

# Optimal Policy Coordination for Financial Regime Stability under Informational Barriers about Political Economic Fundamentals

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## Abstract

This paper examines the conditions for effective financial regulatory policy coordination considering the cross-border externalities caused by multinational banks and the political influences exercised by banking sectors. We demonstrate that when the banking sectors are inefficient with higher loan monitoring costs, the regulatory efforts are strategic substitutes between financial regulators, and therefore, the financial regulator of each country tends to exert less regulatory efforts with higher incentives to free ride other countries' regulatory efforts. In case banking sectors shows higher efficiency with lower monitoring costs, the regulatory efforts are strategic complements with lower incentives to free-ride. However, over-sensitive responses to other countries' policies tend to cause financial instability with multiple equilibria. The introduction of informational barriers enables the refinement of multiple equilibria to a unique equilibrium with policy implications that the cooperative financial policy coordination mechanism is more likely to be sustained among more homogeneous countries with lower political influences of banking sectors.

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*Key Words:* Strategic complementarity and substitutability of financial regulatory policies, International policy coordination, Cross-border externality, Capital adequacy requirements, Financial stability

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## **1. Introduction**

After the onset of the latest global financial crisis, which was initiated by the collapse of US mortgage loan markets in 2007, the importance of international policy coordination for financial regulation has been emphasized as a prerequisite to restrain the global contagion of financial crisis. The effective financial coordination became a critical issue since the US financial crisis had caused the collapse of the global financial system and real economies at the global level in an unprecedented speed with little effective international policy coordination mechanism to restrain the spill-over of the crisis.

The latest experience of the global financial crisis confirmed the fact that a well-organized international policy coordination mechanism is essential for effective renovation of financial systems due to the cross-border externalities caused by the multinational financial intermediaries. Motivated by the latest experiences of the cross-border contagion of financial crisis, this paper examines optimal international policy coordination mechanism in financial regulation considering strong cross-border externalities in financial regulation and monitoring efforts via the multinational banking sectors. Moreover, we focus on how the asymmetric political influences of financial sectors affect the effectiveness of the international policy coordination mechanism for financial regulation.

We demonstrate that the effectiveness of financial policy coordination mechanism depends on the level of political influences commanded by the banking sectors and the asymmetry of the banking sectors' political power between coordinating countries. Based on a model integrating political influences commanded by banking sectors with cross-border externalities of financial stability via multinational banking sectors, this paper shows that financial regulatory efforts are strategic substitutes when banking sectors are inefficient with higher monitoring costs. However, when banking sectors are efficient with lower monitoring costs, financial regulatory efforts are strategic complements.

These findings imply that when regulatory efforts are strategic substitutes with relatively lower efficiency of banking sectors, financial regulators prefer to free ride other countries' regulatory efforts ending up globally inefficient level of regulatory efforts. When regulatory efforts are strategic complements with lower monitoring costs, financial instability can be increased with the multiple equilibria in the financial markets. Introduction of informational barriers can reduce the multiple equilibria to a unique

equilibrium via equilibrium refinement with informational noises reduced. Comparative statics of the unique equilibrium show that the cooperative regulatory regime is more likely to be sustained when the political influences of banking sectors are lower, and the asymmetry of banking sectors' political influences among coordinating countries is relatively low. These findings imply that international policy coordination mechanism should be arranged with relatively homogenous countries in terms of banking sectors' constrained political influences.

It is widely believed that the most important factor for the latest financial crisis in 2008 is the wide-spread moral hazard among the issuers of mortgage loan and the mortgage-backed securities (MBS) without proper monitoring efforts. Moreover, the moral hazard was wide-spread even among the financial regulators that are politically influenced and sometimes captured by the banking sectors and the unscrupulous financial sectors such as investment banks and commercial banks that have invested heavily on toxic assets such as the non-performing MBS.

Therefore, a comprehensive approach to design a financial mechanism to contain recurrent financial crisis should handle the mal-functioning banking regulation that is influenced by the banking sectors' lobbying efforts, especially taking consideration of the strong cross-border financial externalities due to multinational banking sectors. The main feature of negative cross-border externalities takes the form of strong incentives to free ride financial regulatory efforts of other countries as observed in case of improper regulatory efforts of toxic assets and the reserved attitude to introduce the regulation against speculative financial traders.

Based on the above backgrounds, this paper examines the conditions for the effective international policy coordination in financial regulation under strong cross-border externalities in financial regulation and banking sectors' monitoring efforts due to multinational banking operations. We examine when financial regulators have a higher incentive to free ride the other country's regulatory efforts focusing on strategic complementarity and substitutability of regulatory efforts that are affected by banking sectors' monitoring and asset management efficiency. In addition, we examine the impact of the asymmetric political influences of banking sectors between coordinating countries.

This paper determines the conditions for self-enforcing international policy coordination mechanism for financial regulation considering the cross-border

externalities caused by multinational banking and asymmetric political influences of banking sectors in each country. We consider two countries with each representative banking sector which operates as a multinational bank in both countries. Each government regulates her representative bank that operates in both home and foreign markets by determining capital adequacy requirements. The government regulation on capital adequacy requirements eventually determines the size of loans made by the banks given the amount of equity. Each banking sector decides the level of monitoring efforts to reduce non-performing loans after observing the government regulation, and the aggregated monitoring efforts of the domestic bank and the foreign bank eventually decide the level of financial stability reflecting the cross-border externality caused by multinational banking operation.

Given these environments, we demonstrate that when banking sectors' monitoring costs are higher than the critical level, the financial regulatory policies are strategic substitutes between regulators, and each regulator has strong incentives to free ride other regulators' regulatory efforts. When financial regulatory efforts are strategic substitutes, the incentives to free ride the regulatory efforts of other countries are increased as policy makers are more short-sighted and the asymmetry of banking sectors' political influences are increased. In addition, we show that when policy makers are far-sighted with homogeneous political economic systems in terms of homogeneous banking sectors' political influences, an introduction of policy coordination mechanism can effectively reduce the incentives to free ride other countries' regulatory efforts.

More specifically, when the asymmetry of political influences of banking sectors is lower than the critical level and policy makers are far-sighted with a higher discount factor, the self-enforcing condition for effective coordination is satisfied with a simple introduction of international financial coordination mechanism itself. Moreover, it is shown that although banks benefit from financial stability, the politically influential bank prefers a regulatory policy, which might lower the financial stability with lower capital adequacy requirement.

These results imply that international policy coordination for financial regulation is feasible among relatively homogeneous countries with political stability, with a high discount factor, by inaugurating the coordination mechanism under the format of repeated coordination game. In other words, the introduction of an international financial policy coordination mechanism should start among relatively homogeneous countries in the initial stage. In the same spirit, countries with relatively

homogenous political economic structure should play the leading roles for financial policy coordination such as in recent discussion for various formats of international financial policy coordination including G20, Trans-Pacific Partnership (TPP), and other regional coordination efforts.

We also demonstrate that when the banking sectors' monitoring costs are lower than the critical level, the regulatory efforts are strategic complements, and therefore, financial regulators do not have incentives to free ride other countries' regulatory efforts. Nonetheless, the strategic complementarity of regulatory policies is the source of the uncertainty of the regulatory regime due to multiple equilibria of regulatory regime. Therefore, we show that even if regulators do not have incentives to free ride the other countries' regulatory efforts when regulatory policies are strategic complements, the introduction of international financial policy coordination mechanism is required to reduce the financial instability due to the multiple equilibria of financial regulatory regimes.

This paper intends to contribute to the existing literature by adding an explicit discussion on the impacts of international policy coordination focusing on the difference between strategic complementarity and substitutability of regulatory efforts that was not addressed by the earlier literature that tried to examine the feature of cross-border externalities of financial stability. Numerous studies, including Stolz (2002), Aghion et al. (2007), Kohler (2002), Dalen and Olsen (2004), have investigated the optimal mechanism of banking regulation in the presence of cross-border lending. Stolz (2002) examines the optimal design of banking supervision in the presence of cross-border lending, and argues that if supervisors are accountable only to their own jurisdictions, they fail to implement the optimal level of supervision from a supranational perspective, and consequently, the probability of bank failures is significantly increased. Aghion et al. (2007) showed that when policy makers are heavily influenced by domestic interest groups, the global policy coordination cannot be achieved.

Assuming an overlapping generation model of two countries with a homogeneous, non-storable consumption good, Chang (1997) demonstrated that financial integration might deteriorate the welfare under non-cooperative policymaking regime. In addition, Kohler (2002) shows that positive spillovers of the coalition formation process and the resulting free-rider problem limit the stable coalition size, and increases the incentives to deviate from the coalition. Dalen and Olsen (2004) analyze the optimal policy coordination mechanism focusing on the impacts of cross-border

banking and entry of multi-national banks (MNBs) for banking supervision and regulation. They show that the improper international coordination mechanism for regulation on MNB-subsidiaries lowers capital adequacy requirements.

In addition, this paper integrates a global game approach in refining multiple equilibria in case regulatory efforts are strategic complements as in Morris and Shin (2002) and Angeletos and Pavan (2007). We claim our approach could provide more explicit policy implications through comparative statics on the unique equilibrium to the existing literature that emphasized the importance of international policy coordination mechanism when cross-border externalities are observed, as Loisel and Martin (2001), Jensen (1999), Botman and Jager (2002), Shin (2012), Bruche and Suarez (2010), and Freixas and Holthausen (2004). Dell’Ariccia and Marquez (2006) showed that centralized regulation is more likely to emerge among relatively homogeneous jurisdictions and entails standards higher than those of the country with the highest individual standards.

This paper contributes to the earlier body of literature by determining the conditions for financial regulators’ incentives to free ride the other countries’ regulatory efforts. We demonstrate that when financial regulatory policies are strategic substitutes with banks’ monitoring costs higher than the critical level, financial regulators have strong incentives to free ride other countries’ regulatory efforts. The economic intuition behind this finding is that the strict financial regulation with higher capital adequacy requirements imposes higher costs to the inefficient banking sectors with higher monitoring costs. Therefore, financial regulator has higher incentives to free ride other countries’ regulatory efforts due to cross-border externalities. Our finding that the financial policy coordination mechanism can be sustained effectively among relatively homogeneous countries is consistent with the results in Dell’Ariccia and Marquez (2006), while they did not examine the condition for strategic substitutability of financial regulatory policies.

Moreover, we demonstrate that when financial regulatory policies are strategic complements with the banking sectors’ monitoring costs lower than the critical level, financial regulators do not have the incentives to free ride other countries’ regulatory efforts, which was not discussed in earlier literatures. Nevertheless, we show that it is required to introduce the international financial policy coordination mechanism to reduce financial instability due to the multiple equilibria of regulatory regimes even if

financial regulators do not have the incentives to free ride with strategic complementarity of regulatory policies. In addition, the comparative statics of the unique equilibrium obtained from global game type equilibrium refinement show that financial regulatory policy coordination mechanism is more sustainable between homogeneous countries with lower political influences of banking sectors.

This paper is organized as follows. Section 2 introduces the model and Section 3 examines the equilibrium of international financial policy coordination when regulators have incentives to free ride other countries' regulatory efforts with strategic substitutability of regulatory policies. Section 4 shows that the introduction of financial policy coordination is required even if banking sectors do not have free riding incentives when regulatory policies are strategic complements, and Section 5 discusses the policy implications of the results and concludes.

## 2. Model

We consider two countries, domestic and foreign countries, with a representative bank in each country, operating as a multinational bank in both domestic and foreign markets. The financial supervisor in each country regulates banks operating in her territory by deciding the capital adequacy requirement ratio given her policy objective function, which is a weighted summation of the banking sector's utility and the public sector's utility represented by the financial stability of the country.

After observing the decision of the financial regulator, the representative banking sector in each country decides how to allocate her loans between the domestic market and foreign market as well as her monitoring efforts level over her loans. The financial stability of the country is decided by the aggregate monitoring efforts of the domestic bank and the foreign bank to minimize the non-performing loans. For the simplicity of the analysis without loss of generality, the banking sectors' aggregate monitoring efforts level is interpreted as the level of financial stability that determines the final rate of return from loan making.<sup>1</sup> First, we examine the case of one-shot game where each policy maker employs a non-cooperative Nash strategy, which can be interpreted as the case where each government takes a short-sighted policy approach.

A representative banking sector operating both in the domestic and the foreign markets has two strategic variables such as monitoring efforts over risky loans that it extends to borrowers and the allocation of loans between domestic and foreign markets. The rate of return from loan making in country  $i$  is given as follows, taking the form of an inverse demand function of loans:

$$r_i = \bar{r}_i - (L_{ii} + L_{ji}) = \bar{r}_i - \left( \frac{\theta_i E_i}{k_i} + \frac{(1-\theta_j) E_j}{k_i} \right) \quad (1)$$

where  $L_{ji}$  is the loan made by bank  $j$  in country  $i$ .

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<sup>1</sup> The financial regulator in each country regulates both domestic banks and foreign banks operating within domestic market, while domestic banks operating in the foreign market are regulated by the foreign financial regulator. Therefore, when a banking sector decides the allocation of loans and the level of monitoring efforts, the regulatory policies of the foreign country is considered in her profit maximization process. Since the foreign regulatory policies are already reflected in the domestic banking sector's decision on the monitoring efforts, even if we assume that the banking sector makes different monitoring efforts in different markets, it does not make significant qualitative difference in the results from those based on the current assumption that each banking sector makes symmetric monitoring efforts in both markets reflecting two countries' regulatory policies.

More specifically, the amount of money loaned by bank  $j$  in market  $i$ , is defined as follows:  $L_{ji} = \frac{(1-\theta_j)E_j}{k_i}$  where  $\theta_i$  is the strategic variable decided by bank  $i$  as the share of loan made in market  $i$ . Therefore,  $1-\theta_j$  represents the share of the bank  $j$ 's loan made in market  $i$  among the total loan made by bank  $j$ .  $E_j$  is the level of equity procured by bank  $j$ .  $k_i$  is the capital requirement ratio imposed by the financial regulator in country  $i$ ,  $k_i = \frac{E_i}{L_i}$ , where  $E_i$  represents the equity level of bank  $i$ , and  $L_i$  represents the amount of money loaned by the representative bank in country  $i$ .<sup>2</sup>

Bank  $i$  tries to maximize her profits by deciding her loan portfolio between the domestic market and the foreign market as well as her level of monitoring efforts for risky loans with the profit function defined as follows:

$$\text{Max}_{q_i, \theta_i} \Pi_i = (q_i + \gamma_{ji}q_j)r_iL_{ii} + \mu(q_j + \gamma_{ij}q_i)r_jL_{ij} - c_iq_i^2 \quad (2)$$

$$\text{such that } (q_i + \gamma_{ji}q_j)r_iL_{ii} + (q_j + \gamma_{ij}q_i)r_jL_{ij} - c_iq_i^2 \geq \phi_iD_{ii} + \rho_iE_{ii} + \phi_jD_{ij} + \rho_jE_{ij} \quad (3)$$

where  $q_i$  is bank  $i$ 's monitoring efforts level to minimize the non-performing loan. The banks' monitoring efforts reduce the non-performing loan and improve financial stability of the banking sector. Therefore, the level of monitoring efforts is regarded as a parameter determining financial stability and the final rate of return from loan making.

The aggregate monitoring efforts level of the banking sector including the cross-border impact of foreign bank's monitoring efforts,  $q_i + \gamma_{ji}q_j$ , decides the

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<sup>2</sup> The representative banking sector has two strategic variables to maximize the banking sector's profits such as the monitoring effort level to minimize risky assets and the allocation of the available funds among the domestic market and the foreign market. When the financial regulator increases the capital requirement ratio, the representative bank should reduce the amount of risky loans, eventually reducing the total amount of loan given the bank's equity level. Therefore, the increased rate of return from loan making further induces the higher level of monitoring efforts by the representative banking sector. Since we target to examine the impact of cross-border externalities of financial regulation, we do not introduce other investment opportunities for the banking sector that are free from the influence of the financial regulator.

domestic financial stability that influences the final rate of return from domestic loan making.  $\gamma_{ji}$  represents the cross-border externality of foreign bank  $j$ 's monitoring efforts on domestic financial stability in country  $i$ .<sup>3</sup> The cross-border externalities in banking sectors are created by multinational banks that make loans in the foreign market affecting foreign rate of return from loan making directly. In addition, cross-border externalities are also made by the psychological factor that drives cross-border financial herd behaviors. The direct impact of cross-border externalities are represented by the multinational banks' loan made in the foreign market and the ' $\mu$ ' that is explained later. Therefore,  $\gamma_{ji}$  can be interpreted as a parameter representing the indirect cross-border externalities in banking sectors.

With the cross-border financial externalities due to multinational banking operation, the financial stability of the domestic country is influenced by the foreign financial monitoring efforts by the scale of  $\gamma_{ji}$ .<sup>4</sup> ' $\mu$ ' is the parameter representing the level of capital market integration, with the lower ' $\mu$ ' representing the higher capital market barriers such as the restriction of profit transfer from host country  $j$  to home country  $i$ .<sup>5</sup> The cost of banking sector's monitoring efforts takes the quadratic form,  $c_i q_i^2$ , where  $c_i$  is the monitoring cost parameter of bank  $i$ , representing the banking sector  $i$ 's efficiency.

Based on equation (1), the profit function of the banking sector can be represented as follows:

$$\text{Max}_{q_i, \theta_i} \prod_i = (q_i + \gamma_{ji} q_j) r_i \frac{\theta_i E_i}{k_i} + \mu (q_j + \gamma_{ij} q_i) r_j \frac{(1 - \theta_i) E_i}{k_j} - c_i q_i^2 \quad (4)$$

The liquidity constraint is given as equation (3), where the left-hand side term of the inequality is the liquidity available as profits of the banking sector, while the

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<sup>3</sup>  $(q_i + \gamma_{ji} q_j) \in [0, 1]$ . When there is no financial instability, there is no non-performing loan with  $(q_i + \gamma_{ji} q_j) = 1$ . When the financial stability is deteriorated to the worst case, all loan made by the bank become non-performing loan with  $(q_i + \gamma_{ji} q_j) = 0$ , implying the banking sectors' assets become junk assets with no return retrieved.

<sup>4</sup> The cross-border externalities of monitoring efforts on domestic financial stability are created by the multinational banking operation in this model. However, we might assume that the cross-border externalities,  $\gamma_{ji}$ , includes psychological cross-border contagion effects that are often discussed in behavioral finance literatures.

<sup>5</sup> As a parameter representing the level of financial market integration, ' $\mu$ ' denotes the level of free transfer of the profits made in the foreign markets.

right-hand side is the payment requirement.  $D_{ii}$  is the amount of the deposit that bank  $i$  receives in country  $i$  while  $\varphi_i$  is the cost involved with raising deposits, while  $\rho_i$  is the parameter showing the cost of raising its own equity, i.e., the cost of capital formation. Therefore, the total amount of payment requirement is the summation of the payment requirement for the deposit, and the cost of the capital formation in the domestic country and the foreign country. When the liquidity constraint is not satisfied, the representative banking sector faces the bankruptcy, and the financial system and the financial stability is collapsed.<sup>6</sup>

The objective function of the country  $i$ 's financial supervisor is defined as a weighted summation of the utilities of the banking sector, the profits of the banking sector, and the utilities of the public that is dependent on the financial stability.<sup>7</sup>:

$$Max_{k_i} W_i = \alpha_i \prod_i (L_i, L_j) + \beta_i (q_i + \gamma_{ji} q_j) \quad (5)$$

where  $\alpha_i$  is the coefficient representing the political influences commanded by the banking sector of country  $i$  while  $\beta_i$  is the coefficient representing the political concerns about the public utility represented by the financial stability of society as a whole. If  $\alpha_i$  is relatively higher than  $\beta_i$ , the financial supervisor is captured by the banking sector, giving higher political importance to the banking sector's profit than to general social welfare represented by the financial and economic stability.<sup>8</sup>

The structure of the game can be summarized as follows: The financial supervisor in each country decides financial regulatory policy, i.e., the capital adequacy

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<sup>6</sup> The government policy interventions to resolve the bankrupt financial sectors are not considered in this model since we focus on cross-border externalities and resulted financial coordination issues. Moreover, the liquidity constraint of each representative banking sector is assumed to be satisfied in this paper since the parameters in liquidity constraint do not directly affect the coordination mechanism over cross-border externalities in financial markets.

<sup>7</sup> The stability of domestic financial market is decided not only by the domestic banking sectors' monitoring efforts, but also by the foreign bank's monitoring efforts by the rate of externalities reflected by the parameter  $\gamma$ . In addition, the objective function of the financial regulator is assumed to be equivalent to the objective function of social planner in this paper.

<sup>8</sup> Dell'Ariccia and Marquez (2006), which is closest to this paper in terms of model setting, sets the weight on the financial stability in the policy objective function as  $(1 - \alpha) \beta$  assuming that  $\beta$  is a scaling factor of the financial stability. However, we simplify the weight given to the financial stability to  $\beta$  instead of  $(1 - \alpha) \beta$  to focus on the different political economic weight given the banking sector's profits and public interests related to the financial stability of the economy.

The banking sector's profit is positively affected by the financial stability of the economy. However, the optimal level of financial regulation on the capital adequacy requirement that maximizes the social welfare is higher than the level of capital adequacy requirement that maximizes the banking sectors' profits. Therefore, as  $\alpha_i$  is higher, the optimal  $k^*$  is lowered, eventually lowering the level of financial stability,  $q_i + \gamma_{ji} q_j$  as shown in Proposition 2.

requirement, to maximize the policy objective function, which is the weighted summation of the utilities of the banking sector and the public utility, i.e., the financial stability of the economy. After observing the government decision, the representative bank in each country maximizes her profits from the multinational banking operations in domestic and foreign markets with respect to two strategic variables: the allocation of loan-making between home and foreign markets and the bank's monitoring efforts level to reduce the non-performing loans.

### **3. Policy coordination for financial regulation with strategic substitutability of regulatory policies**

When there are cross-border externalities in financial market stability, international policy coordination is required to internalize the cross-border externalities. Given cross-border externalities in the financial markets, if financial regulatory policies as capital adequacy regulation of involved countries have the property of strategic substitutability, each country has an incentive to free ride the regulatory efforts of other countries. Therefore, international policy coordination mechanism is required to prevent insufficient provision of regulatory efforts for financial stability.

However, if financial regulatory policies have strategic complementarity between countries with cross-border externalities, financial regulatory efforts of a country will be complemented with the regulatory efforts of other countries under cross-border externalities. Therefore, each country has no incentive to free ride the regulatory efforts of neighboring countries, and henceforth, the explicit arrangement for international policy coordination mechanism for cooperative regulatory measures is not required to prevent the under-provision of the regulatory efforts for financial stability.

Nonetheless, strategic complementarity of the financial regulatory policies involves another problem of economic uncertainty caused by multiple equilibria in financial regulation under complete information. Under strategic complementarity of regulatory efforts, both cases of under-provision and over-provision of regulatory efforts by involved countries can be equilibria as multiple equilibria. Conditions for each type of equilibrium are examined in the next section.

First, we define the market equilibrium when each policy maker makes a decision in a non-cooperative Nash equilibrium fashion via backward induction. A bank decides the loan allocation between foreign and domestic markets, and then it makes a decision about its level of monitoring efforts. The optimal level of monitoring efforts by each

bank is given from the first order condition of the bank's profit maximization problem as follows<sup>9</sup>:

$$\frac{\partial \Pi_i}{\partial q_i} = 0 \rightarrow q_i^* = \frac{E_i}{2c_i} \left( \frac{r_i \theta_i}{k_i} + \frac{\mu \gamma_{ji} r_j (1 - \theta_i)}{k_j} \right) \quad (6)$$

The bank then decides on its allocation of the loans between two markets to maximize its profits. The optimal allocation of the loan is determined from the following first order condition, which is a function of the level of optimal efforts as given above.

$$\frac{\partial \Pi_i(q_i^*)}{\partial \theta_i} = 0 \rightarrow \theta_i^* = \frac{k_i (2c_i k_j q_j (\mu r_j k_i - \gamma r_i k_j) + E_i \gamma \mu r_j (\gamma \mu r_j k_i - r_i k_j))}{E_i (r_i k_j - \gamma \mu r_j k_i)^2} \quad (7)$$

Considering the equilibrium values of each banking sector's strategic variables, the financial regulator in each country decides the capital requirement ratio,  $k_i$ .<sup>10</sup> When the policy maker takes a short-sighted approach as opposed to a long-term approach, the regulator makes a decision as a one-shot non-cooperative Nash equilibrium strategy. The financial regulator's objective function with a short-sighted policy horizon is defined as a non-cooperative game maximizing her own welfare given the other country's regulatory policy as follows:

$$Max_{k_i} W_i(k_i, k_j) = \alpha_i \Pi_i^*(k_i, k_j) + \beta_i (q_i^*(k_i, k_j) + \gamma q_j^*(k_i, k_j)) \quad (8)$$

However, when the policy maker, i.e., the financial regulator, takes a long-term approach and therefore, the discount factor of the policy maker is relatively high, the policy maker takes an approach to choose a cooperative strategy derived from the joint-welfare maximization problem defined as follows:

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<sup>9</sup> The banking sector is assumed not to make separate monitoring efforts between the home and foreign markets, but to make a single decision for the monitoring efforts level in both markets taking consideration of two countries' regulatory policies to focus on the role of the banking sectors' different efficiency levels, i.e., the different monitoring costs.

<sup>10</sup> The regulation of the capital requirement ratio can be interpreted as a form of general financial supervision including the forward looking criteria of financial institutions' asset management.

$$Max_k(W_i(k, q_i^*, q_j^*) + W_j(k, q_i^*, q_j^*)) = Max_k(\alpha_i \prod_i^*(k) + \beta_i (q_i^*(k) + \gamma_{ji} q_j^*(k)) + \alpha_j \prod_j^*(k) + \beta_j (q_i^*(k) + \gamma_{ij} q_i^*(k)))$$

From the comparative static analysis of the optimal monitoring efforts level and the equilibrium welfare under a non-cooperative regime, cross-border externalities of the financial regulation are determined as summarized in Lemma 1. <sup>11</sup>

**Lemma 1.** *Each country's financial regulation policy creates positive externalities in that a higher capital adequacy requirement of a country increases the monitoring efforts of the other country's banking sector.*

**Proof:** See the Appendix.

When there is the positive cross-border externality in the financial regulatory policies, it is required to consider the strategic interaction between each country's financial regulatory policies. Especially, strategic substitutability of each country's financial regulatory policies makes a big difference in the international policy coordination mechanism from the case of strategic complementarity of regulatory policies. When the strategic properties of financial regulatory policies are characterized by strategic substitutes, each country prefers to free ride the other country's financial regulatory efforts taking advantage of the positive spillover effects of the other country. However, when financial regulatory policies take the property of strategic complementarity, international coordination over financial regulatory policies become more uncertain with multiple equilibria although free riding incentives are removed, in contrary to the case of strategic substitutability.

In case of strategic complementarity of financial regulatory policies, there might be multiple policy coordination equilibria under complete information about the payoffs from each policy choice. In this case, explicit coordination mechanism is required to prevent a serious uncertainty caused by the multiple equilibria in international policy coordination. If we introduce informational barriers with noisy signals about banking sector's efficiency of coordinating countries, a unique equilibrium

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<sup>11</sup> The positive externality is determined in such a way that more prudent financial regulation of a country enhances the representative bank's monitoring efforts of another country and welfare of the country. Whether a bank's increased monitoring efforts of a country's will enhance the monitoring efforts of the representative bank's monitoring efforts of another country as a strategic complement or replace the monitoring efforts of other banks' monitoring efforts depends on the assumption of the strategic characteristics of monitoring efforts of competing banking sectors. The assumption of the cross-border spillover effects of financial stability implies strategic complementarity of the monitoring efforts of competing banking sectors.

of policy coordination can be achieved, while multiple equilibria are unavoidable under complete information given strategic complementarity of regulatory policies as demonstrated in general global game theoretic literatures.<sup>12</sup>

Now, we examine the conditions for strategic substitutability and strategic complementarity given the current setting of financial regulation of capital requirement ratio, i.e., capital adequacy ratio regulation. By checking the cross partial derivative of the social welfare function with respect to each country's regulatory policy variables, we can determine the strategic substitutability and strategic complementarity. It is shown that when loan monitoring cost of banking sectors is higher than the critical value and foreign bank's equity is relatively lower than the domestic equity size, and the level of international financial market integration is lower, it is more likely that the financial regulatory policy, i.e., the capital adequacy ratio regulation, has the property of strategic substitute.

**Proposition 1.** *When the loan monitoring cost of banking sectors,  $c$ , is higher than the critical level,  $T$ , and a foreign bank's equity,  $E_j$ , is relatively lower than the domestic bank's equity size,  $E_i$ , it is more likely that the financial regulatory policy, i.e., the capital adequacy ratio regulation, has the property of strategic substitute. Moreover, given  $c > T$ , when the international financial markets are more integrated with higher  $\mu$ , the strategic substitutability of the financial regulatory policies is increased.*

**Proof:** See the Appendix.

Proposition 1 demonstrates that when the banking sector is inefficient with the loan monitoring cost of banking sectors being higher than the critical level, it is more likely that the financial regulatory policies are strategic substitutes with higher incentive for each country to free ride the other country's financial regulatory efforts. The intuition behind this result is that when the banking sector is inefficient with the higher monitoring costs, the financial regulation with the higher capital adequacy requirement is costly not only to inefficient banking sectors but to politically influenced regulators. Therefore, each regulator has higher incentives to free ride the other country's regulatory efforts under the cross-border externality of financial regulatory policies.

Moreover, when the domestic banking sector's equity size is higher and the

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<sup>12</sup> The seminal paper by Carlsson and Van Damme (1993) shows how multiple equilibria with strategic complements can be refined to a unique equilibrium with the introduction of noisy signals.

foreign banking sector's equity size is smaller, with the smaller impact of the foreign banking sector on the domestic market, the domestic banking sector has less incentive to coordinate with the foreign banking sector. In addition, when the loan monitoring cost is higher than the critical level, the higher financial market integration provides higher incentives to free ride the foreign country's regulatory efforts. These results imply that when the banking sector of the partner country has a larger amount of equity with higher monitoring efforts, a country's financial regulator has a higher incentive to coordinate with the country since the gains from the coordination is larger. Contrarily, when a country's equity is relatively larger than the partner's, the incentive for policy coordination gets lower since the gains from the coordination is lower.

Based on Lemma 1 and Proposition 1, it is shown straightforwardly that joint-welfare maximizing financial policy coordination cannot be sustained when both policy makers take short-sighted approaches in Corollary 1.

**Corollary 1.** *International policy coordination for the cooperative regulatory policy might not be sustained when  $c > T$  and both policy makers take short-sighted approaches.*

**Proof:** See the Appendix.

The intuition behind Corollary 1 is that the positive cross-border externalities in financial regulation provide incentives for free-riding in financial regulation when a credible enforcement mechanism for the cooperative regulatory policy is not established, where non-cooperative Nash regulatory strategy is taken with the short-sighted one-shot game approach. However, when the financial regulators take far-sighted approaches, the financial regulatory game is changed to a repeated game where cooperative regulatory strategies are Nash equilibrium strategies. Therefore, an introduction of a policy coordination mechanism in financial regulation might allow for a cooperative equilibrium in banking regulation by making the cooperative regulatory policy as a self-enforcing policy, changing the regulatory policy game to a repeated game.

The asymmetry of the parameter,  $\alpha_i$ , which stands for the political influences of the representative banking sector, represents the asymmetry of political economic structure of financial regulatory system. It is shown that the level of the political economic asymmetry among the coordinating countries play a major role in the introduction of the effective policy coordination mechanism for financial regulation in

Corollary 2.<sup>13</sup>

**Corollary 2.** *Given strategic substitutability of financial regulatory policies with  $c > T$ , if countries show relatively low asymmetry in political economic characteristics and take long-term policy approaches as represented in a higher discount factor, the simple adoption of an international coordination mechanism for financial regulation might enable international policy coordination in financial regulation, even without a credible enforcement mechanism to implement the cooperative strategy.*

**Proof:** See the Appendix.

Corollary 2 implies that when countries show fairly large asymmetry in political economic structures and relatively short-sighted policy approach with low discount factor, the self-enforcement condition for the cooperative financial regulatory policy cannot be sustained without a credible external enforcement mechanism. When a bigger asymmetry of political economic feature of each country is observed, with  $\sigma \geq \underline{\sigma}$ , it is more likely that each country has a larger incentive to deviate from the cooperative financial regulatory policies as shown in equation (A6).

Therefore, if the self-enforcement condition for the cooperative financial regulatory policies cannot be satisfied with a relatively lower discount factor and higher heterogeneity in the political economic structure of coordinating countries, it is required to introduce a mechanism for cooperative financial regulatory policies that is enforced by a third party. The credible enforcement mechanism enforced by a third party should make the cooperative financial regulatory policy as a dominant strategy as summarized in Corollary 3.

**Corollary 3.** *When the self-enforcement condition for the cooperative financial regulatory policies is not satisfied due to a lower discount factor of the policy makers and a higher political economic heterogeneity among coordinating countries, effective*

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<sup>13</sup> The policy coordination mechanism is assumed to take the form of repeated game structure as in most coordination games. Therefore, the adoption of the policy coordination mechanism implies that the game structure is transformed to a repeated game. Each country's regulator is assumed to take a tit-for-tat strategy. Therefore, a country keeps the cooperative strategy as long as the partner keeps cooperative strategy. In the same context, when a partner country deviates to a non-cooperative regulatory policy, a country retaliates with a non-cooperative policy. When the retaliatory non-cooperative regulatory policy is taken indefinitely, it can be labeled as a trigger strategy approach, which is assumed in this paper for the sake of simplicity without loss of generality.

*financial policy coordination can be sustained only with an introduction of a credible enforcement mechanism by a third party.*

When a discount factor of a policy maker is relatively lower, the policy maker makes a short sighted approach, as in the case of discontinuous policies over different political regimes after the regime changes. As a financial regulator takes a short sighted approach, the regulator has an incentive to choose a non-cooperative policy, i.e., a lower capital requirement ratio. The intuition is that when the discount factor of the policy maker is relatively lower, the policy maker has a larger incentive to collect political donations from the financial sector while paying less attention to the financial stability which might be enhanced with more rigorous regulatory policy, i.e., a higher capital requirement ratio.

In the same context, when countries show larger heterogeneity in the banking sector's political influences, i.e., when  $\sigma > \underline{\sigma}$ , a country with a higher political influence of banking sectors, a higher  $\alpha$ , is more likely to deviate to a non-cooperative regulatory policy. That is, when the asymmetry of political influences of banking sectors is higher than the critical level, a financial regulator under the higher political influence of the banking sector, a higher  $\alpha$ , will deviate to a lower capital requirement ratio with the eventual collapse of the policy coordination mechanism of the financial regulation.

Therefore, if  $\sigma > \underline{\sigma}$ , the introduction of the credible enforcement mechanism enforced by a third party is required for effective financial policy coordination.<sup>14</sup> Considering the real world constraint that it is politically complicated to introduce the credible enforcement mechanism over the cross-border financial regulatory policies, Corollary 3 suggests that it is more likely that the cooperative financial policy coordination can work among countries where policy makers have higher discount factors with relatively homogenous political economic structures in financial policy making process.

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<sup>14</sup> The role of a credible external enforcement mechanism is to make the cooperative financial regulation policy as a dominant strategy for all countries involved with the policy coordination. The typical path to make the cooperative financial regulatory policy as a dominant strategy is to impose heavy enough penalties against a deviation strategy making the payoffs from the non-cooperative policy lower than the payoffs from the cooperative policy. However, considering the international political reality where the credible mechanism to impose the penalty does exist, the self-enforcing condition for the cooperative regulatory policy can be interpreted as the unique condition for the cooperative policy coordination.

Finally, with the cross-border externalities considered, it is shown that when financial regulatory policies are strategic substitutes, the more political influence the banking sector commands in each country, it is less likely that the socially optimal financial regulatory policy is adopted. When the financial sector has a higher political influence over the financial regulator with a higher  $\alpha$ , the level of capital adequacy requirement decided by the regulator gets lower, eventually leading to a lower financial stability in each country as shown in Proposition 2.

**Proposition 2.** *When financial regulatory policies are strategic substitutes with  $c > T$ , if the representative banking sector commands higher political influences on the financial policy making process, it is more likely that the capital adequacy requirement is lowered, leading to a lower level of financial stability.*

**Proof:** See the Appendix.

Proposition 2 shows that, in contradiction to the general perception that the banking sector benefits most from the financial stability, the politically influential banking sector has an incentive to add political pressures on the financial regulator to lower the level of capital adequacy requirement at the sacrifice of financial stability. This implies that it is socially desirable to reduce or limit the banking sectors' efforts to increase the political contribution to influence policy makers providing regulators incentives to free-ride other countries' regulatory efforts when financial regulatory policies are strategic substitutes with  $c > T$ .

#### **4. Policy coordination for financial regulation with strategic complementarity of regulatory policies**

In contrary to the case of strategic substitutability of financial regulatory policies, when strategic complementarity holds for financial regulatory policies of neighboring countries with cross-border externalities, a country has no incentive to free ride other country's monitoring efforts. Under strategic complementarity of regulatory policies, a country benefits from her own monitoring efforts in a complementary way to the other country's monitoring efforts. However, strategic complementarity provides multiple equilibria under complete information, which might aggravate the economic uncertainty. We examine the condition for unique equilibrium under strategic complementarity of regulatory policies in this section. The condition for the strategic complementarity of

regulatory policies is shown in Lemma 2.

**Lemma 2.** *The strategic complementarity of the financial regulatory policies holds when the loan monitoring cost is lower than the critical level.*

**Proof:** See the Appendix.

When financial regulatory policies are strategic complements, there are multiple equilibria under complete information about the payoffs from each type of regulatory policy if the strategic complementarity is strong enough as follows <sup>15</sup>:

$$\frac{\partial^2 W_i^*(k_i, k_j) / \partial k_i \partial k_j}{\partial^2 W_i^*(k_i, k_j) / (\partial k_i)^2} > 1. \quad (9)$$

If the strategic complementarity of the financial regulatory policies is strong enough as equation (9), each financial regulator responds to other country's regulatory policies too sensitively in a complementary way that there would be multiple equilibria. Multiple equilibria with strong strategic complementarity include extreme types of equilibria such as an equilibrium with excessive financial regulation,  $\bar{k}$ , and an equilibrium with insufficient regulation,  $\underline{k}$ , implying higher financial instability. The financial instability due to the multiple equilibria of financial regulation is aggravated by the higher level of cross-border externalities in financial market as shown in proposition 3.

**Proposition 3.** *Given the strategic complementarity of financial regulatory policies with low loan monitoring costs and relatively larger foreign banks' equity size,  $E_j$ , when the financial cross-border externalities, represented by  $\gamma$  and  $\mu$ , are higher, it is more likely that there are multiple equilibria in international financial regulation on capital adequacy requirement.*

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<sup>15</sup> The condition for a unique equilibrium in the financial policy coordination game is given as:

$\left| \frac{\partial^2 W_i^*(k_i, k_j) / \partial k_i \partial k_j}{\partial^2 W_i^*(k_i, k_j) / (\partial k_i)^2} \right| < 1$ . This condition implies that there can be a unique equilibrium when the strategic

complementarity is contained within the following range:  $0 < -\frac{\partial^2 W_i^*(k_i, k_j) / \partial k_i \partial k_j}{\partial^2 W_i^*(k_i, k_j) / (\partial k_i)^2} < 1$ . In the same spirit,

given strategic substitutability of financial regulator policies, the condition for the unique equilibrium is:

$-1 < -\frac{\partial^2 W_i^*(k_i, k_j) / \partial k_i \partial k_j}{\partial^2 W_i^*(k_i, k_j) / (\partial k_i)^2} < 0$ .

**Proof:** See the Appendix

This implies that as the financial markets are more integrated with higher financial cross-border externalities, the strategic complementarity of financial regulatory policies is increased with regulators being more sensitive to the other countries' policies.<sup>16</sup>

It has been shown in Proposition 1 that when the banking sector's efficiency is lower than the critical level, financial regulatory policies are strategic substitutes where each country has a strong incentive to deviate to non-cooperative policies. On the other hand, if the monitoring cost of the banking sector is lower than the critical value, the regulatory policies are strategic complements providing no incentive to free ride the other country's regulatory efforts, while the financial stability is reduced due to multiple equilibria under complete information. The basic feature of the strategic complementarity and substitutability can be characterized with the following payoff matrix of each type of financial regulatory policy.

< The payoffs from each case of financial regulatory regime >

	Cooperative financial regulatory regime	Non-cooperative financial regulatory regime
Cooperative financial policy ( $k^C$ )	$SW_i(k_i^C(c_i), k_j^C(c_j)) = C_i$	$SW_i(k_i^C, k_j^N) = D_i$
Non-cooperative financial policy ( $k^N$ )	$SW_i(k_i^N, k_j^C) = H_i$	$SW_i(k_i^N, k_j^N) = N_i$

Under complete information, if the payoff from each case is given as  $C_i > H_i > N_i > D_i$ , then financial regulatory policies are strategic complements. However, if the payoffs are given as  $H_i > C_i > D_i > N_i$ , then, financial regulatory policies are strategic substitutes. As shown in Proposition 1, when the monitoring costs of the banking sectors are lower than the critical value, the financial regulatory policies are given as strategic complements, and ends up with multiple equilibria.

When the financial regulatory policies are strategic complements, the equilibrium financial regulatory regime might be either the case with maximum level of regulatory efforts by coordinating countries or the case with a minimum level of

<sup>16</sup> This result is in the same context as the fact that herd behavior in the financial markets is increased in an integrated financial market with reduced financial transaction costs, and the increased herd behavior amplifies the financial volatility.

regulatory efforts as multiple equilibria. Therefore, even if there is no strong incentive to free ride the other country's regulatory efforts, when there is no explicit regulatory policy coordinating mechanism, the financial regulatory regime might be unstable with the multiple equilibria of two extreme cases. The case of strategic complementarity of financial regulatory policies provides another rationale for the necessity of the international coordination mechanism for financial regulatory policies to avoid the uncertainty in the financial regulatory regime due to multiple equilibria, which is summarized in Corollary 4.

**Corollary 4.** *When financial regulatory policies are strategic complements with relatively lower monitoring costs of banks, the introduction of international financial policy coordination mechanism is required to reduce the uncertainty in financial regulatory regime due to multiple equilibria of the regulatory regime even if there is no free-riding incentive among regulators.*

When financial regulatory policies are strategic substitutes, the introduction of international policy coordination mechanism among relatively homogeneous countries in political economic structures is required to reduce the incentives for free-riding other countries' regulatory efforts. However, when financial regulatory policies are strategic complements with relatively lower monitoring costs of banks, regulators do not have the incentives to free ride other countries' regulatory efforts. Nonetheless, it is required to introduce international policy coordination mechanism to reduce the uncertainty of the regulatory regime due to multiple equilibria of the regulatory regime.

To resolve the uncertainty problems caused by multiple equilibria when financial regulatory policies are strategic complements, global game theoretic approach is taken introducing informational barriers on banking sectors' financial efficiency of each country. When informational barriers are introduced, we consider the case where the actual type of the banking sectors' efficiency, i.e., the banking sectors' monitoring costs, are unknown to the other countries. Given the informational barriers, each financial regulator has a normal prior on the state of the banking sectors' efficiency,  $c$ ,  $c \sim N(m_c, \sigma_c)$ , and each financial regulator observes private signals about the banking sectors' monitoring cost,  $s_i = c + \varepsilon_i$ , with normally distributed noise,  $\varepsilon_i \sim N(0, \sigma_\varepsilon)$ . After equilibrium refinement via iterated elimination of dominated strategies, a unique equilibrium can be obtained if the noise of the signal,  $\sigma_\varepsilon / (\sigma_c)^2$ , is small enough as in a

general context of global game. In equilibrium, each country exerts enough regulatory efforts cooperatively if  $c < c^*$ , while each country makes insufficient regulatory efforts if  $c > c^*$  with the critical value of the monitoring cost,  $c^*$ , obtained after iterated refinement of dominated strategies.

Given the multiple equilibria due to strong strategic complementarity with informational barriers about the actual monitoring efficiency of the banking sector, if noisy signals observed by regulators are reduced with repeated refinement processes, multiple equilibria causing financial instability can be reduced to a unique equilibrium as noted in Proposition 5.

**Proposition 4.** *Given financial regulatory policies as strategic complements, the multiple equilibria of financial regulation is reduced to a unique equilibrium if and only if  $\sigma_\varepsilon / (\sigma_c)^2 \leq 2\pi$ .*

**Proof:** See the Appendix.

Now, we examine the features of the unique equilibrium derived from the repeated equilibrium refinement of dominated strategies with the introduction of informational barriers. Through the comparative statics of the critical level of monitoring costs,  $\hat{c}$ , with respect to banking sectors' political influences,  $\alpha$ , and the level of asymmetry in banking sectors' political influences between coordinating countries, it is shown that even in the unique equilibrium, the cooperative financial regulatory regime is more likely to be sustained when banking sectors command less political influences with higher homogeneity among coordinating countries.

In the limit where the noise of the signal,  $\sigma_\varepsilon$ , tends to 0, the critical value of the monitoring cost,  $\hat{c}$ , is defined as follows:

$$G(\hat{s}, \hat{c}) = F((\hat{s} - \hat{c}) / \sigma_\varepsilon)(N_i(\hat{c}) - D_i(\hat{c})) - (1 - F((\hat{s} - \hat{c}) / \sigma_\varepsilon))(C_i(\hat{c}) - H_i(\hat{c})) = 0$$

If the critical value of the monitoring cost,  $\hat{c}$ , is increased, it is more likely that cooperative financial regulatory regime might be sustainable. First, we check how the critical value of the monitoring cost is affected by the political influence of the financial sector, represented by  $\alpha$ , via implicit function theorem. If the function  $G(\hat{s}, \hat{c})$  is continuous in  $\hat{c}$  and  $\alpha$ , and  $G_c \neq 0$ , then the impact of the financial sector's political influence on the financial stability can be determined by checking the sign of the

following:  $\frac{\partial \hat{c}}{\partial \alpha} = -\frac{G_\alpha}{G_c}$ .

**Proposition 5.** *The comparative statics of the unique equilibrium, obtained via repeated refinement of dominated equilibrium after the introduction of informational barriers about banking sectors' efficiency, shows that the cooperative financial regulatory regime is more likely to be sustained i) when banking sectors command lower political influences and ii) when the coordinating countries have higher homogeneity in terms of political influences of banking sectors.*

**Proof:** See the Appendix.

Proposition 2 and 5 show that in both cases where financial regulatory efforts are strategic substitutes and strategic complements, the financial regulatory policy coordination mechanism is more likely to be sustained when banking sectors command lower political influences and coordinating countries are more homogeneous in terms of political economic structure of financial regulatory regimes. In case financial regulatory policies are strategic substitutes, international policy coordination mechanism improves social welfare by reducing incentives to free-ride neighboring countries' regulatory efforts. Even when there is no free-riding incentive under strategic complementarity of regulatory efforts, international policy coordination mechanism improves social welfare by reducing financial instability due to multiple equilibria. In both cases, cooperative regulatory policy coordination mechanism is more likely to be sustained with lower political influences of banking sectors and higher homogeneity of coordinating countries.

## 5. Concluding remarks

This paper examines the equilibria of international policy coordination game in both cases of strategic substitutability and complementarity of financial regulatory policies. Moreover, we examine the conditions for cooperative financial regulatory policy coordination mechanism to be self-enforcing considering the cross-border externalities of multinational banks and the political influences of the banking sectors on the financial regulator. Given strategic substitutability of financial regulatory policies with a relatively higher loan monitoring costs, the higher is the asymmetry of the political influences of banking sectors, the higher are the incentives to free ride the regulatory efforts of other countries, deteriorating the self-enforcing condition for policy

coordination condition.

More specifically, we demonstrate that when the level of political economic asymmetry is lower than the critical level and policy maker's discount factor is higher than the critical value, the simple introduction of a policy coordination mechanism itself can make cooperative policy coordination as self-enforcing even without a credible external enforcement mechanism even if financial regulatory policies are strategic substitutes. However, when the asymmetry in the political economic structure is larger than the critical level, and policy continuity represented by the policy maker's discount factor is lower than the critical value, an external enforcement should be adopted to ensure credible policy coordination in carrying out effective financial regulation. This implies that cooperative financial regulatory policy coordination regime is more likely to be sustained among relatively homogeneous countries with lower political influence of banking sectors simply by implementing a coordination mechanism. Moreover, although banks benefit from financial stability, we found that the banking sector with higher political influence prefers a regulatory policy that might lower financial stability with lower capital adequacy requirement.

However, when financial regulatory policies are strategic complements with higher efficiency of banking sectors, i.e., lower monitoring costs, financial regulators have no incentive to free ride other countries' regulatory efforts while the uncertainty of financial regulatory regime is increased due to multiple equilibria caused by too sensitive complementary responses to other countries' policies. Therefore, even if the incentives to free ride regulatory efforts of other countries are removed with strategic complementarity of regulatory policies, it is required to introduce the international regulatory policy coordination mechanism to reduce the uncertainty of regulatory regime due to multiple equilibria. The unique equilibrium with cooperative regulatory policies is more likely to be sustained with lower political influences of banking sectors among more homogeneous coordinating countries.

These findings suggest that the initial efforts to introduce an international policy coordination mechanism in financial regulation should be made among relatively homogeneous country group. In the same context, more efforts are required to arrange homogenous political economic approaches on financial regulatory issues among coordinating countries in the initial stage of coordination. If the differences in the political economic position on certain issues of financial regulation cannot be resolved among the all coordinating countries in short term, sub-group approaches among

relatively more homogenous countries would be a second-best approach. In addition, it would be socially desirable to reduce or limit the banking sectors' efforts to increase political contribution or influences on policy makers with the introduction of more transparent decision making mechanism for financial regulation.

The results obtained require a few caveat in interpretation since the model in this paper did not consider the case where banking sectors have various options for investment other than loan-making. In addition, the extension of the policy objective function to consider the welfare of the borrowers, which would be more important issues in welfare analysis, might provide further insights on the mechanism design of the optimal international coordination mechanism for financial regulatory regime. These issues remain for the future studies.

## Appendix

**Proof of Lemma 1:** From the comparative static analysis of optimal monitoring efforts,  $q_i^*$ , with respect to the other country's regulatory policy, the positive externality is shown straightforwardly as follows:

$$\frac{\partial q_j^*}{\partial k_i} = \frac{E_j \mu \gamma_{ij} (1 - \theta_j) \left( 2(\theta_i E_i + \lambda(1 - \theta_j) E_j) - \bar{r} k_i \right)}{2c k_i^3} > 0 \quad (\text{A.1})$$

Therefore, the financial regulatory policy has a positive cross-border externality on the foreign financial stability.  $\square$

**Proof of Proposition 1: Proof:**  $k_i$  and  $k_j$  are strategic substitutes when  $\frac{\partial W_i^*(k_i, k_j)}{\partial k_i \partial k_j} < 0$ .

The cross derivative of the country  $i$ 's social welfare with respect to  $k_i$  and  $k_j$ , the domestic and foreign financial regulatory measure, i.e., the capital adequacy requirement ratio, is given as follows:

$$\begin{aligned} \frac{\partial^2 W_i^*(k_i, k_j)}{\partial k_i \partial k_j} &= \alpha_i \frac{\partial^2 \prod_i^*(k_i, k_j)}{\partial k_i \partial k_j} + \beta_i \left( \frac{\partial^2 q_i^*(k_i, k_j)}{\partial k_i \partial k_j} + \gamma \frac{\partial^2 q_j^*(k_i, k_j)}{\partial k_i \partial k_j} \right) \\ &= \frac{c r_i r_j \gamma \alpha_i E_i \left( (2 - c^2) E_i \mu (1 - \theta_i) \theta_i + E_j \left( \mu^2 (1 - \theta_i) (1 - \theta_j) + \theta_i \theta_j \right) \right)}{2k_i^2 k_j^2} < 0 \text{ if } c > T \end{aligned}$$

$$\text{where } T = \left( \frac{E_j \left( \mu^2 (1 - \theta_i) (1 - \theta_j) + \theta_i \theta_j \right)}{E_i \mu (1 - \theta_i) \theta_i} + 2 \right)^{1/2}.$$

Therefore, financial regulatory policies of each country,  $k_i$  and  $k_j$ , are strategic substitutes,  $\frac{\partial W_i^*(k_i, k_j)}{\partial k_i \partial k_j} < 0$ , when  $c > T$ , while the policies are strategic complements if  $c < T$ .

Moreover, it is shown straightforwardly that  $\frac{\partial T}{\partial E_j} > 0$  and  $\frac{\partial T}{\partial E_i} < 0$ . In addition,

when  $c > T$ ,  $\left. \frac{\partial T}{\partial \mu} \right|_{c>T} = -\frac{E_j(\theta_i\theta_j - \mu^2(1-\theta_i)(1-\theta_j))}{E_i\mu^2(1-\theta_i)\theta_i} < 0$ . Therefore, when the loan

monitoring cost is higher than the critical level, the strategic substitutability of the financial regulatory policies is increased with the higher level of financial integration,  $\mu$ .

□

**Proof of Corollary 1:** The capital requirement ratio under a one-shot non-cooperative Nash game type financial regulation policy decision process should satisfy the following first order condition:

$$\alpha_i \frac{\partial \Pi_i^*(k_i, k_j)}{\partial k_i} + \beta_i \frac{\partial (q_i^*(k_i, k_j) + \gamma_{ji} q_j^*(k_i, k_j))}{\partial k_i} = 0 \quad (\text{A.2})$$

The joint welfare maximizing financial regulation policy,  $k^*$ , satisfies the following first order condition:

$$\alpha_i \frac{\partial \Pi_i^*(k)}{\partial k} + \beta_i \frac{\partial (q_i^*(k) + \gamma_{ji} q_j^*(k))}{\partial k} + \alpha_j \frac{\partial \Pi_j^*(k)}{\partial k} + \beta_j \frac{\partial (q_j^*(k) + \gamma_{ij} q_i^*(k))}{\partial k} = 0 \quad (\text{A.3})$$

However, without a credible enforcement mechanism for the optimal cooperative regulation policy under a short-sighted policy approach, country  $i$  might have an incentive to deviate from the cooperative strategy, despite homogenous political economic structures as shown in the follows:

$$\left( \alpha_i \frac{\partial \Pi_i^*(k_i, k_j)}{\partial k_i} + \beta_i \frac{\partial (q_i^*(k_i, k_j) + \gamma_{ji} q_j^*(k_i, k_j))}{\partial k_i} \right) \Big|_{k_i=k_j=k^*, c>T} < 0 \quad (\text{A.4})$$

The above inequality implies that the financial regulator in country  $i$  with a short-sighted policy approach has an incentive to deviate from the cooperative financial

regulation to a non-cooperative regulatory policy:  $W_i(k_i^{N^*}, k_j^{C^*}) > W_i(k^{C^*})$ .<sup>17</sup>  $\square$

**Proof of Corollary 2:** A long-term policy approach is reflected by a higher discount factor in the policy coordination game. In addition, the adoption of international policy coordination itself implies that the mode of the game is transformed from a one-shot game to a repeated game. The proposition is proved by demonstrating that it is self-enforcing for a country to choose a cooperative financial regulatory policy,  $k^C$ , when the discount factor is higher than a critical level and the political economic asymmetry is lower than a critical level.

When the parameters representing the discount factor and the asymmetry in political economic structures belong to the intervals defined as and  $\sigma \in [0, \underline{\sigma}]$ , where  $\sigma = |\alpha_i - \alpha_j|$ , the incentive compatibility condition for each policy maker to abide by the cooperative financial regulatory policy coordination, defined as follows, should hold<sup>18</sup> :

$$W_i(k_i^{N^*}, k^{C^*}) + \frac{\delta W_i(k_i^{N^*}, k_j^{N^*})}{1 - \delta} \leq \frac{W_i(k^{C^*}, k^{C^*})}{1 - \delta} \quad (\text{A.5})$$

where  $k^N$  represents non-cooperative regulatory policy that maximizes domestic political objective function, and  $k^C$  represents the cooperative regulatory policy that maximizes the joint political objective function.

When the financial regulator is extremely myopic and political economic structures of cording countries show extreme asymmetry with  $\delta \approx 0$  and  $\sigma \approx \underline{\sigma}$ , the incentive compatibility condition cannot hold even in the case of an infinitely repeated game<sup>19</sup>:

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<sup>17</sup> Inequality (13) shows that at the given level of cooperative regulatory policies, the partial derivative of the social welfare with respect to the capital requirement ratio is negative. This result implies that the domestic government can improve the social welfare by reducing the level of capital adequacy requirements from the cooperative level.

<sup>18</sup> The asymmetry of banking sectors' political influences between coordinating countries,  $\sigma$ , is represented by the absolute value of difference between of  $\alpha_i$  and  $\alpha_j$ , parameters representing the political weight given to banking sectors' profits in regulators' objective function. Therefore, a larger  $\sigma$  denotes a larger difference between the political weight given to the banking sectors' profits between coordinating countries.

<sup>19</sup> The discount factor,  $\delta$ , describes the level of long-term policy approach taken by the regulators. The extreme case of the short-term policy approach taken by the financial regulator is the case with  $\delta = 0$

$$W_i(k_i^{N^*}, k^{C^*}) + \frac{\delta W_i(k_i^{N^*}, k_j^{N^*})}{1-\delta} - \frac{W_i(k^{C^*}, k^{C^*})}{1-\delta} \Big|_{\delta=0, \sigma=\underline{\sigma}} \simeq W_i(k_i^{N^*}, k^{C^*}) - W_i(k^{C^*}, k^{C^*}) > 0 \quad (\text{A6})$$

However, when  $\delta \simeq 1$  and  $\sigma \simeq 0$ , the incentive compatibility condition always holds as follows:

$$\frac{W_i(k^{C^*}, k^{C^*})}{1-\delta} - W_i(k_i^{N^*}, k^{C^*}) - \frac{\delta W_i(k_i^{N^*}, k_j^{N^*})}{1-\delta} \Big|_{\delta=1-\varepsilon, \sigma=0} > \frac{W_i(k^{C^*}, k^{C^*})}{1-\delta} - W_i(k_i^{N^*}, k^{N^*}) - \frac{\delta W_i(k_i^{N^*}, k_j^{N^*})}{1-\delta} \Big|_{\delta=1-\varepsilon, \sigma=0} > 0$$

Therefore, there are values such as  $\bar{\delta}$  and  $\underline{\sigma}$  that satisfy the equality condition of the left-hand terms and right-hand terms of inequality (A5). Consequently, a self-enforcement condition for the choice of the cooperative financial regulatory policy, (A5), holds within the range of  $\delta \in (\bar{\delta}, 1]$ ,  $\sigma \in [0, \underline{\sigma}]$ .  $\square$

**Proof of Proposition 2:** The impact of the government regulation via capital adequacy requirement on banking sector's profits is shown to be negative as follows:

$$\frac{\partial \Pi_i(k_i, k_j)}{\partial k_i} = -r_i \frac{\theta E_i}{k_i^2} \left( q_i(k_i, k_j) + \gamma_{ji} q_j(k_i, k_j) - k_i (q_i'(k_i, k_j) + \gamma_{ji} q_j'(k_i, k_j)) \right) - 2c q_i'(k_i, k_j) < 0 \quad (\text{A7})$$

Moreover, given a continuously differentiable policy objective function,  $W(k_i, k_j)$ , the impact of the banking sector's political influence on the government decision of the capital adequacy requirement is given as follows:

$$\frac{\partial k_i^*}{\partial \alpha_i} = - \left( \frac{\partial W(k_i, k_j)}{\partial k_i} \right)^{-1} \left( \frac{\partial W(k_i, k_j)}{\partial \alpha_i} \right) = - \underbrace{\Pi_i^*(k_i, k_j)}_{+} \left( \frac{\partial W(k_i, k_j)}{\partial k_i} \right)^{-1} \Big|_{k_i=k_i^*} < 0 \quad (\text{A8})$$

Therefore, the higher political influences of the banking sector induce the financial regulator to impose a lower capital adequacy requirement, and eventually

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which is equivalent to a one-shot game. The extreme case of long-term policy approach is the case with  $\delta = 1$ , that applies to the case of infinitely repeated game with no discount.

lower the financial stability with lower monitoring efforts of the banking sectors due to the lower level of capital adequacy requirement.  $\square$

**Proof of Lemma 2:** Financial regulatory policies of neighboring countries are strategic complements when the cross-derivative of welfare with respect to each country's regulatory policies on capital requirement ratio shows a positive sign:

$$\frac{\partial^2 W_i^*(k_i, k_j)}{\partial k_i \partial k_j} = \frac{c r_i r_j \gamma \alpha_i E_i \left( (2 - c^2) E_i \mu (1 - \theta_i) \theta_i + E_j \left( \mu^2 (1 - \theta_i) (1 - \theta_j) + \theta_i \theta_j \right) \right)}{2 k_i^2 k_j^2} > 0 \text{ if } c < T$$

$$\text{where } T = \left( \frac{E_j \left( \mu^2 (1 - \theta_i) (1 - \theta_j) + \theta_i \theta_j \right)}{E_i \mu (1 - \theta_i) \theta_i} + 2 \right)^{1/2}. \quad (\text{A9})$$

The conditions for the strategic complementarity are just opposite to the case of strategic substitutability of the financial regulatory policies. That is, as the  $E_j$  is relatively larger than  $E_i$ , and the loan monitoring cost is lower than the critical level, it is more likely that the financial regulatory policy, i.e., the capital adequacy ratio regulation, has the property of strategic complements.  $\square$

**Proof of Proposition 3:** There are multiple equilibria in financial market when the absolute value of equation (9) is larger than unity. It is shown that the value of equation (9) is increasing with the higher level of cross-border externalities in the financial markets,  $\gamma$  and  $\mu$  as follows:

$$\frac{\partial^2 W_i^*(k_i, k_j) / \partial k_i \partial k_j}{\partial^2 W_i^*(k_i, k_j) / (\partial k_i)^2} = \gamma \mu^2 \alpha_i (1 - \theta_i) \theta_i + (1 - \theta_i) (1 - \theta_j) + \theta_i \theta_j = L \quad (\text{A10})$$

$$\frac{\partial L}{\partial \gamma} = \mu^2 \alpha_i (1 - \theta_i) \theta_i > 0, \quad \frac{\partial L}{\partial \mu} = 2 \gamma \mu \alpha_i (1 - \theta_i) \theta_i > 0. \quad \square$$

**Proof of Proposition 4:** Assume that there is a threshold level of the signal about the monitoring cost,  $\hat{s}$ , such that each regulator deviates to a non-cooperative regulatory policy if the regulator obtains a signal  $s \geq \hat{s}$ . Then, the measure to deviate is given as:

$$A(c) = \Pr(s \geq \hat{s} | c) = F((\hat{s} - c) / \sigma_\varepsilon).$$

Therefore, the financial regulator will deviate to a non-cooperative financial regulatory policy if  $s \geq \hat{c}$  where  $\hat{c}$  is derived the following condition:

$$F((\hat{s} - \hat{c}) / \sigma_\varepsilon)(N_i(\hat{c}) - D_i(\hat{c})) = (1 - F((\hat{s} - \hat{c}) / \sigma_\varepsilon))(C_i(\hat{c}) - H_i(\hat{c})) \quad (\text{A11})$$

Based on the above assumption, the posterior probability for the collapse of policy coordination mechanism of financial regulatory regime is given as:

$$\Pr(c \geq \hat{c} | s) = 1 - F\left(\frac{(\sigma_\varepsilon^{-2}s + \sigma_c^{-2}m_c) / (\sigma_\varepsilon^{-2} + \sigma_c^{-2})^{1/2} - \hat{c} / (\sigma_\varepsilon^{-2} + \sigma_c^{-2})^{1/2}}{\sigma_\varepsilon^{-2} + \sigma_c^{-2}}\right).$$

Denoting  $F\left(\frac{(\sigma_\varepsilon^{-2}s + \sigma_c^{-2}m_c) / (\sigma_\varepsilon^{-2} + \sigma_c^{-2})^{1/2} - \hat{c} / (\sigma_\varepsilon^{-2} + \sigma_c^{-2})^{1/2}}{\sigma_\varepsilon^{-2} + \sigma_c^{-2}}\right)$  as  $K$ , the critical value of  $c, \hat{c}$ , is defined as follows:

$$U(\hat{c}; \sigma_\varepsilon^2, \sigma_c^2, m_c) = K(N_i(\hat{c}) - D_i(\hat{c})) - (1 - K)(C_i(\hat{c}) - H_i(\hat{c})) = 0.$$

$U(c)$  is continuous and differentiable in  $c$  and  $\lim_{c \rightarrow 0} U(c) < 0$  since  $(1 - K)(C_i|_{c=0} - H_i|_{c=0}) > K(N_i|_{c=0} - D_i|_{c=0})$ . In addition,  $\lim_{c \rightarrow \bar{c}} U(c) > 0$  since  $K(N_i|_{c=\bar{c}} - D_i|_{c=\bar{c}}) > (1 - K)(C_i|_{c=\bar{c}} - H_i|_{c=\bar{c}})$ . Finally, the condition for the monotonicity of  $U(c)$  is that the following derivative of  $U(c)$  with respect to  $c$  to be positive:

$$\frac{\partial U(c)}{\partial c} = \frac{\partial K(N_i - D_i)}{\partial c} - \frac{\partial (1 - K)(C_i - H_i)}{\partial c} = (\sigma_c^{-2} + \sigma_\varepsilon^{-2})^{1/2} f(c) \frac{\partial (N_i + C_i - D_i - H_i)}{\partial c} \left( \frac{\sigma_\varepsilon}{\sigma_c^2} - \frac{1}{f(F^{-1}(c))} \right).$$

It is straightforward that  $U(c)$  is monotonous if and only if  $\sigma_\varepsilon / (\sigma_c)^2 \leq 2\pi$ .

As long as the above condition holds, a unique equilibrium critical value,  $\hat{c}$ , exists by single crossing property.  $\square$

**Proof of Proposition 5:** First, we show that  $G_c \neq 0$  and then determine the sign of  $-G_\alpha / G_\alpha$  by taking total derivative of the equilibrium condition.

The sign of  $G_c$  is determined as follows:

$$\frac{\partial G(\hat{s}, \hat{c})}{\partial \hat{c}} = -\frac{1}{\underbrace{\sigma_\varepsilon}_{+\infty}} \underbrace{\frac{\partial F(\hat{s}, \hat{c})}{\partial \hat{c}}}_{-} \underbrace{(N - D + C - H)}_{+} + F(\hat{s}, \hat{c}) \left( \underbrace{\frac{\partial N(\hat{s}, \hat{c})}{\partial \hat{c}}}_{-} - \underbrace{\frac{\partial D(\hat{s}, \hat{c})}{\partial \hat{c}}}_{+} \right) - \underbrace{(1 - F(\hat{s}, \hat{c}))}_{+} \left( \underbrace{\frac{\partial C(\hat{s}, \hat{c})}{\partial \hat{c}}}_{+} - \underbrace{\frac{\partial H(\hat{s}, \hat{c})}{\partial \hat{c}}}_{-} \right) > 0$$

Now we examine the sign of  $G_\alpha$  as follows:

$$\frac{\partial G(\hat{s}, \hat{c})}{\partial \alpha} = F(\hat{s}, \hat{c}) \left( \underbrace{\frac{\partial N(\hat{s}, \hat{c})}{\partial \alpha}}_{+} - \underbrace{\frac{\partial D(\hat{s}, \hat{c})}{\partial \alpha}}_{-} \right) - \underbrace{(1 - F(\hat{s}, \hat{c}))}_{+} \left( \underbrace{\frac{\partial C(\hat{s}, \hat{c})}{\partial \alpha}}_{-} - \underbrace{\frac{\partial H(\hat{s}, \hat{c})}{\partial \alpha}}_{+} \right) > 0$$

Therefore, according to the implicit function theorem, the sign of  $\frac{\partial \hat{c}}{\partial \alpha}$  is

determined as follows:  $\frac{\partial \hat{c}}{\partial \alpha} = -\frac{G_\alpha}{G_c} < 0$ .

The above result implies that when the political influence of the banking sector is increased, the policy coordination mechanism for financial regulation is more likely to collapse.

Now we examine the impact of the asymmetry of the political influences of banking sectors on the regulatory policy coordination by checking the sign of  $\frac{\partial \hat{c}}{\partial \sigma}$ . The sign of  $G_\sigma$  is determined as follows:

$$\frac{\partial G(\hat{s}, \hat{c})}{\partial \sigma} = F(\hat{s}, \hat{c}) \left( \underbrace{\frac{\partial N(\hat{s}, \hat{c})}{\partial \sigma}}_{+} - \underbrace{\frac{\partial D(\hat{s}, \hat{c})}{\partial \sigma}}_{-} \right) - \underbrace{(1 - F(\hat{s}, \hat{c}))}_{+} \left( \underbrace{\frac{\partial C(\hat{s}, \hat{c})}{\partial \sigma}}_{-} - \underbrace{\frac{\partial H(\hat{s}, \hat{c})}{\partial \sigma}}_{+} \right) > 0$$

Therefore, the sign of  $\frac{\partial \hat{c}}{\partial \sigma}$  is determined as follows:  $\frac{\partial \hat{c}}{\partial \sigma} = -\frac{G_\sigma}{G_c} < 0$ .

This result implies that when the asymmetry of the political influence of the financial sector between coordinating countries is increased, it is more likely that the cooperative regulatory policy coordination mechanism collapses.  $\square$

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