Regulating Financial Conglomerates

Xavier Freixas
Universitat Pompeu Fabra
and CEPR

Gyöngyi Lóránth
London Business School

Alan D. Morrison
Saïd Business School,
University of Oxford

Hyun Song Shin
London School of Economics
and CEPR

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Abstract

We analyse a model of financial intermediation in which intermediaries are subject to moral hazard and they do not invest socially optimally, because they ignore the systemic costs of failure and, in the case of banks, because they fail to account for risks which are assumed by the deposit insurance fund. Capital adequacy requirements are designed to minimise the social costs of these effects. We show that banks should always have higher regulatory capital requirements than insurance companies. Contrary to received wisdom, when banks and insurance companies combine to form financial conglomerates we show that it is socially optimal to separate their balance sheets. Moreover, the practice of "regulatory arbitrage", or of transfering assets from one balance sheet to another, is welfare increasing.

Correspondence address: Xavier Freixas, Universitat Pompeu Fabra, Department of Economics and Business, Jaume I building, Ramon Trias Fargas 25-17, 08005-Barcelona, Spain. email: xavier.freixas@econ.upf.es. Alan Morrison, Merton College, Oxford OX1 4JD, UK. email: alan.morrison@sbs.ox.ac.uk. Hyun Shin, Room A350, London School of Economics, Houghton Street, London WC2A 2AE, UK. email: H.S.Shin@lse.ac.uk

This paper examines the optimal capital regulation of financial conglomerates: institutions which provide under a single corporate umbrella the provision of banking, insurance and other financial products.

The emergence of financial conglomerates is one of the major financial developments of recent years. This has raised concerns amongst regulators about the appropriate measurement of capital within a financial group. In contrast, the existing theoretical academic literature about conglomerates focuses on internal and industrial organisational issues, although an empirical study by Berger *et. al* shows that conglomerated firms tend to take more risks. Our objective in this paper is to fill a gap in the literature by analysing optimal capital adequacy regulations for financial conglomerates.

Several issues arise in the context of conglomerate regulation. Firstly, should the conglomerate be structured as a unique entity, or should its various divisions be allowed to fail independently? In the former case, capital requirements will be determined on a centralised basis for the entire conglomerate, while in the latter, the regulator can set decentralised capital requirements for each of the conglomerate's divisions. Secondly, when capital is computed on a decentralised basis, how should the regulator respond to the existence of *regulatory arbitrage*, under which conglomerate assets are held in the division where they will attract the lowest regulatory capital charge? At this point it should be emphasized that our contribution does not deal with loss transferts from one division to another, a practice that allows the solvent division of a holding to dump its bad assets on a division that is close to failure. This is a practice that is usually forbidden by regulators (as for instance in regulation W implementing the Federal Reserve Act Sections 23A/23B). The difference with regulatory arbitrage is that in this case the allocation of assets to the division is made ex ante, while in the case of loss transferts it is done ex post.

Capital regulations are currently computed on a decentralised basis. This encourages regulatory arbitrage, which has been identified by both practitioners and regulators as evidence of undesirable inconsistencies in the treatment of financial assets. It has been argued that a centralised system with a unique capital requirement would resolve these inconsistencies and that, by enforcing cross-division warranties against failure, it would reap additional diversification benefits and reduce bankruptcy risk.

We analyse these questions using a model in which the role of capital requirements is to force shareholders (and hence managers) to internalise effects which are not adequately priced. The specific effects which concern us in this paper are a social cost of bankruptcy and the existence of a deposit insurance safety net for banks, both of which result in overinvestment relative to the social optimum. We assume that capital is exogenously costly as a result of informational frictions of the type considered by blah, and hence that capital requirements will cause some underinvestment in marginal projects. The optimal capital regulation trades off these under- and over-investment effects.

We examine two division conglomerates consisting of a bank and an insurance company. Two features distinguish the bank from the insurance company. Firstly, only the bank has access to the deposit insurance net; and secondly, the bank has monopoly access to positive net present value projects, while the insurance company must compete in an efficient marketplace for the right to invest in its projects. Since the insurance company does not have access to the deposit insurance net it follows immediately that its standalone capital requirements will be lower than the bank's.

We consider in turn decentralised and centralised structures. In a decentralised conglomerate capital arbitrage will occur to transfer assets to the division which has the lowest capital charges. By increasing the capital charge of the bank sufficiently, the regulator can induce it to transfer all of its assets to the insurance company. This has three consequences. Firstly, the investment distortions induced by the deposit insurance fund will no longer occur. Secondly, marginal projects in which the standalone bank would not invest will now attract funds, because of the lower capital. Thirdly, the bank will as a result of the arbitrage have only safe cash assets. Regulatory arbitrage therefore reduces the extent of the safety net and, by allowing for a more efficient use of capital, results in a greater degree of bank credit extension.

Under a centralised structure, the various operating units of the conglomerate are compelled to bail one another out. Losses in one division may therefore be covered by profits in another. However, it is also true that the failure of one division may result in the insolvency of the entire conglomerate. Thus, centralisation may open new channels for financial contagion. In particular, the costs of insurance company failure may be borne by the deposit insurance fund. We show that, for a given regulatory capital requirement, the lending decisions of the bank will depend upon the fragililty of the insurance company. When the insurance company is relatively low risk the diversification effect dominates and the value of the bank's deposit insurance safety net is decreased. As a result the bank is less willing to lend to riskier projects. In contrast, when the insurance company is riskier the contagion effect dominates and the bank therefore extracts a higher expected payment from the deposit insurance safety net. This renders it more willing to lend. We therefore show that centralised conglomerates have an amplifying effect: that is, the bank invests in more risky projects precisely when the insurance company is facing more risk.

We conclude from the above discussion that, contrary to the majority view, decentralised conglomerates allow for a more efficient allocation of resources than centralised ones. Moreover, the amplification effect which we have identified in centralised conglomerates gives rise to systemic concerns which do not arise in decentralised conglomerates.

1. Stand-alone Capital Requirements

1.1. The Model

In this section we introduce our basic modelling approach and use it to consider the optimal capital requirements for standalone bank and insurance companies. In later sections we consider the capital regulation of conglomerates which contain both banks and insurance companies. Our modelling approach is similar to Lóránth and Morrison (2003), extended to include a systemic cost of institutional insolvency.

The financial institutions in our model are risk neutral profit maximisers which collect funds from depositors and policy-holders and invest them on their behalf. We assume that bank depositors are protected by deposit insurance and that policy-holders are not. In this model we ignore payments which the banker makes into a deposit insurance scheme; in such schemes the banker is charged for the average rather than the marginal cost of his moral hazard and these schemes cannot entirely resolve the allocative problems which we identify. In the interests of brevity, we will refer to depositors and policy-holders collectively as "investors".

The model for both banks and insurance companies is identical. At time t_0, nature presents the financial institution with an investment project (B, R) which is drawn from the region $\mathcal{A} \equiv \{(B, R) \in \Re^2 : R_l \leq R \leq R_h, 0 \leq B \leq R\}$ with measure A, according to the uniform distribution. The project requires a time 1 investment of 1 and at time t_2 returns $R + B$ or $R - B$, each with probability 0.5.

At time t_1 the bank decides whether or not to invest in the project; if it does so then it raises $1 - C$ from investors and C as equity capital. The capital requirement C is stipulated by the regulator. We assume that there is an exogenous cost κ per unit of capital which the bank deploys. This is intended to reflect a lemons problem in the capital markets (see Myers and Majluf, 1984; Froot, Scharfstein and Stein, 1993; Froot and Stein, 1998; and Bolton and Freixas, 2000) and κ is therefore a wealth transfer whose only effect upon the welfare calculations in our paper will be through the investment distortions which is causes.

Capital in our model is a real cushion of external equity which will bear losses. We therefore assume that cross holdings, multiple gearing and downstreaming are excluded from the capital computation according to the standard consolidation rules. In the context of our model, the structure of the capital as tier 1 or tier 2 is irrelevant insofar as it has an informational cost.

Returns from the project are realised at time t_2 and are distributed to the various providers of funds.

As it is well known, financial institution insolvency has a social cost. We assume that this is equal to 2ϕ for both banks and insurance companies and that it is a pure externality so that financial institutions will fail to account for it in their calculations.

1.2. Banker Investment Decisions

In this section we analyse the incentives to which the banker is subject and we discuss the optimal capital adequacy response to them.

In the social optimum the banker invests in any project which has positive NPV, after accounting for the social costs of failure. To analyse these projects, we define $\mathcal{S} \equiv \{(B, R) \in \mathcal{A} : R - B < 1 - C\}$ to be the set of *speculative* projects and $\mathcal{P} \equiv \mathcal{A} \backslash \mathcal{S}$ to be the set of *prudent* projects and we refer to a bank as speculative or prudent according to its project type. Speculative projects will with probability 0.5 become insolvent and incur a social cost of 2ϕ; prudent projects will not. The first best investment rule is therefore to invest whenever $R \geq \sigma(B)$, where

$$\sigma(B) \equiv \begin{cases} 1, & (B, R) \in \mathcal{P}; \\ 1 + \phi, & (B, R) \in \mathcal{S}. \end{cases} \tag{1}$$

The banker will not adopt this investment rule for two reasons: firstly, because he does not bear the systemic cost 2ϕ; and secondly, because depositors are protected by deposit insurance. The deposit insurance cost will cover losses sustained by depositors if the bank becomes insolvent: this is relevant precisely when the bank is speculative, and in this case the deposit insurance fund will make a payment of $1 - C - (R - B)$ if the project fails. The effects of deposit insurance are well understood (see for example Merton, 1977): because depositors do not fully internalise the riskiness of speculative projects, they do not demand compensation for it. The bank's shareholders therefore experience a gain equal to the value of the unpriced risks:

$$\mathcal{D} \equiv \frac{1}{2}\left[(1-C)-(R-B)\right].$$

To derive the banker's investment rule, note that with a capital requirement of C the cost of investing in project (B,R) is $1+C\kappa$. When (B,R) is prudent the bank's shareholders will experience all of the profits and losses associated with the project and they will therefore price them correctly. This yields the following hurdle rate for prudent projects:

$$H_B^P(B) \equiv 1+C\kappa. \tag{2}$$

When (B,R) is speculative the bank's shareholders will in addition receive a wealth transfer $\mathcal{D}$ from the deposit insurance fund. They will therefore invest in any project for which $R \geq 1+C\kappa-\mathcal{D}$, which yields the following hurdle rate for speculative projects:[1]

$$H_B^S(B) \equiv 1-B+C(1+2\kappa). \tag{3}$$

We define the hurdle rate function $H_B(B)$ to be $H_B^P(B)$ for prudent projects and to be $H_B^S(B)$ for speculative projects.

The discussion so far is illustrated in figure 1. Nature selects the project from the region $\mathcal{A}$, with border $A_1A_2A_3A_4A_1$. Prudent projects are separated from speculative projects by the line P_1P_2. The bank's hurdle rate is given by the line $U_1U_2O_1$: U_1U_2 is the locus of $H^P(B)$ in $\mathcal{P}$ and U_2O_1 is the locus of $H^S(B)$ in $\mathcal{S}$. The socially first best policy is to accept projects for which $R \geq \sigma(B)$. The discrepancy between the banker's objective function and that of society is represented by the shaded areas $\mathcal{U}$ and $\mathcal{O}$. These represent respectively the banker's under- and over- investment relative to the social optimum.

The banker's deviation from the social optimum can be explained as follows. He will overinvest in speculative projects for two reasons: because the deposit insurance fund renders him insufficiently sensitive to the risks assumed by his depositors, and because he will ignore the expected social cost ϕ associated with speculative projects. Prudent projects do not result in insolvency and hence are not subject to these distortions. The banker will however include in his calculations the transfer cost $C\kappa$ of capital which does not appear in the social welfare function. He will therefore underinvest in prudent projects. Distortions of the type which we identify here have been observed in the wake of the first Basle Accord on bank capital (Furfine *et. al*, 1999).

To understand better the relative contributions of the systemic cost ϕ of insolvency and the incentive effects of the deposit insurance safety net to the inefficiencies identified here, consider figure 2, which defines new regions $\mathcal{O}_0$, Σ_U and Σ_O. Define in addition the region $\mathcal{U}_0 \equiv \mathcal{U} \cup \Sigma_U$. Then $\mathcal{U}_0$ and $\mathcal{O}_0$ represent the respective under- and over- investment regions when there is no

[1] The hurdle rates can be derived directly. The expected shareholder payoff from prudent investments is $R-1-C\kappa$ and from speculative projects is $\frac{1}{2}(R+B-1-C)-C(1+\kappa)$. Requiring each of these to be positive yields H^P and H^S respectively.

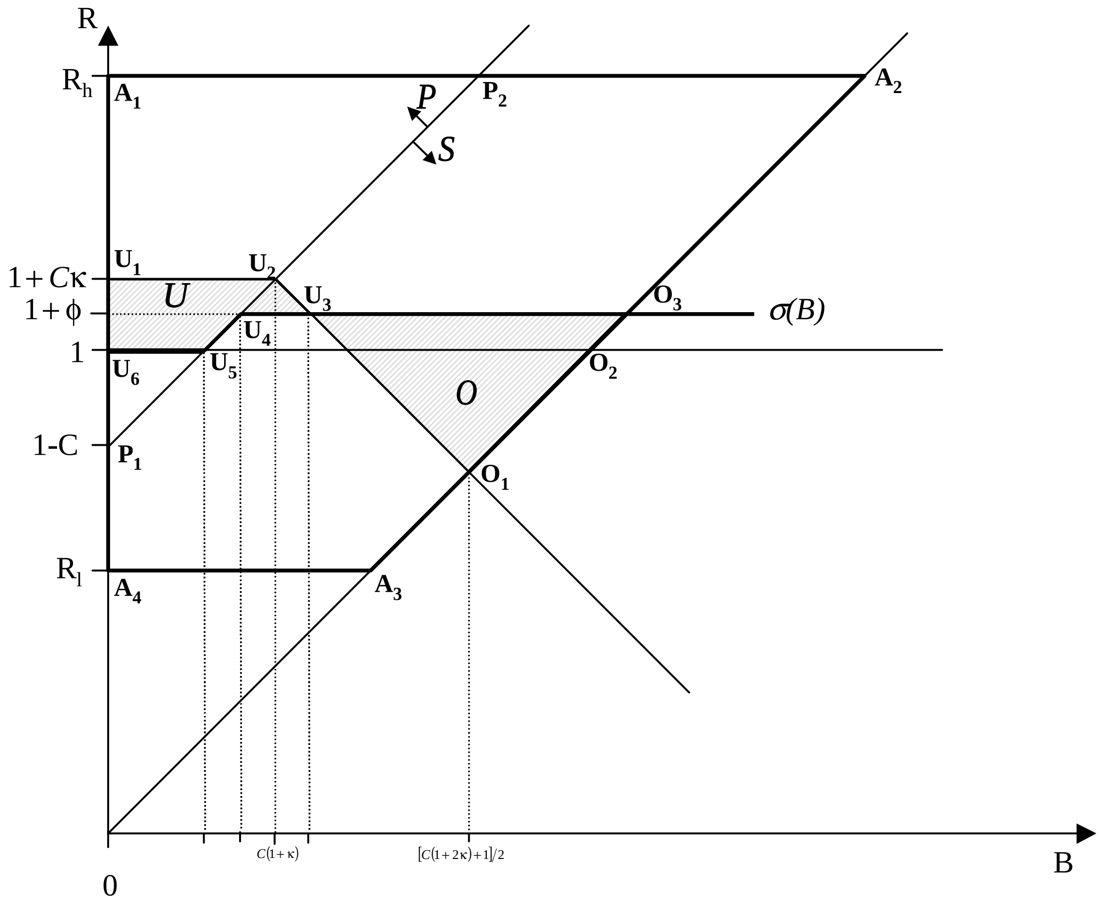

Figure 1: **Investment decisions of a stand alone bank in response to a capital requirement C.** The banker will invest in projects in the region $A_1A_2O_1U_2U_1A_1$. The socially first best policy is to invest in the region $A_1A_2O_3U_4U_5U_6A_1$. The regions $\mathcal{U}$ and $\mathcal{O}$ represent over- and under-investment, respectively.

systemic cost of bank failure (so that $\phi = 0$ and $\sigma(B) \equiv 1$). The total expected welfare generated by bank investment when there is no systemic cost of failure is therefore

$$\mathcal{W}_0^B \equiv \frac{1}{A}\iint_{\substack{R\geq 1\\ R\in\mathcal{A}}} R - 1.dRdB - \frac{1}{A}\iint_{\mathcal{U}_0} R - 1.dRdB - \frac{1}{A}\iint_{\mathcal{O}_0} 1 - R.dRdB,$$

where A is the area of the region $\mathcal{A}$ from which nature selects the project. When ϕ is non-zero, the total expected welfare generated by a stand alone bank's investments is

$$\mathcal{W}^B \equiv \frac{1}{A}\iint_{\substack{R\geq\sigma(B)\\ R\in\mathcal{A}}} R - \sigma(B).dRdB - \frac{1}{A}\iint_{\mathcal{U}} R - \sigma(B).dRdB - \frac{1}{A}\iint_{\mathcal{O}} \sigma(B) - R.dRdB. \quad (4)$$

The following proposition, which is proved in the appendix, identifies the effect upon welfare of the systemic cost ϕ:

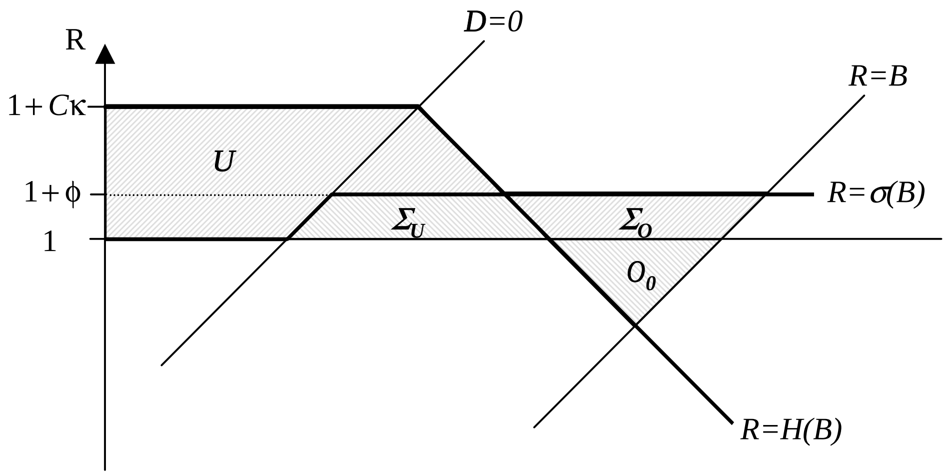

Figure 2: Definitions of sub-regions in $\mathcal{A}$.

Proposition 1 *Let* $\mathcal{W}_0^B$ *and* $\mathcal{W}^B$ *be the welfare generated by a standalone bank in the respective cases where insolvency has no systemic cost, and where it has. Then*

$$\mathcal{W}^B = \mathcal{W}_0^B - \frac{1}{A} \iint_{\substack{R \geq H(B) \\ R \in \mathcal{A}}} \sigma(B) - 1.dRdB. \tag{5}$$

Let

$$\mathcal{S}_B(C) \equiv \frac{1}{A} \iint_{\substack{R \geq H(B) \\ R \in \mathcal{A}}} \sigma(B) - 1.dRdB. \tag{6}$$

Proposition 1 states that $\mathcal{S}_B(C)$ is a measure of the *systemic risk* associated with a standalone bank which has capital requirement C. It is obvious from inspection of figure 1 that $\mathcal{S}'_B(C) < 0$; moreover, since when $C = 1$, $\sigma(B) \equiv 1$ within $\mathcal{A}$, $\mathcal{S}_B(1) = 0$. Systemic risk in our model therefore arises when banks have fractional capital requirements and is diminishing in their capital level.

The regulator sets the capital requirement C_B^{s*} for a standalone bank to minimise the combined effect of the distortion caused by systemic costs of failure and deposit insurance incentive effects. Proposition 2, which is proved in the appendix, guarantees that $0 < C_B^{s*} < 1$:

Proposition 2 *The optimal capital requirement for a standalone bank lies between* 0 *and* 1 *and is increasing in the magnitude of the systemic cost* 2ϕ *of insolvency and decreasing in* κ.

1.3. Insurer Investment Decisions

The only difference in our model between an insurance company and a bank is that the former has no deposit insurance, and the latter does. Speculative insurance companies still incur an expected systemic cost of ϕ and their first best investment rule is to accept investments whenever $R \geq \sigma(B)$, where $\sigma(B)$ is defined by equation 1.

Since the policy holders are not insured they will internalise the risks which the insurer takes for both speculative and prudent projects. Since the systemic cost 2ϕ is an externality the insurer and the insured will ignore it and the hurlde rate for the standalone insurance company will therefore be

$$H_I(B) \equiv 1 + C\kappa.$$

The insurance company's investment decision is illustrated in figure 3. As in the bank case, the insurance company should invest in all projects for which $R \geq \sigma(B)$. However, the insurer will invest in projects for which $R \geq 1 + C\kappa$. When $C\kappa < \phi$ as shown (this will trivially always be the case for an optimal capital requirement), both under and over investment occur: projects in region $\mathcal{U}$ will be sub-optimally rejected, and those in region $\mathcal{O}$ will sub-optimally be accepted.

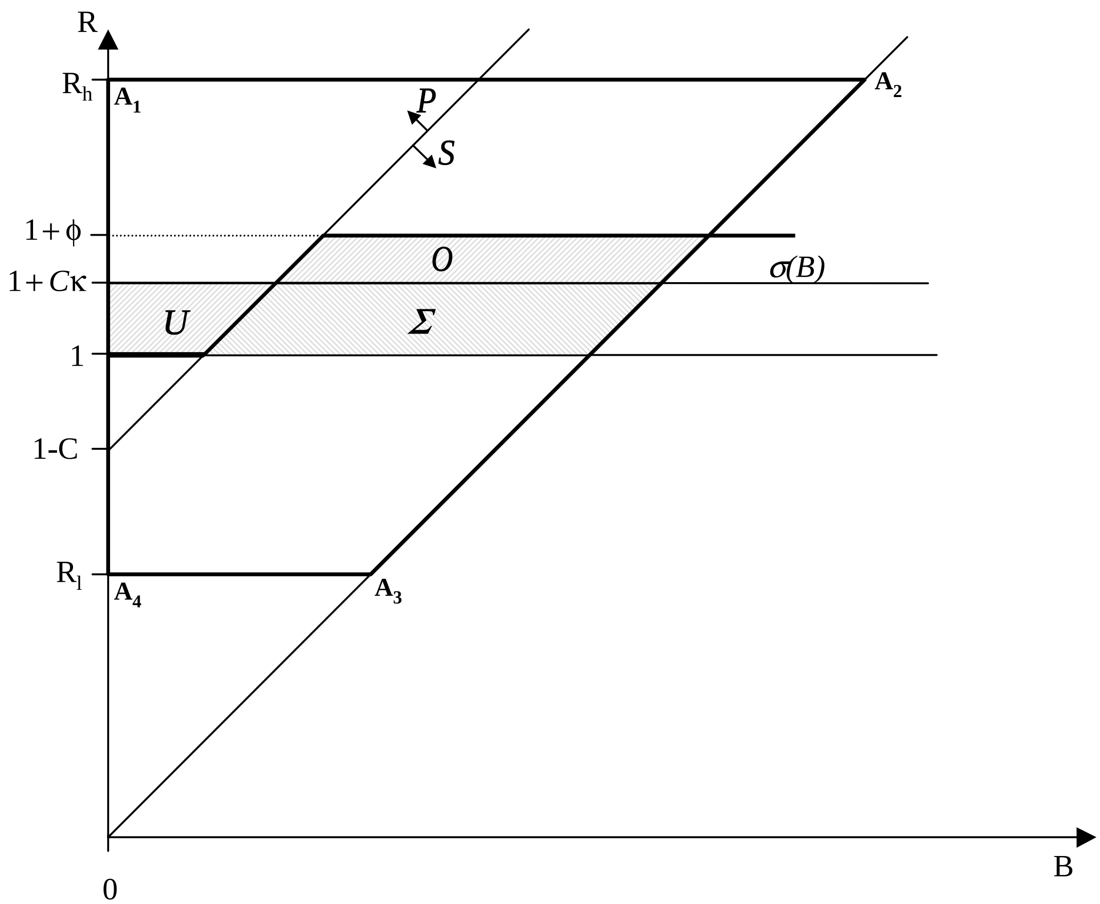

Figure 3: **Insurance company investment decisions in response to a capital requirement C.**

As in section 1.2, we examine the difference between welfare levels with and without systemic costs of bank failure. Define $\mathcal{W}_0^I$ and $\mathcal{W}^I$ as follows to be the expected welfare generated by the insurance company without and with a systemic cost 2ϕ of insolvency:

$$\mathcal{W}_0^I \equiv \frac{1}{A}\iint_{\substack{R\geq 1\\ R\in\mathcal{A}}} R - 1.dRdB - \frac{1}{A}\iint_{\mathcal{U}} R - 1.dRdB - \frac{1}{A}\iint_{\Sigma_U} R - 1.dRdB; \tag{7}$$

$$\mathcal{W}^I \equiv \frac{1}{A}\iint_{\substack{R\geq\sigma(B)\\ R\in\mathcal{A}}} R - \sigma(B).dBdB - \frac{1}{A}\iint_{\mathcal{U}} R - \sigma(B).dRdB - \frac{1}{A}\iint_{\mathcal{O}} \sigma(B) - R.dRdB \tag{8}$$

Proposition 3 provides an expression for the difference between $\mathcal{W}_0^I$ and $\mathcal{W}^I$:

Proposition 3 *Let* $\mathcal{W}_0^I$ *be the expected welfare generated by a standalone insurance company's investments in the absence of systemic costs of insolvency, and* $\mathcal{W}^I$ *be the corresponding figure when there are costs of insolvency. Then*

$$\mathcal{W}^I = \mathcal{W}_0^I - \frac{1}{A}\iint_{\substack{R \geq H_I(B) \\ R \in \mathcal{A}}} \sigma(B) - 1.dRdB. \tag{9}$$

Proposition 3 is entirely analogous to proposition 1 and we make the following definition by analogy to equation 6:

$$\mathcal{S}_I(C) \equiv \frac{1}{A}\iint_{\substack{R \geq H_I(B) \\ R \in \mathcal{A}}} \sigma(B) - 1.dRdB. \tag{10}$$

$\mathcal{S}_I(C)$ is a measure of the systemic risk associated with the standalone insurance company. $\mathcal{S}_I$ is decreasing in C with $\mathcal{S}_I(1) = 0$.

Since policy-holders in standalone insurance companies do not have access to a deposit insurance safety net, the optimal capital requirement for a standalone insurance company in the absence of systemic risk is 0. This provides the intuition for the following result, which we prove in the appendix.

Proposition 4 *The optimal capital requirement for a standalone insurance company lies strictly between* 0 *and* 1 *and is strictly less than the optimal capital requirement for a standalone bank.*

Proposition 4 is contrary to the frequently advanced practitioner belief that banks and insurance companies should be subject to the same prudential capital requirements. As banks and insurance companies increasingly invest in the same assets internally calculated capital requirements, commonly referred to as "economic capital", are similar for both institutions. Practitioners argue that there is therefore no justification for differing regulatory capital requirements.

This argument does not hold water in the context of our model, even though we assume that banks and insurance companies have access to an identical universe of investments. In our model the only role of capital requirements is the correction of externalities, which are by definition ignored in economic capital calculations. Since banks, whose debt-holders are protected by deposit insurance, inflict greater externalities upon society than insurance companies, whose policy-holders are not, they should inevitably be subject to more stringent capital regulation.

The simplicity of our approach allow us to extend the analysis to cope with alternative assumptions. Thus, the extension to different social costs for banks and insurance is straightforward. Also, conflicts of interest between managers and shareholders where managers care about their reputation can also be dealt with and yield intuitive results.

2. Capital Regulation of Financial Conglomerates

In this section we consider the regulation of financial conglomerates. We define a financial conglomerate to be a corporation which consists of a bank and an insurance company and we will refer to the individual business units (banks and insurance companies) of the conglomerate as divisions. We examine two liability structures for financial conglomerates as follows:

Decentralised conglomerates consist of two divisions operating as standalone businesses under a single holding company umbrella. The divisions in a decentralised conglomerate can fail independently of one another, so that cross-division bail outs are not necessary and, in our simple one-period model, will not occur.[2]

Centralised conglomerates have consolidated balance sheets so that their divisions operate using the same capital base. An inevitable consequence of this is that the various divisions of the corporation are compelled to bail one another out.

The choice between decentralised and centralised conglomerates is driven by three factors. Firstly, by compelling cross-division bail outs, centralisation introduces risk diversification which serves to reduce the potential systemic costs of failure. This effect will not obtain in decentralised conglomerates in which cross-division bail outs will not occur.

Secondly, centralisation may also result in financial contagion: this occurs when one division experiences losses so severe that the other division also fails, even though it is on a standalone basis profitable. For non zero costs ϕ of financial institution insolvency this latter effect will reduce social welfare. Decentralised conglomerates have "firewalls" between their divisions which prevent financial contagion from occuring.

Finally, because each of the divisions of a decentralised conglomerate has its own balance sheet it is possible for assets to be transferred from one division to another. In practice this is typically done to avoid regulatory capital charges and it is often referred to as "regulatory arbitrage." Regulators sometimes argue that regulatory arbitrage enables bankers to bend capital adequacy rules and hence that it is welfare reductive. We demonstrate below that, on the contrary, it allows assets to be held where they will minimise social externalities and hence that it is welfare enhancing.

In the following sections we consider the optimal capital regulation of decentralised and centralised conglomerates.

2.1. Decentralised Conglomerates

To examine the optimal capital regulation of decentralised financial conglomerates, we extend the model of section 1 as follows. At time t_0 nature presents the bank and the insurance company with an investment opportunity, each of which is drawn independently from the distribution described in section 1. At time t_1 the bank and the insurance companies decide whether to invest in the projects. At time t_2 they have an opportunity costlessly to trade their projects, using the mechanism outlined below. At time t_3 (*after* trade has occurred) the conglomerate's divisions raise capital and other funds for investment as above. Capital requirements for the bank are set at C_B and for the insurance company at C_I. At time t_4 returns are realised from the project.

The time t_2 trading allows the bank and insurance divisions to exchange projects. Since capital charges are determined at time t_3 trading allows the divisions to decide for themselves the regime

[2] In a multi period model divisions may sometimes elect to bail one another out to maintain charter value or reputation (see Boot and Thakor, 1993, for a discussion of related issues). These factors are not externalities and so including them in our model would merely complicate it without affecting the essential intuition.

under which the projects will be assessed for capital adequacy regulation. The key point is that trade will enable projects to be accepted when they would have been rejected by a standalone financial institution. As we are concerned only with the aggregate social return on investment the precise rules under which trade occurs are not important for our results. For convenience we will assume that at time t_2 one division can make a take-it-or-leave-it offer to the other for its project. This trading rule ensures that a project will be accepted provided its expected returns exceeds *either* of the divisions' hurdle rate. After time t_3 trade the project will be retained by the division which has the lowest hurdle rate.

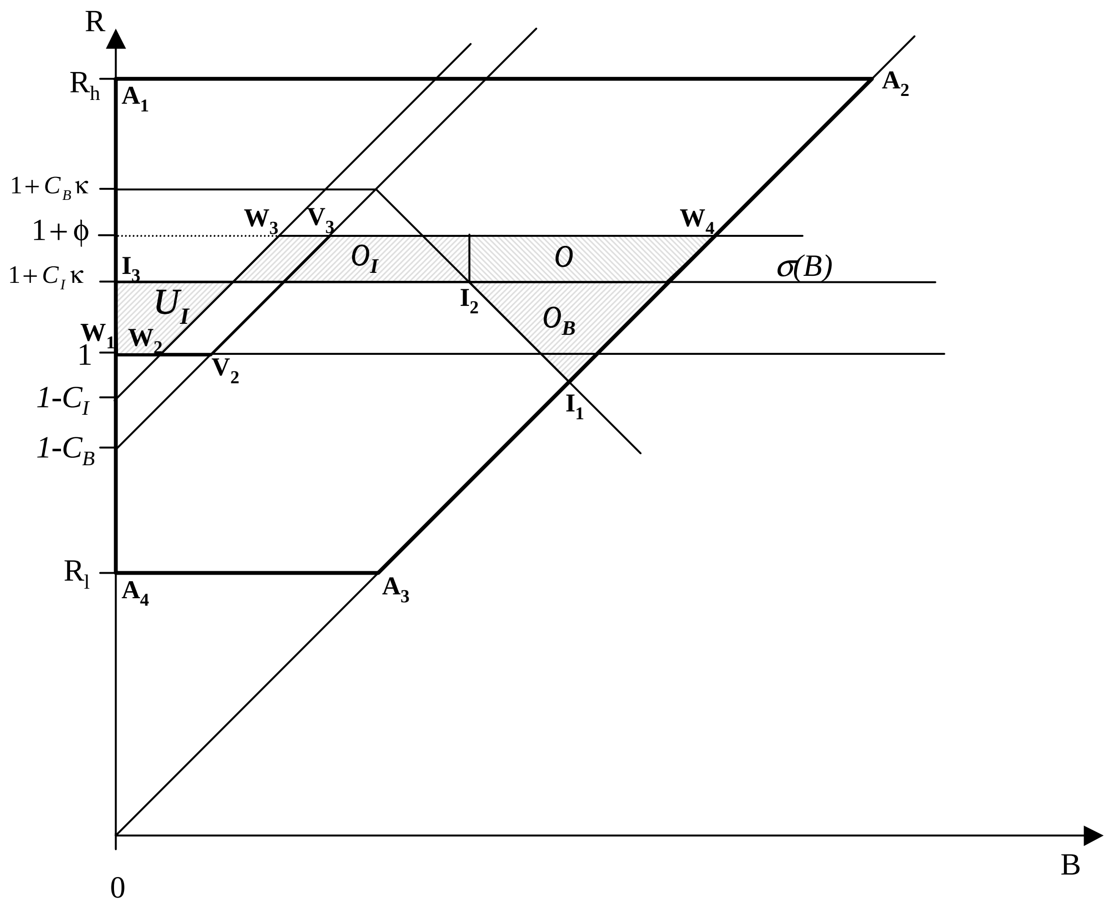

Figure 4: Over- and under- investment regions for decentralised financial conglomerates.

The situation described here is illustrated in figure 4. With trade as described in the previous paragraph, both divisions will accept any project whose expected return exceeds the hurdle rate $\min(H_B, H_I)$: this implies that all investments in the region $A_1A_2I_1I_2I_3A_1$ will be accepted. $H_I < H_B$ for precisely those investments which lie to the left of I_2 and these will therefore be held in the insurance company's portfolio; investments to the right of I_2 will be held in the bank portfolio. The consequence of time t_2 trade is therefore that the bank retains the riskiest investments and that the others are passed to the insurance company.

The socially first best investment policy for the insurance company is to accept all investments which lie above the line $W_1W_2W_3W_4$. The region $\mathcal{U}_I$ therefore represents insurance company underinvestment, while the region $\mathcal{O}_I$ represents insurance company overinvestment. Likewise, the social optimum is for the bank to accept investments which lie above the line $W_1V_2V_3W_4$ so the region $\mathcal{O}_B \cup \mathcal{O}$ represents bank overinvestment. The regulator must select the capital requirements C_I and C_B for the bank and the insurance company respectively so as to minimise the social cost associated with these regions.

To understand how optimal capital requirements should be set, consider the effect of increasing the bank's capital requirement C_B. This would would raise the bank's hurdle rate thus moving the intersection point I_1 up the line $R = B$. Although some investments in region $\mathcal{O}$ would then fall below the bank's hurdle rate, they would continue to lie above the insurance company's hurdle and hence would continue to be accepted by both divisions. In other words, the effect on the left side is nil, while the effect on the right side is positive. The only effect upon investment behaviour of an increase in C_B would therefore be to diminish the size of the region $\mathcal{O}_B$ and with it the associated investment distortions. It follows that the optimal regulatory policy would be to set the bank's capital requirement so high that the area $\mathcal{O}_B$ was empty. This is trivially higher than the stand alone bank capital requirement.

With C_B set so as to empty $\mathcal{O}_B$, the only remaining investment distortions are the under investment region $\mathcal{U}_I$ and the overinvestment region $\mathcal{O}_I \cup \mathcal{O}$. This is the identical situation to that illustrated in figure 3: in other words, when C_B is set so as to render $\mathcal{O}_B$ empty, the social effect of both divisions' investment decisions is the same as that of a standalone insurance company's. The optimal capital requirement C_I for the insurance division is therefore the same as that of a stand alone insurance company.

We summarise the discussion so far in proposition 5.

PROPOSITION 5 *The optimal capital requirement C_I^{*d} for the insurance division of a decentralised conglomerate is equal to the optimal capital requirement for a standalone insurance company. Any capital level in excess of $\frac{1+2C_I^{*d}}{1+2\kappa}$ is optimal for the bank division.*

Proof. The above discussion demonstrates that C_I^{*d} is optimal for the insurance division and that any capital requirement which renders $\mathcal{O}_B$ empty when the insurance division has capital requirement C_I^{*d} is optimal for the bank division. The point I_1 lies where $R = 1 - B + C_B(1 + 2\kappa)$ intersects $R = B$, or where $R = \frac{1}{2}\{1 + C_B(1 + 2\kappa)\}$. $\mathcal{O}_B$ is empty provided this exceeds $1 + C_I^{*d}$, or when $C_B \geq \frac{1+2C_I^{*d}}{1+2\kappa}$ as required. □

To appreciate why proposition 5 must be true, recall that capital requirements are set to correct as well as possible for the externalities which the financial institution will not account for when selecting its investments. These comprise a systemic cost for the insurance company, and a deposit insurance cost and a systemic cost for the bank. Since only the bank imposes a risk shifting externality upon society it is sensible to set capital requirements at such a level that the deposit insurance fund is not called upon. In this case both divisions will accept precisely those investments which the insurance company would accept on a stand alone basis. Capital requirements for the insurance company must therefore be set at the optimal stand alone level.

Corollary 6

1. *Optimal capital requirements for the bank division of a decentralised conglomerate are higher than those for a standalone bank;*
2. *Optimal capital requirements for the bank division of a decentralised conglomerate are to be set at a higher level than those for the insurance division.*
3. *The expected social welfare generated by a decentralised conglomerate with optimal capital requirements exceeds the expected sum of welfares of a standalone bank and insurance company;*
4. *Regulatory arbitrage is welfare increasing. Restrictions upon regulatory arbitrage cause an inefficient drop in the supply of credit.*

Proof. The first statement is a trivial consequence of the above discussion and the second follows immediately from the first. The third statement follows from the observations that the expected social welfare generated by a standalone insurance company exceeds that of a standalone bank and that conglomeration with optimal capital requirements guarantees that the bank accepts the same investments as a standalone insurance company. The welfare increase identified in part 3 of the proposition occurs precisely because of the time t_2 trading, from which part 4 follows immediately. □

The statements in the above corollary contradict received regulatory wisdom. The standard argument is that regulatory arbitrage allows insurance companies to dump low quality assets on the bank's balance sheet and that this is welfare reductive. While this is true for suboptimal capital requirements (in which case $\mathcal{O}$ is non-empty and the insurance company accepts investments in this region and then dumps them on the bank), it is incorrect when capital requirements are set optimally. With optimal capital requirements the bank's deposit insurance net is valueless. In this case the insurance company will never dump poor quality assets on the bank. The bank's capital requirements then serve precisely as a *disincentive to asset retention*; after originating assets it simply passes them onto the insurance company. In other words, capital requirements are set so as to *encourage* regulatory arbitrage.

Note that, unless $C_B = 1$, I_2 will lie strictly within $\mathcal{A}$ and after regulatory arbitrage the bank will retain all investments which lie to the right of this point. In other words, the bank's portfolio in the presence of regulatory arbitrage will be significantly riskier than the insurance company's. With optimal capital requirements this is evidence of the efficient use of capital, and not of excessive risk-taking incentives.

2.2. Optimal Capital Regulation for Centralised Conglomerates

Our set up provides the tools to analyse the behaviour of a centralised conglomerate and its implications for capital regulation. This follows closely Gyongyi and Morrison (2004).

To simplify the analysis we assume that the insurance company is first to select a project. The bank will then select a project knowing the risks it inherits from the insurance company project. This means that at times one division's profit will allow the whole conglomerate to break even, which is the diversification argument, and at other times one division's losses will cause the whole conglomerate to go under.

A second simplification will be brought in concerning the independence of the two divisions. We will assume, not only that the insurance company investment does not alter the set of possible investments $\mathcal{A}$ of the bank, but also that the two projects returns are independent. This means that the case we focus on is the one where there are neither economies of scope nor economies of scale.

We denote the projects selected by the insurance company and the bank by (B_I, R_I) and (B_B, R_B) respectively. This allow us to define four different cases depending on the realisations of the two projects.

Denoting outcomes by ordered pairs in which the bank's result (S for solvency and F for failure) appear first, the payoff from each outcome is as follows.

$$V_{SS} \equiv R_I + B_I - 1 + R_B + B_B - 1 + C_B; \tag{11}$$
$$V_{SF} \equiv R_I + B_I - 1 + R_B - B_B - 1 + C_B \tag{12}$$
$$V_{FS} \equiv R_I - B_I - 1 - R_B + B_B - 1 + C_B \tag{13}$$
$$V_{FF} \equiv R_I - B_I - 1 - R_B - B_B - 1 + C_B \tag{14}$$

Shareholders' payoffs will be given by $V_{SF}^{+} = \max(V_{SF}, 0), V_{FS}^{+} = \max(V_{FS}, 0), V_{FF}^{+} = \max(V_{FF}, 0)$ and their expected profit is given by

$$\Pi \equiv \frac{1}{4}\left[V_{SS}^{+} + V_{SF}^{+} + V_{FS}^{+} + V_{FF}^{+}\right] - C_I k + C_B (1 + \kappa). \tag{15}$$

Depending on the two selected investment projects, the conglomerate may fail or may not fail. This will depend on whether V_{FF} is strictly positive.

In the same way we define prudent projects for the standalone bank, we will now characterize a safe (centralised) conglomerate by the following condition: $V_{FF} \geq 0$

Regarding the cases where the conglomerate might fail, we are able to distinguish four cases, which are illustrated in Figure 4.

First when $V_{FS} > 0$ and $V_{SF} > 0$, one financial entity rescues the other. The diversification of the assets allows the conglomerate to survive provided one of the two financial institutions is succesful. We will refer to this case as the diversified case.

Second, when $V_{FS} > 0$ and $V_{SF} < 0$ the conglomerate result is driven by what happens at the bank level. Third, symetrically when $V_{FS} < 0$ and $V_{SF} > 0$, the insurance company results are the only ones that matter for the conglomerate solvency.

Finallly, the fourth case is the one where $V_{FS} < 0$ and $V_{SF} < 0$, where one failure is enough to trigger the conglomerate failure. This we interpret as the contagious case.

The analysis here follows closely Loranth and Morrison(2004).

First it is shown that the insurance company project choice affects the investment behaviour of the bank, while this would not happen in the decentralised case. This is the case because

Figure 2: Branch bank projects, speculative home bank

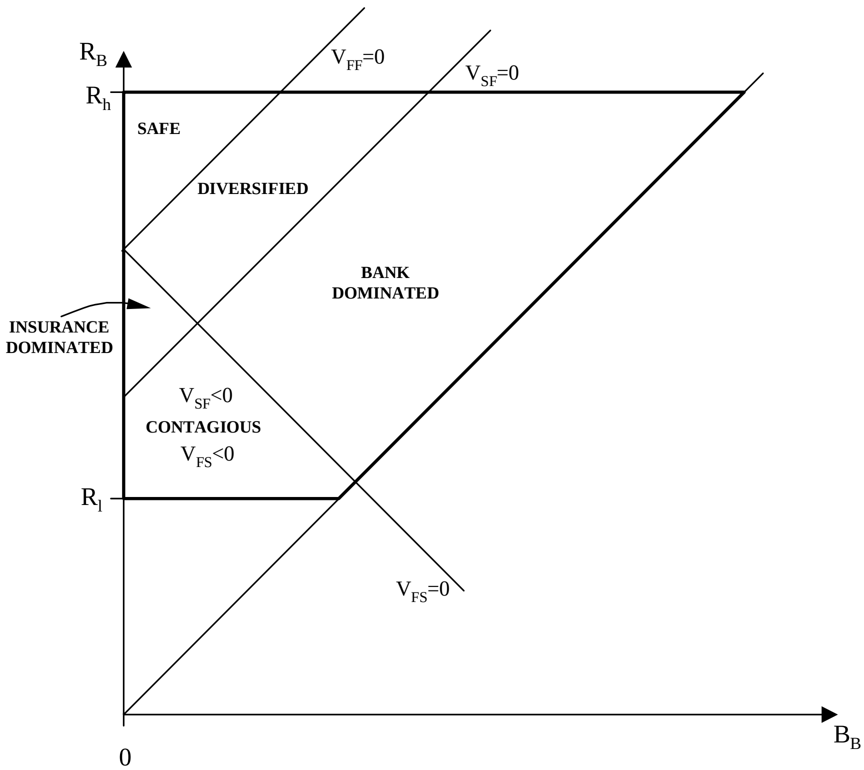

Figure 5:

depending on the choice of (B_I, R_I) the different areas in figure 4 will change. In particular, if the insurance company choice is prudent, this decreases the value of the deposit insurance put option and therefore the bank tends to underinvest. Conversely, if the insurance company is speculative, this increase in riskiness B_I increases the value of the deposit insurance put option[3].

Second, diversification reduces the value of the deposit insurance net. As a consequence the capital requirement for a bank within a centralised financial conglomerate will be lower than the one for a standalone bank. Yet, since the insurance will now benefit from the deposit insurance of the bank division, its capital requirements will have to be set at a higher level than for the standalone insurance company.

Finally, decentralised financial conglomerates constitute a more efficient form of conglomerate for the optimal capital requirements. This is the case as the distortive effect of deposit insurance is fully eliminated in the decentralised conglomerates while they are not in the centralised ones.

3. Conclusion

The main contribution of this paper is to consider simultaneously a rationale for the existence of capital requirements and the issue of capital regulation. This perspective allow us to characterize the optimal levels of capital for a conglomerate. We think this is worthwhile because the fact that a financial conglomerate is able to decrease its capital burden through regulatory arbitrage is not, per se, inefficient.

We show that, on the contrary, once we take into account the different distortions, regulatory arbitrage leads to allocating the asset to the division that bears the lowest cost of funds and, if capital coefficients are set correctly, this is efficient.

The result is in stark contrast with the argument often made that capital requirements should be set at the same level. The fact that banks are funded through deposits at a flat risk premium will adds an additional distorition to the ones existing because of the cost of raising capital that is borne by any financial institution.

Our model allow us also to compare the centralised, i.e.with consolidated limited liability, and decentralised financial conglomerates where each division has limited liability and to show that decentralised financial conglomerates may represent a better choice from the efficiency point of view.

4. Appendix

4.1. Proof of Proposition 1

Observe that

[3] An interesting implication of our analysis is that the response of investment behaviour to the business cycle is not the same for a decentralised and for a centralised conglomerate..

$$\mathcal{W}_0^B = \frac{1}{A}\iint_{\substack{R\geq 1\\ R\in\mathcal{A}}} R-1.dRdB - \frac{1}{A}\iint_{\mathcal{U}} R-1.dRdB - \iint_{\Sigma_U} R-1.dRdB$$
$$-\frac{1}{A}\iint_{\mathcal{O}} 1-R.dRdB + \iint_{\Sigma_0} 1-R.dRdB. \quad (16)$$

Equation 4 can be re-written as follows:

$$\begin{aligned}
\mathcal{W}^B &= \frac{1}{A}\iint_{\substack{R\geq 1\\ R\in\mathcal{A}}} R-1.dRdB - \frac{1}{A}\iint_{R\in\Sigma_U} R-1.dRdB - \frac{1}{A}\iint_{R\in\Sigma_O} R-1.dRdB \\
&\quad -\frac{1}{A}\iint_{\substack{R\geq\sigma(B)\\ R\in\mathcal{A}}} \sigma(B)-1.dRdB - \frac{1}{A}\iint_{\mathcal{U}} R-1.dRdB - \frac{1}{A}\iint_{\mathcal{U}} 1-\sigma.dRdB \\
&\quad -\frac{1}{A}\iint_{\mathcal{O}} \sigma-1.dRdB - \frac{1}{A}\iint_{\mathcal{O}} 1-R.dRdB \\
&= \mathcal{W}_0^B - \iint_{\substack{R\geq\sigma(B)\\ R\in\mathcal{A}}} \sigma(B)-1.dRdB - \iint_{\mathcal{U}} 1-\sigma dRdB - \frac{1}{A}\iint_{\mathcal{O}} \sigma(B)-1.dRdB \\
&= \mathcal{W}_0^B - \frac{1}{A}\iint_{R\geq H(B)} \sigma(B)-1.dRdB,
\end{aligned}$$

where the second line follows from equation 16.

4.2. Proof of Proposition 2

Define $\Delta(C)$ to be the total investment distortion caused by deposit insurance in the absence of systemic effects, as a function of the capital requirement C. Then

$$\Delta(C) = \frac{1}{A}\left\{\iint_{\mathcal{O}_O}(1-R)\,dBdR + \iint_{\mathcal{U}_O}(R-1)\,dBdR\right\}.$$

Lemma 7

$$\Delta(C) = \frac{C^3\kappa^2}{6A}(4\kappa+3) + \frac{1}{24A}\left[1-C(1+2\kappa)\right]^3. \quad (17)$$

Proof. There are two cases to consider, according to whether $C(1+2\kappa)$ is less than or greater than 1. The former is illustrated in figure 1; in the latter, which is illustrated in figure 6, region $\mathcal{O}_O$ vanishes.

Case 1: $\mathbf{C}(1+2\kappa)\leq\mathbf{1}$. This is the case which is illustrated in figure 1. $\mathcal{U}_O$ is comprised of a rectangular area and a right angled triangle bounded below by $R=1$ and above by $R=C(1+2\kappa)+1-B$:

$$\begin{aligned}
\frac{1}{A}\iint_{\mathcal{U}_O}(R-1)\,dBdR &= \frac{1}{A}\int_0^{C(1+\kappa)}\int_0^{C\kappa} RdRdB + \frac{1}{A}\int_{C(1+\kappa)}^{C(1+2\kappa)}\int_0^{C(1+2\kappa)-B} RdRdB \\
&= \frac{C^3\kappa^2}{2A}(1+\kappa) + \frac{1}{6A}\left[\{C(1+2\kappa)-B\}^3\right]_{C(1+2\kappa)}^{C(1+\kappa)} = \frac{C^3\kappa^2}{6A}(4\kappa+3). \quad (18)
\end{aligned}$$

It is convenient to think of O_O as comprising two identical right angled triangles:

$$\frac{1}{A}\iint_{\mathcal{O}_O}(1-R)\,dBdR = \frac{2}{A}\int_{\frac{C(1+2\kappa)+1}{2}}^1\int_B^1(1-R)\,dRdB$$
$$= \frac{1}{A}\int_{\frac{C(1+2\kappa)+1}{2}}^1(1-B)^2\,dB = \frac{1}{3A}\left[(1-B)^3\right]_1^{\frac{C(1+2\kappa)+1}{2}} = \frac{1}{24A}(1-C(1+2\kappa))^3.$$

Adding these expressions yields equation 17.

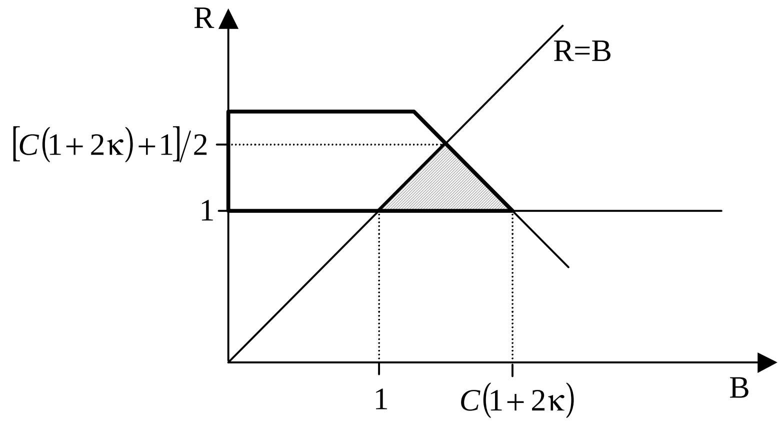

Figure 6: Region $\mathcal{U}_O$ when $C(1+2\kappa) > 1$.

Case 2: $\mathbf{C}(1+2\kappa) > \mathbf{1}$. This case is illustrated in figure 6. In this case region $\mathcal{O}_O$ vanishes and region U_O is the region with the bold outline, with the shaded area removed. $\alpha(C)$ can therefore be obtained by subtracting the welfare which could be attained by investing in shaded area projects from that attained by investing in all projects in the bold outline. The welfare from projects in the bold outline is given by equation 18 above; that from projects in the shaded area is

$$\frac{2}{A}\int_1^{\frac{C(1+2\kappa)+1}{2}}\int_0^{B-1} RdRdB = \frac{1}{24A}\left(1 - C(1+2\kappa)\right)^3,$$

from which the required result follows immediately. □

To prove the proposition, note that

$$\Delta'(0) = -\frac{(1+2\kappa)}{24A} < 0;$$
$$\Delta'(1) = \frac{\kappa^2}{A}(1+\kappa),$$

and $S_B'(1) \leq 0$ with $S_B'(1) = 0$, so that the aggregate distortion is decreasing in C when $C = 0$ and increasing when $C = 1$. It follows that the optimal capital requirement is strictly between 0 and 1. That the optimal capital requirement is increasing in ϕ follows immediately from the observation that $\frac{\partial S_B}{\partial \phi} > 0$.

4.3. Proof of Proposition 3

Equation 8 can be re-written as follows:

$$\mathcal{W} = \iint_{\substack{R\geq 1\\ R\in\mathcal{A}}} R - 1.dRdB - \iint_{\Sigma} R - 1.dRdB - \iint_{\mathcal{O}} R - 1.dRdB$$
$$- \iint_{\substack{R\geq\sigma(B)\\ R\in\mathcal{A}}} \sigma(B) - 1.dRdB - \iint_{\mathcal{U}} R - 1.dRdB - \iint_{\mathcal{U}} 1 - \sigma(B).dRdB$$
$$- \iint_{\mathcal{O}} \sigma(B) - R.dRdB$$

Using equation 7 this reduces to

$$\begin{aligned} \mathcal{W} &= \mathcal{W}_0 - \iint_{\mathcal{O}} \sigma(B) - 1.dRdB - \iint_{\substack{R \geq \sigma(B) \\ R \in \mathcal{A}}} \sigma(B) - 1.dRdB - \iint_{\mathcal{U}} 1 - \sigma(B).dRdB \\ &= \mathcal{W}_0 - \iint_{\substack{R \geq 1+Ck \\ R \in \mathcal{A}}} \sigma(B) - 1.dRdB. \end{aligned}$$

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