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FINANCIAL CRISIS AND THE PARADOX OF UNDER- AND OVER-REGULATION

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Financial Crisis and the Paradox of Under- and Over-Regulation

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ABSTRACT

This paper illustrates the paradox of prudential under-regulation in an economy that adopts financial reform, a reform which exposes the economy to future financial crises. There is individual-uncertainty about the crisis incidence, and the probability of the crisis is updated sequentially applying Bayesian inference. Costly regulation can mitigate the probability of the crisis. We identify conditions where the regulation level supported by the majority is positive after the reform, but below the socially optimal level. Tranquil time, when the crisis would not take place, reduces the regulation intensity. If the spell of no crisis is long enough, the regulation level may drop to zero, despite the fact that the socially optimal regulation level remains positive. The less informative is the prior regarding the probability of a crisis, the faster will be the drop in regulations induced by a no-crisis, good luck run. The challenges facing the regulator are aggravated by asymmetric information, as is the case when the public does not observe regulator's effort. Higher regulator effort, while helping avoiding a crisis, may be confused as a signal that the environment is less risky, reducing the posterior probability of the crisis, eroding the support for costly future regulation. The other side of the regulation paradox is that crisis resulting with unanticipated high costs may induce over-regulation and stagnation, as the parties that would bear the cost of the over regulation are underrepresented in the decision making process. We also outline a regulatory structure that mitigates the above concerns, including information disclosure; increasing the independence of the regulatory agency from the political process; centralizing the regulatory process and increasing its transparency; and adopting global standards of minimum prudential regulations and information disclosure, enforced by the domestic regulator.

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History is the sum total of things that could have been avoided.

Konrad Adenauer

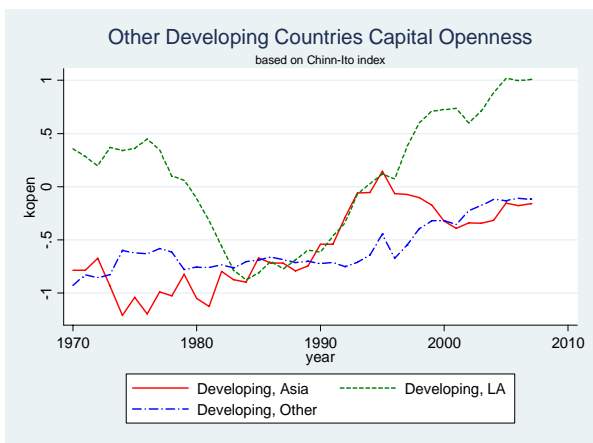
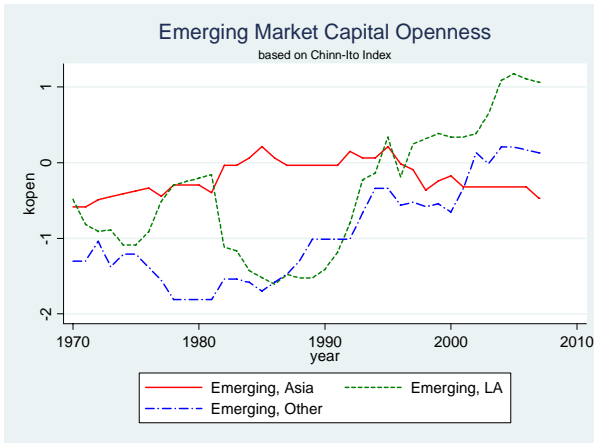
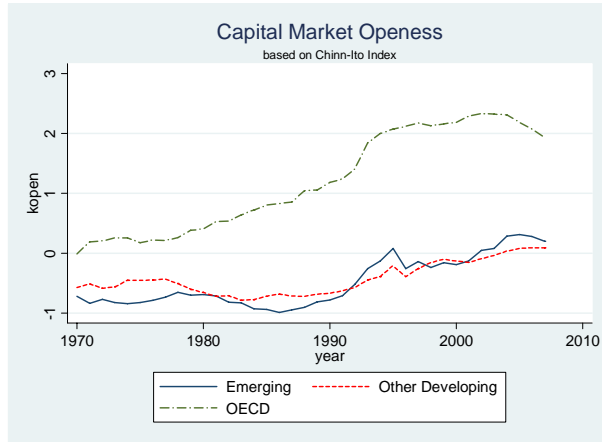
No less than the tourist, the writer of history profits from maps.

Charles F. Mullett

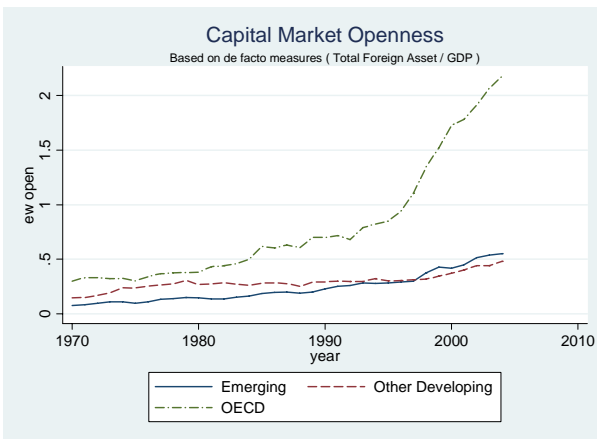
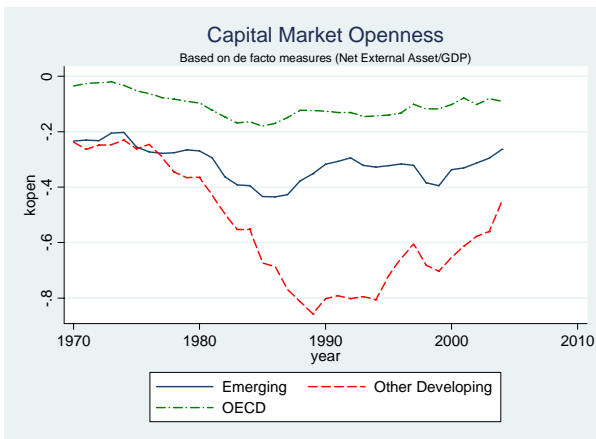
Following the “lost development decade” of the 1980s, the attitude towards financial integration of developing countries switched remarkably in the 1990s. The growing optimism about the gains from globalization supported trade liberalizations, frequently coupled with financial opening in Latin America, and to a lesser degree in Asia. Figure 1 plots the broad patterns of financial integration, applying the Chinn-Ito index of de-jure financial openness (top panel) and de-facto measures (lower panel, reporting the net and the gross foreign asset/GDP ratios).¹ While financial liberalization took off in the OECD in the 1980s, that decade was marked by massive sovereign defaults and by growing financial isolation of developing countries. In sharp contrast, in the 1990s developing countries joined the trend set by the OECD, increasing their capital openness, a trend that continued globally until the mid 2006. Disaggregation reveals the heterogeneity of the financial openness patterns of developing countries. Latin America moved more assertively to embrace capital openness. In contrast, the increase in financial openness in Asia has been timid, with reversal in financial openness taking place around the onset of the East-Asian crisis of 1997-8. The attitude towards financial integration of the most populated countries - China and India - remains guarded and skeptical. With a lag, these changes in policies were associated with large increases of total foreign asset/GDP positions, and with more modest changes in net foreign asset/GDP ratios (though these changes are more pronounced for developing and emerging markets). Econometric evidence suggests the presence of two way positive ‘Granger causality’ between *de-facto* and *de-jure* measures of financial openness, in line with theoretical models outlining such effects.²

¹ The choice of a *de jure* measure of capital account openness is driven by the motivation to look into the policy intentions of the countries. The Chinn and Ito index (2008) is based on information in the IMF’s *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)*. Specifically, it is the first standardized principal component of the variables that indicate the presence of multiple exchange rates, restrictions on current account transactions and on capital account transactions, and the requirement of the surrender of export proceeds. Higher values of this index indicate that a country is more open to cross-border capital transactions. The index is available for 171 countries for the period of 1970 through 2006.

² See Aizenman and Noy (2009) for further analysis of such two-way positive feedback effects, applying panel regressions and Geweke’s decomposition methodology.



De-jure financial integration, Chinn Ito index, 1970-2007



De-facto financial integration; Net and total foreign asset/GDP, 1970-2006

Figure 1

De-jure and de-facto financial integration

The differential path towards financial openness taken by Asia versus Latin America may reflect the vigorous debate about financial opening. This deliberation is a reincarnation of the earlier immiserizing growth literature, identifying conditions under which growth may be welfare reducing in the presence of preexisting distortions. While financial opening increases welfare when the only distortion is restricting intertemporal trade across countries, financial opening may be welfare reducing in the presence of other distortions. An important example of such a distortion is moral hazard, which frequently acts as an implicit subsidy to borrowing and investment. Moral hazard arises when investors believe they will be bailed out of bad investment by the taxpayer. This bailing out may be carried out by the treasury, the central bank, or by international agencies [the IMF, World Bank, etc]. In these circumstances, the tax-payer subsidizes the investment. A frequent rationale for the bailing out is the “too big to fail” doctrine – the fear that allowing large borrowers to go under will trigger a systemic crisis.³

Less deliberated has been the rapid adoption of financial innovations and financial deregulation in the OECD countries, being led by the US. Frequently, the presumption was that the superior financial intermediation of the OECD implies that these innovations are welfare improving, with negligible downside risk exposure. The prolonged spell of what was dubbed “the great moderation” further reduced concerns about the downside risk associated with financial intermediation, as was reflected by the remarkable decline in the market price of risk. The moderation also reduced the appetite for regulation, with growing acceptance of Greenspan’s seductive “market-stabilizing private regulatory forces” doctrine.⁴ Concerns about the inherent principal-agent/moral hazard associated with financial intermediation were swept aside, minimizing thereby the potential role of the regulator. The data also reveals high persistency of the stances of countries towards financial integration -- the autoregressive coefficient of AR(1) process fitted to the Chinn Ito index overtime is 0.84 for Emerging Asian,

³ The peril of moral hazard and financial fragility associated with financial liberalization was the focus of McKinnon and Pill (1996), Demigüç-Kunt and Detragiache (1998), and Hellmann, Murdock, and Stiglitz (2000). See Dooley and Shin (2000) and Bongini, Claessens, and Ferri (2001) for empirical validations of the moral hazard interpretation in the context of the 1997-8 crisis in East Asia. An overview of these issues and the debate about the desirability of financial opening can be found in and Aizenman (2004).

⁴ “As we move into a new century, the market-stabilizing private regulatory forces should gradually displace many cumbersome, increasingly ineffective government structures.” Remarks by Alan Greenspan, FED Chair, April 12, 1997.

and 0.99 for Emerging Latin American countries, 0.93 for non-Emerging Developing Asian and 1 for non Emerging Developing Latin American countries. The high co-movement of the Chinn Ito index across countries, and the persistence of policies towards financial openness suggest a pendulum dynamics towards financial integration. Indeed, the process of globalization increases the interdependency of national capital markets, possibly leading to tighter co-movements of policies and attitudes towards financial openness and other policy dimensions of globalization.

The unfolding global liquidity crisis illustrates vividly the universality of moral hazard, and the notion that the “too big to fail” doctrine is shaping governments and central banks policies in times of systemic crises. It also serves as a painful reminder of the risk of under-regulating domestic and international financial intermediation, exposing the tax payer to excessive risk taking that in due course would be subsidized by tax payers’ financed bailing outs. The magnitude of the global crisis in terms of the exposure, the global distribution of toxic assets, and the speed of deleveraging surprised most observers [as of April 2009, the IMF estimates the global toxic assets that banks and financial institutions will have to dispose of or write down to be about \$4 trillion]. The high costs of the crisis suggest that the pendulum of financial integration may shift towards reversal of financial globalization. Even if we recognize that “Those who cannot learn from history are doomed to repeat it” (George Santayana), a necessary condition for successful learning is understanding the forces accounting for the past. Simply reversing the policy stances of the past twenty years would backfire as we may overshoot the needed adjustment, inducing other distortions.

The purpose of this paper is to provide a map and explain the tendency to under regulate in “good times,” and the risk associated with overshooting the adjustment called for, following a financial crisis. Both under- and over-regulation may reflect the paradox of financial regulation: the success of the prudential regulator or a prolonged period of economic tranquility lead to complacency, reducing the demand for regulator’s services, inducing under regulation, which leads to a financial calamity. While the identity of economic agents that benefit directly from crisis avoidance is unknown, the cost and the cumbrance of regulations are transparent. Hence, crises that have been avoided are imperceptible and are underrepresented in the political discourse. The demand for regulation declines during prolonged good times, thereby increasing the ultimate cost of eventual crises. The other side of the regulation paradox is the hazard of over-regulating financial intermediation, in an environment where the identity of economic

agents that benefit directly from financial regulations is known, while the identity of successful projects and the entrepreneurs that would not be financed due to over-regulation is unknown -- they are unrepresented in the political discourse. These considerations suggest the need to strive towards a golden-rule of Goldilocks prudential regulations.

We consider an economy that adopts a financial reform, a reform that exposes the economy to a future crisis. There is individual-uncertainty about the crisis, and uncertainty regarding the probability of future crises. The public's initial prior is updated sequentially applying a Bayesian inference. Costly regulation determined by a majority rule can mitigate the probability of the crisis. We show that when the majority in the economy is partially exposed to the crisis, and the efficacy level of regulation is high enough, the regulation level following the reform is positive, but below the socially optimal level. Tranquil time, when the crisis would not take place, reduces overtime the regulation intensity. If the spell of no crisis is long enough, the regulation level may drop to zero, despite the fact that the socially optimal regulation level remains positive. The less informative is the prior regarding the probability of a crisis, the faster will be the drop in regulations induced by a no crisis good-luck run. The challenges facing the regulator are aggravated by asymmetric information. This would be the case if the probability of a crisis is reduced by regulator's effort, but this effort is unobserved by the public. In these circumstances, higher regulator effort, helping to avoid a crisis, may be confused as a signal that the environment is less risky, reducing the posterior probability of the crisis. This in turn would reduce the support for costly future regulation. Asymmetric information may put the regulator in an odd position of damned if you don't regulate today, damned tomorrow if you regulate today.

A crisis that results with unanticipated high costs, may induce over-regulation and stagnation, as the parties that would bear the cost of the over regulation are under-represented in the decision making process. We close the paper with an outline of a regulatory structure that mitigates the above concerns. Improving information disclosure is needed to allow the regulator real time assessment of systemic risk triggered by "too big to fail" concerns. Increasing the independence of the regulatory agency from the political process would reduce the tendency to under-regulate in good times. Centralizing the regulatory process and increasing its transparency would mitigate the problems associated with asymmetric information. Adopting global standards of minimum prudential regulations and information disclosure enforced by the domestic regulator would mitigate the tendency to under-regulate in good times.

I. FINANCIAL REFORMS, REGULATION AND INDIVIDUAL-SPECIFIC UNCERTAINTY

We outline a minimal model that allows tracing the dynamics of regulation in the aftermath of a financial reform in the presence of individual-specific uncertainty. The key role of individual-specific uncertainty in explaining the status quo-bias in the context of trade reform was highlighted by Fernandez and Rodrik (1991), but seems to be overlooked in explaining the dynamics of regulation in the aftermath of a financial reform. As the experience of the 1990s vividly illustrated, financial reforms increase the economy's exposure to costly financial crises, events that are associated with asymmetric incidence among agents and sectors. The intertwining of financial institutions operating with limited transparency frequently resulted in nasty news, when agents found that they were far more exposed to the crisis than they expected. The dynamics in our model are the outcome of an interaction between two ingredients. First, agents update overtime their assessment of the probability of a crisis, possibly applying a Bayesian inference. Second, regulation is costly. While the costs are shared by all agents, the regulation intensity is determined by a majority rule. We study the dynamics of regulations during a spell of no-crisis episodes in the aftermath of a reform until the crisis happens. We focus on the case where the majority of agents face individual-specific uncertainty regarding their exposure to crises' incidences. We contrast it to a case where the intensity of regulation is set in order to maximize the expected utility of the 'average agent,' a concept akin to the expected discounted GDP net of regulation costs.

At time zero a policy reform takes place. The policy reform exposes the economy to a risk of a financial crisis, which will reduce the income of the affected agents by τ . There is uncertainty regarding the probability of such a crisis, and its incidence. We assume a recursive structure, where the regulation intensity at time t impacts the probability of a crisis at time $t + 1$. In the absence of regulation, the perceived probability at time zero of a crisis occurring at period 1 is $P_{0,1}$. Regulation associated with spending resources ρ_0 per agent at time zero reduces the probability of a crisis from $P_{0,1}$ to $P_{0,1} \cdot Q$, $Q(0) = 1$; $Q \leq 1$. The regulation efficacy increases with the spending: $Q = Q(\rho_0)$; $Q' < 0$.

To fix ideas, we assume that $Q(\rho_0)$ is a logistic function:

$$(1) \quad Q(\rho_0) = \frac{2 \exp - \nu \rho_0}{1 + \exp - \nu \rho_0},$$

where ν measures the efficacy of regulation. Hence, $Q'(\rho_0) = -\nu \frac{Q(\rho_0)}{1 + \exp - \nu \rho_0}$. Overtime, agents update the probability $P_{t,t+1}$ in a Bayesian manner, so that no crisis in period zero would induce a lower perceived probability of a crisis in period 2, $P_{0,1} \geq P_{1,2}$. The same applies for an arbitrary t : no crisis from period one to t , would imply $P_{t-1,t} \geq P_{t,t+1}$. A detailed example of such inference is provided in the Appendix.

The economy is populated by a large number of atomistic agents, a fraction ω of which are fully exposed to the crisis [dubbed *FE*]. The remaining population is partially exposed [dubbed *PE*] – each agent in the *PE* group is adversely affected by the crisis with probability q . The income in period zero of all agents is normalized to 1 minus the per capita cost of the regulation, ρ_0 . The time line is described in Figure 2. Financial reform takes places at the beginning of period zero. Next, the authorities set the regulation intensity, ρ_0 . At the beginning of period 1 the uncertainty regarding the crisis and its individual incidences is resolved. With probability $P_{0,1} \cdot Q(\rho_0)$, a crisis will take place in period 1, reducing the income per capita of the impacted agents to $1 - \tau$. With probability $1 - P_{0,1} \cdot Q(\rho_0)$, no crisis will take place in period 1.

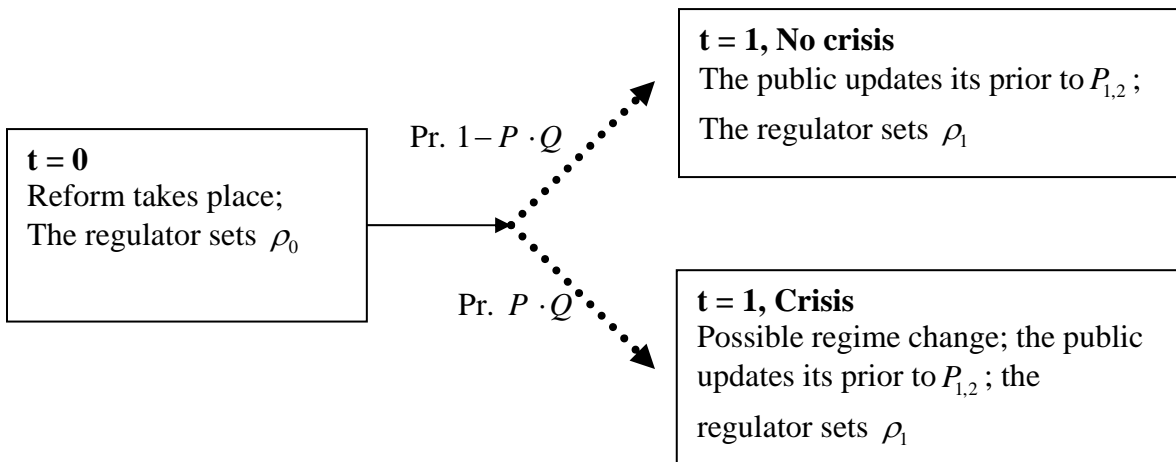


Figure 2: the time line, $t = 0, 1$

The key difference between the two groups is the individual's risk of being exposed to the crisis. In group *FE*, all are adversely exposed to crisis; whereas in group *PE* only a fraction $q < 1$ are impacted, and there is individual uncertainty regarding each agent's exposure. The income profiles of the agents in each group are summarized in Table 1.

If no crisis occurs at time 1, the same scenario will repeat itself in period 1, updating the time indices, leading to the following sequence in period 1 and 2

- I. Agents adjust downwards their prior of a crisis at time 2 to $P_{1,2}$, $P_{0,1} \geq P_{1,2}$, anticipating that the actual probability of the crisis taking place in period 2 is $P_{1,2} \cdot Q(\rho_1)$ [the updating follows the Bayesian inference outlined in the Appendix].
- II. The policy maker sets regulation intensity in period 1 at $\tilde{\rho}_1$. The income of the agents in periods 2 and 3 can be seen in Table 1, updating the time indices forward by one period.
- III. At the beginning of period 2 the uncertainty regarding the crisis and its individual incidence is resolved. If no crisis takes place in period 2, the priors about the probability of a crisis in period 3 are updated as described above, and the problem repeats itself.

Table 1

Income and crisis incidence for the FE and PE groups, $t = 0, 1$

Group	Income in $t = 0$	Income in $t = 1$
<i>FE</i>	$1 - \rho_0$	$\begin{cases} 1 - \tau & \text{crisis happens, Pr } P_{0,1} \cdot Q(\rho_0) \\ 1 & \text{no crisis, Pr } 1 - P_{0,1} \cdot Q(\rho_0) \end{cases}$
Share ω		
<i>PE</i>	$1 - \rho_0$	$\begin{cases} 1 - \tau & \text{for fraction } q \\ 1 & \text{for fraction } 1 - q \end{cases} \begin{cases} \text{crisis happens, Pr } P_{0,1} \cdot Q(\rho_0) \\ \text{no crisis, Pr } 1 - P_{0,1} \cdot Q(\rho_0) \end{cases}$
Share $1 - \omega$		

If a crisis takes place, there may be a regime change impacting future regulations, described in more detail in Section 3. In the absence of regime change, the sequence described above continues with the proper adjustment of the prior regarding future crises. Agents are risk neutral, maximizing their expected utility, $\sum_{t=0}^{\infty} \beta^t C_t$. The recursive nature of the problem, and the observation that regulation today impacts the probability of the crisis tomorrow reduces the policy maker's problem to a two period optimization.

We focus first on the optimal regulation in period zero, contrasting two cases. The first is when the regulation intensity is determined by a planner maximizing the expected income of the 'average agent,' the second is when the regulation is determined by a majority rule.

Regulation Intensity Optimizing the Average Agent's welfare

The policy maker sets the regulation intensity, ρ_0 , as to maximize the representative agents' expected utility

$$(2) \quad \underset{\rho_0}{\text{Max}} \left[1 - \rho_0 + \beta \left[\omega(1 - \tau P_{0,1} Q(\rho_0)) + (1 - \omega)[q(1 - \tau P_{0,1} Q(\rho_0)) + (1 - q)1] \right] \right].$$

Equivalently, the regulation is maximizing $1 - \rho_0 + \beta[1 - \tau P_{0,1} \cdot Q(\rho_0)(\omega + (1 - \omega)q)]$. An internal solution with positive regulation will take place only if the marginal benefit of the first dollar spent on regulation exceeds one: if $-1 - \tau \beta P_{0,1} \cdot Q'_{|\rho_0=0}(\omega + (1 - \omega)q) > 0$. Applying (1),

$Q'_{|\rho_0=0} = -0.5\nu$, hence positive regulation will take place only if $0.5\nu\tau\beta P_{0,1}(\omega + (1 - \omega)q) > 1$.

High enough regulation efficacy ν induces positive regulation. The critical level of regulation efficacy associated with positive regulation depends negatively on the crisis probability $P_{0,1}$; crisis cost, τ , the discount factor, β ; and the share of the agents exposed to the crisis, $\omega + (1 - \omega)q$.

Assuming an internal equilibrium, the FOC determining the regulation level set by the planner, $\tilde{\rho}_{S,0}$, is

$$(3) \tilde{\rho}_{S,0} = \begin{cases} \text{solution of } 1 = -P_{0,1} Q'_{\rho_0} \beta \tau \lambda_s & \text{if } 0 < 0.5\nu\beta\tau\lambda_s - 1 \\ 0 & \text{if } 0 \geq 0.5\nu\beta\tau\lambda_s - 1 \end{cases} \quad \text{where } \lambda_s = \omega + (1-\omega)q .$$

Optimal regulation equates a marginal dollar spent on regulation to its marginal benefit: the drop in the probability of a crisis; times the discounted cost of a crisis, $\beta\tau$; times the share of agents exposed to the crisis, λ_s , $\lambda_s = \omega + (1-\omega)q$.

Regulation Intensity set by Majority Rule

The economy is composed of two groups, hence there are two cases corresponding to this scenario.

The fully exposed group forms the majority, as would be the case when $\omega > 0.5$. The regulation intensity is determined by applying considerations akin to the case of a planner, (3), with the modification that the share of the agents exposed to the crisis *increases* from $\lambda_s = (1-\omega) + \omega q$ to $\lambda_{FE} = 1$.

The partially exposed group forms the majority, as would be the case when the individual uncertainty dominates, $\omega < 0.5$. The regulation intensity is determined in a way akin to the planner's solution, (3), with the modification that the share of agents exposed to the crisis *drops* from $\lambda_s = (1-\omega) + \omega q$ to $\lambda_{PE} = q$. Consequently, if an internal equilibrium takes place (i.e., when $\tilde{\rho}_0 > 0$), the optimal regulation equates the marginal cost (one) with the marginal benefit,

$$-P_{0,1} Q'_{\rho_0} \beta \tau \lambda_k; \quad \text{where } \lambda_k = \begin{cases} \omega + (1-\omega)q & \text{for } k = S \\ 1 & \text{for } k = FE \\ q & \text{for } k = PE \end{cases} .$$

Consequently, the regulation levels are ranked by the following claim:

Claim 1

With positive regulation, the regulation level set by the 'social planner' is below the level that is optimal for the *FE* group, and above the level that is optimal for the *PE* group:

$$\tilde{\rho}_{FE,0} > \tilde{\rho}_{S,0} > \tilde{\rho}_{PE,0} .$$

Discussion

The only difference between the FOC conditions determining optimal regulation is the probability of the deciding group, λ , being exposed to crisis incidence. If the regulation is set by group *FE*, the probability is 1, as all agents in that group are fully exposed. If the regulation is determined by the *PE* group, this probability drops to q . The social planner attaches a probability of crisis incidence that is a weighted average of the incidence affecting the two groups: $\omega \cdot 1 + (1 - \omega)q$. As $q < \omega \cdot 1 + (1 - \omega)q < 1$, the weight attached to the marginal benefit of regulation is highest when the regulation is determined by a majority composed of the fully exposed group (*FE*); the lowest when the regulation is determined by a majority composed of the partially exposed group (*PE*); and in between these two when the regulation is determined by the planner.

Applying the above discussion, the factors impacting the regulation intensity are summarized by the following claim:

Claim II

In an internal equilibrium with positive regulation, the regulation rate increases the higher is the perceived probability of a crisis; the higher are crisis costs; and the higher is the effectiveness of regulation, υ . All these factors also increase the likelihood of positive regulation.

To get further insight, we review a simulation of an economy where individual-specific uncertainty dominates, and the partially exposed agents are a majority ($\omega < 0.5$). Suppose that agents in the *PE* group are exposed to the crisis with probability half ($q = 0.5$), and that the conditions for internal equilibrium are met: $-1 + 0.5\beta\nu\tau q > 0$. Figure 3, panel (I) illustrates a simulation where the share of the partially exposed agents is 0.7, and the probability P of a crisis, in the absence of regulation, is half. The top bold curve corresponds to the net marginal benefit of a social planner, and the solid curve to that of the *PE* decision maker. The optimal regulation

level is determined at the intersection of each curve with the horizontal axis.⁵ Group *PE* overlooks the regulations' benefits accruing to the fully exposed group, *FE*. Consequently, the regulation set by the *PE* group is well below that of the social planner

[$\tilde{\rho}_{PE} = 0.026 < \tilde{\rho}_S = 0.0415$].⁶ Figure 4 depicts the impact of the regulation on *Q*: regulation intensity $\tilde{\rho}_{PE} = 0.026$ cuts the probability of a crisis by about half, from $0.5 P$ to about $0.25 P$.

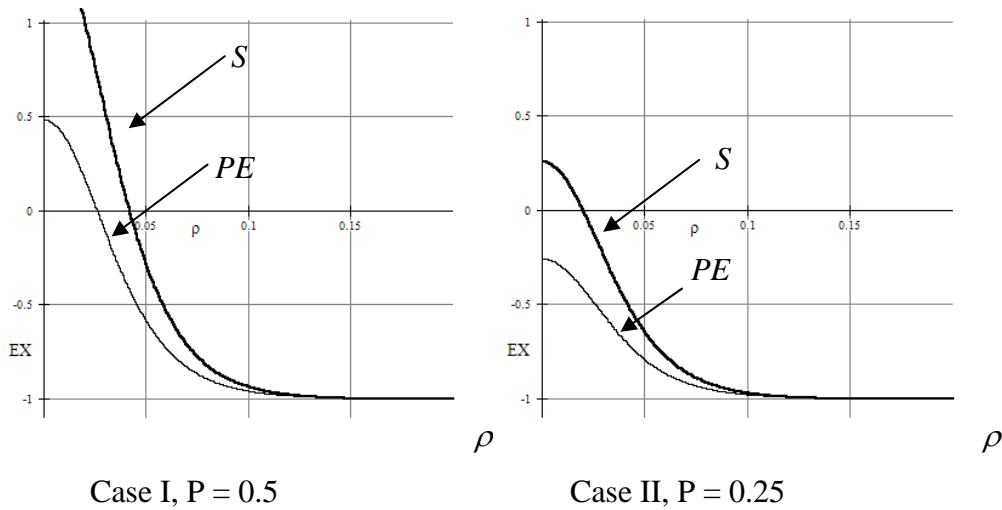


Figure 3: The net marginal benefit of regulation and regulation intensity

The simulation corresponds to $\beta = 0.95$, $\nu = 50$, $\tau = 0.25$, $q = 0.5$, $\omega = 0.3$, drawing $-1 + \beta\tau PQ'q$ (solid) and $-1 + \beta\tau PQ'(\omega + (1-\omega)q)$ (bold) for varying ρ .

⁵ The marginal gain associated with increasing the regulation from the perspective of the planner is the bold, top curve, plotting $\beta[-\tau_{0,1} \cdot P_{0,1} \cdot Q'_{\rho_0} (\omega + (1-\omega)q)] - 1$. The marginal gain associated with increasing the regulation from the perspective of the *PE* group is the lower curve, plotting $\beta[-\tau P_{0,1} \cdot Q'_{\rho_0} q] - 1$. The social marginal benefit of regulation exceeds the marginal benefit assessed by the *PE*, as $\omega + (1-\omega)q > q$.

⁶ The vertical gap between the two curves, $-\tau\beta_{0,1} \cdot Q'_{\rho_0} (1-q)$, drops with the share of exposed agents in the *PE* group. Thus, individual-uncertainty is a key factor accounting the gap between the socially optimal regulation level and the regulation determined by group *PE* [if all agents are fully exposed ($q = 1$), the majority would choose the socially optimal regulation level].

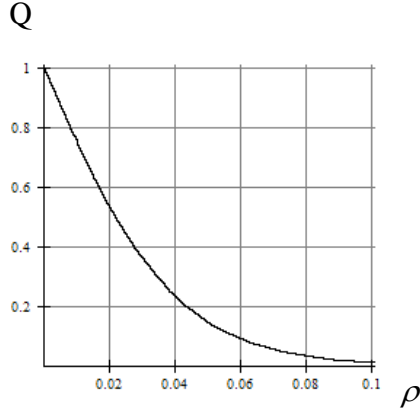


Figure 4: regulation intensity and risk reduction

II. INTERTEMPORAL INFERENCE AND THE DYNAMICS OF UNDER-REGULATION

In this section we evaluate the intertemporal patterns of under regulation during a spell of “good times,” a run with no financial crises. In the Appendix we outline a Bayesian inference example where the prior information about crisis occurrence follows a beta pdf, with the prior mean of the crisis occurring in period 1 being $P_{0,1} = \frac{a}{a+b}$; $a, b > 0$. The coefficients a, b reflect the prior information of the public regarding the mean and the variance of the probability of a crisis. We show there that a run of “good luck” with no crises occurring in periods (1, 2, ..., t) would induce a posterior mean of $P_{t,t+1} = \frac{a}{a+b+t}$. Hence, a longer spell of good luck reduces the perceived mean of a crisis’ next period.

Consequently, each period that the crisis is avoided; the probability P is adjusted downward, shifting both curves in Figure 3 downward, reducing thereby the regulation intensity. A long enough spell of no crisis may induce zero regulation, as would be the case if P drops from 0.5 to 0.25 in the above simulation. This situation is captured in panel II of Figure 3. The socially optimal regulation is positive, yet the regulation level set by group *PE* would be zero: $\tilde{\rho}_{PE} = 0 < \tilde{\rho}_S = 0.02$. This simulation illustrates the following claim:

Claim 3

Suppose that the majority of the economy is partially exposed to the crisis. If the efficacy level of regulation is high enough, the regulation level in period zero is positive, but below the socially optimal level. The under-regulation drops with the share of exposed agents, q . Tranquil time, when the crisis would not take place, reduces the regulation intensity. If the spell of no crisis is long enough, the regulation level may drop to zero, despite the fact that the socially optimal regulation level remains positive.

Discussion

Individual-uncertainty regarding crisis incidences leads to under regulation, with the possibility of converging to zero regulation during long spells of no crisis, despite the fact that it's socially optimal to regulate. Consequently, uncertainty regarding the incidence of the crisis leads to under-regulation, which increases the probability of the crisis above the socially optimum level. If regulation reduces both the probability of a crisis and the intensity of a realized crisis, then under-regulation may increase the depth of the ultimate crisis. Claim 3 illustrates the paradox of prudential regulation: the uncertainty regarding the identity of the agents that benefit from crisis avoidance leads to under-regulation.

The impact of the precision of the prior information is summarized by the following claim [derived in the Appendix]:

Claim 4

The less informative is the prior regarding the probability of a crisis, the faster will be the drop in regulations induced by a “good luck” run.

Discussion

With less informative prior, the impact of a no crisis event is greater, as the agent operates with greater initial ignorance. Thus, good luck runs are especially damaging in the context of financial innovations. Arguably, this was the case of some of the recent financial innovations in the US [new exotic derivatives, bundling, etc...]. Therefore, good luck runs are more damaging in the aftermath of unprecedented financial reform, where the public is exposed for the first time to new financial instruments.

The above discussion assumed transparency of the regulatory effort, where the public is fully informed about it. The implications of regulation opacity and asymmetric information are summarized in the following Claim [see the Appendix for the analysis]

Claim 5

Consider an economy with asymmetric information between the public and the regulator. The regulator determines the regulation intensity, but the public gets only noisy signals about it. A higher regulator effort which avoids a crisis may be confused as a signal that the environment is less risky, reducing the posterior probability of the crisis, $P_{t,t+1}$ below the level observed with symmetric information [recall that P is the probability of the crisis in the absence of regulation]. This in turn may erode the future support for costly regulation.

Discussion This example deals with the costs of asymmetric information regarding the regulator effort. Higher effort helping in averting a crisis today would induce overconfidence, leading the public to infer that the risk is lower than the actual one, as the public under weighs the regulator's effort. This in turn may reduce the support for costly future regulations, and increase the ultimate cost of the crisis. Asymmetric information puts the regulator in the odd position of *damned if you do, damned if you don't*. Probabilistically, with asymmetric information the regulator would be damned if he is not putting the effort today, as it may lead to a crisis tomorrow. Yet, a regulator's effort today may induce the public to overconfidence, as it undervalues the regulator's contribution to crisis avoidance, and overvalues the no-crisis event as a signal reducing the posterior probability of a crisis, P . Such overconfidence may lead down the road to a deeper crisis [see the appendix for a detailed example of this situation]. Centralized regulation designed to reduce the confusion may mitigate the cost of asymmetric information.

III. THE HAZARD OF OVERREGULATION

The onset of a crisis may change the above scenario in circumstances where the crisis depth exceeds the anticipated one. This may happen if the crisis would lead to the unexpected disappearance of markets for risk, implying that the realized cost of the crisis, τ , would be of a higher order of magnitude than the anticipated one. A possible interpretation for the disappearance of markets for risk is the emergence of Knightian uncertainty. This concept was postulated by Frank Knight, dealing with situations where agents who were exposed to quantifiable risks, drawn from known probability distribution, find that they operate in an environment where the probability distribution of a random outcome is unknown [what was perceived as “known unknowns,” is viewed now as “unknown unknowns”]. The aversion to Knightian uncertainty may account for the flight to quality and the large cost of the unfolding present crisis, as well as for the costs of the 1997-8 East Asian crises, when prime borrowers (as were viewed before the crisis) lost access to credit.⁷

A crisis that leads to costs of a higher order of magnitude than the anticipated ones may induce a pendulum shift from under-regulation to overregulation. Interestingly, such overshooting was avoided in the 1990s. Indeed, the opposite took place in various countries (including Mexico and Korea): following the onset of the crisis, countries adjusted by increasing their financial openness as part of a global trend of financial liberalization. This was probably because the crises in the 1990s were localized, at times of global growth, when the affected countries found that depreciation and higher exports facilitated the recovery. Today’s crisis is globalized, being propagated globally from the US, leading to massive de-leveraging of OECD exposure to developing countries. The global recession and the resulting drop in international trade imply that, on average, exporting the adjustment would not work this time. The present crisis exposes the fault lines of globalization, calling for domestic adjustment of policies and regulations in the OECD. While it’s pre-mature to conclude regarding the ultimate regulatory adjustment, the risk is that in the rush to regain credibility, we may overshoot the adjustment, or adjust in the wrong direction.

⁷ See Caballero and Krishnamurthy (2008) and Blanchard’s guest article at the Economist (January 29, 2009) for the role of Knightian Uncertainty in explaining flight to quality and the disappearance of risk markets.

The argument about under-regulation following a financial reform may have a symmetric counterpart dealing with over regulation following a financial calamity. In a system that represses financial intermediation, the stake holders that would have benefited from financial intermediation are under-represented in the decision making. This would be the case when there is individual-uncertainty regarding the incidence of being a successful entrepreneur. We skip modeling this situation, as it is analogous to Fernandez and Rodrik (1991). The main difference between the case of over and under regulation is that in the first, the absence of crisis induces a drop of the probability of a crisis, deepening overtime the under-regulation. In contrast, over-regulation cuts the channels leading to the crisis, at a cost of reducing the actual output below the potential. Over-regulation induces a static economy, where the benefit of crisis avoidance may come with a larger cost of stagnation, a cost that may be underrepresented in the political discourse.

IV. ON THE DESIGN OF BALANCED REGULATIONS

We close the paper with a discussion of regulatory changes needed to deal with the challenges associated with under and over-regulation.⁸

Information Disclosure

A necessary condition for successful regulation is that the regulator should be informed about the exposure to systemic risks. This requires having timely detailed information, preferably on a confidential basis, about financial institutions whose size/GDP is deemed large enough to be in the category of “too big to fail.” The lack of such information has been vividly illustrated in the US.⁹ In the US, the regulator (i.e., the Federal Government) imposes stringent disclosure requirements on the non-financial corporate sector, subject to strict confidentiality of the micro-level data disclosed to the regulator. Curiously, there is no comparable information disclosure requirement imposed on the financial sector. To illustrate, the Bureau of Economic Analysis (BEA) does an annual survey of US direct investment abroad. The data collection is confidential, and is based on mandatory surveys conducted by the BEA of all the establishments above a critical size. It contains detailed confidential information, including direct investment, employment data, R&D expenditures, trade in goods and services, and selected financial data. This, and other data collected by federal agencies, provides the regulator with timely information about the non-financial sector.

In contrast, in the decades before the crisis, there was no comparable attempt to collect data dealing with exposure of the financial sector. As a result, the regulator was frequently in the dark regarding the overall balance sheet exposure of investment banks, hedge funds, and other non-commercial financial intermediaries. This information gap is troublesome, as the cost of bailing out the financial system is frequently much higher than the costs of bailouts targeting the non-financial, real sector. Such cost discrepancy reflects the quick diffusion of financial panic. Furthermore, financial institutions tend to be more intertwined than the non financial corporate sector, implying that a bankruptcy of a large enough financial institution may lead to large

⁸ See Barth, Lin, Ma, Seade and Song (2009) for a comprehensive empirical study of the impact of differential bank regulations and supervision.

⁹ The crisis exposed the large systemic exposure of the US financial system to credit-default swaps (CDSs), at levels that seemed to surprise both the public and the regulators [see the case of AIG].

domino effects and systemic risks (see the massive bailout of AIG during the fall of 2008). Hence, any serious regulatory reform should start with upgrading data collection, inducing mandatory periodic confidential reports of the balance sheet exposure of all financial institutions above a minimum size operating in the domestic market.

Independence of the regulatory agency from the political process and various pressure groups

In the presence of individual risk regarding the incidence of a crisis, there are costs associated with designing regulations by a simple majority rule. Preferably, regulation should be the responsibility of an independent body managed by civil servants aiming at the expected GDP, with no sartorial biases. The logic for this independence is akin to the gains attributed to Central Bank independence. In the presence of principle-agent problems, the regulator's independence is needed to avoid the wish of the regulated agents to minimize information disclosure. This follows from the moral hazard involved, where the agent would prefer under-regulation as a way to facilitate excessive risk taking subsidized by the tax payers. Indeed, observers noted the bargaining clout of Wall Street as a contributing factor for the under regulation of the financial system in the US.¹⁰

Centralizing the regulatory process

A fractured regulatory process has the risk of each agency focusing on its narrowest task, viewing the need to deal with the big picture as beyond its mandate. Facing the challenges of dealing with potential toxic assets, each regulatory agency would opt for “not in my neighborhood” approach, preferring that other agencies deal with it. A fragmented regulatory approach is damaging because with intertwining financial exposures, evaluating the systemic risk requires combining all the pieces of the financial puzzle together. A centralized regulatory

¹⁰ See Rajan and Zingals (2003) and Rajan (2005) for insightful discussions of political economy aspects of financial intermediation. They point out the hazard associated with the incumbent ability to leverage the power of governmental regulation to protect incumbent's economic position. This comes frequently at the expense of the public interest.

Similar concerns were raised recently in the US: “The New York Fed is, by custom and design, clubby and opaque. It is charged with curbing banks' risky impulses, yet its president is selected by and reports to a board dominated by the chief executives of some of those same banks.” Becker and Morgenson, NYT, April 27, 2009.

process would also minimize the risk that a proactive financial system would attempt to arbitrage between diverse regulatory agencies.

Effective regulation also benefits by increasing the quality of the signal provided by the regulatory agency. The risk of fractured regulation is of increasing the opacity of the system, making it harder for the public to assess the regulatory effort. As was shown in Claim 5, greater opacity that leads to asymmetric information, distorts the regulatory process, and may magnify future under-regulation.

Adopting global standards of minimum prudential regulations and information disclosure, enforced by the domestic regulator.

The discussion in section 2 implies that the regulatory agency might face growing pressure to under-regulate during spells of no crisis. Imposing global minimum standards increases the costs of deregulation, as it involves deviating from an international treaty. Thereby, such a treaty serves as a commitment device, increasing the odds of resisting transitory domestic pressure stemming from a ‘good luck’ run. Another rationale for the gains associated with minimum prudential standards follows the theory of the second best: the incidence of the moral hazard distortion associated with the ‘too big to fail’ doctrine increase with the magnitude of the distorted activity. Under-regulation, in a country that is financially open, may induce regulatory arbitrage, attracting capital inflows in search of higher returns induced by the higher implicit subsidy provided in more under-regulated countries. Imposing minimum regulatory standards would help in curbing and mitigating the costs of such speculative inflows.¹¹ Arguably, the large exposure of AIG to European and US banks reflected such regulatory arbitrage, where the under-regulation of AIG allowed it to sell underpriced insurance contracts, insurance arrangements that were de-facto subsidized by the US tax payers. These contracts were in the form of a type of guarantee against default. As of June 2008, \$307 billion of these contracts were written on instruments owned by banks in America and Europe and designed to guarantee the banks’ asset quality, thereby helping their regulatory capital levels [see *AIG’s rescue, Size matters*, Sep 18th 2008, *The Economist*]. The sheer size of AIG made these contracts more attractive, as it increased the odds of a bailout. Foreign parties operating in more conservative markets that did not offer such insurance (or markets that charged more for it) had the incentive

¹¹ Further discussion on these issues is in Aizenman (2009)

to purchase the insurance offered by AIG, increasing thereby the short run profits of AIG, and the long run costs to US tax payers.

To conclude, the challenge facing the global financial system is to reform the global financial architecture to allow Goldilocks regulations, and mitigating the temptation to under-regulate in spells of good time, preventing overregulation in the aftermath of a financial crisis. The risk of not meeting these challenges is that affected countries will opt to reduce their financial integration, some will overshoot the regulatory adjustment inducing lower future growth, and other countries would remain exposed to the hazard of replaying crisis dynamics in the future.

APPENDIX

In this Appendix we review a Bayesian inference problem leading to the results discussed in the paper [see Zellner (1971) for detailed analysis of similar inference problems]. Assume that the probability of the crisis is constant overtime. Hence, the probability of n independent draws from the crisis distribution follows a discrete binomial pdf. Specifically, the probability of observing during n periods (1, 2, ..., n), of which m tranquil, no crisis events, and $n-m$ crises events is

$$(A1) \quad p(m | \theta, n) = \binom{n}{m} \theta^m (1-\theta)^{n-m}.$$

Equation (A1), viewed as a function of the unknown parameter θ , is the likelihood function. Suppose that the prior information about the probability of crisis occurrence, θ , is summarized the following beta pdf:

$$(A2) \quad p(\theta) = k\theta^{a-1}(1-\theta)^{b-1}; \quad a, b > 0,$$

where k is a normalization constant [$k = \Gamma(a+b)/\Gamma(a)\Gamma(b)$]. Applying the properties of the beta pdf, it follows that the prior mean of the crisis in period 1 [$P_{0,1}$ in the notation of our paper, for the case where $Q = 1$] is

$$(A3) \quad E(\theta) = a/(a+b).$$

It can be shown that $V(\theta) = ab/[(a+b)^2(a+b+1)]$. Hence, the values of a and b reflect the public's prior information about the mean and the variance of crises occurrence.

Applying (A1) and (A2) and Bayes' theorem, the posterior pdf for the crisis after n periods with m crises realizations is a modified beta pdf:

$$(A4) \quad p(\theta | n, m) = k' \theta^{a-1+m} (1-\theta)^{b-1+n-m}; \quad a, b > 0$$

where k' is the modified normalization constant. The posterior mean of a crisis can be shown to be

$$(A5) \quad E(\theta | n, m) = (a+m)/(a+b+n).$$

Thus, no crisis in period one result with a posterior probability of a crisis in period 2 of

$$P_{1,2} = \frac{a}{a+b+1}.$$

Equation (A5) also imply that the posterior mean of a crisis after a good luck spell of no crisis during periods 1, ..., t is $E(\theta | t) = a/(a+b+t)$. Hence, the marginal impact of another period of no crisis on the crisis probability is

$$(A6) \quad \partial P_{t,t+1} / \partial t = -\frac{P_{t,t+1}}{a+b+t},$$

Recalling that $V(\theta) = ab / [(a+b)^2(a+b+1)]$, a more informative priors are associated with higher a and b ($V(\theta) \xrightarrow{a,b \rightarrow \infty} 0$). Thus, (A6) implies that less informative priors would increase the impact of another period with no crisis on the posterior probability of a crisis [**Claim 4** in the paper].

We close this Appendix with overview of **Claim 5**. Suppose that the public has incomplete information about the regulator efficacy. This would be the case if the actual $Q(\rho_0)$ is impacted by regulatory effort, which is noisily observed by the public. For example, suppose that the actual impact of the regulation intensity increases with the regulator effort, e,

$$(A7) \quad \widehat{Q}(\rho_0, e) = Q(\rho_0)(1 - e),$$

where \widehat{Q} is the regulatory impact on P , as a function of regulatory cost and effort, ρ_0, e , respectively. The public observes the regulation cost, ρ_0 , but has only a noisy indicator ε of the regulator's effort, $\varepsilon = e + \delta$, where δ is the noise. The two components of ε are assumed to be zero mean, independent, $E(e) = E(\delta) = \text{cov}(e, \delta) = 0$, and uncorrelated with the factors impacting the occurrence of a crisis in the absence of regulation.

In these circumstances, observing ε leads the public to infer that the expected regulatory effort is

$$(A8) \quad E(e | \varepsilon) = \varepsilon \frac{V(e)}{V(e) + V(\delta)}.$$

Higher noisiness of the information (i.e., higher $V(\delta)/V(e)$), implies that a given observed ε is associated with lower perceived regulatory effort. Observing ε , the public would infer that the regulation function is

$$(A9) \quad \widehat{Q}^p(\rho_0, \varepsilon) = Q(\rho_0) \left(1 - \varepsilon \frac{V(e)}{V(e) + V(\delta)}\right).$$

The actual ‘‘regulation function’’ observed by the regulator is $\widehat{Q}^a(\rho_0, e) = Q(\rho_0)(1 - e)$, where upper indexes p and a indicates the public inferred Q and actual Q , respectively. Thus, the public understates the impact of regulator's effort by

$$(A10) \quad \widehat{Q}^a(\rho_0, e) - \widehat{Q}^p(\rho_0, e) = Q(\rho_0) \left[\delta \frac{V(e)}{V(e) + V(\delta)} - e \frac{V(\delta)}{V(e) + V(\delta)} \right].$$

The public's undervaluation the regulatory effort increases with the noisiness of the information (i.e., $V(\delta)/V(e)$), and with the realized effort e . Hence, greater regulatory effort that prevents a crisis would induce the public to understate the role of the regulator, magnifying the reduction in the perceived risk of a crisis. The asymmetric information about the actual effort implies that if no crisis would take place in period 1, the posterior probability of a crisis in period 2 will be lower than the one with symmetric information.

To illustrate, suppose that e and δ follow the simplest discrete distribution, each having values $(h, -h)$, with probability half. Hence, the observed ε has three possible values: $2h, -2h$, (corresponding to $(e, \delta) = (h, h)$ or $(-h, -h)$, each pair having a probability 0.25); and 0 , with probability half (corresponding to $(e, \delta) = (h, -h)$ or $(-h, h)$, each pair having a probability 0.25). Suppose that the regulator chooses the high effort $e = h$. With probability half, $\delta = h$, hence $\varepsilon = 2h$, inducing the public to infer correctly the regulator effort. With probability half, $\delta = -h$, hence $\varepsilon = 0$. Not having the full information about e and δ , the public notes that this signal is consistent with either high or low effort ($e = h; \delta = -h$ or $e = -h; \delta = -h$), each with probability half. Thus, the public inferred expected effort, conditional on $\varepsilon = 0$ is:

$$E(e | \varepsilon = 0) = 0 .$$

Consequently, had the regulator follow the high effort enforcement ($e = h$), the public would infer expected effort of $0.5h$ [$= (0.5*1+0.5*0)h$], instead of the actual effort, h . The gap between the actual and public's expected effort is the outcome of asymmetric information. Consequently, had the regulator follow the high effort policy ($e = h$), the public expected posterior in the absence of the crisis would be lower than the symmetric information [$P_{1,2} = a/(a+b+1)$] in states when the realized signal would be $\varepsilon = 0$.

This example illustrates the distortion induced by asymmetric information regarding the regulator effort. Higher effort helping in averting a crisis today would induce overconfidence, leading the public to infer that the risk is lower than the actual one, as the public under weighs the role of the regulator. This in turn would reduce the support for regulations in the future, and may increase the ultimate cost of the crisis.

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