1997; Leuz et al. 2003; Bergstresser et al. 2006; Bhojraj et al. 2009).[6] We apply similar techniques to central banks. We investigate both whether there are discontinuities in the distribution of central bank profits, and whether central banks' monetary policy decisions reflect profit concerns.

Using a large sample of more than 150 central banks spanning more than 20 years, we document that central banks are discontinuously more likely to report small positive profits than small negative profits. This finding suggests that at least some central banks, at least some of the time, inflate their profits in order to avoid reporting a loss. Presumably, they would not do so if their reported profits were deemed irrelevant. We hence infer that central banks care about the profits they report.

Cross-sectional variation in the size of the discontinuity strengthens this interpretation and sheds light on the causes behind central banks' profit concerns. We find the significance and magnitude of the discontinuity varies predictably with central banks' *ability* to control their reported income (e.g., exposure to foreign-exchange risk and rigid accounting rules) and *incentives* to avoid losses (e.g., central bankers' reappointment prospects, the level of political pressure to produce profits, the public's receptiveness to more extreme political views, dividend policies for the distribution of central bank profits to the government, etc.). Moreover, the discontinuity is present *only if* enough such factors are present, and it cannot be solely explained by central bank observations with low exposures to profitability risks (e.g., interest-rate and exchange-rate risks).

[6] The broader literature has used similar discontinuity tests to establish manipulation of performance metrics in many different settings, including, among others, education (Urquiola and Verhoogen 2009), medical research and policies (Barreca et al. 2014), government budgeting (Liebman and Mahoney 2017), environment (Pierce and Snyder 2012), sports (Pope and Simonsohn 2011), taxation (Saez 2010), residential mortgage loans (Garmaise 2015), hedge funds (Bollen and Pool 2009), and debt covenants (Dichev and Skinner 2002).

Overall, these results indicate the discontinuity is unlikely to be driven by the nature of the central bank business model or a mechanical propensity to produce small profits, but it is more likely to be the result of imperfect *de facto* independence of the average central bank in the sample. Observing the variation in accounting choices thus answers the question of whether central banks care about their profitability and sheds light on the political economy factors that drive such profit concerns, with implications for central bank design, central bank remittance policies, and public finance.

An interesting follow-up question that emerges from the analysis is whether the discontinuity in central bank profits is *solely* due to accounting manipulations—such as income smoothing through an opportune use of accounting estimates— or whether profitability concerns are also measurably related to policy choices and outcomes. Central banks concerned with their profitability may, for example, avoid or delay increases in interest rates that are harmful to their profitability, leading to higher inflation rates (see, among others, Bhattarai et al. 2015; Del Negro and Sims 2015; Mendes and Berriel 2015).[7]

Consistent with these predictions, we find that the discontinuity in central bank profits is related to higher realized inflation both in levels and relative to the central bank's stated inflation target or professional inflation forecasts. These results are robust to controlling for country fixed effects. Additional Taylor rule analysis shows that the discontinuity in profits is related to a smaller sensitivity of policy rates to deviations of inflation from its target when inflation is above the target and the central bank needs to raise interest rates. The level of inflation and short-term interest rates in a country can be related to the central bank's profits for various reasons. However, it is more difficult to rationalize why those variables would be *discontinuously* different for central banks whose profits are slightly above or slightly below

[7] Non-neutrality of central bank balance-sheet operations can of course also be broken in ways other than with frictions between central bank and treasury balance sheets. For example, Iovino and Sergeyev (2018) show that a lack of common knowledge about central bank strategy can make QE effective.

zero, if not because both policy rules and profit levels are endogenous choice variables that respond to the same underlying factors.

Overall, our results have implications for macroeconomic modeling, monetary policy, and the effectiveness and sustainability of quantitative easing (QE) programs. The usefulness of our results lies in their potential to help assess the likely applicability of existing theories assuming, to a varying degree, that central banks' profitability or capital concerns alter their policies on the margin, and help inform future theoretical modeling by showing which factors may contribute to profit concerns.

Theories that entertain the possibility of central bank profit concerns include Sims (2005), who shows that central bank capital concerns can lead to higher inflation through self-fulfilling expectations. Jeanne and Svensson (2007) emphasize that resulting inflationary expectations can enable the economy to escape a liquidity trap.[8] Berriel and Bhattarai (2009) embed an exogenous positive-profit constraint in a dynamic New Keynesian model and show the constraint leads the central bank to distort its policy choices, making it less effective at governing the quantity of money, inflation, and the output gap. In Del Negro and Sims (2015) and Benigno and Nisticò (2018), the absence of full fiscal support for fiscally independent central banks generates profitability concerns that distort their policy choices and compromise their ability to control inflation.[9] Our findings provide support to the key assumption of these papers, and inform on the political and economic environments to which they may be most applicable.

Our results also inform a literature on optimal central bank design. Reis (2013, 2015) and Hall and Reis (2015) study the conditions under which central bank losses can or cannot undermine its solvency. A key result in Hall and Reis (2015) is that a central bank can never become insolvent as long as it can accrue earnings before or after a negative capital shock to smooth its budget constraint. In the absence of

[8] In related work, Bhattarai et al. (2015) and Mendes and Berriel (2015) point out that a central bank's fear of losses is also what can make QE effective, because it turns large-scale asset purchases into a commitment device to keep future rates low. Reis (2016) explains how QE can be an effective tool to respond to fiscal crises.
[9] Reis (2015) points out that period insolvency can lead to rule insolvency.

any additional pressures on central banks arising from political or behavioral frictions, profits should be entirely irrelevant to central banks; profits are not an "afterthought" but rather are no thought at all. Yet even if all these conditions are met, "markets may [nevertheless] react badly in the *false belief* that losses imply a loss of policy effectiveness" (emphasis added; Archer and Moser-Boehm 2013, 1). Central bankers may anticipate such irrational reactions and adjust their accounting reports and policy choices accordingly. Therefore, an empirical test of whether and when central banks are impervious to their profits is important, despite the clarity of the existing theoretical investigations.

Our findings reject the null hypothesis that central banks are indifferent to their profitability. Instead, we find evidence that the extent of loss aversion is related to the political environment in which the central bank operates, as well as to behavioral and agency frictions. One may thus conclude that future modeling should entertain the notion that profits are an important consideration in central banking, and that optimal central bank design should be robust to such frictions. However, our empirical design does not have the power to reject that profits are irrelevant to any particular central bank in the sample. Thus, a nuanced interpretation of our findings is in order, which we attempt in the conclusions.

The paper proceeds as follows. Section 2 outlines our key testable hypotheses and explains the intuition behind our tests. Section 3 describes our data. Section 4 reports our key findings on central bank profit concerns. Section 5 reports results on policy inputs and outcomes. Section 6 concludes.

2. Testable hypotheses and empirical strategy

To understand why central banks may be concerned about their profitability, it is useful to consider a central bank's budget constraint. Different from other government branches, central bank accounts are not generally consolidated with the accounts of the central government. The central bank has its own balance sheet and resulting budget constraint. Central bank liabilities consist primarily of interest-bearing (required and excess) reserves and currency in circulation, whereas their assets consist primarily of fixed-

income securities (government bonds and corporate bonds) and foreign assets (foreign currency and gold). Revenues earned on its assets (e.g., interest income, revaluation gains) are used to cover interest on its liabilities and other expesnes (e.g., loan loss and general risk provisions, staff expenses). The resulting central bank profits are transferred to the central government (treasury) in the form of dividends.

When the central bank's income cannot cover its expenses, the shortfall is met with reductions in its equity and reserves or through transfers from the central government budget. In the absence of any political or behavioral frictions and as long as the central bank's charter allows for intertemporal smoothing (e.g., through past or future reductions in dividends) or transfers from the government (i.e., allows for negative dividends), the central bank faces no serious risk of insolvency (Hall and Reis 2015). The central bank's financial position is irrelevant and does not affect its policies.

However, when such transfers are not possible (legally or effectively, perhaps due to political economy or behavioral considerations), incentives to avoid losses may arise. For example, even if a central bank's charter allows for automatic recapitalizations by tapping into the resources of the government, central bank losses may be met with discontent by the government or the public who may interpret losses as a sign of weakness, incompetence or failure. If such concerns enter the calculations of central bankers, profit concerns and incentives to avoid losses may ensue.

Central banks have many tools at their disposal that they can use to avoid losses. One accounting item central banks can adjust with some discretion, and without obvious short-term consequences are provisions for future losses. By decreasing provisions for loan losses or some future risks, central banks can increase their profits. Furthermore, because central banks have some control over interest rates and asset values, they can adjust their profits by adjusting real economic parameters. For example, decreasing the central bank policy rate reduces the interest expense on central banks' liabilities and increases their profits. Similarly, setting the value of a currency peg affects the value of currency holdings denominated in local currency on the central banks' balance sheets.

Our primary goal is to test whether central banks are in fact concerned about their profitability and take actions to avoid losses when "frictions" that favor such concerns are more pronounced.[10] The null hypothesis is that central banks' policies and accounting profits are entirely determined by fundamental factors. The alternative hypothesis is that central banks are not indifferent about the level and sign of their profits and take actions to manage their profits. Under this alternative hypothesis, central banks' profits are at times different from what they would have been in the absence of profit concerns. Note that profit levels per se can have "real" consequences, as they determine or affect the level of dividends distributed to the government, and therefore affect the government's budget.

The challenge is that under the alternative hypothesis, this counterfactual level of profits (i.e., the level of profits they would have reported in the absence of profit concerns) is typically not observable. The key idea of the present paper is to focus on a subset of observations for which we can arguably elicit an average counterfactual: those central banks that report profits just above or just below zero. The argument underlying our first set of tests is that in a frictionless world, we have no strong reason for why a central bank would generate a very small profit as opposed to a very small loss. (We will critically examine and weaken that null hypothesis later.) The reason is that zero is not a fundamentally important number in a neoclassical theory of central banking—indeed, profits are supposed to be entirely irrelevant. A discontinuity in the profit distribution at any point would be unexpected in a frictionless model. The profit distribution should be smooth. By contrast, a discontinuity is a natural consequence of a model in which profit concerns play a role. If central banks (or, more specifically, the agents acting on their behalf) care about the level or sign of their profits, and if the agents have the ability to affect the profit levels, we expect that central banks are more likely to report small profits than small losses.

Formally, the empirical hypotheses follow:

[10] We use the term "frictions" to refer to balance-sheet or income-related factors that may generate profit concerns; recall that in neoclassical theory central banks should not care about their profits.

H_0: *No discontinuity exists in central banks' profit distributions.*

H_1: *A discontinuity exists at zero in central banks' profit distributions.*

H_{1a}: *The discontinuity is larger when ability or incentives to manage profits are more pronounced.*

H_{1b}: *No discontinuity exists when ability or incentives to manage profits are low or not present.*

To examine these hypotheses, we test for a discontinuity in central banks' profit distribution around zero, and check whether the magnitude and significance of the discontinuity vary systematically with factors that proxy for central banks' *ability* and *incentives* to manage reported profits.[11] To conserve space, we only give an exhaustive list of these factors in the empirical section. They cover a variety of agency, political, behavioral, and accounting considerations, motivated by the related theoretical work on central bank balance sheet considerations as well as insights from the vast corporate finance and accounting literature on earnings management in profit-maximizing firms.

In a second set of tests, we investigate whether the discontinuity is more likely to be the result of accounting manipulations alone, or whether evidence suggests the discontinuity is also associated with changes in the central banks' policy choices and outcomes. The theoretical basis for the latter hypothesis is well grounded in theory. As shown in Del Negro and Sims (2015) and Benigno and Nisticò (2018), among others, the absence of full and frictionless fiscal support generates central bank profitability concerns that distort policy choices and compromise inflation outcomes. By "leaning against the wind" central banks may generate losses. For example, increases in interest rates aimed to curtail inflationary pressures or maintain a peg, can harm central banks' profitability by reducing their net interest margins

[11] Various measures of incentives and the ability to avoid losses (described in section 4) may also give rise to higher central bank profits more generally. However, we can only observe a counterfactual profit level for banks around the zero-profit threshold. Our focus in the small profit and loss region is thus explained by the desire to establish internal validity of the notion that certain factors induce central banks to take actions that influence their reported profits. The downside of our approach is that the empirical results, and in particular the magnitude of the estimated coefficients, may not enjoy strong external validity. In fact, central banks may prefer to not only upward-adjust small losses and turn them into small profits, but also make adjustments to large profits, as the latter may garner attention from the government and threaten independence. Our setting does not allow us to test that latter hypothesis.

and generating capital losses through both decreases in the market values of securities that are marked-to-market and the devaluation of foreign assets.[12] (Such losses are more pronounced when central banks need to raise interest rates after a prolong period of low interest rates and when central bank assets have longer durations and balance sheets are exposed to greater currency mismatches.) Central banks concerned with their profitability may thus avoid or delay increases in interest rates, leading to higher inflation rates (see, among others, Bhattarai et al. 2015; Del Negro and Sims 2015; Mendes and Berriel 2015).

We empirically examine whether central banks' tendency to avoid losses leads to higher inflation by comparing the inflation outcomes of central banks that report small losses with those that report small profits. This allows us to contrast central banks who arguably have no profit concerns with a set of central-bank-year observations, some of which are likely affected by profit concerns. The idea is that central banks can quite easily turn small losses into small profits. If they choose not to, it suggests that profit concerns for these central banks are likely to be less important. Therefore, using the inflation outcomes of central banks in the small loss-region provides a proxy for the counterfactual inflation rates in the absence of profit concerns. We expect that if the central banks' tendency to avoid losses results in higher inflation rates, we should observe a discontinuity in inflation rates at the zero-profit threshold: the average inflation rates (or inflation rates relative to targets) should be systematically higher as we move from just below to just above the zero-profit threshold.[13] By contrast, a *placebo test* predicts that no discontinuity should be present at any other point in the profit distribution.

[12] The vast majority of central bank observations in our sample (94%) incur an interest expense, and the average interest margin (interest expense to interest income) is 68%. Thus, increases in interest rates—the cost of interest-bearing liabilities—lead to an immediate increase in central banks' interest expenses, whereas the interest income on fixed income securities does not adjust, reducing their net interest margins. Increases in interest rates may additionally generate losses on mark-to-market securities, particularly when these assets have longer maturities. Similarly, increases in interest can generate losses on foreign assets because these assets are recorded on central bank balance sheets in domestic currency, and increases in interest rates, all else equal, lead to an appreciation of the domestic currency. Whereas fixed-income securities held at amortized (historical) cost are not affected by interest-rate changes, selling such securities before they mature (e.g., when unwinding previous asset purchases) leads to realized losses because the market values of those securities are below their amortized cost.

[13] Identification is obtained using only observations of central banks with very similar levels of profitability around the threshold. In more conservative specifications, we also introduce country-fixed effects, exploiting variation within the same country when it falls just below or just above the threshold.

In additional tests, reported in Appendix 2, we further examine whether profit concerns distort the setting of monetary policy interest rates, using Taylor rule regressions. Given well-known conceptual problems associated with such regressions (Cochrane 2011) and further complications introduced by our use of cross-country data, the results of these tests should be viewed as suggestive, not conclusive.

3. Data

We use data from several sources. Financial statement information such as central bank profitability, components of central bank income and expenses, and accounting rules come from Bankscope.

Central banks measure assets and income following either accounting rules that also apply to commercial banks (e.g., International Financial Reporting Standards, IFRS), or specifically developed accounting rules. We use financial statements and measures reflecting the accounting rules that apply to the particular central bank. We collect information from both consolidated and unconsolidated financial statements because some central banks report both sets of accounts and we have no priors that they manage profit in one but not the other type of accounts.[14] We measure central bank profitability as the return on assets (ROA): the ratio of net income over total assets, whereas total assets are calculated as the average between the beginning and end of the fiscal year to which the net income calculation applies.[15]

For inclusion in the sample, we require that a central bank has information on net income and total assets in the current and previous year. The analysis focuses on national central banks and excludes data on supranational central banks (ECB) and local central bank branches. This approach yields a sample of 2,591 bank-year observations that covers 23 years and 155 countries.

[14] Using both sets of accounts implies that we sometimes have two observations for each bank-year. In robustness checks, we repeat our key analyses after excluding the "duplicate" observations for central banks that report both sets of accounts.
[15] Durtschi and Easton (2005) and Durtschi and Easton (2009) argue that the discontinuity in the profit distribution can result from scaling profits by a variable that differs between profit and loss observations. To ensure that the deflator does not change the shape of the distribution, we follow their analysis and examine whether average total assets differ between (unscaled) profits and losses of similar magnitude (e.g., +/-1, 10, 100 million). We do not find any systematic differences in our scaler.

Table 1 provides an overview of the resulting sample of central banks. The starting point of our analysis is 1992, when Bankscope began coverage of central banks. As can be observed in Table 1, not all countries have data for all years. The average number of observations per country is 16.7, with high-income countries having more complete coverage. Low-income countries have lower coverage, especially in the earlier years. In the analysis that follows, we examine the robustness of our key results across time and across high- and low-income countries. Table 1 also reports the number and frequency of loss observations for each central bank in the sample. Out of 155 central banks, 98 (63%) reported losses at least once during the sample period. The minimum number (frequency) of loss observations per central bank is 0 (0%), the maximum is 18 (100%), and the average is 2.8 (18%). In the analysis that follows, we report results excluding central banks that may be naturally insulated from losses.

(Insert Table 1 about here)

We complement the Bankscope data with data from several sources. Information about central banks' dividend distribution rules are taken from Archer and Moser-Boehm (2013). Macroeconomic indicators such as economic development, inflation rates, and growth rates of GDP come from the World Development Indicators. Data on short-term interest rates are taken from the International Financial Statistics of the International Monetary Fund (IMF). Dincer and Eichengreen (2014) and Dreher et al. (2008) provide information on central bank *de jure* independence and the central bank's governor tenure, respectively. We use political-party affiliation of the country's chief executive from Beck et al. (2001) (their extended dataset covers 179 countries up to 2012). Data on institutional characteristics such as government effectiveness, rule of law, and corruption are from Kaufmann et al. (2010). Data on banking, currency, and sovereign crises are taken from Laeven and Valencia (2012). Appendix 1 reports detailed definitions and data sources for all variables used in the paper.

Not all variables are available for all central banks and/or for the entire sample period. Therefore, in what follows, we begin with a detailed descriptive analysis of the propensity to avoid losses and various

country-year characteristics, whereas we consider the role of one factor at a time. We then turn to a multivariate regression framework, which examines whether the correlation between various factors affects their respective roles in shaping central banks' loss avoidance. This analysis, as discussed further below, is more affected by missing observations.

4. Results

4.1. Is a discontinuity present in central banks' profits distribution?

The top panel of Figure 1 reports the distribution of central bank "profits" (net income scaled by average total assets) for all observations in our sample truncated at +/- 9% for better readability.[16] We observe a discontinuous increase in the number of observations to the right of the zero-profit threshold. This finding supports Hypothesis 1 and rejects the null hypothesis of a smooth distribution.

(Insert Figure 1 about here)

The bottom panel of Figure 1 plots the expected number of earnings observations and confidence intervals for the intervals to the left and to the right of the zero-profit threshold. The resulting confidence intervals to the left and to the right of zero do not overlap, indicating the discontinuity is statistically significant. The McCrary (2008) test reported in the upper-left corner of the figure indicates the discontinuity is statistically significant at the 1% level.[17]

Next, we examine whether this discontinuity is present throughout our sample period and across high- and low-income countries. We first split our sample into three subsamples, one for each decade in our sample: 1992-1999, 2000-2009, and 2010-2014. Figure 2 shows the discontinuity is present for each

[16] We use the optimal bin size, which is proportional to the interquartile range of the distribution and the sample size (see Scott 1992). In our sample, the optimal bin size is 0.003. "Outlier" countries with observations outside the +/- 9% range include, e.g., Zimbabwe, Argentina, Czech Republic, and Pakistan.

[17] Based on McCrary (2008), we use a nonparametric local polynomial density estimator to examine the continuity of profits' density function in the neighborhood of the threshold.

of the three decades in our sample. Figure 3 shows the discontinuity is present for both high- and low-income countries. This finding rejects the plausible hypothesis that the discontinuity is only a feature of low-income countries, where the rule of law and institutions may be poorer.[18]

(Insert Figures 2 and 3 about here)

Next, we examine whether the discontinuity is an artefact of pooling central banks that never make losses—because they may not pay interest on reserves or have no other significant risk exposures— with central banks that report profits in all regions of the profit distribution and continuously so around the zero-profit threshold. Out of 155 central banks, 57 never reported losses during the sample period. Although some of these central banks may never have reported losses because they were able to avoid losses over many years, removing these central banks from the sample does not change the results.

Figure 4 reports the profits distribution for central banks that reported a loss at least once during the sample period. Like before, we observe a significant discontinuity at zero, suggesting the discontinuity is not a mechanical byproduct of pooling.[19]

(Insert Figure 4 about here)

In what follows, we aim to inform more thoroughly the interpretation of these results by testing sub-hypotheses H1a and H1b, which shed light on the cross-sectional determinants of the discontinuity. Much of this analysis focuses on the narrow interval around the threshold (i.e., in the first bin to the left and to the right of zero). Table 1 reports the number of observations and frequency with which different

[18] In additional tests, reported in the Internet Appendix (IA), we confirm the discontinuity in both crisis and non-crisis periods, for countries with both high and low inflation levels, and for countries with high and low interest-rate levels, as well as for the subsamples of European Union and Eurozone central banks (Figures IA-1 to IA-4). Note that Eurozone central banks do not conduct an independent monetary policy, but they nevertheless have their own separate financial statements that are used to determine dividend distributions. The loss observations for the Eurozone are from France (1), Slovakia (2), and Slovenia (2).

[19] We further show the discontinuity is present after we remove central bank observations that do not incur interest expenses (and thus are mechanically more likely to report profits; see Figure IA-5). We also note the distributional properties of ROA are not consistent with the notion that central banks are generally immune to losses and earn stable profits that do not change much over time (see Table IA-1). The overall standard deviation of ROA is 0.062, with within and between variation equal to 0.054 and 0.034, respectively. The persistence coefficient of ROA is 0.644, which is quite low and comparable to the persistence that prior studies estimate for U.S. listed firms (about 0.7-0.8). See, e.g., Sloan (1996).

central banks are in the [-0.003, +0.003) region. Out of 155 central banks, 108 (70%) are in this region at least once and 78 (50%) are in it at least twice.

4.2. Which factors drive the discontinuity?

In this section, we aim to uncover the factors (frictions) that drive central banks' ability and incentives to avoid losses, and we investigate whether the discontinuity disappears when no (or not sufficiently many) such factors are present. By doing so, we not only answer the question of which factors are more likely to make central banks averse to losses, but also attenuate the likelihood that the discontinuity is a mechanical byproduct of the central bank business model. We show the discontinuity in the profit distribution is stronger for central banks that have greater ability to precisely control their profits, and—perhaps more interestingly— for central banks whose key policymakers face greater pressure or have greater career incentives to avoid losses. Whereas we find the graphical comparison of subsample histograms most transparent, we also provide formal test statistics to inform whether the discontinuity is more pronounced in one subsample relative to another subsample in a statistically significant way.[20]

4.2.1. Comparative statics with respect to *ability* to manage earnings

The ability of central banks to manage earnings and avoid reporting losses is influenced by many factors, including the composition of their assets and the accounting rules they use.

Central banks with relatively large foreign assets (e.g., foreign-currency reserves, gold, and other foreign securities) may have lower ability to manage earnings, because foreign assets are reported on their

[20] We provide two-tailed tests for two reasons. First, whereas we may have a prior as to which subsample is likely to display a more pronounced discontinuity, we do not want that subjective prior to influence the statistical tests. Second, we want to offer conservative test statistics. Along a similar vein, we do not formally adjust the tests as a function of the number of observations in each subsample, because we find the graphical analysis more transparent and informative. To illustrate, compare Figure 10 (central banks with negative equity) with Figure 8-III (publicly traded central banks). Both have a low number of observations, but one seems to clearly display a discontinuity whereas the other does not. We think attempts to offer formal adjustments to the hypothesis tests, e.g., by Monte Carlo simulations, are unlikely to capture these differences in a transparent way.

balance sheet in the local currency, and changes in the exchange rate thus imply changes in the central bank's asset values. The associated gains and losses in the values of foreign assets have to be reported in the income statement, creating volatility in central banks' profits.[21] To the extent that central banks with significant foreign assets do not perfectly control the exchange rate, they cannot precisely control their profits, predicting a smaller discontinuity. We instead predict a larger discontinuity for central banks with low foreign assets or fixed-exchange-rate systems.

Results in Figure 5 support these predictions. We find that central banks with high foreign-assets-to-total-assets ratios (greater or equal to 50%) and a floating-exchange-rate system have a smaller discontinuity than central banks with low foreign assets or a pegged exchange rate.[22] Because central banks have some control over when and how they set a peg, we next examine the discontinuity for central banks introducing a peg. Figure 6 shows the discontinuity is more pronounced in this case and it exhibits a dip right before zero, suggesting the peg value may be calibrated to avoid small losses.

(Insert Figures 5 and 6 about here)

Accounting standards may also influence central banks' ability to manage earnings. Whereas the multitude of accounting regimes is too great for a statistical analysis, as a general rule, central banks using IFRS have less room for discretion than those using non-IFRS regimes. The reason is that IFRS does not allow general-purpose provisions, limits the use of off-balance sheet items that can be used to hide losses, and requires that a greater share of assets and liabilities are marked-to-market.[23] Barth et al. (2008) find

[21] Taylor (1982) documents some of the methods central banks employ to hide losses from foreign-exchange interventions; Alexander and Oren (2004) contribute a theoretical treatment of exchange-rate interventions and consequences for central bank profits. Dziobek and Dalton (2005) provide case studies of large central bank losses due to various causes.

[22] Data availability with respect to foreign assets is limited. Data for foreign assets are available only for 1,173 out of 2,591 observations in our sample. Composition of foreign assets is only available for a very small number of countries (see the IMF's Composition of Foreign Exchange Reserve, COFER, database) and a small fraction of those countries that have a peg. Therefore, we cannot verify whether the foreign exchange exposures are in the same currency as the peg. However, to support a peg, the central bank is likely to hold large foreign reserves in the currency of the peg.

[23] General purpose provisions whose values are arguably subjective may afford central banks a greater ability to reduce volatility in reported earnings and dividends that may arise from "paper" gains and losses on revaluation of foreign assets and liabilities or assets and liabilities that are marked-to-market.

that firms using IFRS are less likely to manage earnings than firms using local accounting standards. One may thus expect that central banks under IFRS have generally a lower ability to manage reported earnings and thus exhibit a smaller discontinuity. As can be observed in Figure 7, the discontinuity is present under both IFRS and local accounting standards—consistent with the ability to manage earnings under both sets of accounting standards— but it is statistically and economically smaller under IFRS.[24]

(Insert Figure 7 about here)

These results provide support for a key premise of our paper, namely, the notion that central banks can tailor their profits quite precisely, especially when a particular set of factors is present.

4.2.2. Comparative statics with respect to *incentives* to manage earnings

We now turn to perhaps the most interesting part of the paper. We examine whether the magnitude of the discontinuity varies predictably with central banks' and central bank policymakers' incentives to avoid losses. The existing literature in profit-maximizing firms finds that earnings management and loss avoidance are the result of external pressures and ensuing agent problems due to manager career concerns (Jensen 1986; Stein 1989; Graham et al. 2005; Bennett et al. 2017). Such pressures and incentives may also be present in central banks. For example, even when the central bank's dividend distribution rules provide for automatic recapitalizations by tapping into the resources of the central government, central bank losses may be met with discontent by politicians or the public, or they may be interpreted as a sign of weakness or failure. If the possibility of discontent amid losses enters the calculation of central bankers, incentives to avoid losses may ensue even if no economic reason exists for avoiding losses. One may thus

[24] In untabulated robustness tests, we also find that central banks under IFRS exhibit a larger discontinuity when the greater share of total assets is measured at historical cost.

hypothesize that the incentives to avoid losses are greater when the political pressure is greater, or when the central bankers are more receptive to such pressures.

Measuring such pressures is difficult in general but may be possible in particular cases. For example, central bank governor *career concerns* may provide incentives to avoid losses. Indeed, we find the discontinuity is significantly larger (both economically and statistically) when central bank governors are re-appointable (Figure 8-I). Small profits are 2.16 times more likely than small losses when central bank governors are not re-appointable as opposed to 7.02 times more likely when they are re-appointable; the difference between them is statistically significant at 1%. Table 2 summarizes the results of these tests.

(Insert Figure 8 and Table 2 about here)

Relatedly, loss avoidance may be rooted in central banks' concerns that losses will be interpreted as signs of "bad" policies and "weak" central banks, even if such interpretations would be unfounded, irrational, or due to "behavioral" factors not easily captured by neoclassical models. For example, behavioral theories are used to explain why corporate managers avoid losses (Burgstahler and Dichev 1997), and survey evidence supports the view that corporate managers inflate profits relative to benchmarks to prevent market turmoil, further questions, and negative publicity, although doing so can be harmful in the long run (Graham et al. 2005).

One may expect that such pressures are stronger when countries are governed by extreme political parties, because the populations in these countries have revealed themselves to be more receptive to populism. When countries are governed by extreme nationalist or populist parties, central banks may have more difficulty convincing governments or the public of the necessity of occasional negative profits; losses are more likely to be interpreted as evidence of failed policies and weak central banks in need of ad hoc recapitalizations or politicized at the expense of the central bank.[25]

[25] See also a broader discussion in Goodhart and Lastra (2018) on threats to central bank independence in the aftermath of the global financial crisis from the rise in populism in Western economies and the expanded mandates of central banks.

We find indeed that the discontinuity is significantly larger when central banks face a more extreme leader of either left or right affiliation (see Figure 8-II and Table 2). Small profits are 19 times more likely than small losses when the country leader is affiliated with an extreme right- or left-wing party, whereas it is only 4.89 times more likely when the country leader is affiliated with a centrist party.[26] The difference between them is statistically significant at 5%.

Similarly, incentives to avoid losses may be stronger when losses are more likely to receive more public scrutiny. Although central banks with private shareholders are institutionally shielded from market pressures,[27] we expect that any losses they may generate are more likely to receive public attention. Publicly traded central banks hold press conferences to discuss their financial performance and issue profit warnings that may draw attention to balance sheet considerations.[28] We find that publicly traded central banks exhibit an economically and statistically larger discontinuity (see Figure 8-III and Table 2).

Next, we explore the role of budgetary considerations. Governments may have become accustomed to receiving dividends from central banks to support their budgets and avoid unpopular increases in taxation.[29] Failing to provide a constant stream of dividends may bring central banks under pressure to continue to produce profits.[30] We expect that pressures to avoid losses are greater when the

[26] In robustness tests, we also distinguish between extreme right and extreme left political leaders. We find the discontinuity is present in both samples and is slightly more pronounced for extreme right than extreme left (although the difference is not significant at the conventional level).

[27] "The rights of ordinary shareholders to select management and determine strategy are severely circumscribed and allow no role in the formulation of public policy. Dividends to private shareholders are predetermined or limited in law, making these central banks wholly or mostly independent of the profit motive, and removing a potential conflict of interest between financial advantage and public welfare" (Archer and Moser-Boehm 2013, 7).

[28] We note the results on publicly traded central banks should be viewed with caution because only five central banks (Belgium, Greece, Japan, Switzerland, and South Africa prior to 2002) are publicly traded, and obviously many other variables can potentially be used to describe the particular features of these central banks.

[29] For example, the Federal Reserve has sent close to $100bn in profits per year to the Treasury in the recent past. This income stream to the government is bound to shrink when the Fed raises interest rates or shrinks its balance sheet (*Wall Street Journal*, January 10 2017); see also https://www.federalreserve.gov/econresdata/notes/feds-notes/2017/confidence-interval-projections-of-the-federal-reserve-balance-sheet-and-income-20170113.html.

[30] Anecdotal evidence is plentiful. For example, "[o]ne rationale for the SNB 'gold initiative' was to bullet-proof the SNB's balance sheet against losses… The fear was that the SNB's balance-sheet losses might anger cantonal leaders to such a degree that the central bank's independence would be threatened" (Eichengreen and Weder de Mauro, Project Syndicate, February 12, 2015). Similarly, the Banque de France in its 2010 annual report states that "[t]he strict management… of its invested monetary

central bank faces a more fiscally conservative government, or when the scope of central bank operations is large relative to the size of the government's budget.[31] (To the extent that the size of the central bank's scope is predetermined—because central banks are constrained to perform certain operations— this treatment may afford some degree of exogenous variation.)

Results in Figures 8-IV, V, and Table 2 are consistent with these predictions. We find a larger discontinuity when the country's leader is affiliated with a right-leaning party than when it is affiliated with a left-leaning party. Using the ratio of central bank operating expenses to the total tax revenues of the government, we further find that central banks with above-median expense ratios exhibit a larger discontinuity than central banks with below-median values.[32] We find similar results if we scale operating expenses with GDP (i.e., the size of the country's economy); untabulated sample splits with respect to the country's debt to GDP or government deficit (surplus) to GDP, instead, do not reveal any systematic differences in the size of the discontinuity.

Budgetary pressures are also influenced by central bank dividend distribution rules. As shown in the extant theoretical literature, dividend rules influence whether central banks can "soften" their budget constraints (Reis 2013; Hall and Reis 2015). Central banks whose charter allows for negative dividends can draw more easily on external resources to cover their obligations when internally generated income is insufficient; the ability to reduce dividend payments to the government below the level of period profits to absorb future or past losses serves a similar function. Such central banks may thus have weaker or no incentives to avoid losses, because they face no risk of period insolvency.

income is the best guarantee of the Banque de France's independence. This strict management allows the Bank to: finance its development completely independently, while also paying a regular dividend to the French State" (p. 57).

[31] An alternative way to interpret this proxy is that it measures the relative cost of running a central bank for the government if the central bank accounts were consolidated with those of the government. Failing to independently cover their expenses puts pressure on the government's budget, particularly when such expenses are a large fraction of the government budget.

[32] Mechanical relations between operating expenses and profitability push in the opposite direction (i.e., higher operating expenses produce lower profitability), which is not true for alternative measures such as the fraction of average central bank profits to tax revenues of the government, because more profitable centrals banks are more likely to be in the profit region.

To distinguish between central banks that face a "hard" versus a "soft" budget constraint, we use information on the central banks' dividend distribution rules in each country. This information is available for 30 countries from Archer and Moser-Boehm (2013, Annex 2). We label central banks that can draw on resources from the government to cover losses or that can smooth intertemporally as having a soft budget constraint.[33] This group includes Chile, Czech Republic, Finland, Iceland, India, Israel, Germany, Korea, Malaysia, Mexico, Netherlands, Peru, Poland, Philippines, Thailand, Turkey, Singapore, Slovakia, South Africa, Spain, Switzerland, Sweden, and the United States.[34] We assign all remaining central banks from the Archer and Moser-Boehm sample into a second group. These central banks are either substantially limited in the amount of profits they can retain or their dividend distribution decisions are taken jointly with the government. We label these central banks as facing a hard budget constraint and expect them to have greater incentives to avoid losses. This group includes Australia, Canada, Denmark, Japan, New Zealand, and the United Kingdom.

Results in Figure 8-VI and Table 2 indicate the discontinuity is more pronounced for central banks with "hard" budget constraints: whereas central banks with soft budget constraints are twice as likely to report small profits as opposed to small losses, central banks with hard budget constraints are *infinitely* more likely to report small profits—in fact they never report losses. The difference in the odds ratios of the two groups is statistically significant at the 1% level.

[33] The latter includes (i) central banks that face an equity target (or equivalent) that allows future surpluses to be retained to an unusual extent to cover losses and/or rebuild equity or allows to build buffers toward a target level, (ii) central banks that have full discretion in the determination of general-purpose provisions without any specific limit, and (iii) central banks with smooth distributions, where dividends are determined based on a trailing average of net income in past years.

[34] Following the announcement QE2, the Fed changed its accounting rules to further soften its budget constraint. In case of losses, the Fed will build a buffer account reducing dividends to the Treasury until it covers all past losses. This change makes unlikely to ever have to go "cap-in-hand" to the US Treasury for a capital top-up, protecting Fed's independence. However, it may also undermine the Fed's credibility and the credibility of the US government who provides ultimate back-up. Bank of America Merrill Lynch's Ralph Axel states, "Such moves do not promote confidence in the Fed, but rather cause concerns within markets. We will not make too much of a fuss over this accounting change, but the overall theme of reduced government credibility is strengthened by it… In our view the ongoing decline in credibility translates into a higher chance of a downgrade in the sovereign credit rating." ("The Fed can't go bankrupt. Anymore," *Financial Times*, January 20 2011).

We obtain similar insights using central banks' actual dividend payments during the sample period that are available for most central banks in our sample (see Figure 8-VII and Table 2). In this case, we designate central banks with negative dividends at some point during the sample period or with consistently low dividend payout ratios throughout the sample period as having a soft budget constraint. Instead, central banks that pay dividends to the government even when they make losses or that have consistently high payout ratios are classified as having a hard budget constraint. We use the top and bottom tertiles of the dividend distribution as cutoff points, corresponding to 90% and 50% payout ratios, respectively.[35]

These findings are consistent with the hypothesis that central banks with hard budget constraints have stronger incentives to avoid losses, but they are inconsistent with the notion that central banks with soft budget constraints are generally oblivious to the profits they report. The fact that central banks with soft budget constraints also exhibit a statistically significant discontinuity indicates flexible distribution rules alone are not sufficient to remove central banks' incentives to avoid losses.

4.2.3. "Switching off" the discontinuity

Overall, these cross-sectional differences in the magnitude and significance of the discontinuity are consistent with various frictions leading central banks to actively avoid losses and are more difficult to reconcile with the notion that the discontinuity is simply a mechanical byproduct of the central bank business model. To further support this conclusion, we examine whether the discontinuity disappears when factors hypothesized to generate profit concerns are "switched-off."

[35] We thus posit that central banks with average payout ratios below 50% have a greater ability to build buffers and smooth intertemporally than those with payout ratios greater than or equal to 90%. In Figure IA-6 we also contrast central banks with dividend payouts lower than 90% and central banks with dividend payouts greater or equal to 90%. Differences between the two groups are more pronounced when we allow for larger disparities in the payout ratios. This classification is also more similar to the one obtained using the dividend rules (the correlation coefficient equals to 0.48 as opposed to 0.12).

Under the null hypothesis that the discontinuity is mechanical, the discontinuity should persist unchanged no matter which factors are present. Under the alternative hypothesis that the discontinuity is due to frictions, the discontinuity should disappear when no frictions are present.

We first explore whether central bank *de jure* independence removes profit concerns. Perhaps surprisingly, we find that central banks that enjoy more legal independence if anything exhibit a *larger* discontinuity (Figure 9). This result highlights the distinction between *de jure* independence and *de facto* independence. For example, *de jure* independence still allows for re-appointable central bank governors, which is a feature that may impede de facto independence. The larger discontinuity for de jure independent central banks may also be due to the endogeneity of central bank independence: positive profits may help the central bank justify and maintain its independence.[36]

(Insert Figure 9 about here)

Next, we examine whether negative equity insulates central banks from profit concerns.[37] When the central bank's equity is deeply negative and the payout rule is such that profits must not be distributed to the Treasury until all past cumulative losses are replenished, receiving dividends from the central bank in the foreseeable future is virtually impossible, no matter the realization of period profits. This impossibility may effectively isolate the central bank from pressures to generate profits.[38] Figure 10 indicates the profits distribution of central banks with negative equity (Chile, Slovakia, and Israel) indeed does not exhibit a significant discontinuity.[39]

[36] We find no significant differences with respect to central bank policy transparency or the country's broader quality of institutions and respect for the law as captured by World Bank measures of the rule of law, government effectiveness, and control of corruption (see Figures IA-7 and IA-8).

[37] Central banks are exposed to the risk of negative profits more frequently than to negative equity. Whereas roughly a third of central banks in our sample either reported a loss or were on the brink of reporting a loss in any given year, only 7% of central banks had negative equity during our sample period. Virtually all central banks (86%) reported a loss or were close to reporting a loss at least once during our sample period.

[38] We are grateful to Luboš Pástor for this insight.

[39] Taken at face value, these results might suggest that, in contrast to concerns expressed in existing literature (e.g., Stella 1997), negative equity positions help sustain rather than jeopardize independence. However, because of the low number of observations in this test, we do not attach high confidence to this interpretation.

(Insert Figure 10 about here)

Another approach is to examine which minimum combination of factors can "switch off" the effect. We find that no economically and statistically significant discontinuity when the following combinations of factors are "switched off": (1) when central bank governors are not re-appointable *and* dividend distribution rules do not impose a hard budget constraint *or* (2) when central bank governors are not re-appointable *and* the central bank's operating expenses are not large relative to size of the government's tax revenues (Figure 11). These findings suggest profit concerns are much reduced or eliminated if central bank governors are less receptive to external pressures (by design) and if losses do not impose significant pressures on their respective budgets.[40]

(Insert Figure 11 about here)

4.2.4. Multivariate analysis

Table 3 transfers the above analyses to a multivariate framework to account for correlations between the various factors and to explore the role of each factor, conditional on the others.[41]

Before we start, we note the sample is significantly smaller because many of these factors are not available for the same set of observations, which makes this approach less attractive than would be desirable. Indeed, a key reason to show the discontinuity plots earlier is to provide the greatest possible level of transparency to the reader and use the largest available sample in each case. The regression analysis presented now should be seen as a complement. That said, the results are remarkably similar to those obtained in the bivariate analysis above; we point out exceptions where applicable.

[40] This interpretation of Figures 10 and 11 is subject to the limitation that weak power due to the smaller samples may contribute to a less pronounced discontinuity. In robustness tests, we confirm that the results are maintained if we pool these three sub-samples together (Figure IA-9). The sample includes 369 observations with 49 unique central banks.

[41] Table IA-2 reports a correlation matrix. The correlations between various factors are generally low. VIF tests for each model of Table 3 indicate multicollinearity is not a concern. For example, the highest VIF of the model that includes all incentive factors (model 8 in Table 3) is 1.58, which is well below 10—a commonly used threshold for acceptable VIF.

(Insert Table 3 about here)

Using the subsample of observations around the discontinuity for which all explanatory variables are available, we estimate a regression model in which the dependent variable equals 1 if central bank profit falls into the small-profit region, [0, 0.003), and equals zero if it falls into the small-loss region, [-0.003, 0). The sample consists of 61 observations and 18 unique central banks. We also report results using a slightly wider interval based on the two bins to the left and the two bins to the right of zero, [0.006, -0.006). The wider interval increases the sample size to 114 observations and 21 central banks.

All explanatory variables are expressed as dummy variables using the same cut-offs as in the figures and are coded so that they all predict positive coefficients when associated with higher incentives to avoid losses. This approach facilitates the comparison and the economic interpretation of the estimated coefficients. Each coefficient represents the change in the odds of reporting a small profit as opposed to a small loss when that factor is present, controlling for all other factors.[42] The model is estimated with OLS and standard errors are clustered at the central bank account level.[43]

Supporting our prior inferences, we find that career concerns of central bank governors, dividend distribution rules, and the size of central bank operations are the three most important factors: they have the largest impact on the likelihood of reporting a small profit as opposed to a small loss and retain their statistical significance even in the most saturated specifications. In terms of economic significance, our column (10) estimates indicate that when central bank governors are re-appointable, the odds of reporting a small profit as opposed to a small loss are five times larger than when they are not re-appointable (1.69 vs. 0.33). Central banks that face hard budget constraints are two and half times more likely to report small

[42] In particular, constant/(1-constant) indicates the odds ratio (i.e., the probability of reporting a small profit over the probability of reporting a small loss) when all factors in the specification are equal to zero. The coefficient estimate of each factor can then be used to calculate the odds ratio when that particular factor is set to 1: (constant + coefficient)/[1-(constant + coefficient)].
[43] We do not estimate a logit model, because, depending on sample composition, some variables perfectly predict the outcome, which leads to their automatic exclusion from the logit model, due a mechanical problem caused by the functional form of the logit that does not extend to the OLS.

profits than central banks with soft budget constraints (0.84 vs. 0.33). Similarly, central banks that are large relative to their governments are twice as likely relative to those that are small (0.72 vs. 0.33).

Consistent with unconditional results, extreme party and right-wing affiliations are each associated with higher probabilities of reporting small profits than small losses, but we do not have enough variation in this smaller sample to distinguish between them. Publicly traded central banks are also more likely to report small profits than losses, except for the last specification where the variable loses its statistical power.

Similar to unconditional results, we find no significant evidence that the overall quality of country institutions and economic development matter for the discontinuity of profits. We find that central bank legal independence and transparency do not matter, except when we enlarge the sample using the wider [-0.006, 0.006) interval. Consistent with earlier insights, more legally independent (and transparent) central banks are more likely to report small profits than small losses. In turn, the growth rate of GDP is statistically insignificant, consistent with the idea that narrow-interval regressions compare countries with similar business cycle conditions. Introducing a peg is associated with a higher incidence of small profits rather than losses, suggesting the exchange rate of the pegged currency may be chosen to manage earnings. IFRS and interest on reserves do not matter once we control for other factors.[44] This result is consistent with prior literature on corporations that finds incentives prevail over any constraining effects of accounting rules (Leuz et al. 2003).

Overall, the multivariate analysis in Table 3 corroborates the findings of the distributional tests. These analyses rely mostly on cross-sectional variation, which accounts for the bulk of the variation in our data. In the remainder of the analysis in this section, we provide some within-country evidence using a fixed-effects model, reported in Table 4, exploring variation in the central bank governor's time to

[44] We do not include exposure to foreign assets, because our sample size will be significantly reduced because data on foreign assets are not available for a large part of our baseline sample.

regular turnover and the proximity to national elections. All else being equal, we expect that central bank governors are less receptive to external pressures the further away they are from reappointment or end of term. We instead expect that government pressures on central banks are stronger in the run-up to elections (i.e., in the election year or the prior year).

(Insert Table 4 about here)

We find that time to central bank governor regular turnover matters in the expected way. Interaction terms between either the size of the central bank operations or the hard budget constraint—the two variables previously found to play a key role in central bank profit concerns— with time to regular governor turnover reveal that these two factors matter less the further away the governor is from re-appointment or end of term. Proximity to elections does not relate significantly to loss avoidance, though the estimated coefficients have the expected signs. Overall, these results, though limited in scope, corroborate key insights from previous analyses in a within-country setting.

5. Do profit concerns relate to monetary policy?

To examine whether central bank profit concerns are reflected in monetary policy, we study central banks' inflation outcomes around the discontinuity. Theory predicts that central banks concerned with their profitability may avoid or delay increases in interest rates that are harmful to their profitability, leading to higher inflation rates (see, among others, Bhattarai et al. 2015; Del Negro and Sims 2015; Mendes and Berriel 2015).[45] If this were the case, we should observe a similar discontinuity in inflation rates at the zero-profit threshold: inflation rates should be systematically—and discontinuously— higher for central banks that report small profits relative to central banks that report small losses. By contrast, under the null hypothesis, we should observe a smooth distribution and no discontinuity in inflation rates across central

[45] This channel may operate entirely through self-fulfilling expectations (Sims 2005). As long as the market expects a central bank to internalize the negative implications of higher interest rates on its profitability, inflation will increase.

banks that are just to the left or to right of any given profit threshold, including zero. Our test are meant to document that profit concerns are reflected in monetary policy and are not "just" a matter of accounting. Our results are not meant to suggest the profits cause inflation.

We test these predictions using narrow interval regressions around the threshold (i.e., in the [-0.003, 0.003) region) as well as polynomial regressions using the entire sample. In particular, using observations around the threshold, we estimate the following model:

$$\pi_{i,t} = \beta d_{i,t} + \delta z_{i,t} + \alpha_i + \varepsilon_{i,t}, \qquad (1)$$

where $\pi_{i,t}$ denotes the inflation rate or inflation gap in country i in year t. $d_{i,t}$ is a dummy variable that equals 1 if the central bank in country i in year t reported a profit (i.e., $roa_{i,t} \geq 0$), and 0 otherwise. $z_{i,t}$ and α_i denotes time-varying country characteristics and country-fixed effects, respectively, while $\varepsilon_{i,t}$ denotes the idiosyncratic error term. A positive and significant β indicates that inflation rates are discontinuously higher as one moves from just below to just above zero.

Results are reported in columns (1) to (5) Table 5. We find inflation rates are systematically higher when we move from just below the zero-profit threshold to just above it. This result becomes stronger in column (2), which controls for broad economic conditions such as GDP growth, country income levels, and the rule of law.[46] The estimated β coefficient increases from 0.014 to 0.025 and becomes significant at 5%. This is not surprising because better economic conditions correlate negatively with both inflation rates and central bank profitability. In other words, richer countries tend to have lower inflation and their central banks are less likely to report losses. Controlling for factors that drive central bank profit concerns that may also correlate with inflation rates directly has a similar effect, raising the profit coefficient from 0.025 to 0.036 and 0.033, because such factors tend to be associated with lower inflation rates (see columns

[46] To be able to compare our estimates, we keep our sample constant across the various specifications using for all specifications the subsample of observations for which all control variables up to column (3) are available.

(3) and (4)).[47] In column (5), we further introduce country-fixed effects to control for a broader set of time-invariant country and central bank characteristics that may be poorly captured by our controls. Identification in this case is obtained using variation in inflation rates in the same country when the central bank's profitability is just below or just above zero. Results are again very similar, with a point estimate equal to 0.022.

(Insert Table 5 about here)

In column (6), we report results of a similar fixed-effects specification using the inflation gap (inflation minus the central bank's stated inflation target) as the dependent variable for the subsample of central banks with explicit inflation targets. Results are again very similar: central banks with small positive profits have systematically larger inflation gaps than central banks with small losses by 0.016 percentage points.[48] A similar result is also obtained in column (7) when we replace the dependent variable with "inflation surprises," which equal to the difference between a country's inflation rate at the end of the year relative to the IMF's inflation forecasts in the World Economic Outlook in April of the same year. We find that central banks in the small profit region have about 1 percentage point higher realized inflation than the IMF's projected inflation rate earlier in that year. We view this result as auxiliary evidence consistent with profit concerns distorting monetary policy outcomes.

Results in Table 5 are also robust to the use of polynomial regressions, which use all available observations (i.e., observations further away from threshold). In these specifications, we control for a possible underlying relationship between inflation rates and central bank profitability using polynomials of profitability, along with other controls, as follows:

[47] Existing literature shows that countries with autonomous central banks experience lower inflation (Banian et al. 1983; Bade and Parkin 1987; and many that followed), although whether these correlations constitute causal effects and therefore justify efforts to increase central bank independence is disputed (Walsh 2005).

[48] The magnitudes appear plausible compared to estimates in Adler et al. (2012) on the impact of central bank *capital* levels (as opposed to *marginal profit* levels in our study) on monetary policy and inflation outcomes; see also Stella (2008), Klüh and Stella (2008), and Benecká et al. (2012) for a critical evaluation of these findings.

$$\pi_{i,t} = \beta d_{i,t} + \sum_{s=1}^{n}\left[\beta_s roa_{i,t}^{s} + \gamma_s roa_{i,t}^{s} * d_{i,t}\right] + \delta z_{i,t} + \alpha_i + \varepsilon_{i,t}, \qquad (2)$$

where $\sum_{s=1}^{n}\left[\beta_s roa_{i,t}^{s} + \gamma_s roa_{i,t}^{s} * d_{i,t}\right]$ indicates polynomials of profitability, $roa_{i,t}$. We use a flexible functional form allowing for nonlinearities with polynomials up to order *n* and a different functional form for profit and loss observations.[49] A positive and statistically significant β indicates the conditional expectation of inflation rates, $E(\pi_{i,t}/d_{i,t})$, is systematically higher as one moves from just below the zero-profit threshold to just above it. We estimate equation (2) using specifications similar to Table 5.

Table 6 reports our findings. Like before, we find a positive and statistically significant coefficient for $d_{i,t}$, which becomes stronger when we control for broad economic conditions and factors that may influence central banks' inflation rates directly. In terms of magnitudes, our point estimates are higher than in Table 5, ranging from 0.014 to 0.049, due to the presence of more low-income countries in the sample, which tend to have higher average inflation rates.[50]

(Insert Table 6 about here)

Panel I of Figure 12 offers an illustration of this result. The plot shows predicted inflation rates from column (1) for different levels of central bank profitability. The horizontal axis divides roa into bins that contain a small range of roa-values.[51] The vertical line indicates the zero-profit threshold. Each circle on the plot corresponds to the average inflation rate for a particular bin. The solid line indicates the average predicted values for each bin. The dashed lines indicate the 95% confidence interval. A clear and

[49] We have no a priori reason to expect this relationship to be the same on both sides of the threshold in general (Lee and Lemieux 2010) and in our context in particular. Therefore, and to avoid forcing a result due to a rigid functional-form assumption, we allow for different polynomial coefficients on both sides.

[50] In untabulated robustness checks, we confirm the jump for both high- and low-income countries. The estimated coefficient is larger for low-income countries: 0.043 as opposed to 0.025 for high-income countries, reflecting the higher average inflation rates between the two groups. For low-income countries, average inflation rate in the sample is 0.087 with a standard deviation of 0.103 as opposed to 0.027 and 0.025, respectively, for high-income countries.

[51] The bins are constructed so that each bin falls on either side of the threshold (no bin contains the threshold in its interior).

significant discontinuity in inflation rates exists at the zero-profit threshold, consistent with the hypothesis that central bank profit concerns compromise inflation outcomes.

(Insert Figure 12 about here)

As a *placebo* test, we examine whether inflation rates exhibit similar discontinuities at various ex ante non-meaningful thresholds of roa such as 0.024, 0.012, 0.006, -0.006, -0.012, and -0.024. We find no evidence of a discontinuity in any of these cases.[52] Panel II of Figure 12 illustrates the results for two of these thresholds, 0.012 and -0.012, respectively. Thus, whereas inflation levels may be related to central bank profits at various or all levels of profitability, the discontinuous jump in inflation appears to be unique to the discontinuity around zero profits. This result supports the hypothesis that profit concerns distort monetary policy. It is inconsistent with the hypothesis that a mechanical relationship between inflation and profits drives the results reported earlier.

The results in Tables 5 and 6 are consistent with two hypotheses: one is that the same factors and characteristics that cause central banks to be more likely to report a small positive profit than a small negative profit overlap with the factors and characteristics that cause monetary policy decisions that lead to higher inflation levels. Another is that discontinuously higher inflation is what causes central banks to end up in the small-profit as opposed to the small-loss bucket. Either interpretation indicates that central bank profit concerns are related to monetary policy outcomes, and not "just" accounting choices.

In additional tests in Appendix 2, we further examine whether profit concerns distort monetary policy decisions by estimating Taylor rule regressions around the zero-profit threshold. Consistent with theoretical predictions that central bank profit concerns create incentives to delay or avoid increases in interest rates, we find that the responsiveness of monetary policy interest rates to deviations of inflation from its target is systematically smaller for central banks in the small-profit region, particularly when

[52] Similarly, we find no evidence of a discontinuity when we replicate results of the narrow interval in Table 5 using placebo thresholds 0.024, 0.012, 0.006, -0.006 that have a sufficient number of observations to produce meaningful estimates.

Taylor rules indicate the central banks need to raise interest rates. Given the conceptual and practical problems associated with the use of Taylor rule regressions, we view the results of these additional tests as suggestive, rather than conclusive. Insofar as the methodological difficulties and measurement errors associated with such regressions apply to both sets of central banks (those in the small profit and small loss regions) the results of these tests may nevertheless be informative. We discuss both the results and the associated challenges of the Taylor rule analysis in Appendix 2.

6. Conclusions

This paper provides empirical facts that inform a thus-far theoretical debate on whether central banks are impervious to their profits and how profit concerns may interact with optimal central bank design and monetary policy. In particular, we devise an empirical test of whether central banks care about the sign of their profits. Specifically, the key idea is that a discontinuity in the profit distribution is a necessary consequence of central banks being concerned with the sign of their profits.

We document the presence of such a discontinuity, as well as various factors that drive its significance and magnitude. We find that measures of political and market pressure, central bankers' career concerns, and the ability to precisely control profits are significant predictors of small profits versus losses. Small positive profits are also correlated with a more lenient monetary policy and higher inflation levels and inflation gaps. These findings suggest a preference for positive profits is a friction that may be important for future theoretical modeling to consider.

Interpreting these facts literally within the framework of existing models might lead one to conclude that risks to monetary stability may be greater than is often assumed, especially in countries in which factors that generate central bank profit concerns are present. An extreme interpretation would be

that especially amid large-scale asset repurchases and increased political pressure,[53] the risks of higher-than-desirable inflation may be more pronounced than generally assumed.

This interpretation should be put into perspective, however. Many central banks (e.g., the Bank of Japan) have long conducted monetary policy with large-scale asset purchases, and the apparent risks to monetary stability have not materialized until now. Also, the central banks of Chile, Israel, and Slovakia have successfully operated with negative equity for a sustained period of time, which casts doubt on the influence balance sheet concerns have on the functioning of central banks.

That said, the facts we present about central banks' profit concerns are in important respects different from concerns about negative equity positions. Importantly, profit concerns may exist simply for political or "behavioral" reasons, such as the difficulty in communicating losses to the public, shareholders, or other constituents. Moreover, as we document, many central banks seem to be exposed to sufficient political pressure and career concerns, such that incentives for profit considerations enter their policy-making. The insight may be that de jure independence and optimally designed dividend and accounting rules may not be sufficient to entirely shield central bankers from these pressures.

Whereas we focused on profit patterns around zero to infer the influence of political pressure on central banks because small profits and losses provide measurable counterfactuals, central bank profit concerns are, if present, likely to be more general than a preference for the *sign* of profits. On the one hand, private benefits for central bankers and politicians might be greatest when the central bank maximizes the discounted stream of profits. However, the best strategy for a central bank to maintain independence might be to report small positive profits. Doing so might help "keep the [central bank] out of the press, and the press out of the [central bank]" (Lambert 2005, 63) and may thus attenuate the government's attention to a potential source of revenue that could be accessed either by changing the

[53] See *Fortune*, "Read the Full Cease-and-Desist Letter a Senior Congressman Just Sent to Janet Yellen," February 3, 2017, for recent developments in the United States.

central banks' dividend rules or their rules on reserve requirements.[54] An outright nationalization of the central bank, as recently proposed by Italy's "Five Star" movement, is a less subtle but (in the short term) no less effective way for the government to seize central bank profits.[55] Similarly, losses—even when fully justified— may just give governments the excuse and leverage needed to take control of the central bank finances and policy independence. Small positive profits might thus be the globally optimal choice of profit levels for a central bank that seeks to maintain its independence.

To some, the results presented in this paper substantiate a concern about recent calls for legislation that would require the Fed to propose a Taylor-like rule and explain any deviations from it.[56] For the same reason that central banks do not like to report losses and seem willing to distort policy choices to avoid this outcome as per our results, one may fear central bankers may also be reluctant to deviate too far from an announced monetary policy rule, even when economic conditions warrant the deviation. If so, a rule that aims to promote transparency could end up distorting policy decisions.

Lastly, based on our results and the above considerations, one might conclude that devising accounting rules that allow central banks to avoid the disclosure of losses could enable central banks to steer clear of political pressures that may otherwise influence their policy-making. We leave these open questions to future research.

[54] Changes to the latter were the method by which the US Congress effectuated multiple payouts from the Federal Reserve in recent years. See Binder and Spindel (2017) on the 2015 incident. For a discussion of the 2018 repetition of a similar strategy, see "Groans as Congress again uses Fed's capital fund to plug holes," *American Banker*, February 8, 2018, and "Congress raids the Federal Reserve's piggy bank once again, this time to help pay for the new budget deal," CNBC, February 9, 2018.

[55] See https://www.corriere.it/elezioni-2018/notizie/commissione-banche-tutte-strane-richieste-partiti-aada926c-007d-11e8-9961-f20884a97d4b.shtml.

[56] Todd Keister contributed this insight.

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Appendix 1: Variable definitions and sources

Variable name	Definitions and data sources
ROA or $roa_{i,t}$	Net income of a central bank *i* in year *t* divided by its average total assets. The data are from Bankscope.
Profit or $d_{i,t}$	An indicator variable that equals 1 if ROA of central bank *i* in year $t \geq 0$, and 0 otherwise.
Governor re-appointable	An indicator variable that equals 1 if a central bank governor is re-appointable, and 0 otherwise. The country is deemed to allow the reappointment of a central bank governor if at least one central bank governor served more than one legal term during the sample period. The data on central bank governors' time in office are from Dreher et al. (2008).
Extreme party affiliation	An indicator variable that equals 1 if a country's chief executive is affiliated with the nationalist party, and 0 otherwise. The data are from (Beck et al. 2001) and are available for years 1992-2012.
Publicly traded central banks	An indicator variable that equals 1 if the shares of a central bank are quoted on a public exchange, and 0 otherwise. The data are from Bankscope.
Time to governor turnover	The time (in years) remaining until the regular governor turnover. This variable ranges between 0 and 8 years in our sample. The data on central bank governors' time in office are from Dreher et al. (2008).
Right-wing party affiliation	An indicator that equals 1 if the country's chief executive is affiliated with the right-leaning party (conservative, Christian democratic, or right-wing), and 0 if the country's chief executive is affiliated with the left-leaning party (communist, socialist, social democratic, or left-wing). The data are from Beck et al. (2001) and are available for years 1992-2012.
Right-leaning party affiliation	An indicator that equals 1 if the country's chief executive is affiliated with the right-leaning party (conservative, Christian democratic, or right-wing), and 0 otherwise. The data are from Beck et al. (2001) and are available for years 1992-2012.
Left-leaning party affiliation	An indicator that equals 1 if the country's chief executive is affiliated with the left-leaning party (communist, socialist, social democratic, or left-wing), and 0 otherwise. The data are from Beck et al. (2001) and are available for years 1992-2012.
Close to elections	An indicator variable that equals 1 if elections of the country's chief executive take place in the current year or the following year, and 0 otherwise.

Operating expenses	The ratio of central bank personnel expenses from Bankscope to the country's total tax revenues from World Bank. The data are from Beck et al. (2001) and are available for years 1992-2012.
Hard budget constraint	An indicator variable that equals 1 if the central bank dividend payout ratio (dividends divided by net income) is greater than 90% (third tertile of the central bank dividend payout distribution) or when a central bank pays dividends despite incurring a loss. The indicator variable equals 0 if the central bank dividend payout ratio is less than 50% (first tertile of the central bank dividend payout distribution) or when a central bank receives dividends from the government. The data are from Bankscope.
Central bank legal independence	An index of central bank independence (CBIW) from (Dincer and Eichengreen 2014). The index scores answers to 24 questions covering different aspects of central bank legal independence (incl. policy choice, objectives, and governance structures). The index has a theoretical range from 0 to 1 with higher values indicating more independent central banks. The index is available for years 1998-2010. We use the value of the index in 1998 for the time period between 1994 and 1997. We assign values of the index from 2010 for years 2011-2014. All central banks in Eurozone countries receive the same score.
Central bank transparency	An index of central bank policy transparency from (Dincer and Eichengreen 2014). The index scores answers to 15 questions covering different aspects of the transparency of central bank operations (incl. openness about policy objectives, economic inputs used for policy decisions, and decision making). The index has a theoretical range from 0 to 15 with higher values indicating more independent central banks. The index is available for years 1998-2010. We use the value of the index in 1998 for the time period between 1994 and 1997. We assign values of the index from 2010 for years 2011-2014.
Rule of law	Rule of law captures the extent to which economic agents have trust in and abide by legal institutions, such as contract enforcement, property rights, and the courts. The index is expressed in standard normal units, ranging from approximately -2.5 to 2.5. Higher values indicate greater rule of law. We use the world-average value (index = 0) for our sample splits. The data are from Worldwide Governance Indicators (see Kaufmann et al. 2010).
Government effectiveness	The government-effectiveness index captures the quality of public services and the degree of its independence from political influence. The index is expressed in standard normal units, ranging from approximately -2.5 to 2.5. Higher values indicate greater government effectiveness. We use the world-average value (index = 0) for our sample splits. The data are from Worldwide Governance Indicators (see Kaufmann et al. 2010).

Control of corruption	Control of corruption captures perceptions of the use of power by political elites for private gain. The index is expressed in standard normal units, ranging from approximately -2.5 to 2.5. Higher values indicate greater control of corruption. We use the world-average value (index = 0) for our sample splits. The data are from Worldwide Governance Indicators (see Kaufmann et al. 2010).
Do not follow IFRS	An indicator variable that equals 1 if a central bank prepares financial statements in accordance with local standards, and 0 if it follows IFRS. The data are from Bankscope.
Exchange rate peg	An indicator variable that equals 1 if a country has an exchange-rate peg based on classification of Klein and Shambaugh (2008), and 0 otherwise. The data are from Klein and Shambaugh (2008) and are available for all the years in our sample period.
Introduce exchange rate peg	An indicator variable that equals 1 if a country introduces an exchange-rate peg in a given year based on classification of Klein and Shambaugh (2008), and 0 otherwise. The data are from Klein and Shambaugh (2008).
Do not incur interest on reserve	An indicator variable that equals 1 if the central bank interest expense from Bankscope equals zero, and 0 otherwise.
Foreign assets	The ratio of central bank foreign assets to total assets. The data on central bank foreign assets are from IMF.
Inflation	The country rate of consumer price inflation in a given year. The data are from World Bank.
Inflation less target	The country rate of consumer price inflation in a given year less the central bank inflation target for that year. The data on inflation targets are from Siklos (2017).
Inflation surprises	The difference between a country's consumer price inflation at the end of the year relative to the IMF's inflation forecasts in the World Economic Outlook in April of the same year.
Growth rate of nominal GDP	The percentage change in nominal GDP based on the data from World Bank.
Low-income countries	An indicator variable that equals 1 if a country is a low-income economy in a given year, and 0 otherwise. Low-income economies are defined based on GNI per-capita threshold of less than $12,475 (see World Bank).
$r_{i,t}$ or $r_{i,t-1}$	In the forward-looking Taylor rule, the short-term Treasury-bill interest rate in country *i* at the beginning of year *t* or *t-1*. The data are from International Financial Statistics (IFS), IMF.

$(\pi_{i,t,1} - \pi^*)$	In the forward-looking Taylor rule, the deviations of the inflation rate of country i between period t and $t+1$ from its estimated target level, π^*. The target level is estimated as one of model parameters. The data on inflation rates are from World Bank.
$(y_{i,t,1} - y^*_{i,t,1})$	In the forward-looking Taylor rule, the output gap of country *i* between period t and $t+1$, calculated as the difference between the actual GDP and the predicted GDP based on the Hodrick and Prescott (1997) filter.
rr^*_i	In the forward-looking Taylor rule, the long-run equilibrium real interest rate of country *i*. The real interest rate is calculated as the difference between the average interest on short-term treasury bills and the average inflation of country *i* using all available data during our sample period.
$e_{i,t-1}$	In the forward-looking Taylor rule, the real effective exchange rate of the country *i* during period $t-1$ based on the data from Darvas (2012).

Appendix 2: Taylor rule analysis

In this section, we examine whether central bank profit concerns distort monetary policy rates using Taylor rule regressions around the zero-profit threshold (i.e., in the [-0.003, 0.003) profit region).

A Taylor rule is a reduced-form approximation assessing the responsiveness of the short-term nominal interest rate to economic fundaments. Taylor rules assume that within each operating period, the central bank has a target for the nominal short-term interest rate that is based on the state of the economy and adjusts the short-term interest rate when the economy deviates from its desired target.[57]

To test whether profit concerns distort monetary policy, we study whether the responsiveness of short-term nominal interest rates to the state of the economy is associated with a central bank reporting a small profit as opposed to reporting a small loss. Absent a policy distortion, we should not observe any systematic differences between central banks just to the right or to the left of the zero-profit threshold, because zero is not a meaningful number in a frictionless model of central banking. By contrast, if profit concerns distort policy, we should observe that the responsiveness to fundamentals is systematically smaller for central banks in the small-profit region, particularly when they are expected to raise (rather than decrease) interest rates.

Since its inception in the early 1990s (Taylor 1993), Taylor rule specifications and estimation techniques have undergone various modifications. Economic fundamentals are typically approximated with inflation and output. Output is sometimes replaced with unemployment. Augmented specifications using additional factors are also specified in the literature. A typical extension, also considered here, involves the inclusion of real exchange rates, which may be important for small open economies. Because

[57] Taylor rules are often rationalized within a wide range of New Keynesian models with nominal wage and price rigidities, where monetary policy can affect real activity in the short-run. In such setting, by changing the nominal interest rate, the central bank can effectively change the real interest rate and other economic variables such as the output gap. Although such rules are shown to be optimal within a certain class of models (e.g., Woodford 2001; Svensson 2003), empirical studies use them in a more descriptive way (similar to the one adopted here) and as approximations of central banks' interest rate setting that is neither complete nor prescriptive.

the literature has not settled on a widely accepted specification or method, we present results using common approaches in the literature and expose these results to several robustness tests.

We begin using the approach in Clarida et al. (2000) (CGG thereafter). CGG specify a forward-looking policy rule and estimate the average inflation target in the sample along with the sensitivity of short-term interest rates to fundamentals as follows:

$$r_{i,t} = (1-\rho)\left[rr_i^* + \pi^* + \gamma_\pi(\pi_{i,t+k} - \pi^*) + \gamma_y(y_{i,t+q} - y_{i,t+q}^*)\right] + \rho r_{i,t-1} + \epsilon_{i,t}, \text{ (a1)}$$

where $r_{i,t}$ denotes the short-term nominal interest rate in country i in period t and rr_i^* denotes the long-run equilibrium real interest rate. $(\pi_{i,t+k} - \pi^*)$ denotes the inflation gap as deviations of the inflation rate between period t and $t+k$ from the level of inflation target level, π^*. $(y_{i,t+q} - y_{i,t+q}^*)$ denotes the output gap as deviations of output between period t and $t+q$ from its long-term equilibrium level. The coefficients γ_π and γ_y measure how strongly the central bank responds to deviations of inflation and output from their target and long-term equilibrium levels, respectively. Lagged short-term interest rates, $r_{i,t-1}$, accounts for interest rate "smoothing," with ρ measuring the degree of interest rate smoothing.[58]

The model parameters $\{\rho,\ \pi^*,\ \gamma_\pi,\ \gamma_y\}$ are estimated using the Generalized Method of Moments (GMM) with a weighting matrix that accounts for possible correlation in the error term, $\epsilon_{i,t}$, within countries. A set of instruments, $z_{i,t}$, is used to forecast the expected inflation and output gaps. This includes lagged values of the inflation and output gaps and other contemporaneous variables, known to the central bank when $r_{i,t}$ is chosen. Equation (a1) implies an orthogonality condition: $E\{\epsilon_{i,t} \mid z_{i,t}\} = 0$, which provides the basis for the estimation of the model parameters. When the dimension of $z_{i,t}$ is greater

[58] As discussed in CGG, a central bank may smooth interest rate changes for several reasons (e.g., considerations about model uncertainty, fears of disrupting capital markets, possible loss of credibility from sudden large policy reversals, consensus building). Lagged interest rates may also capture policy responses to *serially correlated policy shocks* not captured by inflation and output gaps (Rudebusch 2002) and data *measurement errors* in the timing of fundamentals (Orphanides 2001; Carare and Tchaidze 2005).

than the number of parameters to be estimated (as in CGG), equation (a1) implies overidentifying restrictions that can be tested to assess the validity of the set of instruments used (Hansen 1982).

CGG assume that rr_i^* is constant and determined by nonmonetary conditions. This assumption is needed to estimate π^*. Using data for the United States from 1960 to 1996, CGG take the sample average of the real Federal funds rate as a measure of rr^*. Similarly, we use the sample average of the real short-term treasury rate in each country. Inflation is measured using the annualized growth rate of the consumer price index, which allows us to better capture "imported" inflation that is likely to be important for open economies. CGG measure the output gap using estimates from the Congressional Budget Office (CBO). As CBO estimates are not available for other countries we measure the output gap using the Hodrick-Prescott (HP) filter and offer robustness checks using other commonly used measures in the literature, such as deviations of the log output or unemployment from their quadratic trend.

CGG use quarterly data and set $k = q = 1$, assuming the central bank sets the policy rate using estimates of the inflation and output gap in the next quarter. Our data are annual. We thus assume the central bank uses estimates of inflation and output gap over the next 12 months. Similar to CGG, $z_{i,t}$ includes (two-year) lagged values of the central bank policy rate,[59] inflation, output gap, M2 growth, and the spread between the long-term bond rate and the short-term Treasury-bill rate. Because central banks in some countries are likely to respond to changes in the US interest rates, we also include the lagged Fed interest rate. In robustness tests, we also include the lagged real exchange rate.[60]

Table A1 reports our findings. We begin by estimating equation (a1) in the [-0.003, 0.003) profit region. Results are reported in column (2). All estimated parameters are positive and statistically

[59] CGG use the central bank policy rate as a dependent variable and lagged short-term Treasury-bill rates as instruments. We use short-term Treasury-bill rates as a dependent variable and lagged policy rates as an instrument due to greater data availability of the Treasury-rate. (With GMM, the number of observations is reduced when values of the dependent variable are missing, but not when does values of an instrument are missing.) The correlation between the two interest rates is 0.94.

[60] Augmented models with real exchange rates among the explanatory variables have lagged real exchange rates among the instrument set, $z_{i,t}$, as in e.g., Clarida et al. (1998) and Chadha et al. (2004).

significant and of comparable magnitudes to CGG and the broader literature.[61] The smoothing coefficient, ρ, is equal to 0.552, which is slightly below the CGG's range of estimates (0.68-0.79). The average inflation target, π^*, is equal to 0.051, which is slightly higher than CGG's range of the U.S. estimates (0.036-0.042). This is expected as our sample includes developing countries and emerging markets that may have higher inflation targets. γ_π and γ_y, are equal to 1.860 and 0.225, respectively and comparable to those in CGG (0.83-2.15 and 0.27-0.93, respectively). The Hansen J statistic supports the validity of our instruments (p-value = 0.59).

(Insert Table A1 about here)

Next, we allow the inflation and output gap coefficients, γ_π and γ_y, to differ between central banks in the small-profit and small-loss regions. Results are reported in columns (3) and (4) of Table A1. We find that central banks in the small-profit region are less responsive to deviations of future inflation rate from its target. The γ_π estimate is 1.817 for central banks that report a small profit and 2.047 for those that report a small loss; the difference between the two estimates is statistically significant at 1%. This finding indicates central banks with profit concerns adjust their policy rates less aggressively to inflation gaps. We find instead no significant differences with respect to γ_y between the two groups of central banks.[62]

To further understand the inflation result in column (3), we re-estimate the model separately when inflation is above or below its target level.[63] Because it is the increases in interest rates (rather than the decreases) that are harmful to central banks' profitability, theoretical predictions suggest the result in column (3) should be stronger when the inflation rate is above its target and the central bank needs to raise (rather than decrease) interest rates. We find precisely this. Results in column (5) show central banks in

[61] See, for example, Clarida et al. (1998), Chadha et al. (2004), and Carare and Tchaidze (2005).
[62] Similarly, in untabulated tests we also find no systematic differences with respect to the smoothing parameter ρ.
[63] The data on central bank inflation targets are from Siklos (2017). When the inflation target is not available, we use the sample median inflation targets and assume 2% and 4.5% inflation targets for high- and low-income countries, respectively.

the small-profit region are less responsive to inflation than central banks in the small-loss region when inflation is above its target (the difference between them is significant at 1%). When inflation is below its target in column (6), we find no systematic differences between the two groups.[64]

Consistent with our earlier findings for inflation rates, the results in Table A1 are consistent with predictions in Bhattarai et al. (2015), Mendes and Berriel (2015), Del Negro and Sims (2015), and Benigno and Nisticò (2018) that profit concerns create incentives for central banks to avoid or delay increases in interest rates at the expense of higher inflation rates. In what follows, we subject our Taylor rule analysis to several robustness tests. To conserve space, we discuss our findings from these tests in the text and only tabulate the results of key specifications.

First, we re-estimate the Table A1 specifications using deviations of output or the unemployment rate from their quadratic trend as alternative measures of the output gap. Deviations of the output from its quadratic trend yield similar baseline estimates to column (2): $\rho = 0.583$, $\pi^* = 0.054$, $\gamma_\pi = 2.134$, $\gamma_y = 0.179$, and the p-value for J statistic = 0.37. Comparing the small-profit to the small-loss region also yields similar insights to Table A1. We find that when central banks are expected to raise interest rates, γ_π is systematically smaller for central banks in the small-profit region than for those in the small-loss region (2.347 vs. 3.385). Deviations of the unemployment rate from its quadratic trend, $\left(u_{i,t+q} - u^*_{i,t+q}\right)$, yield instead less reasonable baseline estimates. The inflation coefficient is very large ($\gamma_\pi = 4.878$) and the coefficient of the unemployment gap has the wrong sign ($\gamma_u = 0.084$). Unemployment data for developing countries and emerging markets may be less reliable, resulting in less plausible estimates.

Next, we explore the role of exchange rate considerations that are likely to be important for (small) open economies.[65] We begin by re-estimating the specifications in Table A1 after excluding countries

[64] A similar exercise for the output gap coefficient does not yield a statistically significant difference between the two groups.
[65] Although equation (a1) may appear to ignore an interest rate reaction to exchange rates, we note that exchange rate changes affect both inflation and output (Taylor 2001).

with an exchange rate peg. Results are similar to those reported earlier. The baseline estimates in column (2) are of similar magnitude: $\rho = 0.41$, $\pi^* = 0.048$, $\gamma_\pi = 1.80$, $\gamma_y = 0.22$, and the p-value for J statistic = 0.34. Like before, we find that when central banks are expected to raise interest rates, the sensitivity of interest to the inflation gap is smaller for central banks in small-profit region. Corresponding results for columns (3), (5) and (6) of the Table A1 are reported in Table A2.

For further robustness, we also re-estimate an augmented version of equation (a1) with lagged real effective exchange rates, $e_{i,t-1}$, as an additional explanatory variable, similar to Clarida et al. (1998) and Chadha et al. (2004). The real exchange rate may be significant either because the central bank directly targets the real exchange rate (decreasing interest rates when the real exchange rate appreciates as predicted in Obstfeld and Rogoff (1995)) or because the real exchange rate is an important information variable for forecasting the expected inflation and output gaps (Taylor 2001). Results are similar to those reported earlier and the new variable is not found to matter (see Table A2, columns (4)-(6)).

(Insert Table A2 about here)

A potential concern with using the CGG approach in a cross-country setting is that the inflation target is not allowed to vary across countries. Although inflation targets do not vary greatly from one year to the other, they do exhibit significant cross-country variation, particularly between high- and low-income economies. Thus, to allow inflation targets to vary across countries, we estimate:

$$r_{i,t} = \alpha_i + \beta_\pi(\pi_{i,t+k} - \pi_i^*) + \beta_y\left(y_{i,t+q} - y_{i,t+q}^*\right) + \rho r_{i,t-1} + \varepsilon_{i,t}, \quad \text{(a2)}$$

where the inflation target, π_i^*, is set equal to the central bank's stated inflation target using data from Siklos (2017). When this information is not available, we use the sample median inflation rates for high- and low-income countries and set the inflation targets equal to 2% and 4.5%, respectively. Equation (a2) is otherwise very similar to equation (a1), where $\alpha_i \equiv (1-\rho)[rr_i^* + \pi_i^*]$, $\beta_\pi \equiv (1-\rho)\gamma_\pi$, and $\beta_y \equiv (1-\rho)\gamma_y$. To account for unobservable country-fixed effects, α_i, equation (a2) is estimated using the

GMM estimator that includes the lagged changes of the dependent variable and the lagged changes of the inflation and output gaps in the instrument list (Blundell and Bond 1998). Similarly, we estimate an augmented version of equation (a2) with the real effective exchange rate, $e_{i,t-1}$, among the explanatory variables (and lagged changes of this variable in the instrument list). For both models, results are very similar to those found earlier in Tables A1 and A2 and are reported in Table A3.

Table A1: Taylor rule (policy input)

	(1)	(2)	(3)	(4)	(5)	(6)
	Clarida et al. (2000)	all	all	all	inflation > target	inflation < target
γ_π	0.83-2.15	1.860***				
		(0.037)				
$\gamma_{\pi_{Profit}}$			1.817***	1.834***	2.002***	0.341
			(0.043)	(0.042)	(0.062)	(0.290)
$\gamma_{\pi_{Loss}}$			2.047***		2.570***	0.025
			(0.052)		(0.134)	(0.166)
γ_y	0.27-0.93	0.225***	0.211***		0.209***	0.055***
		(0.012)	(0.012)		(0.037)	(0.009)
$\gamma_{y_{Profit}}$				0.244***		
				(0.014)		
$\gamma_{y_{Loss}}$				0.165***		
				(0.045)		
ρ	0.68-0.79	0.552***	0.544***	0.559***	0.518***	0.583***
		(0.010)	(0.010)	(0.011)	(0.025)	(0.030)
π^*	0.036-0.042	0.051***	0.050***	0.050***	0.081***	0.003
		(0.002)	(0.002)	(0.002)	(0.003)	(0.005)
Hansen's J-test (p-value)		0.59	0.59	0.61	0.45	0.44
Observations		140	140	140	98	42
Countries		45	45	45	36	23

Notes: Column (1) reports the ranges of Taylor rule coefficients from Table II, Clarida et al. (2000, p. 157). Columns (2)–(6) report results of the regression analysis for our sample of central banks that report either a small profit or a small loss, i.e., central bank profitability ROA is [0; 0.003) or [-0.003; 0), respectively. The table estimates a forward-looking Taylor rule $r_{i,t} = (1-\rho)\left[rr_i^* + \pi^* + \gamma_\pi(\pi_{i,t,1} - \pi^*) + \gamma_y(y_{i,t,1} - y_{i,t,1}^*)\right] + \rho r_{i,t-1} + \epsilon_{i,t}$, using the GMM estimator with a weighting matrix that accounts for possible correlation in the error term within countries. $r_{i,t}$ ($r_{i,t-1}$) is the interest rate on short-term Treasury bills of the country *i* at the beginning of year *t* (*t-1*). rr_i^* is the long-run equilibrium real interest rate of the country *i*. $(\pi_{i,t,1} - \pi^*)$ denotes deviations of the inflation rate of the country *i* between period t and $t+1$ from its estimated target level. $(y_{i,t,1} - y_{i,t,1}^*)$ is the output gap of the country *i* between period t and $t+1$, calculated as the difference between the actual GDP and the predicted GDP based on HP filter. Column (3) allows the coefficient on inflation gap $(\pi_{i,t,1} - \pi^*)$ to be different for central banks that report a small profit and central banks that report a small loss. Column (4) allows the coefficient on output gap $(y_{i,t,1} - y_{i,t,1}^*)$ to be different for central banks that report a small profit and central banks that report a small loss. Columns (5) and (6) split the sample based on whether the inflation rate is above or below the stated central bank inflation target. The data on inflation targets are from Siklos (2017). The median inflation target for low-income economies (4.5%) or high-income economies (2%) is used when a central bank does not state an explicit inflation target. ***, **, and * represent significance at the 1%, 5%, and 10% levels for the two-tailed tests.

Table A2: Taylor rule and exchange rate considerations

	(1)	(2)	(3)	(4)	(5)	(6)
	No peg countries			Controls for REER		
	all	inflation > target	inflation < target	all	inflation > target	inflation < target
$\gamma_{\pi_{Profit}}$	1.763***	1.916***	0.080	1.758***	2.000***	0.689***
	(0.052)	(0.072)	(0.332)	(0.097)	(0.125)	(0.238)
$\gamma_{\pi_{Loss}}$	1.867***	2.333***	0.128	2.655***	2.869***	0.586**
	(0.039)	(0.124)	(0.220)	(0.149)	(0.241)	(0.242)
γ_y	0.222***	0.247***	0.047	0.026	0.036	0.046***
	(0.010)	(0.053)	(0.083)	(0.026)	(0.045)	(0.011)
ρ	0.393***	0.412***	0.602***	0.620***	0.584***	0.623***
	(0.021)	(0.050)	(0.058)	(0.026)	(0.009)	(0.057)
π^*	0.044***	0.071***	0.001	0.065***	0.085***	-0.165
	(0.007)	(0.004)	(0.005)	(0.008)	(0.014)	(0.186)
γ_e				0.0001	0.00001	0.0004
				(0.0001)	(0.0002)	(0.0003)
Hansen's J-test (p-value)	0.33	0.46	0.36	0.40	0.29	0.38
Observations	92	67	25	129	87	42
Countries	33	27	17	44	35	24

Notes: The table reports results of the regression analysis for our sample of central banks that report either a small profit or a small loss, i.e., central bank profitability ROA is [0; 0.003) or [-0.003; 0), respectively. Columns (1)–(3) use only countries that have a floating exchange rate (i.e. no currency peg) and estimate a forward-looking Taylor rule $r_{i,t} = (1-\rho)\left[rr_i^* + \pi^* + \gamma_\pi(\pi_{i,t,1} - \pi^*) + \gamma_y(y_{i,t,1} - y_{i,t,1}^*)\right] + \rho r_{i,t-1} + \epsilon_{i,t}$, using the GMM estimator with a weighting matrix that accounts for possible correlation in the error term within countries. Columns (4)–(6) use all countries and a control for real effective exchange rates (REER) $r_{i,t} = (1-\rho)\left[rr_i^* + \pi^* + \gamma_\pi(\pi_{i,t,1} - \pi^*) + \gamma_y(y_{i,t,1} - y_{i,t,1}^*) + \gamma_e e_{i,t-1}\right] + \rho r_{i,t-1} + \epsilon_{i,t}$. $r_{i,t}$ ($r_{i,t-1}$) is the interest rate on short-term Treasury bills of the country *i* at the beginning of year *t* (*t-1*). rr_i^* is the long-run equilibrium real interest rate of the country *i*. $(\pi_{i,t,1} - \pi^*)$ denotes deviations of the inflation rate of the country *i* between period t and $t+1$ from its estimated target level. $(y_{i,t,1} - y_{i,t,1}^*)$ is the output gap of the country *i* between period t and $t+1$, calculated as the difference between the actual GDP and the predicted GDP based on HP filter. $e_{i,t-1}$ is the real effective exchange rate of the country *i* during period $t-1$ based on the data from Darvas (2012). The estimations allow the coefficient on inflation gap $(\pi_{i,t,1} - \pi^*)$ to be different for central banks that report a small profit and central banks that report a small loss. Columns (2), (3), (5) and (6) split the sample based on whether the inflation rate is above or below the stated central bank inflation target. The data on inflation targets are from Siklos (2017). The median inflation target for low-income economies (4.5%) or high-income economies (2%) is used when a central bank does not state an explicit inflation target. ***, **, and * represent significance at the 1%, 5%, and 10% levels for the two-tailed tests.

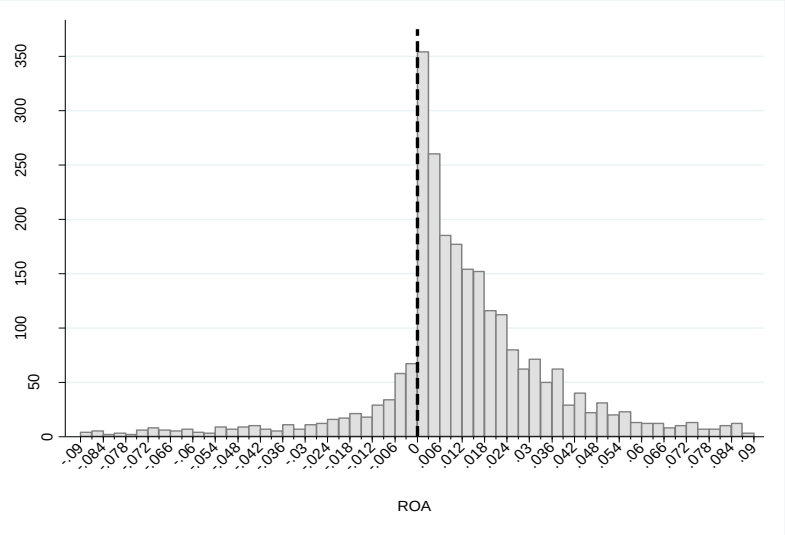
Table A3: Taylor rule and country-specific inflation targets

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	all	all	inflation > target	inflation < target	all	inflation > target	inflation < target
β_{π}	0.375***						
	(0.002)						
$\beta_{\pi_{Profit}}$		0.368***	0.417***	0.037**	0.639***	0.778***	0.108
		(0.002)	(0.002)	(0.015)	(0.020)	(0.016)	(0.243)
$\beta_{\pi_{Loss}}$		0.596***	0.683***	0.310	1.097***	1.392***	0.278
		(0.021)	(0.028)	(0.396)	(0.036)	(0.0324)	(0.412)
β_{y}	0.155***	0.153***	0.237***	-0.032***	-0.004	0.008	-0.038**
	(0.001)	(0.001)	(0.002)	(0.002)	(0.012)	(0.009)	(0.018)
ρ	0.823***	0.819***	0.741***	0.774***	0.661***	0.597***	0.701***
	(0.001)	(0.001)	(0.001)	(0.021)	(0.019)	(0.004)	(0.029)
β_{e}					0.0001***	-0.00004***	0.0001***
					(0.00001)	(0.00001)	(0.00002)
Hansen's J-test (p-value)	0.41	0.37	0.40	0.41	0.34	0.43	0.43
Observations	140	140	98	42	129	87	42
Countries	45	45	36	23	44	35	24

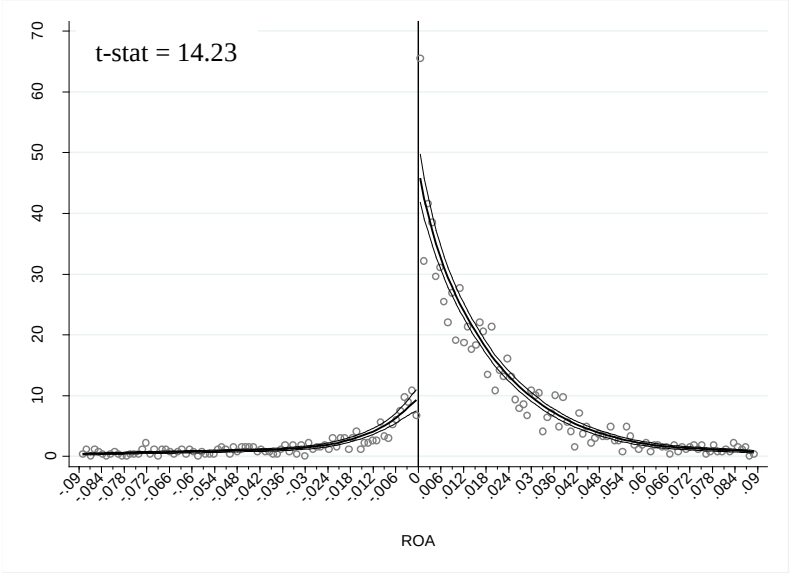
Notes: The table reports results of the regression analysis for our sample of central banks that report either a small profit or a small loss, i.e., central bank profitability ROA is [0; 0.003) or [-0.003; 0), respectively. The table reports the estimates of a forward-looking Taylor rule $r_{i,t} = \alpha_i + \beta_{\pi}(\pi_{i,t+k} - \pi_i^*) + \beta_y(y_{i,t+q} - y_{i,t+q}^*) + \beta_e e_{i,t-1} + \rho r_{i,t-1} + \varepsilon_{i,t}$, using the GMM estimator with a weighting matrix that accounts for possible correlation in the error term within countries. $r_{i,t}$ ($r_{i,t-1}$) is the interest rate on short-term Treasury bills of the country *i* at the beginning of year *t* (*t-1*). rr_i^* is the long-run equilibrium real interest rate of the country *i*. $(\pi_{i,t,1} - \pi^*)$ denotes deviations of the inflation rate of the country *i* between period t and $t+1$ from its observed target level. The data on inflation targets are from Siklos (2017). The median inflation target for low-income economies (4.5%) or high-income economies (2%) is used when a central bank does not state an explicit inflation target. $(y_{i,t,1} - y_{i,t,1}^*)$ is the output gap of the country *i* between period t and $t+1$, calculated as the difference between the actual GDP and the predicted GDP based on HP filter. $e_{i,t-1}$ is the real effective exchange rate of the country *i* during period $t-1$ based on the data from Darvas (2012). Columns (2)–(7) allow the coefficient on inflation gap $(\pi_{i,t,1} - \pi^*)$ to be different for central banks that report a small profit and central banks that report a small loss. Columns (3), (4), (6) and (7) split the sample based on whether the inflation rate is above or below the stated central bank inflation target. ***, **, and * represent significance at the 1%, 5%, and 10% levels for the two-tailed tests.

Figure 1: Distribution of central bank profits and McCrary (2008) test for discontinuity at zero

I. Distribution of central bank profits

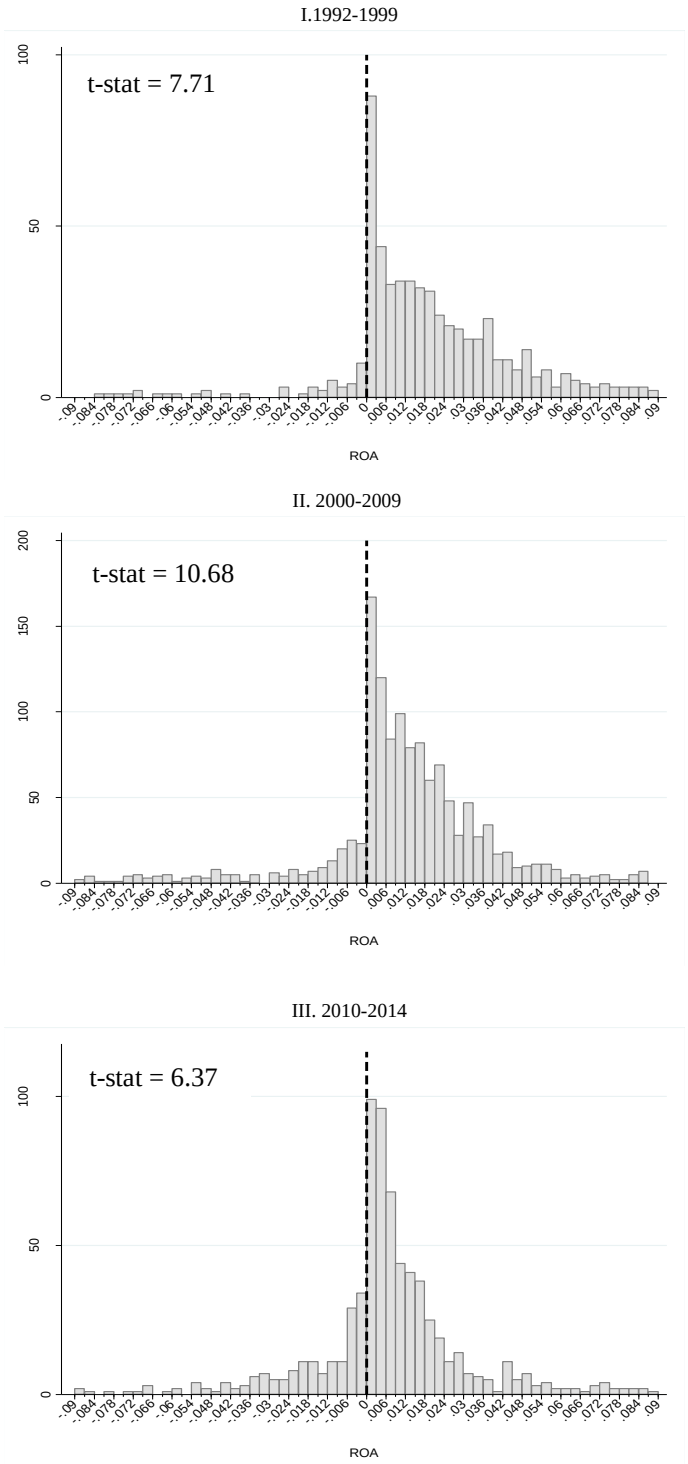


II. McCrary (2008) test for the discontinuity at zero



Notes: This figure plots the distribution of central bank profits over years 1992-2014 (N = 2,591). ROA is defined as central bank net income divided by average total assets. The distribution of ROA in both graphs is trimmed at [-0.09; 0.09]. The upper graph reports the histogram of ROA. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The lower graph shows the estimated density function around the zero-profit threshold and its upper and lower confidence intervals. The McCrary test, reported in the upper left corner, examines whether the discontinuity at zero is significant.

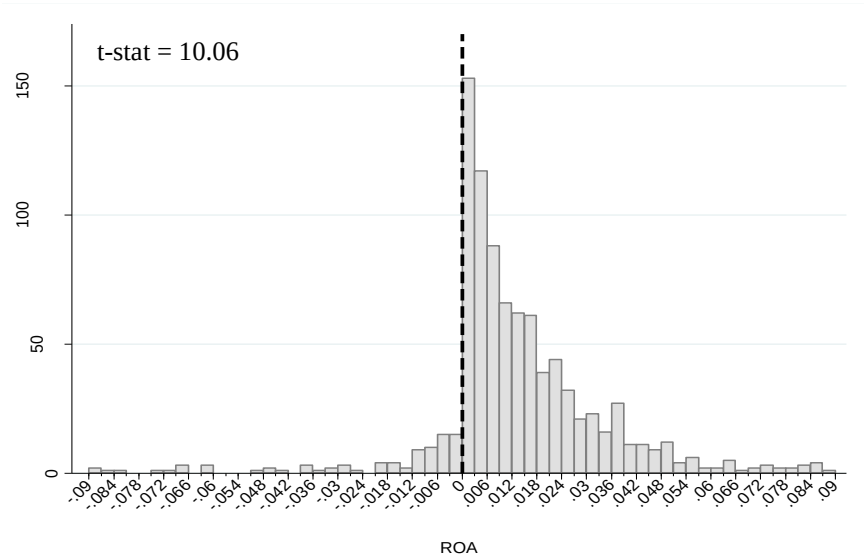
Figure 2: Distribution of central bank profits for each of the three decades in the sample



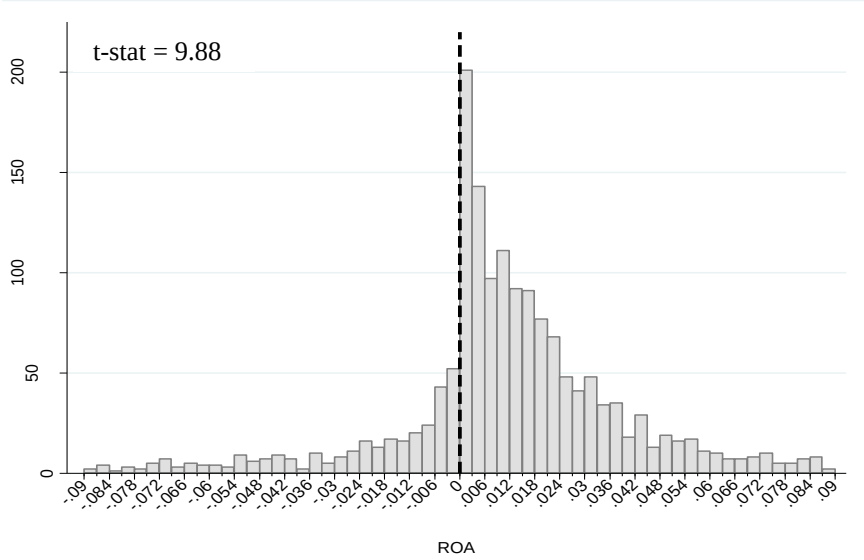
Notes: This figure plots the histogram of central bank profits (ROA) for 3 sub-periods: 1992-1999, 2000-2010, and 2010-2014. The distribution of ROA in all the graphs is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant.

Figure 3: Distribution of central bank profits in high-income vs. low-income countries

I. High-income countries

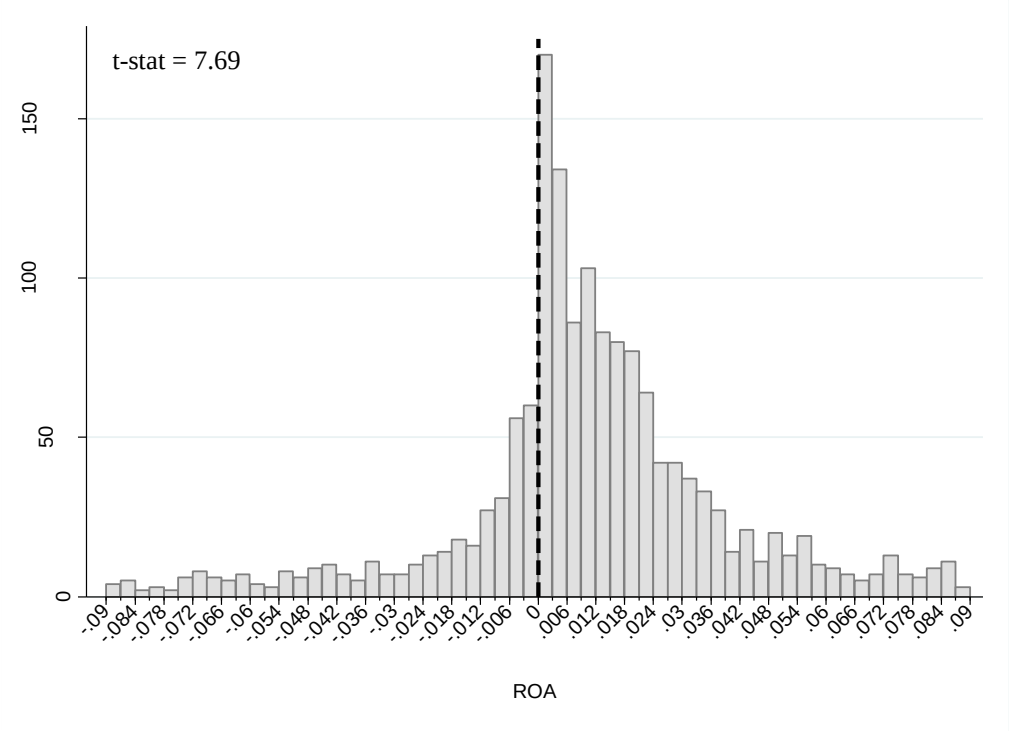


II. Low-income countries



Notes: This figure plots the histogram of central bank profits for high-income and low-income economies. The low-income economies have GNI per capita based on the World Bank cut-off point of less than $12,475. High-income economies have GNI per capita that exceeds $12,475. ROA is defined as central bank net income divided by average total assets. The distribution of ROA in both graphs is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant.

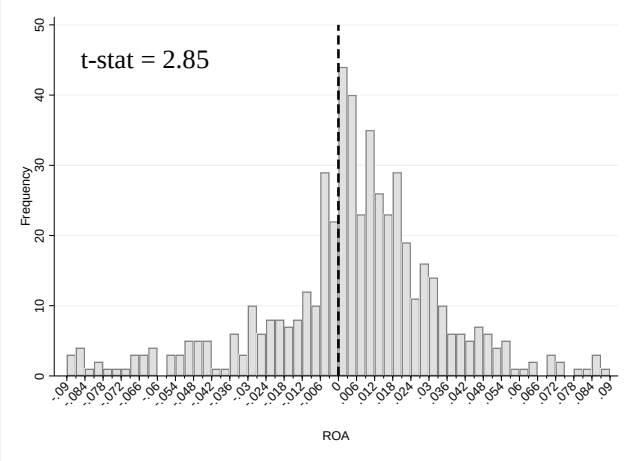
Figure 4: Distribution of central bank profits for central banks that incur losses



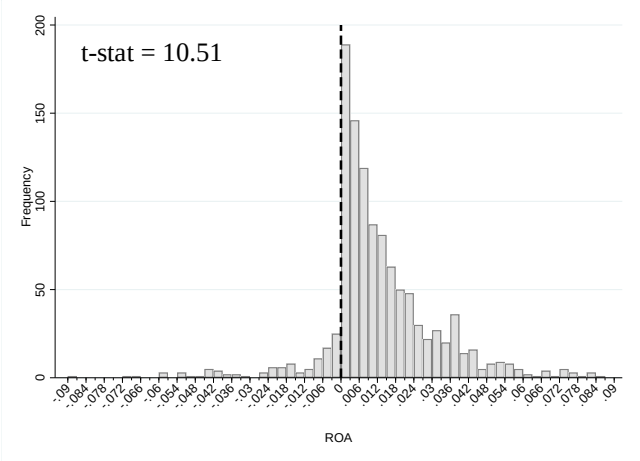
Notes: This figure plots the histogram of central bank profits for central banks that report a loss at least once during the sample period and for which we have at least 10 observations. ROA is defined as central bank net income divided by average total assets. The distribution of ROA is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant.

Figure 5: Distribution of central bank profits conditional on holdings of foreign assets and the exchange-rate system

High foreign assets and floating exchange rate



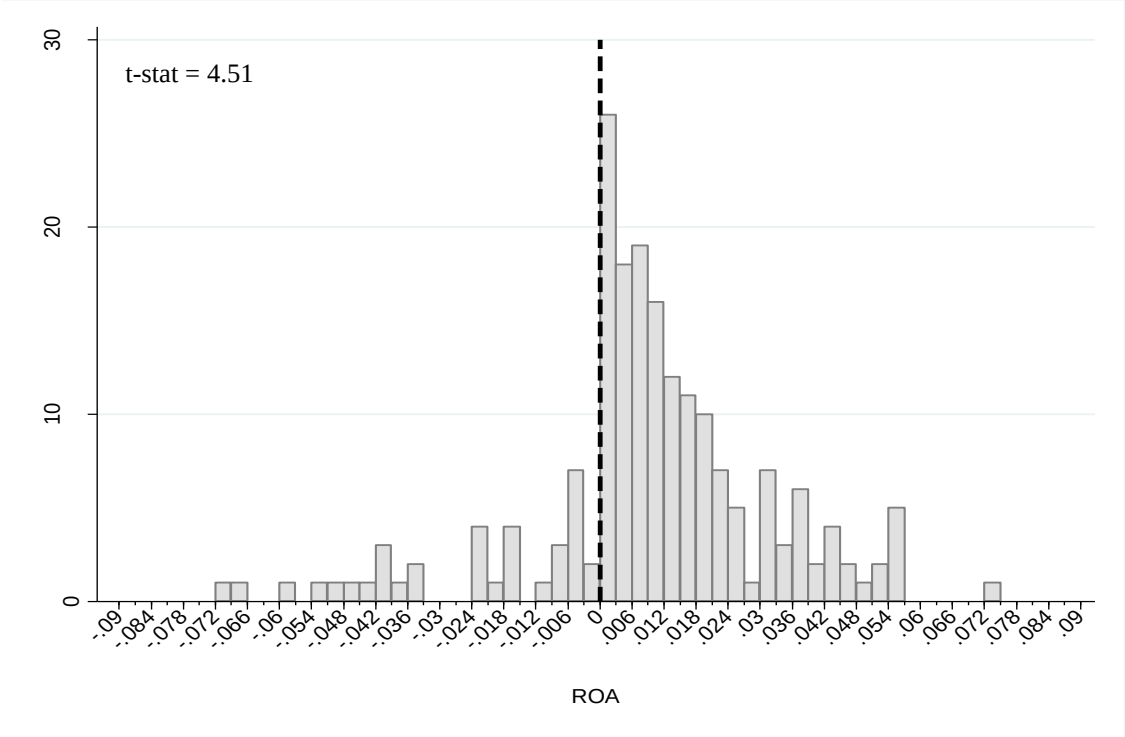
Low foreign assets or pegged exchange rate



	High foreign and floating rate	Low foreign or pegged rate	Total	
Small profit	44	189	233	
Small loss	22	25	47	**χ^2-test 16.93**
Total	66	214	280	**p < 0.001**
Small profit/small loss	2.00	7.56		

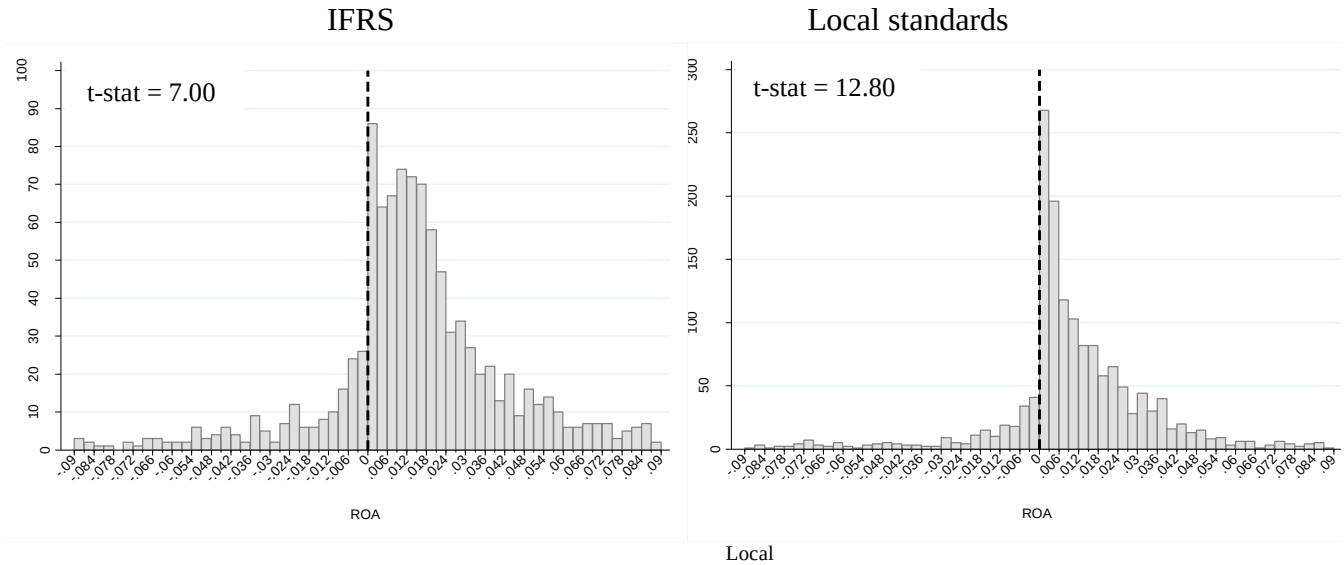
Notes: This figure plots the histogram of central bank profits (ROA) for sample splits. The left histogram uses central banks that have a high foreign-assets-to-total-assets ratio (≥50%) and a floating exchange rate. The right histogram reports central banks that have a low foreign-assets-to-total-assets ratio (<50%) or a pegged exchange rate. The distribution of ROA is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant. The table below each set of histograms reports the number of observations falling into the small-profit or small-loss region in the adjacent histograms (i.e., central bank profitability ROA is [0; 0.003) or [-0.003; 0), respectively). The χ^2-test shows whether the number of small profits relative to the number of small losses is different in the two adjacent histograms.

Figure 6: Distribution of central bank profits for central banks introducing an exchange-rate peg



Notes: This figure plots the histogram of central bank profits for countries introducing a pegged exchange-rate system. ROA is defined as central bank net income divided by average total assets. The distribution of ROA is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant.

Figure 7: Distribution of central bank profits and accounting standards



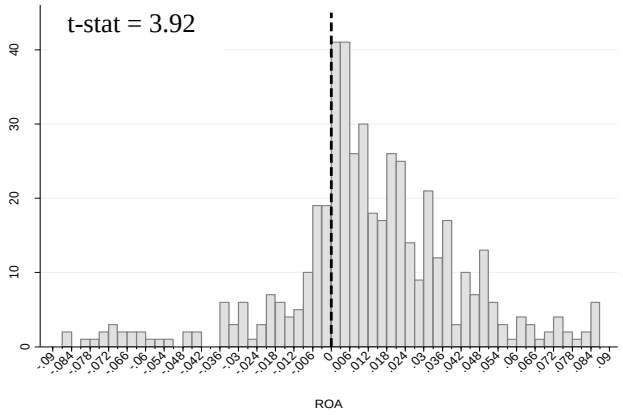
	IFRS	Local standards	Total	
Small profit	86	268	354	
Small loss	26	41	67	χ^2-test 6.08
Total	112	309	421	p = 0.014
Small profit/small loss	3.31	6.54		

Notes: This figure plots the histogram of central bank profits (ROA) for sample splits based on accounting standards. The left (right) plot is for central banks that use International Financial Reporting Standards, IFRS (local accounting standards). The distribution of ROA is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant. The table below the histograms reports the number of observations falling into the small-profit or small-loss region in the adjacent histograms (i.e., central bank profitability ROA is [0; 0.003) or [-0.003; 0), respectively). The χ^2-test shows whether the number of small profits relative to the number of small losses is different in the two adjacent histograms.

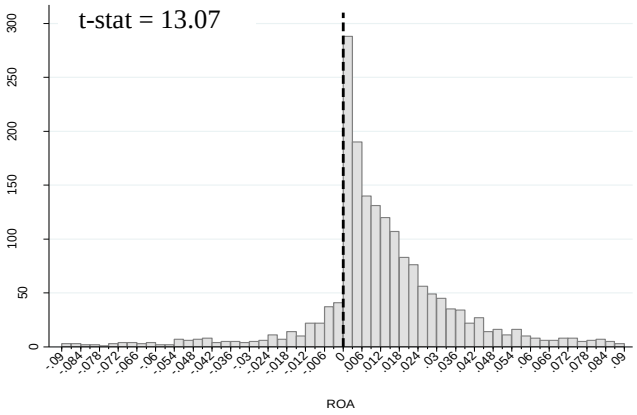
Figure 8: Distribution of central bank profits and incentives to manage earnings

I. Central bank governor re-appointable vs. not

Not re-appointable

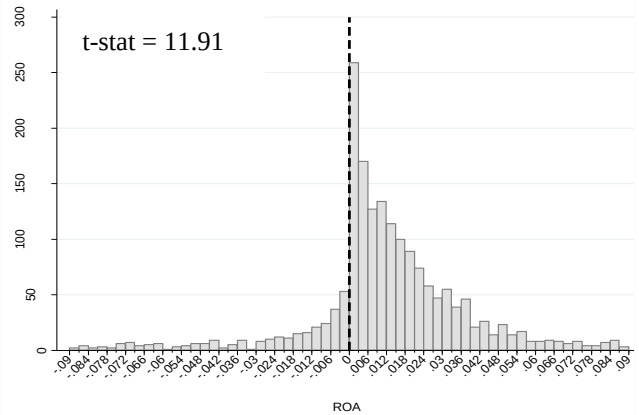


Re-appointable

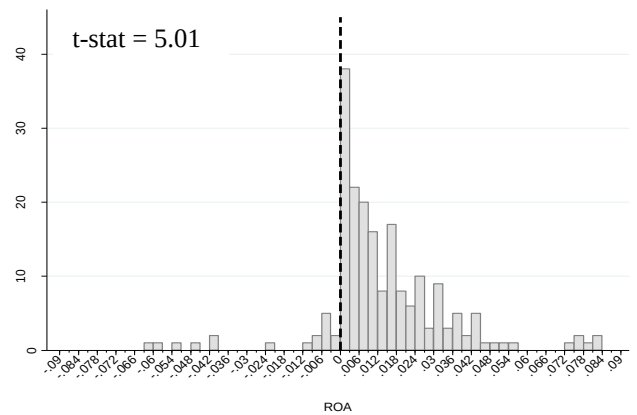


II. Country leader affiliated with extreme (left- or right-wing) parties vs. centrist parties

Centrist parties

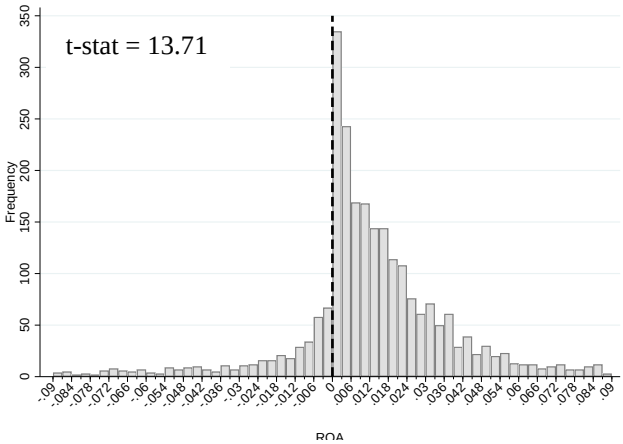


Extreme parties

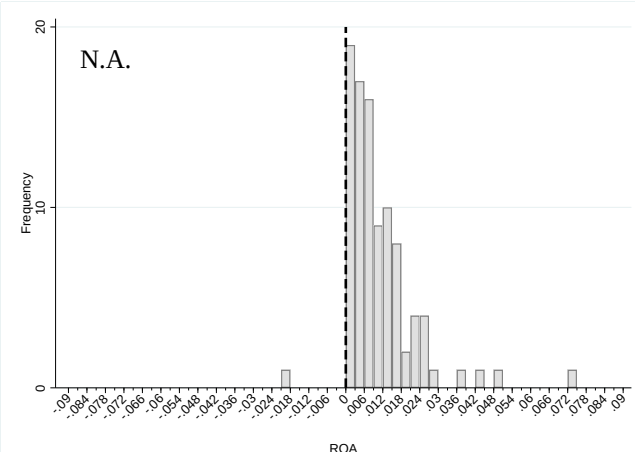


III. Central bank is publicly traded vs. not

Not publicly traded

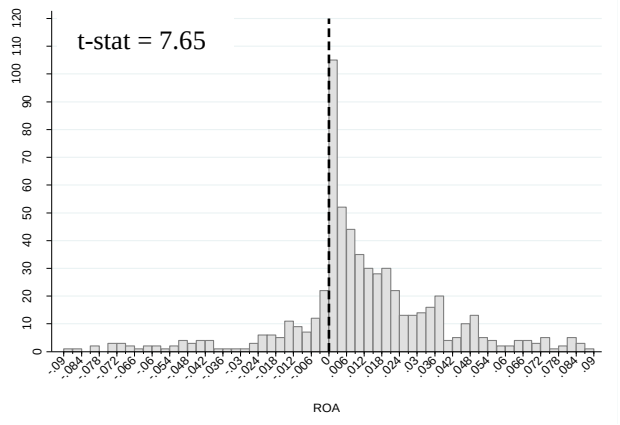


Publicly traded

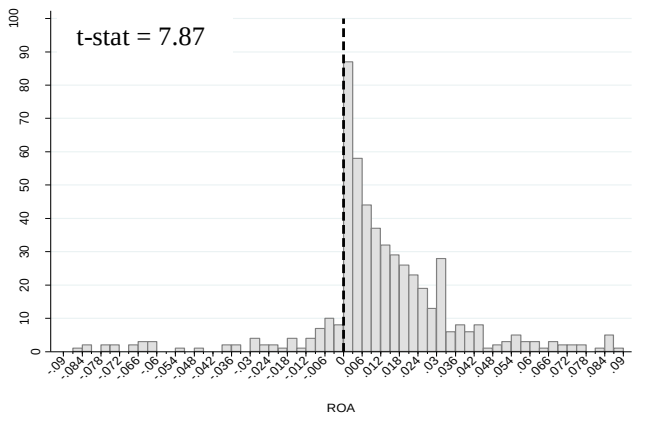


IV. Country leader affiliated with left-leaning party vs. right-leaning parties

Left-leaning parties

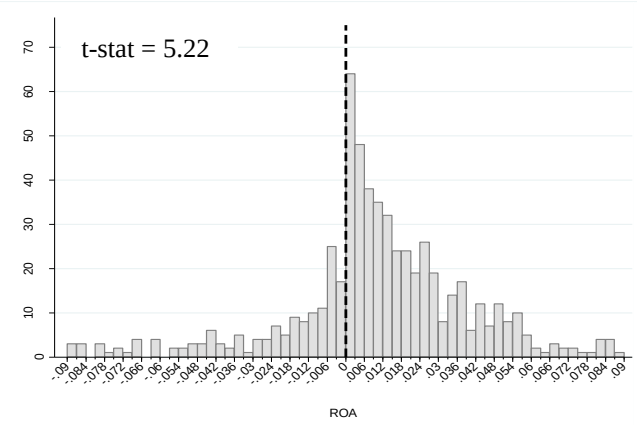


Right-leaning parties

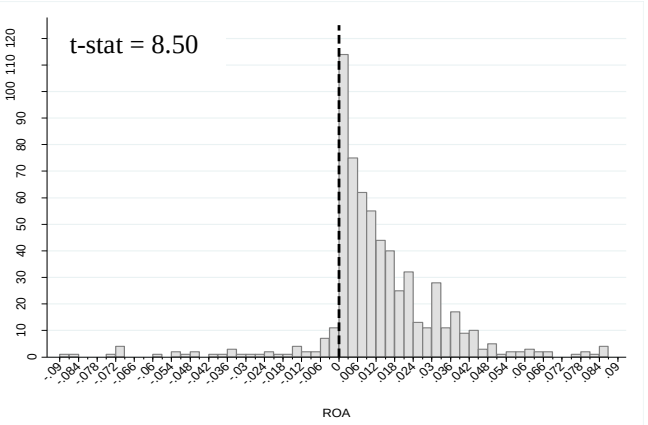


V. Central bank operating expenses to total government income from taxes

Below median

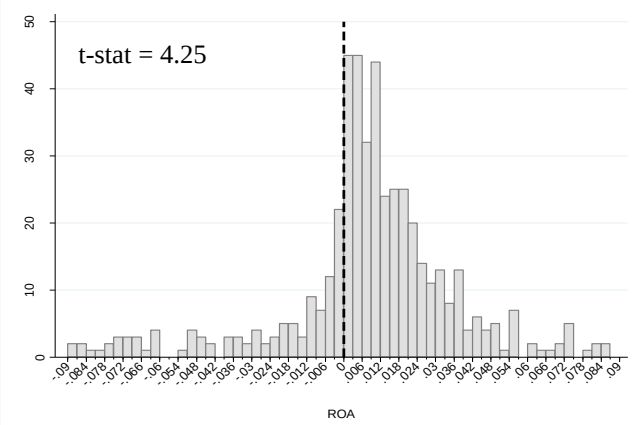


Above median

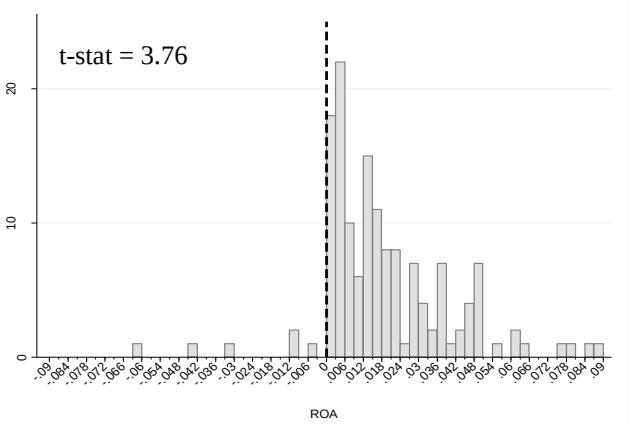


VI. Dividend distribution rules

"Soft" budget constraint

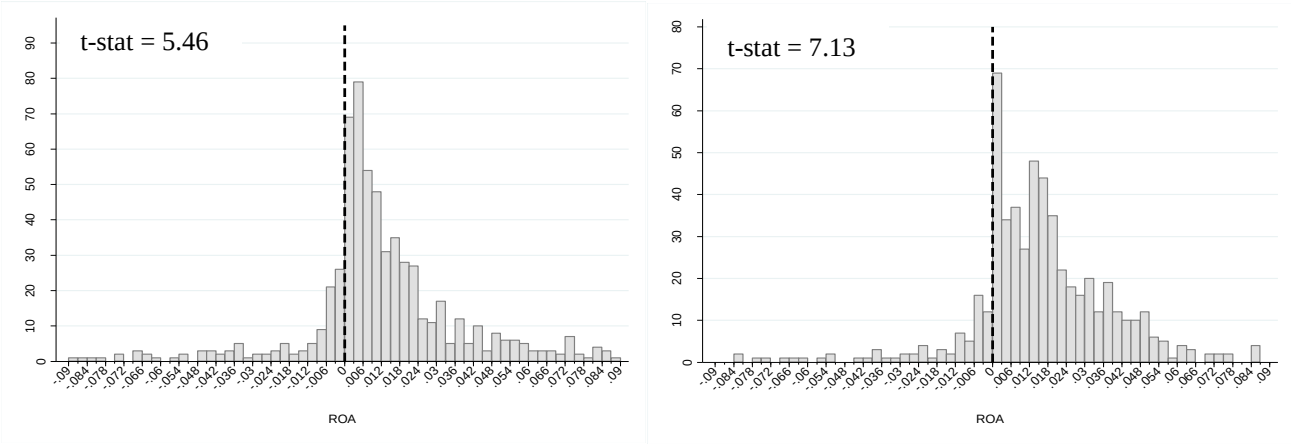


"Hard" budget constraint



VII. Dividend payment—tertile split

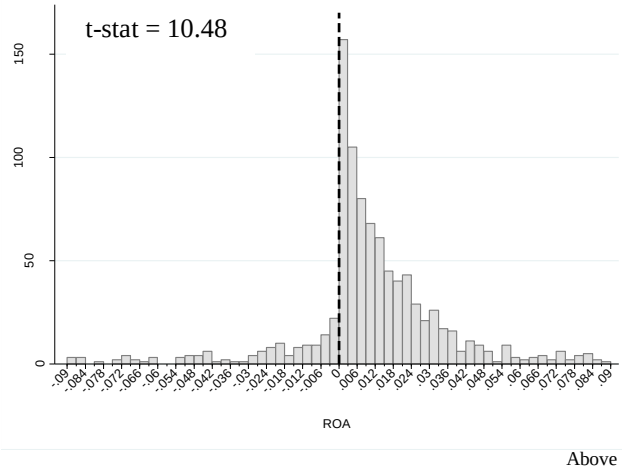
Payout < 50% (first tertile) Payout ≥ 90% (third tertile)



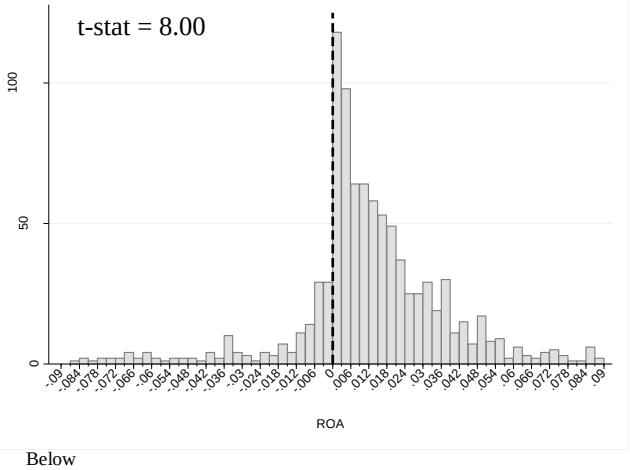
Notes: This figure plots the histogram of central bank profits (ROA) for sample splits based on prevailing incentives for loss avoidance. The variables that are used to split the sample are described in Appendix 1. In panel VI, the assignment into "hard" and "soft" budget constraints is based on the classification of central bank dividend rules for 30 countries in Archer and Moser-Boehm (2013, Annex 2). "Soft"-budget-constraint central banks can draw on external resources to cover losses or if they are allowed to reduce dividend payments to cover future or past losses (Chile, Czech Republic, Finland, Iceland, India, Israel, Germany, Korea, Malaysia, Mexico, Netherlands, Peru, Poland, Philippines, Thailand, Turkey, Singapore, Slovakia, South Africa, Spain, Switzerland, Sweden, and the United States). "Hard" budget constraints face central banks that are either substantially limited in the amount of profits they can retain or their dividend distribution decisions are taken jointly with the government (Australia, Canada, Denmark, Japan, New Zealand, and the United Kingdom). In panel VII, the samples are based on the tertile splits of the central bank's dividend payout ratio. The central banks that pay dividends in the presence of losses have high payout ratios. Central banks that receive dividends from the government (i.e., report negative dividends) have low payout ratios. The distribution of ROA in all the plots is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant. The McCrary test in panel III (histogram on the right) is not available because no loss observations are close to the zero-profit threshold. (The confidence interval of the estimated density to the right of zero can be estimated and is consistent with the existence of the discontinuity at zero.)

Figure 9: Distribution of central bank profits conditional on central bank legal independence

Above-median central bank legal independence



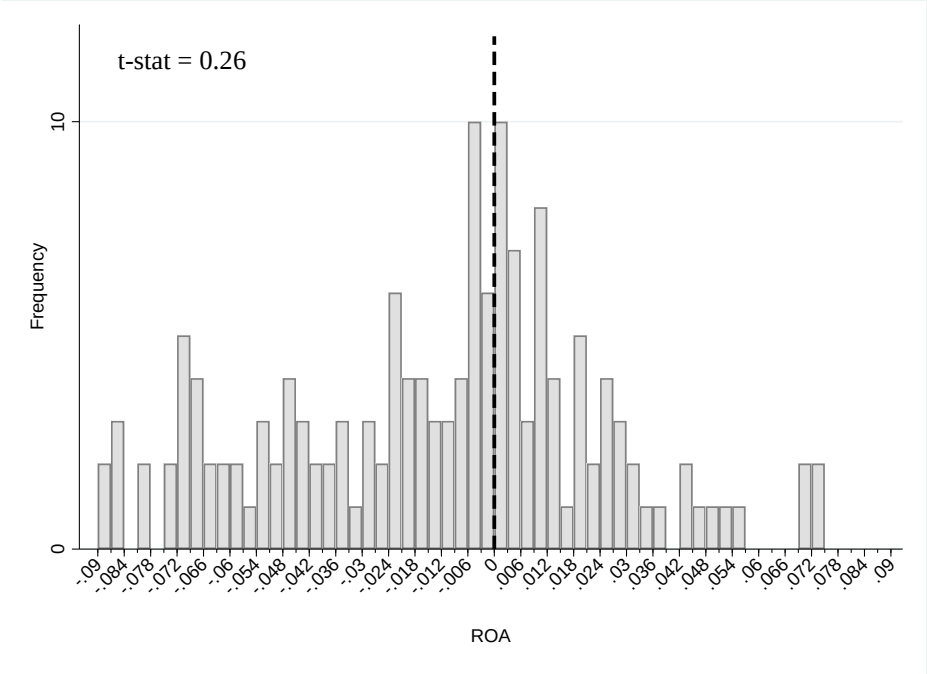
Below-median central bank legal independence



	Above median	Below median	Total	
Small profit	157	118	275	
Small loss	22	29	51	**χ^2-test 3.38**
Total	179	147	326	**p = 0.066**
Small profit/small loss	7.14	4.07		

Notes: This figure plots the histogram of central bank profits (ROA) for sample splits. The left (right) histogram reports on central banks that have above-median (below-median) values of the central bank independence index from Dincer and Eichengreen (2014). The distribution of ROA in both plots is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant. The table below each set of histograms reports the number of observations falling into the small-profit or small-loss region in the adjacent histograms (i.e., central bank profitability ROA is [0; 0.003) or [-0.003; 0), respectively). The χ^2-test shows whether the number of small profits relative to the number of small losses is different in the two adjacent histograms.

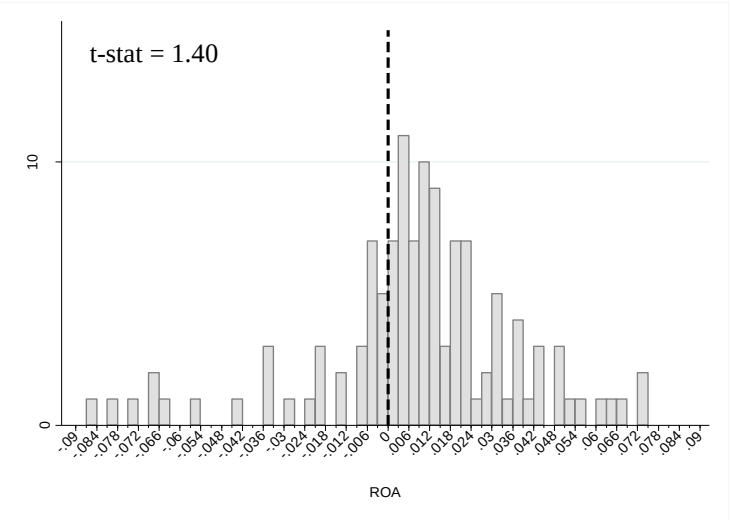
Figure 10: Distribution of central bank profits for central banks with negative equity



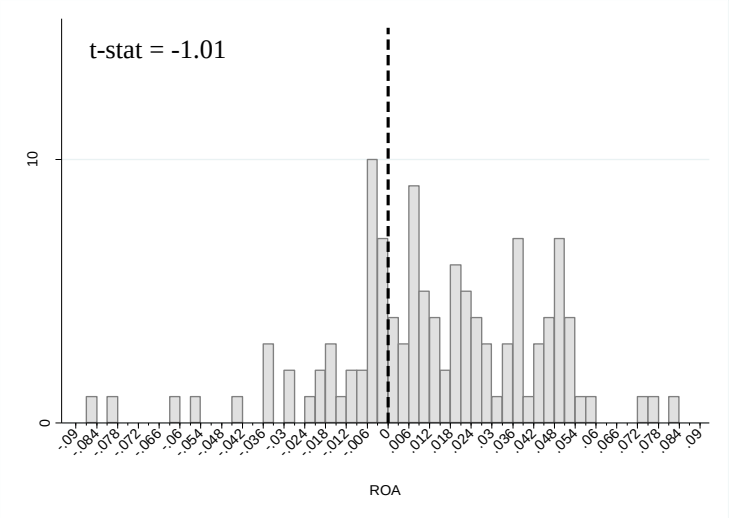
Notes: This figure plots the histogram of central bank profits for central banks with negative equity. ROA is defined as central bank net income divided by average total assets. The distribution of ROA is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant.

Figure 11: Minimum combination of factors that can "switch off" the effect

I. Central bank governor not re-appointable and dividend distribution allows contemporaneous or intertemporal smoothing



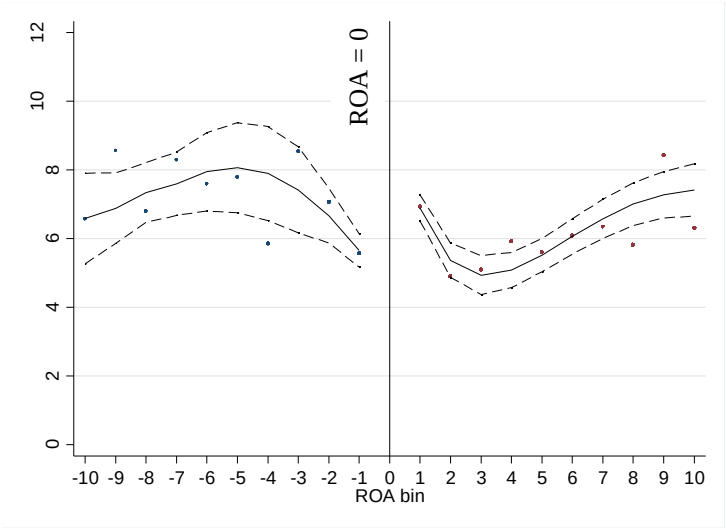
II. Central bank governor not re-appointable and central bank operating expenses to total government income from taxes



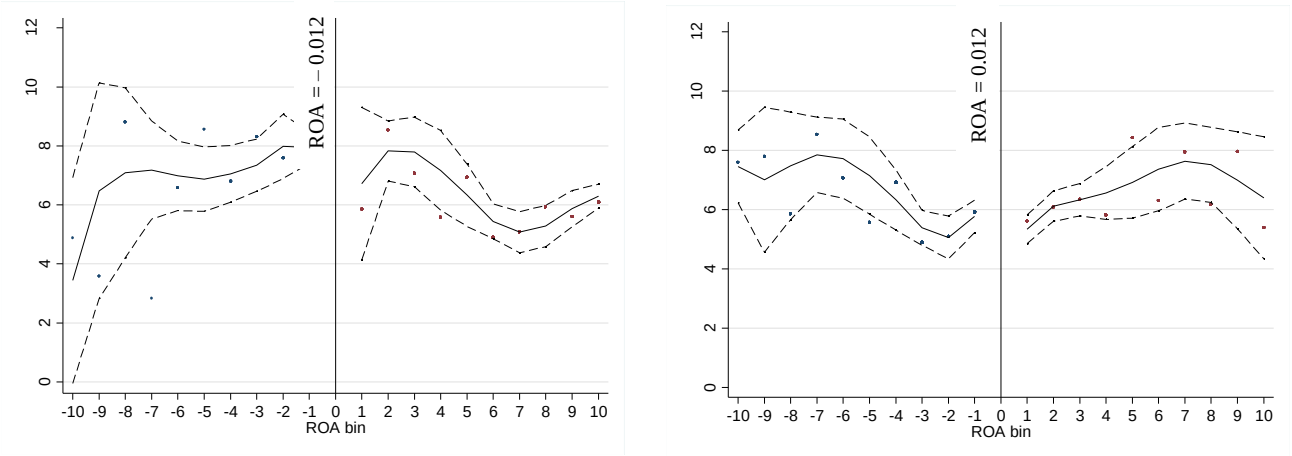
Notes: This figure plots the histogram of central bank profits (ROA) based on the combination of factors reported in Figure 8. The first plot uses the intersection of subsamples used in Figure 8.I (left histogram) and Figure 8.VII (left histogram). The second plot uses the intersection of subsamples used in Figure 8.I (left histogram) and Figure 8.V (left histogram). The distribution of ROA in both plots is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant.

Figure 12: Predicted inflation rates from polynomial regression

I. Predicted inflation rates at zero-profit threshold



II. Predicted inflation rates at placebo thresholds



Notes: The figure plots predicted inflation rates from the polynomial regression reported in column (1) of Table 8. The vertical axis shows inflation rates. The horizontal axis shows the intervals of the ROA distribution. The dots show the mean inflation rates for each ROA interval. The solid line shows the mean predicted inflation rates, and the dotted lines show the 95% confidence interval for predicted values. The vertical line in the middle of each plot shows the critical ROA threshold. Panel I examines inflation rates at the zero-profit threshold. The first interval to the right of zero (1) denotes the ROA interval [0; 0.003). The first interval to the left of zero denotes the ROA interval [-0.003; 0). In panel II, the ROA threshold is -0.012 (left plot) and 0.012 (right plot). The first interval to the right of zero (1) denotes the ROA interval that is shifted by 0.003 relative to the threshold. The first interval to the left of zero denotes the ROA interval that is shifted by -0.003 relative to the threshold.

Table 1: Sample composition by country

Country/Region	First	Obs.	Small profit or small loss	Small profit	Loss
Afghanistan	2011	4	0%	0%	25%
Albania	1998	17	0%	0%	6%
Angola	1996	14	7%	7%	36%
Argentina	1998	16	0%	0%	6%
Armenia	1995	18	6%	6%	33%
Aruba	1994	21	24%	24%	0%
Australia	1995	21	5%	5%	14%
Austria	1993	22	32%	32%	0%
Azerbaijan	2001	14	7%	0%	43%
Bahamas	1994	21	19%	14%	5%
Bahrain	1994	18	0%	0%	0%
Bangladesh	2000	21	10%	10%	5%
Barbados	1993	21	43%	33%	19%
Belarus	1997	17	18%	18%	18%
Belgium	1994	21	24%	24%	0%
Belize	1994	21	5%	5%	0%
Bermuda	1993	22	5%	5%	18%
Bhutan	2007	7	14%	0%	29%
Bolivia	2000	15	40%	20%	20%
Bosnia & Herzegovina	1999	16	0%	0%	0%
Botswana	1994	21	5%	0%	19%
Brazil	1995	20	10%	5%	40%
Brunei Darussalam	2013	2	0%	0%	50%
Bulgaria	1996	19	0%	0%	5%
Burundi	1994	12	0%	0%	8%
Canada	1994	21	0%	0%	0%
Cape Verde	2001	9	44%	33%	44%
Cayman Islands	2002	5	40%	40%	0%
Chile	1994	20	10%	5%	60%
Colombia	1998	16	6%	6%	31%
Costa Rica	1993	22	14%	14%	82%
Croatia	1999	16	38%	38%	6%
Curacao	1995	16	0%	0%	0%
Cyprus	1992	23	26%	26%	0%
Czech Republic	1994	21	10%	10%	43%
Denmark	1993	22	0%	0%	9%
Djibouti	2010	5	40%	0%	40%
Dominican Republic	2003	11	0%	0%	100%
Ecuador	2005	6	17%	0%	33%
Egypt	2013	3	0%	0%	0%
El Salvador	1993	21	76%	76%	0%
Estonia	1993	22	5%	0%	14%
Ethiopia	1995	9	0%	0%	0%
Fiji	1995	20	0%	0%	0%
Finland	1994	22	32%	32%	0%
France	1993	25	36%	32%	4%
Gambia	1995	10	20%	10%	50%
Georgia	1999	16	6%	6%	6%
Germany	1994	21	19%	19%	0%
Ghana	1993	34	15%	15%	6%
Greece	1994	21	33%	33%	0%
Guatemala	2006	9	0%	0%	78%
Guinea	1996	5	100%	80%	20%
Guyana	1995	20	25%	25%	10%
Haiti	1998	12	50%	50%	25%
Honduras	2006	3	0%	0%	33%
Hong Kong	1999	28	7%	4%	21%
Hungary	1995	20	50%	40%	35%
Iceland	1995	20	25%	15%	35%
India	1994	22	0%	0%	0%
Indonesia	1996	19	16%	5%	21%
Iran	1993	12	0%	0%	0%
Iraq	2011	4	5%	5%	25%
Ireland	1993	22	42%	42%	0%
Israel	1994	21	10%	10%	57%
Italy	1994	21	62%	62%	0%
Jamaica	1993	22	9%	9%	41%
Japan	1993	23	26%	26%	0%
Jordan	1994	21	71%	38%	33%
Kazakhstan	1998	16	6%	6%	6%
Kenya	1994	22	5%	5%	14%
Korea	1995	20	10%	0%	20%
Kuwait	1994	22	18%	18%	0%
Kyrgyzstan	2002	13	0%	0%	0%
Latvia	1993	22	14%	14%	0%
Lebanon	2007	2	100%	100%	0%
Lesotho	1996	18	11%	11%	11%
Liberia	2006	4	0%	0%	25%
Lithuania	1995	19	11%	11%	0%
Luxembourg	1995	20	80%	80%	5%
Macao	1996	19	0%	0%	0%
Macedonia	2001	14	14%	7%	29%
Madagascar	1996	18	22%	17%	61%
Malawi	1994	23	9%	9%	43%
Malaysia	1995	19	16%	16%	0%
Maldives	2000	15	0%	0%	7%
Malta	1992	23	0%	0%	0%
Mauritania	2005	3	0%	0%	0%
Mauritius	1992	24	0%	0%	17%
Mexico	1996	9	11%	0%	44%
Moldova	1999	16	0%	0%	25%
Mongolia	1997	18	6%	0%	44%
Montenegro	2005	7	29%	29%	0%
Morocco	1994	21	0%	0%	0%
Mozambique	1997	17	76%	76%	0%
Namibia	1999	16	6%	6%	13%
Nepal	1997	13	0%	0%	23%
Netherlands	1993	22	0%	0%	0%
New Guinea	1996	16	0%	0%	31%
New Zealand	1995	20	5%	5%	5%
Nicaragua	1993	20	25%	10%	40%
Nigeria	1993	22	23%	23%	0%
Norway	1993	23	26%	17%	30%
Oman	1992	23	0%	0%	0%
Pakistan	1995	21	5%	5%	0%
Palestine	2007	7	29%	29%	0%
Paraguay	2003	6	0%	0%	100%
Peru	1994	21	43%	29%	29%
Philippines	1996	21	19%	14%	38%
Poland	1994	21	14%	14%	5%
Portugal	1993	22	68%	68%	0%
Qatar	2002	3	0%	0%	0%
Romania	1995	24	8%	8%	42%
Russia	1996	20	15%	15%	5%
Rwanda	2002	14	7%	7%	7%
Saint Kitts & Nevis	1992	24	13%	8%	8%
Samoa	2001	10	0%	0%	30%
San Marino	1995	20	35%	35%	0%
Saudi Arabia	1998	16	63%	63%	0%
Senegal	2006	1	100%	100%	0%
Serbia	2001	14	0%	0%	21%
Seychelles	1995	15	0%	0%	13%
Sierra Leone	1998	15	20%	13%	27%
Singapore	1994	22	5%	5%	14%
Slovakia	1994	22	9%	0%	45%
Slovenia	1993	22	5%	5%	23%
Solomon Islands	1993	21	5%	5%	38%
South Africa	1994	37	30%	14%	27%
Spain	1994	21	0%	0%	0%
Sri Lanka	1996	19	0%	0%	21%
Sudan	2000	9	22%	22%	0%
Swaziland	1994	22	14%	14%	14%
Sweden	1994	21	10%	10%	19%
Switzerland	1993	22	5%	5%	5%
Taiwan	1996	19	0%	0%	0%
Tajikistan	2012	3	0%	0%	100%
Tanzania	1993	22	14%	5%	18%
Thailand	1993	22	9%	0%	64%
Timor-Leste	2011	1	100%	100%	0%
Tonga	2004	7	0%	0%	0%
Trinidad & Tobago	1994	21	5%	5%	0%
Tunisia	1995	18	0%	0%	0%
Turkey	1994	27	15%	7%	26%
Uganda	2000	16	13%	6%	44%
Ukraine	1997	16	13%	13%	0%
United Arab Emirates	1993	22	0%	0%	0%
United Kingdom	1998	18	50%	50%	0%
United States	2010	10	0%	0%	20%
Uruguay	2000	14	14%	7%	57%
Uzbekistan	2003	4	25%	25%	0%
Vanuatu	2003	5	0%	0%	0%
Venezuela	2006	6	100%	100%	0%
Yemen	2000	15	0%	0%	7%
Zambia	1996	16	50%	44%	25%
Zimbabwe	1997	15	7%	7%	40%

Notes: The table shows the sample composition by country. The columns "Small profit or small loss" and "Small profit" report the fraction of a central bank observations that fall into the ROA region [-0.003; 0.003) and [0; 0.003), respectively. The column "Loss" records the incidence of losses on any magnitude.

Table 2: Loss avoidance and prevailing incentives

Prevailing incentives	Sub-sample with low incenives for loss avoidance	Propensity to report small profits	Sub-sample with high incenives for loss avoidance	Propensity to report small profits	P-value of χ^2-test	Internet appendix figure
Central bank governor re-appointable?	Not re-appointable	2.16	Re-appointable	7.02	<0.001	Figure 8-I
Country leader affiliation, centrist or extreme (left/right)?	Centrist parties	4.89	Extreme parties	19.00	0.049	Figure 8-II
Central bank is publicly traded?	Not traded	5.00	Traded	∞	0.052	Figure 8-III
Country leader affiliation, left or right?	Left-wing party	4.77	Right-wing party	10.88	0.055	Figure 8-IV
Central bank operating expenses to government tax revenues	Below median	3.76	Above median	10.36	0.013	Figure 8-V
Dividend distribution rules	"Soft" budget constraint	2.05	"Hard" budget constraint	∞	0.005	Figure 8-VI
Dividend payment – tertile split	Payout < 50%	2.65	Payout ≥ 90%	8.63	0.005	Figure 8-VII

Notes: The table shows the propensity to report small profits over small losses for sample splits based on prevailing incentives for loss avoidance. The variables that are used to split the sample are described in Appendix 1. Propensity to report small profits is the number of central bank observations with small profits, ROA = [0; 0.003), divided by the number of central bank observations with small losses, ROA = [-0.003; 0). ∞ denotes cases in which the number of small losses in a given sample is zero. The χ^2-test shows whether the number of small profits relative to the number of small losses is different between the subsamples.

Table 3: Multivariate analysis—small profit/loss region

	(1) Profit	(2) Profit	(3) Profit	(4) Profit	(5) Profit	(6) Profit	(7) Profit	(8) Profit	(9) Profit	(10) Profit	(11) Profit
Governor re-appointable	0.321***	0.296***	0.322***	0.377***		0.311***		0.368***	0.373***	0.378***	0.612***
	(0.052)	(0.061)	(0.056)	(0.087)		(0.044)		(0.073)	(0.074)	(0.127)	(0.086)
Publicly traded central banks	0.089***	0.113*	0.088***	0.089***	0.102***	0.098***	0.115***	0.097**	0.098**	0.066	0.088
	(0.029)	(0.055)	(0.030)	(0.030)	(0.027)	(0.034)	(0.033)	(0.035)	(0.035)	(0.089)	(0.064)
Extreme party affiliation	0.005	0.114**		-0.024	0.011	0.000	0.014	-0.028	-0.031	0.008	0.080
	(0.045)	(0.050)		(0.052)	(0.043)	(0.042)	(0.034)	(0.056)	(0.056)	(0.094)	(0.058)
Right-wing party affiliation	0.218**		0.220***	0.205**	0.206**	0.222**	0.218***	0.208**	0.198**	0.175	0.010
	(0.079)		(0.068)	(0.085)	(0.084)	(0.079)	(0.075)	(0.084)	(0.093)	(0.117)	(0.076)
High operating expenses	0.141**	0.169**	0.142**	0.120*	0.141**	0.140**	0.148**	0.120*	0.116	0.168*	0.223**
	(0.058)	(0.080)	(0.058)	(0.067)	(0.067)	(0.059)	(0.059)	(0.066)	(0.068)	(0.091)	(0.091)
Hard budget constraint	0.171**	0.177**	0.172**	0.188***	0.153**	0.167**	0.143**	0.184***	0.178**	0.205**	0.140*
	(0.063)	(0.072)	(0.064)	(0.062)	(0.071)	(0.061)	(0.065)	(0.059)	(0.066)	(0.089)	(0.071)
Low central bank legal independence				-0.084	-0.037			-0.082	-0.091	-0.129	-0.186*
				(0.087)	(0.097)			(0.083)	(0.086)	(0.094)	(0.090)
Low central bank transparency						0.034	0.052	0.029	0.067	0.012	-0.281*
						(0.094)	(0.098)	(0.084)	(0.082)	(0.175)	(0.146)
Low rule of law									-0.055		
									(0.088)		
Low-income countries										0.029	0.080
										(0.132)	(0.089)
Growth rate of nominal GDP										-0.415	-0.366
										(0.549)	(0.351)
Do not follow IFRS										0.120	-0.007
										(0.136)	(0.107)
Exchange-rate peg										-0.079	-0.114
										(0.104)	(0.087)
Introduce exchange-rate peg										0.257*	0.340***
										(0.135)	(0.109)
Do not incur interest on reserves										0.097	0.155
										(0.121)	(0.106)
Constant	0.219***	0.323***	0.218***	0.210**	0.554***	0.222***	0.523***	0.212**	0.223**	0.250*	0.145
	(0.076)	(0.072)	(0.072)	(0.076)	(0.117)	(0.076)	(0.087)	(0.076)	(0.089)	(0.129)	(0.106)
R^2	0.156	0.106	0.171	0.148	0.135	0.141	0.136	0.132	0.116	0.079	0.180
Observations	61	61	61	61	61	61	61	61	61	61	114
Countries	18	18	18	18	18	18	18	18	18	18	21

Notes: The table reports results of the OLS regression analysis for the sample of central banks that report either a small profit or a small loss. Columns (1)–(10) use small profits and small losses from the ROA interval [0; 0.003) and [-0.003; 0), respectively. Column (11) widens the interval to [0; 0.006) for small profits and [-0.006; 0) for small losses. The dependent variable *Profit* is an indicator for small profits and equals 1 if the central bank reports a small profit in year t. All explanatory variables (except for the *Growth rate of nominal GDP*) are expressed as dummy variables using the same cut-off points as in Figure 8 and are coded so that they all predict positive coefficients when associated with higher incentives to avoid losses. *Governor re-appointable* is an indicator variable that equals 1 if a central bank governor is re-appointable, and 0 otherwise. *Publicly traded central banks* is an indicator variable that equals 1 if the shares of a central bank are quoted on a public exchange, and 0 otherwise. *Extreme party affiliation* is an indicator variable that equals 1 if a country's chief executive has affiliation with the nationalist party, and 0 otherwise. *Right-wing party* affiliation is an indicator that equals 1 if the country's chief executive is affiliated with the right-leaning party (conservative, Christian democratic, or right-wing), and 0 if the country's chief executive is affiliated with the left-leaning party (communist, socialist, social democratic, or left-wing). *High operating expenses* is the ratio of central bank personnel expenses to the country's total tax revenues. *Hard budget constraint* is an indicator variable that equals 1 if the central bank dividend payout ratio (dividends divided by net income) is greater than 90% (third tertile of the central bank dividend payout distribution) or when a central bank pays dividends despite incurring a loss. The indicator variable equals 0 if the central bank dividend payout ratio is less than 50% (first tertile of the central bank dividend payout distribution) or when a central bank receives dividends from the government. *Central bank legal independence* is an index of central bank independence. *Low central bank policy transparency* is an index of central bank policy transparency. *Low rule of law* captures the extent to which economic agents trust and abide by legal institutions. *Low-income countries* is an indicator variable that equals 1 if a country is a low-income economy in a given year, and 0

otherwise. *Growth rate of nominal GDP* is the percentage change in nominal GDP. *Do not follow IFRS* is an indicator variable that equals 1 if a central bank prepares financial statements in accordance with local standards, and 0 if it follows IFRS. *Exchange-rate peg* is an indicator variable that equals 1 if a country has an exchange-rate peg, and 0 otherwise. *Introduce exchange-rate peg* is an indicator variable that equals 1 if a country introduces an exchange-rate peg in a given year, and 0 otherwise. *Do not incur interest on reserves* is an indicator variable that equals 1 if a central bank reports no interest expenses, and 0 otherwise. Robust standard errors are clustered by central bank and are reported in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels for the two-tailed tests.

Table 4: Multivariate analysis—within country evidence

	Sign	(1) Profit	(2) Profit	(3) Profit	(4) Profit
Time to governor turnover x High operating expenses	-		-0.139**		-0.129**
			(0.058)		(0.059)
Time to governor turnover x Hard budget constraint	-		-0.104*		-0.110*
			(0.060)		(0.063)
Close to elections x High operating expenses	+			0.055	0.123
				(0.151)	(0.158)
Close to elections x Hard budget constraint	+			-0.211	-0.121
				(0.159)	(0.135)
Time to governor turnover	-/+		0.141**	0.014	0.141**
			(0.052)	(0.032)	(0.054)
Close to elections	-/+		0.065	0.141	0.075
			(0.073)	(0.190)	(0.136)
Extreme party affiliation	+	0.037	-0.052	-0.038	-0.065
		(0.035)	(0.159)	(0.157)	(0.173)
Right-wing party affiliation	+	-0.021	0.126	0.041	0.128
		(0.047)	(0.102)	(0.104)	(0.102)
High operating expenses	+	0.212**	0.416	0.158	0.326
		(0.100)	(0.245)	(0.146)	(0.288)
Exchange-rate peg	+	-0.010	0.175	0.169	0.155
		(0.099)	(0.211)	(0.134)	(0.191)
Do not incur interest on reserves	+	-0.109	0.079	-0.065	0.051
		(0.096)	(0.127)	(0.125)	(0.116)
Low-income countries	-/+	-0.094	0.154**	0.170***	0.202**
		(0.142)	(0.061)	(0.059)	(0.072)
Growth rate of nominal GDP	-/+	-0.370	-0.570	-0.525	-0.558
		(0.248)	(0.461)	(0.464)	(0.474)
Within R^2		0.030	0.128	0.074	0.141
Observations		209	209	209	209
Countries		43	43	43	43

Notes: The table reports results of the fixed-effects regressions, which use small profits and small losses from the wider ROA interval [0; 0.006) and [-0.006; 0), respectively. "Sign" refers to the expected sign of the relationship. Column (1) uses all Table 3 variables that show variation over time. The dependent variable *Profit* is an indicator for small profits and equals 1 if the central bank reports a small profit in year t. *Time to governor turnover* is the time (in years) remaining till the regular governor turnover. *Close to elections* is an indicator variable that equals 1 if elections of the country's chief executive take place in the current year or the following year, and 0 otherwise. *High operating expenses* is the ratio of central bank personnel expenses to the country's total tax revenues. *Hard budget constraint* is an indicator variable that equals 1 if the central bank dividend payout ratio (dividends divided by net income) is greater than 90% (third tertile of the central bank dividend payout distribution) or when a central bank pays dividends despite incurring a loss. The indicator variable equals 0 if the central bank dividend payout ratio is less than 50% (first tertile of the central bank dividend payout distribution) or when a central bank receives dividends from the government. *Extreme party affiliation* is an indicator variable that equals 1 if a country's chief executive is affiliated with the nationalist party, and 0 otherwise. *Right-wing party* affiliation is an indicator that equals 1 if the country's chief executive is affiliated with the right-leaning party (conservative, Christian democratic, or right-wing), and 0 if the country's chief executive is affiliated with the left-leaning party (communist, socialist, social democratic, or left-wing). *Exchange-rate peg* is an indicator variable that equals 1 if a country has an exchange-rate peg, and 0 otherwise. *Do not incur interest on reserves* is an indicator variable that equals 1 if a central bank reports no interest expenses, and 0 otherwise. *Low-income countries* is an indicator variable that equals 1 if a country is a low-income economy in a given year, and 0

otherwise. *Growth rate of nominal GDP* is the percentage change in nominal GDP. Robust standard errors are clustered by central bank and are reported in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels for the two-tailed tests.

Table 5: Loss avoidance and inflation rates—narrow interval regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Inflation	Inflation	Inflation	Inflation	Inflation	Inflation less target	Inflation surprises
Profit	0.014	0.025**	0.036**	0.033*	0.022**	0.016**	0.009*
	(0.010)	(0.010)	(0.014)	(0.017)	(0.010)	(0.006)	(0.005)
Growth rate of nominal GDP		0.066	0.087	0.093	0.013	-0.074**	-0.029
		(0.074)	(0.071)	(0.079)	(0.038)	(0.032)	(0.025)
Low-income countries		0.040**	0.034**	0.020	0.021	0.006***	-0.009
		(0.017)	(0.013)	(0.012)	(0.022)	(0.001)	(0.006)
Rule of law		-0.020**	-0.024***	-0.029***			
		(0.009)	(0.008)	(0.010)			
Right-leaning party affiliation			0.021	0.024			
			(0.017)	(0.020)			
Left-leaning party affiliation			0.023	0.030			
			(0.016)	(0.018)			
Extreme party affiliation			-0.030**	-0.029*			
			(0.014)	(0.017)			
Governor re-appointable			-0.045	-0.063*			
			(0.028)	(0.035)			
Central bank legal independence				-0.033			
				(0.025)			
Country fixed effects	No	No	No	No	Yes	Yes	Yes
R^2 / Whithin R^2	0.003	0.210	0.270	0.290	0.029	0.311	0.019
Observations	319	319	319	272	319	57	317
Countries	81	81	81	64	81	20	80

Notes: The table reports results of the OLS regression analysis for the sample of central banks that report either a small profit or a small loss (i.e., central bank profitability ROA is [0; 0.003) or [-0.003; 0), respectively). The dependent variable in columns (1)-(5) is the rate of consumer price inflation. The dependent variable in column (6) is the rate of inflation minus the target inflation rate. Column (6) uses only central banks that target inflation. The dependent variable in column (7) is the rate of inflation minus the IMF's inflation forecasts in the World Economic Outlook in April of the same year. *Profit* is an indicator for whether a central bank reports a profit or a loss. *Growth rate of nominal GDP* is the percentage change in nominal GDP. *Low-income countries* is an indicator variable that equals 1 if a country is a low-income economy in a given year, and 0 otherwise. *Rule of law* captures the extent to which economic agents trust and abide by legal institutions. *Right-leaning party affiliation* is an indicator that equals 1 if the country's chief executive is affiliated with the right-leaning party, and 0 otherwise. *Left-leaning party affiliation* is an indicator that equals 1 if the country's chief executive is affiliated with the left-leaning party, and 0 otherwise. *Extreme party affiliation* is an indicator variable that equals 1 if a country's chief executive is affiliated with the nationalist party, and 0 otherwise. *Governor re-appointable* is an indicator variable that equals 1 if a central bank governor is re-appointable, and 0 otherwise. *Central bank legal independence* is an index of central bank independence. Standard errors are reported in parentheses and are based on robust standard errors clustered by central bank. ***, **, and * represent significance at the 1%, 5%, and 10% levels for the two-tailed tests.

Table 6: Loss avoidance and inflation rates—polynomial regressions

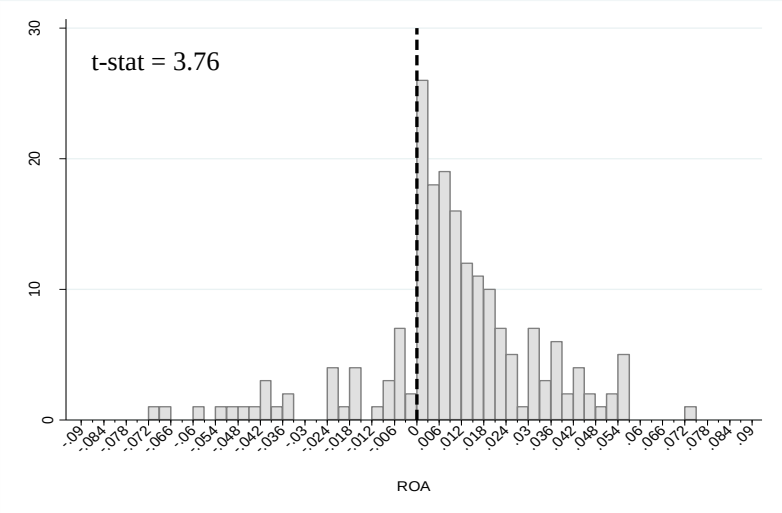
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Inflation	Inflation	Inflation	Inflation	Inflation	Inflation less target	Inflation surprises
Profit	0.029**	0.038***	0.046***	0.049**	0.038**	0.020**	0.014**
	(0.015)	(0.013)	(0.017)	(0.023)	(0.017)	(0.010)	(0.007)
Growth rate of nominal GDP		-0.014	-0.011	-0.018	-0.033	-0.014	-0.022**
		(0.022)	(0.022)	(0.026)	(0.022)	(0.016)	(0.011)
Low-income countries		0.016	0.015	0.009	-0.003	-0.010**	-0.003
		(0.011)	(0.011)	(0.012)	(0.009)	(0.004)	(0.003)
Rule of law		-0.028***	-0.030***	-0.034***			
		(0.006)	(0.006)	(0.008)			
Right-leaning party affiliation			0.017	0.013			
			(0.014)	(0.016)			
Left-leaning party affiliation			0.012	0.011			
			(0.008)	(0.009)			
Extreme party affiliation			-0.017*	-0.019*			
			(0.009)	(0.011)			
Governor re-appointable			-0.026	-0.035			
			(0.018)	(0.025)			
Central bank legal independence				-0.008			
				(0.016)			
Polynomials	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	No	No	No	No	Yes	Yes	Yes
R^2 / Whithin R^2	0.020	0.150	0.170	0.190	0.025	0.110	0.025
Observations	1,775	1,775	1,775	1,417	1,775	350	1,766
Countries	117	117	117	88	117	31	117

Notes: The table reports results of the OLS regression analysis using all central banks with available observations. The dependent variable in columns (1)-(5) is the rate of consumer price inflation. The dependent variable in column (6) is the rate of inflation minus the target inflation rate. Column (6) uses only central banks that target inflation. The dependent variable in column (7) is the rate of inflation minus the IMF's inflation forecasts in the World Economic Outlook in April of the same year. *Profit* is an indicator for whether a central bank reports a profit or a loss. *Growth rate of nominal GDP* is the percentage change in nominal GDP. *Low-income countries* is an indicator variable that equals 1 if a country is a low-income economy in a given year, and 0 otherwise. *Rule of law* captures the extent to which economic agents have trust in and abide by legal institutions. *Right-leaning party affiliation* is an indicator that equals 1 if the country's chief executive is affiliated with the right-leaning party, and 0 otherwise. *Left-leaning party affiliation* is an indicator that equals 1 if the country's chief executive is affiliated with the left-leaning party, and 0 otherwise. *Extreme party affiliation* is an indicator variable that equals 1 if a country's chief executive is affiliated with the nationalist party, and 0 otherwise. *Governor re-appointable* is an indicator variable that equals 1 if a central bank governor is re-appointable, and 0 otherwise. *Central bank legal independence* is an index of central bank independence. Polynomials include a vector of polynomials of ROA up to the factor of 6 and their interactions with the profit dummy. We trim ROA at the 1st and 99th percentiles to control for outliers. Standard errors are reported in parentheses and are based on robust standard errors clustered by central bank. ***, **, and * represent significance at the 1%, 5%, and 10% levels for the two-tailed tests.

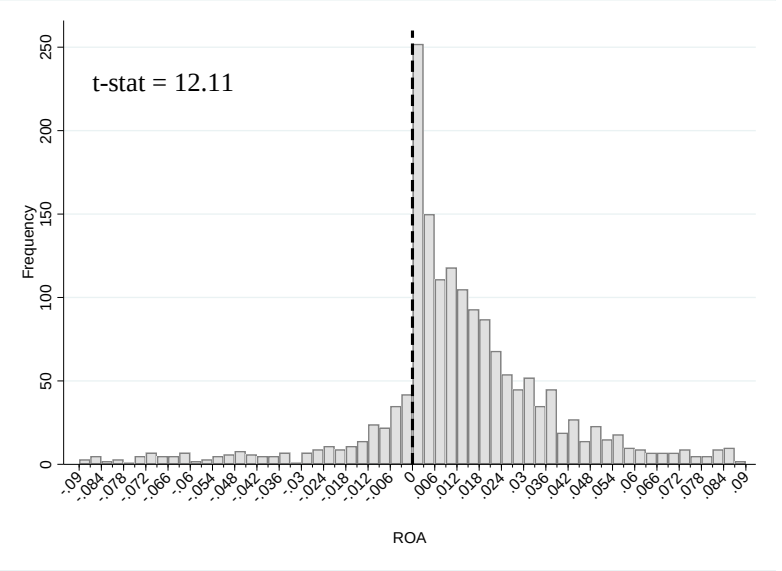
INTERNET APPENDIX

Figure IA-1: Distribution of central bank profits in the (non-)crisis years

I. Crisis years



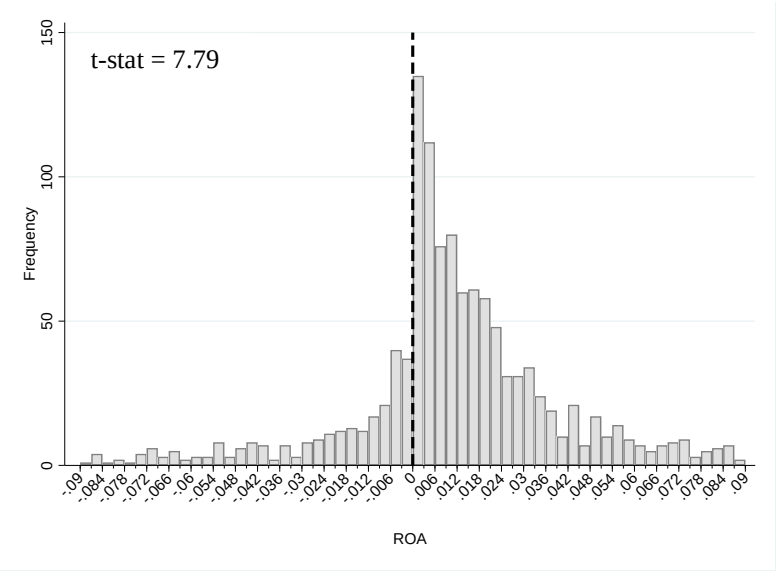
II. Non-crisis years



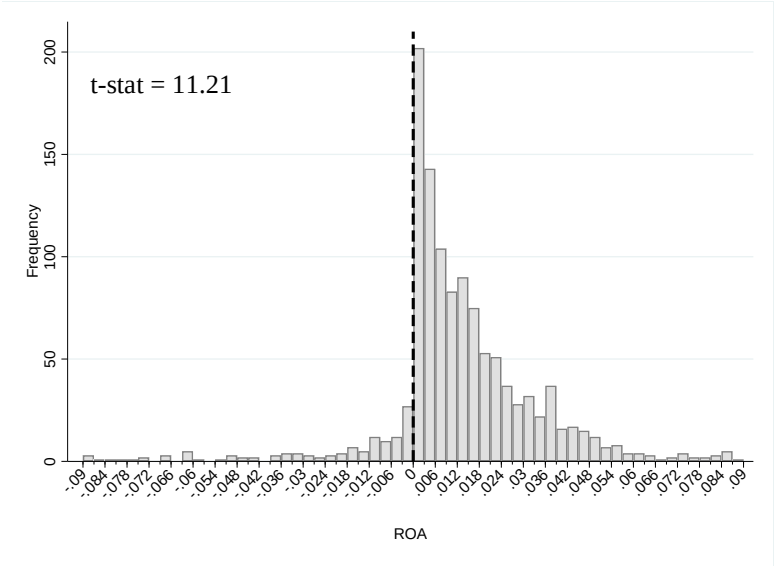
Notes: This figure plots the histogram of central bank profits for countries and years that experience a systemic banking crisis, currency crisis, or sovereign debt crisis (due to default or restructuring). The crisis data are from Laeven and Valencia (2012). Systemic banking crises database: an update. IMF Working Paper No. 12/163. ROA is defined as central bank net income divided by average total assets. The distribution of ROA in both graphs is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant.

Figure IA-2: Distribution of central bank profits and the rate of inflation

I. Above-median inflation rate



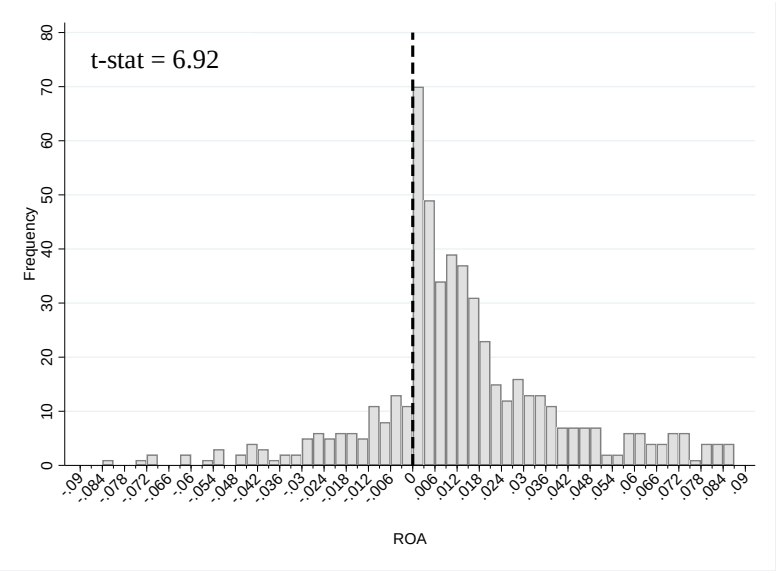
II. Below-median inflation rate



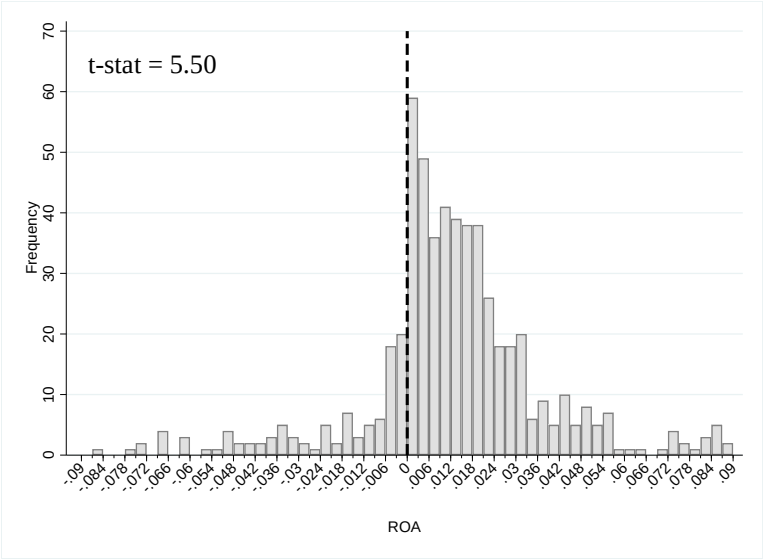
Notes: This figure plots the histogram central bank net income divided by average total assets (ROA) for countries with high (above-median) and low (below-median) inflation. Inflation is the country rate of consumer price inflation in a given year. The data are from World Bank. The distribution of ROA in both graphs is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant.

Figure IA-3: Distribution of central bank profits and short-term interest rates

I. Above-median interest rate



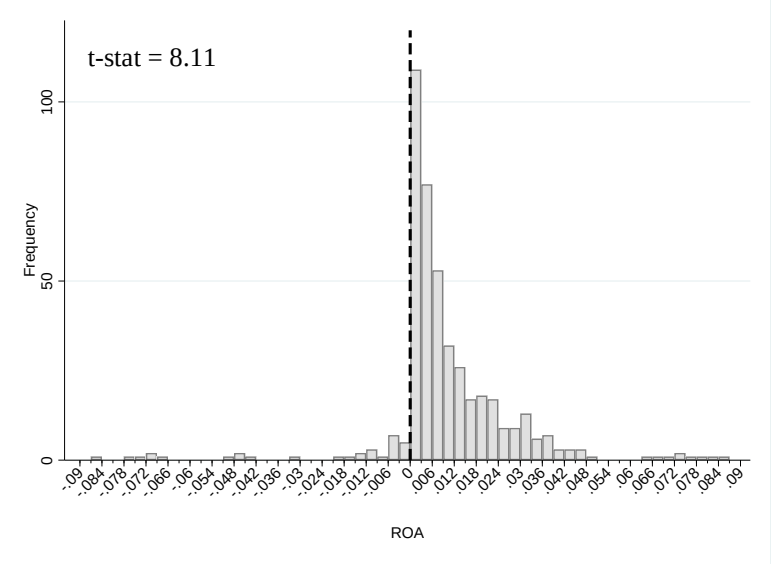
II. Below-median interest rate



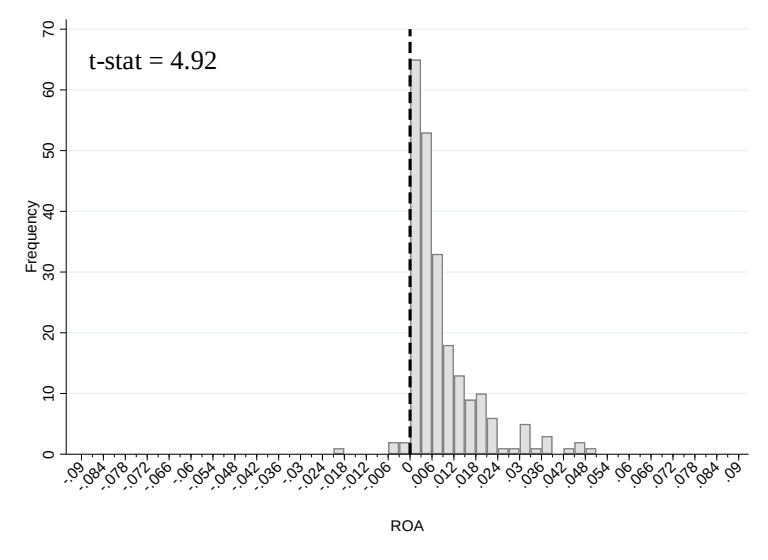
Notes: This figure plots the histogram central bank net income divided by average total assets (ROA) for countries with high (above-median) and low (below-median) short-term Treasury-bill interest rate. The data are from International Financial Statistics (IFS), IMF. The distribution of ROA in both graphs is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant.

Figure IA-4: Distribution of central bank profits for European Union and Eurozone central banks

I. European Union (EU)

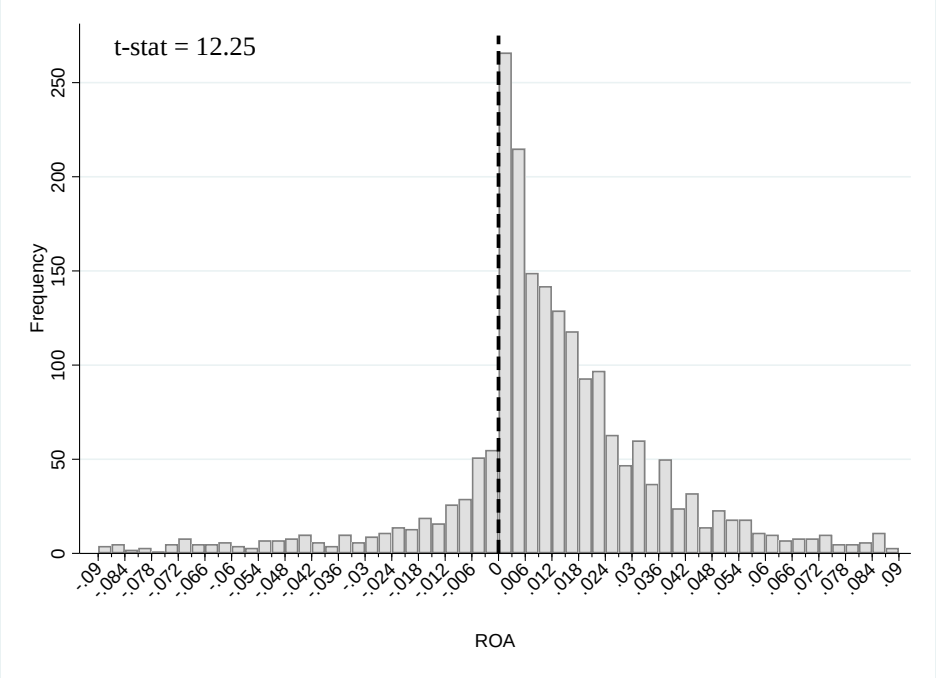


II. Eurozone



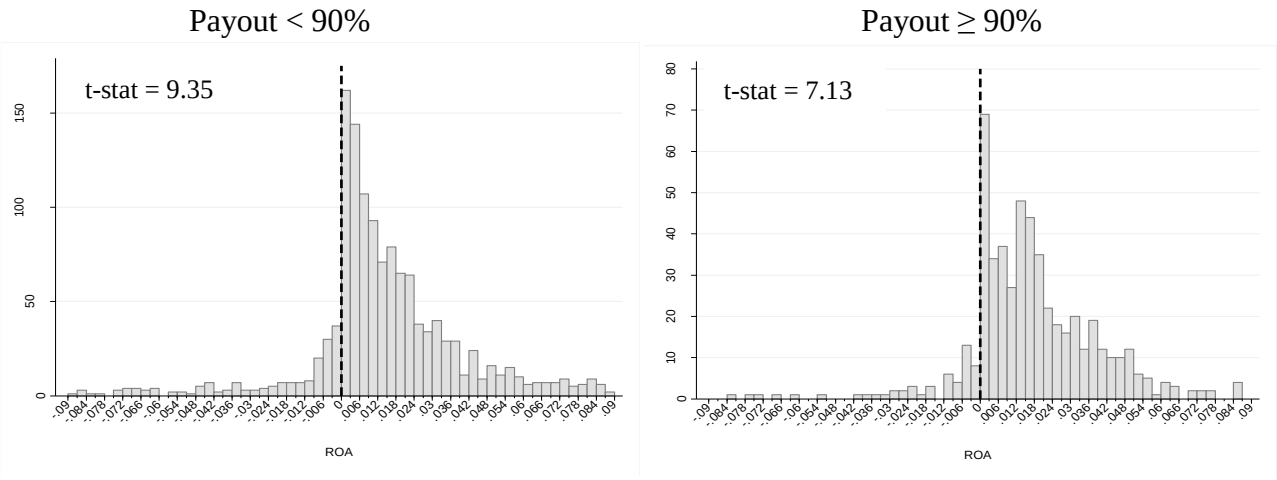
Notes: This figure plots the histogram of EU and Eurozone central bank profits. ROA is defined as central bank net income divided by average total assets. The distribution of ROA in both graphs is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant.

Figure IA-5: Distribution of central bank profits for central banks that incur interest on reserves



Notes: This figure plots the histogram of central bank profits for central banks that incur interest on reserves (i.e., central banks with positive interest expense on Bankscope). The distribution of ROA is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant.

Figure IA-6: Distribution of central bank profits and dividends to government—alternative split

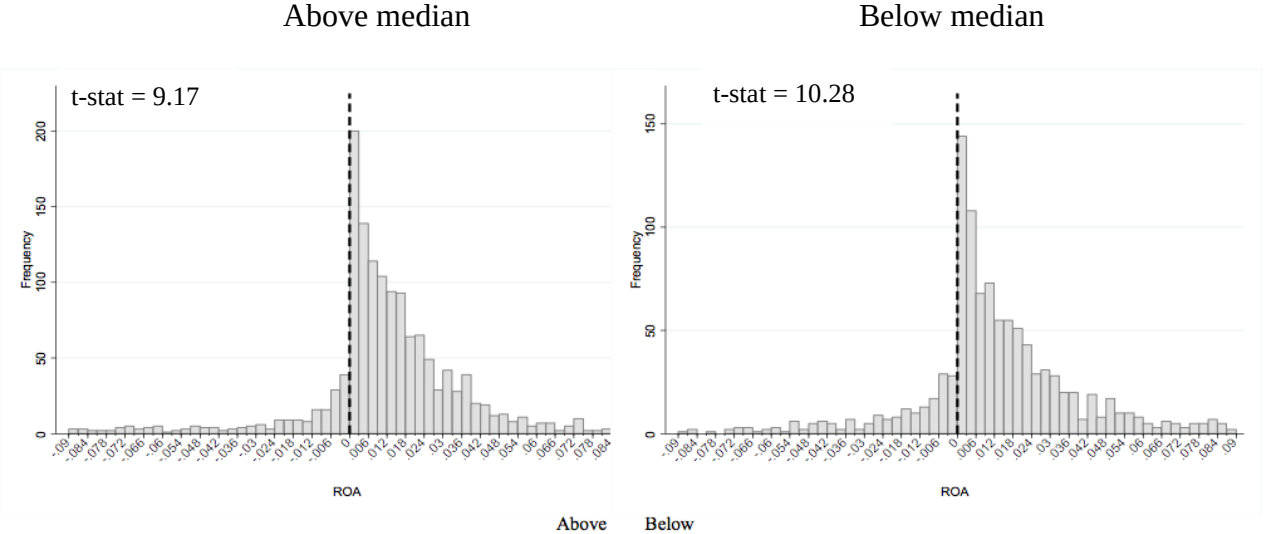


Contingency tables

	Payout < 50%	Payout > 90%	Total	
Small profit	162	69	231	
Small loss	37	8	45	χ^2-test 2.74
Total	199	77	276	p = 0.098
Small profit/small loss	4.38	8.63		

Notes: This figure plots the histogram of central bank profits (ROA) for sample splits based on central banks' dividend payout ratios. The third tertile of the dividend payout ratio is 90%. The central banks that pay dividends in the presence of losses have high payout ratios. Central banks that receive dividends from the government (i.e., report negative dividends) have low payout ratios. The distribution of ROA is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant. The table below the histograms reports the number of observations falling into small-profit or small-loss region in the adjacent histograms (i.e., central bank profitability ROA is [0; 0.003) or [-0.003; 0), respectively). The χ^2-test shows whether the number of small profits relative to the number of small losses is different in the two adjacent histograms.

Figure IA-7: Distribution of central bank profits and central bank policy transparency



	Above median	Below median	Total
Small profit	151	156	307
Small loss	29	23	52
Total	180	179	359
Small profit/small loss	5.21	6.78	

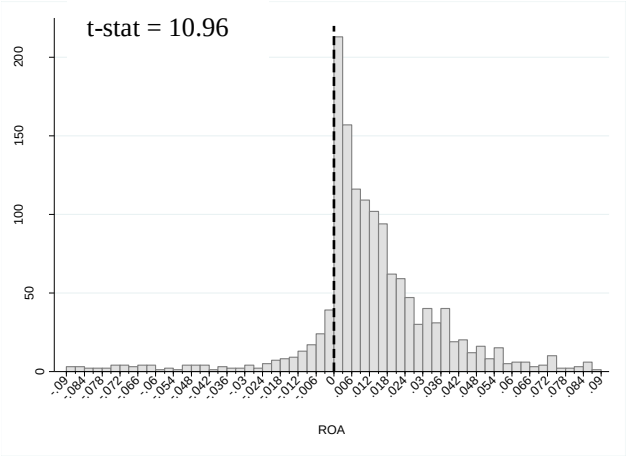
X^2-test 0.77
p = 0.380

Notes: This figure plots the histogram of central bank profits (ROA) for sample splits based on the central bank policy transparency index from Dincer and Eichengreen (2014). The index scores answers to 15 questions covering different aspects of the transparency of central bank operations (incl. openness about policy objectives, economic inputs used for policy decisions, and decision making). The index has a theoretical range from 0 to 15 with higher values indicating more independent central banks. The index is available for years 1998-2010. We use the value of the index in 1998 for the time period between 1998 and 2010. We assign values of the index from 2010 for years 2011-2014. In the histogram, the distribution of ROA is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant. The table below the histograms reports the number of observations falling into small-profit or small-loss region in the adjacent histograms (i.e., central bank profitability ROA is [0; 0.003) or [-0.003; 0), respectively). The χ^2-test shows whether the number of small profits relative to the number of small losses is different in the two adjacent histograms.

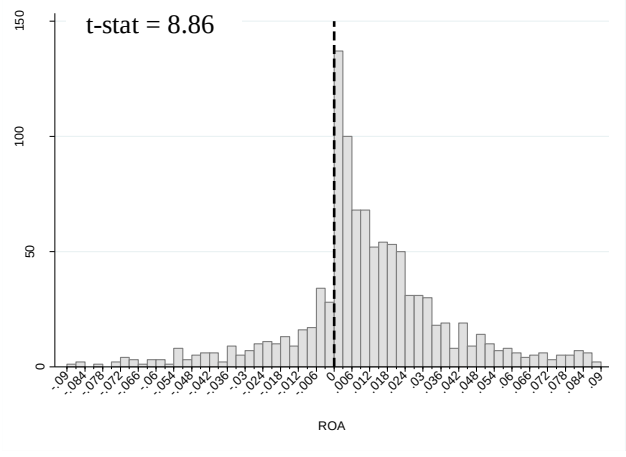
Figure IA-8: Distribution of central bank profits and country institutional environment

I. Rule of law

Above median



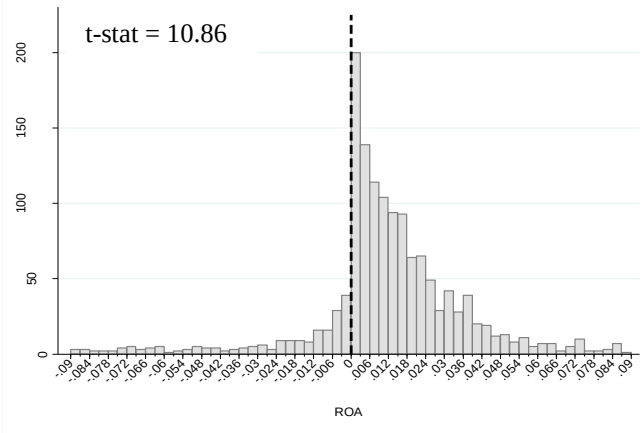
Below median



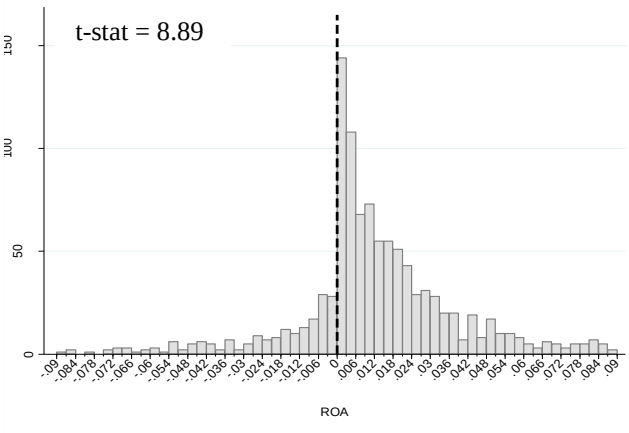
	Above median	Below median	Total	
Small profit	210	140	350	
Small loss	39	28	67	χ^2-test 0.08
Total	249	168	417	p = 0.784
Small profit/small loss	5.38	5.00		

II. Government effectiveness

Above median



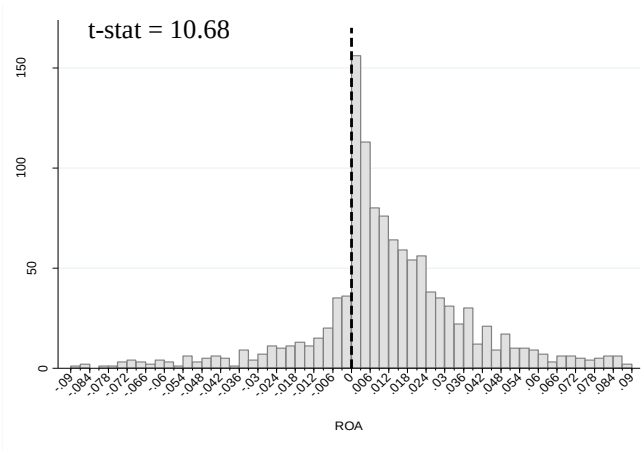
Below median



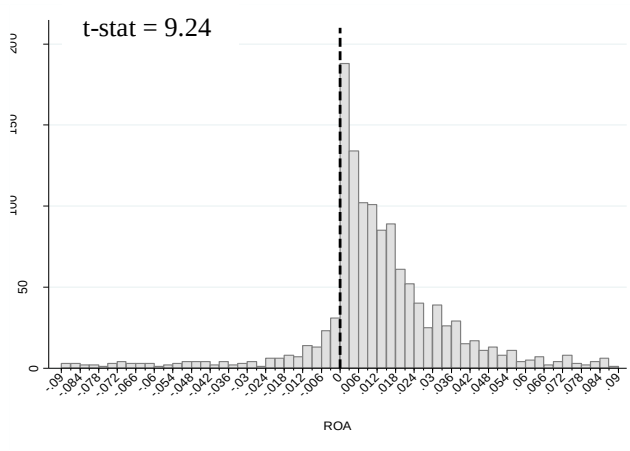
	Above median	Below median	Total	
Small profit	198	146	344	
Small loss	38	29	67	χ^2-test 0.02
Total	236	175	411	p = 0.899
Small profit/small loss	5.21	5.03		

III. Control of corruption

Above median



Below median



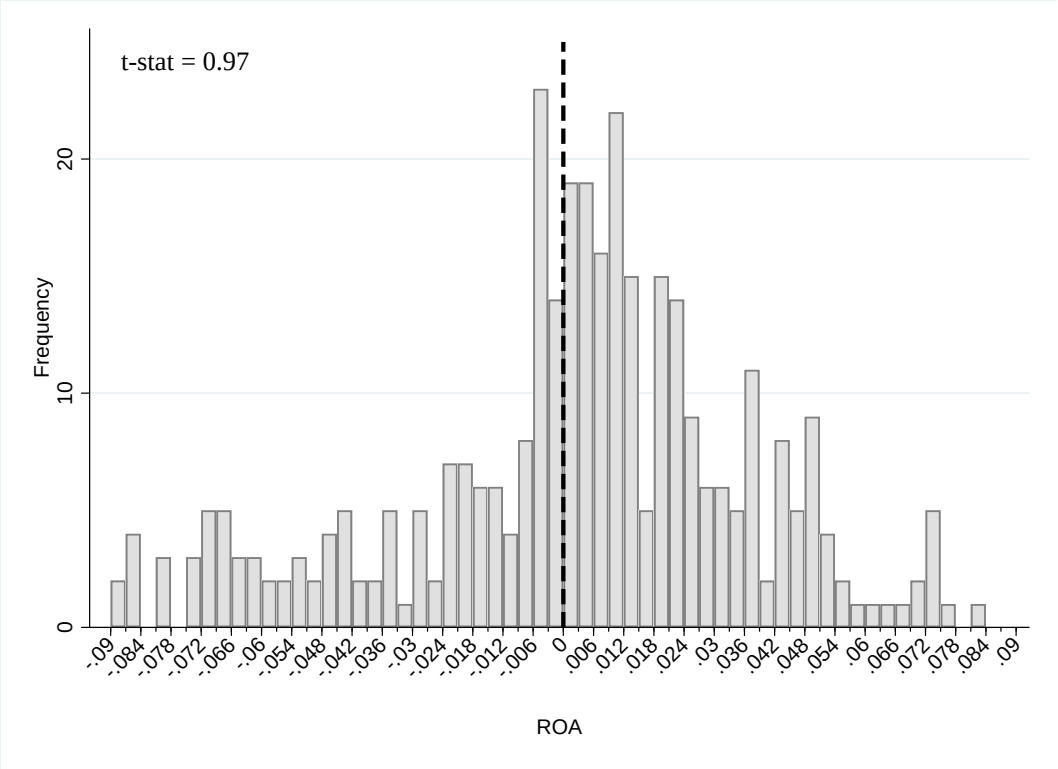
	Above median	Below median	Total
Small profit	159	185	344
Small loss	36	31	67
Total	195	216	411
Small profit/small loss	4.42	5.97	

χ^2-test **1.27**

p = 0.260

Notes: This figure plots the histogram of central bank profits (ROA) for sample splits based on the World Bank measures of country institutions. Rule of law captures the extent to which economic agents have trust in and abide by legal institutions, such as contract enforcement, property rights, and the courts. Higher values indicate greater rule of law. The government-effectiveness index captures the quality of public service and the degree of its independence from political influence. Higher values indicate greater government effectiveness. Control of corruption captures perceptions of the use of power by political elites for private gain. Higher values indicate greater control of corruption. The indices are expressed in standard normal units, ranging from approximately -2.5 to 2.5. We use the world-average value (index = 0) for our sample splits. The data are from Worldwide Governance Indicators (see Kaufmann et al. 2010). In the histogram, the distribution of ROA is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant. The table below the histograms reports the number of observations falling into small-profit or small-loss region in the adjacent histograms (i.e., central bank profitability ROA is [0; 0.003) or [-0.003; 0), respectively). The χ^2-test shows whether the number of small profits relative to the number of small losses is different in the two adjacent histograms.

Figure IA-9: Minimum combination of factors that "switches off" the effect—pooled samples



Notes: This figure plots the histogram of central bank profits (ROA) based on the combination of factors reported in Figures 10 and 11. The plot uses the intersection of three subsamples: (1) central bank governor not re-appointable and dividend distribution allows contemporaneous or intertemporal smoothing (Figure 10, Panel I); (2) central bank governor not re-appointable and low central bank operating expenses to total government income from taxes (Figure 10, Panel II); and (3) central banks with negative equity (Figure 11). The distribution of ROA is trimmed at [-0.09; 0.09]. The dotted vertical line shows when ROA equals zero. The number of observations falling into each bin is reported on the vertical axis. The McCrary test, reported in the upper left corner of each histogram, examines whether the discontinuity at zero is significant.

Table IA-1: Properties of central bank ROA

	(1) Overall standard deviation	(2) Within standard deviation	(3) Between standard deviation
ROA volatility	0.062	0.054	0.034

	(1)
Persistence of ROA	0.644***
	(0.159)

Notes: The table shows descriptive statistics for ROA (N=2,591). The bottom rows of the table pool all available central bank observations and estimate the OLS regression $roa_{t+1} = \alpha_0 + \alpha_1 roa_t + \varepsilon_{t+1}$. The table reports the coefficient α_1 (persistence coefficient) and its robust standard error, clustered by central bank and shown in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels for the two-tailed tests.

Table IA-2: Correlation between the test variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Governor re-appointable	1.000														
(2) Extreme party affiliation	0.110	1.000													
	0.04														
(3) Publicly traded central banks	0.097	0.073	1.000												
	0.06	0.17													
(4) Right-wing party affiliation	0.103	-0.010	0.111	1.000											
	0.13	0.88	0.10												
(5) High operating expenses	0.017	0.020	0.048	0.133	1.000										
	0.81	0.78	0.49	0.13											
(6) Hard budget constraint	-0.034	0.096	0.205	-0.060	-0.092	1.000									
	0.66	0.24	0.01	0.54	0.40										
(7) Low central bank legal independence	0.159	0.025	-0.068	-0.260	-0.496	0.114	1.000								
	0.00	0.68	0.22	0.00	0.00	0.16									
(8) Low central bank transparency	0.096	0.099	-0.236	-0.111	-0.162	-0.004	0.388	1.000							
	0.07	0.08	0.00	0.12	0.02	0.96	0.00								
(9) Low rule of law	-0.036	0.067	-0.180	-0.138	-0.339	-0.396	0.049	0.527	1.000						
	0.47	0.21	0.00	0.04	0.00	0.00	0.38	0.00							
(10) Do not follow IFRS	0.123	0.033	-0.131	-0.065	-0.189	-0.117	0.352	0.281	0.131	1.000					
	0.02	0.54	0.01	0.33	0.01	0.13	0.00	0.00	0.01						
(11) Exchange-rate peg	0.170	0.082	-0.027	0.106	0.665	0.155	-0.208	0.080	-0.197	-0.034	1.000				
	0.00	0.13	0.59	0.12	0.00	0.04	0.00	0.14	0.00	0.50					
(12) Introduce exchange-rate peg	0.005	0.014	-0.058	0.017	-0.003	0.076	-0.001	0.065	0.112	0.034	0.256	1.000			
	0.93	0.79	0.23	0.80	0.96	0.32	0.99	0.22	0.02	0.49	0.00				
(13) Do not incur interest on reserves	0.096	0.127	0.121	0.067	-0.096	0.413	0.139	0.233	-0.131	0.042	0.037	0.046	1.000		
	0.08	0.03	0.02	0.34	0.18	0.00	0.02	0.00	0.01	0.43	0.50	0.39			
(14) Low-income countries	-0.057	0.083	-0.220	-0.277	-0.332	-0.414	0.202	0.492	0.658	0.183	-0.258	0.062	-0.186	1.000	
	0.26	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00		
(15) Growth rate of nominal GDP	-0.014	0.052	-0.102	0.061	-0.050	-0.029	-0.111	0.084	0.096	-0.049	-0.007	0.046	-0.027	0.098	1.000
	0.79	0.34	0.04	0.37	0.48	0.71	0.05	0.12	0.05	0.32	0.89	0.35	0.62	0.05	

Notes: The table reports Pearson correlation coefficients for the variables used in Table 3. The sample consists of central bank observations that report either a small profit or a small loss, that is, ROA interval [0; 0.003) and [-0.003; 0), respectively. The p-values are reported below the correlation coefficients. All variables (except for the *Growth rate of nominal GDP*) are expressed as dummy variables using the same cut-off points as in Figure 8 and are coded so that they all predict positive coefficients when associated with higher incentives to avoid losses. *Governor re-appointable* is an indicator variable that equals 1 if a central bank governor is re-appointable, and 0 otherwise. *Extreme party affiliation* is an indicator variable that equals 1 if a country's chief executive is affiliated with the nationalist party, and 0 otherwise. *Publicly traded central banks* is an indicator variable that equals 1 if the shares of a central bank are quoted on a public exchange, and 0 otherwise. *Right-wing party* affiliation is an indicator that equals 1 if the country's chief executive is affiliated with the right-leaning party (conservative, Christian democratic, or right-wing), and 0 if the country's chief executive is affiliated with the left-leaning party (communist, socialist, social democratic, or left-wing). *High operating expenses* is the ratio of central bank personnel expenses to the country's total tax revenues. *Hard budget constraint* is an indicator variable that equals 1 if the central bank dividend payout ratio (dividends divided by net income) is greater than 90% (third tertile of the central bank dividend payout distribution) or when a central bank pays dividends despite incurring a loss. The indicator variable equals 0 if the central bank dividend payout ratio is less than 50% (first tertile of the central bank dividend payout distribution) or when a central bank receives dividends from the government. *Central bank legal independence* is an index of central bank independence. *Low central bank policy transparency* is an index of central bank policy transparency. *Low rule of law* captures the extent to which economic agents have trust in and abide by legal institutions. *Do not follow IFRS* is an indicator variable that equals 1 if a central bank prepares financial statements in accordance with local standards, and 0 if it follows IFRS. *Exchange-rate peg* is an indicator variable that equals 1 if a country has an exchange-rate peg, and 0 otherwise. *Introduce exchange-rate peg* is an indicator variable that equals 1 if a country introduces an exchange-rate peg in a given year, and 0 otherwise. *Do not incur interest on reserves* is an indicator variable that equals 1 if a central bank reports no interest expenses, and 0 otherwise. *Low-income countries* is an indicator variable that equals 1 if a country is a low-income economy in a given year, and 0 otherwise. *Growth rate of nominal GDP* is the percentage change in nominal GDP.