Regulatory Cycles: A Political Economy Model*

Pooya Almasi† Jihad Dagher‡ Carlo Prato§

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Abstract

Financial regulatory policy in the U.S. has been conspicuously pro-cyclical over the last two decades. A historical look at financial boom-bust cycles shows that pro-cyclicality in financial regulation is a common and recurring pattern. This paper introduces electoral concerns a model of financial intermediation to study how public opinion, financial innovation, and policy-makers incentives shape financial regulation. We show that politicians' electoral incentives can generate an *ex ante* inefficient pro-cyclicality in financial regulation. In the presence of incompetent politicians and a polarized electorate, competent politicians take regulatory risks to signal their competence. This leads to an amplification of the impact of public opinion on regulatory policy.

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JEL Classification: D72, D82, G18

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†Georgetown University. Email: pa402@georgetown.edu

‡University of Southern California and Goethe University Email: jihad.dagher@gmail.com

§Columbia University. Email: cp2928@columbia.edu

1 Introduction

The recent wave of financial crises has brought unprecedented attention to financial regulatory policy. The crisis in the United States alone has generated a long string of academic research and extensive policy debates on the topic. At the heart of policy debates is a lingering question about the policies that could have avoided the 2008-09 crash and the subsequent Great Recession.

The literature acknowledges that, in the United States, the crisis came after a deregulatory phase (Kaufman and Mote, 1990; Blinder, 2009; Barth et al., 2012). The crisis also led to a extensive overhaul of the financial regulatory landscape with the passage of the Dodd-Frank Act (DFA) in 2011. DFA created a plethora of agencies and regulations that took more than five years to be fully implemented. Many commentators agreed that the DFA led to an over-regulated system.[1]

The first contribution of this paper is to document how the cycle of deregulation and re-regulation, that went in tandem with the financial boom-bust cycle, is not unique to the Great Recession. This pro-cyclicality is a hallmark of most financial boom-bust cycles (see Section 2) and can be observed from the very early days of financial markets (e.g., the Bubble Act in 1720 England). History shows that the regulatory stance tend to weaken during booms and strengthen following busts. In most cases, deregulation and a weakening of financial supervision take place in the midst of a financial boom and a during a period of financial optimism. Crashes almost always lead to a significant and very rapid overhaul of regulations and to restrictive financial policies despite the dangers of "choking" the recovery.

Given the economic and political costs of financial crises, one wonders why do policy makers tend to 'ride the cycle' and fuel the boom, rather than leaning against the wind. Some economists see these financial booms and crashes as an unavoidable feature of capitalist economies where markets learn about new innovations (see, e.g., Minsky, 1992; Gorton, 1988; Calomiris and Gorton, 1991; Snowden, 1997; Allen and Gale, 1998, 2000; Calomiris and Mason, 2000; Rose and Snowden, 2013; Frame and White, 2014), and thus not necessarily a regulatory failure. Nevertheless, after financial crashes, policy-makers and economists alike point to regulatory failures that exacerbated a bubble.

The second contribution of this paper is to show that while pro-cyclical changes in public

[1] See e.g., "Over Regulated America", the Economist, 2012; "Too big not to fail", the Economist, 2012; "Dodd Frank Nasty Double Whammy", the Wall Street Journal, 2015; "Is Dodd-Frank too Complex to work", Harvard Business Review, 2012; GAO, 2016; Cochrane, 2017; "Dodd-Frank is complex and overburdens the financial sector", Financial Times, 2017.

sentiment naturally lead to pro-cyclical regulation, this relation is amplified in an electoral model where policy-makers have an incentive to maintain a reputation for competence.

This amplification mechanism is especially pronounced when (mass) political polarization is high. We obtain these results by combining a simple model of electoral accountability with a bare-bone model of financial regulation. While we recognize that each individual episode contextual factors play an important role, our findings can help explain the ubiquity of regulatory cycles across time and space. One does not need to make heroic assumptions about politicians' preferences nor the importance of lobbying by the financial sector (which could be driven by demand and supply factors) in order to generate regulatory cycles.

In our model of financial regulation, the policy maker can impose a constraint on risk-taking by banks—for instance a capital requirement (see, e.g., Vanhoose, 2007; Acharya et al., 2014; Korinek and Kreamer, 2014). As in many earlier contributions (see e.g. Kose et al., 1991; Rochet, 1992; Gollier et al., 1997; Acharya, 2009), limited liability lead bankers to excessive risk taking relative to the utilitarian benchmark and voters' preferences. The socially optimal level of risk-taking depends on the common prior on the return on risky investments. The well known opacity of financial products means that voters need to rely on a politician's expertise to set the constraint on risk-taking appropriately.

In line with a longstanding political economy literature, we assume that (i) politicians have mixed motives (they care about reelection but also about the economic consequences of policy), (ii) they vary in their competence level, and (iii) that a reputation for competence improves their chances of reelection. More competent politicians can make a better use of the resources at their disposal to assess the true nature of financial innovations and their riskiness. For simplicity, we assume that competent politicians and bankers have an informational advantage over non-competent politicians and entrepreneurs. Specifically, politicians and bankers have a full knowledge of the losses when investments fail.[2]

Any model of financial regulation during booms and busts cannot ignore the well documented role of changes in market (and thus voter) sentiment. After a prolonged period of financial stability voters' tend to be optimistic about finance (and financial innovation) but this attitude can swiftly change following a crisis as illustrated in Figure 1 obtained from a survey of households in the United States. In the absence of competent politicians, the ex-ante optimal level of regulation

[2]Similar results can be obtained under any degree of asymmetric information about the probability of failure. For simplicity, we focus on its starkest form.

indeed depends on voters' perception of risk.[3]

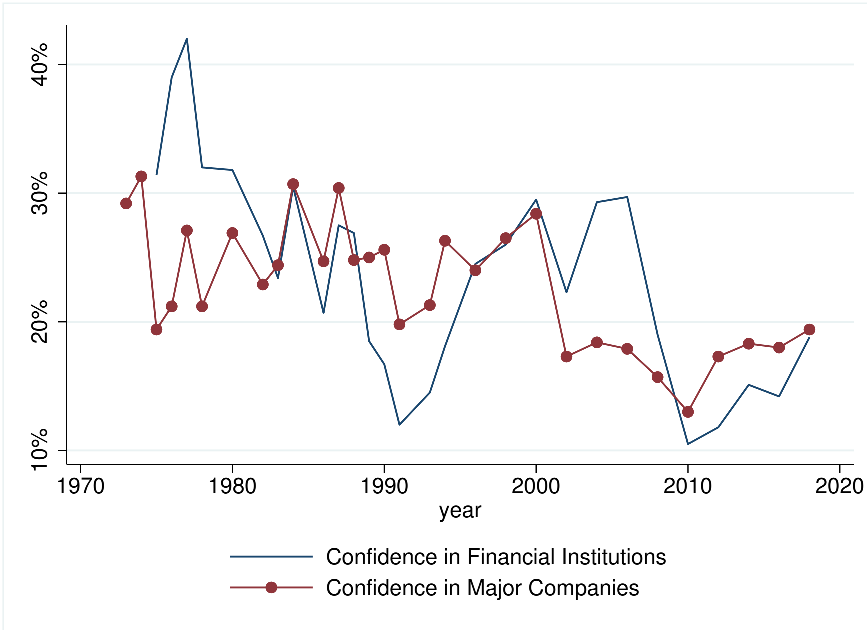

Figure 1: Confidence in Corporations and Banks in the U.S.

The graph shows the percent of the respondents who have a great deal of confidence in Banks and in Major companies. The data are the General Social Survey produced by the National Opinion Research Center at the University of Chicago. www.norc.org

Given what we assume about her goals, in the absence of electoral concerns a competent politician would implement the ex-post socially optimal regulation. However, electoral incentives lead politicians to try to signal through their actions that they are competent. And, to credibly do so, they are willing to implement sub-optimal regulation. We show that a competent politician 'overshoots' relative to her private information: when the riskiness of financial innovation is low, she under-regulates relative to the social optimum; when the riskiness is high, she over-regulates. We show that an increase in polarization exacerbate this inefficiency. At low levels of polarization, the incentive for the non-competent politician to pool (at least in one state of nature) is very high, and an equilibrium where both types choose the ex-ante optimal regulation becomes more likely. In other words, a low polarization can cushion the adverse effect on overall welfare created by the presence of an incompetent.

Therefore we show that even under a standard set of assumptions to both the financial regulation

[3]Indeed, in our model these changes in attitude can generate a form of regulatory cycle when politicians are known to be incompetent. But, these cycles would take an extremely stylized form as the analysis shows.

and political economy literature, regulation will amplify public opinion: de-regulation and re-regulation will overshoot relative to the ex-ante optimal levels. A period of optimism might lead voters to prefer a less regulated financial system, but the incumbent will de-regulate even more than what is warranted by voters' sentiment (and beyond what is ex-ante optimal from her perspective) only to send a signal of competence.

One might wonder whether the cyclicality present in the data are merely a reflection of changes in voter sentiment alone. That is, in the context of our model, a deviation from the ex-ante optimal policy plays at best a small role in the cyclicality of regulation. As we discuss in Section 2, a long string of prominent literature contradicts such hypothesis and has offered a plethora of evidence pointing to political factors as a key determinant in financial regulation. Evidence of political interference in financial regulation, despite regulators' knowledge of the associated risks and repeated warnings, has also been discussed in the literature (see e.g., Ramirez, 1999, Peretz and Reith, 2009, Levine, 2012, McCarty et al, 2013). The empirical literature has also shown convincing evidence of electoral incentives in financial regulatory policy making (e.g., Brown and Dinc, 2005, Muller, 2019, Saka et al., 2020). The question is therefore not whether political economy factors had a role, but rather as to what are the key mechanisms that generate such patterns. Undoubtedly, there are multitude factors at play, which are also likely to vary across time and countries. Our paper simply shows that the very electoral models that are often used to explain other public policy matters, also generate, in their plain form, a pro-cyclical pattern in regulation.

This paper contributes to a literature on the political economy of financial regulation. While this topic has been rarely explored in the context of a theoretical model, several influential works study the history of financial regulation shedding light on the configurations of interests that shaped their inception (See, e.g., Hammond, 1967; Cameron, 1967; White, 1983; Kroszner, 1998; Calomiris, 2010; Calomiris and Haber, 2014). Calomiris and Haber (2014) conceptualize regulation as the result of a bargaining game between politicians and bankers. The literature, however, does not try to explain the cyclical behavior beyond noting this pattern (see, e.g., Blinder, 2016) and examining its recurrence throughout history and across countries (Dagher, 2018). The empirical literature largely focuses on identifying special interest influence on financial regulatory outcomes (Posner, 1997; Kroszner, 1998; Kroszner and Strahan, 1999; Benmelech and Moskowitz, 2010; Mian et al, 2010 and 2013; Igan et al., 2012 and 2014, Rajan and Ramcharan, 2016).

This paper is also related to a body of theoretical scholarship on the electoral determinants of public policy. Most papers focus on informational asymmetries and the resulting frictions stemming from candidates' desire to cultivate a good reputation. This reputation can concern either their policy preferences/honesty (Coate and Morris, 1995; Maskin and Tirole, 2004; Besley, 2006; Acemoglu et al, 2013; Schnakenberg and Turner, 2019; Foarta and Morelli, 2020) or their expertise (Scharfstein and Stein, 1990; Canes-Wrone et al., 2001; Kartik et al., 2015; Fortunato and Turner, 2018), which is the perspective we adopt in this paper.

From a modeling perspective, the anti-pandering results in Kartik et al. (2015) and Bils (2020) are perhaps closest to this paper. In these models, politicians have an incentive to over-react to their private signal about a policy-relevant state for electoral reasons. Unique to this paper is the possibility of *simultaneous* over- and under-reaction and the application to financial regulation.

From a more substantive perspective, Groll et al. (2017) is perhaps the most closely related to our paper. Like us, they study how political frictions shape financial regulation under limited liability. This paper, however, focuses on politicians' electoral concerns, rather than conflict of interests between executive and legislative branches and allows for a continuous policy tool.

There is a vast literature on political business cycles,[4] which shows how the timing of elections systematically influence economy policy—and thus macroeconomic outcomes. Nordhaus (1975) and Hibbs (1977) were among the first to formalize these ideas but relied on irrational behavior by voters. Subsequent models included rational expectations and showed how repeated interactions (Alesina, 1987) and information asymmetries (Rogoff and Sibert, 1988; Rogoff, 1990) can generate political budget cycles. To our knowledge, our paper is the first to show that a similar adverse selection logic can lead politicians to 'overshoot' regulation or deregulation relative to a socially desirable benchmark that they know how to enact. Another distinguishing feature of our model is that it takes the economic cycle as given while showing how political frictions can amplify the regulatory response to business cycles and, thereby exacerbating the bust and/or heightening boom.

The remainder of the paper is structured as follows. Section 2 provides an overview of pro-cyclicality in financial regulation over past two centuries. Section 3 presents the model, section 4 provides the equilibrium analysis, and section 5 concludes. Proofs are provided in the appendix.

2 Regulatory Cycles

Through a historical overview, this Section argues that a pro-cyclical financial regulation has been a defining feature of the booms and busts cycle since the early days of modern capitalism.

[4]see e.g., Ben-Porath, 1975; Hibbs, 1977; Tufte, 1980; for a survey on early contributions both empirical and theoretical see Drazen, 2000

Over the last twenty years, financial regulations in the United States have conspicuously co-moved with the cycle. During the economic and financial boom leading to the Great Recession, financial policy provided a stimulus to the financial sector. The repeal of the Glass-Steagall Act and the passage of the Commodity Futures Modernization Act (CFMA) are two prominent examples of this trend. Both encouraged increased risk-taking in the period leading up to 2007-2008 (Shiller, 2013; Gorton, 2010; Acharya et al, 2010; Claessens et al, 2012; Dewatripont et al., 2010; Acharya et al, 2011a; Financial Crisis Inquiry Commission, 2011; Levine, 2011; Blinder, 2013). Policies that encouraged mortgage lending, especially to riskier borrowers, and their political underpinnings, are also well documented literature (see, e.g., Acharya et al, 2010).[5]. Criticism for the deregulation and lax supervision was voiced by economists, members of Congress, as well as regulators (see e.g. Dagher, 2018) during the boom. A notable example, is that of Brooksley Born, the head of the Commodities Futures Trading Commision (CFTC) who has consistently expressed discontent with the lack of oversight on over-the-counter (OTC) derivatives to the Administration. Her suggestion to regulate the OTC market backfired, as the Administration rushed to pass a bill that would protect the OTC market from the CFTC, after which she resigned.

Following the Great Recession, and at the initiative of the Administration, Congress passed a 2,300-page Act in 2010, the Dodd-Frank Act (DFA), the most extensive overhaul of the regulation of the financial sector since the New Deal. DFA is often criticized for its complexity and over-reach, some arguing that it added a 'complexity risk' to the financial sector (e.g., Groll and O'Halloran, 2019). The bill required 243 rulemakings and 67 studies that took four years to (nearly) fully implement. DFA passage happened in an environment of low confidence and even hostility toward the banking sector (Figure 1).

In 2017, a week after the Dow Jones crossed the symbolic 20,000-point threshold, and in the midst of the longest expansion in US history, the new Administration announced the intention of fulfilling a campaign pledge to provide regulatory relief for banks to spur growth. The administration's efforts resulted in the "Economic Growth, Regulatory Relief and Consumer Protection Act" bill, that Congress passed in 2018. While on the face of it, the Act's objective seemed to focus on providing regulatory relief to small banks, it provided some regulatory relief to all but the largest banks. The move toward deregulation was further reinforced by the appointment of bank-friendly

[5]While public subsidy to home ownership has long enjoyed bipartisan support, its scale increased considerably in mid 2000s, as exemplified by the American Dream Downpayment Act (for an analysis of the political consequences of these measures, see Prato, 2018)

regulators.[6].

Similar patterns can be observed in the regulation of securities, during the Doctcom era. The period leading up to the bubble was marked by a series of deregulations (see, e.g., Coffee, 2002; Western, 2004; Gerding, 2006). Following the NASDAQ crash, congress passed the Sarbanes-Oxley bill, sponsored by the Administration. The Sarbanes-Oxley law remains one of the most critiqued piece of financial legislation amongst both academic and business circles (see, e.g., Ribstein, 2002, Solomon and Brian-Low, 2004, Romano, 2005). Its passage happened at a time of marked collapse in confidence in large corporations (Figure 1).

The period around the Great Depression offers another instance of a regulatory cycle.[7] During the roaring 20s, under President Coolidge (1923-1929), the regulatory state was "thin to the point of invisibility" (Ferrell, 1998). Just as in the Great Recession, the years preceding the crash saw significant financial deregulation coupled with increased support to the housing sector—all while the economy was booming. The Federal Farm Loan Act of 1916 created joint stock and federal land banks with the goal of expanding mortgage availability to farmers. Support of the real estate sector and financial deregulation continued until the end of the boom: At a time of rapid credit expansion, the McFadden Act (1927) allowed national banks to expand their lending bond trading operations, establish subsidiaries while circumventing capital requirements (White, 1990). As the complexity of the financial system increased, the supervisory framework did not adjust. Banks were able to bypass restrictions on securities trading by resorting to affiliates whose importance grew exponentially.[8]

The Great Depression led to a series of regulations and agencies that shaped the US financial landscape for decades to come. The Banking Act of 1933 established the FDIC and the Glass-Steagall legislation separated commercial banking from investment banking. The Banking Act of 1933 also imposed restrictions on speculations while enhancing the monitoring of these activities and regulated interests rates on deposits (so called "Regulation Q").

The patterns described above are not unique to the U.S., nor to modern financial systems. Following one of the earliest financial crises, the South Sea Bubble of 1720, the Parliament of Great Britain passed the Bubble Act that imposed major restrictions on the formation of joint-

[6]see, e.g., Financial Times, 2017

[7]For brevity, we omit a discussion of the Saving and Loan crisis in the 1980s, which also fits the pattern of pro-cyclical regulation.

[8]The political support of the housing boom can be most prominently seen in Florida, where politicians had a direct hand in the explosive growth of mortgage lenders and the deterioration of landing standards (Vickers, 1994; White, 2009a).

stock companies (Harris, 1994). These limitations remained in place for nearly a century, hindering financial development in the England (see, e.g., Temin and Voth, 2004). The Bubble Act was repealed in 1825, at the height of another major financial boom. The panic of 1825, in turn, led to a series of reforms that shaped the British financial market for a century to come (Neal, 1998).

Regulatory cycles are not limited to the Anglo-Saxon world. Following a period of financial crises and instability in the early twentieth century, Japan enacted a series of banking reforms and regulations that remained in place until the 1980s (Hoshi and Kashyap, 1999). The 1980s saw liberalization and deregulation at a time of sustained expansion in both housing and stock markets. Informal regulation took hold, as politically affiliated *jusen* companies, established to provide individual housing credit, expanded well beyond their mission and ended up fueling the residential crisis(e.g., Haggard, 2000). Financial supervision deteriorated as the Ministry of Finance division in charge of regulating financial institutions was dissolved in 1984 (Amyx, 2004). After the crisis, Japan's financial market underwent a series of comprehensive reforms.

Similar regulatory cycles can be observed during the early- and mid-2000s in Ireland and Spain. In both countries, political interventions to expand credit and hinder regulation helped further fuel the financial boom (e.g., Fernandez-Villaverde et al, 2013). Notably, Ireland expressly adopted the infamous light-touch regulation doctrine (Clarke and Hardiman, 2012). The crisis led to a far-reaching regulatory backlash in both countries.

In summary, pro-cyclical regulation has been a hallmark of financial boom-bust cycles throughout history. Scholarly accounts of these crises point to government regulatory actions that amplified the preceding boom.

3 The Model

The model features an electoral stage followed by an economic stage.

3.1 The Economic Stage

The economic stage is divided into three phases and features a unit mass of agents divided into bankers (**B**) and entrepreneurs (**E**). For simplicity, we assume that each group is equally sized.[9]

There is a single good that serves both as consumption good and capital. For simplicity we set

[9]The relative size of each group does not affect our results, though the distribution of stock ownership suggests that bankers should be a relative minority.

interest rates on both deposits and loans to zero. In line with the literature (see, e.g., the textbook by Freixas and Rochet, 1997), banks in our model invest both their equity (starting endowment) and the deposits of Entrepreneurs in a portfolio of assets with heterogeneous risk profile.

First, **B** and **E** begin with an endowment K and D, respectively. We normalize initial assets to one: $K + D = 1$. In this stage bankers have access to financial investment opportunities, while entrepreneurs don't. We also assume that the storing cost for **E**'s endowment are such that they strictly prefer to deposit it with **B** without earning interest. Given the existing regulation, **B** have the option to invest $D + K$ in a combination of a safe and risky assets, with x denoting the share of risky assets invested. Regulation takes the form of an upper bound $\overline{x} \in [0, 1]$ on the share of risky investment that bankers can take.

After the return from **B**'s investment is realized, total assets in the economy are equal to A, which depends on the (stochastic) return of the risky asset and its weight x (chosen by **B**). If $A - D \geq 0$, **E** cash out their deposits D and borrow $A - D$ to invest in a non-stochastic production technology with return f. At this stage bankers do not have access to additional investment opportunities and therefore are indifferent between lending $A - D$ at a zero interest rate or storing it. We assume they lend it.

In line with existing literature, we assume that a banking crisis takes place when losses exceed a certain threshold (see, e.g., Diamond and Rajan, 2000) and that its associated cost is proportional to the extent to which banks are 'in the hole'—i.e., the losses in deposits. Specifically, we assume that when $A - D < 0$ the economy experiences a banking crisis, whose cost of resolution is $c(D - A)$, with per unit-cost $c > 0$.[10]

Finally, production takes place and yields $(1 + f)A$. If $A - D \geq 0$, **E** repays the loan to the bank and both **E** and **B** consume their assets—respectively, $A(1 + f) - (A - D)$ and $A - D$. If instead $A - D < 0$, **E** consumes its production after payment of the resolution cost: $(1 + f)A - c(D - A)$ and **B** is left with no consumption goods. The limited liability for banks creates an incentive for excess risk-taking and is the source of the classic regulatory problem (see, e.g., Bhattacharya et al. 1998, for a review of the literature).

To summarize, the economic stage proceeds as follows:

I. **B** receives D from **E**, allocates $K + D = 1$ across risky (share x) and safe asset (share $1 - x$).

[10]Abstracting from deposit insurance and the role of government is without substantial loss of generality. A model with insured deposits would yield similar findings as long as banking failure are associated with welfare costs.

II. Returns are realized and **B** obtain A. **E** employ A in the production technology.

III. Production takes place, $A(1+f)$ becomes available, and **E** consume it net of the resolution cost or the repayment of banking loans.

Financial investments At the beginning of the first stage, banks have access to both a safe asset with unitary return and a risky asset. The risky asset yield a positive return in normal times (return $1+\alpha$) and a negative return during a recession. We assume that the probability of a recession is q. Hence, **B**'s assets at the end the second stage are either $A = 1 + x\alpha$ or $A = 1 - x\zeta$. We assume that the size of the loss, ζ is ex ante uncertain to voters. Specifically, ζ can be either high—the bad state $\zeta = \zeta_b$—with probability ϕ, or low—the good state $\zeta = \zeta_g$—with probability $1-\phi$. The parameter ϕ captures the public's sentiment about the fragility of the financial system, with larger values of ϕ reflecting a more pessimistic stance.[11] One can interpret q as being the sentiment about the state of the economy, and ϕ the sentiment about the financial sector. Since our model focuses on financial regulation, and since, as we will show, the magnitude of risk taking allowed by the regulator will be determined ζ and not q, the word "sentiment" will henceforth refer to ϕ for simplicity, unless stated otherwise.

Both bankers and entrepreneurs care about their final consumption. Each banker obtains

$$u^B(x) = \max\{A - D, 0\}$$

and each entrepreneur obtains

$$u^E(x) = A(1+f) - \max\{A - D, c(D - A)\}.$$

Substituting for A and using the fact that $D = 1 - K$, we obtain the following expected utilities:

$$u^B(x;\zeta) = (1-q)(x\alpha + K) + q\max\{K - x\zeta, 0\} \tag{1}$$

$$u^E(x;\zeta) = (1-q)(f(1+x\alpha) + 1 - K) + q\Big[(1+f)(1-x\zeta) - \max\{K - x\zeta, c(x\zeta - K)\}\Big] \tag{2}$$

To ensure a role for financial regulation, we make the following assumption:

[11] Our results do not require (but can accommodate) an incorrect risk assessments by the public.

Assumption 1 *i. Loss can wipe out equity:* $\zeta_g > K$.

ii. Moral hazard problem in financial intermediation:

$$\alpha \in \left(\frac{q}{1-q}\zeta_b,\ \frac{q}{1-q}\zeta_g \frac{1+f+c}{1+f} \right). \tag{3}$$

Assumption 1.*i* implies that a government bailout might be necessary. Assumption 1.*ii* implies that under both values of ζ, the banker's preferred level of exposure exceeds the entrepreneur's.[12]

3.2 The Electoral Stage

Prior to the economic stage, an incumbent I chooses regulation before facing a challenger C in an election. A politician either be competent ($t = c$) or incompetent ($t = n$). For simplicity, we assume that before choosing regulation, a competent incumbent observes a fully informative signal about the state ζ and an incompetent type receives a fully uninformative signal. Both incumbent and challenger's types are privately observed and it is common knowledge that the ex-ante probability of a competent type is μ_0.

Let $V^W(x, \overline{x}; \zeta)$ denote the utilitarian social welfare function under state ζ, regulation $\overline{x}$ and chosen risk profile $x \leq \overline{x}$. We assume that the incumbent cares about societal welfare as well as holding office. Her payoff is given by

$$u^I(x, \overline{x}; \zeta) = \begin{cases} 1 + \lambda V^W(x, \overline{x}; \zeta) & \text{if re-elected} \\ \lambda V^W(x, \overline{x}; \zeta) & \text{otherwise} \end{cases}$$

The parameter $\lambda > 0$ captures the extent to which politicians care about societal welfare relative to reelection concerns. [13]

Each citizen can either vote for the incumbent or for a challenger of expected competence μ_0. While an untried challenger has a probability μ_0 of being competent, the voter conditions her assessment of the incumbent on his implemented regulation: $\mu_I(\overline{x}) = \Pr(t_I = c|\overline{x})$.

To focus on the incumbent's career concerns, we assume that each citizen votes based on (i) her partisan affinity and (ii) her conjecture about the incumbent's competence.[14] Specifically, we

[12]Expression 3 requires that c is large enough: $(1 + f)(\zeta_b - \zeta_g) < c\zeta_g$.

[13]In practice, λ is affected by an array of factors affecting policy-makers' incentives. Examples include the extent to which institutions insulate politicians from special interests, as well as the extent to which political parties can force office-holders to internalize the long term consequences of policy-making, as well individual legacy concerns.

[14]This is equivalent to assuming that ownership in the entrepreneurial sector is diffused enough relative

assume that each voter j is characterized by a degree of partisan affinity for the challenger θ_j, distributed according to a cdf F with median θ_m. The net payoff to citizen j of voting for the incumbent equals

$$\mu_I(\overline{x}) - \mu_0 - \chi\theta_j.$$

θ_j captures, among other things, the relative popularity of the challenger's policy positions on positional issues such as abortion, redistribution, and religious freedom. The parameter χ captures the relative importance of these considerations relative to competence. Since higher values of χ correspond to societies that are more ideologically polarized, we refer to χ as (mass) polarization.

Under the assumptions, all voters with affinity below $\frac{\mu_I(\overline{x})-\mu_0}{\chi}$ vote for the incumbent, whose vote share is then equal to $\int_{-\infty}^{\frac{\mu_I(\overline{x})-\mu_0}{\chi}} dF(z)$.

Finally, we assume that when choosing regulation the incumbent is not fully able to anticipate the average popularity of the incumbent's positions: from his perspective, the median affinity θ_m is drawn from a uniform distribution. For simplicity, we assume that uniform distribution has a support $[-1/2, 1/2]$ and accordingly, impose $\chi \geq 2$ to ensure an upper bound of 1 on re-election probability.[15] As a result, the incumbent's winning probability equals to

$$\pi(\overline{x}) = \Pr\left(\theta_m \leq \frac{\mu_I(\overline{x}) - \mu_0}{\chi}\right) = \frac{1}{2} + \frac{\mu_I(\overline{x}) - \mu_0}{\chi}. \tag{4}$$

To summarize, the timing of the game is as follows:

I. Nature draws the state $\zeta \in \{\zeta_g, \zeta_b\}$, and the incumbent's and challenger's types

II. The incumbent chooses a level of regulation $\overline{x}$, which is publicly observed

III. θ_m is realized

IV. Each citizen makes her voting decision

V. The economic stage takes place

VI. Payoffs are realized and the game ends

A mixed strategy is a tuple $\{\sigma_b^c, \sigma_g^c, \sigma^n\} \in \Delta[0,1]^3$, where $\sigma_b^c(\overline{x})$ is the probability that a competent type who learned that the state is ζ_b chooses regulation level $\overline{x}$. Similarly, we denote by $\{\overline{x}_b^c, \overline{x}_g^c, \overline{x}^n\}$

to the banking sector.

[15]The normalization of the support is immaterial to our results.

the corresponding pure strategies. Our equilibrium concept is Perfect Bayesian Equilibrium. We further restrict to assessments that (i) satisfy D1 (Banks and Sobel, 1987), and (ii) within each category—pooling ($\sigma_b^c = \sigma_g^c = \sigma^n$), separating ($\{Supp(\sigma_b^c) \cup Supp(\sigma_g^c)\} \cap Supp(\sigma^n) = \emptyset$), semi-separating—maximize societal welfare.

4 Analysis

4.1 Financial Regulation

Lemma 1 *The bankers' optimal level of exposure is the largest allowed:*

$$\text{argmax}_{x\in[0,\overline{x}]} u^B(x) = \overline{x}$$

Using the expected utilities derived in equations (1) and (2), we can construct $V^B(\overline{x}, \zeta)$ and $V^E(\overline{x}, \zeta)$, the indirect utilities of E and B as a function of regulation, and $V^W(\overline{x}, \zeta) = V^E(\overline{x}, \zeta) + V^B(\overline{x}, \zeta)$, the utilitarian social welfare function:

$$V^B(\overline{x}, \zeta) = (1-q)(\overline{x}\alpha + K) + q \max\{K - \overline{x}\zeta, 0\}$$

$$V^E(\overline{x}, \zeta) = (1-q)(f(1+\overline{x}\alpha) + D) + q\Big[(1+f)(1-\overline{x}\zeta) - \max\{K - \overline{x}\zeta, c(\overline{x}\zeta - K)\}\Big]$$

$$V^W(\overline{x}, \zeta) = (1-q)(1+f)(1+\overline{x}\alpha) + q\Big[(1+f)(1-\overline{x}\zeta) - \max\{0, c(\overline{x}\zeta - K)\}\Big]$$

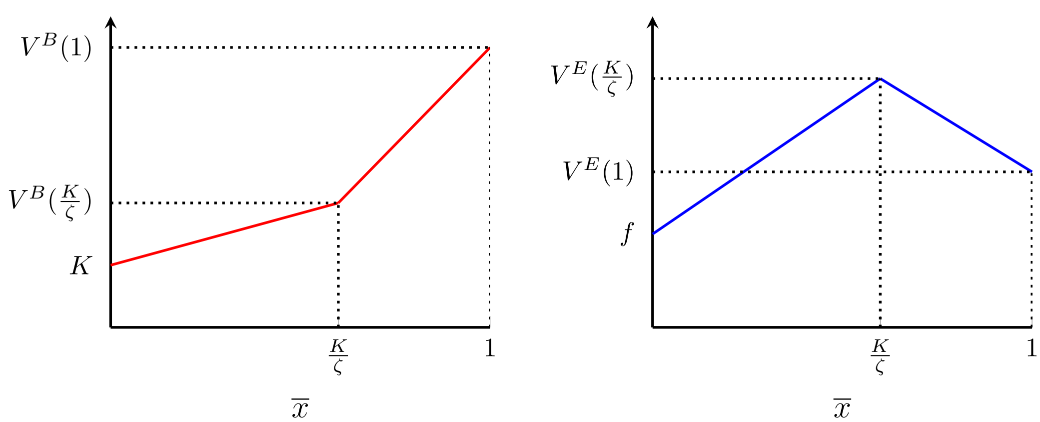

Figure 2: The indirect utility of B and E.

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Notice that

$$\frac{\partial V^E}{\partial \overline{x}} = \begin{cases} f((1-q)\alpha - q\zeta) & \text{if } \overline{x} < \frac{K}{\zeta} \\ f((1-q)\alpha - q\zeta) - q\zeta(1+c) & \text{if } \overline{x} > \frac{K}{\zeta} \end{cases}$$

By Assumption 1.ii, $(1-q)\alpha - q\zeta \geq (1-q)\alpha - q\zeta_b > 0$ and $f(1-q)\alpha - q\zeta(1+c+f) < 0$. As a consequence, $\frac{K}{\zeta}$ is the preferred regulation of the entrepreneurs. Due to limited liability, bankers prefer no regulation at all ($\overline{x} = 1$) regardless of the state: $\frac{\partial V^B}{\partial \overline{x}} \geq (1-q)\alpha - q\zeta > 0$. Moreover,

$$\frac{\partial V^W}{\partial \overline{x}} = \begin{cases} (1+f)((1-q)\alpha - q\zeta) & \text{if } \overline{x} < \frac{K}{\zeta} \\ (1+f)((1-q)\alpha - q\zeta) - cq\zeta & \text{if } \overline{x} > \frac{K}{\zeta} \end{cases}$$

Again, Assumption 1.ii implies that $V^W(\overline{x};\zeta)$ is increasing when $\overline{x} < \frac{K}{\zeta}$ and decreasing when $\overline{x} > \frac{K}{\zeta}$. As a result, the welfare-maximizing level of regulation (which coincides with the entrepreneurs') ensures that no bailout is necessary without imposing additional choking on the economy. We record this observation as a Lemma.

Lemma 2 *The socially optimal level of regulation is given by* $\overline{x}_i^* = \frac{K}{\zeta_i}$ *for* $i = \{b, g\}$.

Intuitively, the social cost of a financial crisis is convex in regulation: zero as long as $K - \overline{x}\zeta \geq 0$, when bank capital can absorb losses, and strictly increasing otherwise. As a result, the *ex-ante* socially optimal regulation (i.e., absent the knowledge of the state) takes a bang-bang form:

Lemma 3 *There exists* $\underline{\phi}$ *such that*

$$\overline{x}^e = \arg\max \mathbb{E}\{V^W(\overline{x};\zeta)\} = \begin{cases} \overline{x}_g^* & \text{if } \phi \leq \underline{\phi} \\ \overline{x}_b^* & \text{otherwise} \end{cases}$$

In words, there exists a threshold for the probability of a bad state at which regulation discretely tightens, going from $\overline{x}_g^*$ to $\overline{x}_b^* < \overline{x}_g^*$). For convenience, we will say that agents have a positive sentiment when $\phi \leq \underline{\phi}$ and negative outlook otherwise. Notice that, in the absence of electoral incentives, an incompetent incumbent would choose $\overline{x}^e$ and a competent one would choose $\overline{x}_g^*$ under a good state and $\overline{x}_b^*$ under a bad state. This strategy profile constitutes a *constrained optimum*: each incumbent chooses the socially optimal level of regulation conditional on her information. Since incumbents also care about electoral incentives, the question is whether this strategy profile can be part of an equilibrium.

4.2 Policy making

After having described the agents' intrinsic preferences over regulation, we study how electoral incentives shape the incumbents' choice of regulation. While both types of politicians, the competent (c-type) and non-competent (n-type), care about societal welfare, the presence of office benefits can potentially lead to deviation from optimal policy if doing so achieves a higher chance of re-election. We will show that, since the c-type observes the state of nature, she can afford to implement more extreme policies to credibly separate herself from the n-type. We formalize this discussion below and explore possible equilibria of this signaling game.

We begin with a technical Lemma, which establishes that the social value of deregulating is higher when the downside risk is lower.

Lemma 4 *The function V^W has increasing differences in $(\overline{x}, -\zeta)$. For $x' > x$ and $\zeta' > \zeta$ we have:*

$$V^W(x';\zeta) - V^W(x;\zeta) > V^W(x';\zeta') - V^W(x;\zeta')$$

Lemma 4 implies that:

$$V^W(x';\zeta_g) - V^W(x;\zeta_g) > \mathbb{E}\{V^W(x';\zeta)\} - \mathbb{E}\{V^W(x;\zeta)\} > V^W(x';\zeta_b) - V^W(x;\zeta_b)$$

As a result, the expected loss in welfare from deregulating beyond $\overline{x}_g^*$ is higher than the actual loss when the state of nature is known to be good, $\zeta = \zeta_g$. Similarly, the expected welfare loss from over-regulating below $\overline{x}_b^*$ is larger than the actual loss from over-regulating when the state of nature is known to be ζ_b.

4.2.1 Incumbents' incentives

Before discussing equilibria, it is useful to examine the incentive compatibility constraints for the c-type and n-type. We first look at the case in which the outlook matches the state of the nature, specifically, and without loss of generality, when the outlook is positive ($\phi \leq \underline{\phi}$) and the state of the nature is good ($\zeta = \zeta_g$). In that case the utility of the c-type for choosing the ex post optimal regulation is given by:

$$\begin{aligned} u_c^I(\overline{x}_g^*;\zeta_g) &= \pi(\overline{x}_g^*) + \lambda V^W(\overline{x}_g^*;\zeta_g) \\ &= \frac{1}{2} + \frac{\hat{\mu} - \mu_0}{\chi} + \lambda V^W(\overline{x}_g^*;\zeta_g) \end{aligned}$$

where $\hat{\mu} = \mu(\overline{x}_g^*)$. The c-type is willing to deviate to an $\overline{x}'$ for which $\mu(\overline{x}') = 1$ as long as:

$$u_c^I(\overline{x}'; \zeta_g) \geq u_c^I(\overline{x}_g^*; \zeta)$$
$$V^W(\overline{x}_g^*; \zeta_g) - V^W(\overline{x}'; \zeta_g) \leq \frac{1-\hat{\mu}}{\chi\lambda}$$

In words, the deviation should be such that the marginal loss of welfare is smaller than the marginal expected electoral gain adjusted by the relative weight of office benefits in the utility function, λ. Since $V^W(\overline{x}; \zeta)$ is strictly quasi-concave there exist *at most* two levels of regulations $\overline{x}_{min}^c \leq \overline{x}_{max}^c$ at which:

$$V^W(\overline{x}_g^*; \zeta_g) - V^W(\overline{x}'; \zeta_g) = \frac{1-\hat{\mu}}{\chi\lambda} \tag{5}$$

At these points the c-type reaches the the maximum inefficiency that she is willing to impose on the economy to be perceived as competent with certainty. Similarly an n-type is willing to deviate to $\overline{x}'$ as long as:

$$\mathbb{E}V^W(\overline{x}^e; \zeta) - \mathbb{E}V^W(\overline{x}'; \zeta) \leq \frac{1-\hat{\mu}}{\chi\lambda} \tag{6}$$

It follows from Lemma 4 that $\overline{x}_{max}^c$ does not satisfy the incentive compatibility constraint of the n-type. Therefore the c-type is able to implement a policy to separate herself from the n-type. By a similar logic, when the outlook is negative ($\phi > \underline{\phi}$) and the state of the nature is bad ($\zeta = \zeta_b$) the c-type is also able to separate at a level $\overline{x}_{min}^c < \overline{x}_b^*$ that does not satisfy the n-type incentive compatibility constraint.

However, the c-type does not need to implement such extreme policies $\{\overline{x}_{min}^c, \overline{x}_{max}^c\}$ to send a credible signal of competence. Doing so is inefficient (Pareto sub-optimal) since all agents would be better off if she separates herself at a smaller deviation from the optimal regulation. All she has to do is to play the least costly strategy that the n-type will not imitate. It will become clear below that the D1 refinement (Cho and Kreps, 1987) rules out such inefficient behavior and restricts the set of possible equilibria to those where players spend the least amount of resources to separate themselves (sometimes referred to as Riley outcome, after Riley, 1979). As a result, what is relevant for our analysis is the feasibility set of the n-type, $[\overline{x}_{min}^n \overline{x}_{max}^n]$. Since the remainder of the paper focuses on the n-type's constraints, and to simplify notation, we drop the n and simply refer to the n-type's indifference points as $\{\overline{x}_{min}, \overline{x}_{max}\}$. Let

$$R(\overline{x}) \equiv \mathbb{E}\{V^W(\overline{x}^e; \zeta)\} - \mathbb{E}\{V^W(\overline{x}; \zeta)\} - \frac{1}{\chi\lambda} \tag{7}$$

denote the maximal gain associated with regulation $\overline{x}$.

Lemma 5 $R(\overline{x}) = 0$ *admits two interior roots* $0 < \overline{x}^n_{min} < \overline{x}^n_{max} < 1$ *when office benefits are not exceedingly high, specifically:*

$$\frac{1}{\lambda\chi} < \left(\mathbb{E}\{V^W(\overline{x}^e;\zeta)\} - \max\{\mathbb{E}\{V^W(1;\zeta)\}, \mathbb{E}\{V^W(0;\zeta)\}\}\right\} \tag{8}$$

Note that $\frac{1}{\lambda\chi}$ is the maximum utility derived from signalling financial competence. When such benefits exceed a certain threshold, politicians are willing to fully regulate or deregulate the economy in order to remain in office. Going forward we assume that the condition in Lemma 5 are met, ruling out extreme preferences.

We illustrated how the c-type can send a credible signal when the outlook is in line with the state of the world but did not yet consider cases in which the state of the world and the outlook are at odds with each other (e.g., $\phi \leq \underline{\phi}$ but $\zeta = \zeta_b$). In that case it would appear possible for the c-type to separate herself while choosing the *ex post* optimal regulation. For example, as $\phi \to 0$, $\overline{x}^*_b$ becomes more and more costly for the n-type. The following lemma establishes the conditions under which $\overline{x}^*_i$ falls outside $[\overline{x}_{min}\ \overline{x}_{max}]$.

Lemma 6 *There exist* ϕ^l *and* ϕ^h *with* $\phi^l < \underline{\phi} < \phi^h$ *such that:*

1. *When* $\phi < \phi^l$, $\overline{x}^*_b \notin S^n(\phi)$
2. *When* $\phi \in [\phi^l, \phi^h]$, $\overline{x}^*_b \in S^n(\phi)$ *and* $\overline{x}^*_g \in S^n(\phi)$
3. *When* $\phi > \phi^h$, $\overline{x}^*_g \notin S^n(\phi)$

Where $S^n(\phi) = \{\overline{x} \in [0,1] \mid R(\overline{x}) \leq 0\}$ *is the feasibility set based on the n-type constraints.*

This result is driven by the fact that when the outlook is exceedingly good (bad) the bad-state (good-state) optimal regulation makes the n-type strictly worse off, irrespective of its electoral benefits, due to its large expected welfare cost.

4.2.2 Equilibrium Behavior

Lemma 7 *(i) The constrained optimum cannot be supported as an equilibrium outcome satisfying the D1 refinement.*

(ii) No pooling strategy profile can be supported as an equilibrium satisfying the D1 refinement.

The intuition behind this finding is as follows. For the constrained optimum to be supported as an equilibrium, voters' beliefs on off-the-equilibrium play must disincentive deviation by either player. Therefore, the voter must place a lower probability of the incumbent being competent when observing a level of regulation outside $[\overline{x}_b^*, \overline{x}_g^*]$. However such beliefs are unreasonable since the c-type is much more willing to regulate outside such boundaries for a given reelection probability. Therefore, the D1 refinement requires voters to believe that the incumbent is competent when observing such levels of regulation, which would lead the c-type to deviate, ruling out the constrained optimum as an equilibrium outcome. The same intuition applies all other pooling strategies.

The following lemma establishes the existence of a separating equilibrium that satisfied D1.

Proposition 1 *In the welfare-maximizing D1-robust separating equilibrium, the n-type chooses the ex-ante optimal policy and the c-type either over-regulates, under-regulates, or both:*

$$\sigma^n(\overline{x}^e) = 1 \tag{9}$$

$$\sigma_b^c(\overline{x}_b^*) = \mathbf{1}\{\phi \leq \phi^l\} \quad \sigma_b^c(\overline{x}_{\min}) = \mathbf{1}\{\phi > \phi^l\} \tag{10}$$

$$\sigma_g^c(\overline{x}_{\max}) = \mathbf{1}\{\phi < \phi^h\} \quad \sigma_g^c(\overline{x}_g^*) = \mathbf{1}\{\phi \geq \phi^h\} \tag{11}$$

with $\overline{x}_{\min} < \overline{x}_b^* < \overline{x}_b^* < \overline{x}_{\max}$.

In words, Proposition 1 implies that in the welfare-maximizing separating equilibrium, the non-competent type chooses the ex-ante optimal level of regulation. Depending on public sentiment, the competent type will either over-regulate under the bad state, under-regulate in the good state, or both. The competent type will chose the *ex post* optimal regulation when the public is sufficiently optimistic (pessimistic) when the state of nature is bad (good).

The existence of this separating equilibrium hinges on the assumption for Lemma 5 being satisfied. That is, the utility from signaling competence is not exceedingly high to trump concerns about voter welfare.

4.3 Voter Sentiment

We have seen from Proposition 1 that voters' expectations about financial fragility (ϕ) determine the type of equilibrium outcome, i.e., whether the c-type would choose to over or under regulate. From the proof of Proposition 1 we also see that ϕ also has a bearing on the level of over- and under- regulation. In what follows we explore the direct relation between ϕ and the c-type strategy. Similarly, we explore the relation between the probability of a recession (q) and the level of regulation at the equilibirum.

Lemma 8 *In a separating equilibrium, the competent type's regulation in good times, $\overline{x}_g^c(\phi)$, and in bad times, $\overline{x}_b^c(\phi)$, are decreasing for all ϕ in $[0, \phi^h]$ and $[\phi^l, 1]$, respectively.*

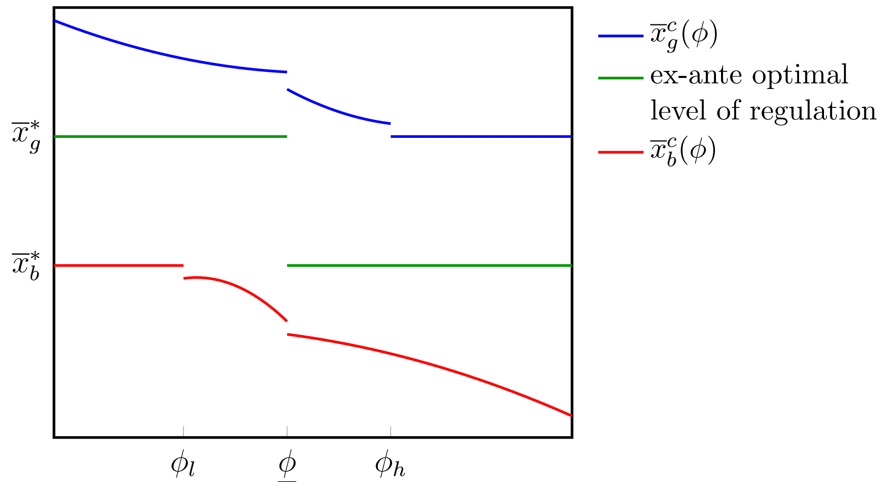


Figure 3: The welfare-maximizing separating equilibrium.

Figure 3 illustrates the relation between $\overline{x}_c$ and ϕ that is established in Lemma 8. We see that ϕ determines whether the c-type would deviate from the ex-post optimal regulation, and the extent to which she deviates. For example, when the state of nature is good, the c-type would choose the ex-post optimal level of regulation when voter sentiment is very negative ($\phi > \phi^h$), but that that she would increasingly under-regulate as sentiment improves. The intuition behind this pattern is simple: the larger (small) is ϕ, the more (less) difficult for the n-type to imitate the play of a c-type operating under a good state, and therefore the less (more) the c-type needs to deviate from optimal policy to separate herself.

Lemma 9 *In a separating equilibirum:*

1. *$\underline{\phi}$, ϕ^l, and ϕ^h are all decreasing in q. And $(\phi^h - \underline{\phi}) = (\underline{\phi} - \phi^l)$ is also decreasing in q.*

2. *In a separating equilibrium, the competent type's regulation in good times, $\overline{x}_g^c(\phi)$, and in bad times, $\overline{x}_b^c(\phi)$, are decreasing in q.*

It follows from the first statement in Lemma 9 that the perceived probability of a recession affect the frequency of over- and under- regulation. This can been seen from Figure 3. Since $\underline{\phi}$ and $(\phi^h - \underline{\phi})$ are decreasing in q an increase in q makes under-regulation under the good state less likely. That is, under-regulation happens from a smaller set of ϕ. However it makes over-regulation under the bad state more likely. The second statement in Lemma 9 implies that q affect the extent to which the c-type over- or under- regulate in equilibrium. This result is similar to what have been shown in Lemma 8 and has a similar interpretation: The larger (small) is q, the more (less) difficult for the n-type to imitate the play of a c-type operating under a good state, and therefore the less (more) the c-type needs to deviate from optimal policy to separate herself.

4.4 Discussion

In our model, the optimal-ex-ante regulation is aligned with the voter's prior about the size of the loss, and is one of the two ex-post optimal ones: when the voter is optimistic ($\phi \leq \underline{\phi}$) the ex-ante optimal regulation coincides with the optimal regulation under the good state ($\overline{x}_g^*$); when the voter is pessimistic ($\phi > \underline{\phi}$), the ex-ante optimal regulation coincides with the optimal regulation under the bad state ($\overline{x}_b^*$).

In the absence of electoral competition, a competent politician, who observes the state of the world, can increase welfare by choosing the ex-post level of regulation. Had politicians been equally competent (or non-competent) the chosen level of regulation would coincide with the ex-post (ex-ante) optimal level of regulation.

In our model, over-regulation and under-regulation arise due to the presence of a financially non-competent politician. The presence of incompetency, in the presence of office benefits, creates an incentive for the competent one to signal her competence. We have shown how the incentive compatibility constraints are such that the competent type is willing to implement more extreme levels of regulations.

When the realization of the state *goes against* voters' prior, it is easier for the competent type to separate from the non-competent one precisely because the latter is more reluctant to deviate from optimal ex-ante policy (indeed, when $\phi \notin [\phi^l, \phi^h]$, the c-type can choose the ex-post optimal regulation without fear of being imitated by the n-type). However, when the state *confirms* the voter's prior, the competent type cannot distinguish herself from the non-competent type by choosing the ex-post optimal regulation. As long as she does care about reelection ($\lambda \neq \infty$) she has always an incentive to 'overshoot' regulation in order to signal confidence in his expertise.

While the presence of office benefits is a requirement for any such signalling, we have also shown that the ability of the competent type to be able to signal her competence hinges on the assumption that politicians care to some extent about social welfare (λ is large enough) and that financial competence is not is not a guarantee for reelection, due to polarization (χ is large enough), or in other words, the presence of other electoral considerations. When the marginal benefit of signaling competence is very large ($\chi\lambda$ is small), the non-competent type has no restraints in terms of deviating from ex-ante optimal policy, and therefore separation cannot exist.

As long as these conditions hold, we have shown that there exist a separating equilibrium in which the competent type will always chose an optimal policy that differ from the ex-ante optimal policy. When the state *confirms* the voter's prior, she will over-regulate in bad times and under-regulate in good time. When the realization of the state *goes against* voters' prior, the competent type would either chose the ex-post optimal regulation or over- and under- regulate. The latter will take place when voters' prior is sufficiently close to the indifference point between the two ex-ante optimal regulation levels.

How much does the competent type deviates from ex-post optimal regulation? Section 4.3. explores how changes in ϕ and q affect the equilibirum outcome. As we discussed earlier, both ϕ and q can be characterized as being related to sentiment. The first being about financial fragility (determining the size of losses during recession) while the second relates to the frequency of losses (probability of recession). We have chosen to describe the equilibirum with respect to ϕ for several reasons. First, financial regulation is determined by the losses in bad times and not by the risk of recession. Second, we find it more reasonable that a competent type would have an informational advantage on financial risk as opposed to the probability of recession. Third, we argue that the wide swings in voter sentiment around boom-bust episode is better described by the characteristics of the financial innovation itself rather than sudden large changes in the risk of recession.

Lemma 8 shows that the extent of under-regulation (when the state of nature is good) increases with optimism about financial conditions. Similarly, the extent of over-regulation (when the state of nature is bad) increases with voters' pessimism about financial conditions. Lemma 9 shows that optimism about the state of the economy (a low risk of recession) also goes in the same direction as optimism about financial conditions. Taken together these results imply that the model would generate the highest level of over-shooting when sentiment is extreme. As discussed in Section 2, extreme optimism and pessimism are a predominant feature of financial booms and busts. Our model is able to rationalize the fact that such periods of massive regulatory changes are infrequent and do not happen at the business cycle frequency.

For example, in the case of the US we discussed two major deregulation-regulation cycles over the last century. These episodes, the 1920s and the the late 1990s and early 2000s, were periods marked with high degree of optimism about both economic growth and financial innovation. These two episodes share many similarities which are discussed in the literature (White, 2006). The most notable regulatory cycles happened in the United States, the United Kingdom, and Japan. These countries stand out for having experienced periods of prolonged high economic growth couple with a high level of financial innovation.

In our model, regulatory cycles are contingent on the existence of office benefits in moderate levels. To the extent that low corruption reflect preferences tilted toward benevolence by politicians, or the absence of office benefits, our model can also rationalize the lack of major regulatory cycles in countries with very low corruption levels. For example, the boom-bust financial cycles in the Nordic countries stand out as being one of the few boom-bust cycles that did not feature excessive level of deregulation or re-regulation.

5 Conclusion

For centuries, financial regulation has been notably procyclical. We reviewed evidence of political forces behind such large swings in regulations. Our model has shown that such behavior can be arise in the context of a simple model of financial regulation nested in a standard signaling model of electoral competition. The literature on the political economy of financial regulation highlight the complex nature of the forces that shape regulations over time. Therefore, we consider this research as a first step toward a better understanding of such relationships.

Appendix

Lemma 1. *The bankers' optimal level of exposure is the largest allowed:*

$$\arg\max_{x\in[0,\overline{x}]} U^B(x) = \overline{x}.$$

Proof. The bankers are solving $\max_{0\leq x\leq \overline{x}} \big\{(x\alpha + K)(1-q) + q \max\{K - x\zeta, 0\}\big\}$. When $K \leq x\zeta$, $U^B(x) = (x\alpha + K)(1-q)$, which is strictly increasing in x. When instead $K > x\zeta$, we have $U^B(x) = x((1-q)\alpha - q\zeta) + K$, which is again increasing in x by Assumption 1.ii. ■

Lemma 3. *There exists $\underline{\phi}$ such that*

$$\overline{x}^e = \arg\max \mathbb{E}\{V^W(\overline{x};\zeta)\} = \begin{cases} \overline{x}_g^* & \textit{if } \phi \leq \underline{\phi} \\ \overline{x}_b^* & \textit{otherwise.} \end{cases}$$

Proof. Notice that

$$\mathbb{E}\{V^W(\overline{x};\zeta)\} = (1-q)(1+f)(1+\overline{x}\alpha) + q\Big[(1+f)(1-\overline{x}\phi\zeta_b + \overline{x}(1-\phi)\zeta_g)\Big] - q\Big[\phi \max\{0, c(\overline{x}\zeta_b - K)\} + (1-\phi)\max\{0, c(\overline{x}\zeta_g - K)\}\Big]$$

First, when $\overline{x} > \frac{K}{\zeta_g}$

$$\begin{aligned} \frac{\partial\, \mathbb{E}\{V^W(\overline{x};\zeta)\}}{\partial \overline{x}} &= (1+f)[(1-q)\alpha - q(\phi\zeta_b + (1-\phi)\zeta_g)] - cq(\phi\zeta_b + (1-\phi)\zeta_g) \\ &< (1+f)((1-q)\alpha - q\zeta_g) - cq\zeta_g < 0 \end{aligned}$$

where the first inequality follows from the fact that $\zeta_g < \zeta_b$ and second inequality follows from Assumption 1.ii. Thus, $\mathbb{E}\{V^W(\overline{x};\zeta)\}$ is a decreasing linear function of $\overline{x}$ in the interval $\Big[\frac{K}{\zeta_g}, 1\Big]$. Second, when $\overline{x} < \frac{K}{\zeta_b}$ we have

$$\begin{aligned} \frac{\partial\, \mathbb{E}\{V^W(\overline{x};\zeta)\}}{\partial \overline{x}} &= (1+f)[(1-q)\alpha - q(\phi\zeta_b + (1-\phi)\zeta_g)] \\ &> (1+f)((1-q)\alpha - q\zeta_b) > 0 \end{aligned}$$

where, again the first inequality follows from $\zeta_b > \zeta_g$ and the second from Assumption 1.ii. Hence, the socially optimal regulation must be in the interval $\Big[\frac{K}{\zeta_b}, \frac{K}{\zeta_g}\Big]$.

Finally, when $\frac{K}{\zeta_b} < \overline{x} < \frac{K}{\zeta_g}$ we show that $\mathbb{E}\{V^W(\overline{x};\zeta)\}$ is linear and continuous. Moreover:

$$\frac{\partial\ \mathbb{E}\{V^W(\overline{x};\zeta)\}}{\partial \overline{x}} = (1+f)[(1-q)\alpha - q(\phi\zeta_b + (1-\phi)\zeta_g)] - \phi c q \zeta_b$$

We define $\underline{\phi}$ as the unique root of the derivative above:

$$\frac{\partial\ \mathbb{E}\{V^W(\overline{x};\zeta)\}}{\partial \overline{x}} = 0 \implies \underline{\phi} = \frac{(1+f)[(1-q)\alpha - q\zeta_g]}{(1+f)q(\zeta_b - \zeta_g) + cq\zeta_b} \in (0,1)$$

Assumption 1 guarantees that $\underline{\phi} \in (0,1)$. Since the derivative is decreasing in ϕ we have

$$\phi < \underline{\phi} \quad \to \quad \frac{\partial\ \mathbb{E}\{V^W(\overline{x};\zeta)\}}{\partial \overline{x}} > 0$$
$$\phi > \underline{\phi} \quad \to \quad \frac{\partial\ \mathbb{E}\{V^W(\overline{x};\zeta)\}}{\partial \overline{x}} < 0$$

In the first case, $\phi < \underline{\phi}$, a utilitarian social planner is optimistic about the economy and prefers higher risk-taking (so lower regulation level), and hence $\overline{x}^*_g = \frac{K}{\zeta_g}$, while in the second case he prefers $\overline{x}^*_b = \frac{K}{\zeta_b}$ as he is pessimistic about state of the economy. ■

Lemma 4. *The function V^W has increasing differences in $(\overline{x}, -\zeta)$. For $x' > x$ and $\zeta' > \zeta$ we have:*

$$V^W(x';\zeta) - V^W(x;\zeta) > V^W(x';\zeta') - V^W(x;\zeta').$$

Proof. Note that V^W is the sum of three terms:

$$V^W = (1-q)(1+f)(1+\overline{x}\alpha) + q(1+f)(1-\overline{x}\zeta) - q\max\{0, c(\overline{x}\zeta - K)\}$$

The first term is independent of ζ. The second has strictly decreasing differences in $(\overline{x}, \zeta)$. Therefore it is sufficient to show that the third component is weakly decreasing in differences. We need to prove that:

$$\max\{0, c(\overline{x}'\zeta' - K)\} - \max\{0, c(\overline{x}\zeta' - K)\} \geq \max\{0, c(\overline{x}'\zeta - K)\} - \max\{0, c(\overline{x}\zeta - K)\}$$

It is immediate to see that this holds with equality if $\overline{x}'\zeta' \leq K$ (since all terms are reduced to zero) and with strict inequality for $\overline{x}\zeta > K$ (since $\overline{x}\zeta$ is increasing in differences). Therefore we have to only consider cases where $\overline{x}\zeta < K$ and $\overline{x}'\zeta' > K$. In which case it is clear that the inequality holds if either $\overline{x}\zeta' - K \leq 0$ or $\overline{x}'\zeta - K \leq 0$. Finally, when $\overline{x}\zeta' - K > 0$ and $\overline{x}'\zeta - K > 0$, the expression becomes $c\zeta'(\overline{x}' - \overline{x}) \geq c(\overline{x}'\zeta - K)$, which holds since $K > \overline{x}\zeta$ and $\zeta'(\overline{x}' - \overline{x}) > \zeta(\overline{x}' - \overline{x})$. This completes the proof. ■

Lemma 5 $R(\overline{x}) = 0$ admits two interior roots $0 < \overline{x}^n_{min} < \overline{x}^n_{max} < 1$ when office benefits are not exceedingly high, specifically:

$$\frac{1}{\lambda\chi} < \left(\mathbb{E}\{V^W(\overline{x}^e;\zeta)\} - \max\{\mathbb{E}\{V^W(1;\zeta)\}, \mathbb{E}\{V^W(0;\zeta)\}\}\right\} \tag{12}$$

Proof. For $\overline{x}$ to be a solution for $R(\overline{x}) = 0$ it must satisfy:

$$\mathbb{E}\{V^W(\overline{x};\zeta)\} = \mathbb{E}\{V^W(\overline{x}^e;\zeta)\} - \frac{1}{\lambda\chi} \tag{13}$$

We know that $\mathbb{E}\{V^W(\overline{x};\zeta)\}$ is maximized at $\overline{x}^e$, and is decreasing for all $\overline{x} < \overline{x}^e$ and $\overline{x} > \overline{x}^e$. Note that the RHS term in (13) is constant in $\overline{x}$ and can be represented by a straight line parallel to the x-axis in the $(V(x), x)$ plane. Therefore for $R(\overline{x})$ to admit two interior solutions in (0,1) we must have the RHS intersect with $\mathbb{E}\{V^W(\overline{x};\zeta)\}$ under $\mathbb{E}\{V^W(\overline{x}^e;\zeta)\}$ (which we know is true since $\lambda\chi > 0$), and above $\mathbb{E}\{V^W(0;\zeta)\}$ *and* $\mathbb{E}\{V^W(1;\zeta)\}$. Therefore condiiton (8) is sufficient for the existence of $0 < \overline{x}^n_{min}$ and $\overline{x}^n_{max}$ in the unit interval. ■

Lemma 6. *There exist ϕ^l and ϕ^h with $\phi^l < \underline{\phi} < \phi^h$ such that:*

1. *When $\phi < \phi^l$, $\overline{x}^*_b \notin S^n(\phi)$*
2. *When $\phi \in [\phi^l, \phi^h]$, $\overline{x}^*_b \in S^n(\phi)$ and $\overline{x}^*_g \in S^n(\phi)$*
3. *When $\phi > \phi^h$, $\overline{x}^*_g \notin S^n(\phi)$*

Where $S^n(\phi) = \{\overline{x} \in [0,1] \mid R(\overline{x}) \leq 0\}$ is the feasibility set based on the n-type constraints.

Proof. The proof proceeds in two steps:

Step 1. Finding ϕ for which $\overline{x}^*_b \in S^n(\phi)$.

We know that $\overline{x}^*_b \in S^n(\phi)$ for $\phi \geq \underline{\phi}$ since we have shown that in that case $\overline{x}^e = \overline{x}^*_b$. Therefore we restrict our attention to $\phi \leq \underline{\phi}$, in which case $\overline{x}^e = \overline{x}^*_g$. Then $\overline{x}^*_b \in S^n$ if:

$$\phi[V^W(\overline{x}^*_g, \zeta_b) - V^W(\overline{x}^*_b, \zeta_b)] + (1-\phi)[V^W(\overline{x}^*_g, \zeta_g) - V^W(\overline{x}^*_b, \zeta_g)] \leq \frac{1}{\lambda\chi}$$

The inequality can be re-written as:

$$\left\{ \begin{array}{c} [\overline{x}_g^* - \overline{x}_b^*](1+f)[\alpha(1-q) - q\phi\zeta_b - q(1-\phi)\zeta_g] \\ -q\phi[T^W(\overline{x}_g^*, \zeta_b) - T^W(\overline{x}_b^*, \zeta_b)] - q(1-\phi)[T^W(\overline{x}_g^*, \zeta_g) - T^W(\overline{x}_b^*, \zeta_g)] \end{array} \right\} \leq \frac{1}{\lambda\chi}$$

$$\Leftrightarrow \left\{ \begin{array}{c} \frac{K}{\zeta_g\zeta_b}(\zeta_b - \zeta_g)(1+f)[\alpha(1-q) - q\phi(\zeta_b - \zeta_g) - q\zeta_g] \\ -q\phi c\frac{K}{\zeta_g}(\zeta_b - \zeta_g) \end{array} \right\} \leq \frac{1}{\lambda\chi}$$

$$\Leftrightarrow (1+f)[\alpha(1-q) - q\zeta_g] - q\phi(1+f)(\zeta_b - \zeta_g) - q\phi c\zeta_b > \frac{\zeta_g\zeta_b}{\lambda\chi(\zeta_b - \zeta_g)K}$$

$$\Leftrightarrow \phi^l \equiv \underline{\phi} - \frac{\zeta_g\zeta_b}{\lambda\chi(\zeta_b - \zeta_g)K[q(1+f)(\zeta_b - \zeta_g) + qc\zeta_b]} \leq \phi$$

Step 2. Finding ϕ for which $\overline{x}_g^* \in S^n(\phi)$.

We proceed through similar steps restricting our attention to $\phi > \underline{\phi}$, in which case $\overline{x}^e = \overline{x}_b^*$. Then $\overline{x}_g^* \in S^n$ if:

$$\phi[V^W(\overline{x}_b^*, \zeta_b) - V^W(\overline{x}_g^*, \zeta_b)] + (1-\phi)[V^W(\overline{x}_b^*, \zeta_g) - V^W(\overline{x}_g^*, \zeta_g)] \leq \frac{1}{\lambda\chi}$$

$$\Leftrightarrow \left\{ \begin{array}{c} -[\overline{x}_g^* - \overline{x}_b^*](1+f)[\alpha(1-q) - q\phi\zeta_b - q(1-\phi)\zeta_g] \\ -q\phi[T^W(\overline{x}_b^*, \zeta_b) - T^W(\overline{x}_g^*, \zeta_b)] - q(1-\phi)[T^W(\overline{x}_b^*, \zeta_g) - T^W(\overline{x}_g^*, \zeta_g)] \end{array} \right\} \leq \frac{1}{\lambda\chi}$$

$$\Leftrightarrow \left\{ \begin{array}{c} -\frac{K}{\zeta_g\zeta_b}(\zeta_b - \zeta_g)(1+f)[\alpha(1-q) - q\phi(\zeta_b - \zeta_g) - q\zeta_g] \\ +q\phi c\frac{K}{\zeta_g}(\zeta_b - \zeta_g) \end{array} \right\} \leq \frac{1}{\lambda\chi}$$

$$\Leftrightarrow -(1+f)[\alpha(1-q) - q\zeta_g] + q\phi(1+f)(\zeta_b - \zeta_g) + q\phi c\zeta_b \leq \frac{\zeta_g\zeta_b}{\lambda\chi(\zeta_b - \zeta_g)K}$$

$$\Leftrightarrow \phi^h \equiv \underline{\phi} + \frac{\zeta_g\zeta_b}{\lambda\chi(\zeta_b - \zeta_g)K[q(1+f)(\zeta_b - \zeta_g) + qc\zeta_b]} \geq \phi$$

This completes the proof. ■

Lemma 7. *The constrained optimum cannot be supported as an equilibrium satisfying the D1 refinement.*

(ii) No pooling strategy profile can be supported as an equilibrium satisfying the D1 refinement.

Proof. (i) Without loss of generality, we consider the case in which $\phi \leq \underline{\phi} \Rightarrow \overline{x}^e = \overline{x}_g^*$. In the constrained optimum, we have $\sigma_i^c(\overline{x}_i^*) = 1$ for $i \in \{g, b\}$ and $\sigma^n(\overline{x}_g^*) = 1$. The beliefs on equilibrium strategies have to satisfy Bayes rule. Therefore $\mu(\overline{x}_g^*) = \frac{\mu_0(1-\phi)}{1-\mu_0+\mu_0(1-\phi)} \equiv \mu^l < \mu_0$. Hence, the reelection probability of type c under ζ_g and of type n equal $\frac{1}{2} + \frac{\mu^l - \mu_0}{\chi}$. For any off-the-path regulation $\overline{x}'$ we define D^c as the set of reelection probabilities π for which the c-type is strictly better off in deviating from her strategy:[17]

$$D^c(\overline{x}') = \Big\{\pi \in [0,1] \ \mid \ \pi > \lambda[V^W(\overline{x}_g^*, \zeta_g) - V^W(\overline{x}', \zeta_g)] + \frac{1}{2} + \frac{\mu^l - \mu_0}{\chi}\Big\}$$

Similarly, we define D^n as the set of reelection probabilities for which the n-type is strictly better off in deviating, and D_0^n the corresponding set in which she is indifferent. Therefore,

$$D^n(\overline{x}') \cup D_0^n(\overline{x}') = \Big\{\pi \in [0,1] \ \mid \ \pi \geq \lambda[\mathbb{E}\{V^W(\overline{x}_g^*, \zeta)\} - \mathbb{E}\{V^W(\overline{x}', \zeta)\}] + \frac{1}{2} + \frac{\mu^l - \mu_0}{\chi}\Big\}$$

We know that by Lemma 4, for $\overline{x}' > \overline{x}_g^*$,

$$\mathbb{E}\{V^W(\overline{x}_g^*, \zeta)\} - \mathbb{E}\{V^W(\overline{x}', \zeta)\} > V^W(\overline{x}_g^*, \zeta_g) - V^W(\overline{x}', \zeta_g).$$

Hence $\{D^n(\overline{x}') \cup D_0^n(\overline{x}')\} \subset D^c(\overline{x}')$. Under D1, the voter must believe that *any* $\overline{x}' > \overline{x}_g^*$ came from the c-type, i.e., $\mu(\overline{x}') = 1 > \mu^l$. As a result, the constrained optimum cannot be supported as a PBE that survives the D1 refinement.

(ii) Consider a pooling equilibrium with with policy $\overline{x}^p$ on path, so that $\sigma_g^c(\overline{x}^p) = \sigma_b^c(\overline{x}^p) = \sigma^n(\overline{x}^p)$, which implies that the reelection probability of type n and of type C (regardless of the realization of ζ) when choosing x^p equals $\frac{1}{2}$. First, we show that $Supp(\sigma^n) \subset [0,1]$, so there are off path regulation levels. Suppose not. Then the c-type must indifferent between $\overline{x}_g^*$ and $\overline{x}_b^*$ after seeing ζ_g, which is impossible since the two yield the same reelection probability but $V^W(\overline{x}_g^*, \zeta_g) > V^W(\overline{x}_b^*, \zeta_g)$. Second, for any off-the-path regulation $\overline{x}'$ we define $D^c(\overline{x}'; \zeta)$ as the set of reelection probabilities π for which the c-type is strictly better off in deviating from her strategy:

$$D^c(\overline{x}'; \zeta) = \Big\{\pi \in [0,1] \ \mid \ \pi > \lambda[V^W(\overline{x}^p, \zeta) - V^W(\overline{x}', \zeta)] + \frac{1}{2}\Big\}$$

Similarly, we define $D^n(\overline{x}')$ as the set of reelection probabilities for which the n-type is strictly better off in deviating, and $D_0^n(\overline{x}')$ the corresponding set in which she is indifferent. Therefore,

$$D^n(\overline{x}') \cup D_0^n(\overline{x}') = \Big\{\pi \in [0,1] \ \mid \ \pi \geq \lambda[\mathbb{E}\{V^W(\overline{x}^p, \zeta)\} - \mathbb{E}\{V^W(\overline{x}', \zeta)\}] + \frac{1}{2}\Big\}$$

[17] To apply the refinement, we treat the electorate as a single player—the receiver—who chooses a reelection probability $\pi(\overline{x}')$.

We know that by Lemma 4, for $\overline{x}' > \overline{x}^p$,

$$\mathbb{E}\{V^W(\overline{x}^p, \zeta)\} - \mathbb{E}\{V^W(\overline{x}', \zeta)\} > V^W(\overline{x}^p, \zeta_g) - V^W(\overline{x}', \zeta_g)$$

and for $\overline{x}' < \overline{x}^p$,

$$\mathbb{E}\{V^W(\overline{x}^p, \zeta)\} - \mathbb{E}\{V^W(\overline{x}', \zeta)\} > V^W(\overline{x}^p, \zeta_b) - V^W(\overline{x}', \zeta_b)$$

Hence, either $\{D^n(\overline{x}') \cup D_0^n(\overline{x}')\} \subset D^c(\overline{x}'; \zeta_g)$ or $\{D^n(\overline{x}') \cup D_0^n(\overline{x}')\} \subset D^c(\overline{x}'; \zeta_b)$. Under D1, the voter must believe that *any* $\overline{x}'$ came from the c-type (under either ζ_g or ζ_b), i.e., $\mu(\overline{x}') = 1$. As a result, the pooling equilibrium cannot be supported as a PBE that survives the D1 refinement. ■

Proposition 1. In the welfare-maximizing D1-robust separating equilibrium, the n-type chooses the ex-ante optimal policy and the c-type either over-regulates, under-regulates, or both:

$$\sigma^n(\overline{x}^e) = 1 \tag{14}$$

$$\sigma_b^c(\overline{x}_b^*) = \mathbf{1}\{\phi \leq \phi^l\} \quad \sigma_b^c(\overline{x}_{\min}) = \mathbf{1}\{\phi > \phi^l\} \tag{15}$$

$$\sigma_g^c(\overline{x}_{\max}) = \mathbf{1}\{\phi < \phi^h\} \quad \sigma_g^c(\overline{x}_g^*) = \mathbf{1}\{\phi \geq \phi^h\} \tag{16}$$

with $\overline{x}_{\min} < \overline{x}_b^* < \overline{x}_b^* < \overline{x}_{\max}$.

Proof.

We proceed through three steps. We first establish that the strategies form a PBE under the following belief system:

$$\mu(\overline{x}) = \mathbf{1}\{\overline{x} \in [0, \overline{x}_{\min}] \cup [\overline{x}_{\max}, 1]\}$$

We then prove that voters' beliefs on off-the-equilibrium paths satisfy D1 and finally argue voter-optimality.

Step 1. The strategies and beliefs form a PBE:

n-type. By definition of $\overline{x}_{\min}$ and $\overline{x}_{\max}$, there are no beliefs under which the n-type is willing to play $\overline{x} \notin [\overline{x}_{\min}, \overline{x}_{\max}]$. Since $\mu(\overline{x}) = 0$ when $\overline{x} \in (\overline{x}_{\min}, \overline{x}_{\max})$, it is straightforward to see that they are strictly dominated by $\overline{x}^e$.

c-type with $\zeta = \zeta_g$. Consider the cases where the outlook is consistent with the state of nature. Without loss of generality, assume $\phi \leq \underline{\phi}$ (so $\overline{x}^e = \overline{x}_g^*$). We know that $\overline{x}_{\max}$ belongs to the feasibility set of c-type, since by definition $\overline{x}_{\max}$ is such that:

$$\mathbb{E}V^W(\overline{x}_g^*;\zeta) - \mathbb{E}V^W(\overline{x}_{\max};\zeta) = \frac{1}{\chi\lambda}$$

which, from Lemma 4, implies that:

$$V^W(\overline{x}_g^*;\zeta_g) - V^W(\overline{x}_{\max};\zeta_g) < \frac{1}{\chi\lambda}.$$

At $\overline{x}_{\min}$ the last inequality is reversed. Therefore it follows that:

$$u_c^I(\overline{x}_{\max};\zeta_g) > u_c^I(\overline{x}_g^*;\zeta_g) > u_c^I(\overline{x}';\zeta_g)$$

for all $\overline{x}' \in (\overline{x}_{\min}, \overline{x}_{\max})/\{\overline{x}_g^*\}$. It is also immediate to see that $u_c^I(\overline{x}_{\max};\zeta_g) > u_c^I(\overline{x}';\zeta_g)$ for all $\overline{x}' > \overline{x}_{\max}$, since $V^W(\overline{x};\zeta_g)$ is decreasing in $\overline{x}$ for all $\overline{x} > \overline{x}_g^*$, and the c-type gains no electoral advantage from such move. Therefore when $\phi < \underline{\phi}$ and $\zeta = \zeta_g$ the c-type plays $\overline{x}_{\max}$. The same analysis directly applies to the case where $\phi > \underline{\phi}$ and $\zeta = \zeta_b$ and shows that the c-type in that case plays $\overline{x}_{\min}$.

c-type with $\zeta = \zeta_b$. We next consider the case where $\phi \leq \underline{\phi}$ but $\zeta = \zeta_b$. Here we consider two cases. When $\phi \leq \phi^l$, $\overline{x}_b^* \notin [\overline{x}_{\min}, \overline{x}_{\max}]$. and $\mu(\overline{x}_b^*) = 1$. We know that when $\zeta = \zeta_b$, $V^W(\overline{x}_b^*;\zeta_b) > V^W(\overline{x}';\zeta_b)\ \forall \overline{x}' \neq \overline{x}_b^*$. Therefore the c-type maximizes his utility by choosing $\overline{x}_b^*$. When $\phi^l > \phi > \underline{\phi}$ we have $\overline{x}_b^* \in [\overline{x}_{\min}, \overline{x}_{\max}]$ and $\mu(\overline{x}_b^*) = 0$. Due to the electoral gain from deviating, we can show that $u_c^I(\overline{x}_{\min};\zeta_b) > u_c^I(\overline{x}_b^*;\zeta_b)$. Note that when: $\phi \leq \underline{\phi}$ we have:

$$\mathbb{E}V^W(\overline{x}_b^*;\zeta) - \mathbb{E}V^W(\overline{x}_{\min};\zeta) \leq \mathbb{E}V^W(\overline{x}_g^*;\zeta) - \mathbb{E}V^W(\overline{x}_{\min};\zeta) = \frac{1}{\chi\lambda}$$

By Lemma 4, we have:

$$V^W(\overline{x}_b^*;\zeta_b) - V^W(\overline{x}_{\min};\zeta_b) < \mathbb{E}V^W(\overline{x}_b^*;\zeta) - \mathbb{E}V^W(\overline{x}_{\min};\zeta) \leq \frac{1}{\chi\lambda}$$

Therefore $u_c^I(\overline{x}_{\min};\zeta_b) > u_c^I(\overline{x}_b^*;\zeta_b) > u_c^I(\overline{x}';\zeta_b)\ \forall \overline{x}' > \overline{x}_{\min}/\{\overline{x}_b^*\}$. Since $V^W(\overline{x};\zeta_b)$ is increasing in $\overline{x} < \overline{x}_b^*$, it is immediate to see that $u_c^I(\overline{x}_{\min};\zeta_b) > u_c^I(\overline{x}'';\zeta_b)\ \forall \overline{x}'' < \overline{x}_{\min}$.

The same reasoning applies for the case where $\phi > \underline{\phi}$ and $\zeta = \zeta_g$, to show that the c-type has no profitable deviation from her strategy.

Step 2. The PBE survives the D1 refinement.

$\mu(\overline{x}) = 0$ for all $\overline{x} \in (\overline{x}_{\min}, \overline{x}_{\max})$. Notice that we must have $\overline{x}_g^c \geq \overline{x}_{\max} > \overline{x} > \overline{x}_{\min} \geq \overline{x}_b^c$. The minimum reelection probabilities that each type needs in order to switch to $\overline{x}$ equal, respectively

$$\underline{\pi}_g^c = \lambda[V^W(\overline{x}_g^c,\zeta_g) - V^W(\overline{x},\zeta_g)] + \frac{1}{2} + \frac{1-\mu_0}{\chi} \tag{17}$$

$$\underline{\pi}_b^c = \lambda[V^W(\overline{x}_b^c,\zeta_b) - V^W(\overline{x},\zeta_b)] + \frac{1}{2} + \frac{1-\mu_0}{\chi} \tag{18}$$

$$\underline{\pi}^n = \lambda[\mathbb{E}V^W(\overline{x}^e;\zeta) - \mathbb{E}V^W(\overline{x};\zeta)] + \frac{1}{2} - \frac{\mu_0}{\chi} \tag{19}$$

To show that D1 requires putting $\mu(\overline{x}) = 0$ for $\overline{x} \in (\overline{x}_{\min}, \overline{x}_{\max})$, we just need to show that $\underline{\pi}^n < \max\{\underline{\pi}_g^c, \underline{\pi}_b^c\}$. Notice that, by definition of $\overline{x}_{\max}$ and $\overline{x}_{\min}$, we must have

$$\underline{\pi}_g^c = \lambda[V^W(\overline{x}_g^c,\zeta_g) - V^W(\overline{x},\zeta_g)] + \frac{1}{2} - \frac{\mu_0}{\chi} + \lambda[\mathbb{E}V^W(\overline{x}^e;\zeta) - \mathbb{E}V^W(\overline{x}_{\max};\zeta)] \tag{20}$$

$$\underline{\pi}_b^c = \lambda[V^W(\overline{x}_b^c,\zeta_b) - V^W(\overline{x},\zeta_b)] + \frac{1}{2} - \frac{\mu_0}{\chi} + \lambda[\mathbb{E}V^W(\overline{x}^e;\zeta) - \mathbb{E}V^W(\overline{x}_{\min};\zeta)] \tag{21}$$

Hence,

$$\underline{\pi}_g^c - \underline{\pi}^n = \lambda[V^W(\overline{x}_g^c,\zeta_g) - V^W(\overline{x},\zeta_g)] - \lambda[\mathbb{E}V^W(\overline{x}_{\max};\zeta) - \mathbb{E}V^W(\overline{x};\zeta)] > 0 \tag{22}$$

$$\underline{\pi}_b^c - \underline{\pi}^n = \lambda[V^W(\overline{x}_b^c,\zeta_b) - V^W(\overline{x},\zeta_b)] - \lambda[\mathbb{E}V^W(\overline{x}_{\min};\zeta) - \mathbb{E}V^W(\overline{x};\zeta)] > 0 \tag{23}$$

where both inequalities follow from Lemma 4 and the fact that $V^W(\overline{x}_g^c,\zeta_g) \geq V^W(\overline{x}_{\max},\zeta_g)$ and $V^W(\overline{x}_b^c,\zeta_g) \geq V^W(\overline{x}_{\min},\zeta_b)$. This completes the argument.

Step 3. By construction, no other separating equilibrium improves voter welfare relative to the one constructed above: any other equilibrium strategy by the C-type would involve less socially efficient regulation. Any other strategy by the n-type would involve less socially efficient regulation and would involve *more stringent* incentive compatibility constraints. ■

Proof of Lemma 8.

In a separating equilibrium, the competent type's regulation in good times, $\overline{x}_g^c(\phi)$, and in bad times, $\overline{x}_b^c(\phi)$, are decreasing for all ϕ in $[0,\phi^h]$ and $[\phi^l,1]$, respectively.

Let $\phi < \underline{\phi}$, then by Lemma 5 and (1) we can write the following identity

$$\mathbb{E}\{V^W(\overline{x}_g^*;\zeta)\} - \mathbb{E}\{V^W(\overline{x}_g^c(\phi);\zeta)\} - \frac{\psi}{\lambda} \equiv 0$$

By Implicit Function Theorem we have

$$\frac{d\overline{x}_g^c(\phi)}{d\phi} = \frac{\big(V^W(\overline{x}_g^*;\zeta_b) - V^W(\overline{x}_g^c;\zeta_b)\big) - \big(V^W(\overline{x}_g^*;\zeta_g) - V^W(\overline{x}_g^c;\zeta_g)\big)}{\phi\frac{\partial V^W(\overline{x}_g^c;\zeta_b)}{\partial x} + (1-\phi)\frac{\partial V^W(\overline{x}_g^c;\zeta_g)}{\partial x}} < 0 \tag{24}$$

where the inequality follows from two facts: first, by lemma 2, the denominator of (24) is negative. Second, the numerator can be rewritten as

$$V^W(\overline{x}_g^*;\zeta_b) - V^W(\overline{x}_g^*;\zeta_g) + V^W(\overline{x}_g^c;\zeta_g) - V^W(\overline{x}_g^c;\zeta_b) = q(\overline{x}_g^c - \overline{x}_g^*)(1+f+c)(\zeta_b - \zeta_g) > 0$$

Next let $\underline{\phi} < \phi < \phi_h$, applying the IFT again

$$\frac{d\overline{x}_g^c(\phi)}{d\phi} = \frac{\big(V^W(\overline{x}_b^*;\zeta_b) - V^W(\overline{x}_g^c;\zeta_b)\big) - \big(V^W(\overline{x}_b^*;\zeta_g) - V^W(\overline{x}_g^c;\zeta_g)\big)}{\phi\frac{\partial V^W(\overline{x}_g^c;\zeta_b)}{\partial x} + (1-\phi)\frac{\partial V^W(\overline{x}_g^c;\zeta_g)}{\partial x}} < 0$$

similarly, the denominator is negative and the numerator is simplified to

$$V^W(\overline{x}_b^*;\zeta_b) - V^W(\overline{x}_b^*;\zeta_g) + V^W(\overline{x}_g^c;\zeta_g) - V^W(\overline{x}_g^c;\zeta_b) = q(\zeta_b - \zeta_g)[(1+f)(\overline{x}_g^c - \overline{x}_b^*) + c\overline{x}_g^c] > 0$$

For over-regulation we have the following

$$\mathbb{E}\{V^W(\overline{x}^e(\phi);\zeta)\} - \mathbb{E}\{V^W(\overline{x}_b^c(\phi);\zeta)\} - \frac{\psi}{\lambda} \equiv 0$$

by IFT

$$\frac{d\overline{x}_b^c(\phi)}{d\phi} = \frac{V^W(\overline{x}^e(\phi);\zeta_b) - V^W(\overline{x}_b^c;\zeta_b) + V^W(\overline{x}_b^c;\zeta_g) - V^W(\overline{x}^e(\phi);\zeta_g)}{\phi\frac{\partial V^W(\overline{x}_b^c;\zeta_b)}{\partial x} + (1-\phi)\frac{\partial V^W(\overline{x}_b^c;\zeta_g)}{\partial x}} < 0$$

where the inequality holds since the denominator is positive and its numerator can be rewritten as

$$\begin{cases} (1+f)q(\zeta_g - \zeta_b)(\overline{x}_g^* - \overline{x}_b^c) - qc\zeta_b(\overline{x}_g^* - \overline{x}_b^*) < 0 & \text{if } \phi_l < \phi < \underline{\phi} \\ (1+f)q(\overline{x}_b^c - \overline{x}_b^*)(\zeta_b - \zeta_g) < 0 & \text{if } \underline{\phi} < \phi \end{cases}$$

Now, let $\underline{\phi} < \phi < \phi_h$, applying the IFT again

$$\frac{d\overline{x}_g^c(\phi)}{d\phi} = \frac{\big(V^W(\overline{x}_b^*;\zeta_b) - V^W(\overline{x}_g^c;\zeta_b)\big) - \big(V^W(\overline{x}_b^*;\zeta_g) - V^W(\overline{x}_g^c;\zeta_g)\big)}{\phi\frac{\partial V^W(\overline{x}_g^c;\zeta_b)}{\partial x} + (1-\phi)\frac{\partial V^W(\overline{x}_g^c;\zeta_g)}{\partial x}} < 0$$

Similarly, the denominator is negative and the numerator is simplified to

$$V^W(\overline{x}_b^*;\zeta_b) - V^W(\overline{x}_b^*;\zeta_g) + V^W(\overline{x}_g^c;\zeta_g) - V^W(\overline{x}_g^c;\zeta_b) = q(\zeta_b - \zeta_g)[(1+f)(\overline{x}_g^c - \overline{x}_b^*) + c\overline{x}_g^c] > 0$$

Finally since competent type's regulation in good times, $\overline{x}_g^c$, is discontinuous at $\underline{\phi}$, we need to show that the $\overline{x}_g^c(\phi)$ is decreasing at $\phi \in [\underline{\phi}, \underline{\phi}+\epsilon]$ that is $\overline{x}_g^c(\underline{\phi}) > \overline{x}_g^c(\underline{\phi}+\epsilon)$. $\overline{x}_g^c$ is the solution to $\mathbb{E}\{V^W(\overline{x}^e;\zeta)\} - \mathbb{E}\{V^W(\overline{x}^c(\phi);\zeta)\} - \frac{1}{\chi\lambda} = 0$, rearranging them gives

$$\begin{aligned}
&For\ \phi \le \underline{\phi}, \quad \phi[V^W(\overline{x}_g^*;\zeta_b) - V^W(\overline{x}_g^c;\zeta_b)] + (1-\phi)[V^W(\overline{x}_g^*;\zeta_g) - V^W(\overline{x}_g^c;\zeta_g)] - \frac{1}{\chi\lambda} = 0 \\
&\quad\implies \phi\big[(1-q)(1+f)\alpha(\overline{x}_g^* - \overline{x}_g^c) + q\zeta_b(\overline{x}_g^c - \overline{x}_g^*)(1+f+c)\big] \\
&\qquad + (1-\phi)\big[(1-q)(1+f)\alpha(\overline{x}_g^* - \overline{x}_g^c) + q\zeta_g(\overline{x}_g^c - \overline{x}_g^*)(1+f+c)\big] - \frac{1}{\chi\lambda} = 0 \\
&\quad\implies (1-q)(1+f)\alpha(\overline{x}_g^c - \overline{x}_g^*) + q(1+f+c)(\overline{x}_g^c - \overline{x}_g^*)(\phi\zeta_b + (1-\phi)\zeta_g) - \frac{1}{\chi\lambda} = 0 \\
&\quad\implies \overline{x}_g^c(\underline{\phi}) = \frac{1}{\chi\lambda\big[q(1+f+c)(\underline{\phi}\zeta_b + (1-\underline{\phi})\zeta_g) - (1-q)(1+f)\alpha\big]} + \overline{x}_g^*
\end{aligned}$$

$$\begin{aligned}
&For\ \phi > \underline{\phi}, \quad \phi[V^W(\overline{x}_b^*;\zeta_b) - V^W(\overline{x}_g^c;\zeta_b)] + (1-\phi)[V^W(\overline{x}_b^*;\zeta_g) - V^W(\overline{x}_g^c;\zeta_g)] - \frac{1}{\chi\lambda} = 0 \\
&\quad\implies \phi\big[(1-q)(1+f)\alpha(\overline{x}_b^* - \overline{x}_g^c) + q\zeta_b(\overline{x}_g^c - \overline{x}_b^*)(1+f+c)\big] \\
&\qquad +(1-\phi)\big[(1-q)(1+f)\alpha(\overline{x}_b^* - \overline{x}_g^c) + q(1+f)\zeta_g(\overline{x}_g^c - \overline{x}_b^*) + qc\zeta_g(\overline{x}_g^c - \overline{x}_g^*)\big] - \frac{1}{\chi\lambda} = 0 \\
&\quad\implies (1-q)(1+f)\alpha(\overline{x}_b^* - \overline{x}_g^c) + q(1+f)(\overline{x}_g^c - \overline{x}_b^*)(\phi\zeta_b + (1-\phi)\zeta_g) \\
&\qquad +qc[\phi\zeta_b(\overline{x}_g^c - \overline{x}_b^*) + (1-\phi)\zeta_g(\overline{x}_g^c - \overline{x}_g^*)] - \frac{1}{\chi\lambda} = 0 \\
&\quad\implies \overline{x}_g^c(\phi) = \frac{\frac{1}{\chi\lambda} + qc(1-\phi)\zeta_g\overline{x}_g^* + \overline{x}_b^*[(1-q)(1+f)\alpha + q(1+f)(\phi\zeta_b + (1-\phi)\zeta_g) + qc\phi\zeta_b]}{(1-q)(1+f)\alpha + q(1+f+c)(\phi\zeta_b + (1-\phi)\zeta_g)}
\end{aligned}$$

Hence,

$$\overline{x}_g^c(\phi) = \begin{cases} \frac{1}{\chi\lambda\big[q(1+f+c)(\phi\zeta_b+(1-\phi)\zeta_g)-(1-q)(1+f)\alpha\big]} + \overline{x}_g^* & \text{if } \phi_l < \phi \le \underline{\phi} \\ \frac{\frac{1}{\chi\lambda}+qc(1-\phi)\zeta_g\overline{x}_g^*+\overline{x}_b^*[(1-q)(1+f)\alpha+q(1+f)(\phi\zeta_b+(1-\phi)\zeta_g)+qc\phi\zeta_b]}{(1-q)(1+f)\alpha+q(1+f+c)(\phi\zeta_b+(1-\phi)\zeta_g)} & \text{if } \underline{\phi} < \phi \end{cases}$$

It remains to show that $\overline{x}_g^c(\underline{\phi}) > \overline{x}_g^c(\underline{\phi}+\epsilon)$, this is trivial since the second part in equation above can be rewritten as

$$\begin{aligned}
\overline{x}_g^c(\underline{\phi}+\epsilon) &= \frac{\frac{1}{\chi\lambda}+qc(1-\underline{\phi}-\epsilon)\zeta_g\overline{x}_g^*+\overline{x}_b^*[(1-q)(1+f)\alpha+q(1+f)((\underline{\phi}+\epsilon)\zeta_b+(1-\underline{\phi}-\epsilon)\zeta_g)+qc(\underline{\phi}+\epsilon)\zeta_b]}{(1-q)(1+f)\alpha+q(1+f+c)((\underline{\phi}+\epsilon)\zeta_b+(1-\underline{\phi}-\epsilon)\zeta_g)} \\
&< \frac{1}{\chi\lambda\big[q(1+f+c)((\underline{\phi}+\epsilon)\zeta_b+(1-\underline{\phi}-\epsilon)\zeta_g)-(1-q)(1+f)\alpha\big]}+\overline{x}_g^* \\
&= \frac{1}{\chi\lambda\big[q(1+f+c)(\underline{\phi}\zeta_b+(1-\underline{\phi})\zeta_g+\epsilon(\zeta_b-\zeta_g))-(1-q)(1+f)\alpha\big]}+\overline{x}_g^* \\
&< \frac{1}{\chi\lambda\big[q(1+f+c)(\underline{\phi}\zeta_b+(1-\underline{\phi})\zeta_g)-(1-q)(1+f)\alpha\big]}+\overline{x}_g^* = \overline{x}_g^c(\underline{\phi})
\end{aligned}$$

where the first inequality follows from $\overline{x}_g^* > \overline{x}_b^*$ and second inequality follows from the fact that $\epsilon(\zeta_b-\zeta_g) > 0$.

■

Proof of Lemma 9.

1. *$\underline{\phi}$, ϕ^l, and ϕ^h are all decreasing in q over $\mathbb{R}_{\geq 0}$.*
2. *In a separating equilibrium, the competent type's regulation in good times, $\overline{x}_g^c(\phi)$, and in bad times, $\overline{x}_b^c(\phi)$, are decreasing in q.*

Proof of (1)

By lemma 3:

$$\underline{\phi} = \frac{(1+f)[(1-q)\alpha-q\zeta_g]}{(1+f)q(\zeta_b-\zeta_g)+cq\zeta_b}$$

differentiating with respect to q yields: $\frac{\partial\underline{\phi}}{\partial q} < 0$. Moreover, by lemma 6 we have

$$\begin{aligned}
\phi^l &= \underline{\phi} - \frac{1}{\chi\lambda(\overline{x}_g^*-\overline{x}_b^*)[(1+f)q(\zeta_b-\zeta_g)+qc\zeta_b]} \\
\phi^h &= \underline{\phi} + \frac{1}{\chi\lambda(\overline{x}_g^*-\overline{x}_b^*)[(1+f)q(\zeta_b-\zeta_g)+qc\zeta_b]}
\end{aligned}$$

since the second term in both identities is equal and decreasing in q we have $\underline{\phi}-\phi^l = \phi^h-\underline{\phi}$ decreasing in q. This establishes that ϕ^h is decreasing in q. As for ϕ^l we have:

$$\begin{aligned}\frac{\partial \phi^l}{\partial q} &= \frac{\partial \underline{\phi}}{\partial q} - \frac{-1}{\chi\lambda(\overline{x}_g^* - \overline{x}_b^*)q[(1+f)q(\zeta_b - \zeta_g) + qc\zeta_b]} \\ &= \frac{-(1+f)\alpha}{q[(1+f)q(\zeta_b - \zeta_g) + cq\zeta_b]} + \frac{1}{\chi\lambda(\overline{x}_g^* - \overline{x}_b^*)q[(1+f)q(\zeta_b - \zeta_g) + qc\zeta_b]} \\ &= \frac{1/\chi - \lambda(\overline{x}_g^* - \overline{x}_b^*)(1+f)\alpha}{\lambda(\overline{x}_g^* - \overline{x}_b^*)q[(1+f)q(\zeta_b - \zeta_g) + qc\zeta_b]}\end{aligned}$$

Therefore, $\frac{\partial \phi^l}{\partial q} \leq 0 \iff \frac{1}{\chi\lambda} < (\overline{x}_g^* - \overline{x}_b^*)(1+f)\alpha$*. However,* $\frac{1}{\chi\lambda} < (\overline{x}_g^* - \overline{x}_b^*)(1+f)[(1-q)\alpha - q\zeta_b] < (\overline{x}_g^* - \overline{x}_b^*)(1+f)\alpha$ *is a requirement for* $\phi^l \in \mathbb{R}_{\geq 0}$*. Therefore the probablity* ϕ^l *is decreasing in* q*.*

Proof of (2)

In order to show $\overline{x}_g^c(q)$ *is decreasing in* q*, there are two cases to consider:*

Case 1: $(\phi \leq \underline{\phi})$ *According to equation (7) we have*

$$R(\phi, \overline{x}_g^c) \equiv \mathbb{E}\{V^W(\overline{x}_g^*; \zeta)\} - \mathbb{E}\{V^W(\overline{x}_g^c; \zeta)\} - \frac{1}{\lambda\chi} = 0$$

by IFT we have

$$\begin{aligned}\frac{d\overline{x}_g^c(\phi)}{dq} &= \frac{\phi\big(\frac{\partial V^W(\overline{x}_g^*;\zeta_b)}{\partial q} - \frac{\partial V^W(\overline{x}_g^c;\zeta_b)}{\partial q}\big) + (1-\phi)\big(\frac{\partial V^W(\overline{x}_g^*;\zeta_g)}{\partial q} - \frac{\partial V^W(\overline{x}_g^c;\zeta_g)}{\partial q}\big)}{\phi\frac{\partial V^W(\overline{x}_g^c;\zeta_b)}{\partial x} + (1-\phi)\frac{\partial V^W(\overline{x}_g^c;\zeta_g)}{\partial x}} \\ &= \frac{(\overline{x}_g^c - \overline{x}_g^*)[(1+f)\alpha + (1+f+c)(\phi\zeta_b + (1-\phi)\zeta_g)]}{\phi\frac{\partial V^W(\overline{x}_g^c;\zeta_b)}{\partial x} + (1-\phi)\frac{\partial V^W(\overline{x}_g^c;\zeta_g)}{\partial x}} < 0\end{aligned}$$

Inequality follows since by lemma 2 the denominator is negative, and numerator is positive.

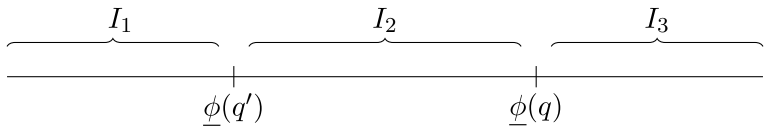
Case 2: $(\underline{\phi} < \phi \leq \phi^h)$ *Equation (7) can be written as*

$$R(\phi, \overline{x}_g^c) \equiv \mathbb{E}\{V^W(\overline{x}_b^*; \zeta)\} - \mathbb{E}\{V^W(\overline{x}_g^c; \zeta)\} - \frac{1}{\lambda\chi} = 0$$

Applying IFT again

$$\begin{aligned}\frac{d\overline{x}_g^c(\phi)}{dq} &= \frac{\phi\big(\frac{\partial V^W(\overline{x}_b^*;\zeta_b)}{\partial q} - \frac{\partial V^W(\overline{x}_g^c;\zeta_b)}{\partial q}\big) + (1-\phi)\big(\frac{\partial V^W(\overline{x}_b^*;\zeta_g)}{\partial q} - \frac{\partial V^W(\overline{x}_g^c;\zeta_g)}{\partial q}\big)}{\phi\frac{\partial V^W(\overline{x}_g^c;\zeta_b)}{\partial x} + (1-\phi)\frac{\partial V^W(\overline{x}_g^c;\zeta_g)}{\partial x}} \\ &= \frac{(\overline{x}_g^c - \overline{x}_b^*)(1+f)(\alpha + \phi\zeta_b + (1-\phi)\zeta_g) + c(\phi\zeta_b + (1-\phi)\zeta_g(\overline{x}_g^c - \overline{x}_g^*))}{\phi\frac{\partial V^E(\overline{x}_g^c;\zeta_b)}{\partial x} + (1-\phi)\frac{\partial V^E(\overline{x}_g^c;\zeta_g)}{\partial x}} < 0\end{aligned}$$

Finally, what remains to show is that $\overline{x}_g^c(\phi, q)$ *is decreasing in the neighborhood around* $\underline{\phi}(q)$*. Note* *that $\overline{x}_g^c(\phi, q)$ is discontinuous (and hence non-differentiable) at $\underline{\phi}(q)$. However, as q changes so the point of discontinuity. Without loss of generality, assume $q' > q$. By part (1) we know that $\underline{\phi}(q)$ is decreasing in q, hence $\underline{\phi}(q') < \underline{\phi}(q)$.*



We already showed that if $\phi \in \{I_1, I_3\}$ then $\overline{x}_g^c(q)$ is decreasing in q. We need to show that when $\phi \in I_2$ so that $\phi > \underline{\phi}(q')$ and $\phi < \underline{\phi}(q)$, then $\overline{x}_g^c(q') < \overline{x}_g^c(q)$.

$$\begin{aligned}
\overline{x}_g^c(q') &= \frac{\frac{1}{\chi\lambda} + q'c(1-\phi)\zeta_g\overline{x}_g^* + \overline{x}_b^*[(1-q')(1+f)\alpha + q'(1+f)(\phi\zeta_b + (1-\phi)\zeta_g) + q'c\phi\zeta_b]}{(1-q')(1+f)\alpha + q'(1+f+c)(\phi\zeta_b + (1-\phi)\zeta_g)} \\
&< \frac{1}{\chi\lambda\big[q'(1+f+c)(\phi\zeta_b + (1-\phi)\zeta_g) - (1-q')(1+f)\alpha\big]} + \overline{x}_g^* \\
&< \frac{1}{\chi\lambda\big[q(1+f+c)(\phi\zeta_b + (1-\phi)\zeta_g) - (1-q)(1+f)\alpha\big]} + \overline{x}_g^* = \overline{x}_g^c(q)
\end{aligned}$$

where the first inequality follows from $\overline{x}_g^* > \overline{x}_b^*$ and the second inequality comes from the fact that $q' > q$. This concludes that $\overline{x}_g^c(q)$ is decreasing in q.

Similarly, for $\overline{x}_b^c(q)$ we have

Case 1: ($\phi^l \leq \phi \leq \underline{\phi}$)

$$R(\phi, \overline{x}_b^c) \equiv \mathbb{E}\{V^W(\overline{x}_g^*; \zeta)\} - \mathbb{E}\{V^W(\overline{x}_b^c; \zeta)\} - \frac{1}{\lambda\chi} = 0$$

$$\frac{d\overline{x}_b^c(\phi)}{dq} = \frac{(1+f)(\overline{x}_b^c - \overline{x}_g^*)(\alpha + \phi\zeta_b + (1-\phi)\zeta_g) + c\phi\zeta_b(\overline{x}_b^* - \overline{x}_g^*)}{\phi\frac{\partial V^W(\overline{x}_b^c;\zeta_b)}{\partial x} + (1-\phi)\frac{\partial V^W(\overline{x}_b^c;\zeta_g)}{\partial x}} < 0$$

The inequality holds because numerator is negative while the denominator is positive.

Case 2: ($\phi > \underline{\phi}$)

$$R(\phi, \overline{x}_b^c) \equiv \mathbb{E}\{V^W(\overline{x}_b^*; \zeta)\} - \mathbb{E}\{V^W(\overline{x}_b^c; \zeta)\} - \frac{1}{\lambda\chi} = 0$$

$$\frac{d\overline{x}_b^c(\phi)}{dq} = \frac{(\overline{x}_b^c - \overline{x}_b^*)(1+f)(\alpha + \phi\zeta_b + (1-\phi)\zeta_g)}{\phi\frac{\partial V^W(\overline{x}_b^c;\zeta_b)}{\partial x} + (1-\phi)\frac{\partial V^W(\overline{x}_b^c;\zeta_g)}{\partial x}} < 0$$

Thus, $\overline{x}_b^c(\phi)$ is also decreasing in q. ∎

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