Financial Liberalisation and Capital Regulation in Open Economies

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ABSTRACT

We model the interaction between two economies where banks exhibit both adverse selection and moral hazard and bank regulators try to resolve these problems. We find that liberalising bank capital flows between economies *reduces* total welfare by reducing the average size and efficiency of the banking sector. This effect can be countered by forcing international harmonisation of capital requirements across economies, a policy reminiscent of the "level playing field" adopted in the 1988 Basle Accord. Such a policy is good for weaker regulators whereas a *laissez faire* policy under which each country chooses its own capital requirement is better for the higher quality regulator. We find that imposing a level playing field among countries is globally optimal provided regulators' abilities are not too different. We also show how shocks will be transmitted differently across the two policy regimes.
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I. Introduction

Recent financial globalisation and the liberalisation of capital markets is a source of controversy. Does financial liberalisation cause financial fragility and lead to financial crises? Or does it allow for better risk-sharing and for the more effective channelling of capital to productive investments? Much of the literature on this topic has concentrated upon the potentially adverse effects of capital flows upon developing countries. In contrast, we examine in this paper a model in which only bank capital can flow across borders, while depositors' funds are deployed within the local economy. We show that even in this simple setting, local regulatory decisions may impose *reputational externalities* upon foreign banks and may in turn result in financial contagion.

Previous work on financial liberalisation has stressed the importance of international capital mobility. Several authors have argued that opening an economy increases welfare when there are insufficient local funds to cover all of the available productive investments, or when international diversification increases investors' risk-bearing capabilities (see for example Obstfeld and Rogoff, 1996, and Obstfeld, 1998). The South East Asian crisis of 1997 challenged this consensus (Radelet and Sachs, 1998): several countries which had opened their economies experienced severe problems as a result of a rapid capital withdrawals by foreign investors. Many of the difficulties may be attributable to foreign currency borrowings: Stiglitz (2004) and Sachs (1998) have argued that they could have been avoided by restricting capital flows, or substantially increasing capital requirements for developing country banks. However, the latter recommendation runs against the grain of the Basle Committee (1988) capital adequacy regulations, and its theoretical basis is unclear.

In this paper we present an alternative link between the openness of economies and their vulnerability to financial contagion. We consider an economy in which some bankers are able to perform welfare-increasing monitoring. Monitoring is costly and depositors will commit their funds only if monitoring is incentive compatible. Bankers achieve incentive compatibility by holding capital and by charging depositors for their services (i.e., by limiting deposit rates). The lower the bank's capital level, the greater the payment which depositors must make. A problem arises because some bankers are incapable of monitoring and will accept the depositors' fees without providing anything in return: the possibility that they will encounter such a banker limits the size of the payment which depositors are willing to make. This in turn limits the size of the bank. Regulators can reduce this adverse selection problem by screening potential bankers: this increases confidence in the banking sector and so increases the size of the banking sector.

We use this model to analyse the effect of financial liberalisation in a two economy world where regulators differ in their screening abilities. The intuition for our results is widely applicable and can be easily communicated using the following simple story. Consider a world in which students select their university on the basis of the quality of the signal which it sends to the labour market. There are two universities, which are distinguished only by their respective abilities to identify talent. In this situation, every candidate will apply firstly to the elite institution; unsuccessful applicants will then apply to the other one. After the elite university has employed its superior screening technology the pool from which the other one samples will be of lower average quality. This is inefficient: it would be better for the second tier school to make the first choice, so that the subsequent harder decision problem is faced by the elite school, which is better equipped to deal with it. Allowing the candidates to apply to both schools has minimal effect upon the desirability of an elite school education, but serves to weaken the signal provided by the second tier school, and hence to diminish its value.

Precisely the same effect is at work in our model. We consider two open economies in which one regulator (the “Northern” one) is better at screening licence applicants than the other (the “Southern” regulator). Posession of a Northern banking licence therefore sends a better signal to the capital markets and hence results in higher profits. It follows that when bank capital is mobile, every institution will apply in the first instance for a Northern licence. Southern licences in an open economy will therefore send a weaker signal than they would in a closed economy. This will reduce the size of the Southern banking sector and with it Southern welfare levels. Opening the economies leaves Northern welfare unchanged, but imposes a *cherry-picking externality* upon the South.

Cherry-picking externalities arise because Northern banks are larger and have lower deposit rates. We examine the effects of a level regulatory playing field, as imposed, for example, by the Basle (1988) Accord.[1] When capital requirements are the same in the North and the South there is no reason to prefer one regulator over another and opening the economy will not reduce welfare in the South. However, a level playing field policy is only tenable if capital requirements in the North increase to the minimum level in the South: a *lowest common denominator effect* prevails. Regulators are therefore faced with two options: international coordination upon a level playing field which will disadvantage the North, and a laisser-faire policy of no international regulation of the playing field, in which case regulatory contagion will adversely affect the South.

We compare welfare across the two policy regimes to analyse the appropriate trade-off between the cherry-picking externality and the lowest common denominator effect. For a given Northern regulator ability the cherry picking effect is unaffected by the Southern regulator's ability while the lowest common denominator effect is decreasing in Southern regulator ability. It is therefore better to adopt a level playing field and hence to experience the lowest common denominator effect when Northern and Southern regulator abilities are similar; when they are very different the cherry-picking externality will be the lesser of the two evils and an unregulated playing field will dominate.

This model highlights a previously unrecognised *reputational* form of contagion. Consider firstly a world without international regulatory competition and hence with an unregulated playing field. Suppose that in this world the Northern regulator's reputation is exogenously shocked upwards and hence that the Northern adverse selection problem is somewhat diminished. This will result in lower Northern capital requirements, larger Northern banks and an increased level of economic activity in the North. There will however be a knock-on effect in the South. Strengthening the

[1]For a discussion of the motivation behind the Basle (1988) Accord, see Wagster (1996). Wagster argues that Western Banks hoped that the Accord would even out competitive inequalities between themselves and Japanese Banks, but that based on an analysis of Japanese banks' stock prices, it did not in fact achieve this objective. If Japanese regulators were perceived as generally weaker or less effective than (e.g.) US regulators, this result is consonant with our theory, in that common capital requirements would have to be set to accommodate Japanese banks.

Northern regulator's ability to identify able bankers will exacerbate the cherry-picking externality: the pool from which the Southern regulator selects will be of lower average quality and the adverse selection will become a greater problem in the South as it diminishes in the North. As a result Southern capital requirements will necessarily increase: an improvement in Northern credit markets will cause a credit contraction in the South.

The contagion effect runs in the opposite direction with international cooperation and a level playing field. This case is easier to understand: because the size of Northern banks is determined by the maximum size of Southern banks, changes in the Southern credit markets must be mirrored in the North.

Reputational contagion occurs in our model after banking licences have been allocated. It arises because depositors' assessments of bank quality change and with them, the maximum size of the bank. As a result, capital flows into or out of the banking sector in each country, but it does not cross borders. The international contagion which we identify is not therefore *triggered* by capital flows, but occurs rather because bankers are able to set up shop abroad. After this has occurred, neither exchange nor capital controls seem likely to attenuate this effect.

In our model, financial liberalisation without international coordination on capital requirements must ultimately raise Southern bank capital requirements. This result is in accordance with Hellman, Murdock, and Stiglitz (2000), who argue that South East Asian financial fragility in the wake of financial liberalisation is attributable to the failure of local regulators to raise capital requirements. However, Hellman *et al*'s results are driven by the deliterious effects of bank competition when depositors are insured. There is no deposit insurance in our model and banks can compete only until their monitoring incentive constraint binds: higher deposit rates would be inconsistent with monitoring and would fail to attract depositors, who thereby exert market discipline. Our results are driven instead by an adverse selection effect.

The regulators in our model do not compete: they simply try to maximise welfare by selecting the most able bankers. In our simple framework with only national banks, the cherry-picking externality which the Northern regulator imposes upon the Southern one does not benefit Northern institutions. This distinguishes our work from some recent papers examining regulatory interaction. Acharya (2003) considers a model in which regulators maximise national bank value rather than social welfare *per se* and argues that when closure policies are heterogeneous, level playing fields can result in a welfare-reducing race to the bottom. Similarly, Dell'Ariccia and Marquez (2003) analyse incentives for international regulatory cooperation in a world in which regulators care only about national welfare, and are to some extent actuated by a concern for shareholders of domestic banks.

Our analysis is consonant with recent literature stressing the importance of institutions in emerging markets. If weak institutions are synonymous with low regulator ability then our model demonstrates that financial liberalisation is potentially welfare-decreasing when instutitions are weak because it worsens the adverse selection problem in the local market. The central role of local institutions has also been stressed by Prasad, Rogoff, Wei, and Kose (2003), Stiglitz (2004), and Demirgüç-Kunt and Kane (2002).

The paper is organised as follows. Section II presents a simple model of unregulated banking in which there is adverse selection of and moral hazard by banks. Section III shows how a regulator can increase value in a closed economy by screening licence applicants, and section IV examines the effect of opening the economy to foreign bankers with both level and unregulated playing fields for capital requirements. Section VI considers extensions of our model to multinational banks, exchange controls, regulatory unions and banking crises. Section VII concludes. The first appendix contains a numerical example; the second contains our proofs.

II. The Model

We consider in world in which there are two countries, "the North" and "the South", each of which has a population of N risk neutral agents. The inhabitants of each country are endowed with \$1 and with a project which will return R in case it succeeds and 0 otherwise. The probability that a project succeeds is p_L.[2]

We assume in addition that there exist in each country B risk neutral agents whom we refer to as *bankers*. Each banker is also endowed with \$1 (his *capital*) and with a constant returns to scale project, which will also return R or 0. Bankers' projects succeed with probability p_L if unmonitored. A proportion of each country's bankers is also endowed with a *monitoring technology*: we will refer to these bankers as *sound*. The monitoring technology increases the probability of project success to $p_H = p_L + \Delta p > p_L$. Monitoring is neither observable nor verifiable and its cost to the banker per dollar invested in his project is $\$C > 0$.

We assume that only $\mu < B$ bankers in each country are sound and we write $g \equiv \frac{\mu}{B}$ for the probability that a banker chosen at random will be sound: g is therefore a measure of the licence applicant *pool quality*.

Because bankers' projects are scaleable they can augment their funds with deposits from other agents and manage them on their behalf. A banker who accepts deposits and manages funds in this fashion is said to be running a *bank*. We assume that the returns from bank investments are verifiable and hence contractible, so that *ex post* theft is outside the scope of our model. The relationship between a banker and his depositors is governed by a deposit contract under which the depositor receives a payment of $R - Q$ per dollar invested if the project of the bank in which he invested is successful, and nothing otherwise. A banker who runs a bank of size k therefore receives a payment of $R + (k-1)\,Q$ in the event that his project succeeds (equal to R on his own capital and $R - (R - Q) = Q$ left from the investment of the depositors' money).

We assume that it is efficient for bankers to monitor their investments if they can:

$$R\Delta p > C.$$

The return on deposits is therefore as least a great as that on self-managed funds. It follows that the social optimum is attained when all agents deposit their funds in banks and sound bankers monitor their investments. The greater the proportion of sound bankers, the greater will be the welfare gain from banking, and the higher will be the incentive of agents to deposit.

[2] This project will serve as depositors' outside option to investing in a bank. The fact that it is risky is immaterial here since all agents are risk neutral. In other work (Morrison and White, 2002) we endogenise the choice to become a banker.

In this paper we are mainly concerned with examining the welfare effects of competition between national banking regulators upon social welfare when bank capital is internationally mobile. However, for completeness, we begin in this section by describing the constraints which the banking contract must satisfy with closed economies and in the absence of regulation. In the next section we will introduce a banking regulator into the model.

Firstly, sound bankers running a bank of size k must elect to monitor. This will be the case if the returns to a bank from a monitored investment exceed those on an unmonitored investment:

$$\begin{aligned} (R + (k-1)\,Q)\,p_H - Ck &\geq (R + (k-1)\,Q)\,p_L, \text{ or} \\ Q &\geq \frac{Ck - R\Delta p}{(k-1)\,\Delta p}. \end{aligned} \tag{1}$$

Secondly, banking will not occur unless the deposit contract satisfies the bankers' participation constraint. Sound bankers are willing to accept deposits as long as $(R + (k-1)\,Q)\,p_H - Ck \geq Rp_H - C$, or

$$Q \geq \frac{C}{p_H}. \tag{2}$$

Unsound bankers cannot monitor and so take the fee Q without working for it: their participation constraint is always satisfied when the sound bankers are willing to participate. When the banking incentive compatibility constraint (2) is satisfied, and in the absence of regulation which restricts bank entry or the number of banking licences, sound bankers will be unable to separate themselves from unsound bankers and so there will be B banks in each economy. The unconditional probability that a depositor's investment will yield a non-zero return is therefore

$$\pi(g) \equiv p_L + g\Delta p. \tag{3}$$

Because all depositors are *ex ante* identical and are faced with incentives which do not depend upon the actions of other depositors, we can without loss of generality consider only symmetric equilibria. We further restrict ourselves to pure strategy equilibria.

Depositing must satisfy the following individual rationality constraint:

$$\begin{aligned} (R - Q)\,\pi(g) &\geq Rp_L, \text{ or} \\ Q &\leq \frac{gR\Delta p}{\pi(g)}. \end{aligned} \tag{4}$$

The left hand side of the first line above is the expected return to depositors from depositing when the probability of a payout is $\pi(g)$; this must exceed the outside option Rp_L which they could earn by managing their own projects.

The monitoring IC constraint (1) is plotted in figure 1 with the banker's and depositor's participation constraints (2) and (4) in the case where the monitoring IC constraint crosses the depositors' IR constraint: this happens when

$$\pi(g) < \frac{Rp_L\Delta p}{R\Delta p - C}.$$

Sound bankers will wish to bank only when the fee Q which they receive from depositors is sufficiently high to compensate them for their delegated monitoring activities and also to ensure that monitoring is incentive compatible. This is the case above the lines labelled MIC and BIC in figure 1. Depositors will elect to monitor only when the deposit rate $(R-Q)$ is sufficiently high: in the absence of regulation, this occurs for values of Q below the line labelled $UDIR$. Unregulated banking is therefore possible for (k, Q) pairs which lie within the shaded region on the figure and the largest possible bank size is k^U. Note that when $\gamma(g) > \frac{Rp_L\Delta p}{(R\Delta p - C)}$ so that equations (1) and (4) never interesect, the shaded region is unbounded and banks of any size are possible.

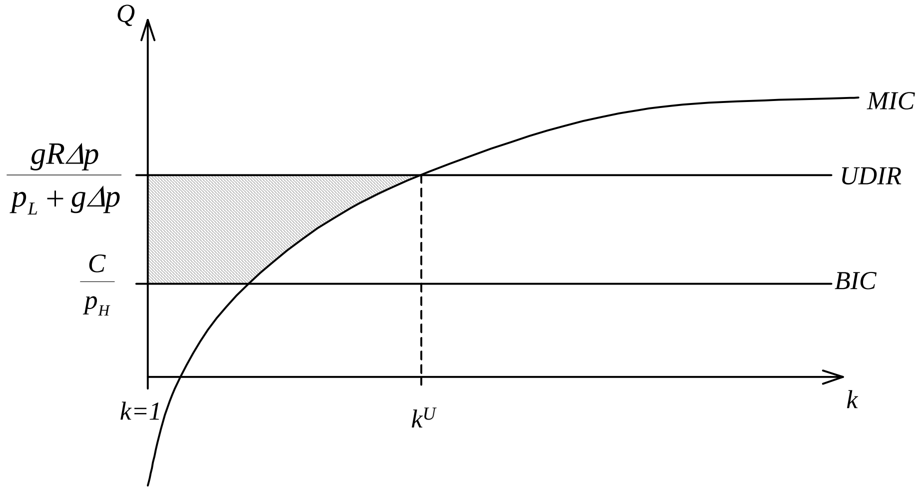

Figure 1: **Banking in Unregulated Closed Economies.** The monitoring IC constraint (1) and the banker's and depositors' respective IR constraints (2) and (4) and labelled MIC, BIC and $UDIR$. Banks in the unregulated economy are possible at (k, Q) pairs in the shaded region. The maximum bank size is k^U.

The following result details the properties of unregulated closed economies.

Proposition 1 *In unregulated closed economies:*

1. *Banking is possible if and only if*
$$\pi(g) \geq \frac{Rp_Lp_H}{Rp_H - C}; \tag{5}$$
2. *When condition (5) is satisfied, the largest possible bank size is* $\min\left(k(g), \frac{N}{B}\right)$ *for* $\gamma(g) < \frac{Rp_L\Delta p}{R\Delta p - C}$*, where*
$$k(g) \equiv \frac{Rp_L\Delta p}{Rp_L\Delta p - \pi(g)(R\Delta p - C)}, \tag{6}$$
and it is $\frac{N}{B}$ *for larger values of* g.
3. *When condition (5) is satisfied, the volume of funds deposited with sound bankers is* $\mu \times \min\left(k^U, \frac{N}{B}\right)$.

Proof. Banking is possible precisely when the depositor's IR constraint (4) lies above the banker's participation constraint (2): this reduces to equation 5. The largest possible bank occurs when (k, Q) lies at the intersection between equations (1) and (4): this occurs when $k = k^U$. Part 3 follows immediately from the fact that there are μ sound bankers in each country. $\square$

Note that the statement and proof of proposition 1 implicitly rely upon an assumption that unregulated banks are able to commit to a particular bank size. In the remainder of the paper we examine regulated economies, where a regulator could enforce such a commitment to a given bank size through setting and enforcing capital requirements. So this assumption will not be crucial to our later results.

When equation (5) is satisfied banks can exist in the absence of regulation and some deposits will be managed by sound agents. At the productive optimum depositors are indifferent between their own projects and banks, while bankers are strictly better off than they are in autarky. Although unregulated banking is a Pareto-improvement upon autarky, it does not follow that assets are allocated in the most productive fashion: welfare would be increased by denying unsound bankers licences to accept deposits. When the condition is not satisfied restricting access to licences will be a necessary precondition for depositing to occur at all. In the next section we show how a regulator can increase both bank size and social welfare by screening banking licence applicants.

III. Bank Regulation in Closed Economies

In this section, we introduce to each economy a banking regulator whose aim is to maximise domestic social welfare. The regulator's role is to award banking licences.[3] Deposit-taking is illegal without a banking licence. As in section II we assume that bankers can commit to a particular bank size k and that they extract all of the surplus which their monitoring brings.

The regulator has a screening technology for distinguishing between sound and unsound bankers when awarding licences. Suppose that the regulator is required to assign m licences from a population of M bankers of whom a proportion γ is sound. When she applies the technology it will randomise between the following two outcomes:

1. *Random assignment*. In this case the technology will allocate licences randomly in such a way as to allocate precisely γm licences to sound bankers and $(1-\gamma)\,m$ licences to unsound bankers;
2. *Correct assignment*. In this case the technology will allocate licences to $\min(m, \gamma M)$ sound bankers, and if $m > \gamma M$ it will randomly assign the remaining $m - \gamma M$ licences to unsound bankers.

We refer to the probability that the licences are correctly assigned to sound bankers as the regulator's *ability*. Regulator ability is a technological parameter; the Northern regulator's ability is a^N and the Southern regulator has ability $a^S < a^N$. In this section we continue to analyse closed economies and so we will typically drop the country superscript and refer to abilities as a.[4]

[3] In related work (Morrison and White, 2002, 2004) we examine the regulator's role as an *ex post* bank auditor and as the administrator of a deposit insurance fund.

[4] For much of the paper, this technology could be alternatively presented in terms of regulator reputation. Suppose that good regulators are able to distinguish sound from unsound bankers, while bad ones do so with probability $\frac{1}{2}$, and interpret the regulator's ability as the probability which depositors assign to the event that she is good. Then the technology in the text is equivalent in a one-shot game with more than m sound bankers to licence allocation by a regulator who repeatedly samples the applicant pool with replacement until m licences have been awarded. We do not adopt this approach for two reasons. Firstly, when a is a reputational parameter rather than a technological one regulators may in some circumstances attempt to signal their types. Secondly, the reputational approach causes

We assume that the regulator allocates precisely μ banking licences. This simplifying assumption is actually the first best policy for sufficiently high ability. To see this, note that if the regulator's ability was 1 it would clearly be optimal to allocate μ licences, since allocating more licences would serve only to diminish the quality of the banker pool. This would reduce depositors' confidence in the banking sector and so would increase the minimum deposit rate which they would accept; this in turn would lower the maximum bank size compatible with monitoring. This size effect would reduce welfare. For lower abilities the size effect would still obtain, but its welfare consequences would to some extent be countered by a quality effect: increasing the number of licences raises the likelihood that all sound bankers receive a licence when the technology randomises. For sufficiently high a, the size effect outweighs the quality effect and the first best policy is to allocate μ licences.[5]

The banker participation and monitoring incentive compatibility conditions (2) and (1) are unchanged by the introduction of the regulator.

With μ banks the probability γ that depositors invest in a sound bank depends upon the regulator's ability and the applicant pool quality g as follows:

$$\gamma_a(g) \equiv a + (1-a)\, g. \tag{7}$$

The probability $\pi_a(g)$ of positive bank returns is therefore

$$\pi_a(g) \equiv p_L + \gamma_a(g)\, \Delta p. \tag{8}$$

It follows immediately that the depositors' individual rationality constraint in this case is

$$\begin{aligned} (R-Q)\, \pi_a(g) &\geq Rp_L, \text{ or} \\ Q &\leq \frac{\gamma_a(g)\, R\Delta p}{\pi_a(g)}. \end{aligned} \tag{9}$$

Note that the maximum fee Q which the depositor is prepared to pay is equal to the fee in the unregulated case when $a = 0$ and that it is increasing in the regulator's ability.

Proposition 2 describes the properties of regulated closed economies.

Proposition 2 *In regulated closed economies with regulator ability a:*

1. *Banking is possible if and only if*

$$\pi_a(g) \geq \frac{Rp_L p_H}{Rp_H - C}; \tag{10}$$

2. *There exists a continuously decreasing function $\bar{a}(g)$ such that when condition (10) is satisfied, the maximum possible bank size is $k_a(g)$, where*

$$k_a(g) \equiv \begin{cases} \frac{Rp_L\Delta p}{Rp_L\Delta p - \pi_a(g)(R\Delta p - C)}, & a \leq \bar{a}(g); \\ \frac{N}{\mu}, & a > \bar{a}(g). \end{cases} \tag{11}$$

unnecessary complication when there are fewer than m sound bankers in the economy.

[5] Under the reputational screening model of footnote 4 it is always optimal to allocate μ licences since to do otherwise would signal low quality and would reduce the size of the banking sector and with it welfare levels.

3. *When condition (10) is satisfied, the expected volume of funds deposited with sound bankers is*

$$\gamma_a(g)\,\mu \times k(a,g)\,. \tag{12}$$

Proof. Banking is possible precisely when the depositors' IR constraint (9) lies above the banker's IR constraint (2), which yields equation (10). When $a < a^*(g) \equiv \frac{Cp_L-(R\Delta p-C)g\Delta p}{(R\Delta p-C)\Delta p(1-g)}$, the monitoring IC constraint (1) crosses the depositors' participation constraint (9) at $f(g) \equiv \frac{Rp_L\Delta p}{Rp_L\Delta p-\gamma_a(g)(R\Delta p-C)}$ and $k(a,g)$ is therefore the minimum of this term and $\frac{N}{\mu}$; for $a > a^*(g)$, equations (1) and (9) never cross and $k(a,g)$ is $\frac{N}{\mu}$. The existence of $\bar{a}(g)$ follows immediately from the monotonicity of $f(g)$. The first term in equation 12 is the expected number of sound bankers: this is multiplied by bank size to obtain the expected volume of funds deposited with sound bankers. □

It will be convenient to assume that when the regulator is never wrong ($a = 1$), there will be no rationing of deposits and that it will be possible to run banks of maximum size $\frac{N}{\mu}$. A sufficient condition for this to be the case is $a^*(g) < 1$, or

$$Cp_L < (R\Delta p - C)\,\Delta p. \tag{13}$$

Note that $k_a(g)$ is strictly increasing in a with $k_0(g) = k(g)$: as a consequence of the regulator's screening activities, the maximum bank size $k_a(g)$ in closed regulated economies is strictly greater than the maximum size $k(g)$ without regulation. Since each bank has an endowment of \$1, we can regard $\frac{1}{k}$ as a capital adequacy ratio (enforced in this model by the market rather than the regulator: see Morrison and White, 2002, for a detailed discussion of optimal capital requirements). The effect of the regulator's screening activities is to allow banks to operate with slacker capital requirements. Note however that the regulator need not necessarily increase social welfare: although she increases the size of individual banks, she reduces the number of banks to μ. The former effect will outweigh the latter only for sufficiently high a (so that the expected number of sound regulated banks is high), or for sufficiently high B (so that the size of unregulated banks is very small). In what follows we will assume that a^N and a^S are sufficiently large to ensure that regulation increases welfare in both the North and the South.[6]

To avoid notational clutter, when it is possible to do so without confusion, we will write γ_N and γ_S for γ_{a^N} and γ_{a^S} respectively, and we will adopt similar conventions for $\pi_a(.)$ and $k_a(.)$. Note that, since $k_N(g) > k_S(g)$, that depositing and welfare is greater in the North than in the South. In the following section, we consider the welfare consequences of cross-border banking in our model.

IV. Bank Regulation in Open Economies

In this section we allow bankers to seek licences abroad. For simplicity, we assume that depositors must continue to place their funds with an institution which is locally regulated.[7] We model the

[6] When $k(a,g) < \frac{N}{\mu}$ it is easy to show that a necessary and sufficient condition for this to be the case is $a > \frac{Cp_L-(R\Delta p-C)g\Delta p}{Cp_L+(R\Delta p-C)g\Delta p}$.

[7] When deposits are rationed in both countries, this assumption is without loss of generality. Relaxing it would introduce additional complications if the northern regulator has ability $a > \overline{a}(g)$.

licence allocation procedure in two stages. In the first stage, all bankers apply to their first choice regulator for a banking licence. If they are indifferent between the two regulators we assume that they apply to their home regulator. Licences are allocated using the technology of section III. We continue to assume that μ licences are awarded in each country.[8] If all bankers have the same first choice regulator then there is a second stage in which bankers who have not been awarded a licence can apply for a licence in their second choice country. In this section we allow bankers to hold only one licence; we relax this assumption in section V, where we analyse multinational banks.

We compare two possible capital adequacy regimes: a *level playing field* approach, in which international conformity of capital requirements is enforced by international agreement, and an *unregulated playing field*, in which there are no cross-country restrictions on capital requirements and each country's regulator sets domestic capital requirements to maximise domestic welfare.

A. Unregulated Playing Field

With an unregulated playing field the higher ability Northern regulator will be able to run larger banks than the Southern regulator. Moreover, since Northern banks have a higher probability of success, depositors will accept lower deposit rates and the Northern bankers will therefore earn higher per-depositor profits than the Southern bankers. It follows that every banker will apply in the first instance for a Northern banking licence. The Northern regulator will therefore select bankers from a pool of size $2B$, of whom 2μ are sound; in other words, the proportion of sound licence applicants in the North will be

$$g^N \equiv \frac{2\mu}{2B} = g.$$

If the Northern regulator allocates licences randomly then the Southern regulator selects from a pool whose expected proportion of sound bankers is g; if the Northern regulator allocates correctly then the Southern regulator's pool of $2B - \mu$ licence applicants contains precisely μ sound applicants. The expected proportion of sound licence applicants in the South will therefore be

$$g^S \equiv a^N \frac{\mu}{2B-\mu} + \left(1 - a^N\right) \frac{\mu}{B} = g - a^N \frac{g\,(1-g)}{2-g}.$$

An identical argument to that of section III implies that the size of a bank in an economy with regulator quality a and proportion $\tilde{g}$ of sound licence applicants is given by the expression $k_a\left(\tilde{g}\right)$ defined in equation (11).

Figure 2 illustrates the position of Northern and Southern banks on the monitoring incentive compatibility constraint (1) in (k, Q) space in the case of an unregulated playing field. Since the applicant pool from which the Northern regulator selects bankers has a proportion g of sound applicants in open and closed economies, bank size in both cases will be $k_N\left(g\right)$. The proportion

[8] The Northern regulator is stronger and one might expect her to award all of the licences. We continue to assume that there are μ banks in each country for two reasons. Firstly, we wish to model the effects of regulator competition and so we assume that no national regulator will be permitted by her government to delegate to a foreign insitution all responsibility for bank licensing. Secondly, we assume that a total of 2μ licences will be awarded to avoid awkward signalling problems. If more than 2μ licences were awarded in total then the Southern regulator could attempt to signal her quality by refusing to allocate all of the licences available to her. This would complicate our analysis withough generating additional insights.

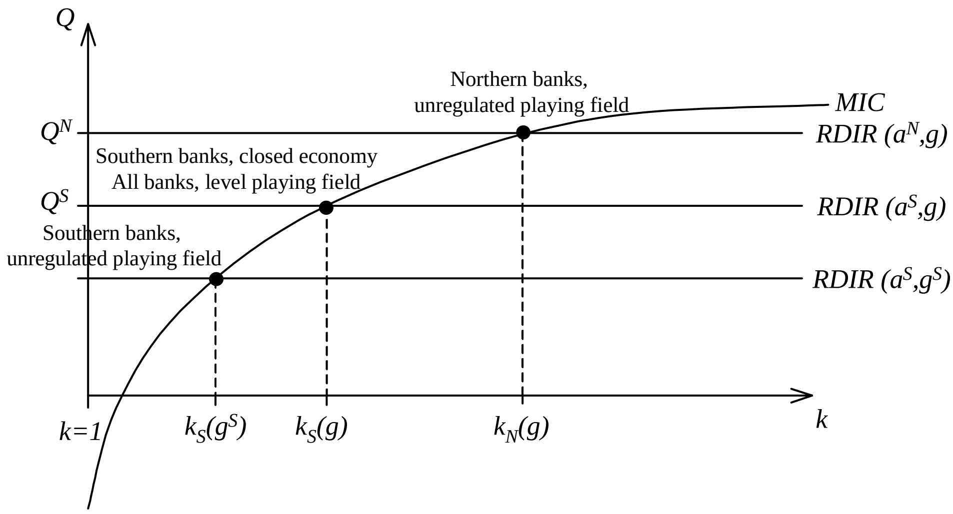

Figure 2: **Bank Size and Deposit Rates in Open Economies.** The banker's monitoring incentive compatibility constraint (1) is labelled MIC; the depositor IR constraint (9) is labelled $RDIR$, and is indexed by ability a and pool quality g.

of sound applicants in the Southern regulator's pool is g in closed economies and g^S in open economies with no international restrictions on capital requirements. The corresponding bank sizes are therefore $k_S\left(g\right)$ and $k_S\left(g^S\right)$.

We again measure welfare within each country by the productivity of its banking sector. When a regulator of ability a selects bankers from a pool containing a proportion $\tilde{g}$ of sound applicants and runs banks of size k the appropriate welfare measure is therefore

$$W\left(a, \tilde{g}, k\right) \equiv \mu \times \gamma_a\left(\tilde{g}\right) \times k. \tag{14}$$

Since $g^S < g$ and $k_S\left(g\right) < k_S\left(g^S\right)$, the following proposition is immediate from examination of figure 2:

Proposition 3 *With an unregulated playing field the welfare of the Northern economy is the same in the open and the closed economies; the welfare of the Southern economy is lower in the open than in the closed economy. Hence allowing international capital flows reduces welfare.*

As noted above, proposition 3 follows because bankers will prefer to operate in the North. They therefore open a Southern bank only if they are turned away by the Northern bank and this reduces the expected number of sound bankers in the Southern pool. This reduces the expected quality of Southern banks, so depositors in the South demand a higher deposit rate. Monitoring with the higher deposit rate is incentive compatible only if the Southern bank size is reduced. This lowers production levels and hence welfare in the South. Note that we have assumed that the productivity of banks' investment projects *per se* is the same in the North as in the South, so the only reason why bankers prefer to operate in the North is that in this economy the strength of the regulator's reputation is such that they can extract more rent from depositors while the latter are still willing to deposit. (This in turn allows bankers in the North to run larger banks.) The South would be better off imposing capital controls to prevent the flight of bank capital to the North; moreover, imposing such controls would not harm the North.

We now consider cross-country regulatory effects. Firstly, note that in an open economy the quality of the Northern regulator affects the Southern banking sector:

PROPOSITION 4 *With an unregulated playing field, Southern bank size is a decreasing function of Northern regulator quality. Northern bank size is unaffected by Southern regulator quality.*

Proof. Note that $\frac{\partial k_S(g^S)}{\partial a^N} = -\frac{k_S(g^S)^2}{Rp_L\Delta p}\frac{(R\Delta p - C)\Delta p(1-a)g(1-g)}{2-g} < 0$. $k_N(g)$ is not affected by a^S. □

Proposition 4 identifies a form of "reputational contagion": a positive shock to the Northern regulator's reputation will shrink Southern bank size. Conversely, improvements in the quality of the Southern regulator will not transmit shocks to the Northern economy, so poorly regulated economies are much more vulnerable to such shocks. To understand how the effect operates, note that an increase in a^N will have two effects. Firstly, there will be a *quality effect.* The expected proportion of sound bankers in the North will increase. As a result, the proportion of sound bankers in the pool available to the Southern banker will drop. The Northern banker's ability to "cherry pick" from the available pool of bankers will therefore cause a worsening of the expected quality of Southern bankers. Secondly, the increase in average banker quality in the North will reduce the level of capital required to make depositing incentive compatible and Northern banks will therefore become larger: in other words, there will be a *size effect.* Since confidence in Southern banks will be reduced by the quality effect, the size effect will have the opposite sign in the South, as set out in the proposition.

Without international capital adequacy regulation, we would expect increases in Northern economy reputation to increase inequality between the North and the South. The effect of reputational contagion is to exacerbate this effect: the increase in Northern economy welfare is accompanied by a *reduction* in Southern economy welfare. The aggregate international consequence of the opposing welfare changes in the North and South resulting from improved Northern reputation is not immediately clear. With an unregulated playing field, the respective Northern and Southern welfares (as defined by equation 14) are given by the following expressions:

$$W_U^N \equiv W\left(a^N, g, k_N(g)\right) = \begin{cases} \mu\frac{Rp_L\Delta p\gamma_N(g)}{Rp_L\Delta p - \pi_N(g)(R\Delta p - C)}, & a^N \leq \bar{a}(g) \\ N\gamma_N(g), & a^N > \bar{a}(g) \end{cases} \quad (15)$$

$$W_U^S \equiv W\left(a^S, g^S, k_S\left(g^S\right)\right) = \begin{cases} \mu\frac{Rp_L\Delta p\gamma_S(g^S)}{Rp_L\Delta p - \pi_S(g^S)}, & a^S \leq \bar{a}\left(g^S\right) \\ N\gamma_S\left(g^S\right), & a^S > \bar{a}\left(g^S\right) \end{cases} \quad (16)$$

The function $\bar{a}(.)$ is defined in part 2 of proposition 2. The space partition implied by equations (15) and (16) reflects the fact that bank size cannot increase past the maximum level $\frac{N}{\mu}$. It is illustrated in figure 3. Admissible $\left(a^N, a^S\right)$ values lie below the leading diagonal in the figure. In the lower left region $a^S < a^N < \bar{a}(g)$ so that neither bank's maximum size constraint binds; in the middle region $a^N > \bar{a}(g)$ and $a^S < \bar{a}\left(g^S\right)$ so that only the Northern bank's size constraint binds; and in the top region $\bar{a}(g) < \bar{a}\left(g^S\right) < a^S < a^N$ so that both constraints bind.

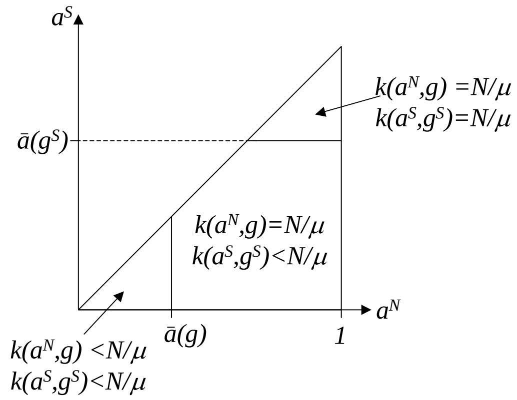

Figure 3: Bank sizes in open economies with unregulated playing field.

We define international welfare to be the unweighted sum of national welfares: in other words, to be the total productivity of the international economy. Proposition 5 relates the partition of figure 3 to the welfare implications of an increase in a^N:

PROPOSITION 5 *In an open economy with an unregulated playing field for capital requirements:*

1. *When $a^N < \bar{a}(g)$, international welfare is increasing in a^N;*
2. *When $a^N > \bar{a}(g)$ and $a^S < \bar{a}(g^S)$, international welfare is increasing in a^N if and only if*

$$k_S\left(g^S\right)^2 < \left(\frac{N(2-g)}{g\mu} - k_S\left(g^S\right)\right)\frac{Rp_L}{\gamma_S\left(g^S\right)(R\Delta p - C)};$$

3. *When $a^S > \bar{a}(g^S)$, international welfare is increasing in a^N.*

To understand this result, recall that a change in a^N will have a size effect and a quality effect. Since the Northern bank is larger than the Southern bank, the welfare consequences of the quality effect will apply on a larger scale in the North than in the South and its aggregate welfare consequence will therefore be positive. The size effect arises because a change in the rate $R - Q$ required to induce depositing changes the intersection point of the depositors' IR constraint (9) with the bank's monitoring IC constraint (1). Since the monitoring IC constraint is concave, a given movement in the depositors' IR constraint will have a greater effect upon the size of the larger Northern bank than the smaller Southern one, so that the aggregate welfare consequence of the size effect will be positive.

Now consider the three regions identified in figure 3. Part (1) of the proposition refers to the bottom left region in which neither size constraint binds: the size and the quality effect therefore apply in both the North and the South. Since each has a positive aggregate effect upon welfare, increases in a^N must increase total welfare. Part (3) of the proposition refers to the top right region in the figure, where both size constraints bind and only the quality effect applies in each region. Once again, welfare is increasing in a^N because the aggregate quality effect is positive. Part (2) of the proposition refers to the middle region, within which the Northern size constraint binds but the Southern one does not. The size effect in this region therefore applies only in the South and is therefore welfare reductive. This effect dominates only when the size difference between Northern and Southern banks is sufficiently small to render the positive quality effect insignificant: this happens for high enough $k\left(g^S(a^S)\right)$ as in the statement of the proposition.

From an efficiency point of view the phenomena identified in this section are the opposite of what is desirable. In open economies with an unregulated international playing field for capital regulation, bankers would prefer to obtain a licence from the more competent regulator, as this would provide them with a better signal and allow them to run a more profitable bank. The more talented regulator therefore gets the pick of the crop: it would be preferable to allow the Southern regulator to cherry pick and then to let the Northern regulator to sort the wheat out from the remaining chaff, since the Northern regulator is better equipped to do this.[9] This leads to the idea that it might be efficient from the point of view of total (international) social welfare to enforce a level playing field, so that the Southern regulator picks from a pool that is no worse than that enjoyed by the Northern Regulator. We now turn to the analysis of this policy.

B. Level Playing Field

Under the level playing field approach, regulators would agree upon international regulations which rendered banking in the North and the South equally attractive. In this case bankers would apply for licences only in their home jurisdiction and the quality effect observed in proposition 3 would not arise.

We are able with a level playing field for capital to prove results which are analogous to propositions 3, 4, and 5.

Proposition 6 *With a level playing field the welfare of the Southern economy is the same in the open and closed economies; the welfare of the Northern economy is lower in the open than in the closed economy. Hence allowing capital flows reduces welfare.*

The size of Southern economy banks is $k_S(g)$ in both open and closed economies. In Northern economies it is $k_S(g)$ in open economies and $k_N(g) > k_S(g)$ in closed economies.

Proposition 6 follows because the level playing field must render banking equally attractive in the North and in the South. It is clear from figure 2 that this is most efficiently accomplished by setting the size of both banks equal to $k_S(g)$: this is equal to the closed economy bank size in the South, but is less than $k_N(g)$, the closed economy Northern bank size.

Note that deposit rate regulation is also required to achieve a level playing field. To see this, note that banks regulated in the North could charge up to $Q^N > Q^S$. If they did so then they would continue to attract *all* of the stage 1 licence applicants and the problems identified in section IV.A would arise. To avoid this, the deposit rate in both countries must be set equal to $R - Q^S$.

[9] It might seem that this result relies on the fact that the screening technology employed by our regulators is an ex ante one, and that because in reality regulators also perform ex post auditing, it is in practice implausible that *all* banks, including unsound ones, would prefer to be regulated by the better regulator as they do in our model. A moment's reflection, however, reveals that allowing for the Northern regulator to be better at ex post as well as ex ante auditing would only *strengthen* our results by further improving the pool of applicants to the Northern regulator and worsening that available to the Southern regulator. It might even be desirable to prevent the Northern regulator from extensive ex post audits on the grounds that this would simply force marginal banks to relocate in economies where they would be audited by a less competent regulator. We leave this as a topic for future research.

In other words, a level playing field requires both *common capital requirements* and *deposit rate floors*.

Analogously to proposition 4, a reputational spill-over effect from the South to the North arises with a level playing field for capital requirements:

PROPOSITION 7 *In an open economy with a level playing field, Northern bank size is an increasing function of Southern regulator quality. Southern bank size is unaffected by Northern regulator quality.*

Proof. This follows immediately from the observation that with a level playing field, bank size in both the North and the South is $k_S(g)$. $\square$

Although there is a form of reputational contagion with level playing fields, it is less complex than with unregulated playing fields. Capital requirements with a level playing field are set to ensure that both regulators are drawing from an identical pool and the pool quality effects identified in section IV.A do not therefore apply. Reputational spillover occurs with level playing fields simply because all banks are constrained to the size of the weakest closed economy bank.

With a level playing field, the respective welfares as defined by equation 14 of the North and the South are given by the following expressions:

$$W_L^N \equiv W\left(a^N, g, k\left(a^S, g\right)\right) = \begin{cases} \mu \frac{Rp_L \Delta p \gamma_N(g)}{Rp_L \Delta p - \pi_S(g)(R\Delta p - C)}, & a^N \leq \bar{a}(g) \\ N\gamma_N(g), & a^N > \bar{a}(g) \end{cases} \tag{17}$$

$$W_L^S \equiv W\left(a^S, g, k\left(a^S, g\right)\right) = \begin{cases} \mu \frac{Rp_L \Delta p \gamma_S(g)}{Rp_L \Delta p - \pi_S(g)(R\Delta p - C)}, & a^S \leq \bar{a}(g) \\ N\gamma_S(g), & a^S > \bar{a}(g) \end{cases} \tag{18}$$

It follows immediately that the welfare effects of an increase in the Southern regulator's reputation are unambiguously positive:

PROPOSITION 8 *In an open economy with a level playing field for capital requirements international welfare is increasing in a^S.*

Although Proposition 8 may be demonstrated using equations (17) and (18), it is obvious from the preceding discussion. The size of the banking sector in each economy is $k_S(g)$. An increase in a^S will therefore have a positive size effect in both economies. It will also have a positive quality effect in the South, where the average bank quality is increasing in a^S. International welfare with level playing fields is therefore increasing in a^S.

We now examine the choice of international capital regulation regime.

C. Optimal International Capital Regulation

In this section, we determine the circumstances under which a level playing field is preferred to an unregulated one. The discussion in sections IV.A and IV.B indicated that international welfare with a level playing field depends upon the ability of the Southern regulator, and that with an unregulated playing field, it depends upon the ability of the Northern regulator. It is therefore intuitive that the level playing field will be preferred when the Southern regulator's ability is sufficiently high; equivalently, when $a^N - a^S$ is sufficiently low. We show below that this is indeed the case.

Total welfare with an unregulated playing field exceeds that with a level playing field precisely when

$$\Delta W \equiv \left(W_U^N + W_U^S\right) - \left(W_L^N + W_L^S\right) > 0.$$

For convenience of exposition, we break the welfare difference ΔW between the unregulated and the level playing field into the differences $N\left(a^N, a^S, g\right) \equiv W_U^N - W_L^N$ and $S\left(a^N, a^S, g\right) \equiv W_U^S - W_L^S$ in the North and the South respectively. Straightforward manipulations yield the following expressions:

$$N\left(a^N, a^S, g\right) = \begin{cases} \mu\frac{\left(a^N - a^S\right)\gamma_N(g)(1-g)(R\Delta p - C)}{Rp_L} k_N(g)\, k_S(g)\,, & a^N < \bar{a}(g)\,; \\ \mu\gamma_N(g)\left(\frac{N}{\mu} - k_S(g)\right), & a^S < \bar{a}(g) < a^N; \\ 0, & \bar{a}(g) < a^S. \end{cases}$$

$$S\left(a^N, a^S, g\right) = \begin{cases} -\mu\frac{a^N\left(1-a^S\right)g(1-g)Cp_L}{(2-g)Rp_L\Delta p} k_S\left(g^S\right) k_S(g)\,, & a^S < \bar{a}(g)\,; \\ \mu\frac{\gamma_S\left(g^S\right)Rp_L\Delta p}{Rp_L\Delta p - \pi_S\left(g^S\right)(R\Delta p - C)} - \gamma_S(g)\,N, & \bar{a}(g) < a^S < \bar{a}\left(g^S\right); \\ -\frac{\left(1-a^S\right)a^N g(1-g)N}{2-g}, & \bar{a}\left(g^S\right) < a^S. \end{cases}$$

These expressions partition $\left(a^N, a^S\right)$ space as illustrated in figure 4. Since $a^N > a^S$, possible parameter values are those below the diagonal line. In the shaded region, $a^N > a^S > \bar{a}(g)$ and $N\left(a^N, a^S, g\right)$ is therefore equal to 0. Since $S\left(a^N, a^S, g\right) < 0$ it follows that $\Delta W < 0$ in this region and hence that level playing fields are preferred to unregulated ones. Along the leading diagonal for $a^N < \bar{a}(g)$, N is again zero (since $\left(a^N - a^S\right)$ is a factor) and ΔW is again negative.

A detailed discussion of the properties of figure 4 appears in the appendix, where the following result is proved:

Proposition 9 *There exists a function $\lambda(a) < \min(a, \bar{a}(g))$ (possibly negative) with $\lambda'(a) \geq 0$ such that for every $a^N \in [0,1]$, a level playing field for capital requirements is preferred to an unregulated playing field precisely when $a^S > \lambda\left(a^N\right)$.*

The function $\lambda\left(a^N\right)$ is illustrated in figure 4. Unregulated capital requirements are optimal in the region below this line and level requirements are optimal in the region above it. To understand the intutition behind the result, recall that a "lowest common denomimator" effect causes the Northern economy's welfare to be reduced to that of the South with level playing fields, while with unregulated playing fields the Northern regulator inflicts a "cherry-picking externality" upon the South, whose welfare is thereby reduced. The former effect is more important when the Northern regulator is significantly better than the Southern one so that the loss caused by standardization is significant. This is the case for high $a^N - a^S$: in other words, when $a^S < \lambda\left(a^N\right)$. A numerical illustration of proposition 9 is provided in appendix 1.

V. Multinational Banks

We have concentrated in this paper upon the choice between level and unregulated playing fields when all banks are locally regulated. In this section we extend our work to multinational banks.

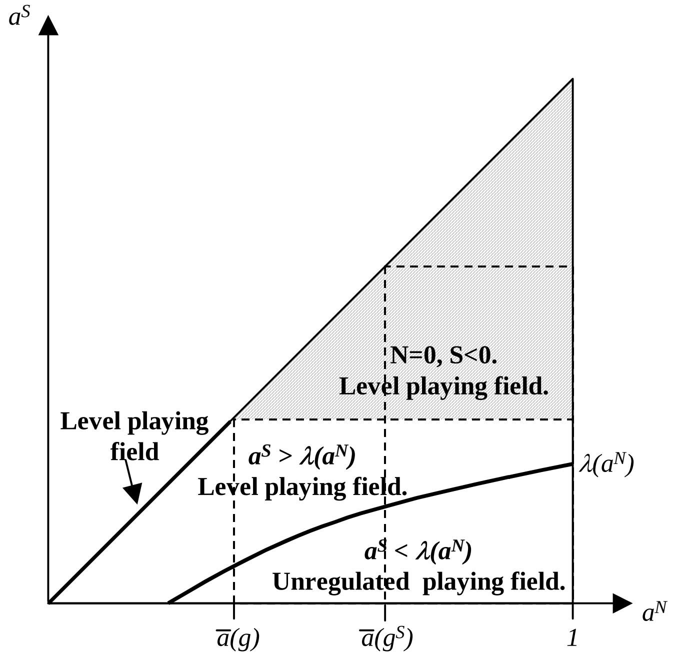

Figure 4: Optimal capital regimes for open economies in $\left(a^N, a^S\right)$ space.

We suppose that as above, that would-be bankers can apply to the two regulators, but we now allow an applicant to accept licences from more than one regulator. It is natural to call a bank with a licence to operate in more than one country a *multinational bank*.

Intuitively, acceptance by two regulators is a better signal of quality than acceptance by only one and multinational banks are therefore more likely to be sound than banks which operate in only one country. At a given deposit rate multinational banks could therefore operate with looser capital requirements than their nationally based rivals, and the public would still be willing to deposit in them. Conversely, if multinational and local banks had the same capital requirements, the multinational banks would be able to offer lower deposit rates while still attracting savers.

It follows from this argument that if regulation does allow multinational banks to exploit their reputational advantage by accepting more deposits or offering lower deposit rates, all licence applicants would prefer to be multinationals. The fact that a bank is only local then becomes a negative signal: multinational banks exert a negative externality upon locally regulated banks, which shrink accordingly. This result is consistent with the empirical work of Claessens, Demirgüç-Kunt, and Huizinga (2001) which suggests that the entry of foreign banks squeezes domestic competition (see also Demirgüç-Kunt and Huizinga, 1999, who show that foreign banks earn higher margins than domestic banks in developing countries).

We examine below two different licence allocation procedures: one in which borders are opened after licences have been assigned to local banks, at which stage they can apply for a foreign licence; and one in which borders are open initially and banks can choose where to make their initial licence applications: in this second case all banks will apply first in the North then in the South.

The first of these games accurately reflects the way in which international banking networks are formed. When local bankers apply for local banking licences before attempting to expand overseas there is no cherry-picking effect. In this case foreign charters are valuable because they supply additional certification for the local bank and hence allow it to operate with looser capital requirements. In this case, opening borders to international capital flows in unambiguously welfare-increasing.

The second of these games is not observed in practice. Nevertheless, we believe that it may represent a more long-term picture of equilibrium. After borders are opened, new licence applicants will in the first instance elect as in our analysis of this section to apply for Northern regulator certification. Over time, therefore, one might expect some cherry-picking externalities to manifest themselves in the Southern economy. We demonstrate that in this case, the Southern economy will be better off with free capital flows than without them only for sufficiently high Norther regulator ability.

In the light of our results from previous sections, it is clear that the net welfare effect of allowing multinationals in this second case is not obvious. On the one hand we have larger, better quality, multinational banks, and on the other we have a smaller local banking sector. One might think that since the ability to "double check" a licence applicant constitutes an improvement in the screening technology, it must enhance bank quality and hence welfare. However, as before there is a concommittant size effect which may go in the reverse direction. The trade-off is similar to that studied in proposition 5, where an improvement in the screening technology of the Northern regulator is not necessarily beneficial for overall welfare.

A. Borders Opened After Local Licence Allocation

In this section we assume that bankers apply for local licences in closed economies as in section III, after which the economies are opened and successful bankers can if they wish apply for foreign licences. We further assume that applicants who were unsuccessful in their home economies cannot apply for foreign licences.

When a bank's first licence was in the North (respectively, the South), we say that it is *based in the North* (respectively, the South). When a multinational bank is based in the North (resp. South), we refer to its Northern (resp. Southern) branch as its *head office*. As in section III, we assume that each regulator will allocate μ local licences. We write m_N and m_S for the number of *multinational* banks with Northern and Southern head offices, respectively.

Note that in equilibrium, every banker would prefer to have two charters, as this would send a better signal to depositors and so would reduce rates, which would lower capital requirements. Let q be the probability that the bank is sound, conditional upon random licence allocation by the local regulator and correct allocation by the foreign regulator. Then the probability γ that a randomly selected bank is sound will therefore depend upon q, g and the respective abilities a^l and a^f of the local and foreign regulatorsas follows:

$$\gamma_{l,f}^{q}(g) \equiv a^l + \left(1 - a^l\right)\left(a^f q + \left(1 - a^f\right) g\right). \tag{19}$$

If the local regulator assigns licences correctly (probability a^l) then the bank will certainly be sound. Otherwise (probability $1 - a^l$) the probability that the bank is sound is given by the applicant pool quality g if the foreign regulator randomly assigns licences (probability $1-a^f$) and by q otherwise(probability a^f).

To derive an expression for q, note that a total of γm sound bankers will apply for multinational banking licences when the local regulator randomly assigns licences. If the foreign regulator correctly assigns licences it will therefore licence $\min(g\mu, m)$ sound multinational banks, and this will leave $\max(g\mu - m, 0)$ sound local bankers. It follows that

$$q = \begin{cases} \theta_g \equiv \min\left(\frac{g\mu}{m}, 1\right), & \text{for multinational banks;} \\ \psi_g \equiv \max\left(\frac{g\mu-m}{\mu-m}, 0\right), & \text{for local banks.} \end{cases}$$

We will reduce notational clutter by writing θ_N, θ_S for θ_{g^N} and θ_{g^N} respectively, and ψ_N, ψ_S for ψ_{g^N} and ψ_{g^S}.

The probability that a randomly selected bank generates positive returns is

$$\pi^q_{l,f}(g) \equiv p_L + \gamma^q_{l,f}(g)\,\Delta p, \tag{20}$$

where again $q \in \{\theta, \psi\}$ depends upon the bank's type. The depositor's individual rationality constraint is therefore

$$\begin{aligned} (R-Q)\,\pi^q_{l,f}(g) &\geq Rp_L, \text{ or} \\ Q &\leq \frac{\gamma^q_{l,f}(g)\,R\Delta p}{\pi^q_{l,f}(g)}. \end{aligned} \tag{21}$$

We now prove an analogous result to proposition 2.

PROPOSITION 10 *In open economies with multinational banks in which liberalisation occurs after the assignment of banking licences:*

1. *Local banking ($q=\theta$) and multinational banking ($q=\psi$) are possible if and only if*

$$\pi^q_{l,f}(g) \geq \frac{Rp_Lp_H}{Rp_H - C}; \tag{22}$$

2. *For $(l,f) \in \{(S,N),(N,S)\}$ there exist $\bar{a}^\psi_{l,f}(g,m,a^f) < \bar{a}^\theta_{l,f}(g,m,a^f)$ such that:*
   (a) *For $q \in \{\theta,\psi\}$, $\bar{a}^q_S$ and $\bar{a}^q_N$ are decreasing in a^N and a^S respectively;*
   (b) *For $q \in \{\theta,\psi\}$, $\bar{a}^q_S\left(g,m,\bar{a}^q_N\left(a^S\right)\right) > a^S$;*
   (c) *The respective sizes of multinational and local banks are given by $k^\theta_{l,f}(g)$ and $k^\psi_{l,f}(g)$, where*

$$k^\theta_{l,f}(g) \equiv \begin{cases} \frac{Rp_L\Delta p}{Rp_L\Delta p - \pi^\theta_{l,f}(g)(R\Delta p - C)}, & a^l \leq \bar{a}^\theta_{l,f}\left(g,m,a^f\right); \\ \frac{N}{m}, & a^l > \bar{a}^\theta_{l,f}\left(g,m,a^f\right), \end{cases}$$

and

$$k^\psi_{l,f}(g) \equiv \begin{cases} \frac{Rp_L\Delta p}{Rp_L\Delta p - \pi^\psi_{l,f}(g)(R\Delta p - C)}, & a^l \leq \bar{a}^\psi_{l,f}\left(g,m,a^f\right); \\ \frac{N - mk^\theta_{l,f}}{\mu - m}, & \bar{a}^\psi_{l,f}\left(g,m,a^f\right) < a^l \leq \bar{a}^\theta_{l,f}\left(g,m,a^f\right); \\ 0, & a^l > \bar{a}^\theta_{l,f}\left(g,m,a^f\right). \end{cases}$$

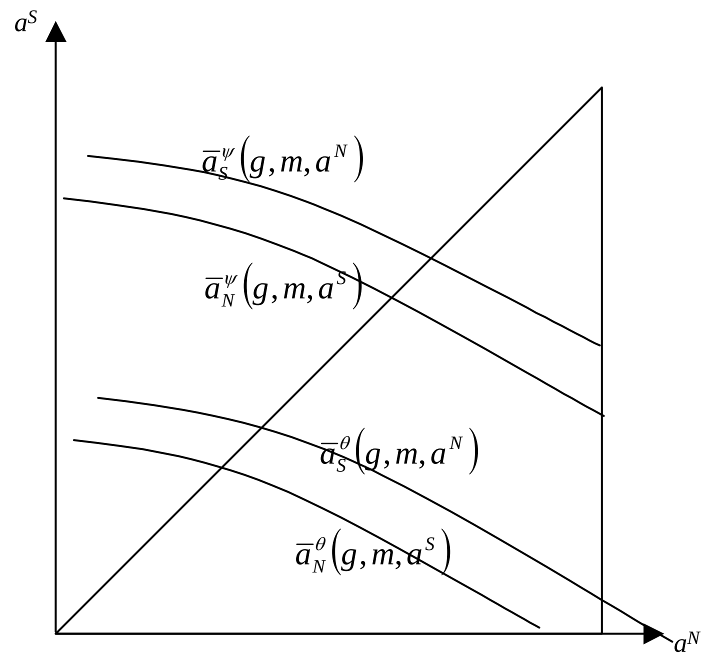

Figure 5: **Bank sizes in open economies when borders are opened before first licence applications.** The regions illustrated here are defined in proposition 10.

Proof. In the appendix. □

The regions of the (a^N, a^S) space defined in proposition 10 are illustrated in figure 5.

The proof of the second part of proposition 10 assumes that the local regulator will restrict the size of local banks in order to ensure that as much as possible is deposited with the stronger multinational banks. In the situation where foreign deposits are rationed and local ones are not[10] this nationally-interested regulator behaviour is second best: it would be better from the perspective of total welfare to allow the multinational bank to meet some of the foreign demand for deposits, while its local competitors met residual domestic demand. In the case where there is rationing in both countries this problem will not arise.

We note that, although in the open economy all banks are screened two times, banks which are based in the North are larger:

LEMMA 1 $k^{\theta}_{a^N,a^S} \geq k^{\theta}_{a^S,a^N}$.

Lemma 1 is true because the identity of the head office determines the value of the parameter q. The quality of the pool which the foreign regulator faces depends upon the quality of the initial screening, and this will be higher in the North.

We now examine welfare levels in the open economy, and we derive the optimal numbers of Northern- and Southern- domiciled multinational banks. The welfare of the open economy is

[10] Note that in this case, "local" must refer to the North, and "foreign" to the South.

defined to be the expected volume of funds under management in sound banks:

$$W_l^{\mathrm{Op}} \equiv \gamma_{l,f}^{\theta}(g)\, m k_{l,f}^{\theta}(g) + \gamma_{l,f}^{\psi}(g)\,(\mu - m)\, k_{l,f}^{\psi}(g)\,. \tag{23}$$

PROPOSITION 11 *The welfare of an open economy is increasing in m for $m \leq g\mu$, and decreasing for $m > g\mu$. Hence welfare is maximised when $m = g\mu$, at which point $\theta = 1$ and $\psi = 0$.*

The intuition for proposition 11 is as follows. When $m < g\mu$, increasing m replaces a local bank with a multinational one. The provides an additional valuable signal to depositors. When depositors are more confident of the quality of the banking sector they will accept lower deposit rates, so the banking sector can be expanded without violating the bankers' monitoring constraint (1). On the other hand, increasing m past $g\mu$ ensures that some multinational banks will be unsound. This reduces the value of a multinational bank signal and with it depositor confidence, the size of the banking sector, and hence welfare.

Note that the the case where $m = 0$ collapses to the closed economy case. Proposition 11 therefore has the following obvious corollary:

COROLLARY 1 *Welfare in both the North and the South is strictly increased by liberalisation which allows existing local banks to apply for foreign licences.*

In the absence of the cherry-picking effects of section IV, financial liberalisation does not impose a negative externality upon the Southern economy. Hence, while levelling the international regulatory playing field would still damage the Northern economy, it is not necessary to protect the Southern one:

COROLLARY 2 *Level playing fields are unambiguously welfare-reductive in open economies formed by liberalisation which allows existing local banks to apply for foreign licences.*

B. Borders Opened Before Local Licence Allocation

In this section we consider a model in which multinational bank licences are allocated using an extension of the model of section IV. In the first stage of the licence allocation game bankers start to operate in an open economy, and may apply to any country for their banking licence. If bankers are indifferent between licences in the North and the South then they apply to their local regulator for a licence. Unsuccessful applicants may apply to the other country for a banking licence. In the second stage of the game bankers with licences may apply for a second licence. Bankers with two licences operate as multinational banks, while bankers with only one operate as local bankers.

Recall from lemma 1 that in the absence of international playing field regulation, if every banker applied for a local licence both local and multinational banks would be larger in the North than in the South. As a result, banks based in the North would be more profitable than banks based in the South. It follows that all bankers will apply in the first instance for a Northern licence and hence that the Southern banking sector will be subject to a cherry-picking externality of the type identified in section IV.A. Without playing field regulation the pool qualities in the North and the South will therefore be a^N and a^S, respectively.

As in section IV we consider welfare in this case with both unregulated and level playing fields. As in section IV.B, the purpose of level playing fields is to make Northern and Southern home banking licences equally attractive and hence to remove the cherry-picking externality. This is achieved by equating bank size, deposit rates, and also the number of multinational banks based in each country. Welfare is again defined to be the expected volume of funds under management in sound banks. Let W_l^U and W_l^L be the respective welfares of country $l \in \{N, S\}$ with unregulated and level playing fields. Then

$$W_l^U = \gamma_{l,f}^{\theta_l}\left(g^l\right) m k_{l,f}^{\theta_l}\left(g^l\right) + \gamma_{l,f}^{\psi_l}\left(g^l\right)(\mu - m)\, k_{l,f}^{\psi_l}\left(g^l\right); \tag{24}$$

$$W_l^L = \gamma_{l,f}^{\theta_g}(g)\, m k_{S,N}^{\theta_g}(g) + \gamma_{l,f}^{\psi_g}\left(g^l\right)(\mu - m)\, k_{S,N}^{\psi_g}(g). \tag{25}$$

In this section, where we assume that borders are opened before first licence application, many of the conclusions of sections IV.A and IV.B remain true, for the same reasons. Specifically, Southern welfare will always be (weakly) higher with level playing fields, and Northern welfare will always be (weakly) higher with unregulated playing fields.

Recall from section V.A that welfare is increased when liberalisation allows only existing local banks to apply for foreign licences. The welfare effects of the liberalisation of this section, which allows *all* local bankers to apply for a foreign licence, are the same in the North. The effects in the South are ambiguous:

Proposition 12 *With unregulated playing fields, Southern welfare is higher with open markets which allow all local bankers to apply for a foreign licence than in the closed economy case precisely when*

$$g^S \mu \left[\gamma_{S,N}^1\left(g^S\right) - \gamma_S(g)\right] k_{S,N}^1\left(g^S\right) \geq \left(1 - g^S\right)\mu\left[\gamma_{S,N}^0\left(g^S\right) - \gamma_S(g)\right] k_{S,N}^0\left(g^S\right) \tag{26}$$

Liberalisation with cherry-picking and multinational banks has two effects. Firstly, the cherry-picking effect reduces the size of local banks, which is value-reductive. Secondly, the increased certification effect of multinational banks increases the size of multinational banks. The certification effect is illustrated on the right hand side of equation (26): the number of multinational banks is equal to $g^S\mu$, the square-bracketted term represents the quality change due to liberalisation, and the size of the effect is given by $k_{S,N}^1\left(g^S\right)$. Note that, although the multinational banks are certified twice, they are drawn from a lower quality pool (due to the cherry-picking effect) and hence there may not be a welfare gain. The size effect on local banks is similarly given by the left hand side of the equation. Increases in a^N serve both to raise the value of the second licence, and also to diminish the quality of the pool. The net effect on multinational banks is ambiguous; on local banks it is unambiguously bad. Further manipulation of equation (26) is not revealing.

Finally, we examine the relate welfare merits of level and unregulated playing fields. It transpires that the move from unregulated to level playing fields in the North is always less damaging with multinational banks than without (as in section IV.A). Whether the same is true for the South depends upon the specific parameters of the problem.

Proposition 13 *In liberalised economies when bankers can apply for a first banking licence in any country:*

1. *Welfare is higher with level regulatory playing fields whenever* $a^N \geq \bar{a}^{\theta}_{N,S}\left(g, m, a^S\right)$*;*
2. *When* $a^N < \bar{a}^{\theta}_{N,S}\left(g, m, a^S\right)$*, the difference between welfare levels in the North with unregulated and level international playing fields is decreasing in* m *for* $m \leq g\mu$*;*
3. *When* $\bar{a}^S \geq \bar{a}^{\theta}_{S,N}\left(g, m, a^N\right)$*, the difference between welfare levels in the South with unregulated and level international playing fields is decreasing in* m *for* $m \leq g^S\mu$ *whenever condition (27) is satisfied:*

$$\left(1-a^N\right)\left[k^{\theta_S}_{S,N}\left(g^S\right)k^{\theta}_{S,N}(g) - k^{\psi_S}_{S,N}\left(g^S\right)k^{\psi}_{S,N}(g)\right] - \frac{\left(\mu - m\left(1-a^N\right)\right)a^N\left(1-a^S\right)(1-g)\mu}{(\mu-m)^2}\left(R\Delta p - C\right)\Delta p\left[\frac{k^{\psi_S}_{S,N}\left(g^S\right)}{Rp_L\Delta p} + \frac{k^{\psi}_{S,N}(g)}{Rp_L\Delta p}\right] > 0 \quad (27)$$

The intuition for part 1 of proposition 13 is simple. When Northern multinational banks are so large that no money is deposited with local banks, shrinking the bank will not affect Northern welfare.

The following corollary follows immediately:

Corollary 3 *When condition (27) is satisfied, level playing fields are preferred in a strictly larger set of economies with multinational banks than without.*

VI. Extensions and Directions for Future Research

A. Banking Crises, Liberalisation and Regulator Reputation

We can interpret a spate of bank failures (i.e. 0 outcomes instead of R outcomes) as a banking crisis. Clearly, banking crises are more likely in the South than in the North, since the pool of banks selected in the South will on average contain more unsound banks. Indeed, Demirgüç-Kunt and Detragiache (1998) show that "... high values of the 'law and order' index, which should measure [...] the ability to carry out effective prudential supervision, tend to reduce the likelihood of a crisis." If banking capital is mobile then the cherry picking externality imposed by the Northern Regulator increases further the likelihood of banking crises in the South. With mobile bank capital, an improvement in the quality of the Northern Regulator will all else equal cause more crises in the South and fewer in the North, whereas an improvement in the Southern Regulator's reputation will reduce Southern crises and have no impact in the North. An international agreement on a level playing field which raises capital requirements in the North and reduces them in the South will reduce the likelihood of Southern Banking crises, and leave the probability of Northern crises unchanged.

As regulator quality declines the fraction of the economy's funds deposited in banks must also decline, so the ratio of deposits to GDP will decline. Hence bank failures are more likely when the ratio of deposits to GDP is low. This effect may explain why Demirgüç-Kunt and Detragiache (1998) find an inconsistent sign on the effect of credit to GDP ratios in predicting banking crises. Although they anticipated that credit *growth* would be associated with financial liberalisation and would cause banking crises (see for example Hellman *et al*, 2000), our model shows that credit *contractions* signal poor regulator reputation and hence a greater likelihood of crisis.

B. Regulatory Unions and the Benefits of Local Regulators

We have assumed that bank regulators in the North and the South operate independently. However, in the context of our simple model, unifying the regulatory framework would clearly be beneficial. A simple welfare improvement could be achieved by having the more skilled Northern regulator assess applications for Southern Banking licences as well as Northern ones. Moreover, in contrast to work by Dell'Ariccia and Marquez (2003) and Acharya (2003), the Southern regulator would be happy to agree to this change. Even if the Northern regulator cares primarily about Northern welfare and only lexicographically about welfare in the South, the South will be better off under either unilateral or multilateral capital requirements if the more talented regulator chooses the banks. An even better outcome for both countries can be achieved if both regulators continue to screen licence applicants before pooling information and jointly allocating licences. This observation holds even when regulators are concerned primarily about national welfare: given either immobility of depositor capital or deposit rationing, Northern and Southern banks do not compete with one another and so there is no conflict of regulatory interest.[11]

When would a regulatory union or regulation by a remote regulator fail to deliver welfare improvements? One plausible circumstance is when local regulators have superior information about local banks: on other words, when regulator screening ability is not the one-dimensional object which we have analysed, but differs according to the geographical proximity of the bank being screened. For a model along these lines, see Holthausen and Rønde (2002). It might in this case be desirable to keep the two economies as separate regulatory jurisdictions, as we have assumed in this paper. In practice, of course, there are also strong policital reasons why an economy may not wish to delegate power over its banking sector to a foreign regulator.

C. Deposit Insurance

It would also be interesting to investigate the optimal deposit insurance policy in the economies studied in this paper. Elsewhere, we show that *subsidised* deposit insurance schemes are welfare increasing in this environment - and that weaker regulators should provide more deposit insurance. Could more generous deposit insurance schemes be used by weaker regulators as an alternative way of levelling the playing field and making their economy a more attractive location for banks?

It would also be interesting to investigate how the presence of multinational banks should interact with the domestic provision of domestic deposit insurance. A scheme under which all banks operating in a country (whether national or multinational) must contribute to and benefit from the national. deposit insurance scheme on an equal basis will tend to level the playing field between national and international banks for two reasons.[12] Firstly, note that insured depositors are indifferent to the failure risk of their banks. As a result, with deposit insurance the sounder

[11] This seems to be a reasonable approximation to reality in many cases. US Banks are not in strong competition with most African Banks, for example, so it seems that there should be few political economy barriers to cooperation in screening banks between American and African regulators. There will of course be conflict of interest in the setting of capital requirements, however.

[12] Whether this indeed occurs depends on whether the foreign office of the multinational bank is set up as a branch or as a subsidiary of the headquarters. We leave the analysis of the optimal choice in this respect for future research.

multinational banks will no longer be able to borrow at a lower rate than local banks. Secondly, if all banks pay the same deposit insurance premium the insurance scheme constitutes a subsidy from the sounder mulitnational banks to the riskier local banks. We conjecture that this net subsidy is is most likely inefficient since the multinational investments are of higher average quality.

D. Free Movement of Depositor Funds and Exchange Controls

Throughout this paper we have implicitly assumed that depositors may deposit only in their home country. When - as is the case for most of our analysis - deposits are rationed, this assumption is without loss of generality: it would not be possible for the foreign banking system to absorb any more deposits even if depositors were allowed to deposit across national boundaries. Similarly when deposits are not rationed in either country there is no benefit to depositors from depositing across boundaries if, as we have assumed, they continue to receive their outside option. The ability to deposit overseas is of interest mainly when deposits in one country (i.e., the South, since it has the weaker regulator) are rationed, whereas those in the North are not. It seems clear that in this case, the adverse welfare impact of policies which shrink the Southern banking sector is likely to be smaller, because depositors can reallocate their funds to the North instead. Thus the disadvantages of free movement of bank capital and the benefits of level playing fields in capital regulation are both reduced when Southern residents' funds are more mobile. Further, in the simple model presented here, there are no costs to allowing free movement of depositor funds, so we suggest that if capital requirements for Northern Banks are not binding, then free movement of depositor funds across borders should be encouraged. This contrasts with the case for free movement of bank capital, which we saw in propositions 3 and 6 above, can be harmful. Of course it can be difficult in practice to distinguish these two types of capital flows, but a policy of exchange controls for the South, where sums above a given limit cannot be easily converted, might be helpful. This may help us to understand why exchange controls are often adopted by developing countries, although, as mentioned in the introduction, there are also a number of other justifications for such a policy.

VII. Conclusion

In this paper we have examined a stripped-down model of two banking sectors with regulators with different degrees of competency. We have deliberately abstracted from many real world features associated with contagion in order to deomonstrate that important externalities arise between the two regulators *even when the banks which they regulate do not compete with one another at all.* This is in contrast to much of the recent literature (e.g., Acharya (2003), Dell'Ariccia and Marquez (2003)) which address issues of financial integration when foreign banks compete directly with domestic ones. Instead, we show that when bank capital is internationally mobile, various forms of *reputational contagion* can arise.

Since there are no direct linkages between the economies we study, one might imagine that it would be optimal to allow regulators to act independently of one another and choose the capital requirements which are best suited to the local economy which they are regulating, rather than force them to use a one-size-fits-all prescription such as the Basle Accord. In particular, as a consequence of its better reputation for screening, the Northern regulator can afford to set its capital requirements more loosely without a loss of depositor confidence. This allows a larger banking system for a given quantity of bank capital, so it appears to be more efficient. The problem, however, is that every banker would then prefer to hold a Northern bank charter, as this is more profitable. It follows that all bankers will apply in the first instance to the Northern regulator and hence that any bank chartered in the South must have been rejected in the North. This effect reduces public confidence in Southern banks. Thus, when bank capital is internationally mobile, the mere existence of the Northern regulator imposes a *cherry-picking externality* upon the South.

One possible response to this externality would be simply to try to contain or to limit international capital flows. In our model this improves welfare in the South and has no impact in the North, and so is unambiguously welfare improving. In contrast, allowing international capital flows is harmful because it reduces condidence in weakly regulated economies and increases their chances of experiencing a banking crisis. This result accords well with the casual observation of Hellman *et al* (2000) that in recent years financial liberalisation seems to have resulted in both increased international capital flows and a greater incidence of banking crises.

Capital account liberalisation leaves weakly regulated economies vulnerable to shocks from well-regulated economies from which they would otherwise be insulated. In our model, a shock to the reputation of the Northern regulator will affect the Southern banking system. The impact in the South could be even larger than in the North, where the affected regulator actually operates. For example, the adverse shock to the US regulator's reputation in the wake of the savings and loan scandal should have been beneficial for emerging economies, whereas the gradual recovery in reputation thereafter may have led to reduced confidence in them. If we take our model literally, confidence in all of these economies banking systems is intimately bound up with confidence in the developed country regulators' ability to root out unsound banks. More broadly, the international mobility of a limited sum of capital means that investment into any of these economies is a substitute to investment in developed economies.

Our model points to a problem with some standard responses to financial crises. Contagion arises in our model because depositors update their beliefs about the quality of their local banking sector. To be sure, this problem arises because international capital mobility gives rise to a cherry-picking externality, but instances of contagion do not involve capital flows. Crises in our model involve capital flight from the banks, but they do not cause, and nor are they caused by, cross-border capital flows: money which leaves the banking sector is hoarded locally. Responding to a crisis by restricting international capital flows or by imposing exchange controls is in our model akin to closing the stable door after the horse's departure.

While closing borders to bank capital flows *ex ante* will prevent reputational contagion, a second possible response is to level the playing field between regulators, so that being chartered by the better regulator becomes relatively less attractive. The Basle Accord can be interpreted in this light. We show that forcing the Northern regulator to tighten capital requirements beyond the locally optimal level allows the Southern regulator to loosen local capital requirements, so that the net effect can be an overall larger and better quality banking sector. The absence of an international agreement will be to the detriment of the Southern economy. Interestingly, when international agreements enforce level playing fields, the level of capital requirements should be adjusted in accordance with the needs of the weakest economy, so that an adverse shock to its regulator's reputation (resulting for example from a wave of bank failures) should cause a tightening of capital requirements everywhere, not just in the economy concerned.

Of course, our discussion of policy is predicated on the assumption that the competence of the Southern regulator is given. Evidently it would be better for all concerned if her ability and reputation could be improved, irrespective of whether playing fields are level or unregulated, and of whether capital flows are substantial or not. (Surprisingly, this is not true of improving the competence of the better regulator, which will exert a negative externality on the worse regulator and thus will not be Pareto improving.) Thus it should clearly be a priority for the IMF, BIS and developed country regulators to try to pass on regulatory skills and best practices to the regulators in developing countries.

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Appendix 1

Proposition 9 is illustrated in figure 6, which shows the welfare gains N and S from unregulated as opposed to regulated playing fields for the North and the South respectively, and the aggregate effect ΔW international economy. Note that S is always negative: the size and quality effects of giving the Northern bank first choice from the pool of bankers are both welfare reductive in the South. Conversely, N is always positive, due to the lowest common denominator effect with level playing fields. The dominance of the lowest common denominator effect for high $a^N - a^S$ and of the cherry picking effect for small $a^N - a^S$ is clear from the final table.

Appendix 2

Proof of Proposition 5

When $a^N < \bar{a}(g)$, differentiation of equations 15 and 16 yields the following:

$$\begin{aligned} \frac{\partial W_U^N}{\partial a^N} &= \mu(1-g)\,k_N(g)\left\{1+\gamma_N(g)\frac{(R\Delta p - C)}{Rp_L}k_N(g)\right\}; \\ \frac{\partial W_U^S}{\partial a^N} &= -\mu\frac{g(1-g)\left(1-a^S\right)}{2-g}k_S\left(g^S\right)\left\{1+\gamma_S\left(g^S\right)\frac{(R\Delta p - C)}{Rp_L}k_S\left(g^S\right)\right\}. \end{aligned}$$

In both of these expressions, the first term in the curly brackets is the quality effect identified in the text, while the second is the size effect. Since $\frac{g\left(1-a^S\right)}{2-g} < 1$, we must have

$$\frac{\partial W_U^N}{\partial a^N} + \frac{\partial W_U^S}{\partial a^N} > \mu(1-g)\left\{k\left(a^N, g\right) - k\left(a^S, g^S\right)\right\} + \mu\frac{(R\Delta p - C)\,\gamma_N(g)}{Rp_L}\left\{k_N(g)^2 - k_S\left(g^S\right)^2\right\} > 0.$$

North

aS \ aN	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
1											0
0.9										0	0
0.8									0	0	0
0.7								0	0	0	0
0.6							0	0	0	0	0
0.5						0	0	0	0	0	0
0.4					0	127	132	136	141	145	150
0.3				0	57	186	193	200	206	213	219
0.2			0	10	67	197	204	211	218	225	232
0.1		0	4	14	71	202	209	216	223	230	237
0	0	2	6	16	74	204	211	218	226	233	240

South

aS \ aN	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
1											0
0.9										-4	-4
0.8									-6	-7	-8
0.7								-8	-10	-11	-12
0.6							-10	-11	-13	-125	-159
0.5						-167	-179	-186	-191	-194	-197
0.4					-62	-65	-68	-70	-71	-72	-73
0.3				-11	-13	-15	-16	-17	-17	-18	-19
0.2			-4	-5	-6	-7	-8	-8	-9	-9	-10
0.1		-1	-2	-3	-4	-4	-5	-5	-6	-6	-6
0	0	-1	-2	-2	-3	-3	-4	-4	-4	-4	-5

North + South

aS \ aN	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
1											0
0.9										-4	-4
0.8									-6	-7	-8
0.7								-8	-10	-11	-12
0.6							-10	-11	-13	-125	-159
0.5						-167	-179	-186	-191	-194	-197
0.4					-62	62	64	67	70	73	77
0.3				-11	44	172	177	183	189	195	201
0.2			-4	5	61	190	196	203	209	216	222
0.1		-1	2	11	68	197	204	210	217	224	231
0	0	1	5	14	71	201	208	215	221	228	235

Figure 6: Welfare gain from unregulated as opposed to level playing fields in the North, the South, and internationally. Level playing fields are preferred in the respective regions when the number in the grid is negative. Figures presented for $R = 2$, $p_L = 0.2$, $\Delta p = 0.4$, $C = 0.5$, $\mu = 12$, $B = 50$, $N = 3000$.

When $a^N > \bar{a}(g)$, $\frac{\partial W_U^N}{\partial a^N} = N(1-g)$ and when $a^S > \bar{a}(g^S)$, $\frac{\partial W_U^S}{\partial a^N} = -N\frac{g(1-g)(1-a^S)}{2-g}$, so when $a^S > \bar{a}(g^S)$,

$$\frac{\partial W_U^N}{\partial a^N} + \frac{\partial W_U^S}{\partial a^N} = \frac{N}{\mu}(1-g)\left\{1 - \frac{(1-a^S)\,g}{2-g}\right\} > 0.$$

When $a^N > \bar{a}(g)$ and $a^S < \bar{a}(g^S)$,

$$\frac{\partial W_U^N}{\partial a^N} + \frac{\partial W_U^S}{\partial a^N} = N(1-g) - \mu\frac{g(1-g)}{2-g}k_S(g^S)\left\{1 + \gamma_S(g^S)\frac{R\Delta p - C}{Rp_L}k_S(g^S)\right\}.$$

Rearrangement of this expression yields part (2) of the proposition.

Proof of Proposition 9

We are concerned only with the region $a^S < \bar{a}(g)$ (for higher values is represented by the shaded region in figure 4 where the level playing field is certainly preferred). The proof consists of a series of lemmas:

LEMMA 2 *When* $a^S < \bar{a}(g)$, $\frac{\partial^2(\Delta W)}{\partial(a^N)^2} > 0$.

Proof. Throughout this region,

$$\frac{\partial S}{\partial a^N} = -\mu \frac{\left(1-a^S\right) g(1-g) k_S\left(g^S\right)}{2-g} \left\{ \underbrace{1}_{\text{Quality effect}} + \underbrace{\frac{k_S\left(g^S\right)(R\Delta p - C)\gamma_S\left(g^S\right)}{Rp_L}}_{\text{Size effect}} \right\}.$$

The quality effect arises because a higher a^N reduces the quality of the Southern regulator's pool, while the size effect arises because the quality effect raises the minimum acceptable deposit rate in the South and hence (to ensure monitoring incentive compatibility) reduces the size of Southern banks. Note that both effects are unambiguously negative. Differentiating again, we obtain:

$$\frac{\partial^2 S}{\partial\left(a^N\right)^2} \Bigg/ \left(\mu \frac{\left(1-a^S\right) g(1-g)}{2-g}\right) = -\frac{\partial k_S\left(g^S\right)}{\partial a^N} 1 + 2k_S\left(g^S\right) \frac{R\Delta p - C}{Rp_L} \gamma_S\left(g^S\right)$$
$$+ k_S\left(g^S\right)^2 \frac{R\Delta p - C}{Rp_L}\left(1-a^S\right) \frac{g(1-g)}{2-g} > 0.$$

For $a^N < \bar{a}(g)$,

$$\frac{\partial N}{\partial a^N} = \mu(1-g) \left\{ \underbrace{\left[k_N(g) - k_S(g)\right]}_{\text{Quality effect}} + \underbrace{\frac{\gamma_N(g) k_N(g)^2 (R\Delta p - C)(1-g)}{Rp_L}}_{\text{Size effect}} \right\},$$

from which it is obvious that $\frac{\partial^2 N}{\partial(a^N)^2} > 0$. For $a^N > \bar{a}(g)$, $\frac{\partial N}{\partial a^N} = (1-g)\left(N - \mu k\left(a^S, g\right)\right)$ so that in this region, $\frac{\partial^2 N}{\partial(a^N)^2} = 0$. □

LEMMA 3 $\frac{\partial}{\partial a^S}\left(\frac{\Delta w}{k(a^S,g)}\right) < 0$.

Proof. For $a^N < \bar{a}(g)$, $\frac{\partial}{\partial a^S}\left(\frac{N}{k_S(g)}\right) < 0$ by inspection. For $a^N \geq \bar{a}(g)$,

$$\frac{\partial}{\partial a^S}\left(\frac{N}{k_S(g)}\right) = -N\gamma_N(g) \frac{R\Delta p - C}{Rp_L}(1-g) < 0.$$

Finally, straightforward differentiation yields

$$\frac{\partial}{\partial a^S}\left(\frac{S}{k_S(g)}\right) = \frac{a^N C g(1-g) p_L \left[Cp_L - (R\Delta p - C)\Delta p\right]}{(2-g)\left[Cp_L - (R\Delta p - C)\Delta p \gamma_S\left(g^S\right)\right]^2} < 0.$$

□

LEMMA 4 *If for some* $\left(\tilde{a}^N, \tilde{a}^S\right)$, $\Delta W \geq 0$ *then* $\Delta W > 0$ *for all* $\left(a^N, a^S\right) \in Q$, *where*

$$Q \equiv \left\{\left(a^N, a^S\right) : a^N \geq \tilde{a}^N \text{ and } a^S \leq \tilde{a}^S, \text{ with at least one strict inequality}\right\}.$$

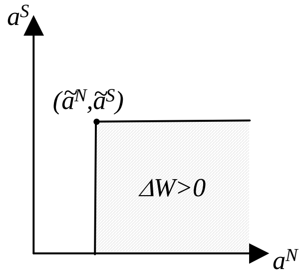

Figure 7: Lemma 4 states that if $\Delta W \geq 0$ at $\left(\tilde{a}^N, \tilde{a}^S\right)$ then $\Delta W > 0$ throughout the shaded region (including the boundary lines).

Proof. Suppose that $\Delta W\left(\tilde{a}^N, \tilde{a}^S\right) \geq 0$. We show that ΔW is increasing throughout S. Since $\Delta W\left(\tilde{a}^S, \tilde{a}^S\right) < 0$, there must be a minimum $\bar{a}^N$ at which $\Delta W\left(\bar{a}^N, \tilde{a}^S\right) \geq 0$ and at this point, ΔW must be increasing in a^N. By lemma 2, ΔW must increase for all $a^N > \bar{a}^N$ and ΔW must therefore be positive for all $a^N > \bar{a}^N$. By lemma 3, $\frac{\Delta W}{k(a^S,g)}$ is never negative for $a < \tilde{a}^S$ and hence neither is ΔW. □

Lemma 4 is illustrated in figure 7, from which the intutition for the proposition is obvious. The formal proof is as follows.

If there is no point $\left(\tilde{a}^N, \tilde{a}^S\right)$ at which $\Delta W \geq 0$ then λ is negative. If there is such a point then since $\Delta W < 0$ at $\left(\tilde{a}^S, \tilde{a}^S\right)$ there is a minimum a^N at which $\Delta W\left(a^N, \tilde{a}^S\right) \geq 0$: without loss of generality we assume that this point is $\tilde{a}^N$ and hence that $\Delta W\left(\tilde{a}^N, \tilde{a}^S\right) = 0$. Lemma 4 implies that $\Delta W > 0$ in the positive quadrant to the SE of $\left(\tilde{a}^N, \tilde{a}^S\right)$. If there are no points outside this quadrant for which $\Delta W \geq 0$ then its boundary is λ. If there are then lemma 4 implies that they must lie to the SW or the NE of $\left(\tilde{a}^N, \tilde{a}^S\right)$. In other words, the set of points $\left(a^N, a^S\right)$ for which $\Delta W = 0$ must always be contained within the SW and the NE quadrant centered at any of the points. Connecting this points must therefore yield an increasing line, as required.

Proof of Proposition 10

Condition (22) follows from the requirement that the depositor IR constraint (21) lie above the banker participation constraint (2).

For the second part, firstly note that the IR constraint (21) intersects the banker's monitoring IC constraint where $k = \frac{Rp_L\Delta p}{Rp_L\Delta p - \pi^q_{l,f}(g)(R\Delta p - C)}$. The maximum quantity that the banking sector can absorb is therefore

$$T_{l,f}\left(g\right) \equiv m\frac{Rp_L\Delta p}{Rp_L\Delta p - \pi^\theta_{l,f}\left(g\right)\left(R\Delta p - C\right)} + \left(\mu - m\right)\frac{Rp_L\Delta p}{Rp_L\Delta p - \pi^\psi_{l,f}\left(g\right)\left(R\Delta p - C\right)}.$$

For a given a^f, $T_{l,f}$ is monotonically increasing in a^l. There therefore exists $\bar{a}^\theta_{l,f}\left(g, m, a^f\right)$ such that $T_{\bar{a}^\theta_{l,f}\left(g,m,a^f\right),a^f}\left(g\right) = N$. Moreover, since $T_{l,f}$ is increasing in a^f, $\bar{a}^\theta_{l,f}$ is decreasing in a^f.

For $a^l > \bar{a}^\theta_{l,f}\left(g, m, a^f\right)$, the banking sector can absorb more that the total amount of local deposits. We assume that the regulator's primary concern is maximisation of local welfare. The optimal policy therefore is to allow multinational banks to expand at the expense of local banks, which are of lower expected quality, in such a way that the total capacity of the banking sector is precisely N. (For higher capacities there is a chance that the foreign country will reap some of the benefits of multinational bank certification.) The regulator will therefore set multinational bank size equal to $\frac{Rp_L\Delta p}{Rp_L\Delta p-\pi^{\theta}_{l,f}(g)(R\Delta p-C)}$, and local bank size equal to $\frac{N-mk^{\theta}_{l,f}}{\mu-m}$. This will be feasible provided $\frac{N-mk^{\theta}_{l,f}}{\mu-m} > 0$; for given a^f, let $\bar{a}^{\psi}_{l,f}\left(g,m,a^f\right)$ be the value of $\bar{a}^l$ for which $\frac{N-mk^{\theta}_{l,f}}{\mu-m} = 0$. For higher values of a^l, the regulator can ensure that the total demand for deposits is met by multinational banks if she sets local bank size equal to zero and multinational bank size equal to $\frac{N}{m}$. Again, $\bar{a}^{\psi}_{l,f}$ is decreasing in a^f.

Finally, note that since $\pi^q_{N,S} > \pi^q_{l,f}$, it must follow that $T_N\left(\bar{a}^N\left(a_S\right),a^S\right) > T_S\left(\bar{a}^N\left(a^S\right),a^S\right)$ and hence that $\bar{a}^{\psi}_S\left(g,m,\bar{a}^{\psi}_N\left(a^S\right)\right) > a^S$. Similarly, $\bar{a}^{\psi}_S\left(g,m,\bar{a}^{\psi}_N\left(a^S\right)\right) > a^S$.

Proof of Lemma 1

The lemma is an immediate consequence of the following observation:

$$k^q_{a^N,a^S} - k^q_{a^S,a^N} = \frac{Rp_L\Delta p^2\left(R\Delta p-C\right)\left(a^N-a^S\right)(1-q)}{\left[Rp_L\Delta p-\pi^q_{a^N,a^S}(g)\left(R\Delta p-C\right)\right]\left[Rp_L\Delta p-\pi^q_{a^S,a^N}(g)\left(R\Delta p-C\right)\right]} \geq 0. \quad (28)$$

Proof of Proposition 11

When $m \leq g\mu$ we have $\theta = 1$, $\psi = \frac{g\mu-m}{\mu-m}$ and hence:

$$\begin{aligned} W_l|_{m\leq g\mu} = &\left(a^l+\left(1-a^l\right)\left(1-a^f\right)g\right)\left\{mk^1_{l,f}(g)+(\mu-m)\,k^{\psi}_{l,f}(g)\right\} \\ &+\left(1-a^l\right)a^f\left\{mk^1_{l,f}(g)+(g\mu-m)\,k^{\psi}_{l,f}(g)\right\}. \quad (29) \end{aligned}$$

Expansion of the first curly bracket yields:

$$\begin{aligned} &mk^1_{l,f}(g)+(\mu-m)\,k^{\psi}_{l,f}(g) \\ &\quad = Rp_L\Delta p\left\{\frac{m}{Rp_L\Delta p-\pi^1_{l,f}(g)\left(R\Delta p-C\right)}+\frac{\mu-m}{Rp_L\Delta p-\pi^{\psi}_{l,f}(g)\left(R\Delta p-C\right)}\right\} \end{aligned}$$

Differentiate with respect to m to obtain after some manipulation:

$$\frac{Rp_L\Delta p^3\left(R\Delta p-C\right)^2\mu^2(1-g)^2\left[a^f\left(1-a^l\right)\right]^2}{\left[Rp_L\Delta p-\pi^1_{l,f}(g)\left(R\Delta p-C\right)\right]\left[Rp_L\Delta p-\pi^{\psi}_{l,f}(g)\left(R\Delta p-C\right)\right]^2(\mu-m)^2} > 0.$$

The second curly bracketted term in equation 29 can be written as $mk^1_{l,f}(g)+(\mu-m)\,k^{\psi}_{l,f}(g)-(1-g\mu)\,k^{\psi}_{l,f}(g)$, and

$$\left.\frac{dk^{\psi}}{dm}\right|_{m\leq g\mu} = -\frac{Rp_L\Delta p^2\left(R\Delta p-C\right)a^f\left(1-a^l\right)\mu(1-g)}{\left[Rp_L\Delta p-\pi^{\psi}_{l,f}(g)\left(R\Delta p-C\right)\right]^2(\mu-m)^2} < 0. \quad (30)$$

Now consider the case where $g\mu < m$ so that $\theta = \frac{g\mu}{m}$ and $\psi = 0$. In this case equation (23) reduces to

$$W_l|_{m>g\mu} = \left(a^l + \left(1-a^l\right)\left(1-a^f\right)g\right)\left\{mk_{l,f}^{\theta}(g) + (\mu - m)\,k_{l,f}^{0}(g)\right\} + \left(1-a^l\right)a^f g\mu k_{l,f}^{\theta}(g)$$

The first curly bracketted term differentiates with respect to m to give after manipulation:

$$-\frac{Rp_L\Delta p^3\left(R\Delta p - C\right)^2\mu^2 g^2\left[a^f\left(1-a^l\right)\right]^2}{\left[Rp_L\Delta p - \pi_{l,f}^{\theta}(g)\left(R\Delta p - C\right)\right]^2\left[Rp_L\Delta p - \pi_{l,f}^{0}(g)\left(R\Delta p - C\right)\right]m^2} < 0.$$

Finally,

$$\left.\frac{dk^{\theta}}{dm}\right|_{m>g\mu} = -\frac{Rp_L\Delta p^2\left(R\Delta p - C\right)\left(1-a^l\right)a^f g\mu}{\left[Rp_L\Delta p - \pi_{l,f}^{\theta}(g)\left(R\Delta p - C\right)\right]^2 m^2} < 0$$

Proof of Proposition 12

Southern welfare with open markets is given by equation (24), and in the closed economy is given by equation (16). The optimum number of multinational bank licences in the open economy case is $g^S\mu$ and in this case $\theta_S = 1$ and $\psi_S = 0$. Then the difference between the open economy and closed economy welfares is given by

$$\mu g^S\left[\gamma_{S,N}^{1}\left(g^S\right)k_{S,N}^{\theta_S}\left(g^S\right) - \gamma_S(g)\,k_S(g)\right] + \mu\left(1-g^S\right)\left[\gamma_{S,N}^{0}\left(g^S\right)k_{S,N}^{0}\left(g^S\right) - \gamma_S(g)\,k_S(g)\right].$$

After some tedious manipulation this reduces to

$$\frac{\mu RCp_L^2\Delta p}{Rp_L\Delta p - \pi_S(g)\left(R\Delta p - C\right)}\left\{\frac{g^S\left[\gamma_{S,N}^{1}\left(g^S\right) - \gamma_S(g)\right]}{Rp_L\Delta p - \pi_{S,N}^{1}\left(g^S\right)\left(R\Delta p - C\right)} + \frac{\left(1-g^S\right)\left[\gamma_{S,N}^{0}\left(g^S\right) - \gamma_S(g)\right]}{Rp_L\Delta p - \pi_{S,N}^{0}\left(g^S\right)\left(R\Delta p - C\right)}\right\},$$

from which the result is immediate.

Proof of Proposition 13

When $a^N \geq \bar{a}_{N,S}^{\theta}\left(g, m, a^S\right)$ the welfare of the Northern bank with unregulated playing fields is

$$\gamma_{N,S}^{\theta}(g)\,mk_{N,S}^{\theta}(g) + \gamma_{N,S}^{\psi}(g)\,(\mu - m)\left(\frac{N - mk_{N,S}^{\theta}(g)}{\mu - m}\right)$$
$$= m\left(1-a^N\right)a^S(\theta - \psi)\,k_{N,S}^{\theta}(g) + N\gamma_{N,S}^{\psi}(g)$$

The corresponding expression with regulated playing fields is

$$m\left(1-a^N\right)a^S(\theta - \psi)\,k_{S,N}^{\theta}(g) + N\gamma_{N,S}^{\psi}(g),$$

so the welfare difference between unregulated and level playing fields in the North is

$$\left(1-a^N\right)a^S(\theta - \psi)\,m\left[k_{N,S}^{\theta}(g) - k_{S,N}^{\theta}(g)\right].$$

Note that at the optimum, $\theta = 1$, and hence from equation (28), that Northern welfare is the same with unregulated and level international playing fields. Since Southern welfare is always (weakly) higher with level playing fields where there is no cherry-picking effect, it follows that when $a^N \geq \bar{a}^{\theta}_{N,S}\left(g, m, a^S\right)$, level playing fields dominate unregulated playing fields.

When $a^N < \bar{a}^{\theta}_{N,S}\left(g, m, a^S\right)$, the welfare difference ΔW is given by the following expression:

$$\Delta W_N \equiv W_N^U - W_N^L = m\gamma^{\theta}_{N,S}(g)\left\{k^{\theta}_{N,S}(g) - k^{\theta}_{S,N}(g)\right\} + \gamma^{\psi}_{N,S}(g)(\mu - m)\left\{k^{\psi}_{N,S}(g) - k^{\psi}_{S,N}(g)\right\}.$$

when $m \leq g\mu$ we have $\theta = 1$ and $\psi = \frac{g\mu - m}{\mu - m}$. Using equation 28 we obtain

$$\begin{aligned}
\Delta W_N\big|_{m \leq g\mu} &= \frac{\gamma^{\psi}_{N,S}(g)\, Rp_L \Delta p^2 (R\Delta p - C)\left(a^N - a^S\right)\mu(1-g)}{\left[Rp_L\Delta p - \pi^{\psi}_{N,S}(g)(R\Delta p - C)\right]\left[Rp_L\Delta p - \pi^{\psi}_{S,N}(g)(R\Delta p - C)\right]} \\
&= \frac{(R\Delta p - C)\left(a^N - a^S\right)\mu(1-g)}{Rp_L} \times \gamma^{\psi}_{N,S}(g) \times k^{\psi}_{N,S}(g) \times k^{\psi}_{S,N}(g).
\end{aligned}$$

Since $\left.\frac{d\pi^{\psi}_{l,,f}(g)}{dm}\right|_{m \leq g\mu} = -\frac{\Delta p a^f\left(1-a^l\right)\mu(1-g)}{(\mu - m)^2} < 0$ and by equation 30, $\frac{dk^{\psi}_{l,f}(g)}{dm} < 0$, it follows that $\frac{d}{dm}\Delta W_N\big|_{m \leq g\mu} < 0$.

The welfare difference ΔW_S in the South is given by

$$\begin{aligned}
\Delta W_S &= m\left\{\gamma^{\theta_S}_{S,N}\left(g^S\right)k^{\theta_S}_{S,N}\left(g^S\right) - \gamma^{\theta}_{S,N}(g)\,k^{\theta}_{S,N}(g)\right\} \\
&\quad + (\mu - m)\left\{\gamma^{\psi^S}_{S,N}\left(g^S\right)k^{\psi^S}_{S,N}\left(g^S\right) - \gamma^{\psi}_{S,N}\left(g^S\right)k^{\psi}_{S,N}\left(g^S\right)\right\} \\
&= RCp_L^2\Delta p\left\{m\frac{\left(\gamma^{\theta_S}_{S,N}\left(g^S\right) - \gamma^{\theta}_{S,N}(g)\right)}{\left[Rp_L\Delta p - \pi^{\theta_S}_{S,N}(g)(R\Delta p - C)\right]\left[Rp_L\Delta p - \pi^{\theta}_{S,N}(g)(R\Delta p - C)\right]}\right\} \\
&\quad + RCp_L^2\Delta p\left\{(\mu - m)\frac{\left(\gamma^{\psi_S}_{S,N}\left(g^S\right) - \gamma^{\psi}_{S,N}(g)\right)}{\left[Rp_L\Delta p - \pi^{\psi_S}_{S,N}(g)(R\Delta p - C)\right]\left[Rp_L\Delta p - \pi^{\psi}_{S,N}(g)(R\Delta p - C)\right]}\right\}.
\end{aligned}$$

When $m \leq g^S\mu$ we can again substitute $\theta = 1$ and $\psi = \frac{g\mu - m}{\mu - m}$ to obtain after some manipulation

$$\begin{aligned}
\Delta W_S = -Rp_L\Delta p C p_L a^N\left(1 - a^S\right)\frac{g(1-g)}{2-g}&\left\{m\left(1 - a^N\right)\frac{k^{\theta_S}_{S,N}\left(g^S\right)k^{\theta}_{S,N}(g)}{(Rp_L\Delta p)^2}\right. \\
&\left. + \left(\mu - m\left(1 - a^N\right)\right)\frac{k^{\theta_S}_{S,N}\left(g^S\right)k^{\theta}_{S,N}(g)}{(Rp_L\Delta p)^2}\right\}.
\end{aligned}$$

Differentiating this expression yields equation (27).