Financial Crisis and the Paradox of Underregulation and Overregulation

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This paper illustrates the paradox of prudential underregulation in an economy that adopts a financial reform that 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. The paper identifies conditions where the level of regulation 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 intensity of regulation. If the spell of no crisis is long enough, the level of regulation may drop to zero, despite the fact that the socially optimal level of regulation remains positive, inducing a regulatory cycle. The less informative is the prior regarding the probability of a crisis, the faster is the drop in regulations induced by a no-crisis run of good luck. The challenges facing the regulator are aggravated by asymmetric information, as is the case when the public does not observe the regulator's effort. Higher regulatory effort, while helping to avoid a crisis, may be misconstrued as a signal that the environment is less risky, reducing the posterior probability of the crisis and eroding the support for costly future regulation. The other side of the regulation paradox is that a crisis resulting in unanticipated high costs may induce overregulation and stagnation, as the parties that would bear the cost of the overregulation are underrepresented in the decision-making process. The paper also outlines a regulatory structure that mitigates these concerns, including requiring 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 toward financial integration of developing countries changed dramatically in the 1990s. The growing optimism about the gains from globalization created support for trade liberalization, 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, and figure 2 plots de facto measures of openness (reporting the ratios of net and gross foreign assets to gross domestic product, GDP).[1] While financial liberalization took off in the Organisation for Economic Co-operation and Development (OECD) in the 1980s, that decade was marked by massive sovereign defaults and growing financial isolation of developing countries. In sharp contrast, in the 1990s developing countries joined the OECD trend toward capital openness, a trend that continued globally until mid-2006. Disaggregation reveals the heterogeneity of the patterns of financial openness of developing countries. Latin America moved more assertively to embrace capital openness, while Asia moved timidly, with financial openness reversing around the onset of the East Asian crisis of 1997–98. The attitude toward 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 in the ratio of total foreign assets to GDP and with more modest changes in the ratio of net foreign assets to GDP (although 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]

FIGURE 1.
De Jure Financial Integration (Chinn–Ito Index), by Level of Development and Region, 1970–2007

a. Emerging, other developing, and OECD countries

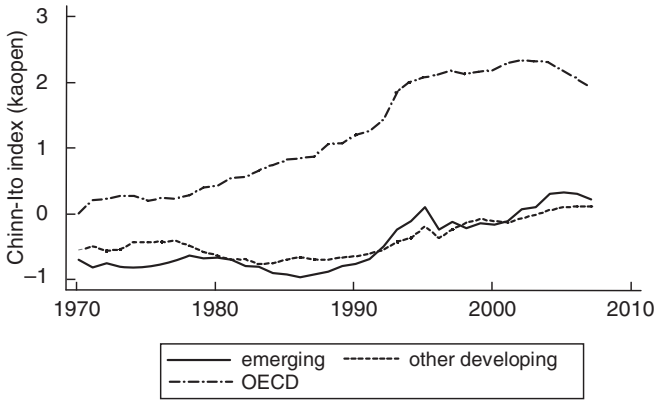
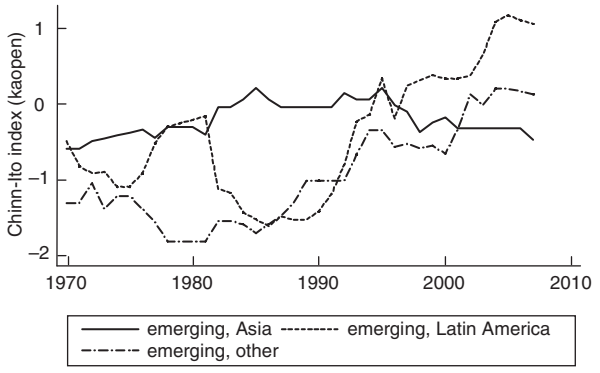
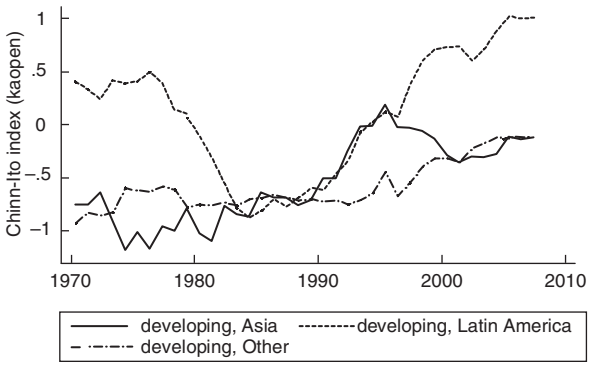


FIGURE 1 (continued).

b. Emerging countries



c. Other developing countries

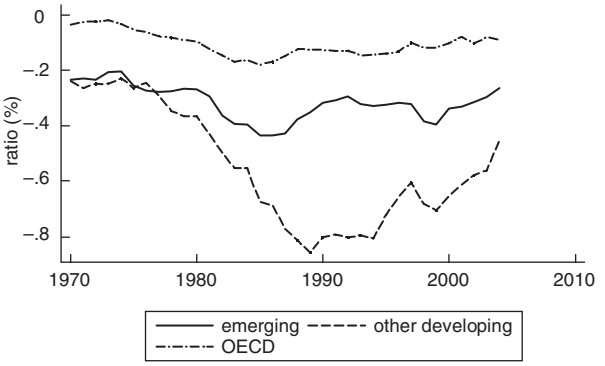


Sources: Ito and Chinn (2008), an index based on information in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions* (*AREAER*). Specifically it is the first standardized principal component of the variables that indicate the presence of multiple exchange rates, restrictions on current account transactions and on capital account transactions, and the requirement of the surrender of export proceeds. By construction, the index's mean is zero, and higher values of this index indicate that a country is more open to cross-border capital transactions.

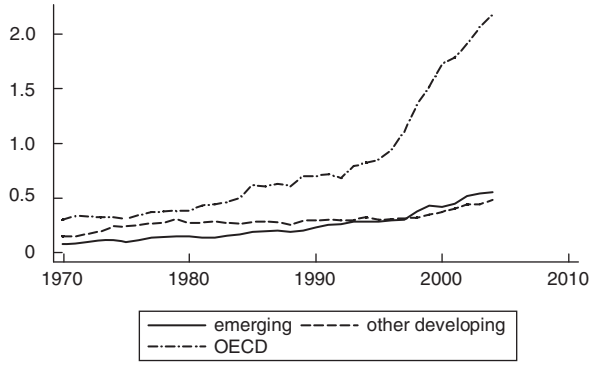
The differences in the path toward financial openness taken by Asia and Latin America may reflect the vigorous debate about financial opening. This deliberation is a reincarnation of the earlier literature on immiserizing growth, which identifies conditions under which growth may be welfare reducing in the presence of preexisting distortions. While financial opening increases welfare when the only distortion is to restrict intertemporal trade across countries, financial opening may reduce welfare 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 that taxpayers will bail them out of a bad investment. This bailout may be carried out by the treasury, the central bank,

FIGURE 2.
De Facto Financial Integration (Ratio of Net and Total Foreign Assets to GDP), by Level of Department and Region, 1970–2006

a. Ratio of net external assets to GDP



b. Ratio of total foreign assets to GDP



Source: External Wealth of Nations Mark II, from Lane and Milesi-Ferretti 2006.

or international agencies such as the International Monetary Fund (IMF) and the World Bank. In these circumstances, the taxpayer subsidizes the investment. A frequent rationale for the bailout 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, led by the United States. Frequently, the presumption has been 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 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 the potential role of the regulator. The data also reveal high persistency of the stances of countries toward financial integration: the autoregressive coefficient of AR(1) process fitted to the Chinn-Ito index over time is 0.84 for emerging Asian countries, 0.99 for emerging Latin American countries, 0.93 for non-emerging developing Asian countries, and 1.00 for non-emerging developing Latin American countries. The high co-movement of the Chinn-Ito index across countries and the persistence of policies toward financial openness suggest that the pendulum is swinging toward financial integration. Indeed, the process of globalization increases the interdependency of national capital markets, possibly leading to tighter co-movements of policies and attitudes toward 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 government and central bank policies in times of systemic crises. It also serves as a painful reminder of the risk of underregulating domestic and international financial intermediation, exposing the taxpayer to excessive risk taking that in due course would be subsidized by taxpayer-financed bailouts. The magnitude of the global crisis with regard to the exposure to risk, the distribution of toxic assets, and the speed of deleveraging surprised most observers; as of April 2009, the IMF estimates that banks and financial institutions globally will have to dispose of or write down about $4 trillion of toxic assets. The high costs of the crisis suggest that the pendulum of financial integration may shift toward a reversal of financial globalization. Even if we agree with George Santayana that "those who cannot learn from history are doomed to repeat it," a necessary condition for successful learning is to understand the forces accounting for the past. Simply reversing the policy stances of the past 20 years would backfire, as doing so might overshoot the needed adjustment, inducing other distortions.

This paper seeks to explain the tendency to underregulate in "good times" and the risk associated with overshooting the adjustment needed following a financial crisis. Both underregulation and overregulation 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 the regulator's services, inducing underregulation, 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 underrepresented in the political discourse. The demand for regulation declines during prolonged good times, increasing the ultimate cost of eventual crises. The other side of the regulation paradox is the hazard of overregulating 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 who would not be financed due to overregulation is unknown (they are not represented in the political discourse). These considerations suggest the need to strive toward a golden rule of Goldilocks prudential regulations.

This paper considers an economy that adopts a financial reform that exposes the economy to a future crisis. There is uncertainty about the crisis and uncertainty about 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. When the majority in the economy is partially exposed to the crisis, and the efficacy of regulation is high enough, the level of regulation following the reform is positive, but below the socially optimal level. Tranquil time, when the crisis would not take place, reduces the intensity of regulation over time. If the spell of no crisis is long enough, the level of regulation may drop to zero, despite the fact that the socially optimal level of regulation remains positive. The less informative is the prior regarding the probability of a crisis, the faster is the drop in regulations induced by a no-crisis run of good luck. The challenges facing the regulator are aggravated by asymmetric information. This would be the case if the probability of a crisis is reduced by the regulator's effort, but the public does not observe this effort. In these circumstances, higher regulatory effort, helping to avoid a crisis, may be seen 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 do not regulate today, damned tomorrow if you regulate today.

A crisis that creates unanticipated high costs may induce overregulation and stagnation, as the parties that would bear the cost of the overregulation are underrepresented in the decision-making process. The paper closes with an outline of a regulatory structure that mitigates these concerns. Better disclosure of information is needed to allow the regulator to assess in real time the 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 underregulate 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 that are enforced by the domestic regulator would mitigate the tendency to underregulate in good times.

Financial Reforms, Regulation, and Individual-Specific Uncertainty

This section outlines 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 is 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 illustrates, 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 results in nasty news, when agents find that they are far more exposed to the crisis than they expected. This model embraces the outcome of an interaction between two ingredients. First, over time agents update 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 intensity of regulation is determined by a majority rule. This section studies the dynamics of regulations during a spell of no-crisis episodes in the aftermath of a reform until the crisis happens. It focuses on the case where the majority of agents face individual-specific uncertainty regarding their exposure to incidences of crisis. This is then contrasted to a case in which 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 0, a policy reform takes place. The policy reform exposes the economy to the 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. A recursive structure is assumed in which the intensity of regulation at time t affects the probability of a crisis at time $t + 1$. In the absence of regulation, the perceived probability at time 0 of a crisis occurring at period 1 is $P_{0,1}$. Regulation associated with spending resources ρ_0 per agent at time 0 reduces the probability of a crisis from $P_{0,1}$ to $P_{0,1} \cdot Q$, $Q(0) = 1$; $Q \leq 1$. The efficacy of regulation increases with the spending: $Q = Q(\rho_0)$; $Q' < 0$.

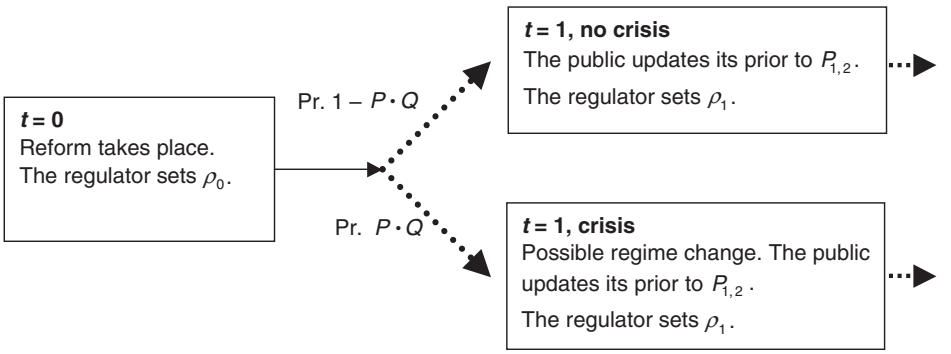
To fix ideas, $Q(\rho_0)$ is assumed to be a logistic function:

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

where υ measures the efficacy of regulation. Hence $Q'(\rho_0) = -\upsilon\,[Q(\rho_0)/(1 + \exp - \upsilon\rho_0)]$. Over time, agents update the probability $P_{t,t+1}$ in a Bayesian manner, so that no crisis in period 0 would induce a lower perceived probability of a crisis in period 2, $P_{0,1} \geq P_{0,2}$. The same applies for an arbitrary t: no crisis from period 1 to t would imply $P_{t-1,t} \geq P_{t,t+1}$. A detailed example of such inference is provided in the appendix to this chapter.

The economy is populated by a large number of atomistic agents, a fraction ω of which is 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 0 of all agents is normalized to 1 minus the per capita cost of the regulation, ρ_0. The timeline is described in figure 3. Financial reform takes place at the beginning of period 0. Next, the authorities set the regulation intensity, ρ_0. At the beginning of period 1, the uncertainty regarding the crisis

FIGURE 3.
Time Line, $t = 0, 1$



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 affected agents to $1 - \tau$. With probability $1 - P_{0,1} \cdot Q(\rho_0)$, no crisis will take place in period 1.

The key difference between the two groups is the individual's risk of being exposed to the crisis. In the *FE* group, all are adversely exposed to the crisis; whereas in the *PE* group, only a fraction $q < 1$ is affected, 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 2, updating the time indexes and leading to the following sequence in periods 1 and 2:

1. Agents adjust downward 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.
2. The policy maker sets the intensity of regulation 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 indexes forward by one period.
3. 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.

If a crisis takes place, a regime change may affect future regulations. In the absence of a 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, $\Sigma_{t=0}^{\infty} \beta^t C_t$. The recursive nature of the problem and the observation that regulation today affects the probability of a crisis tomorrow reduces the policy maker's problem to a two-period optimization.

TABLE 1. Income and Crisis Incidence for the *FE* and *PE* Groups, *t* = 0, 1

Group	Income in *t* = 0	Income in *t* = 1		
Fully exposed (FE) share ω	$1-\rho_0$	$1-\tau$	*crisis* happens,	Pr. $P_{0,1}\cdot Q(\rho_0)$
		1	*no crisis*,	Pr. $1-P_{0,1}\cdot Q(\rho_0)$
Partially exposed (PE) share $1-\omega$	$1-\rho_0$	$1-\tau$ for fraction q	*crisis happens*,	Pr. $P_{0,1}\cdot Q(\rho_0)$
		1 for fraction $1-q$	*no crisis*,	Pr. $1-P_{0,1}\cdot Q(\rho_0)$
		1		

Source: Author.

This section focuses first on the optimal regulation in period 0, 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, to maximize the representative agent's expected utility:

$$\underset{\rho_0}{Max}\left\{1-\rho_0+\beta\left[\begin{array}{l}\omega\left(1-\tau P_{0,1}Q\left(\rho_0\right)\right)+\\(1-\omega)\left[q\left(1-\tau P_{0,1}Q\left(\rho_0\right)\right)+(1-q)1\right]\end{array}\right]\right\}. \tag{2}$$

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 1: that is, if $-1-\tau\beta P_{0,1}\cdot Q'_{|\rho_0=0}(\omega+(1-\omega)q)>0$. Applying equation 1, $Q'_{|\rho_0=0}=-0.5\upsilon$, positive regulation will take place only if $0.5\upsilon\tau\beta P_{0,1}(\omega+(1-\omega)q)>1$. High enough regulatory efficacy υ will induce positive regulation. The critical level of regulatory efficacy associated with positive regulation will depend negatively on the probability of crisis $P_{0,1}$; the cost of crisis, τ; the discount factor, β; and the share of the agents exposed to the crisis, $\omega+(1-\omega)q$. Assuming an internal equilibrium, the first-order condition determining the level of regulation set by the planner, $\tilde{\rho}_{s,0}$, is as follows:

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

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 two cases correspond to this scenario.

The fully exposed (FE) 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, (equation 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 (PE) group forms the majority, as would be the case when individual uncertainty dominates, $\omega < 0.5$. The regulation intensity is determined in a way akin to the planner's solution (equation 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 (that is, $\tilde{\rho}_0 > 0$), the optimal regulation equates the marginal cost, one, with the marginal benefit:

$$-P_{0,1}Q'_{\rho_0}\beta\tau\lambda_k; \text{ where } \lambda_k = \begin{cases} \omega + (1-\omega)q & \text{for } k = S \\ 1 & \text{for } k = FE \\ q & \text{for } k = PE \end{cases} \tag{4}$$

Consequently, the levels of regulation are ranked by claim 1.

Claim 1

With positive regulation, the level of regulation 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:

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

The only difference between the first-order conditions determining optimal regulation is the probability of the deciding group, λ, being exposed to crisis incidence. If the regulation is set by the *FE* group, 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 *FE* group, the lowest when the regulation is determined by a majority composed of the *PE* group, and in between these two when the regulation is determined by the planner.

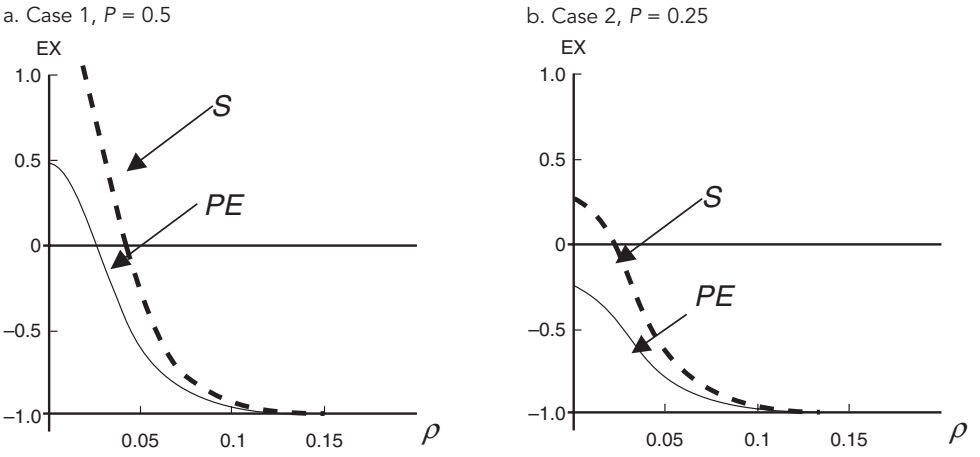
Applying this discussion, the factors affecting the intensity of regulation are summarized in claim 2.

Claim 2

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

To get further insight, this section reviews 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

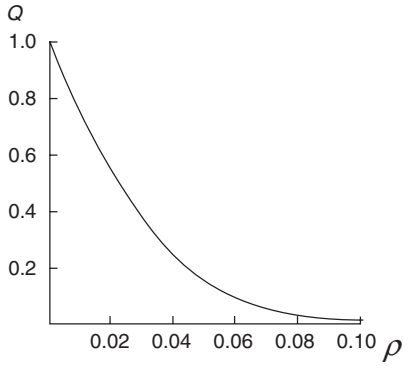
FIGURE 4.
Net Marginal Benefit of Regulation and Regulation Intensity



Source: Author's calculations.

Note: The simulation corresponds to $\beta = 0.95$, $\upsilon = 50$, $\tau = 0.25$, $q = 0.5$, $\omega = 0.3$, drawing $-1 + \beta\tau PQ'q$ (solid) and $[-1 + \beta\tau PQ'(\omega + (1 - \omega)\, q)]$ (dashed) for varying ρ. EX is the expected net marginal benefit.

FIGURE 5.
Regulation Intensity and Risk Reduction



Source: Author's calculations.

probability half ($q = 0.5$) and that the conditions for internal equilibrium are met: $-1 + 0.5\beta\upsilon\tau q > 0$. Figure 4, panel a, 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 dashed curve corresponds to the net marginal benefit of a social planner (S), and the solid curve corresponds to that of the PE decision maker. The optimal level of regulation is determined at the intersection of each curve with the horizontal axis.[5] The PE group overlooks the regulations' benefits accruing to the FE group. 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 5 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 $0.5P$ to about $0.25P$.

Intertemporal Inference and the Dynamics of Underregulation

This section evaluates the intertemporal patterns of underregulation during a spell of good times, a run with no financial crises. The appendix outlines a Bayesian inference example where the prior information about crisis occurrence follows a beta probability density function (pdf), with the prior mean of the crisis occurring in period 1 being $P_{0,1} = a / (a + b)$; $a,b > 0$. The coefficients a,b reflect the prior information of the public regarding the mean and the variance of the probability of a crisis. As shown there, a run of good luck with no crises occurring in periods $(1, 2, \ldots, t)$ would induce a posterior mean of $P_{t, t+1} = a / (a + b + t)$. Hence a longer spell of good luck reduces the perceived mean of a crisis in the next period.

Consequently, each period that the crisis is avoided, the probability P is adjusted downward, shifting both curves in figure 4 downward and thereby reducing 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 b of figure 4. The socially optimal regulation is positive, yet the level of regulation set by the *PE* group is zero: $\tilde{\rho}_{PE} = 0 < \tilde{\rho}_S = 0.02$. This simulation illustrates claim 3.

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 level of regulation in period 0 is positive, but below the socially optimal level. The underregulation drops with the share of exposed agents, q. Tranquil time, when the crisis would not take place, reduces the intensity of regulation. If the spell of no crisis is long enough, the level of regulation may drop to zero, despite the fact that the socially optimal level remains positive.

Individual uncertainty regarding crisis incidences leads to underregulation, with the possibility of converging to zero regulation during long spells of no crisis, despite the fact that it is socially optimal to regulate. Consequently, uncertainty regarding the incidence of the crisis leads to underregulation, 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 underregulation may increase the depth of the ultimate crisis. Claim 3 illustrates the paradox of prudential regulation: uncertainty regarding the identity of the agents that benefit from crisis avoidance leads to underregulation.

The impact of the precision of the prior information is summarized in claim 4, derived in the appendix.

Claim 4

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

With a 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 with some of the recent financial innovations in the United States (exotic derivatives, bundling). Therefore, good luck runs are more damaging in the aftermath of unprecedented financial reform, where the public is exposed to new financial instruments for the first time.

This discussion assumes that the regulatory effort is transparent and that the public is fully informed about it. The implications of regulation opacity and asymmetric information are summarized in claim 5 (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 regulatory effort that avoids a crisis may be misconstrued as signaling 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 may erode the future support for costly regulation.

This example deals with the costs of asymmetric information regarding the regulatory effort. Higher effort that helps to avert a crisis today would induce overconfidence, leading the public to infer that the risk is lower than the actual one, as the public underweighs 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 in the effort today, as this may lead to a crisis tomorrow. Yet a regulator's effort today may induce the public to be overly confident, 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 to a deeper crisis in the future (see the appendix for a detailed example of this situation). Centralized regulation designed to reduce the confusion may mitigate the cost of asymmetric information.

The Hazard of Overregulation

The onset of a crisis may change this scenario in circumstances where the depth of the crisis 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, is of a higher order of magnitude than the anticipated one. A possible interpretation of the disappearance of markets for risk is the emergence of Knightian uncertainty. This concept, postulated by Frank Knight, deals with situations in which 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 were perceived as "known unknowns" are

viewed now as "unknown unknowns"). The aversion to Knightian uncertainty may account for the flight to quality and the large cost of the current crisis, as well as for the costs of the 1997–98 East Asian crisis, when borrowers who were viewed as prime 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 underregulation to overregulation. Such overshooting was avoided in the 1990s. Indeed, the opposite took place in various countries (including Mexico and the Republic of 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 United States, leading to massive deleveraging 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 is premature to reach a conclusion regarding the ultimate regulatory adjustment, the risk is that in the rush to regain credibility, policy makers may overshoot the adjustment or adjust in the wrong direction.

The argument about underregulation following a financial reform may have a symmetric counterpart dealing with overregulation following a financial calamity. In a system that represses financial intermediation, the stakeholders who would have benefited from financial intermediation are underrepresented in the decision making. This would be the case when there is individual uncertainty regarding the incidence of being a successful entrepreneur. The paper does not model this situation, as it is analogous to Fernandez and Rodrik (1991). The main difference between the case of underregulation and overregulation is that in the first, the absence of crisis induces a drop in the probability of a crisis, deepening the underregulation over time. In contrast, overregulation cuts the channels leading to the crisis, at a cost of reducing the actual output below the potential. Overregulation induces a static economy, where the benefit of avoiding a crisis may come with a larger cost of stagnation, a cost that may be underrepresented in the political discourse.

On the Design of Balanced Regulations

The paper closes with a discussion of regulatory changes needed to deal with the challenges associated with underregulation and overregulation.[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 that are large enough to

be considered "too big to fail." The lack of such information has been vividly illustrated in the United States.[9] In the United States, the regulator (the federal government) imposes stringent disclosure requirements on the nonfinancial corporate sector, subject to strict confidentiality of the micro-level data disclosed to the regulator. Curiously, no comparable disclosure requirements are imposed on the financial sector. To illustrate, the Bureau of Economic Analysis (BEA) conducts an annual survey of U.S. 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. The survey contains detailed confidential information, including direct investment, employment data, research and development expenditures, trade in goods and services, and select financial data. This information, and other data collected by federal agencies, provides the regulator with timely information about the nonfinancial 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 noncommercial financial intermediaries. This information gap is troublesome, as the cost of bailing out the financial system is frequently much higher than the cost of bailing out the nonfinancial real sector. Such cost discrepancy reflects the quick diffusion of financial panic. Furthermore, the financial sector tends to be more intertwined than the nonfinancial corporate sector, implying that the bankruptcy of a large enough financial institution may lead to large 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 principal-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 underregulation as a way to facilitate excessive risk taking subsidized by the taxpayers. Indeed, the bargaining clout of Wall Street is seen as having contributed to the underregulation of the financial system in the United States.[10]

Centralizing the Regulatory Process

A fractured regulatory process runs the risk that each agency will focus 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 a "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 process would also minimize the risk that a proactive financial system would attempt to arbitrage between diverse regulatory agencies.

Effective regulation also benefits by improving the quality of the signal provided by the regulatory agency. Fractured regulation runs the risk of increasing the opacity of the system, making it harder for the public to assess the regulatory effort. As shown in claim 5, greater opacity that leads to asymmetric information distorts the regulatory process and may magnify future underregulation.

Adopting Global Standards of Minimum Prudential Regulations and Information Disclosure, Enforced by the Domestic Regulator

The regulatory agency might face growing pressure to underregulate 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 run of good luck. 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 increases with the magnitude of the distorted activity. Underregulation, 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 underregulated countries. Imposing minimum regulatory standards would help to mitigate the costs of such speculative inflows.[11] Arguably, the large exposure of AIG to European and U.S. banks reflected such regulatory arbitrage: underregulation allowed AIG to sell underpriced insurance contracts that were de facto subsidized by the U.S. taxpayers. 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 to boost their levels of regulatory capital.[12] The sheer size of AIG made these contracts more attractive, increasing 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 to purchase the insurance offered by AIG, increasing the company's short-run profits and the long-run costs to U.S. taxpayers.

Concluding Remarks

The framework outlined in this paper can be extended in various ways. The political equilibrium focused on the median voter in a model with two groups, assuming that

the median voter belongs to the partially exposed group. Similar results apply in a framework that allows for a large number of groups differing in their income and exposure to the crisis. As long as the median voter's expected percentage income loss associated with the financial crisis is below that of the economy's wide average, the outcome of the political equilibrium would be underregulation. Alternative modeling would allow for a lobbying equilibrium, where the policy is determined by the balance of contributions. Such modifications tend to magnify the underregulation in good times, as the stakeholders benefiting from underregulation may have access to deeper pools of funds supported by the rents associated with expected underregulation. Similar patterns would take place if agents' priors are updated in a non-Bayesian manner, as may be the case if people pay insufficient attention to low-probability risks of disaster before a crisis happens and too much attention right after.[13]

The analysis of the paper suggests several testable implications. The conjecture that "longer runs" of good times are associated with faster deregulation may be tested directly, although one should recognize that deregulation may increase the duration of the run of good times, deepening the ultimate crisis. When the prior regarding the probability of crisis is less informative, the drop in regulation intensity associated with a spell of no-crisis events is faster. With less initial information, agents operating with greater initial ignorance put greater weight on new information. Thus good luck runs are more damaging in the aftermath of unprecedented financial reform, where the public is exposed to new financial instruments for the first time. This prediction may be tested, subject to the availability of indexes measuring the magnitude and the innovativeness of financial reforms and new financial instruments. Another finding of the paper is that with imperfect observability of the regulator's acts, a higher regulatory effort would be confused with reduced risk in the system, reducing the agent's posterior probability of a future crisis. This, in turn, leads to public complacency about regulation and to underinvestment in regulatory services. Measures of decentralization and opacity of regulatory efforts may be used to verify the degree to which this prediction accounts for the cross-country variation in exposure to the recent crisis as well as for the frequency and depth of crises over time.

In interpreting the results, one should keep in mind that the model applied in the paper is only one example of possible economic environments, where the duration of spells of good times affects the pattern of regulations. This model may be too limiting in that it does not consider the characteristics of the regulated entities or how they influence optimal regulation. Countries differ in structure, such as managerial capacities, political instability, polarization, and aversion to downside risk. These differences may be manifested in different regulatory structures. Yet, independently of the structure, the regulators may face similar challenges across countries, adjusting regulation to reduce exposure to systemic risk, while not forcing banks to become too conservative, and to produce a level of risk that is below the socially optimal level. It is important to keep in mind the difference between regular regulation and systemic regulation. The latter has received much attention during this crisis period. It appears that the costs and benefits associated with crisis occurrence in an uncertain environment is only one dimension of the bigger picture dealing with the short- and long-run trade-offs between a "regular" and a "systemic" regulatory structure.

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

Appendix

This appendix reviews 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 over time. 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 $n–m$ crisis events is

$$p(m \mid \theta, n) = \binom{n}{m} \theta^{m} (1-\theta)^{n-m} \tag{A.1}$$

Equation A.1, 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 as in the following beta pdf:

$$p(\theta) = k\theta^{a-1}(1-\theta)^{b-1}; \quad a,b > 0 \tag{A.2}$$

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 the paper, for the case where $Q = 1$) is

$$E(\theta) = \frac{a}{a+b} \tag{A.3}$$

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 equations A.1 and A.2 and Bayes's theorem, the posterior pdf for the crisis after n periods with m crisis realizations is a modified beta pdf:

$$p(\theta \mid n, m) = k'\theta^{a-1+m}(1 - \theta)^{b-1+n-m}; \quad a,b > 0 \tag{A.4}$$

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

$$E(\theta \mid n, m) = \frac{a+m}{a+b+n} \tag{A.5}$$

Thus no crisis in period 1 results in a posterior probability of a crisis in period 2 of $P_{1,2} = a / (a + b + 1)$. Equation A.5 also implies that the posterior mean of a crisis after a good luck spell of no crisis during period 1, …t is $E(\theta \mid t) = a / (a + b + t)$. Hence the marginal impact of another period of no crisis on the crisis probability is

$$\frac{\partial P_{t,t+1}}{\partial t} = -\frac{P_{t,t+1}}{a+b+c} \tag{A.6}$$

Recalling that $V(\theta) = ab / [(a + b)^2 (a + b + 1)]$, more informative priors are associated with higher a and b [$V(\theta) \xrightarrow[a,b \to \infty]{} 0$]. Thus equation A.6 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 main text).

This appendix closes with an overview of claim 5. Suppose that the public has incomplete information about regulatory efficacy. This would be the case if the actual $Q(\rho_0)$ is affected by regulatory effort, which is noisily observed by the public. For example, suppose that the actual impact of the regulation intensity increases with the regulatory effort, e:

$$\widehat{Q}(\rho_0, e) = Q(\rho_0)(1 - e), \tag{A.7}$$

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 cost of regulation, 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 affecting 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

$$E(e \mid \varepsilon) = \varepsilon \frac{V(e)}{V(e) + V(\delta)}. \tag{A.8}$$

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

$$\widehat{Q}^p(\rho_0, \varepsilon) = Q(\rho_0)\left(1 - \varepsilon \frac{V(e)}{V(e) + V(\delta)}\right) \tag{A.9}$$

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

$$\widehat{Q}^a(\rho_0, e) - \widehat{Q}^p(\rho_0, e) = Q(\rho_0)\left[\delta \frac{V(e)}{V(e) + V(\delta)} - e \frac{V(\delta)}{V(e) + V(\delta)}\right]. \tag{A.10}$$

The public's undervaluation of the regulatory effort increases with the noisiness of the information, that is, $V(\delta)/V(e)$, 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 takes 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 $\varepsilon = 0$, inducing the public to infer correctly the regulatory effort. With probability half, $\delta = h$, hence $\varepsilon = 2h$. 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's inferred expected effort, conditional on $\varepsilon = 0$, is $E(e \mid \varepsilon = 0) = 0$.

Consequently, had the regulator followed 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 the expected effort is the outcome of asymmetric information. Consequently, had the regulator followed the high-effort policy ($e = h$), the public's 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 regulatory effort. Higher effort that helps to avert a crisis today would induce overconfidence, leading the public to infer that the risk is lower than the actual one, as the public underweighs the role of the regulator. This, in turn, would reduce the support for regulations in the future and might increase the ultimate cost of the crisis.

Notes

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 (Ito and Chinn 2008) is based on information in the International Monetary Fund's *Annual Report on Exchange Arrangements and Exchange Restrictions* (IMF various years). 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.
3. The peril of moral hazard and financial fragility associated with financial liberalization is the focus of McKinnon and Pill (1996), Demirgüç-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 1997–98 crisis in East Asia. An overview of these issues and the debate about the desirability of financial opening can be found in 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, April 12, 1997.
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 mar-

ginal 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* group, 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 for the gap between the socially optimal level of regulation and the regulation determined by group *PE*; if all agents are fully exposed ($q = 1$), the majority would choose the socially optimal level of regulation.
7. See Caballero and Krishnamurthy (2008) and Blanchard's guest article in the *Economist* (Blanchard 2009) for the role of Knightian uncertainty in explaining flight to quality and the disappearance of risk markets.
8. See Barth and others (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 U.S. financial system to credit-default swaps at levels that surprised both the public and the regulators (see the case of AIG).
10. See Rajan and Zingales (2003) and Rajan (2005) for insightful discussions of the political economy aspects of financial intermediation. They point out the hazard associated with the incumbent's ability to leverage the power of government regulation to protect the incumbent's economic position. This comes frequently at the expense of the public interest. Similar concerns were raised recently in the United States: "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." Jo Becker and Gretchen Morgenson, "Geithner, Member and Overseer of Financial Club," *New York Times*, April 26, 2009.
11. For further discussion, see Aizenman (2009).
12. See "AIG's Rescue, Size Matters," *Economist,* September 18, 2008.
13. See Viscusi (2010) and the references therein.

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