Regulations in Two Lemon Markets: An Application in Cross-Border Listing

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Abstract

I analyze a model where two independent regulators in two open economies strategically set regulatory stringency in their domestic lemon market. Since firms are allowed to enter either market, foreign regulation affects domestic firms' outside options. I then link the regulations to the fundamentals of the two economies. When the difference in fundamentals between the two economies is moderate, there exists an equilibrium in which the strong economy has stricter regulation than the weak economy, and the good firms in the weak economy flow to the strong economy to signal for their type. When the difference in fundamentals between the two economies is either too large or too small, the equilibrium outcome is the same as the case when both economies are closed. In terms of global welfare, there exist inefficient regions of fundamentals where the strong economy under-regulates, while the weak economy over-regulates.

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1 Introduction

The past decades have witnessed the dramatic growth of financial globalization, which has made it easier than ever for investors to trade foreign securities or for firms to raise foreign capital. This growth has been seen both at the individual investor level and firm level. For example, at the individual level, the value of foreign securities held by U.S. residents was less than 1% of U.S. Gross Domestic Product (GDP) in 1980. By 2013, that number had grown to over 50% (USD 9.1 trillion) with about two-thirds of holdings being equities. At the firm level, we see a growing number of firms going public solely in a foreign country or cross-listing their shares in both domestic and foreign markets. For example, from 2002 to 2011 cross-border IPOs accounted for 9% of the total volume and 13% of the total value of IPOs around the world.[1] And the numbers have kept rising in recent years.[2] In the U.S. stock markets, the proportions of foreign listings are even higher than the global average. From 2005 to 2014, on average foreign IPOs accounted for 23.2% of the total volume and 20.7% of the total value of IPOs that took place in the U.S.

Given the enormous magnitude of foreign IPOs, it would be interesting to understand the main drivers of this trend. Surveys of managers and academic research have identified institutions, including accounting disclosure standards, corporate governance requirements, investor protections and law enforcement practices, as one of the key motives for cross-border IPO.[3] The argument is that due to information asymmetry and agency conflict between major shareholders and retail investors, good firms from a home country with weak institutions can signal their high qualities by putting themselves under scrutiny and committing to stricter regulations in the host country. Indeed, some empirical papers have documented a cross-listing premium.[4] If this is the case, the home country would have the incentive to raise its regulation standards to prevent the run off of good firms. Yet in reality, emerging markets

[1]http://www.pwc.com/gx/en/audit-services/publications/ipo-cross-border-survey.jhtml
[2]http://www.bakermckenzie.com/crossborderipoindex/
[3]See the review by Karolyi (2012)
[4]See Doidge et al. (2004) and Doidge et al. (2009)

continually lag developed markets in terms of regulations and/or enforcement practices. In this paper, I use a theoretical model to try to understand what prevents emerging markets from developing stricter regulations.

In the paper, I abstract away from the commitment problem and enforcement problem by putting a simple unified structure on the regulations. Specifically, in the IPO market with adverse selection problems, the regulator can choose to enforce all market participants to reveal their quality with a certain probability which represents the regulation stringency. Accordingly, all market participants need to pay certain costs, which increases in the revealing probability to fulfill the regulation requirements. As in the speech by SEC commissioner Roel C. Campos, "Congress requires us to undertake cost-benefit analyses and consider the burden of our rules on competition, efficiency and capital formation." A certain level of information revelation can rejuvenate a freezing market. However, if the regulation burden is too high, it may prevent the market from functioning. In a closed economy, the optimal regulation is the minimal regulation that reveals enough information to motivate good firms to enter the market. This minimal regulation naturally decreases in the fundamental.

Optimal regulation is further complicated when there is more than one market, because the regulator in one market needs to take into consideration the externalities from the regulations in other markets. This problem was acknowledged by SEC commissioner Roel C. Campos addressed in his speech, "regulators face a difficult balancing act when considering what to do ...it's much more acute now, in the era of globalization, because of the dangers of regulatory arbitrage and the potential race to the bottom." Indeed, critics of the Sarbanes-Oxley Act (SOX) act say that its severe regulatory burden has caused the loss in competitiveness of U.S. listings relative to other foreign exchanges.[5] In this paper, I analyze the case with two markets, each with an independent regulator. With the strategic interactions between the regulators, the model demonstrates that regulators may have incentive to raise the regulation standard to attract good foreign firms. Therefore, SOX act though

[5]See Berger (2005), Piotroski and Srinivasan (2008) and Zingales (2007)

boosting the listing burden may encourage rather than discourage good foreign firms to list their shares in the U.S. Within this framework, it is possible to derive some novel predictions.

First, the model predicts that the quality of firms pursuing foreign listings is higher than that of firms listed in the domestic market. In the model, within a certain parameter region, there exists an equilibrium in which good firms go public in a foreign country with stricter regulation and weak firms go public in the domestic market. The good firms benefit from revealing information and separating themselves from the weak ones. On the contrary, the weak firms benefit from hiding information and potentially want to follow the good ones to go public abroad. However, stricter foreign regulation, on one hand, imposes larger cost to fulfill; on the other hand, enforces more information revealed by all market participants. Therefore, strict foreign regulation prevents weak firms from mixing with the strong firms. Many existing empirical papers have provided supportive evidence. Doidge et al. (2004), for example, showed that the Tobin's Q of firms pursuing foreign listings is on average 16% higher than firms that listed solely on domestic market.

Second, the interesting equilibrium with flow of firms going public abroad only occurs when the difference in fundamentals between home and host countries is moderate, and the flow of firms is unidirectional, i.e. from the weak to the strong. The intuition is as follows. As a consequence of equilibrium selection based on welfare, domestic regulators have the priority of securing domestic firms to go public in the domestic market. If the two economies both have high fundamentals, both regulators would secure domestic firms with reasonably high regulations. If the two economies both have low fundamentals, neither of the two regulators would want to raise the regulation standard since a large fraction of domestic firms could not afford the costs imposed by harsh regulations. Therefore, flow of firms across countries only occurs when one economy is strong and the other is weak. If this is the case, the strong economy can afford to raise regulations to attract good foreign firms. At the same time, the weak economy is willing to forgo the good firms to keep most of the domestic firms listed in the domestic markets. As far as I know, this hasn't been tested in the existing literature. Empirically, however, we have seen the unidirectional flow from weak to strong economy. From 2002 to 2011, over 300 firms from Asia-Pacific listed their shares on the U.S. or European exchanges, while less than 30 firms from U.S. or Europe listed their shares on Asia-Pacific exchanges. Another interesting feature of this equilibrium is that if two economies are closed, the optimal regulation standard is lower for the stronger economy. However, if they are open to each other, the relative stringency in regulations is reverse, and good firms flow from the weak to the strong market. Actually, it is of the regulators' mutual benefit to do so. The weak economy saves the regulatory costs, while the strong economy shares surplus from the listing of good firms.

Overall, the model demonstrates the link of the regulation in one economy to its fundamental, and more interestingly to the regulation and fundamental of the other connected economy. And it is related to three lines of literatures. First, the model builds fundamentally on the literature on adverse selection and market breakdown initiated by Akerlof (1970). Much existing work has looked at the adverse selection problem in IPO markets and signaling by good firms via various channels. Among them, Leland and Pyle (1977) models signaling through the fraction retained by the issuer; Titman and Trueman (1986) demonstrate signaling through the choice of auditor; and Allen and Faulhaber (1989) argue that firms signal by underpricing. While in this paper, firms signal through the choice of venue for IPO.

Second, the second stage game of the model is closely connected to the "bonding theory" in the literature on cross-listing. The main idea of bonding theory is that good firms are willing to put themselves under scrutiny to differentiate themselves from bad ones. Coffee Jr (1999) and Stulz (1999) are the earliest theoretical papers arguing for bonding through corporate governance and investor protection. In addition, Reese and Weisbach (2002) provide empirical evidence that firms from countries with weak investor protections are more likely to list their shares in the U.S. Fuerst (1998) and Huddart et al. (1999) illustrate theoretically the mechanism of bonding through stricter disclosure requirement. Lang et al. (2003) and

Baker et al. (2002) shows empirically that foreign firms cross-listed on U.S. exchanges have better information environment which is associated with higher valuation. Blass and Yafeh (2001) compares Israeli IPOs in the U.S. and Tel Aviv, and they argue that high-quality Israeli firms are willing to pay the additional cost of compliance to go public solely in U.S. and distinguish themselves from firms that listed back home. All of the existing papers on bonding theory take the regulations as exogenously given. However, in this paper, I take one step back and analyze the formation of regulation endogenously, which answers the question of why some countries stick to loose regulation and forgo good firms to foreign markets.

Third, this paper is related to work on government intervention to rejuvenate markets. Among them, Tirole (2012) develops a model where the government offers to buy back the worst assets to rejuvenate the financial market. The optimal price that the government offers is such that the marginal surplus created equals the marginal cost of the public fund. It is similar to my model in that the government is effectively creating another market and controlling the outside option of firms. However, in my model, two independent regulators have control over the outside option of firms in the other economy. Philippon and Skreta (2012) also analyzes optimal government intervention considering its affect on the outside option of market participants.

The remainder of the paper proceeds as follow. Section 2 analyzes the baseline case with one closed economy. Section 3 then discusses the main model of two open economies. Section 4 provides welfare analysis. Finally, section 5 concludes.

2 One Closed Economy

In this section, I analyze the benchmark case with one closed economy. Specifically, I first look at firms' financing decisions given regulation fixed. Then given firms' behavior, I evaluate the optimal regulatory stringency to achieve maximum social welfare. By comparing the results in the benchmark case with the case of two open economies (section 3), I demonstrate the effect of regulatory externalities on firms' financing decision.

2.1 The Model

Consider a closed economy with two types of agents: H-type firms of measure π and L-type firms of measure $1-\pi$. π stands for the fundamental of the economy. H-type firms each has an investment opportunity of value $H > 0$, and L-type firms each has investment opportunity of value $L \in (0, H)$. However, they are all financially constrained and have two choices to finance their projects. They can get fully financed from the stock market through IPO, and are subject to the disclosure/corporate governance regulation which is costly. Alternatively, they can get partially financed through bank loans and realize a fraction $\alpha \in (0, 1)$ of their project value. Therefore, the social welfare created from getting a t-type firm fully financed in the IPO market is $(1-\alpha)t$. Leland and Pyle (1977) modeled the function of stock market as a risk sharing device and showed that good entrepreneurs can signal their type by retaining a large fraction of the firm. To shut down this channel and highlight the role of regulation, I assume that the whole firm has to be sold on the stock market. Investors in the stock market are competitive and risk neutral, and therefore will offer prices equal to the expected value.

The regulator in the economy can choose a certain level of stringency to impose on the IPO market. Specifically, the regulator can enforce all IPO market participants to send out a signal with precision $q \in [0, 1]$. The information structure is depicted in Figure 1 below. When investors come across a firm on the IPO market, their prior belief for the firm to be a H type is *pi*. Under regulation with stringency q, firms send out a perfectly informative signal with probability q and an uninformative signal with probability $1-q$. A firm seeking IPO on a market with regulatory stringency q needs to pay $c(q) = cq^2$, where $c > 0$, to fulfill the regulatory requirements. The cost function is such that it is too costly to send out a perfect signal: $c(1) = c > (1-\alpha)H$, and it is costless to send a slightly informative signal: $c'(0) = 0$. Another interpretation of the regulation stringency in this model is the effectiveness of enforcement. In reality, some emerging markets lack investors' trust not due

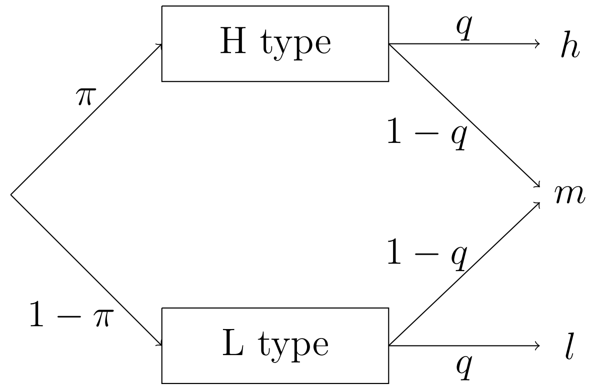

Figure 1: Information structure under regulation q

to their regulation standard but rather their impotent enforcement. The goal of making the assumption that regulation is fully enforceable is to simplify the set up, and attention needs to be paid when interpreting the results.

There are two stages in this game. In the first stage, the regulator chooses the optimal stringency of regulation q to maximize the total welfare, i.e.

$$\max_{q} \pi[(1-\alpha)H - c(q)]\mathbf{1}_{\{\text{H-type}\}} + (1-\pi)[(1-\alpha)L - c(q)]\mathbf{1}_{\{\text{L-type}\}}$$

where $\mathbf{1}_{\{\text{H-type}\}} = 1$ if H-type firms get fully finance in the stock market and 0 otherwise; $\mathbf{1}_{\{\text{L-type}\}} = 1$ if L-type firms get fully finance in the stock market and 0 otherwise. In stage 2, the firms observe the regulatory stringency and make their financing decisions.

2.2 Firms' Financing Decisions

I solve this model by backward induction. In this section, I analyze the second stage equilibrium. Denote the second stage equilibrium as the type of firms entering the IPO market. There are three possible candidates: $\{L\}$, $\{H\}$ and $\{L, H\}$. Given the regulatory stringency q fixed, firms' payoffs are summarized as follow,

	IPO	Other External Resources
H-type firms	$qH + (1-q)P - c(q)$	αH
L-type firms	$qL + (1-q)P - c(q)$	αL

where P denotes the market price for firms with signal m. A t-type firm will choose to go public if $(q-\alpha)t + (1-q)P - c(q) \geq 0$. Consider pure strategies only. If the regulation is loose such that $q < \alpha$, L-type firms have more incentive to be listed, and thus the resulting second stage equilibrium would be either $\{L\}$ or $\{L, H\}$. Alternatively, if $q > \alpha$, H-type firms have more incentive to be listed, and the resulting second stage equilibrium would be either $\{H\}$ or $\{L, H\}$. When there exists multiple equilibria, I assume that the regulator is able to enforce the one with higher social welfare.

To make this problem smooth, I restrict the parameters such that even when π is close to zero, the equilibrium with both H and L-type firms entering the stock market exists under some regulation.

Lemma 1. *If and only if $(H-L)^2 \geq 4c(\alpha H - L)$ and $2c\alpha > H - L$, there exists equilibrium with both types entering the stock market under some q for any $\pi \in [0, 1]$.*

For the rest of the discussion, the parameters are assumed to satisfy the restrictions stated in Lemma 1. Even if the assumption is violated, the analyses still hold except in the extreme parameter region. The equilibrium selection in the second stage game is summarized in proposition 1 below.

Proposition 1. $\forall q \in [0, 1]$, *there exists at least one pure strategy equilibrium in the second stage game. The firm financing choices selected based on welfare can be characterized as follow.* $\exists$ $\underline{q}, \bar{q}$ *and* $\tilde{q}$ *such that* $0 \leq \underline{q} < \bar{q} \leq \tilde{q} < 1$ *and*

1. *when $q < \underline{q}$, only L-type firms go public*

2. *when $q \in [\underline{q}, \bar{q}]$, both L and H-type firms go public*

3. when $q \in (\bar{q}, \tilde{q}]$, only H-type firms go public if $c(\alpha) < (1-\alpha)e$; no firms go public otherwise

4. when $q \in (\tilde{q}, 1]$, no firms go public

The results in proposition 1 are intuitive. Since L-type firms can only be over-priced on the IPO market, they will choose to go public as long as the regulatory cost is not too high, i.e. $q \leq \bar{q}$. While H-type firms can only be under-priced on the IPO market, they are better-off going public only with medium level of regulation. On one hand, they want the regulation to be strict enough to reveal their type with high probability, and on the other hand not overly strict to maintain acceptable regulatory cost.

2.3 Optimal Regulation

In this section, I analyze the first stage in which the regulator sets the regulatory stringency. Note that within each of the four stringency intervals stated in proposition 1, the social welfare achieve strictly decreases in stringency q, because the surplus created from getting firms fully financed is the same within an interval, however the regulatory cost increases in q. Furthermore, setting $q \geq \bar{q}$ is strictly dominated, since by reducing q a bit below $\bar{q}$, both L and H type will enter the market and at the same time the regulatory costs are reduced. Therefore, we can focus on L-only and L-and-H cases. The welfare achieved as a function of the fundamental is summarized in Figure 2 below.

Note that the attractiveness of L-and-H case relative to L-only case is monotonically increasing in the fundamental, π, due to two reasons. First, the price for unrevealed firms increases in fundamental. Therefore, when the fundamental increases, an H-type firm is more willing to enter the IPO market to be pooled with the other firms on the market, and the regulatory stringency required to induce H-type to enter would be lower. Therefore, the regulatory cost decreases in the fundamental. Second, a higher fundamental indicates more H-type firms and less L-type firms, therefore the surplus created by motivating H-type firms

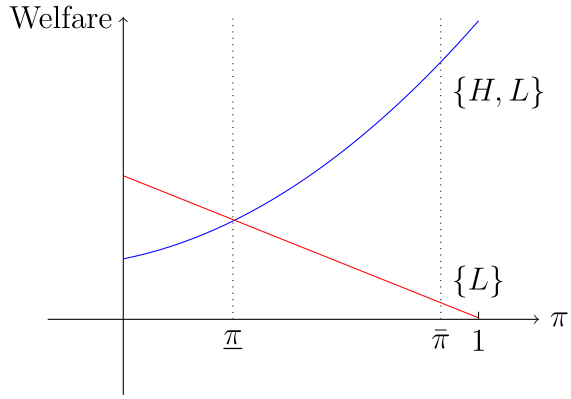

Figure 2: Welfare in two possible second stage equilibriums

to enter the market increases in the fundamental.

In the two extreme cases, $\pi = 1$ and $\pi = 0$, the regulator would go after two different choices. Therefore, there should exist a threshold, above which the regulator would motivate both types to enter the market and below which the regulator would rather have L-type only in the market. Formally, the optimal regulation is summarized in proposition 2.

Proposition 2. *In the closed economy case, there exist two thresholds,* $\underline{\pi}$ *and* $\bar{\pi}$ *(*$0 < \underline{\pi} < \bar{\pi} < 1$*), such that*

1. *if* $\pi \in [0, \underline{\pi}]$*, the optimal regulation* $q^*(\pi) = 0$ *and only L-type firms go public*
2. *if* $\pi \in (\underline{\pi}, \bar{\pi})$*, the optimal regulation* $q^*(\pi)$ *is positive and decreases in* π*, and both L-type and H-type firms go public*
3. *if* $\pi \in [\bar{\pi}, 1]$*, the optimal regulation* $q^*(\pi) = 0$ *and both L-type and H-type firms go public.*

When the fundamental of the economy is high enough such that $\pi H + (1 - \pi)L \geq \alpha H$, i.e. $\pi \geq \bar{\pi}$, the H-type is willing to enter the market even if there is no regulation. Hence, the optimal regulation is naturally zero. Otherwise, there is room for regulation. As analyzed above, the relative attractiveness of the two subgame equilibriums is monotone in the fundamental, and $\underline{\pi}$ is the fundamental such that the regulator is indifferent. The optimal regulation as a function of the fundamental is summarized in Figure 3 below.

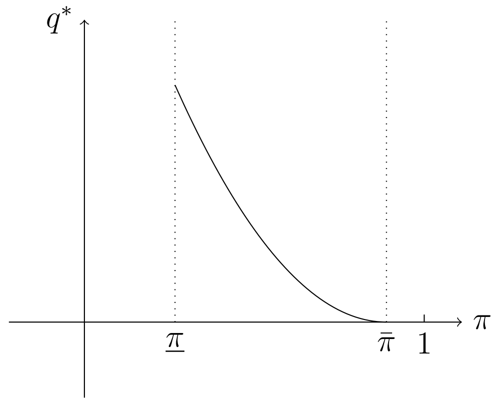

Figure 3: Optimal regulation

Note that the optimal regulations in the two extreme regions are both zero, yet for different reasons. In the left region, it is not worthy to raise the regulation standard for only a few H-type firms. While in the right region, regulation is not necessary to boost the IPO market.

2.4 Welfare Analyses

Figure 4 below plotted the welfare with the optimal regulation (solid line) and without any regulation (dashed line).

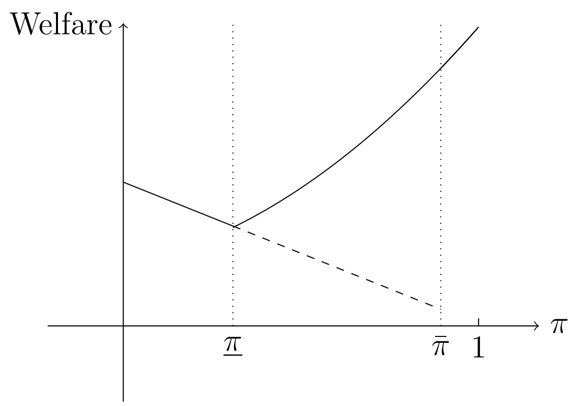

Figure 4: Welfare gain from optimal regulation

The two lines overlap in the two extreme regions, since the optimal regulation is zero in the two extreme regions. In the left region, i.e. $\pi < \underline{\pi}$, the welfare decreases in fundamental, because as fundamental increases, less surplus is created from getting L-type firms fully financed. At the same time, it is not worthy to raise regulation standard to get H-type firms fully financed. In the right region, without any regulation, both types are willing to join the market, and therefore the welfare increases in fundamental, the fraction of H-type firms.

The regulation only plays a role in the middle region, in which the economy is impaired the most by adverse selection problem and also benefits the most from regulation. Without regulation, only L-type firms get fully financed. With medium fundamental, the economies have a fairly large number of good firms not getting fully financed and therefore huge welfare loss due to adverse selection problem. While with optimal regulation, H-type firms necessitate relatively low stringency to enter the stock market, since they are pooled with a fair amount of H-type firms. Moreover, there are a fairly large amount of H-type firms in the economy, thus surplus created by motivating them to enter the IPO market is sizable. In addition, the regulatory cost is relatively affordable to these economies. Hence, in the middle region, the regulator would choose positive level of regulation to remedy for the adverse selection problem. Finally, in this region, the welfare improvement by regulation, i.e. the difference between two lines, increases with the fundamental.

3 Two Open Economies

In this section, I analyze the main model with two open economies and in which firms can choose freely their listing venue. Then I will compare this case with the closed economy case.

3.1 The Model

Two economies with fundamental π_1 and π_2 are open to each other. Firms now have three financing choices: IPO in domestic market, IPO in foreign market and bank loans. If a firm chooses to go public in the foreign market, it can realize its whole project value and is subject to the foreign regulation. In addition to the regulation cost, the firm needs to pay an additional cost f, which can be interpreted as the physical costs of adjusting firm policies to meet the foreign regulation or the cost of being underpriced due to the severe information asymmetry between the firm and foreign investors, i.e. home bias. The additional cost f is assumed to satisfy $\max\{(1-\alpha)L, \frac{1}{4}(1-\alpha)H\} < f < (1-\alpha)H$. The lower bound is to make sure that it is welfare destroying for a L-type firm to go public in the foreign market, and at the same time both H-type and L-type going public in the foreign country is not sustainable, which will be explained in detail in the next section. While the upper bound is to make sure that the cost f is still affordable to H-type firms. As in the closed economy case, if a firm chooses to go public in the domestic market, it can also realize its whole project value and is subject to local regulation. If a firm chooses to finance through bank loans, it only realizes α fraction of the whole project value but is free from regulation. Investors have the knowledge of the origin of each firm, and therefore firms can only be pooled with other firms from the same economy.

The regulator in each economy can enforce a specific level of regulatory stringency of its choice in the domestic market. The notion of stringency follows the one in the closed economy case, i.e. all IPO market participants pay cost $c(q)$ to send out a signal with precision q. All firms, foreign and domestic, are subject to the same regulation. This assumption can be justified by the fact that it is hard to implement regulatory discrimination and treat foreign firms differently in reality. As for the division of surplus, if a firm go public in a foreign market, the surplus created will be shared by the two economies. Specifically, $\beta \in (0, 1)$ fraction of the total surplus goes to the local economy, and the rest goes to the foreign economy. β can be interpreted as a result of bargaining between the investors in the host country and the firm. In fact, it has been shown empirically that foreign IPOs are more severely underpriced than domestic IPOs.[6] The additional underpriced price can be interpreted as the surplus shared by the host economy.

As in the closed economy case, there are also two stages in this game. In stage one, the

[6] See Francis et al. (2001); Cai and Zhu (2015)

regulators choose independently the stringency of domestic regulation to maximize the total welfare. The maximization problem in economy 1 is as follow,

$$\begin{aligned}\max_{q_1}&[(1-\alpha)H-c(q_1)]\mathbf{1}_{\{\text{H1, local}\}}+[(1-\alpha)H-c(q_2)-f]\beta\mathbf{1}_{\{\text{H1, foreign}\}}\\&+[(1-\alpha)H-c(q_1)-f](1-\beta)\mathbf{1}_{\{\text{H2, foreign}\}}+[(1-\alpha)L-c(q_1)]\mathbf{1}_{\{\text{L1,local}\}}\\&+[(1-\alpha)L-c(q_2)-f]\beta\mathbf{1}_{\{\text{L1,foreign}\}}+[(1-\alpha)L-c(q_1)-f](1-\beta)\mathbf{1}_{\{\text{L2,foreign}\}}\end{aligned}$$

where $\mathbf{1}_{\{\text{ti, j}\}}$ equals to 1 if t-type firms from economy i choose to go public in market j, and 0 otherwise. In stage 2, the firms observe the regulations and make their financing decisions to maximize their profits.

3.2 Firms' Financing Decisions

Since the investors can distinguish the foreign firms from domestic ones, firms can only be pooled with others from the same origin. Therefore we can analyze the firms from two economies separately. Consider H-type and L-type firms in economy 2. The financing choices of firms in economy 1 would be exactly symmetric. Given the regulation q_1 and q_2 fixed, firms' payoffs are summarized as follow,

	IPO in Market 1	IPO in Market 2	Bank Loans
H-type firms	$q_1H+(1-q_1)P_1-c(q_1)$	$q_2H+(1-q_2)P_2-c(q_2)-f$	αH
L-type firms	$q_1L+(1-q_1)P_1-c(q_1)$	$q_2L+(1-q_2)P_2-c(q_2)-f$	αL

where P_1 and P_2 denotes the market prices in two markets respectively for firms with signal m.

Denote the strategy profile in this subgame as $\{s_H, s_L\}$, where s_H and s_L are financing choices of H-type and L-type firms respectively. $s_H, s_L \in \{0,1,2\}$, and $0,1,2$ denotes bank loan, IPO in market 1 and IPO in market 2 respectively. Each type has three choices, thus there are 9 pure strategy profiles. From the analysis in the one closed economy case, we know that H-only equilibrium in the second stage is Pareto dominated. Therefore, to simplify the discussion below, I focus on the case when $c(\alpha) > (1-\alpha)H$, such that the regulator will never set the regulation above α. As a result, the L-type firms always have stronger incentive than H-type firms to enter the market. This is also the typical adverse selection problem in which the good ones choose to stay out of market, because otherwise they are mixed with bad ones and are severely underpriced. Then among the 9 possible subgame equilibriums, I can rule out $\{1,0\}$ and $\{2,0\}$. Recall that $f > (1-\alpha)L$. If L-type firms are not pooled with H-type firms, the cost of going abroad cannot cover the benefit of full realization of their positive NPV projects. Therefore, $\{0,1\}$ and $\{2,1\}$ can be ruled out. It is shown in the proof of proposition 3 that $\{1,1\}$ can also be ruled out. The possible candidates left for the subgame equilibrium are $\{2,2\}$, $\{0,2\}$, $\{1,2\}$, and $\{0,0\}$. Next, I analyze the regulation region in which the strategy profiles stand as equilibriums. The last step is to eliminate multiple equilibria. As in the one closed economy case, when a set of q_1 and q_2 can sustain multiple equilibriums, the equilibrium with higher total welfare will be selected.

Lemma 2. *If a pair (q_1, q_2) supports more than one second-stage equilibriums, the order of selection based on welfare is $\{2,2\} \succ \{1,2\} \succ \{0,2\} \succ \{0,0\}$.*

Intuitively, having firms going public domestically saves the additional cost f of going public abroad, and therefore in general achieves higher welfare. Firms will go public only if it is positive NPV, thus it is always welfare-enhancing to induce firms go public. Please refer to the appendix for the detailed proof of the rank of equilibriums by welfare. The firm financing decisions, i.e. second stage equilibrium selection, are summarized in proposition 3 below.

Proposition 3. $\forall q_1, q_2 \in [0,1]$*, there exists at least one pure strategy equilibrium in the second stage game. The firm financing choices selected based on welfare can be characterized as follow.*

1. *$\{2,2\}$ is the equilibrium, when $\{q_1, q_2\} \in Q_{\{2,2\}} = \{q_1, q_2 : q_2 L + (1-q_2)e - c(q_2) \geq$*

$\max\{L-c(q_1)-f, \alpha L\}, q_2H+(1-q_2)e-c(q_2) \geq \max\{q_1H+(1-q_1)L-c(q_1)-f, \alpha H\}\}$.

2. $\{1,2\}$ *is the equilibrium, when* $\{q_1, q_2\} \in Q_{\{2,1\}} = \{q_1, q_2 : L - c(q_2) \geq \max\{q_1L + (1 - q_1)H - c(q_1) - f, \alpha L\}, H - c(q_1) - f \geq \max\{q_2H + (1 - q_2)L - c(q_2), \alpha H\}\} \setminus Q_{\{2,2\}}$

3. $\{0,2\}$ *is the equilibrium, when* $\{q_1, q_2\} \in [0,1] \times [0, \sqrt{\frac{(1-\alpha)L}{c}}] \setminus Q_{\{2,2\}} \setminus Q_{\{1,2\}}$

4. $\{0,0\}$ *is the equilibrium, when* $\{q_1, q_2\} \in [0,1] \times [\sqrt{\frac{(1-\alpha)L}{c}}, 1] \setminus Q_{\{2,2\}} \setminus Q_{\{1,2\}}$

Figure 5 gave a graphic demonstration of the second stage equilibrium as a function of regulation choices. Note that the region in which $\{2,2\}$ holds as an equilibrium (the region with the darkest color on Figure 5) depends on the fundamental of the economy, while the others don't. Specifically, as the fundamental deteriorates, the regulation region that supports $\{2,2\}$ shrinks. Another useful observation is that the left bound of the region that all domestic firms go public in domestic market, i.e. $\{2,2\}$, is a vertical line. This implies that regardless of foreign regulation, the domestic regulator can always set the minimal regulation to incentivize all domestic firms to enter the domestic market.

The only subgame equilibrium with flow of firms is $\{1,2\}$. In the region that supports $\{1,2\}$, the regulations satisfy $q_1 > q_2$. This is consistent with the intuition that high type firms, though paying higher regulation costs, are willing to put themselves under scrutiny and go public in the market with stricter regulation.

3.3 Optimal Regulation: Special Case $\pi_1 = 1$

By having $\pi_1 = 1$, the adverse selection problem is completely eliminated in economy 1, and the firm behaviors in economy 1 is extremely simple. The firms will go public domestically, if $c(q_1) \leq (1-\alpha)H$. By setting q_1 low, the regulator in economy 1 can secure all firms in economy 1 to go public domestically. By increasing the regulation stringency, the regulator in economy 1 can potentially attract H-type firms from economy 2, but the domestic firms need to pay the regulation cost as well. In equilibrium, q_1 must be low such that all firms in economy 1 enter the domestic stock market, because otherwise, the regulator in economy 1 can set $q_1 = 0$ and achieve higher welfare for economy 1.

The regulator in economy 2 can secure all firms in economy 2 to go public domestically by setting the lowest possible regulation that supports $\{2, 2\}$. However, if the fundamental of economy 2 is so low that the benefit of getting H-type fully financed does not cover the cost of strict regulation, the regulator in economy 2 would rather set $q_2 = 0$ and having only L-type listed. If this is the case, the regulator from economy 1 may find it optimal to increase its regulation to attract H-type firms from economy 2. Denote the lowest regulation in economy 1 to attract H-type firms in economy 2 as $\hat{q}$, i.e. $L = \hat{q}L + (1 - \hat{q})H - c(\hat{q}) - f$. The regulator in economy 1 is willing to spend the regulation cost only if the fundamental in economy 2 is high enough, i.e. when $c(\hat{q}) \leq (1 - \beta)\pi_2((1 - \alpha)H - c(\hat{q}) - f)$. Denote the cutoff as $\hat{\pi}$. Since economy 2 also share the surplus created by having H-types going public abroad, the regulator in economy 2 would also want economy 1 to take it over. This happens only when $\pi(1 - \alpha)H - c(q^*(\pi_2)) \leq \beta\pi_2((1 - \alpha)H - c(\hat{q}) - f)$. Denote the cutoff as π^*. The optimal regulation is summarized in proposition 4 below.

Proposition 4. *In the case of two open economies and $\pi_1 = 1$, in equilibrium, L-type firms in economy 2 go public in the domestic market, and H-type firms in economy 1 go public in the domestic market. The regulation and the financing choices of H-type firms in economy 2 will be one of the three cases,*

1. *$q_1 = q_2 = 0$, H-type firms in economy 2 stay out of the stock markets*
2. *$q_1 = \hat{q} > 0 = q_2$, H-type firms in economy 2 go public in the foreign market*
3. *$q_2 = q^*(\pi)$, $q_1 = 0$, H-type firms in economy 2 go public in the domestic market*

There exist three thresholds, $\underline{\pi}$ as defined in proposition 2, π^*, and $\hat{\pi}$ such that depending on parameters

1. *if $\underline{\pi} < \pi^* \leq \hat{\pi}$, case 1 is the equilibrium when $\pi_2 < \underline{\pi}$, and case 3 is the equilibrium when $\pi_2 \geq \underline{\pi}$*

2. *if $\underline{\pi} \leq \hat{\pi} \leq \pi^*$, case 1 will be the equilibrium when $\pi_2 \in [0, \underline{\pi}]$ equilibrium, case 2(Pareto dominating) and case 3 are the two equilibriums when $\pi_2 \in [\hat{\pi}, \pi^*]$, and case 3 is the equilibrium when $\pi_2 \in [\underline{\pi}, \hat{\pi}] \cup [\pi^*, 1]$*

3. *if $\hat{\pi} \leq \underline{\pi} < \pi^*$, case 1 will be the equilibrium when $\pi_2 \in [0, \hat{\pi}]$ equilibrium, case 2(Pareto dominating) and case 3 are the two equilibriums when $\pi_2 \in [\hat{\pi}, \pi^*]$, and case 3 is the equilibrium when $\pi_2 \in [\pi^*, 1]$*

The interesting equilibrium is case 2, in which there is flow of H-type firms from the weak economy to the strong economy. For these H-type firms, although the regulation is not perfect, their type is perfectly signaled and revealed, which is consistent with the empirical observation that mature economies are better at pricing good firms. As stated in proposition 4, the interesting equilibrium happens when the difference in fundamentals of the two economies is medium. Note that there is always another equilibrium, i.e. case 3. But both the economies enjoy higher welfare in case 2 than in case 3, therefore case 2 is Pareto dominating. Thus, the regulators in the two economies are both willing to coordinate to achieve case 2 rather than case 3.

3.4 Optimal Regulation In General

Without loss of generality, assume $\pi_1 \geq \pi_2$, i.e. economy 1 is stronger than economy 2. Once the assumption that $\pi_1 = 1$ is relaxed, when analyzing the regulation game, the adverse selection problems in both economies need to be taken into consideration. As stated in proposition 4, the interesting equilibrium only exists under some parameters. For the following analyses, I assume the parameters satisfy $\hat{\pi} \leq \pi^*$ such that if $\pi_1 = 1$, the interesting equilibrium with flow of firms between two economies exists. It will be shown later that even if the assumption is violated, the interesting equilibrium becomes more and more conceivable as π_1 deters.

Lemma 3. *If $\hat{\pi} \leq \pi^*$, $q^*(\pi^*) > \hat{q}$.*

Lemma 3 states that in the desired equilibrium, in which $q_1 = \hat{q} > q_2 = 0$ and the H-types in economy 2 go public in economy 1, if the economy 2 was to hold its H-type firms, the regulation needs to be stricter than the equilibrium regulation in economy 1. This is intuitive, since economy 2 is only willing to forgo the H-types when doing so saves its regulation costs. Let $q^*(\tilde{\pi}) = \hat{q}$. Since $q^*(\pi)$ decreases monotonically in π, $q^*(\pi) \leq \hat{q}$ if $\pi \geq \tilde{\pi}$ and vice versa.

When $\pi_1 \geq \tilde{\pi} \geq \pi^*$, the regulator in economy 1 always has the incentive to keep domestic H-firms, and $q^*(\pi_1)$, the regulation that keeps domestic H-firms is below $\hat{q}$. In order to attract foreign H-firms, the regulator needs to increases its regulation to $\hat{q}$. The trade-offs that the regulator faces are the same as in the case where $\pi_1 = 1$. As the fundamental deteriorates, $q^*(\pi_1)$ increases, thus the incremental cost to impose regulation $\hat{q}$ decreases. In other words, the regulator has stronger incentive to attract foreign H-type firms, and is willing to take in less H-type firms as domestic fundamental decays. The region of π_2 that supports the interesting equilibrium enlarges. Proposition 5 below summarize the equilibrium as a function of the fundamentals of the two economies.

Proposition 5. *When $\pi_1 \geq \tilde{\pi}$, in equilibrium, L-type firms in economy 2 go public in the domestic market, and all firms in economy 1 go public in the domestic market. There exists a increasing cutoff function $\hat{\pi}(\pi_1)$, such that the regulation and the financing choices of H-type firms in economy 2 depending on the fundamentals of the two economies are as follow.*

1. *If $\underline{\pi} \geq \hat{\pi}(\pi_1)$, there are four cases.*

   (a) *$\pi_2 \in [0, \hat{\pi}(\pi_1))$, in equilibrium $q_1 = q^*(\pi_1)$, $q_2 = 0$, H-type firms in economy 2 stay out of the stock markets.*

   (b) *$\pi_2 \in [\hat{\pi}(\pi_1), \underline{\pi})$, in equilibrium $q_1 = \hat{q}$, $q_2 = 0$, H-type firms in economy 2 go public in the foreign market.*

   (c) *$\pi_2 \in [\underline{\pi}, \pi^*]$, there are two equilibriums. The Pareto dominating equilibrium is $q_1 = \hat{q}$, $q_2 = 0$, and H-type firms in economy 2 go public in the foreign market.*

The Pareto dominated equilibrium is $q_1 = q^*(\pi_1)$, $q_2 = q^*(\pi_2)$, *H-type firms in economy 2 go public in the domestic market.*

(d) $\pi_2 \in (\pi^*, \pi_1]$, *the equilibrium* $q_1 = q^*(\pi_1)$, $q_2 = q^*(\pi_2)$, *H-type firms in economy 2 go public in the domestic market.*

2. *If* $\underline{\pi} < \hat{\pi}(\pi_1)$, *there are three cases*

   (a) $\pi_2 \in [0, \underline{\pi})$, *in equilibrium* $q_1 = q^*(\pi_1)$, $q_2 = 0$, *H-type firms in economy 2 stay out of the stock markets.*

   (b) $\pi_2 \in [\hat{\pi}(\pi_1), \pi^*]$, *there are two equilibriums. The Pareto dominating equilibrium is* $q_1 = \hat{q}$, $q_2 = 0$, *and H-type firms in economy 2 go public in the foreign market. The Pareto dominated equilibrium is* $q_1 = q^*(\pi_1)$, $q_2 = q^*(\pi_2)$, *H-type firms in economy 2 go public in the domestic market.*

   (c) $\pi_2 \in [\underline{\pi}, \hat{\pi}(\pi_1)) \cup (\pi^*, \pi_1]$, *the equilibrium* $q_1 = q^*(\pi_1)$, $q_2 = q^*(\pi_2)$, *H-type firms in economy 2 go public in the domestic market.*

Moreover, $\hat{\pi}(\pi_1)$ *equals 0 at* $\tilde{\pi}$; *strictly increases in* $[\tilde{\pi}, \frac{\alpha H - L}{H-L}]$; *and equals* $\hat{\pi}$ *if* $\pi_1 \geq \frac{\alpha H - L}{H-L}$.

To summarize, as long as $\pi_2 \in [\hat{\pi}(\pi_1), \pi^*]$, the Pareto dominating equilibrium is always the interesting equilibrium featuring flow of firms from the weak to the strong economy. As expected, as the fundamental of π_1 deters, $\hat{\pi}(\pi_1)$ decreases, and therefore the region that supports the interesting equilibrium enlarges. Since $\hat{\pi}(\tilde{\pi}) = 0 < \pi^*$, when $\pi_1 = \tilde{\pi}$, there must exist a region for π_2 that supports the interesting equilibrium. Therefore, it is clear now that the assumption that $\hat{\pi} < \pi^*$ is not very restrictive. Even if it is not true and the interesting equilibrium never holds when $\pi_1 = 1$, it will become conceivable as π_1 gets close to $\tilde{\pi}$. Note that so far, we have assumed that the sizes of the two economies are the same. This can be easily relaxed. In the appendix, I generalized proposition 5 to the case when the mass of firms in economy 1 is different from that in economy 2.

When $\tilde{\pi} > \pi_1 \geq \pi^*$, $q^*(\pi_1) > \hat{q}$, and therefore to attract foreign H-type firms, no additional cost needs to be paid. However, the surplus created by attracting foreign H-type firms decreases, i.e. $(1-\alpha)H - c(q^*(\pi_1)) - f < (1-\alpha)H - c(\hat{q})$, and thus economy 2 is less willing to give up its H-type firms resulting in a shrink of the region that supports the interesting equilibrium. As $q^*(\pi_1)$ increases to $(1-\alpha)H - f$, the surplus created by relinquishing H-type firms decreases to 0, and the equilibrium with flow disappears. Figure 6 in the appendix demonstrates the region that supports the interesting equilibrium.

When $\pi_1 < \pi^*$, even economy 1 is weak such that the regulator in economy 1 is willing to adopt zero regulation and forgo its H-type firms if economy 2 is prone to take in foreign H-type firms at the lowest cost possible. Moreover, the regulator in economy 2 is basically facing the same optimization problem as the regulator in economy 1 when $\pi_1 = 1$. Recall that the optimal regulations in a single closed economy in the two extreme regions are both zero. Therefore, the regulator in economy 2 has incentives to take in foreign H-type firms by raising regulation to $\hat{q}$ if $\pi_1 \geq \hat{\pi}$. However, the only difference from the $\pi_1 = 1$ case is that if the regulation is too costly, more precisely $c(\hat{q}) > (1-\alpha)L$, all domestic firms will stay out of the market. In addition, if the benefit of attracting foreign H-type firms doesn't cover the loss from domestic surplus, i.e. $(1-\beta)\pi_1((1-\alpha)H - c(\hat{q}) - f) - c(\hat{q}) < (1-\pi_2)(1-\alpha)L$, the regulator in economy will secure its L-type by setting $q_2 = 0$ and forgo the foreign H-type firms.

Proposition 6. *When $\pi_2 < \hat{\pi} < \pi_1 < \pi^*$, there might exists an equilibrium in which $q_2 = \hat{q}$ and $q_1 = 0$, and H-type firms in economy 1 go public in economy 2. Specifically,*

1. *If $c(\hat{q}) \leq (1-\alpha)L$, $q_2 = \hat{q}$ and $q_1 = 0$ is an equilibrium. And in this equilibrium, L-type firms all go public in the domestic market, H-type firms in economy 1 go public in the foreign market, while the H-type firms in economy 2 stay out of the market.*

2. *If $c(\hat{q}) > (1-\alpha)L$ and $(1-\beta)\pi^*((1-\alpha)H - c(\hat{q}) - f) - c(\hat{q}) > (1-\hat{\pi})(1-\alpha)L$, there exists a strictly decreasing threshold $\breve{\pi}(\pi_1)$ such that $q_2 = \hat{q}$ and $q_1 = 0$ is an equilibrium only when $\pi_2 > \breve{\pi}(\pi_1)$. Moreover, in equilibrium, firms in economy 2, both H and L-type, stay out of the market. L-type firms in economy 1 go public domestically,*

and H-type firms in economy 1 go public in the foreign market.

3. *If $c(\hat{q}) > (1-\alpha)L$ and $(1-\beta)\pi^*((1-\alpha)H - c(\hat{q}) - f) - c(\hat{q}) < (1-\hat{\pi})(1-\alpha)L$, then the equilibrium doesn't exist.*

Note that this reverse equilibrium, similar to the interesting equilibrium, may not be the unique equilibrium. However, in terms of welfare, it is mutually beneficial for both economies to play this reverse equilibrium rather than others. Hence, the reverse equilibrium is likely to be played if the parameters fall in the valid region.

Although when both π_1 and π_2 are low, there might exist this reverse equilibrium, in which $q_1 < q_2$, I now argue that limited attention needs to be paid to this equilibrium. First, as stated in proposition 6, if $c(\hat{q})$ is high such that economy 2 needs to sacrifice all domestic firms to attract foreign H-type firms, this reverse equilibrium may disappear. Secondly, the existence of this equilibrium relies on the assumption that $\pi^* > \hat{\pi}$. If this assumption is relaxed, the interesting equilibrium still survives when π approaches $\tilde{\pi}$, and the reverse equilibrium will be wiped out completely. Thirdly, the reverse equilibrium only hold when both economies are so weak that they are willing to give out their H-type firms in exchange with low regulation. Therefore, even though there is a flow of H-type firms between two countries, the domestic H-type firms in economy 2 stay out of the market. However, in the real world, for countries with inflow of foreign firms, there are still a lot of domestic good firms on the market. Therefore, the interesting equilibrium is closer to reality.

4 Welfare Analysis

Focus on the case when $\pi_1 \geq \tilde{\pi}$ as in proposition 5. If there exists a global social planner that can set the regulatory stringency in both economies, she would maximize the total surplus created in two economies. In order to do so, the global regulator would always want to keep all firms in economy 1 going public in the domestic market. Otherwise, H-type firms either won't get fully financed or go public in the foreign market at a cost $\hat{q} + f > q^*(\pi_1)$.

When the fundamental in economy 2 is high, the regulatory cost is moderate to motivate H-type firms to join the market and get fully financed. The optimal regulation is then $q_1 = q^*(\pi_1)$ and $q_2 = q^*(\pi_2)$. When the fundamental of economy 2 is medium such that $\pi(1-\alpha)H - c(q^*(\pi_2)) \leq \pi_2((1-\alpha)H - c(\hat{q}) - f)$, the global regulator would want H-type firms from economy 2 to go public in market 1. Denote the fundamental such that the equality holds as $\pi_2 = \pi^{*\prime}$. Then $\pi^{*\prime} > \pi^*$, i.e. the global regulator would want economy 2 to give up the H-type firms at a better fundamental than it would in the competitive case. When π_2 is such that $c(\hat{q}) - c(q^*(\pi_1)) \leq \pi_2((1-\alpha)H - c(\hat{q}) - f)$, the global regulator would want economy 1 to raise its domestic regulation to attract H-type firms from economy 2. Denote the fundamental such that the equality holds as $\pi_2 = \hat{\pi}'(\pi_1)$. Then $\hat{\pi}'(\pi_1) \leq \hat{\pi}(\pi_1)$, i.e. the global regulator would want economy 1 to attract H-type firms from economy 2 at a worse fundamental than it would under the competitive setting. The inefficiency is the result of the regulatory competition between the two regulators for the strong firms.

Proposition 7. *When $\pi_1 \geq \tilde{\pi}$, there is under-regulation in economy 1 when $\pi_2 \in [\hat{\pi}'(\pi_1), \hat{\pi}(\pi_1)] \cup [\pi^*, \pi^{*\prime}]$ and over-regulation in economy 2 when $\pi_2 \in [\pi^*, \pi^{*\prime}]$.*

Figure 7 depicted the globally social optimal regulation. The dark grey areas are the inefficient outcomes in the regulatory competition. In the right dark grey region, $(q_1, q_2) = (0, q^*(\pi_2))$ in the competitive setting and $(q_1, q_2) = (\hat{q}, 0)$ in the cooperative case. The regulator in economy 2 over-regulates its market and economy 1 under-regulates its market. The intuition is that by forgoing H-type firms, economy 1 only realizes partial surplus, therefore it would hold on to H-type firms more often than global optimum. In the left dark grey region, $(q_1, q_2) = (0, 0)$ in the competitive setting and $(q_1, q_2) = (\hat{q}, 0)$ in the cooperative case. The regulator in economy 1 under-regulates its markets. Intuitively, if the regulator in economy 1 raises its regulation to attract H-type firms, it can only realize part of the surplus created while bearing the full cost of regulation. Therefore, when there are very few H-type firms in economy 2, even though the surplus created by providing full finance to H-type firms in economy 2 covers the regulation cost, the regulator in economy 1 would choose not to bring them in.

If the two regulators can coordinate on their regulation selection, the global social optimum can be achieved. One possible implementation is that the regulator in economy 2 can promise a larger than $1-\beta$ fraction of their proceeds from H-type firms going public abroad to make economy 1 indifferent between imposing high regulation $\hat{q}$ to attract foreign H-type firms and imposing low regulation $q^*(\pi_1)$ to save the cost.

5 Conclusion

In this paper, I build a theoretical model featuring strategic interactions between two regulators and link the optimal regulations in two open economies to their fundamentals. When the difference in fundamental between the two economies is moderate, there exists an equilibrium in which the strong economy has stricter regulation than the weak economy, and the good firms in the weak economy flow to the strong economy to signal for its type. Since the regulators in the two economies only internalize partial welfare gain from the flow of firms, there are inefficient regions where the strong economy under-regulates and the weak economy over-regulates.

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Appendices

A Proofs

Proof of lemma 1. For the equilibrium with both types going public to hold, two participation constraints need to be satisfied. Denote $e = \pi H + (1-\pi)L$ as the average firm quality in the economy, and also the fair price for a firm with signal m.

$$qH + (1-q)e - c(q) \geq \alpha H$$

$$qL + (1-q)e - c(q) \geq \alpha L$$

If $c(\alpha) \leq (1-\alpha)e$, $q = \alpha$ is a solution to this system of two inequalities. When $q < \alpha$, the first inequality binds. Denote the lower bound for the first inequality to hold as $\underline{q} = \frac{H-e-\sqrt{(H-e)^2-4c(\alpha H-e)}}{2c}$. When $q > \alpha$, the second inequality binds, Denote the upper bound for the second inequality to hold as $\bar{q} = \frac{-(e-L)+\sqrt{(e-L)^2+4c(e-\alpha L)}}{2c}$. Therefore, the region that both L and H-type firms go public is $q \in [\underline{q}, \bar{q}]$.

If $c(\alpha) > (1-\alpha)e$, the second inequality will never hold for $q > \alpha$. Therefore, q has to be smaller than α, and the binding constraint is the first inequality. Since $(H-L)^2 - 4c(\alpha H - L)$, there always exists a region $[\underline{q}, \bar{q}] = [\frac{H-e-\sqrt{(H-e)^2-4c(\alpha H-e)}}{2c}, \frac{H-e+\sqrt{(H-e)^2-4c(\alpha H-e)}}{2c}]$ in which inequality 1 holds. Moreover, $\underline{q} < \frac{H-L}{2c} < \alpha$. Therefore, the region that both L and H-type firms go public is $q \in [\underline{q}, \bar{q}]$. $\square$

Proof of proposition 1. When $q < \alpha$, L-type firms have more incentive to go public and take advantage of being pooled with H-type firms. Therefore, the two possible equilibriums are L-type only and both types enter the stock market. And if a regulation stringency supports two equilibria, both-types equilibrium will be selected, since under the same regulation it creates higher total surplus. Similarly, when $q > \alpha$, there are also two possible equilibriums: H-type only and both types enter the stock market. And when a q supports two equilibria, both-types equilibrium will be selected. Therefore, in the region $[\underline{q}, \bar{q}]$ as defined in the proof of lemma 1, both types going public is the equilibrium.

As for the region where $q < \underline{q}$, H-type is not willing to enter the stock market, while L-type would want to enter. Therefore, the resulting equilibrium is L-only.

If $c(\alpha) \leq (1-\alpha)e$, H-type only equilibrium holds when $q \in (\bar{q}, \tilde{q}]$, where $\tilde{q}$ is such that $\tilde{q}H + (1-\tilde{q})e - c(\tilde{q}) = H$. If $c(\alpha) > (1-\alpha)e$, H-type won't enter the market when $q > \alpha$, and therefore H-only equilibrium doesn't exists. □

Proof of proposition 2. Since H-only equilibrium is dominated by both-type equilibrium with lower regulation cost, $\forall \pi \in [0,1]$, compare the welfare achieved by having both types in the stock market and only L type in the stock market.

When $\pi \geq \bar{\pi} = \frac{\alpha H - L}{H - L}$, the average firm quality $e \geq \alpha H$, and therefore even without any regulation, both types will enter the stock market. The optimal regulation is $q^*(\pi) = 0$, and both types go public.

When $\pi < \bar{\pi}$, to have both types in the stock market, there is a minimum regulation requirement $\underline{q}(\pi) = \frac{H-e-\sqrt{(H-e)^2-4c(\alpha H - e)}}{2c} > 0$, which is a strictly decreasing function in e or π interchangeably. The welfare achieved as a function of the fundamental is $W_{\{HL\}}(\pi) = (1-\alpha)(\pi H + (1-\pi)L) - c(\underline{q}(\pi))$ then an strictly increasing function in e or π interchangeably. To have only L type in the stock market, the optimal regulation is $q = 0$ to achieve minimum regulation cost. And the welfare achieved is $W_L(\pi) = (1-\alpha)(1-\pi)L$ which is a strictly decreasing function in π. Let $D(\pi) = W_{\{HL\}}(\pi) - W_L(\pi)$. Then $D(\pi)$ is a continuous and monotonically increasing function in π.

Consider two extremes: $\pi = 0$ and $\pi = \bar{\pi}$. If $\pi = 0$, the regulator strictly prefer to adopt zero regulation and have only L type in the stock market, i.e. $D(0) < 0$. If $\pi = \bar{\pi}$, the regulator strictly prefer to adopt $\underline{q}(\bar{\pi})$ and secure both types full financing via IPO, i.e. $D(\bar{\pi}) > 0$. Since $D(\pi)$ is continuous and monotone, there exists a threshold, denoted as $\underline{\pi}$ such that $D(\pi) \lesseqgtr 0$ if $\pi \lesseqgtr \underline{\pi}$. □

Proof of lemma 2. If (q_1, q_2) supports $\{1,2\}$, L-type firms in economy 2 prefer going public in economy 2 to economy 1. Therefore, $L - c(q_2) \geq q_1 L + (1 - q_1)H - c(q_1) - f \Rightarrow c(q_1) + f > c(q_2)$. Now compare $\{2,2\}$ with $\{1,2\}$. The welfare difference is

$$D_{\{2,2\}-\{1,2\}}(\pi) = [(1-\alpha)e - c(q_2)] - [(1-\alpha)e - \pi(c(q_1)+f) - (1-\pi)c(q_2)] = \pi(c(q_1)+f-c(q_2)) > 0$$

Therefore, $\{2,2\}$ is strictly preferred.

Compare $\{1,2\}$ with $\{0,2\}$. The surplus created by L-type firms is the same across these two equilibriums. However, in $\{1,2\}$, H-type firms are willing to participate in market 1, i.e. $H - c(q_1) - f \geq \alpha H$. The surplus created by H-type firms is higher in equilibrium $\{1,2\}$. Therefore, $\{1,2\}$ is preferred to $\{0,2\}$.

The last step is to compare $\{0,2\}$ with $\{0,0\}$. The participation constraint of L-type firms in $\{0,2\}$ makes sure that there is non-negative surplus created. While there is no surplus created in equilibrium $\{0,0\}$. Therefore, $\{0,2\}$ is preferred to $\{0,0\}$. □

Proof of proposition 3. To check the sustainability of a strategy profile, four constraints need to be satisfied. For $\{2,2\}$ to sustain as an equilibrium,

$$q_2 L + (1 - q_2)e - c(q_2) \geq \alpha L \tag{IR-L}$$

$$q_2 L + (1 - q_2)e - c(q_2) \geq q_1 L + (1 - q_1)L - c(q_1) - f \tag{IC-L}$$

$$q_2 H + (1 - q_2)e - c(q_2) \geq \alpha H \tag{IR-H}$$

$$q_2 H + (1 - q_2)e - c(q_2) \geq q_1 H + (1 - q_1)L - c(q_1) - f \tag{IC-H}$$

For $\{1,2\}$ to sustain as an equilibrium,

$$L - c(q_2) \geq \alpha L \tag{IR-L}$$

$$L - c(q_2) \geq q_1 L + (1 - q_1)H - c(q_1) - f \tag{IC-L}$$

$$H - c(q_1) - f \geq \alpha H \tag{IR-H}$$

$$H - c(q_1) - f \geq q_2 H + (1 - q_2)L - c(q_2) \tag{IC-H}$$

For $\{0, 2\}$ to sustain as an equilibrium,

$$L - c(q_2) \geq \alpha L \tag{IR-L}$$

$$L - c(q_2) \geq q_1 L + (1 - q_1)L - c(q_1) - f \tag{IC-L}$$

$$\alpha H \geq q_2 H + (1 - q_2)L - c(q_2) \tag{IR-H1}$$

$$\alpha H \geq q_1 H + (1 - q_1)L - c(q_1) - f \tag{IR-H2}$$

Under the parameter assumptions that $(1 - \alpha)H < c(\alpha)$ and $f > (1 - \alpha)L$, these four constraints boil down to $c(q_2) < (1 - \alpha)L$.

For $\{0, 0\}$ to sustain as an equilibrium,

$$\alpha L \geqq_2 L + (1 - q_2)L - c(q_2) \tag{IR-L1}$$

$$\alpha L \geq q_1 L + (1 - q_1)L - c(q_1) - f \tag{IR-L2}$$

$$\alpha H \geq q_2 H + (1 - q_2)L - c(q_2) \tag{IR-H1}$$

$$\alpha H \geq q_1 H + (1 - q_1)L - c(q_1) - f \tag{IR-H2}$$

Under the parameter assumptions that $(1 - \alpha)H < c(\alpha)$ and $f > (1 - \alpha)L$, these four constraints boil down to $c(q_2) > (1 - \alpha)L$.

Since the space that supports $\{0, 2\}$ or $\{0, 0\}$ covers the whole parameter space, there exists at least one equilibrium for each pair of (q_1, q_2). As stated in lemma 2, when a pair (q_1, q_2) supports multiple equilibriums, the order of selection is $\{2, 2\} \succ \{1, 2\} \succ \{0, 2\} \succ \{0, 0\}$. □

Proof of proposition 4. To find the equilibrium in this regulation game, we need to analyze the best response functions of the two regulators.

First, I analyze the best response of the regulator in economy 2. The regulator in economy 2 has the priority of securing its firms in the domestic stock market, in the sense that if the it sets regulation $q^*(\pi)$, regardless of foreign regulation, all domestic firms will go public in the domestic market. When π_2 is high, $q_2 = q^*(\pi_2)$ is a dominating strategy for the regulator in economy 2. When π_2 is low, the regulator in economy 2 may find it optimal to give up the H-type firms and adopt zero regulation. Whether it is optimal to forgo the H-type firms depends on the regulation in economy 1. If the regulation in economy 1 is high enough, i.e. stricter than $\hat{q}$, such that the H-type firms are willing to go public abroad, surplus is created by H-type firms, and therefore it is more desirable for the regulator in economy 2 to give up H-type firms. Define π^* to be such that

$$(1-\alpha)(\pi^* H + (1-\pi^*)L) - c(q^*(\pi^*)) = (1-\alpha)(1-\pi^*)L + \beta\pi^*((1-\alpha)H - c(\hat{q}) - f)$$

If $q_1 = \hat{q}$, the best response $q_2 = q^*(\pi_2)$ if $\pi_2 > \pi^*$, and $q_2 = 0$ if $\pi_2 < \pi^*$.

However, if the regulation in economy 1 is low such that H-type firms rather stay out of the market, it is less desirable for the regulator in economy 2 to relinquish the H-type firms. Recall the definition of $\underline{\pi}$ as the lowest π such that in a closed economy the regulator would want to hold H-type firms in the market by having stringent regulations, i.e. $(1-\alpha)(\underline{\pi}H + (1-\underline{\pi})L) - c(q^*(\underline{\pi})) = (1-\underline{\pi})(1-\alpha)L$. If $q_1 = 0$, the best response $q_2 = q^*(\pi_2)$ if $\pi_2 > \underline{\pi}$ and $q_2 = 0$ if $\pi_2 < \underline{\pi}$. The other value of q_1 doesn't matter, because the equilibrium q_2 is either $q^*(\pi_2)$ or zero, and the best response of regulator in economy 1 as will be shown later is either $\hat{q}$ or zero.

Next, I analyze the best response of the regulator in economy 1. Although there is no adverse selection problem for firms from economy 1, to maintain the continuity and get the largest possible region that supports one equilibrium, I assume the price that a H-type firm with signal m gets from going abroad is L. This makes more sense when $q_1 > q_2$, since L-type firms prefer low regulation relative to H-type firms. And in the interesting $\{1, 2\}$ second stage equilibrium, $q_1 > q_2$. Firms in economy 1 will stay in the domestic market as long as

$$H - c(q_1) \geq \alpha H$$
$$H - c(q_1) \geq q_2 H + (1 - q_2)L - c(q_2) - f$$

The second constraint turns out to be redundant. And the bonding constraint is always $c(q_1) \leq (1-\alpha)H$. Therefore, $\forall q_1 > \sqrt{\frac{(1-\alpha)H}{c}}$ is strictly dominated by $q_1 = 0$.

When $q_2 = q^*(\pi_2)$, all firms from economy 2 will go public domestically, therefore imposing positive regulation stringency is purely a cost to economy 1. Thus the best response is $q_1 = 0$.

When $q_2 = 0$, the best response of regulation in economy 1 depends on the fundamental of economy 2. If π_2 is high, i.e. there are a lot of H-type firms in economy 1, by raising the regulation to $\hat{q}$, economy 1 receives large surplus created by H-type firms. It can be checked that $\hat{q} < \sqrt{\frac{(1-\alpha)H}{c}}$, therefore with $q_1 = \hat{q}$, the H-type firms in economy 1 will go public in the domestic market in equilibrium. If π_2 is low, say zero, the regulator in economy 1 would never want to raise domestic regulation. Define $\hat{\pi}$ to be such that

$$c(\hat{q}) = (1-\beta)\hat{\pi}((1-\alpha)H - c(\hat{q}) - f)$$

The best response to $q_2 = 0$ would be $q_1 = \hat{q}$ if $\pi > \hat{\pi}$ and $q_1 = 0$ if $\pi < \hat{\pi}$. The last step is to find a fixed point in the compound function of the two best response functions. And the result is stated in proposition 4.

□

Proof of lemma 3. Recall the definition of π^* is such that

$$(1-\alpha)(\pi^* H + (1-\pi^*)L) - c(q^*(\pi^*)) = (1-\alpha)(1-\pi^*)L + \beta\pi^*((1-\alpha)H - c(\hat{q}) - f)$$

Rearrange the terms,

$$c(q^*(\pi^*)) = \pi^*(1-\beta)((1-\alpha)H - c(\hat{q}) - f) + c(\hat{q}) + f$$

Since $\pi^* > \hat{\pi}$, $c(q^*(\pi^*)) > \hat{\pi}(1-\beta)((1-\alpha)H - c(\hat{q}) - f) = c(\hat{q})$. $c(q)$ increases strictly in q, thus $q^*(\pi^*) > \hat{q}$.

$\square$

Proof of proposition 5. As stated in lemma 3, $q^*(\pi^*) > \hat{q}$. Therefore, $\pi_1 \geq \tilde{\pi} > \pi^*$, and economy 1 would never want to give up. The regulation required to secure domestic H-type firms $q^*(\pi_1)$ is less stringent than the regulation required to attract foreign H-type firms, i.e. $\hat{q}$. Moreover, in this region, the regulator would always want to secure domestic H-type firms, because $\pi_1 > \hat{\pi} > \pi^*$ and there are more domestic H-type firms than foreign H-type firms. Similar to the $\pi_1 = 1$ case, the regulator would want to attract foreign H-type firms only when there are enough H-type firms, i.e. when π_2 is high. Define $\hat{\pi}(\pi_1)$ to be such that

$$c(\hat{q}) - c(q^*(\pi_1)) = (1-\beta)\hat{\pi}(\pi_1)((1-\alpha)H - c(\hat{q}) - f)$$

Note that $\hat{\pi}(\pi_1)$ is an increasing function in π_1 and $\hat{\pi}(\tilde{\pi}) = 0$. Specifically, $\hat{\pi}(\pi_1) = \hat{\pi}$ when $\pi \geq \frac{\alpha H - L}{H - L}$ and $\hat{\pi}(\pi_1) < \hat{\pi}$ otherwise. The best response of regulator 1 to $q_2 = 0$ is $q_1 = \hat{q}$ if $\pi_2 \geq \hat{\pi}(\pi_1)$ and $q_1 = q^*(\pi_1)$ otherwise. The best response of regulator 1 to $q_2 = q^*(\pi_2)$ is $q_1 = q^*(q_1)$.

Since the regulator in economy 1 is never going to forgo its H-type firms, the only possible candidates for equilibrium q_2 are $q^*(\pi_2)$ and zero. The best response to $q_1 = q^*(\pi_1)$ is $q_2 = q^*(\pi_2)$ if $\pi_2 \geq \underline{\pi}$ and $q_2 = 0$ otherwise. The best response to $q_1 = \hat{q}$ is $q_2 = q^*(\pi_2)$ if $\pi_2 \geq \pi^*$ and $q_2 = 0$ otherwise. Define $\pi^*(\pi_1)$ as the switching point for the regulator in economy 2, then $\pi^*(\pi_1) = \pi^* \forall \pi_1 \geq \tilde{\pi}$.

$\square$

Proof of proposition 6. If $q_2 = \hat{q}$, there are three plausible responses by the regulator in economy 1: $q_1 = 0$, $q_1 = \hat{q}$ and $q_1 = q^*(\pi_1)$. Since $\pi_1 < \pi^*$, it is optimal to give up domestic H-type firms and save the regulation costs. Moreover, $\pi_2 < \hat{\pi}$, the regulator in economy 1 would not want to raise domestic regulation to attract only a few foreign H-type firms. Therefore the best response is $q_1 = 0$.

If $q_1 = \hat{q}$, again there are three plausible responses by the regulator in economy 2. And similarly, the domestic fundamental is too low to cover the cost of high regulation, thus $q^*(\pi_2)$ is not optimal. Among the two left, if $q_2 = \hat{q}$, on one hand, foreign H-type firms will bring enough positive surplus to cover the cost of regulation; one the other hand, domestic L-type firms may not have enough to pay for the high entry cost. If $c(\hat{q}) \leq (1-\alpha)L$, the domestic L-type firms would enter the market, and there is only benefit but no harm to adopt $\hat{q}$. If $c(\hat{q}) > (1-\alpha)L$, the domestic L-type firms would not enter the market with regulation $\hat{q}$. Therefore, the regulator in economy 2 needs to weigh the benefits and costs to the total welfare. The net effect by having $q_2 = \hat{q}$ rather than $q_2 = 0$ is

$$(1-\beta)\pi_1((1-\alpha)H - c(\hat{q}) - f) - c(\hat{q}) - (1-\pi_2)(1-\alpha)L$$

The net effect increases in both π_1 and π_2, and therefore, reaches maximum at $\pi_1 = \pi^*$ and $\pi_2 = \hat{\pi}$. If the maximum is negative, the best response by the regulator in economy 2 is $q_2 = 0$, which implies the reverse equilibrium doesn't exist. Otherwise, there exists a threshold $\pi_2 = \breve{\pi}(\pi_1)$ which makes the net effect zero. Accordingly, the net effect is positive, thus the reverse equilibrium exist when $\pi_2 > \breve{\pi}(\pi_1)$, and vice versa. □

B Extension: Different Sizes

In this section, I explore the case when two economies are of different sizes. In particular, assume that the firms that are in need of financing in economy 1 and economy 2 are of mass m_1 and m_2 respectively. All other setups follow from the main model specified in section 3. Note that firms' financing decisions in the second stage only depend on the regulatory strictness in the two economies and the fundamentals in the two economies, and are independent of the size of two economies. Hence, the analyses of second stage equilibrium is exactly the same as in section 3.2. Next, I analyze the first stage equilibrium. Without loss of generality, assume $\pi_1 \geq \pi_2$.

The general results are very similar to the main body where $m_1 = m_2 = 1$. There is flow of firms between two economies only when the fundamental in economy 2 is low enough such that the regulator in economy 2 is willing to forgo H-type firms to economy 1, and at the same time high enough such that the regulator in economy 1 is willing to accept. Note that the decision of regulator in economy 2 depends only on the fundamental of economy 2, i.e. the fraction of good firms in economy 2. While the regulator in economy 1 is more willing to attract H-type firms in economy 2 if economy 2 is relatively larger, i.e. $\frac{m_2}{m_1}$ is larger. Specifically, the regulator in economy 1 is willing to attract foreign H-type firms when

$$m_1 \left(c(\hat{q}) - c(q^*(\pi_1)) \right) \leq (1-\beta) m_2 \pi_2 \left((1-\alpha)H - c(\hat{q}) - f \right) \Rightarrow \pi_2 \geq \frac{m_1}{m_2} \hat{\pi}(\pi_1)$$

The lower bound is lower when the size of economy 2 is larger respect to economy 1. Formally, below is the summary of equilibrium analogous to Proposition 5. Recall that $\tilde{\pi}$ is such that $q^*(\tilde{\pi}) = \hat{q}$.

Proposition 8. *When $\pi_1 \geq \tilde{\pi}$, in equilibrium, L-type firms in economy 2 go public in the domestic market, and all firms in economy 1 go public in the domestic market. The regulation and the financing choices of H-type firms in economy 2 depending on the fundamentals of the two economies are as follow.*

1. *If* $\underline{\pi} \leq \frac{m_1}{m_2}\hat{\pi}(\pi_1) \leq \pi^*$*, there are three cases.*

   (a) $\pi_2 \in [0, \underline{\pi})$*, in equilibrium* $q_1 = q^*(\pi_1)$*,* $q_2 = 0$*, H-type firms in economy 2 stay out of the stock markets.*

   (b) $\pi_2 \in [\frac{m_1}{m_2}\hat{\pi}(\pi_1), \pi^*]$*, there are two equilibriums. The Pareto dominating equilibrium is* $q_1 = \hat{q}$*,* $q_2 = 0$*, and H-type firms in economy 2 go public in the foreign market. The Pareto dominated equilibrium is* $q_1 = q^*(\pi_1)$*,* $q_2 = q^*(\pi_2)$*, H-type firms in economy 2 go public in the domestic market.*

   (c) $\pi_2 \in [\underline{\pi}, \frac{m_1}{m_2}\hat{\pi}(\pi_1)) \cup (\pi^*, \pi_1]$*, the equilibrium* $q_1 = q^*(\pi_1)$*,* $q_2 = q^*(\pi_2)$*, H-type firms in economy 2 go public in the domestic market.*

2. *If* $\frac{m_1}{m_2}\hat{\pi}(\pi_1) \leq \underline{\pi} \leq \pi^*$*, there are four cases.*

   (a) $\pi_2 \in [0, \frac{m_1}{m_2}\hat{\pi}(\pi_1))$*, in equilibrium* $q_1 = q^*(\pi_1)$*,* $q_2 = 0$*, H-type firms in economy 2 stay out of the stock markets*

   (b) $\pi_2 \in [\frac{m_1}{m_2}\hat{\pi}(\pi_1), \underline{\pi})$*, in equilibrium* $q_1 = \hat{q}$*,* $q_2 = 0$*, H-type firms in economy 2 go public in the foreign market*

   (c) $\pi_2 \in [\underline{\pi}, \pi^*]$*, there are two equilibriums. The Pareto dominating equilibrium is* $q_1 = \hat{q}$*,* $q_2 = 0$*, and H-type firms in economy 2 go public in the foreign market. The Pareto dominated equilibrium is* $q_1 = q^*(\pi_1)$*,* $q_2 = q^*(\pi_2)$*, H-type firms in economy 2 go public in the domestic market.*

   (d) $\pi_2 \in (\pi^*, \pi_1]$*, the equilibrium* $q_1 = q^*(\pi_1)$*,* $q_2 = q^*(\pi_2)$*, H-type firms in economy 2 go public in the domestic market.*

3. *If* $\underline{\pi} \leq \pi^* \leq \frac{m_1}{m_2}\hat{\pi}(\pi_1)$*, there are two cases.*

   (a) $\pi_2 \in [0, \underline{\pi})$*, in equilibrium* $q_1 = q^*(\pi_1)$*,* $q_2 = 0$*, H-type firms in economy 2 stay out of the stock markets.*

   (b) $\pi_2 \in (\underline{\pi}, \pi_1]$*, the equilibrium* $q_1 = q^*(\pi_1)$*,* $q_2 = q^*(\pi_2)$*, H-type firms in economy 2 go public in the domestic market.*

Compare proposition 8 with proposition 5. When $\pi_2 \in [\frac{m_1}{m_2}\hat{\pi}(\pi_1), \pi^*]$, the interesting equilibrium featuring the flow of firms from the weak to the strong economy is the Pareto dominating equilibrium. This interesting region shrinks as $\frac{m_1}{m_2}$ increases. Intuitively, there are two reasons. On one hand, when economy 2 is relatively small, attracting good firms from economy 2 doesn't improve the welfare of economy 1 much. On the other hand, when economy 1 is relatively large, it is costly to raise domestic regulation since all domestic firms need to pay the additional cost. Note that when $\pi_1 = \tilde{\pi}$, it is costless to attract foreign firms. Hence, no matter how small the interesting region is, it always exists.

C Figures

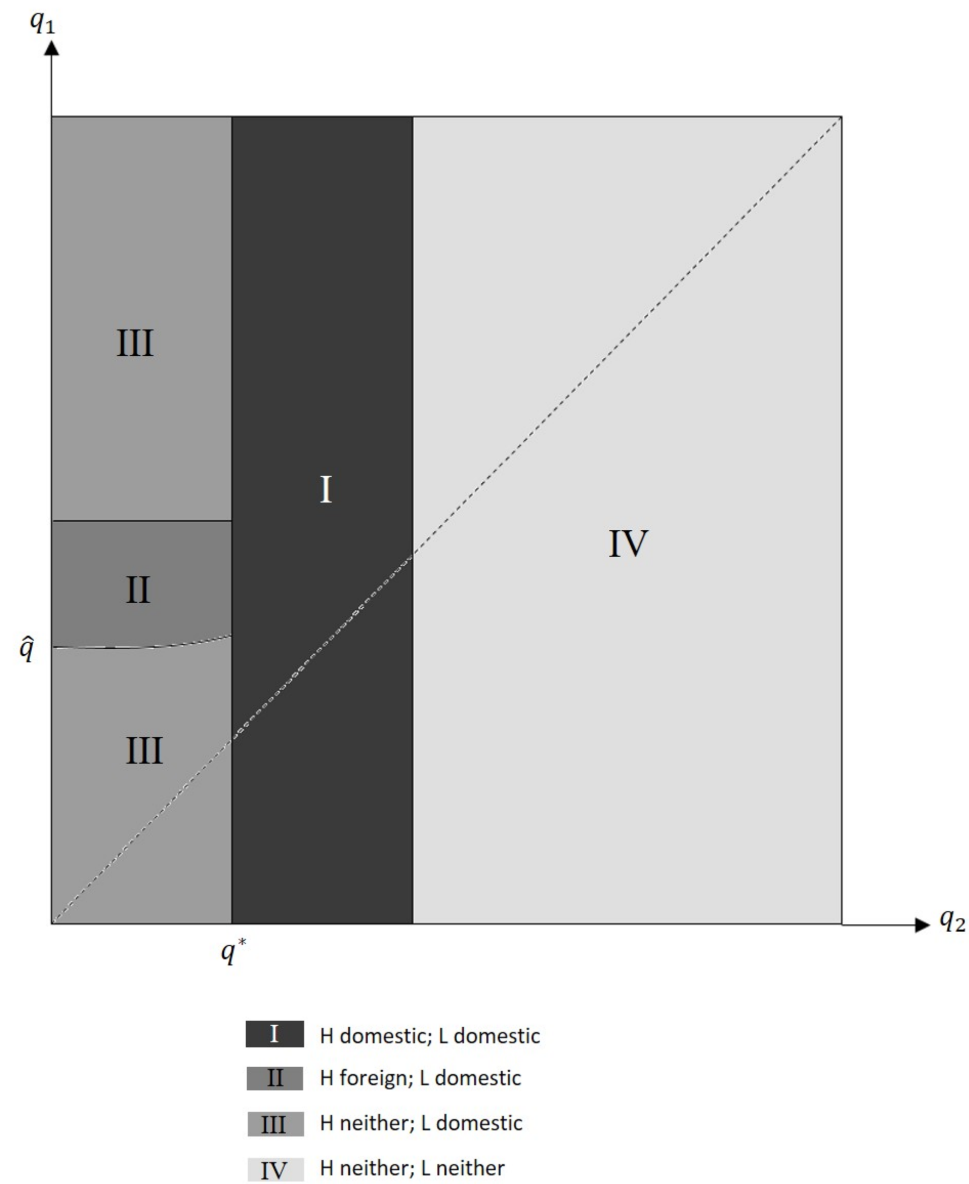

Figure 5: Second Stage Equilibrium Selection

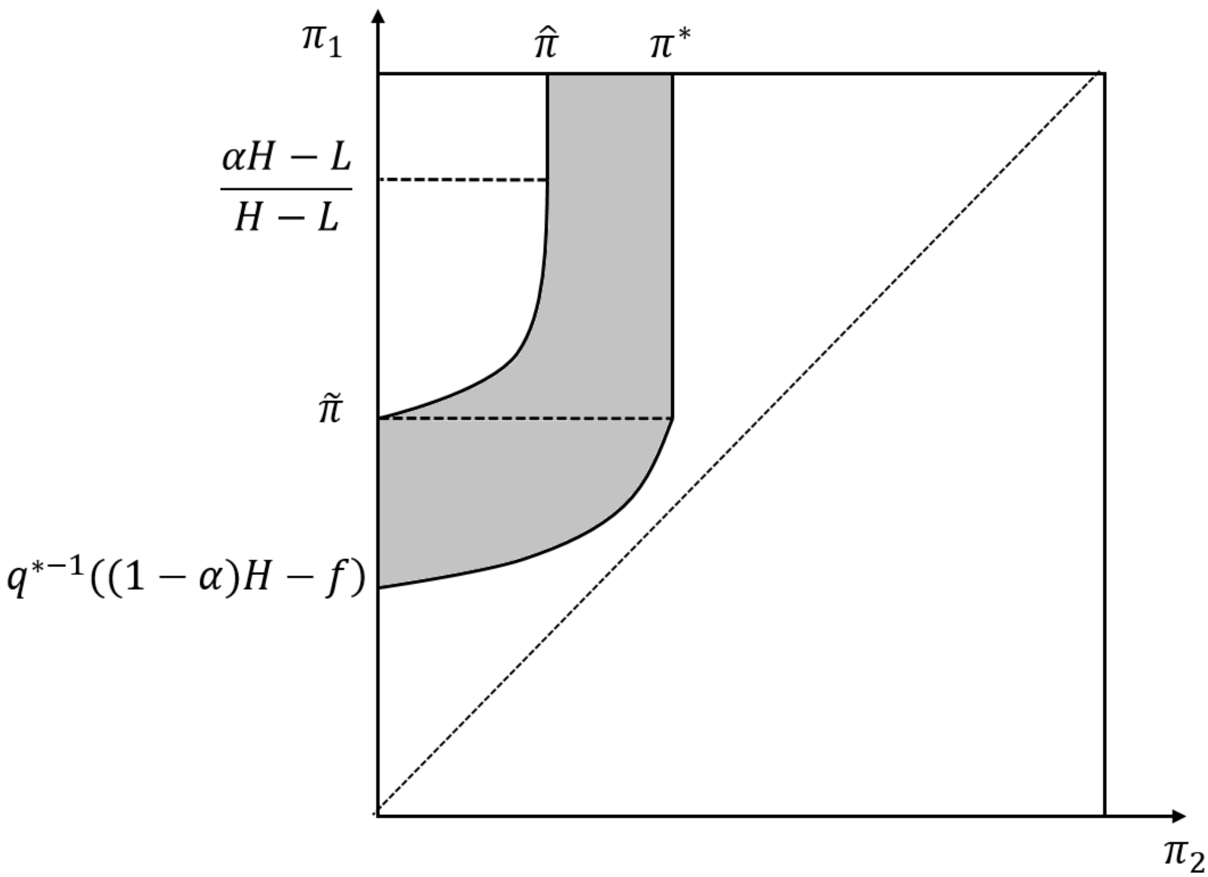

Figure 6: Interesting Equilibrium Region: Two Competitive Regulators

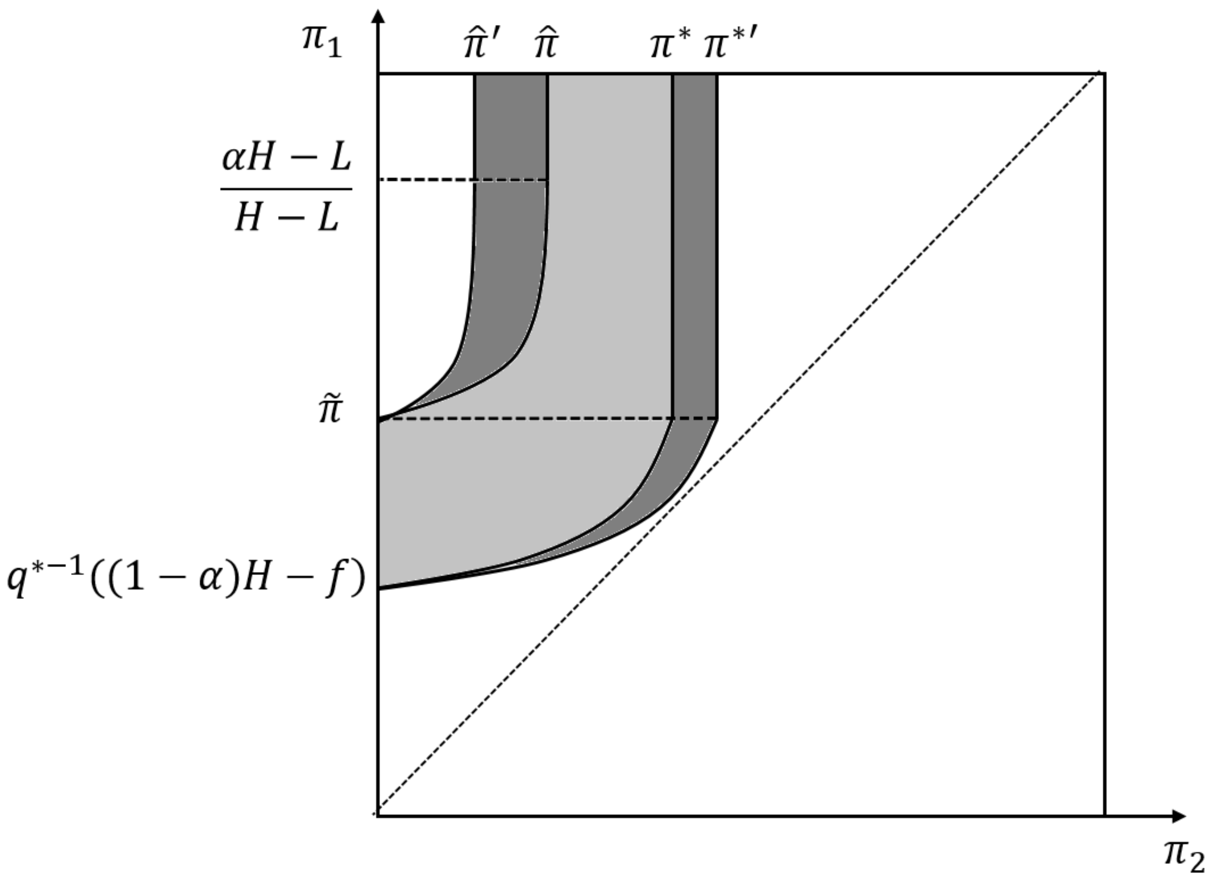

Figure 7: Interesting Equilibrium Region: One Global Regulator